DOE/ID-22230
Prepared in cooperation with the U.S. Department of Energy

Field Methods and Quality-Assurance Plan for Water-Quality Activities and Water-Level Measurements, U.S. Geological Survey, Idaho National Laboratory, Idaho

Open-File Report 2014–1146

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

Field Methods and Quality-Assurance Plan for Water-Quality Activities and Water-Level Measurements, U.S. Geological Survey, Idaho National Laboratory, Idaho

By Roy C. Bartholomay, Neil V. Maimer, and Amy J. Wehnke

DOE/ID-22230
Prepared in cooperation with the U.S. Department of Energy

Open-File Report 2014–1146

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

U.S. Department of the Interior
SALLY JEWELL, Secretary

U.S. Geological Survey
Suzette M. Kimball, Acting Director

U.S. Geological Survey, Reston, Virginia: 2014

Suggested citation:
Bartholomay, R.C., Maimer, N.V., and Wehnke, A.J., 2014, Field methods and quality-assurance plan for water-quality activities and water-level measurements, U.S. Geological Survey, Idaho National Laboratory, Idaho: U.S. Geological Survey Open-File Report 2014–1146 (DOE/ID-22230), 66 p., *http://dx.doi.org/10.3133/ofr20141146.*

ISSN 2331-1258 (online)

Contents

Figures

Tables

Conversion Factors

Inch/Pound to SI

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
	Flow rate	
gallon per minute (gal/min)	0.06309	liter per second (L/s)
	Radioactivity	
picocurie per liter (pCi/L)	0.037	Becquerel per liter (Bq/L)
millirem (mrem)	0.01	millisievert (mSv)

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

$$°F=(1.8×°C)+32.$$

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 either in milligrams per liter (mg/L) or micrograms per liter (µg/L).

Field Methods and Quality-Assurance Plan for Water-Quality Activities and Water-Level Measurements, U.S. Geological Survey, Idaho National Laboratory, Idaho

By Roy C. Bartholomay, Neil V. Maimer, and Amy J. Wehnke

Introduction

Water-quality activities and water-level measurements by the personnel of the U.S. Geological Survey (USGS) Idaho National Laboratory (INL) Project Office coincide with the USGS mission of appraising the quantity and quality of the Nation's water resources. The activities are carried out in cooperation with the U.S. Department of Energy (DOE) Idaho Operations Office. Results of the water-quality and hydraulic head investigations are presented in various USGS publications or in refereed scientific journals and the data are stored in the National Water Information System (NWIS) database. The results of the studies are used by researchers, regulatory and managerial agencies, and interested civic groups.

In the broadest sense, quality assurance refers to doing the job right the first time. It includes the functions of planning for products, review and acceptance of the products, and an audit designed to evaluate the system that produces the products. Quality control and quality assurance differ in that quality control ensures that things are done correctly given the "state-of-the-art" technology, and quality assurance ensures that quality control is maintained within specified limits.

Purposes of and Responsibility for Maintaining the Quality-Assurance Plan

The purposes of the Quality-Assurance Plan (QAP) for water-quality and water-level activities performed by the USGS INL Project Office are to maintain 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:

1. Water-quality and water-level programs will be planned in a technically sound manner, and activities will be monitored for compliance with stated objectives and approaches. The objectives and approaches are defined in an annual project work plan.
2. Field, laboratory, and office activities will be performed in a conscientious and professional manner in accordance with specified USGS Water Mission Area practices and procedures by qualified and experienced employees who are well trained and supervised. 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 conformance with specified standards and guidelines.
4. A record of actions will be kept to document the activities and the assigned responsibilities.
5. Remedial action will be taken to correct activities that are deficient.

The Chief of the USGS INL Project Office has overall responsibility for maintaining this QAP. However, the principal investigator for geochemistry and the lead personnel for the water-quality and water-level monitoring networks are directly responsible for the day-to-day maintenance of the QAP. The QAP will be formally revised and reprinted as necessary. Changes that take place in the interim will be communicated by memoranda to project office personnel on an as-needed basis, and copies of those memoranda will be stored in the USGS INL Project Office quality-assurance file and on the INL Project Office server.

Purpose and Scope

The QAP for the water-quality activities and water-level measurements of the USGS 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, but the QAP provides a method for formalizing and communicating the plan to all employees of the project office and to users of the hydrologic data and interpretive reports. The QAP was implemented in 1989, and revised in 1992, 1996 (Mann, 1996), 2003 (Bartholomay and others, 2003), and 2008 (Knobel and others, 2008). This version of the QAP incorporates the revisions made to the water-quality monitoring program since 2008. Previous QAPs did not incorporate the water-level monitoring program, so procedures and history of changes to the water-level monitoring program are presented herein. A comprehensive list of references containing procedures used in data collection is given in the section, “Selected References”. Tasks not described by the references, owing to field conditions, are detailed herein, or in the Idaho Water Science Center Quality-Assurance Plan for Water-Quality Activities (Mark Hardy, U.S. Geological Survey, written commun., 2008), or in the Quality Assurance Plan for Groundwater Activities of the USGS Idaho Water Science Center (Idaho Water Science Center, U.S. Geological Survey, written commun., June 2011).

Information on water-quality sampling schedules, water-level measurement schedules, data-quality objectives, and water-quality field equipment are included in appendixes A–G.

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 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 (ESRPA), (4) the processes controlling the origin and distribution of contaminants and naturally-occurring constituents in the ESRPA, (5) the location and movement of contaminants in the ESRPA that were contained in wastewater discharged at the INL, either to the ESRPA or to the overlying perched groundwater zones, and (6) the early-detection network for contaminants moving past the INL boundaries. Disposal of contaminants at the INL has taken place through deep disposal wells, shallow infiltration ponds, and disposal ditches.

A large network of about 300 wells has been sampled in the past, and the current routine sampling network consists of 142 wells and 7 surface-water sites (appendix A). Additional monitoring sites will be selected if needed to better document the distribution and migration of contaminants. Most of the 142 wells are open-borehole wells with a screened interval that is open to the aquifer for the entire well depth below the water table. This type of construction is adequate for identifying the time of arrival of contaminant plumes and for delineating the horizontal extent of contaminants; however, it is not conducive to identifying the vertical distribution of contaminants.

In order to better identify the vertical distribution of contaminants in the aquifer, multilevel water-quality sampling, along with pressure and temperature profiling networks, was initiated in 2005. Westbay^{TM}, packer-based, vertical sampling systems were installed in two wells—Middle 2050A and Middle 2051. Each well was configured so that water samples could be collected at 5 discrete depths (at both wells), and pressure and temperature measurements could be made at 15 and 13 discrete depths, respectively. In 2006, wells USGS 132 and USGS 134 were configured so that water samples could be collected at 6 and 5 discrete depths, respectively, and pressure and temperature measurements could be made at 23 and 20 discrete depths, respectively. In 2007, wells USGS 103 and USGS 133 were configured so that water samples could be collected at 7 and 4 discrete depths, respectively, and pressure and temperature measurements could be made at 23 and 13 discrete depths, respectively. In 2009, wells USGS 105 and USGS 135 were configured so that water samples could be collected at 5 and 4 discrete depths, respectively, and pressure and temperature measurements could be made at 18 and 14 discrete depths, respectively. In 2010, USGS 108 was configured so that water samples could be collected at 5 discrete depths and pressure and temperature measurements could be made at 16 discrete depths. In 2012, USGS 131A and USGS 137A were configured so that water samples could be collected at 4 and 4 discrete depths, respectively, and pressure and temperature measurements could be made at 18 and 14 discrete depths, respectively. 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. In addition, this type of construction provides the capability for identifying the vertical distribution of contaminants, pressure, and temperature.

The wells and streams in the INL routine network and in the multilevel monitoring system (MLMS) network are sampled annually as indicated in appendix A. The Radioactive Waste Management Complex (RWMC) Production well also is sampled for volatile organic compounds (VOCs) on a monthly basis. In addition to the routine sampling indicated in appendix A, some wells may be sampled periodically for other constituents, including iodine-129, trace metals, VOCs, dissolved gases, and compounds used for age dating.

In addition to the 149 groundwater and surface-water sites currently sampled annually for the routine-monitoring network and the 11 sites sampled for vertical definition of contaminants in the aquifer, the USGS INL Project Office personnel collects water samples from 11 wells near the Naval Reactors Facility (NRF) on a semiannual basis and 3 wells every other year (appendix A). The purpose of this data-collection program is to provide the 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 ESRPA.

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 to provide long term information on the ESRPA for groundwater recharge, discharge, movement, and storage. The USGS INL Project Office currently (2014) monitors 206 open boreholes (29 perched and 177 aquifer) (appendix B) and 11 MLMS that includes 178 pressure ports.

Water-level data are obtained manually by use of electronic tapes (e-tapes), a pressure profile probe, and continuous data loggers. Water-levels are collected monthly, quarterly, semi-annually, or annually depending on historical data, research needs, and changes in the hydrograph. Within the USGS water-level monitoring network, there currently are five continuous data loggers, two of which are equipped with real-time data.

USGS began installing MLMS in 2005 to provide monitoring of the vertical distribution of pressure gradients in the aquifer. Additionally, four wells (USGS 130, USGS 139, Highway 1, and NRF-15) have been completed with piezometer nests at different levels of the aquifer to better define vertical distribution. The 11 MLMS were equipped with multiple measurement ports (8–23) to help improve the USGS INL groundwater modeling studies. Pressure profiles are collected either quarterly or annually depending on the location of the well and the need for information.

Field Methods for Water-Quality Activities

Sample containers, sample preservation methods, field equipment, and well-head decontamination and sample-collection procedures are crucial components for ensuring that data-quality objectives are achieved at the field level. Equally important are the analytical methods and the quality-control and quality-assurance activities exercised by the laboratories that analyze the samples.

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 that are summarized by the U.S. Geological Survey (variously dated, chapter A5). Containers and chemical preservatives are supplied by the NWQL, where they undergo rigorous quality control to ensure that they are free of contamination (Pritt, 1989, p. 75). Samples analyzed by the U.S. Department of Energy’s Radiological and Environmental Sciences Laboratory (RESL) are containerized and preserved in accordance with requirements specified by the laboratory’s Analytical Chemistry Measurements Team; changes in procedures are documented in writing. Samples analyzed as part of the USGS NRF sample program are containerized and preserved in accordance with requirements specified by TestAmerica Laboratories (2013). Containers and preservatives for selected constituents are summarized in table 1.

Table 1. Containers and preservatives used for water samples, Idaho National Laboratory and vicinity, Idaho.

[**Type of constituent:** VOCs, volatile organic compounds; C, carbon; H, hydrogen; O, oxygen. CFC, chlorofluorocarbon. **Analyzing laboratory:** NWQL, U.S. Geological Survey National Water Quality Laboratory; RESL, U.S. Department of Energy Radiological and Environmental Sciences Laboratory; RSIL, Reston Stable Isotope Laboratory; BYU, Brigham Young University Laboratory of Isotope Geochemistry; PRIME, Purdue Rare Isotope Measurement Laboratory. **Abbreviations**: mL, milliliter; L, liter; N, normal; HNO_3, nitric acid; HCl, hydrochloric acid; H_2SO_4, sulfuric acid; KOH, potassium hydroxide; °C, degrees Celsius]

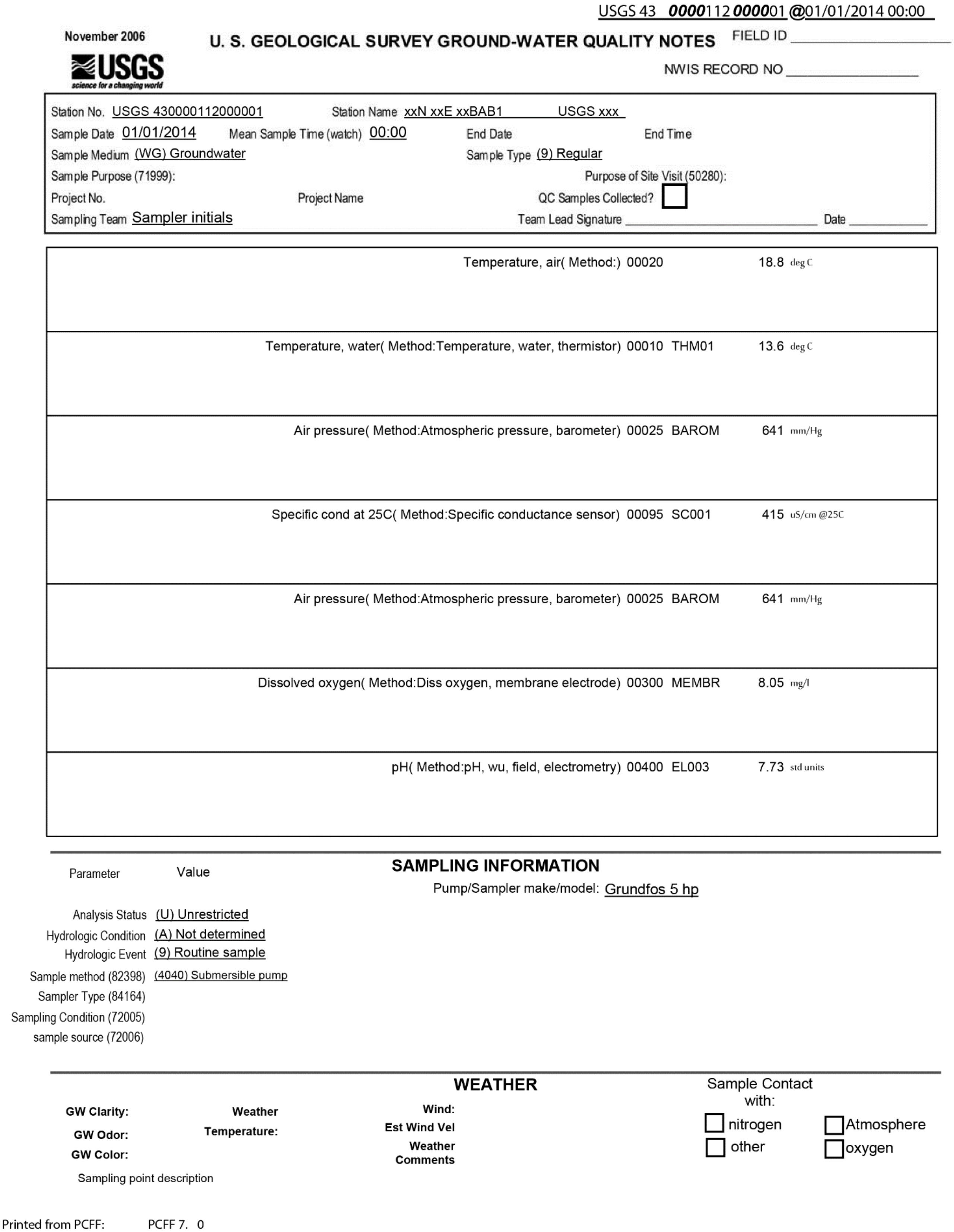
Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size	Type	Volume		
Anions, dissolved	Polyethylene	250 mL	None	None	Filter	NWQL
Anions, dissolved	Polyethylene	1 L	None	None	Filter	TestAmerica
Cations, dissolved	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	Filter	NWQL
Cations, total	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	TestAmerica
Metals, dissolved	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	Filter	NWQL
Metals, total	Polyethylene, acid rinsed	250 mL	HNO_3	2 mL	None	NWQL
Metals, dissolved	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	Filter	TestAmerica
Metals, total	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	TestAmerica
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
Nutrients, dissolved	Glass, baked	500 mL	H_2SO_4	2 mL	Chill, 4°C	TestAmerica
Nutrients, total	Glass, baked	500 mL	H_2SO_4	2 mL	Chill, 4°C	TestAmerica
VOCs	Glass, baked	40 mL (3)	None	None	Chill, 4°C	NWQL
VOCs	Glass	40 mL (3)	HCl	4 drops	Chill, 4°C	TestAmerica
Semi-VOCs	Glass, baked	1 L (2)	HCl	4 mL/bottle	Chill, 4°C	TestAmerica
Gross alpha/ beta-particle	Polyethylene, acid rinsed	1 L	HNO_3	2 mL/bottle	Filter	NWQL

Type of constituent	Container		Preservative		Other treatment	Analyzing laboratory
	Type	Size	Type	Volume		
Gross alpha/ beta-particle	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Nickel-63	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	None	TestAmerica
Strontium-90	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	Filter	TestAmerica
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Gamma spectroscopy	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	None	TestAmerica
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Tritium	Polyethylene	500 mL	None	None	None	NWQL
	Polyethylene	500 mL	None	None	None	RESL
	Polyethylene	500 mL	None	None	None	BYU
Transuranics	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	None	RESL
Isotopic uranium	Polyethylene, acid rinse	1 L	HNO_3	4 mL	Filter	TestAmerica
O-18/O-16 and H-2 /H-1	Glass, w/polyseal cap	60 mL	None	None	None	RSIL
C-13 /C-12	Glass, w/plastic coating, polyseal cap	250 mL	None	None	None	Woods Hole
Dissolved gases	Glass, w/rubber stopper	150 mL	None	None	Relieve pressure w/needle	Reston CFC Laboratory
CFC-Age dating	Glass, w/white plastic caps, aluminum foil liner	125 mL	None	None	None	Reston CFC Laboratory
Iodine-129	Polyethylene w/polyseal cap	1 L	KOH and sulfurous acid	None	Filter	PRIME

Field Equipment

Analytical and other associated equipment used in the field include pH meters, thermometers, multiparameter instruments, titrators for alkalinity measurements, peristaltic pumps, in-line disposable filter capsules with a 0.45-micron filter that is certified to be analyte free, and associated glassware. The analytical equipment is housed and usually operated in mobile field laboratories. The purpose of the mobile laboratories is threefold: (1) they provide a relatively clean area to measure field parameters while minimizing the potential for contamination or degradation of the samples from the wind, dust, rain, snow, and sunlight; (2) they are used as storage for sample and shipping containers, chemical reagents and preservatives, analytical instrumentation, and deionized water used for decontaminating equipment in the field; and (3) they provide a place where samples can be containerized, preserved, and placed in a secured refrigerator or transportation container within minutes after withdrawal from a well or stream.

The multiparameter instruments used to measure field water-quality parameters, such as pH, specific conductance, and dissolved oxygen are maintained and calibrated in accordance with procedures specified by the instrument manufacturer; calibration data can be permanently recorded in the water-quality personal computer field form (PCFF) (fig. 1) or field logbook (fig. 2) and in the instrument calibration logbook (fig. 3). Changes to equipment—for example, changing the batteries or the dissolved oxygen membrane—is recorded in the instrument calibration logbook. An inventory of field equipment is provided in appendix G.



USGS 43 ***0000***112 ***0000***01 @01/01/2014 00:00

November 2006

U. S. GEOLOGICAL SURVEY GROUND-WATER QUALITY NOTES

FIELD ID ____________________

NWIS RECORD NO ________________

Station No. USGS 430000112000001
Station Name xxN xxE xxBAB1 USGS xxx
Sample Date 01/01/2014
Mean Sample Time (watch) 00:00
End Date
End Time
Sample Medium (WG) Groundwater
Sample Type (9) Regular
Sample Purpose (71999):
Purpose of Site Visit (50280):
Project No.
Project Name
QC Samples Collected? ☐
Sampling Team Sampler initials
Team Lead Signature ________________________ Date __________

Temperature, air(Method:)	00020		18.8	deg C
Temperature, water(Method:Temperature, water, thermistor)	00010	THM01	13.6	deg C
Air pressure(Method:Atmospheric pressure, barometer)	00025	BAROM	641	mm/Hg
Specific cond at 25C(Method:Specific conductance sensor)	00095	SC001	415	uS/cm @25C
Air pressure(Method:Atmospheric pressure, barometer)	00025	BAROM	641	mm/Hg
Dissolved oxygen(Method:Diss oxygen, membrane electrode)	00300	MEMBR	8.05	mg/l
pH(Method:pH, wu, field, electrometry)	00400	EL003	7.73	std units

SAMPLING INFORMATION

Pump/Sampler make/model: Grundfos 5 hp

Parameter	Value
Analysis Status	(U) Unrestricted
Hydrologic Condition	(A) Not determined
Hydrologic Event	(9) Routine sample
Sample method (82398)	(4040) Submersible pump
Sampler Type (84164)	
Sampling Condition (72005)	
sample source (72006)	

WEATHER

GW Clarity:
GW Odor:
GW Color:
Weather Temperature:
Wind:
Est Wind Vel
Weather Comments

Sample Contact with:
☐ nitrogen ☐ Atmosphere
☐ other ☐ oxygen

Sampling point description

Printed from PCFF: PCFF 7. 0

Figure 1. Sample sheet from water quality personal computer field form.

USGS 43 ***0000***112 ***0000***01 @01/01/2014 00:00

Depth to set pump from MP	(all units in feet)
Distance to top of screen from LSD	
MP	
dia. factor of well	6"
DEPTH TO PUMP FROM MP	
DEPTH TO PUMP FROM LSD	

Sampling depth(00003/): **TD xxx ft**

WELL DATA

PURGE VOLUME

Casing Volume, Gal.
Number of purges 1
Calculated Purge Vol. , gal.

Flow rate, instant.(00059/): **xx gal/min**

Time pumped before sampling (72004) **xx minutes**

Calculated pump period: Min Min

FIELD OBSERVATIONS

Sampling point: ¼" ss sample port, 5 hp sub pump
Water level: xxx.xx', pump on @ 0000
Control box @ 60 Hz (ccw)
Observers:

Field Sample Comments (for NWIS, 300 characters max.):

LOT NUMBERS

Nitric Acid #1:
Nitric Acid #2:
Sulfuric Acid:
HCl 6N:
VOC 1:1 HCl:
NaOH 5-Normal:

Pesticide Spike (acid):
Pesticide Spike (Base):
VOC spike:
Capsule Filter :

Sulfuric Acid 4.5 N:
Nutrients
DOC

Description	Lot Number
OTHER:	
OTHER:	
OTHER:	
OTHER:	

25mm glass fiber filter

47mm Baked glass fiber filter

Disk Filter
Other

Volume of filtered water for PC/PIC

Filter A
Filter B
Filter C

(99200) Lot No, 1st, inorg grade watr

(99201) Lot No, 2nd, inorg grade watr

(99202) Lot No, 1st, org grade water

(99203) Lot No, 2nd, org grade water

(99204) Lot No, 1st, VOC grade water

(99205) Lot No, 2nd, VOC grade water

Printed from PCFF: PCFF 7. 0

METER CALIBRATION USGS 430000112000001 @ 01/01/2014 00:00

Temperature, water -Temperature, water, thermistor (00010/THM01)

Mtr W-no. or thermometer no. QD01427 Date NIST/ASTM checked:

Temperature subsample from or measurement location: FLOW-THRU CHAMBER

						MEDIAN:	**RMK**	**Qualifier**
Field Readings	13.6	13.6	13.6	13.6	13.6	13.6 deg C		

pH -pH, wu, field, electrometry (00400/EL003)

METER MAKE/MODEL: laMtr S/Nulti-meter7 Thermister Check:

pH subsample from or measurement location: FLOW-THRU CHAMBER

						MEDIAN:	**RMK**	**Qualifier**
Field Readings	7.68	7.71	13.6	13.6	13.6	7.73 std units		

Specific cond at 25C -Specific conductance sensor (00095/SC001)

METER MAKE/MODEL S/N QD01427 Thermister Check:

Sample: FLOW-THRU CHAMBER

						Correction Factor:	**MEDIAN**	**RMK**	**Qualifier**
Field Readings	415	415	417	416	414		415 uS/cm @25C		

Dissolved oxygen -Diss oxygen, membrane electrode (00300/MEMBR)

Thermister Check Date:

D.O. Zero Check Date:

METER MAKE/MODEL S/N QD01427

Calibration : Sample: FLOW-THRU CHAMBER

CALIB. TEMP ° C	BAROMETRIC PRESSURE mm Hg	DO TABLE READING mg/L	SALINITY CORR FACTOR	DO BEFORE ADJ.	DO AFTER ADJ.

						MEDIAN	**RMK**	**Qualifier**
FIELD READINGS	8.15	8.09	7.98	8.05	7.93	8.05 mg/l		

Calibration Notes and Remarks

Date:_____/_____/_____ Time:______ Weather conditions:____________________________
Local

Site Id No:________________________________Site Id______________________________

Purpose of Sampling:____

Type of Sample (circle one): Groundwater Surface water Other________________

Number of Containers:________ Size of Containers/Method of Preservation:_________

____

Laboratory Schedules Requested:____

Descriptions of Sampling Point:(82398)____

Equip. Serial Nos: pH_________ Specific Cond. __________ Other (specify)_______

Instrument Calibrations:

Specific Cond. Yes No Value of Standard Solution_______________________

pH Yes No Number of Buffers____Values of Buffers___________

Other (specify)____

Equipment Maintenance:____

Decontamination Procedures:____

Field Measurements: Sampling Agency (00027) = USGS (1028)

Water Temp °C(00010) = _____ pH(00400) = _______ Sp.C. uS/cm(00095) = _______

Alk.as CaCO3(00410) = _________ DO(00300) = __________ Turb.(61028) = _________

Other(s)____

References (maps, etc.):____

Name and Affiliations of Observers:

1. ___________________________________ 2.________________________________

Field Observations (notes, photos, drawings, pumping period and rate, etc.):

Pump on @ __________________ TIME | T C pH | Sp.Cond. | D.O.

WL = _________ TD = _________ ______|_______________| ____________|____________

Dia = ________ Q = _________ ______|_______________| ____________|____________

Min/Vol = ___________________ ______|_______________| ____________|____________

Latitude_____________________ ______|_______________| ____________|____________

Longitude____________________ ______|_______________|____________|____________

Comments:____

Collector's Names (please print), Signatures, and Date:

Name______________________ Signature_________________________ Date_____________

Name______________________ Signature_________________________ Date_____________

Name______________________ Signature_________________________ Date_____________

Figure 2. Sample sheet from water-quality field logbook.

Date____________________________ **Employee Name** ____________________________

Thermistor

Date of last check/calibration __________________

Schedule

- 2-point check: 3-4 months
- 5-point check: annually and when thermistor is changed

Temperature °C		
ASTM Thermometer	**Meter Thermistor**	**Adjusted to**

pH Calibration

Step	Buffer circle one	Lot #	Exp. Date	Buffer Temp	Initial Reading	Adj. pH	mVolts	Slope	End of Day Check Value
1 calibrate	7			°C					
2 set slope	4 or 10			°C					
3 check	10 or 4			°C					
Special				°C					
Special				°C					

Specific Conductance Calibration

Standard Value	Lot #	Exp. Date	Standard Temp	Initial Reading	Adjusted Reading	End of Day Check Value
			°C			
			°C			
			°C			

Dissolved Oxygen Calibration

Method

☐ Air Calibration in Water
☐ Air Calibration Chamber in Air
☐ Air-Saturated Water
☐ Calibration by Winkler Titration

Barometer ID #	Date of last barometer calibration	D.O. Zero Check using zero D.O. solution	
		mg/L	**% sat**

Measurement	Initial	End of Day Check Value
Barometric pressure	mm Hg*	mm Hg*
Temperature	°C	°C
D.O. Saturation or Winkler	mg/L	mg/L
Meter reading	mg/L	mg/L
Meter adjusted to	mg/L	▨

*mm=inches x 25.4

Remarks and Repairs

Figure 3. Sheet from instrument calibration logbook.

Calibration Procedure for pH

The INL Project Office calibrates pH meters each day during which water-quality samples are collected. Calibration of the meter can be performed in the laboratory or at the first well site where water-quality samples are collected that day. The calibration standards are warmed or chilled to a temperature similar to well temperatures to be measured that day. The calibration data are recorded in the instrument calibration logbook (fig. 3). If the calibration is done in the laboratory, the meter is then transported to the well site, the meter is checked with a pH 7 buffer prior to sampling if the pH differs by more than 0.2 pH units from the previous two readings recorded at the site. The meter is recalibrated if the pH 7 buffer check is off by more than 0.2 pH units. The pH also is checked for accuracy with a pH 7 buffer before samples are collected at each subsequent well, if the initial readings taken at the new site differ by more than 0.2 pH units from the previous two readings recorded at the site. The measured value of the pH 7 buffer is recorded on the PCFF or field logbook (figs. 1 and 2) for the appropriate site. A pH reading of the pH 7 buffer is taken after sampling the last site of the day for the end-of-day check and recorded in the instrument calibration logbook (fig. 3).

Calibration Procedure for Specific Conductance

The INL Project Office calibrates specific conductance meters each day during which water-quality samples are collected. Calibration of the meters can be performed in the laboratory or at the first site where water-quality samples are collected that day, but temperature of the standards should be close to what will be measured. The calibration data are recorded in the instrument calibration logbook (fig. 3). If the calibration is done in the laboratory and the meter is then transported to the site, the specific conductance meter is checked with the appropriate buffer prior to sampling if specific conductance differs by more than 5 percent from the previous two field readings at the site. The buffer solution should have a specific conductance similar to the water that is being sampled. The specific conductance also is checked for accuracy with a buffer before sampling at each subsequent site where water-quality samples are collected, if specific conductance differs by more than 5 percent from the previous two field readings. The measured value of the buffer is recorded in the water-quality PCFF or field logbook (figs. 1 and 2) for the appropriate site. A specific conductance reading is taken after sampling the last well of the day for the end-of-day check, and the reading is recorded in the instrument calibration logbook (fig. 3). The specific conductance meter is recalibrated if at any time the reading of the buffer is off by ±5 percent for conductivity ≤ 100 µS/cm or ±3 percent for conductivity >100 µS/cm (U.S. Geological Survey, variously dated, chapter 6.3).

Calibration Procedure for Dissolved Oxygen

The INL Project Office calibrates dissolved-oxygen meters each day during which water-quality samples are collected. Calibration of the meters can be performed in the laboratory or at the first site where water-quality samples are collected that day. The temperature at the time of calibration is recorded in the instrument calibration logbook (fig. 3). The temperature and the atmospheric pressure are used to obtain the solubility of oxygen in water (U.S. Geological Survey, variously dated, table 6.2-6). The meter will be checked throughout the day to ensure there are no bubbles on the inside of the membrane and there are no tears or wrinkles in the membrane. If bubbles are present or the membrane is damaged, the membrane must be changed.

Decontamination Procedures

Wells that are equipped with dedicated submersible or line-shaft turbine pumps do not require decontamination except for the equipment that is attached to the discharge pipe to accommodate the collection of a water sample. However, one wellbore volume of water is pumped from the well to remove stagnant water and to rinse and equilibrate the pump and delivery line.

Sample collection is facilitated and excess water is diverted away from the well head by fitting wells equipped with dedicated pumps with a portable discharge pipe about 2 ft in length. The discharge pipe has a 1-in. inside diameter and is equipped with a gate valve to control the flow rate. A series of joints, nipples, pipe sections, and valves to control the flow rate of the sampling ports are attached to the portable discharge line to enable splitting of the well discharge into three streams. The diameters of two of the streams are reduced to 0.25-in. and have Tygon^{TM} tubing attached to the discharge pipe. The first tube is attached to a flow-through chamber used for measuring pH, specific conductance, and dissolved oxygen. The second tube is used for filling sample bottles. The third discharge stream is excess water and is diverted away from the well.

All fittings and pipes are stainless steel and are rinsed with deionized water before installation at the well head. Subsequent flushing with several hundred to thousands of gallons of purged well water further reduces the possibility of cross contamination with water from previously sampled wells. After sample collection, the fittings and pipes are rinsed with deionized water prior to storage, to further reduce the chance of cross contamination between wells. In an attempt to extend the longevity of pumps, an amperage reduction system is installed between the generator and the well pump to reduce the speed of 5 horsepower pumps.

Production wells generally have a spigot at or near the well head and do not require special sample-collection equipment; decontamination consists of thoroughly rinsing the spigot with pumped groundwater to remove foreign materials.

A bailer is used for collecting water samples from the following well types: (1) wells without dedicated pumps, (2) wells with only a few feet of water in the well-bore, and (3) wells that do not produce much water. The bailer and that part of the bailer line that enters the well are washed with water and detergent, and rinsed with deionized water prior to and after use; samples of the rinsate are periodically collected and analyzed to document whether the equipment is contaminated by constituents of interest. At most wells, bailers are dedicated to the wells, so cross contamination from other wells is eliminated.

At the sites sampled for vertical definition of contaminants in the aquifer, stainless-steel thief sampling devices (bottles) are used to collect samples. The samples are delivered directly from the stainless-steel thief sampling bottles to a precleaned container which is used for filling the appropriate sample containers. Prior to sampling at each sampling port, the stainless-steel thief sampling bottles are washed with water and detergent and rinsed with deionized water. At the end of the day, the equipment is washed with water and detergent and rinsed with deionized water prior to storage, to further reduce the chance of cross contamination.

For surface-water sites, grab samples are collected from the stream bank, using either a precleaned Teflon® container or precleaned churn splitter. Prior to sampling, the selected container is washed with water and detergent, and rinsed with deionized water and rinsed with deionized water after 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, chapter A4]) or in the USGS Idaho Water Science Center Quality-Assurance Plan for water-quality activities (Mark Hardy, U.S. Geological Survey, written commun., 2008); however, protocols sometimes are modified to collect the best representative water sample possible. At wells equipped with a dedicated pump, a volume of water equivalent to a minimum of one wellbore volume is pumped prior to collecting the samples; at many wells, more than one wellbore volume is pumped. The purging of one well volume instead of three, as recommended in the USGS National Field Manual, is done to limit the amount of purge water that needs to be containerized at some wells. Bartholomay (1993) and Knobel (2006) generally determined that sample concentrations would not be affected by a change in the number of volumes of water purged for the wells evaluated. The diameter of the wellbore, rather than the volume of the casing, is used to calculate the minimum volume because of the potentially great difference between the two. Additionally, temperature, specific conductance, pH, and dissolved oxygen are monitored periodically during pumping using methods described by Wood (1981), Hardy and others (1989), and U.S. Geological Survey (variously dated, chapter A6). Field measurements made immediately prior to sample collection are used to represent those for the sample. When pH measurements are within ±0.1 standard units, water temperature is ±0.2 °C, and specific conductance readings are within 5 percent of each other for three consecutive readings taken 3–5 minutes apart, indicating probable hydraulic and chemical stability; a water sample is collected using the following steps:

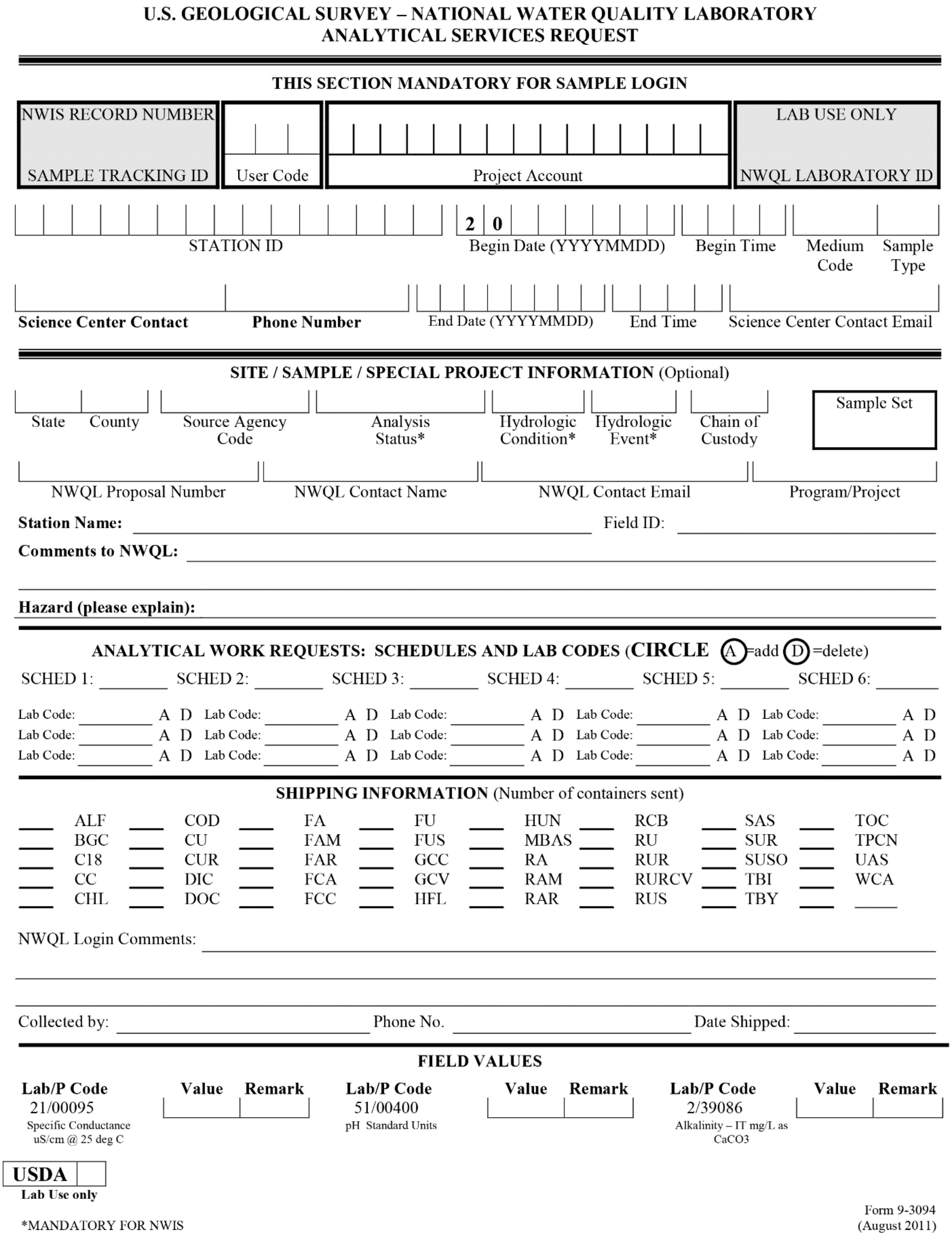
1. The field person responsible for collecting the water sample wears disposable gloves and stands in a position where neither the collector nor the sample can become contaminated.
2. The outside of the sample delivery line is thoroughly rinsed with water pumped from the well.
3. If appropriate, sample containers and filtration equipment are thoroughly rinsed with water pumped from the well or surface-water site before being used. A new, disposable capsule filter with a 0.45-micron membrane filter is used at each site. The capsule filter is inverted to clear trapped air bubbles and 2 L of deionized water is used to rinse the capsule filter prior to sample collection. This removes any surfactants that are adhered to the filter.
4. For groundwater samples from wells equipped with dedicated pumps, the capsule filter is connected to the sample port with precleaned Tygon™ tubing; unfiltered samples are collected directly from the sample port. For surface-water samples, thief samples, and bailer samples, a grab sample is collected in a precleaned container and 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 submersing the sample container into the surface-water body or drawing water from a precleaned container using the precleaned inlet tubing of a peristaltic pump.
5. Samples are capped and are moved into the mobile field laboratory where they are uncapped and preserved (if appropriate) as described in table 1. A new pair of gloves, safety glasses, and a laboratory apron are worn while preserving samples.
6. The bottles are capped, and then labeled (see fig. 4 for example of label). An alternate method for labeling containers 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.

7. Field measurements are made 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 is collected. The second set of samples replaces the original set of samples.
8. A laboratory request schedule is completed for use by each laboratory to which the sample(s) will be sent for analysis (see figs. 5–7 for examples).
9. The water samples are chilled to 4 °C if necessary, and stored in the field laboratory until they can be transferred to a secured storage area. Samples are sent biweekly to the USGS NWQL and daily to TestAmerica Laboratories for analysis; the samples are transported in a sealed ice chest by a contract carrier, and overnight delivery is stipulated for water samples for analyses of nutrients, VOCs, and other time-sensitive constituents. Samples sent to the DOE RESL for analyses are hand carried to the laboratory at the end of the sampling event.
10. All equipment is decontaminated with deionized water and, if necessary, organic-free water.

LOCATION=
SAMPLER =
STA NAME =
DATE =
SAMP SIZE =
DISCHARGE =
WATER TEMP =
SAMPLE TYPE =

1 OF 1
SPEC COND =
TIME =
pH =
TREATMENT =
AIR TEMP =
SCHEDULE =

Figure 4. Label attached to each sample bottle.



U.S. GEOLOGICAL SURVEY – NATIONAL WATER QUALITY LABORATORY
ANALYTICAL SERVICES REQUEST

THIS SECTION MANDATORY FOR SAMPLE LOGIN

NWIS RECORD NUMBER SAMPLE TRACKING ID	User Code	Project Account	LAB USE ONLY NWQL LABORATORY ID

STATION ID	2 0 Begin Date (YYYYMMDD)	Begin Time	Medium Code	Sample Type

Science Center Contact	**Phone Number**	End Date (YYYYMMDD)	End Time	Science Center Contact Email

SITE / SAMPLE / SPECIAL PROJECT INFORMATION (Optional)

State	County	Source Agency Code	Analysis Status*	Hydrologic Condition*	Hydrologic Event*	Chain of Custody	Sample Set

NWQL Proposal Number	NWQL Contact Name	NWQL Contact Email	Program/Project

Station Name: ____________ Field ID: ____________

Comments to NWQL: ____________

Hazard (please explain): ____________

ANALYTICAL WORK REQUESTS: SCHEDULES AND LAB CODES (**CIRCLE** Ⓐ=add Ⓓ=delete)

SCHED 1: ______ SCHED 2: ______ SCHED 3: ______ SCHED 4: ______ SCHED 5: ______ SCHED 6: ______

Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D
Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D
Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D Lab Code: ______ A D

SHIPPING INFORMATION (Number of containers sent)

___ ALF
___ BGC
___ C18
___ CC
___ CHL
___ COD
___ CU
___ CUR
___ DIC
___ DOC
___ FA
___ FAM
___ FAR
___ FCA
___ FCC
___ FU
___ FUS
___ GCC
___ GCV
___ HFL
___ HUN
___ MBAS
___ RA
___ RAM
___ RAR
___ RCB
___ RU
___ RUR
___ RURCV
___ RUS
___ SAS
___ SUR
___ SUSO
___ TBI
___ TBY
___ TOC
___ TPCN
___ UAS
___ WCA
___ ___

NWQL Login Comments: ____________

Collected by: ____________ Phone No. ____________ Date Shipped: ____________

FIELD VALUES

Lab/P Code	**Value**	**Remark**	**Lab/P Code**	**Value**	**Remark**	**Lab/P Code**	**Value**	**Remark**
21/00095 Specific Conductance uS/cm @ 25 deg C			51/00400 pH Standard Units			2/39086 Alkalinity – IT mg/L as CaCO3		

USDA
Lab Use only

*MANDATORY FOR NWIS

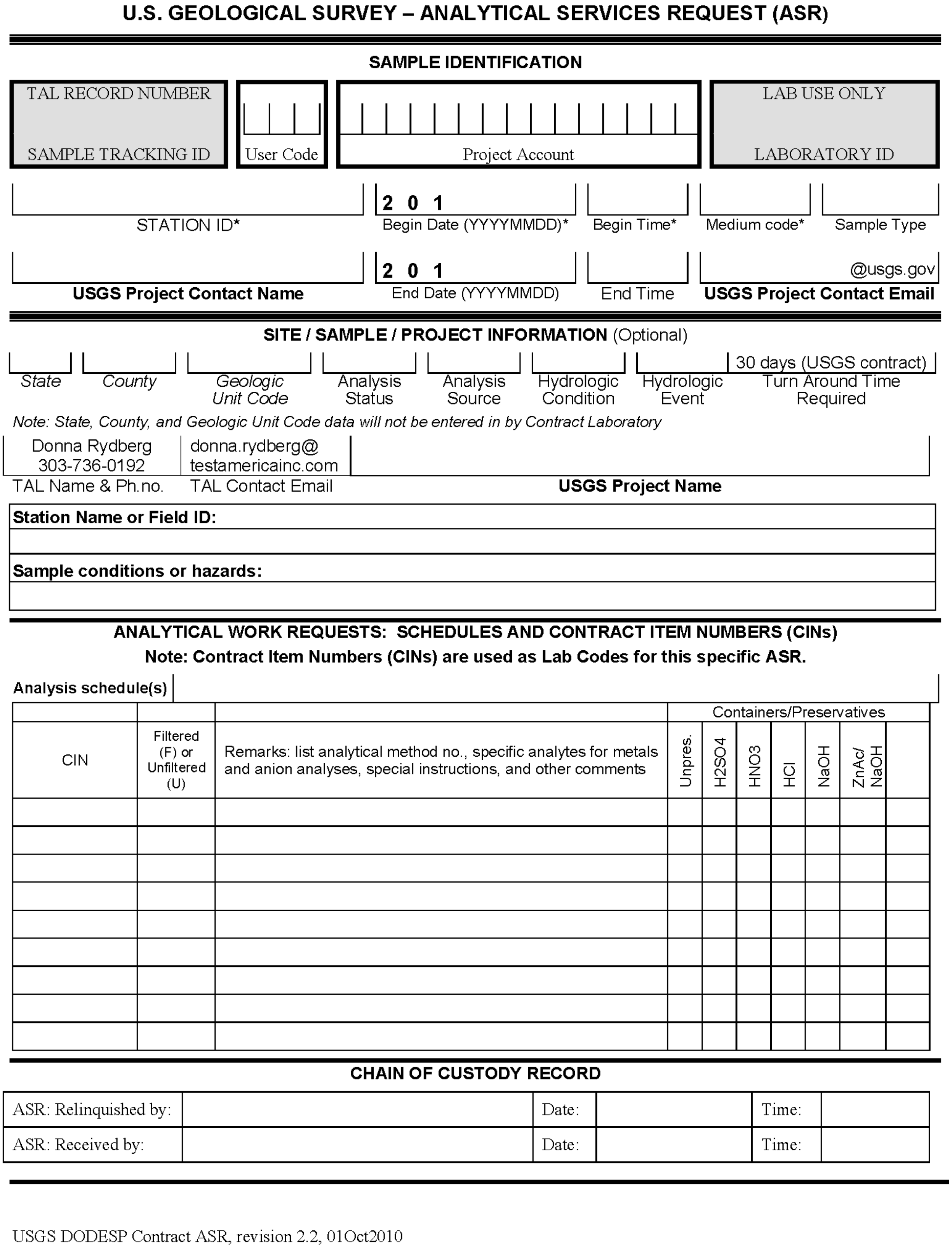
Form 9-3094
(August 2011)

Figure 5. Analytical services request form for the National Water Quality Laboratory.

SAMPLE RECORD SHEET

Site Name (click to UNHIDE)	Site Number	Date Sampled	Time	Medium	RESL Analytes	RESL Bottles	SINT#

Figure 6. Record sheet for the Radiological and Environmental Sciences Laboratory. (RESL, Radiological and Environmental Sciences Laboratory; SINT#, laboratory log in number.)



U.S. GEOLOGICAL SURVEY – ANALYTICAL SERVICES REQUEST (ASR)

SAMPLE IDENTIFICATION

TAL RECORD NUMBER SAMPLE TRACKING ID	User Code	Project Account	LAB USE ONLY LABORATORY ID

	2 0 1			
STATION ID*	Begin Date (YYYYMMDD)*	Begin Time*	Medium code*	Sample Type
	2 0 1		@usgs.gov	
USGS Project Contact Name	End Date (YYYYMMDD)	End Time	**USGS Project Contact Email**	

SITE / SAMPLE / PROJECT INFORMATION (Optional)

							30 days (USGS contract)
State	*County*	*Geologic Unit Code*	Analysis Status	Analysis Source	Hydrologic Condition	Hydrologic Event	Turn Around Time Required

Note: State, County, and Geologic Unit Code data will not be entered in by Contract Laboratory

Donna Rydberg 303-736-0192	donna.rydberg@ testamericainc.com	
TAL Name & Ph.no.	TAL Contact Email	**USGS Project Name**

Station Name or Field ID:
Sample conditions or hazards:

ANALYTICAL WORK REQUESTS: SCHEDULES AND CONTRACT ITEM NUMBERS (CINs)

Note: Contract Item Numbers (CINs) are used as Lab Codes for this specific ASR.

Analysis schedule(s)

			Containers/Preservatives						
CIN	Filtered (F) or Unfiltered (U)	Remarks: list analytical method no., specific analytes for metals and anion analyses, special instructions, and other comments	Unpres.	H2SO4	HNO3	HCl	NaOH	ZnAc/ NaOH	

CHAIN OF CUSTODY RECORD

ASR: Relinquished by:		Date:		Time:	
ASR: Received by:		Date:		Time:	

USGS DODESP Contract ASR, revision 2.2, 01Oct2010

Figure 7. Sample request and chain-of-custody record for the TestAmerica Laboratories.

Some 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. The well is bailed until enough water is collected for all the samples required or until the well is bailed dry. When the bailer is retrieved, its contents are placed either directly in bottles for raw samples or in a precleaned container as described in Sample Collection step 4. Field measurements are made on excess water from the bailer or in the precleaned container. After the sample bottle is filled with either raw or filtered water, samples are preserved appropriately, labeled, stored, and shipped as described in Sample Collection steps 6, 8, and 9.

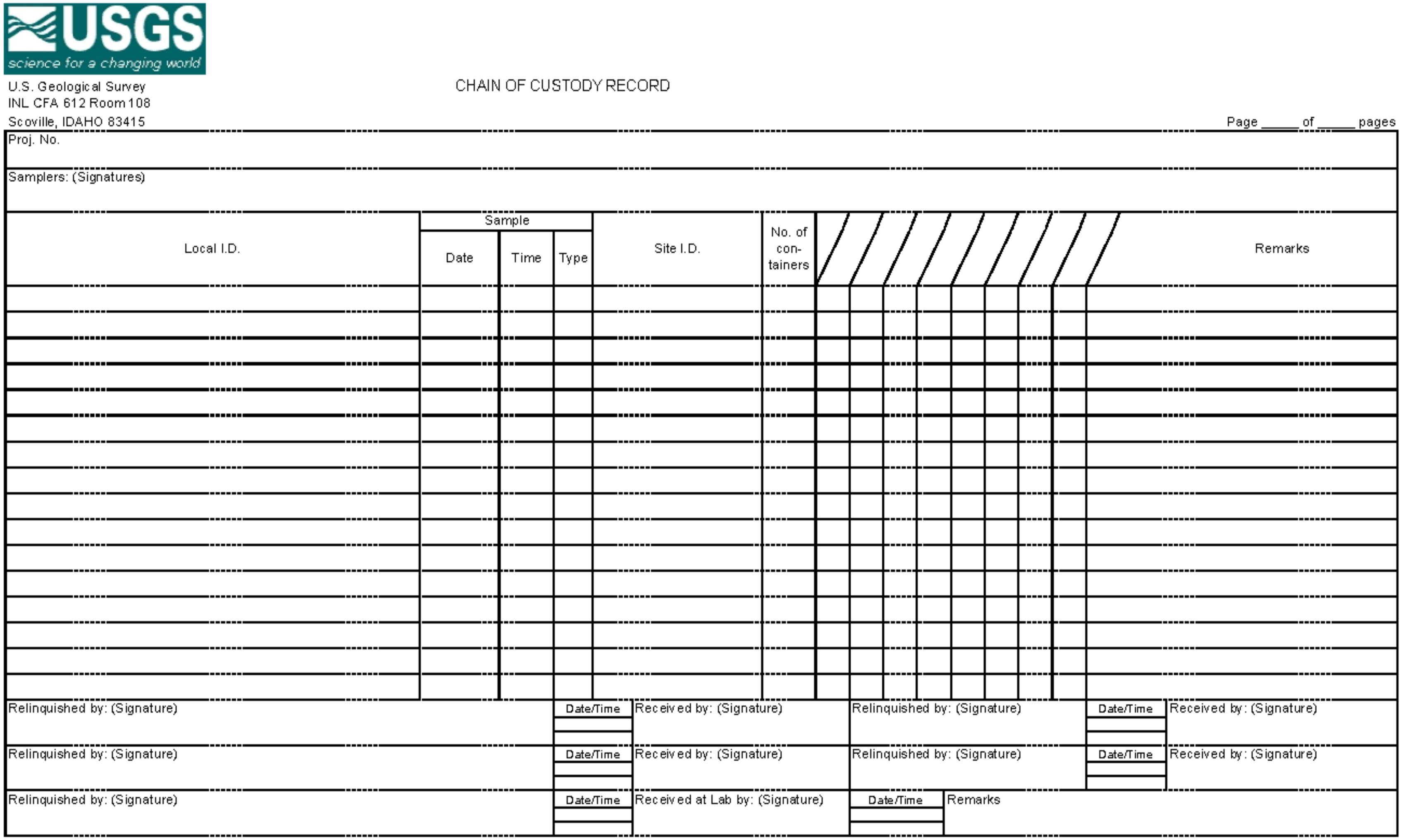
At the sites sampled for vertical definition of contaminants in the aquifer, the evacuated stainless-steel thief sampling devices (bottles) are lowered to the zone to be sampled, mated to the sampling port, and filled with formation water. The stainless-steel bottles are raised to the surface and emptied into a precleaned container; the water is processed to fill sample containers as described in Sample Collection step 4. Field measurements are made on excess water from the precleaned container. After the sample bottle is filled with either raw or filtered water, samples are preserved appropriately, labeled, stored, and shipped as described in Sample Collection steps 6, 8, and 9. This process is repeated until sufficient water has been collected to fill the required sample containers and to make necessary field measurements.

At sites where containerization of purge water is required, the sampling stream is split to accommodate measurement of the field-water-quality indicators (temperature, pH, specific conductance, and dissolved oxygen) and to collect samples. Addtionally, excess purge water is collected at the discharge point in buckets that are subsequently emptied in the trailer-mounted containers and also routed through canvas hoses to the trailer-mounted containers. The containerized purge water is subsequently transported to an approved disposal site.

Wells inside the Advanced Test Reactor Complex and the boundary of the Resource Conservation and Recovery Act Listed Waste Polygon (Knobel, 2006) require containerization of all purge water. These wells are purged at slow rates to minimize the amount of purge water. After three stable readings of temperature, pH, specific conductance, and dissolved oxygen are obtained, and at least one wellbore volume has been purged, samples are collected.

Production wells at the INL generally are connected to water distribution systems, and they cycle on and off in response to system water demand. Because of the frequent pumping cycles, water in the system is representative of aquifer water, and only sample collection lines require purging prior to sampling. In many cases, the production wells cycle off before the multi-parameter field measurement instruments can stabilize. In this case, the requirement for stable readings is waived; however, an end-of-day check must be satisfactory, or the well is resampled.

Conditions at the well during sample collection are recorded in a PCFF or bound water-quality field logbook (figs. 1–2), and a chain-of-custody record (fig. 8) is used to track samples from the time of collection until delivery to the DOE RESL or until mailing to the USGS NWQL, TestAmerica Laboratories, or other labs used. These records are available for inspection at the USGS INL Project Office. The chain-of-custody record for the current NRF contract laboratory, TestAmerica Laboratories, is shown in figure 6. The original is returned to NRF.



U.S. Geological Survey
INL CFA 612 Room 108
Scoville, IDAHO 83415

CHAIN OF CUSTODY RECORD

Page _____ of _____ pages

Proj. No.

Samplers: (Signatures)

Local I.D.	Sample			Site I.D.	No. of con-tainers									Remarks
	Date	Time	Type											

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received at Lab by: (Signature)	Date/Time	Remarks	

Figure 8. Chain-of-custody record.

Data Handling

All valid data analyses are entered into the NWIS database. The method by which the data are entered varies with the capabilities of the laboratory that performed the analyses.

The USGS NWQL and other USGS laboratories format the analytical results into NWIS-compatible batch input files. An electronic copy of the data is sent to the Water Science Center via the QW-Data Transfer System for input to the NWIS. After processing, the batch input and output files are made available for the appropriate field office or individual requestor.

Some contract laboratories provide analysis results in spreadsheet format, tab-delimited text files or paper copy. In these instances the data are formatted into NWIS-compatible batch files or entered manually.

Field Methods for Water-Level Measurements

Calibration of water-level measurement equipment and use of appropriate field procedures are crucial for ensuring that reliable water-level data are collected from open boreholes, data loggers, and MLMS. All sites are surveyed with known measuring points and the water-level is calculated from a known land surface datum (LSD).

Calibration of Electric Tapes

The USGS INL Project Office started the use of e-tapes in 2003; prior to 2003, stainless steel tapes where used. E-tapes are calibrated against a reference steel tape that is maintained in the project office for calibration use only. All e-tapes are initially calibrated before use in the field and recalibrated annually or more frequently if it is used often or if the tape has been subjected to abnormal stress that may have caused it to stretch. An inventory of e-tapes is given in appendix G. The following procedures are used for calibration:

1. Check the distance from the probe sensor to the nearest foot marker on the tape to ensure that this distance sets the sensor at the zero-foot point for the tape. If it does not, a correction must be applied to all depth-to-water measurements.
2. Check the circuitry of the e-tape before lowering the probe into the well by dipping the probe into tap water to observe whether the indicator light and beeper are functioning properly to indicate a closed circuit.
3. Compare water-level measurements made with the e-tape with those made with a reference steel tape in several wells that span the range of depths-to-water that is anticipated. Measurements should agree to within ±0.02 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 server and posted on the corresponding e-tape.

Collection Procedures for Water Levels

All water-level measurements taken with an e-tape have a calibration and measuring point (MP) correction applied to them. Several wells also have deviation corrections applied; these corrections have been calculated from geophysical deviation log files. All data are entered in the Multi Optional Network Key Entry System (MONKES) for electronic download and on a field sheet for back up (fig. 9).

1. Use the e-tape, making all measurements with the same deflection point on the indicator scale, light intensity, or sound so that water levels will be consistent between measurements.
2. Lower the electrode probe slowly into the well until the indicator shows that the circuit is closed and contact with the water surface is made. Take two readings within ±0.02 ft of each other at a known MP; this is the depth to water. Be sure you have a solid beep and if you drop lower in the water table you still have a solid beep. Record the depth to water, date and time of the measurement on the water level field sheet (fig. 9) and into MONKES for electronic download.
3. Rewind the tape and rinse the end of the tape with deionized water after completing the water-level measurement, prior to storing for travel to the next well.
4. Maintain the tape in good working condition by periodically checking the tape for breaks, kinks, and possible stretch.
5. Record the water levels on the field sheet and into MONKES, by applying the MP correction to obtain the depth to water in feet below LSD. All MP descriptions from NWIS are available in the MONKES program. Apply any deviation and e-tape corrections. View historical data and the hydrograph on the MONKES program to verify the water-level is reasonable.

WELL NAME (C190)	Jan	LOCATION BY AREA	PDA FILE	LAT LONG	(hddd mm'ss.ss")
USGS 2	AQ	ARGONNE AREA	SOUTH	433319.87	1124321.28
USGS 4	AQ	NE	NORTH	434655.93	1122821.62
USGS 5	AQ	NRF AREA	CENTRAL	433542.75	1124937.65
USGS 6	AQ	NRF AREA	CENTRAL	434031.12	1124536.66
USGS 7	AQ	NE	NORTH	434914.81	1124439.87
USGS 8	AQ	SW	SOUTH	433120.51	1131157.43
USGS 9	AM	SW	SOUTH	432732.38	1130439.78
USGS 11	AQ	SW	SOUTH	432336.18	1130642.52
USGS 12	AM	NW	CENTRAL	434126.19	1125507.10
USGS 14	AQ	SE	SOUTH	432019.27	1125507.10
USGS 15	AQ	NRF AREA	CENTRAL	434234.84	1125517.35
USGS 17	AQ	NRF AREA	CENTRAL	433936.42	1125154.27
USGS 18	AQ	NRF AREA	CENTRAL	434540.70	1124409.29
USGS 19	AM	NW	NORTH	434426.68	1125756.58
USGS 20	AQ	CFA AREA	CENTRAL	433252.79	1125459.41
USGS 22	AQ	SW	SOUTH	433422.28	1130321.09
USGS 23	AQ	NW	NORTH	434055.15	1130000.02
USGS 26	AQ	NE	NORTH	435210.55	1123940.74
USGS 27	AM	NE-MUDLAKE	NORTH	434851.22	1123218.90
USGS 39	AQ	CFA AREA	CENTRAL	433343.19	1125701.42
USGS 54	PQ	RTC AREA	FACILITY	433503.00	1125728.00
USGS 55	PQ	RTC AREA	FACILITY	433508.00	1125729.00
USGS 57	AQ	INTEC-AREA ICDF	FACILITY	433344.04	1125626.00
USGS 58	AQ	RTC AREA	FACILITY	433500.19	1125725.07
USGS 60	PQ	RTC AREA	FACILITY	433456.00	1125719.00
USGS 61	PQ	RTC AREA	FACILITY	433453.00	1125715.00
USGS 62	PQ	RTC AREA	FACILITY	433446.00	1125705.00
USGS 63	PQ	RTC AREA	FACILITY	433455.00	1125740.00
USGS 65	AQ	RTC AREA	FACILITY	433446.85	1125747.13
USGS 66	PM	RTC AREA	FACILITY	433439.00	1125657.00
USGS 68	PQ	RTC	FACILITY	433516.00	1125740.00
USGS 69	PQ	RTC AREA	FACILITY	433450.00	1125729.00
USGS 70	PQ	RTC AREA	FACILITY	433504.00	1125710.00
USGS 71	PQ	RTC AREA	FACILITY	433439.00	1125714.00
USGS 72	PQ	RTC	FACILITY	433519.00	1125747.00
USGS 73	PQ	RTC AREA	FACILITY	433502.00	1125753.00
USGS 78	R	RTC AREA	RECORDER	433413.00	1125735.00
USGS 82	AQ	INTEC AREA	CENTRAL	433400.93	1125510.34
USGS 83	AQ	SW	SOUTH	433023.03	1125615.28

WELL NAME (C190)	Jan	LOCATION BY AREA	PDA FILE	LAT LONG	(hddd mm'ss.ss")
USGS 84	AQ	CFA AREA	CENTRAL	433356.51	1125741.84
USGS 85	AQ	CFA AREA	CENTRAL	433246.23	1125711.89
USGS 86	AQ	SE	SOUTH	432934.79	1130801.44
USGS 89	AQ	RWMC AREA	SOUTH	433005.67	1130331.73
USGS 92	PQ	RWMC	SOUTH	433000.00	1130253.00
USGS 97	AM	NRF AREA	CENTRAL	433806.77	1125516.76
USGS 100	AQ	ARGONNE AREA	SOUTH	433502.72	1124006.67
USGS 101	AM	ARGONNE AREA	SOUTH	433255.75	1123819.91
USGS 104	AQ	SW	SOUTH	432856.07	1125608.14
USGS 112	AQ	CFA AREA	CENTRAL	433314.50	1125630.74
USGS 116	AQ	CFA AREA	CENTRAL	433331.55	1125532.67
USGS 117	AQ	RWMC AREA	SOUTH	432954.50	1130258.67
USGS 120	AM	SW	SOUTH	432919.19	1130314.01
USGS 125	AQ	SE	SOUTH	432559.41	1130530.37
USGS 126B	AQ	NW	NORTH	435528.51	1124713.67
USGS 127	AQ	CFA AREA	CENTRAL	433058.28	1125722.04
USGS 129	AM	RWMC AREA	SOUTH	433036.52	1130027.45
USGS 130	AM	CFA AREA	CENTRAL	433130.67	1125628.40
USGS 131	AM	SW	SOUTH	433036.28	1125816.05
USGS 138	AM	NW	NORTH		
USGS 139	AM				
ANP 9	AQ	NE	NORTH	434855.71	1124000.36
ARA-MON-A-002	AM	CFA AREA	CENTRAL	433054.00	1124921.00
ARBOR TEST	AQ	ARGONNE AREA	SOUTH	433508.92	1123848.01
CFA LF 2-10	AQ	CFA AREA	CENTRAL	433215.87	1125632.97
COREHOLE 1	AQ	SE	SOUTH	432926.76	1124100.07
COREHOLE 2A	AQ	NRF AREA	CENTRAL	434557.13	1124448.98
ICPP-MON-A-166	AQ	CFA AREA	FACILITY OTHER	433300.12	1125833.19
ICPP-MON-V-200	PQ	CFA AREA	FACILITY OTHER	433321.28	1125815.03
MTR TEST	AM	RTC AREA	FACILITY OTHER	433520.08	1125729.20
NO NAME 1	AQ	NE	NORTH	435038.79	1124532.76
NPR TEST	AQ	INTEC AREA	CENTRAL	433449.43	1125231.26
NRF 15-A	AM	NRF AREA	CENTRAL	433942.18	1125450.60
NRF 15-B	AM	NRF AREA	CENTRAL	433942.18	1125450.60
PW 8	PQ	RTC AREA	FACILITY OTHER	433456.00	1125720.00
PW 9	PQ	RTC AREA	FACILITY OTHER	433501.00	1125755.00
SITE 9	AQ	CFA AREA	CENTRAL	433122.86	1125300.80
SITE 14	AQ	NRF AREA	CENTRAL	434334.66	1124631.50

WELL NAME (C190)	Jan	LOCATION BY AREA	PDA FILE	LAT LONG	(hddd mm'ss.ss")
SITE 17	AM	NW	CENTRAL	434026.74	1125756.50
Monthly totals	78				
Sampled wells	0				
W/L's only	78				
TOTAL PERCHED					
TOTAL AQUIFER					
TOTAL WELLS					

AA-Aquifer well measured annually.
AS-Aquifer well measured semi-annually.
AQ-Aquifer well measured quarterly.
AM-Aquifer well measured monthly.
BM-Well measured monthly for USGS Boise.
S-Water sample collected
PA-Perched well measured annually
PS-Perched well measured semi-annually.
PQ-Perched well measured quarterly
R-Well equipped with continuous water-level recorder.
PM-Perched monthly.
ANRF-Aquifer well measured for NRF

Figure 9. Sample water level field sheet.

Calibration and Collection Procedures of Submersible Pressure Transducer and Data Loggers

Water-level measurements for pressure transducers will be made to the nearest 0.01 ft. The accuracy of a pressure transducer 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. Pressure transducers are subject to drift, offset, and slippage of the suspension system. For this reason, the transducer measurements are checked against the water level in the well on every visit, and the transducer is recalibrated periodically according to manufacturer specifications and a correction is applied to the downloaded data.

The USGS INL Project Office maintains five vented pressure transducers in observation wells for long-term, continuous monitoring of water levels. These wells are scheduled for either semi-annual or quarterly visits in order to download the data, calibrate the transducer, and apply data corrections. The procedure for retrieving water-level measurements from pressure transducers and maintaining the pressure transducers is:

1. Retrieve groundwater data by using instrument or data logger software.
2. Inspect the equipment to confirm that installation is operating properly. Document the current water level recorded by the sensor.
3. Measure the depth-to-water in the well using a calibrated e-tape to obtain an accurate water-level measurement to compare with the water level measured by the transducer. If the water-level measurement and transducer reading differ, slightly raise the transducer in the well and take a reading to confirm that the sensor is working. Check for possible cable kinks or slippage. Return transducer to its original position.
4. Recalibrate the transducer and apply data corrections as needed.
5. Verify the logger channel and scan intervals, document any changes to the data logger program, and reactivate the data logger. Make sure the data logger is operating prior to departure.

Calibration and Collection Procedures for Multilevel Pressure Measurements

Multilevel monitoring ports are calibrated by measuring the depth of the port below land surface with an e-tape and correcting the depth due to deviation as described in Fisher and Twining (2011). Fluid pressure measurements from 11 multilevel monitoring wells are made using a portable sampling probe that is lowered into the multiport casing from land surface and positioned at a selected measurement port coupling as described by Fisher and Twining (2011). Atmospheric pressure is monitored at land surface using a hand-held barometric sensor. Field measurements are recorded on a field sheet (fig. 10).

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

Revision: 7/22/2010

Multilevel Monitoring System

Field Data and Calculation Sheet

Local name: ____________________
BC altitude [Z]: ____________________ ft amsl
Stick-up: ____________________ ft
Probe number: ____________________
Probe range: ____________________ psia
Barometer number: ____________________
Well casing type: ____________________

Site number: ____________________
Date (m/d/y): ____________________
Start/Stop time: ____________________
Weather conditions: ____________________
Operators initials: ____________________
Comments: ____________________
____

Ambient Readings

Fluid pressure (probe)
Start: ______________ psia Finish: ______________ psia
Fluid temperature (probe)
Start: ______________ ˚C Finish: ______________ ˚C
Atmospheric pressure (barometer)
Start: ______________ psia Finish: ______________ psia

Port number	Depth to top of port casing from log (0.1 ft bls)	Depth to pressure transducer sensor [D] (0.1 ft bls)	Atmospheric pressure [P_{Atm}] (0.001 psia)	Fluid pressure readings (0.01 psia)			Probe temperature [T] (0.1 °C)	Time H:M:S (h:m)	Pressure head outside casing [Ψ_2] (0.01 ft)	Hydraulic head [H] (0.1 ft amsl)	Comments
				Inside casing [P_1]	Outside casing [P_2]	Inside casing [P_1]					
											Repeat measurement
											Repeat measurement

Notes:

BC: brass cap at land surface
Stick-up: distance from BC to the top of well casing
psia: pounds per square inch absolute
˚C: degree Celcius
ft bls: feet below land surface or BC
ft amsl: feet above mean sea level

$\Psi_2 = ((P_2 - P_{Atm}) / \gamma_w) * 144$

$H = Z - D + \Psi_2$

$\gamma_w = 62.42796 * (1 - (((T + 288.9414) / (508929.2 * (T + 68.12963))) * (T - 3.9863)^2))$

Figure 10. Field sheet for multilevel pressure and temperature measurements.

Data Handling Procedures for Water Levels

The INL uses MONKES for groundwater data entry and processing as recommended by the USGS Office of Groundwater. The use of mobile technology improves workflow processes in the collection, processing, and quality assurance of groundwater data. MONKES was designed for routine groundwater-level data collection throughout the USGS Water Science Centers. When a field trip is processed, .gwsi and .OD.xml files are generated. The original file is stored on the INL Project Office server and in the NWIS database. The .gwsi file is checked for errors, reviewed, and then uploaded into NWIS.

Data logger files are converted from .log to .prn, and original files are archived on the INL Project Office server. The .prn file is processed and uploaded to an Automated Data Processing System (ADAPS). Calibration corrections are applied within ADAPS. Data are reviewed and approved.

Multilevel pressure measurements are calculated and reviewed. The processed data are uploaded to NWIS.

Quality Assurance for Water-Quality Activities

The USGS Quality-Assurance Program at the INL Project Office incorporates the previously described methods of sample collection and processing with several other elements: (1) analytical methods used by the laboratories; (2) quality-control samples and data-quality objectives; (3) review of analytical results of chemical constituents provided by the laboratories; (4) audits of performance in the field and in the laboratory; (5) corrective actions to resolve problems with field and laboratory methods; (6) reporting of data; and (7) training and site safety requirements for personnel. These elements are included to ensure: (1) reliability of the water-quality data; (2) compatibility of the data with data collected by other organizations at the INL; and (3) applicability of the data to the programmatic needs of the DOE, its 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), and Rose and Schroeder (1995). A list of some analytical methods currently used at the USGS NWQL can be accessed at http://www.nwql.cr.usgs.gov/Public/ref_list.html. Other analytical methods from the U.S. Environmental Protection Agency (EPA) that are currently used at the USGS NWQL can be accessed at http://www.epa.gov/epahome/publications.html. Analytical methods from ASTM International that are currently used at the USGS NWQL can be accessed at http://www.astm.org. The type of analysis and the analytical procedure are specified on the USGS NWQL analytical services request form (fig. 5).

A discussion of procedures used by the DOE RESL for the analysis of radionuclides in water is provided by Bodnar and Percival (1982) and the U.S. Department of Energy (1995). The type of analysis to be performed on a water sample is specified on the DOE RESL sample record sheet (fig. 6).

A detailed description of internal quality control and of the overall quality-assurance practices used by the USGS NWQL is provided by Friedman and Erdmann (1982) and Pritt and Raese (1995); quality-control practices at the laboratory are described by Jones (1987); and quality-assurance data for routine water analyses are presented in Maloney and others (1993), Ludtke and others (2000), and Maloney (2005).

Quality-control samples collected by the INL Project Office includes collection and analysis of the following: (1) duplicate samples—two or more samples collected concurrently or sequentially and sent to different laboratories; (2) replicate samples—samples with the same sample identification numbers submitted to a laboratory; (3) source solution blank samples—samples of deionized water, organic-free water, or inorganic-free water sent to a laboratory; (4) equipment blanks—rinsate collected from bailers and thief samplers during decontamination procedures; (5) field blanks—samples of deionized water, organic-free water, or inorganic-free water poured in bottles in the field; (6) splits—large sample volumes divided into two or more equal volumes and sent to different laboratories for analysis; (7) trip blanks—laboratory supplied samples of boiled deionized water that travel with water samples from time of collection to time of analysis; and (8) spiked samples—samples to which a known concentration of a constituent is added.

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

Comparative studies to determine agreement among analytical results for water-sample pairs analyzed by laboratories involved in the INL Project Office quality-assurance program are summarized by 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) and Rattray (2014). Additional quality-assurance 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), and an evaluation of well-purging effects on water-quality of samples collected from the ESRPA (Knobel, 2006).

Data-Quality Objectives

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

Laboratory data-quality objectives for routine water samples analyzed by the USGS NWQL are included in appendix C, and data-quality objectives for radionuclides in water samples analyzed by the DOE RESL are in appendix D. Data-quality objectives for quality control data (including field and laboratory procedures for replicates and blanks) are included in appendix F.

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:

- The historical concentration of the solute at the site where the sample was collected;
- The concentration of the solute in replicate, split, blank, or other quality-assurance samples;
- The concentrations of the solute in nearby wells that obtain water from the same aquifer or perched-water zone;
- A review of waste-disposal records and changes in disposal techniques, land use, and recharge that may influence the concentration of a solute;
- Cation-anion balance of analyses for which common ions are analyzed; and
- 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. Under certain circumstances, a re-analysis by the laboratory is requested or a second sample is collected and analyzed to verify the concentration of the solute in the water. These circumstances include: (1) a constituent differs from historical data, (2) a constituent differs markedly from the concentrations in water from nearby wells, or (3) an initial analysis for a solute exceeds 80 percent of the maximum contaminant level (MCL) set by the EPA for that constituent, If resampling is necessary, replicates or split samples generally are collected to evaluate field and laboratory variability. Spiked and reference samples are used to measure bias. Constituents for which MCLs have been proposed or established are shown in tables 2–6.

If analytical results indicate that concentrations in samples from one site vary by more than 50 percent from historical record for no obvious reason, reruns are requested and the results also are evaluated by replicate sampling during the next sample period. If the analytical results for the replicates do not agree, the source of the discrepancy is investigated.

Table 2. 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 (2013, p. 472) 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 concentrations assumed to produce a total body or organ dose of 4 millirem per year (mrem/yr) of beta-particle radiation. **Abbreviations:** pCi/L, picocurie per liter; 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
Strontium-90	8 pCi/L
Tritium	20,000 pCi/L
Uranium	30 µg/L

Table 3. Maximum contaminant levels, secondary maximum contaminant levels, and reporting levels of selected trace elements in water.

[The maximum contaminant levels (MCL) are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2013, p 405,468) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels (SMCL)—[in brackets]—are from U.S. Environmental Protection Agency (2013, p. 742). The reporting levels 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 (see appendix A). Units are in micrograms per liter (µg/L). **Symbols:** ••, maximum contaminant level has not been established; *, lead has an action level of 15 µg/L]

Trace element	MCL or SMCL	Reporting levels
Aluminum	[50 to 200]	2.2
Antimony	6	0.027
Arsenic	10	0.1
Barium	2,000	0.25; 0.3
Beryllium	4	0.02; 0.19
Boron	••	2
Cadmium	5	0.03
Chromium	100	0.3
Cobalt	••	0.05
Copper	[1,000]	0.8
Iron	[300]	3, 4
Lead	*	0.04
Lithium	••	0.22
Manganese	[50]	0.4
Mercury	2	0.005
Molybdenum	••	0.05
Nickel	••	0.2
Selenium	50	0.05
Silver	[100]	0.02
Strontium	••	0.8
Thallium	2	0.03
Uranium	••	0.014
Vanadium	••	0.08
Zinc	[5,000]	2.0

Table 4. Maximum contaminant levels, secondary maximum contaminant levels, and reporting levels of selected common ions in water.

[The maximum contaminant levels (MCL) are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2013, p. 468) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels (SMCL)—in brackets—are from U.S. Environmental Protection Agency (2013, p. 742). The reporting levels are taken from the Laboratory Information Management System used by the National Water Quality Laboratory, U.S. Geological Survey. The reporting level for bromide is based on the method detection level; others are based on the long-term method detection levels. Units are in milligrams per liter (mg/L). **Symbols:** –, maximum contaminant level has not been established]

Constituent	MCL or SMCL	Reporting level
Bromide	–	0.03
Calcium	--	0.022
Chloride	[250]	0.02
Fluoride	4 [2]	0.01
Magnesium	–	0.011
Potassium	–	0.03
Silica	–	0.018
Sodium	–	0.06
Sulfate	[250]	0.02

Table 5. Maximum contaminant levels and reporting levels of selected nutrients in water.

[The maximum contaminant levels (MCL) are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2013, p. 405) for community water systems and are for comparison purposes only. The reporting levels 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 plus nitrate are based on method detection levels; others are based on long-term method detection levels. Units are in milligrams per liter (mg/L). **Symbols:** –, maximum contaminant level has not been established]

Constituent	MCL	Reporting level
Ammonia (as nitrogen)	–	0.01
Nitrite (as nitrogen)	1	0.001
Nitrite plus nitrate (as nitrogen)	10	0.004
Orthophosphate (as phosphorus)	–	0.04

Table 6. 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 use an analytical method equivalent to U.S. Environmental Protection Agency method 524.2. Maximum contaminant levels (MCL) were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2013, p. 466) for community water systems and are included for comparison purposes only. Minimum reporting levels (MRL) are from the Laboratory Information Management System used by the National Water Quality Laboratory, U.S. Geological Survey. Units are in micrograms per liter (µg/L). **Symbols:** –, MCL has not been established or proposed; *, total trihalomethanes (which include bromoform, chlorodibromomethane, chloroform, and dichlorobromomethane) in community water systems serving 10,000 or more persons cannot exceed 100 µg/L (U.S. Environmental Protection Agency, 2013, p. 466)]

Compound	MCL	MRL	Compound	MCL	MRL
Acrylonitrile	–	2.5	1,3-Dichloropropane	–	0.2
Benzene	5	.1	2,2-Dichloropropane	–	.2
Bromobenzene	–	.2	cis-1,3-Dichloropropene	–	.2
Bromochloromethane	--	.2	trans-1,3-Dichloropropene	–	.2
Bromoform	*	.2	1,1-Dichloropropene	–	.2
Bromomethane	–	.3	Ethylbenzene	700	.1
n-Butylbenzene	–	.2	Hexachlorobutadiene	–	.2
sec-Butylbenzene	–	.2	Isopropylbenzene	–	.2
tert-Butylbenzene	–	.2	p-Isopropyltoluene (4-Isopropyl-1-methylbenzene)	–	.2
Carbon tetrachloride (Tetrachloromethane)	5	.2	Methylene chloride (Dichloromethane)	–	.2
Chlorobenzene	100	.1	Methyl tert-butylether (tert-Butyl methyl ether)	–	.2
Chlorodibromomethane (Dibromochloromethane)	*	.2	Naphthalene	–	.5
Chloroethane (Xylenes)	–	.2	n-Propylbenzene	–	.2
Chloroform	*	.1	Styrene	100	.1
Chloromethane	–	.2	1,1,1,2-Tetrachloroethane	–	.2
2-Chlorotoluene	–	.2	1,1,2,2-Tetrachloroethan	–	.2
4-Chlorotoluene	–	.2	Tetrachloroethylene	5	.1
1,2-Dibromo-3-chloropropane	.5	.5	Toluene	1,000	.1
1,2-Dibromoethane	.05	.2	1,2,3-Trichlorobenzene	–	.2
Dibromomethane	–	.2	1,2,4-Trichlorobenzene	70	.2
1,2-Dichlorobenzene	600	.1	1,1,1-Trichloroethane	200	.1
1,3-Dichlorobenzene	600	.1	1,1,2-Trichloroethane	5	.2
1,4-Dichlorobenzene	75	.1	Trichloroethene (Trichloroethylene)	5	.1
Dichlorobromomethane (Bromodichloromethane)	*	.2	Trichlorofluoromethane	–	.2
Dichlorodifluoromethane	–	.2	1,2,3-Trichloropropane	–	.2

Compound	MCL	MRL	Compound	MCL	MRL
1,1-Dichloroethane	–	0.1	1,1,2-Trichloro 1,2,2-trifluoroethane	–	0.1
1,2-Dichloroethane	5	.2	1,2,4-Trimethylbenzene	–	.2
cis-1,2-Dichloroethene (cis-1,2-Dichloroethylene)	70	.1	1,3,5-Trimethylbenzene	–	.2
1,1-Dichloroethene (cis-1,2-Dichloroethylene)	7	.1	Vinyl chloride	2	.2
trans-1,2-dichloroethene (trans-1,2-dichloroethylene)	100	.1	Xylenes, total ortho, meta, and para	10,000	.2
1,2-Dichloropropane	5	.1			

Performance Audits

Performance audits are conducted routinely at three levels: (1) at the field level, (2) at the laboratory level, and (3) through National Field Quality-Assurance Tests. At the field level, the Project Chief or a designee routinely accompanies the field personnel to a selected number of sites to ascertain whether proper field techniques are used to collect and preserve the samples; to ensure that proper safety procedures are followed; and, when necessary, to evaluate the training of new employees. The field auditor checklist is shown in appendix H. Written results of the field audits are provided to the employee, and copies of the field audits are stored in the office quality-assurance files. Performance audits at the laboratory level are done in compliance with the process outlined in the individual laboratories quality assurance manuals or procedures.

The USGS INL Project Office participates in the National Field Quality-Assurance Program established by the USGS to evaluate the accuracy of water-quality field measurements. Quality-assurance blind samples are sent to field personnel for testing. The results are sent back to the water-quality service unit for evaluation. If field personnel or equipment do not pass the test, corrective action is taken. The program is described in detail by Erdmann and Thomas (1985).

In addition to the routine performance audits, water-quality activities at the INL Project Office are periodically monitored and reviewed by other USGS personnel: the Water-Quality Specialist for the USGS Idaho Water Science Center, Boise, Idaho; personnel at the Office of the Western Field Team, Menlo Park, California; and personnel at the Office of Water Quality at USGS Headquarters, Reston, Virginia. Reviews by personnel at the USGS Idaho Water Science Center take place at 1- to 2-year intervals; reviews by the Office of the Western Field team and by the Headquarters Office of Water Quality take place at 3- to 4-year intervals. The reviews are summarized in writing, and the reports are distributed to the USGS INL Project Office, Western Field Office team, and the Headquarters Office of Water Quality. If deficiencies are documented, the Chief of the USGS INL Project Office must submit a written reply outlining the necessary corrective action.

Corrective Actions

If the performance audits indicate inconsistencies or inadequacies in field methods or in analytical results by the laboratories, the problems are documented and the field personnel 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 is judged by the USGS INL Project Office Chief to be suitable and consistent with written guidelines.

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. To evaluate whether appropriate actions are taken, the frequency and numbers of replicate, blank, split, or other quality-assurance samples are increased until it is demonstrated that problems in the laboratory methods are resolved.

If USGS INL Project Office personnel discover a problem with sampling procedures, equipment calibration, or data review analysis and interpretation that cannot be resolved at the project level, the USGS Idaho Water Science Center Water-Quality Specialist is notified of the problem. If the specialist cannot resolve the problem in consultation with the USGS Western Field Team Water-Quality Specialist, the problem may be referred to the USGS Office of Water Quality or National Research Program, where research hydrologists and chemists will aid in resolving the problem.

Reporting of Data

All data collected by the USGS INL Project Office are publically available, after review, and most data are published in data reports and used in interpretive reports. Water-quality information, subsequent to its review, is entered into the NWIS and periodically merged with a nationally-accessible database. Data that suggest a possible human health or environmental problem are provided to managerial agencies such as the DOE and to regulatory agencies, such as the State of Idaho Department of Health and Welfare and the EPA, Region 10. After data have been reviewed and verified—by resampling if necessary—they are available to the general public either upon request or through the USGS National Water Information System Web portal at http://waterdata.usgs.gov/nwis.

Quality Assurance for Water-Level Measurements

Routine measurements are collected with a calibrated e-tape and are checked by taking two readings that need to be within ±0.02 ft of each other. While in the field, the final measurement is compared to historical measurements to ensure the readings that are taken are reasonable. If the readings do not seem reasonable, another measurement is taken.

MLMS pressure measurements are checked at each site by taking a second pressure reading from two duplicate ports after all the first pressure readings have been taken from the ports. Historical pressure readings are reviewed in the field to ensure probe location and accurate readings are collected.

Training Requirements and Site Safety

Training and site safety are important components of the USGS INL Project Office QAP. Employees are not assigned tasks for which they are not adequately trained, and all employees have a stop-work authority if they feel that work 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 USGS INL Project Office personnel training requirements and site safety requirements are given in the USGS INL Site Safety and Job Hazard Analysis Document (Roy Bartholomay, USGS, written commun., December 2013).

USGS INL Project Office personnel are called on from time to time to sample or measure wells for which no 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 marked as containing either samples with unknown or expected concentrations of contaminants that are potentially large.

Selected References

Bartholomay, R.C., 1993, Concentrations of tritium and strontium-90 in water from selected wells at the Idaho National Engineering Laboratory after purging one, two, and three bore-hole volumes: U.S. Geological Survey Water Resources Investigations Report 93-4201 (DOE/ID-22111), 21 p, http://pubs.usgs.gov/wri/1993/4201/report.pdf.

Bartholomay, R.C., Hill, G.H., and Randolph, R.B., 1999, Statistical comparison of gross alpha- and gross beta-particle activity in water analyzed using two analytical methods [abs.]: Rocky Mountain Conference on Analytical Chemistry, 41st, Denver, Colo., 1999 Program and Abstracts, p. 132.

Bartholomay, R.C., Knobel, L.L., and Rousseau, J.P., 2003, Field methods and quality-assurance plan for quality-of-water activities, U.S. Geological Survey, Idaho National Engineering and Environmental Laboratory, Idaho: U.S. Geological Survey Open-File Report 03-42 (DOE/ID-22182), 45 p., http://pubs.usgs.gov/of/2003/0042/report.pdf.

Bartholomay, R.C., and Williams L.M., 1996, Evaluation of preservation methods for selected nutrients in ground water at the Idaho National Engineering Laboratory, Idaho: U.S. Geological Survey Water-Resources Investigations Report 96-4260 (DOE/ID-22131), 16 p., http://pubs.usgs.gov/wri/1996/4260/report.pdf

Bodnar, L.Z., and Percival, D.R., eds., 1982, Analytical Chemistry Branch procedures manual—Radiological and Environmental Sciences Laboratory: U.S. Department of Energy Report IDO-12096 [variously paged].

Carkeet, Colleen, Rosentreter, J.J., Bartholomay, R.C., and Knobel, L.L., 2001, Geochemistry of the Big Lost River drainage basin, Idaho: U.S. Geological Survey Water-Resources Investigations Report 01-4031 (DOE/ID-22174), 31 p., http://pubs.usgs.gov/wri/2001/4031/report.pdf.

Cecil, L.D., Knobel, L.L., Wegner, S.J., and Moore, L.L., 1989, Evaluation of field sampling and preservation methods for strontium-90 in ground water at the Idaho National Engineering Laboratory, Idaho: U.S. Geological Survey Water-Resources Investigations Report 89-4146 (DOE/ID-22083), 24 p., http://pubs.usgs.gov/wri/1989/4146/report.pdf.

Childress, C.J.O., Forman, W.T., Connor, B.F., and Maloney, T.J., 1999, New reporting procedures based on long-term method detection levels and some considerations for interpretations of water-quality data provided by the U.S. Geological Survey National Water Quality Laboratory: U.S. Geological Survey Open-File Report 99-193, 19 p., http://water.usgs.gov/owq/OFR_99-193/index.html.

Claassen, H.C., 1982, Guidelines and techniques for obtaining water samples that accurately represent the water chemistry of an aquifer: U.S. Geological Survey Open-File Report 82-1024, 49 p., http://pubs.usgs.gov/of/1982/1024/report.pdf.

Currie, L.A., 1968, Limits for qualitative detection and quantitative determination—application to radiochemistry: Analytical Chemistry, v. 40, no. 3, p. 586–593.

Davis, L.C., Bartholomay, R.C., and Rattray, G.W., 2013, An update of hydrologic conditions and distribution of selected constituents in water, eastern Snake River Plain aquifer and perched groundwater zones, Idaho National Laboratory, Idaho emphasis 2009–11: U.S. Geological Survey Scientific Investigations Report 2013-5214, (DOE/ID-22226), 90 p., http://pubs.usgs.gov/sir/2013/5214/.

Erdmann, D.E., and Thomas, J.D., 1985, Quality assurance of the U.S. Geological Survey water-quality field measurements, *in* Taylor, J.K., and Stanley, T.W., eds., Quality assurance for environmental measurements: American Society for Testing and Materials Special Technical Testing Publication 867, p. 110–115.

Faires, L.M., 1993, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of metals in water by inductively coupled plasma-mass spectrometry: U.S. Geological Survey Open-File Report 92-634, 28 p., http://pubs.usgs.gov/of/1992/0634/report.pdf.

Fisher, J.C., and Twining, B.V., 2011, Multilevel groundwater monitoring of hydraulic head and temperature in the eastern Snake River Plain aquifer, Idaho National Laboratory, Idaho, 2007–08: U.S. Geological Survey Scientific Investigations Report 2010-5253, (DOE/ID-22213), 62 p., http://pubs.usgs.gov/sir/2010/5253/.

Fishman, M.J., ed., 1993, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of inorganic and organic constituents in water and fluvial sediments: U.S. Geological Survey Open-File Report 93-125, 217 p., http://pubs.usgs.gov/of/1993/0125/report.pdf.

Fishman, M.J., and Friedman, L.C., 1989, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. Al, 545 p., http://pubs.usgs.gov/twri/twri5-a1/.

Friedman, L.C., and Erdmann, D.E., 1982, Quality assurance practices for the chemical and biological analyses of water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A6, 181 p., http://pubs.usgs.gov/twri/twri5a6/.

Garbarino, J.R., 2000, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of whole-water recoverable arsenic, boron, and vanadium using inductively coupled plasma-mass spectrometry: U.S. Geological Survey Open-File Report 99-464, 15 p., http://nwql.usgs.gov/Public/pubs/OFR99-464.pdf.

Garbarino, J.R., and Damrau, D.L., 2001, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of organic plus inorganic mercury in filtered and unfiltered natural water with cold vapor—automatic fluorescence spectrometry: U.S. Geological Survey Water-Resources Investigations Report 01-4132, 16 p., http://nwql.usgs.gov/rpt.shtml?WRIR-01-4132.

Garbarino, J.R., and Hoffman, G.L., 1999, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—comparison of a nitric acid in-bottle digestion procedure to other whole-water digestion procedures: U.S. Geological Survey Open- File Report 99-094, 21 p., http://pubs.usgs.gov/of/1999/0094/report.pdf.

Garbarino, J.R., and Struzeski, T.M., 1998, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of elements in whole-water digests using inductively coupled plasma-optical emission spectrometry and inductively coupled plasma-mass spectrometry: U.S. Geological Survey Open-File Report 98-165, 101 p., http://nwql.usgs.gov/OFR-98-165.shtml.

Goerlitz, D.F., and Brown, Eugene, 1972, Methods for analysis of organic substances in water: U.S. Geological Survey Techniques of Water Resources Investigations, book 5, chap. A3, 40 p., http://pubs.usgs.gov/twri/05a03/report.pdf.

Hardy, M.A., Leahy, P.P., and Alley, W.M., 1989, Well installation and documentation and ground-water sampling protocols for the pilot National Water-Quality Assessment Program: U.S. Geological Survey Open-File Report 89-396, 36 p., http://pubs.usgs.gov/of/1989/0396/report.pdf.

Hem, J.D., 1985, Study and interpretation of chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 2254, 264 p., http://pubs.usgs.gov/wsp/wsp2254/.

Jones, B.E., 1987, Quality control manual of the U.S. Geological Survey's National Water Quality Laboratory: U.S. Geological Survey Open-File Report 87-457, 17 p., http://pubs.usgs.gov/of/1987/0457/report.pdf.

Knobel, L.L., 2006, Evaluation of well-purging effects on water-quality results for samples collected from the eastern Snake River Plain aquifer underlying the Idaho National Laboratory, Idaho: U.S. Geological Survey Scientific Investigations Report 2006-5232 (DOE/ID-22200), 52 p., http://pubs.usgs.gov/sir/2006/5232/.

Knobel, L.L., Bartholomay, R.C., Tucker, B.J., Williams, L.M., and Cecil, L.D., 1999, Chemical constituents in ground water from 39 selected sites with an evaluation of associated quality assurance data, Idaho National Engineering and Environmental Laboratory and vicinity, Idaho: U.S. Geological Survey Open-File Report 99-246 (DOE/ID-22159), 58 p., http://pubs.usgs.gov/of/1999/0246/report.pdf.

Knobel, L.L., and Mann, L.J., 1993, Sampling for volatile organic compounds using positive-displacement piston and centrifugal submersible pumps—a comparative study: Ground Water Monitoring Review, Spring 1993, p. 142–148.

Knobel, L.L., Tucker, B.J., and Rousseau, J.P., 2008, Field methods and quality-assurance plan for quality-of-water activities, U.S. Geological Survey, Idaho National Laboratory, Idaho: U.S. Geological Survey Open-File Report 2008-1165 (DOE/ID-22206), 36 p., http://pubs.usgs.gov/of/2008/1165/.

Ludtke, A.S., Woodworth, M.T., and Marsh, P.S., 2000, Quality-assurance results for routine water analyses in U.S. Geological Survey Laboratories, water year 1998: U.S. Geological Survey Water-Resources Investigations Report 00-4176, 198 p., http://bqs.usgs.gov/ibsp/WY98Report/text98.html.

Maloney, T.J., ed., 2005, Quality management system, U.S. Geological Survey National Water Quality Laboratory: U.S. Geological Survey Open-File Report 2005-1263, version 1.3, November 9, 2005, chapters and appendixes variously paged., http://pubs.usgs.gov/of/2005/1263/.

Maloney, T.J., Ludtke, A.S., Krizman, T.L., 1993, Quality assurance for routine water analysis in the laboratories of the U.S. Geological Survey for water year 1990: U.S. Geological Survey Water-Resources Investigations Report 93-4082, 145 p., http://pubs.usgs.gov/wri/1993/4082/report.pdf.

Mann, L.J., 1996, Quality-assurance plan and field methods for quality-of-water activities, U.S. Geological Survey, Idaho National Engineering Laboratory, Idaho: U.S. Geological Survey Open-File Report 96-615 (DOE/ID 22132), 37 p., http://pubs.usgs.gov/of/1996/0615/report.pdf.

Pritt, J.W., 1989, Quality assurance of sample containers and preservatives at the U.S. Geological Survey National Water Quality Laboratory, *in* Pederson, G.L., and Smith, M.M., compilers, U.S. Geological Survey Second National Symposium on Water Quality—abstracts of the technical sessions: U.S. Geological Survey Open-File Report 89-409, 111 p.

Pritt, J.W., and Raese, J.W., eds., 1995, Quality assurance/quality control manual—National Water Quality Laboratory: U.S. Geological U.S. Geological Survey Open-File Report 95-443, 35 p., http://pubs.usgs.gov/of/1995/0443/report.pdf.

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 (DOE/ID-22222), 74 p., http://pubs.usgs.gov/sir/2012/5270/.

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, Idaho, 2002–2008: U.S. Geological Survey Scientific Investigations Report 2014-5027, (DOE/ID-22228), 65 p., http://pubs.usgs.gov/sir/2014/5027/.

Rattray, G.W., and Campbell, L.J., 2004, Radiochemical and chemical constituents in water from selected wells and springs from the southern boundary of the Idaho National Engineering and Environmental Laboratory to the Hagerman area, Idaho, 2002: U.S. Geological Survey Open-File Report 2004-1004 (DOE/ID-22190), 22 p., http://pubs.usgs.gov/of/2004/1004/.

Rattray, G.W., Wehnke, A.J., Hall, L.F., and Campbell, L.J., 2005, Radiochemical and chemical constituents in water from selected wells and springs from the southern boundary of the Idaho National Laboratory to the Hagerman area, Idaho, 2003: U.S. Geological Survey Open-File Report 2005-1125 (DOE/ID-22193), 25 p., http://pubs.usgs.gov/of/2005/1125/.

Rose, D.L., and Schroeder, M.P., 1995, Methods of analysis by the U.S. Geological Survey National Water Quality Laboratory—determination of volatile organic compounds in water by purge and trap capillary gas chromatography/mass spectrometry: U.S. Geological Survey Open-File Report 94-708, 26 p., http://pubs.usgs.gov/of/1994/0708w/report.pdf.

Skougstad, M.W., Fishman, M.J., Friedman, L.C., Erdmann, D.E., and Duncan, S.S., 1979, Methods for determination of inorganic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A1, 626 p.

Stevens, H.H., Jr., Ficke, J.F., and Smoot, G.F., 1975, Water temperature—influential factors, field measurement, and data presentation: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. Dl, 65 p., http://pubs.usgs.gov/twri/twri1-d1/.

Swanson, S.A., Rosentreter, J.J., Bartholomay, R.C., and Knobel, L.L., 2002, Geochemistry of the Little Lost River drainage basin, Idaho: U.S. Geological Survey Water-Resources Investigations Report 02-4120 (DOE/ID-22179), 29 p., http://pubs.usgs.gov/wri/2002/4120/report.pdf.

Swanson, S.A., Rosentreter, J.J., Bartholomay, R.C., and Knobel, L.L., 2003, Geochemistry of the Birch Creek drainage basin, Idaho: U.S. Geological Survey Water-Resources Investigations Report 03-4272 (DOE/ID-22188), 36 p., http://pubs.usgs.gov/wri/wri034272/.

TestAmerica Laboratories, 2013, Quality assurance manual: Document No. TALDenver QAM rev. 5, 165 p.

Thatcher, L.L., Janzer, V.J., and Edwards, K.W., 1977, Methods for determination of radioactive substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A5, 95 p., http://pubs.usgs.gov/twri/twri5a5/.

Timme, P.J., 1995, National Water Quality Laboratory, 1995 services catalog: U.S. Geological Survey Open-File Report 95-352, 120 p., http://pubs.usgs.gov/of/1995/0352/report.pdf.

U.S. Department of Energy, 1995, Radiochemistry manual, revision 10: Idaho Falls, Idaho, U.S. Department of Energy, Radiological and Environmental Sciences Laboratory [variously paged].

U.S. Environmental Protection Agency, 1994, Guidance for the data quality objectives process: U.S. Environmental Protection Agency Report No. 600R-96/005 [variously paged].

U.S. Environmental Protection Agency, 1987, Annual Report, fiscal year 1986—methods validation report (radiation): U.S. Environmental Protection Agency Report No. EPA/600/x-87/128, 55 p.

U.S. Environmental Protection Agency, 2013, Protection of environment, Code of Federal Regulations 40: Office of the Federal Register, National Archives and Records Administration, pts. 136–149, 1,033 p.

U.S. Geological Survey, variously dated, National field manual for the collection of water-quality data: U.S. geological Survey Techniques of Water-Resources Investigations, book 9, chaps. A1–A9,. http://pubs.water.usgs.gov/twri9A.

Wegner, S.J., 1989, Selected quality assurance data for water samples collected by the U.S. Geological Survey, Idaho National Engineering Laboratory, 1980 to 1988: U.S. Geological Survey Water-Resources Investigations Report 89-4168 (DOE/ID-22085), 91 p., http://pubs.usgs.gov/wri/1989/4168/report.pdf.

Wershaw, R.L., Fishman, M.J., Grabbe, R.R., and Lowe, L.E., 1987, Methods for the determination of organic substances in water and fluvial sediments: U.S. Geological Survey Techniques of Water-Resources Investigations, book 5, chap. A3, 80 p., http://pubs.usgs.gov/twri/twri5a3/pdf/twri_5-A3.pdf.

Williams, L.M., 1996, Evaluation of quality assurance/quality control data collected by the U.S. Geological Survey for water-quality activities at the Idaho National Engineering Laboratory, Idaho, 1989 through 1993: U.S. Geological Survey Water-Resources Investigations Report 96-4148 (DOE/ID-22129), 115 p.

Williams, L.M., 1997, Evaluation of quality assurance/quality control data collected by the U.S. Geological Survey for water-quality activities at the Idaho National Engineering Laboratory, Idaho, 1994 through 1995: U.S. Geological Survey Water-Resources Investigations Report 97-4058 (DOE/ID-22136), 87 p., http://pubs.usgs.gov/wri/1997/4058/report.pdf.

Williams, L.M., Bartholomay, R.C., and Campbell, L.J., 1998, Evaluation of quality-assurance/quality control data collected by the U.S. Geological Survey from wells and springs between the southern boundary of the Idaho National Engineering and Environmental Laboratory and the Hagerman area, Idaho, 1989 through 1995: U.S. Geological Survey Water-Resources Investigations Report 98-4206 (DOE/ID-22150), 83 p.

Wood, W.W., 1981, Guidelines for collection and field analysis of ground-water samples for selected unstable constituents: U.S. Geological Survey Techniques of Water-Resources Investigations, book 1, chap. D2, 24 p.

Appendix A. Field Schedule Showing Well and Pump Information and Sampling Schedules for Selected Wells and Streamflow Sites, Idaho National Laboratory, Idaho

[**Abbreviations:** NRF, Naval Reactor Facility; gpm, gallon per minute]

Local site identifier	Method of sampling	Hole diameter (inches)	Well depth (feet)	Analysis type (see code)		Westbay	NRF	
				Apr.	Oct.	Code; zones	May	Nov.
ANP 6	Pump 25 gpm	10	295		5			
ARA-MON-A-002	Pump 15 gpm	6	620		19			
AREA 2	Pump 18 gpm	16	876		5			
Atomic City[1,3]	Spigot	8	639	5				
Badging Facility	Pump 35 gpm	8	644	10				
BLR (near Mackay)	Surface water				3			
BLR (near Arco)	Surface water			3				
BLR (INEL Div.) [1]	Surface water			3				
BLR (Dairy Farm) [1]	Surface water			3				
Birch Creek[1]	Surface water				1			
CFA 1[1]	Pump 1,000 gpm	16	639	10				
CFA 2[1]	Pump 1,400 gpm	16	681		10			
CFA LF 2-10	Pump 8.3 gpm	6	716	20				
CPP 1	Pump 3,000 gpm	16	586	21				
CPP 2	Pump 3,000 gpm	16	605		28			
CPP 4	Pump 400 gpm	16	700		28			
Cross Road[1]	Pump 35 gpm	8	796	19				
CWP 1	Bail	6	58	4				
CWP 3	Bail	6	55	4				
CWP 8	Bail	6	63.5	4				
GIN 2	Pump 2 gpm	2	381		24			
Highway 3[1,3]	Spigot	8	750		22			
ICPP-MON-A-166[1]	Pump 20 gpm	6	527	14				
ICPP-MON-V-200	Pump 4 gpm	6	127		14			
Little Lost River	Surface water				1			
MTR Test	Pump 26 gpm	8	588	8				
Mud Lake	Surface water				1			
Middle 2050A[6]	Multi-depth thief sampler	(7)	1,376			19; zone 15		
Middle 2051[1,6]	Mutli-depth thief sampler	(7)	1,177			19; zones 3,6		
No Name 1 (Tan Expl.)	Pump 42 gpm	12	500	24				
NRF 3	Pump 28 gpm	16	546				36	36
NRF 6	Pump 30 gpm	8	417				[1]33	35
NRF 7	Pump 2.5 gpm[4]	10	417				32	34
NRF 8	Pump 30 gpm	8	423				33	35
NRF 9	Pump 30 gpm	8	422				[1]33	35
NRF 10	Pump 30 gpm	8	427				33	35
NRF 11	Pump 30 gpm	8	417				[1]33	35

Local site identifier	Method of sampling	Hole diameter (inches)	Well depth (feet)	Analysis type (see code)		Westbay	NRF	
				Apr.	Oct.	Code; zones	May	Nov.
NRF 12	Pump 30 gpm	8	421				[1]33	35
NRF 14	Pump 25 gpm	10	550				36	36
NRF 16	Pump 25 gpm	5	422				33	35
NPR Test	Pump 28 gpm	6	600		19			
PBF-MON-A-003	Pump 10 gpm	5	575		19			
P&W 2[1]	Pump 35 gpm	10	378	19				
PW-8	Pump 8 gpm	6	166	13				
PW-9[1]	Pump 5 gpm	6	200		13			
Rifle Range	Pump 25 gpm	5	620		14			
RWMC M1SA	Pump 6 gpm	6	638		17			
RWMC M3S	Pump 6 gpm	6	633		18			
RWMC M7S	Pump 6 gpm	6	628		17			
RWMC M11S	Pump 12 gpm	6	624		19			
RWMC M12S	Pump 6 gpm	6	572		19			
RWMC M13S	Pump 6 gpm	6	643		19			
RWMC M14S	Pump 6 gpm	6	635		19			
RWMC Production [1,2]	Pump 200 gpm	10 < 658 14 > 658	685		17			
Site 4	Pump 500 gpm	8	495	7				
Site 9	Pump 25 gpm	10	1,057	10				
Site 14[1]	Pump 40 gpm	12 < 313 8 > 313	717		19			
Site 17	Pump 25 gpm	15	600	5				
Site 19	Pump 15 gpm	10 < 550 8 > 550	860		7			
SPERT 1	Pump 400 gpm	14	653	6				
TRA 3	Pump 3,800 gpm	20	602		8			
TRA 4	Pump 2,000 gpm	18 < 705 16 > 705	965	8				
TRA Disp.	Pump 25 gpm	8 < 1114 6 > 1114	1,267		14			
W.S. for INEL-1	Pump 30 gpm	6	490	7				
USGS 1	Pump 15 gpm	5	630		19			
USGS 2	Pump 16 gpm	5	699	5				
USGS 5	Pump 3 gpm[4]	6	494	26				
USGS 7	Pump 45 gpm	6 < 760 4 > 760	903	24				
USGS 8[1]	Pump 15 gpm	6	812	19				
USGS 9	Pump 15 gpm	6	632		19			
USGS 11[1,3]	Pump 23 gpm	6	704	19				
USGS 12	Pump 30 gpm	10	563	22				
USGS 14[1,3]	Pump 16 gpm	5	751		2			
USGS 17	Pump 30 gpm	6 < 365 5 > 365	498	19				
USGS 18	Pump 30 gpm	4	329	5				
USGS 19[1]	Pump 17 gpm	6	399	19				
USGS 20	Pump 18 gpm	6	658	10				

Local site identifier	Method of sampling	Hole diameter (inches)	Well depth (feet)	Analysis type (see code)		Westbay	NRF	
				Apr.	Oct.	Code; zones	May	Nov.
USGS 23	Pump 25 gpm	6 < 430 5 > 430	457		19			
USGS 26	Pump 20 gpm	6	266	24				
USGS 27[1]	Pump 20 gpm[4]	6	312	19				
USGS 29	Pump 30 gpm	6	426		5			
USGS 31	Pump 36 gpm	8 < 306 10 > 306	428	5				
USGS 32	Pump 36 gpm	6 < 324 5.5 > 324	392	5				
USGS 34	Pump 30 gpm	10	700	21				
USGS 35	Pump 25 gpm	7	579		10			
USGS 36	Pump 25 gpm	6	567	10				
USGS 37	Pump 25 gpm	6	572		15			
USGS 38	Pump 4 gpm[4]	4	724	21				
USGS 39	Pump 25 gpm	8	492		10			
USGS 41	Pump 25 gpm	6	666		10			
USGS 42	Pump 25 gpm	6	678	10				
USGS 43	Pump 6 gpm	6	564		15			
USGS 44	Pump 25 gpm	6	650	12				
USGS 45	Pump 25 gpm	6	651		10			
USGS 46	Pump 25 gpm	6	651	12				
USGS 47	Pump 8 gpm	6	651		15			
USGS 48	Pump 29 gpm	6	750	10				
USGS 51	Pump 4 gpm	6	647	10				
USGS 52	Pump 30 gpm	6	602		10			
USGS 53	Bail	6	70		13			
USGS 54	Pump 4 gpm	6	81		13			
USGS 55[1]	Pump 1 gpm	6	81	13				
USGS 56	Pump 1 gpm	6	79		13			
USGS 57	Pump 30 gpm	6	582		12			
USGS 58	Pump 26 gpm	6	503	13				
USGS 59	Pump 1 gpm	6	587	10				
USGS 60	Pump 6 gpm	6	117		13			
USGS 61	Pump 6 gpm	4	123	13				
USGS 62	Pump 5 gpm	8	165	13				
USGS 63	Pump 5 gpm	10	109		13			
USGS 65[1]	Pump 8 gpm	4	498	25				
USGS 66	Bail	4	201		13			
USGS 67	Pump 8 gpm	6 < 465 4 > 465	694		10			
USGS 68[1]	Pump 1 gpm[4]	10	128	30				
USGS 69	Pump 5 gpm	4	115		9			
USGS 70	Pump 6 gpm	8	100	13				
USGS 71	Bail	5	171		13			
USGS 72	Pump 1 gpm	4	174	30				
USGS 73[1]	Pump 6 gpm	6	127		13			

Local site identifier	Method of sampling	Hole diameter (inches)	Well depth (feet)	Analysis type (see code)		Westbay	NRF	
				Apr.	Oct.	Code; zones	May	Nov.
USGS 76	Pump 29 gpm	6	718	14				
USGS 77	Pump 25 gpm	6	586		21			
USGS 78	Bail	7	204		9			
USGS 79	Pump 30 gpm	6	702	7				
USGS 82	Pump 25 gpm	6	693	10				
USGS 84	Pump 5 gpm	6	505		25			
USGS 85[1]	Pump 23 gpm	6	614	10				
USGS 86	Pump 19 gpm	8	691		19			
USGS 87[1]	Pump 2 gpm	4	673	23				
USGS 88	Pump 2 gpm	4	663		17			
USGS 89	Pump 5 gpm	6	637	17				
USGS 92	Bail	3.5	214	16				
USGS 97	Pump 27 gpm	4	510	25			[5]32	
USGS 98	Pump 25 gpm	4	508		25		[5]32	
USGS 99	Pump 25 gpm	4	440		8		[1,5]32	
USGS 100[1]	Pump 10 gpm[4]	6	750	8				
USGS 101	Pump 13 gpm	6 < 750 4 >750	842		19			
USGS 102	Pump 29 gpm	6	444	5			33	35
USGS 103[1,6]	Multi-depth thief sampler	(7)	1,297			19; zones 1,3,6,9		
USGS 104[1,3]	Pump 26 gpm	8	700		6			
USGS 105[1,6]	Multi-depth thief sampler	(7)	1,300			19; zones 5,8,11		
USGS 106	Pump 24 gpm	8	760		6			
USGS 107	Pump 30 gpm	8	690	26				
USGS 108 [1,6]	Multi-depth thief sampler	(7)	1,196			19; zones 1,9		
USGS 109[3]	Pump 22 gpm	4	800	19				
USGS 110A	Pump 24 gpm	6	644		19			
USGS 111	Pump 15 gpm[4]	8	560	10				
USGS 112[1,3]	Pump 30 gpm	8	507		10			
USGS 113	Pump 25 gpm	6	556	12				
USGS 114[3]	Pump 10 gpm[4]	6	560		10			
USGS 115[1]	Pump 5 gpm	6	581		10			
USGS 116	Pump 20 gpm	6	572	10				
USGS 117[3]	Pump 12 gpm[4]	6.5	655		17			
USGS 119[3]	Pump 2 gpm#	6.5	705	17				
USGS 120[1,3]	Pump 27 gpm	6.5	705		23			
USGS 121	Pump 8 gpm	6	474	10				
USGS 123	Pump 3 gpm	6	514		10			
USGS 124[1,3]	Pump 15 gpm	4	800	6				
USGS 125[1,3]	Pump 21 gpm	5	774		19			
USGS 126B	Pump 15 gpm	6	472		19			
USGS 127	Pump 25 gpm	6	596	20				
USGS 128	Pump 23 gpm	4.5	615		18			
USGS 130	Pump 25 gpm	4.5	636		31			
USGS 131A[6]	Multi-depth thief sampler	(7)	1,198			19; all zones		
USGS 132[1,6]	Multi-depth thief sampler	(7)	1,238			19; zone 14		

Local site identifier	Method of sampling	Hole diameter (inches)	Well depth (feet)	Analysis type (see code)		Westbay	NRF	
				Apr.	Oct.	Code; zones	May	Nov.
USGS 133[6]	Multi-depth thief sampler	(7)	798			19; zone 10		
USGS 134[6]	Multi-depth thief sampler	(7)	894			19; zone 15		
USGS 135[6]	Multi-depth thief sampler	(7)	1,157			19; zone 7		
USGS 136	Pump 21 gpm	6	560		14			
USGS 137A[6]	Multi-depth thief sampler	(7)	1,317			19, all zones		
USGS 140	Pump 24 gpm	6	546		14			

[1] Well is sampled with someone from the State of Idaho's INL Oversight Program.

[2] Well is sampled monthly for organics (sample code 27) - SH1380.

[3] Well is sampled with someone from Shoshone/Bannock Tribe.

[4] Indicates well needs to be cut back to pump rate indicated; all other pump rates are approximate.

[5] Indicates well is sampled every other year starting in 2014.

[6] 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.

[7] Hole diameter is not required for bore hole volume calculations with Multi-depth thief samplers.

Codes for types of analyses (number of bottles needed in parenthesis)

1. ^{3}H, Cl^{-} (2)
2. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, NO$_{3}^{-}$ (6)
3. ^{3}H, Cl^{-}, α, β, ϒ Spec (4)
4. ^{3}H, ^{90}Sr, Cl^{-}, Cr, SO$_{4}^{--}$ (4)
5. ^{3}H, Cl^{-}, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$ (4)
6. ^{3}H, Cl^{-}, Na^{+}, NO$_{3}^{-}$ (4)
7. ^{3}H, Cl^{-}, Cr, Na^{+}, SO$_{4}^{--}$ (3)
8. ^{3}H, Cl^{-}, Cr, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$ (4)
9. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Na^{+}, SO$_{4}^{--}$ (4)
10. ^{3}H, ^{90}Sr, Cl^{-}, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$ (5)
11. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+} (5)
12. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$ (5)
13. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, SO$_{4}^{--}$ (4)
14. ^{3}H, ^{90}Sr, ϒ Spec, Cl^{-}, Cr, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$ (5)
15. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$ (5)
16. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, VOCs (6)
17. ^{3}H, ^{90}Sr, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, NO$_{3}^{-}$, VOCs, SO$_{4}^{--}$ (8)
18. ^{3}H, ^{90}Sr, Cl^{-}, NO$_{3}^{-}$ (4)
19. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, SO$_{4}^{--}$, NO$_{3}^{-}$ (6)
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$_{3}^{-}$, SO$_{4}^{--}$, F^{-}, VOCs, (9)
22. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO$_{3}^{-}$, SO$_{4}^{--}$, VOCs, (9)
23. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, Cr, NO$_{3}^{-}$, VOCs, SO$_{4}^{--}$ (9)
24. ^{3}H, ^{90}Sr, α, β, ϒ Spec, Cl^{-}, Na^{+}, NO$_{3}^{-}$, VOCs, Hg, metals (SH 1050) + As, Tl (12)
25. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, NO$_{3}^{-}$, SO$_{4}^{--}$, VOCs, Hg, metals (SH 1050) + As, Se (12)
26. ^{3}H, α, β, ϒ Spec, Cl^{-}, Na^{+}, Cr, NO$_{3}^{-}$, VOCs (9)
27. VOCs (3)
28. ^{3}H, ^{90}Sr, Cl^{-}, Cr, Na^{+}, NO$_{3}^{-}$ (5)
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$_{4}^{--}$, metals (SH 1281) (7)
31. ^{3}H, ^{90}Sr, α, β, ϒ Spec, ^{241}Am, ^{238}Pu, ^{239,240}Pu, Cl^{-}, Na^{+}, Cr, NO$_{3}^{-}$, SO$_{4}^{--}$ (6)
32. NRF ^{3}H, ^{90}Sr, ^{63}Ni, ϒ Spec, raw metals, nutrients, anions, VOCs, Semi-vols, (12)
33. NRF ^{3}H, ^{90}Sr, ^{63}Ni, ϒ Spec, raw and filtered metals, nutrients, anions, VOCs, Semi-vols, (13)
34. NRF ^{3}H, ^{90}Sr, ^{63}Ni, ϒ Spec, raw metals, nutrients, anions (7)
35. NRF ^{3}H, ^{90}Sr, ^{63}Ni, ϒ Spec, raw and filtered metals, nutrients, anions (8)
36. NRF drinking water: raw metals, nutrients, anions (3)

Constituent and type of sample

Type of analyses	Lab	Size of sample and schedule or lab code	Type of sample treatment
^{3}H (Ru)	RESL	500 mL (Apr, Oct)	Raw water, unacidified, rinse bottle
^{90}Sr (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
^{90}Sr, γ Spec (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
α, β (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
^{241}Am, ^{238}Pu, $^{239,240}Pu$ (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
^{90}Sr, γ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$ (RA)	RESL	1 L	Raw water, preserved with 4 mL HNO_3, no rinse
γ Spec (RA)	RESL	500 mL	Raw water, preserved with 2 mL HNO_3, no rinse
F^{-}** (FU)	NWQL	250 mL; LC 651	Filtered, unacidified, rinse poly bottle
Na^{+}* (FA)	NWQL	250 mL; LC 675	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
Cr* (FA)	NWQL	250 mL; LC 722	Filtered, preserved with 2mL Ultrex HNO_3, rinse poly bottle
Cl^{-}** (FU)	NWQL	250 mL; LC 1571	Filtered, unacidified, rinse poly bottle
SO_4^{--}** (FU)	NWQL	250 mL; LC 1572	Filtered, unacidified, rinse poly bottle
Hg (FAM)	NWQL	250 mL; LC 2707	Filtered, preserved with 2 mL 6N HCL, rinse, clear glass bottle
Carbon-13/carbon-12 (FUS)	Woods Hole	1L, LC 3213	Filtered, unacidified, plastic coated glass bottle fitted with polyseal cone cap, chill, provide alkalinty & pH
NO_3^{-} (FCC)	NWQL	125 mL; SH101	Filtered, chilled, brown poly bottle, rinse bottle
SH 670 anions (FU) Sp. Cond. (RU)	NWQL	250 mL; SH 670 250 mL; SH 670	Filtered, unacidified, rinse poly bottle Raw water, unacidified, rinse poly bottle
SH 1050 metals (FA) As, Tl (FA) Sp. Cond. (RU)	NWQL	250 mL; SH 1050 and LC 3122 and 2508 250 mL; SH 1050	Filtered, preserved with 2 mL ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse poly bottle
SH 1050 metals (FA) As, Se (FA) Sp. Cond. (RU)	NWQL	250 mL; SH 1050 and LC 3122 and 3132 250 mL; SH 1050	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse, poly bottle
Uranium 234, 235, 238 isotopes (FAR)	Test America	1L; SH 1130	Filtered, acidified with 4 mL Ultrex HNO_3, rinse poly bottle
Oxygen/deuterium isotopes (RUS)	RSIL	60 mL; SH 1142	Raw water, unacidified, no rinse
VOCs (GCV)	NWQL	(3) 40 mL; SH1380	Raw water, chilled, unacidified, rinse glass bottle, amber
SH 1281 TLCP metals (RA) Hg (RAM)	NWQL	250 mL; SH 1281 250 mL; SH 1281	Raw, preserved with 2 mL Ultrex HNO_3, rinse poly bottle Raw water, preserved with 2 mL 6N HCl, rinse clear glass bottle
SH 2126 metals & cations (FA) B (FA) Sp. Cond. and pH (RU)	NWQL	250 mL; SH 2126 and LC 2110 250 mL; SH 2126	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse poly bottle
^{129}I	PRIME	1L	Filtered, unacidified, rinse, polyseal cap, no head space, amber glass or poly

*Analysis can be requested from the same bottle.

**Analysis can be requested from the same bottle.

Appendix B. Field Schedule for Wells and Frequency of Collection of Water Level Measurements, Idaho National Laboratory, Idaho.

Microsoft® Excel file containing the entire field schedule for wells and the frequency of collection of water-level measurements for the Idaho National Laboratory is available for download at *http://pubs.usgs.gov/of/2014/1146*.

[**Abbreviations:** Jan, January, Feb, February, Mar, March, Apr, April, Jun, June, Jul, July, Aug, August, Sep, September, Oct, October, Nov, November. MP, measuring point. DEV COR, deviation correction. NA, not analyzed. C190, 323, and 1 are parameter codes in the National Water Information System. **Type:** AA-aquifer well measured annually; AS-aquifer well measured semi-annually; AM-aquifer well measured monthly; AQ-aquifer well measured quarterly; ANRF-aquifer well measured for Naval Reactor Facility; BM-well measured monthly for USGS Boise; PA-perched well measured annually; PQ-perched well measured quarterly; PM-perched monthly; R-well equipped with continuous water-level recorder; S-water sample collected; SBA, water sample collected biannually]

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
USGS 1	A					R					S	R		1.72	NA
USGS 2	A	AQ			S			AQ			AQ			2.13	NA
USGS 4	A	AQ		AQ				AQ			AQ			1.99	NA
USGS 5	A	AQ			S			AQ			AQ			1.60	NA
USGS 6	A	AQ		AQ				AQ			AQ			2.07	NA
USGS 7	A	AQ			S			AQ			AQ			1.68	NA
USGS 8	A	AQ			S			AQ			AQ			2.11	NA
USGS 9	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	S	AM	AM	2.55	NA
USGS 11	A	AQ			S			AQ			AQ			2.34	NA
USGS 12	A	AM	AM	AM	S	AM	AM	AM	AM	AM	AM	AM	AM	2.05	NA
USGS 13	A				AA									1.20	NA
USGS 14	A	AQ			AQ			AQ			S			1.59	NA
USGS 15	A	AQ			AQ			AQ			AQ			1.55	NA
USGS 17	A	AQ			S			AQ			AQ			2.53	NA
USGS 18	A	AQ			S			AQ			AQ			1.78	NA
USGS 19	A	AM	AM	AM	S	AM	AM	AM	AM	AM	AM	AM	AM	2.08	NA
USGS 20	A	AQ			S			AQ			AQ			1.96	NA
USGS 21	A					R						R		1.00	NA
USGS 22	A	AQ			AQ			AQ			AQ			2.19	NA
USGS 23	A	AQ			AQ			AQ			S			2.90	NA
USGS 24	A		R			R			R			R		1.89	NA

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
USGS 25	A		R			R			R			R		2.40	NA
USGS 26	A	AQ			S			AQ			AQ			2.10	NA
USGS 27	A	AM	AM	AM	S	AM	AM	AM	AM	AM	AM	AM	AM	2.26	NA
USGS 28	A			AS						AS				2.00	NA
USGS 29	A			AS							S			2.53	NA
USGS 30A	A			AQ			AQ			AQ			AQ	1.80	NA
USGS 30B	A			AQ			AQ			AQ			AQ	1.80	NA
USGS 30C	A			AQ			AQ			AQ			AQ	1.80	NA
USGS 31	A				S						AS			1.70	NA
USGS 32	A				S						AS			1.81	NA
USGS 34	A				S									1.73	NA
USGS 35	A										S			2.23	NA
USGS 36	A				S									1.60	NA
USGS 37	A										S			2.07	NA
USGS 38	A				S									2.02	NA
USGS 39	A	AQ		AQ				AQ			S			1.63	NA
USGS 41	A			AS							S			2.14	NA
USGS 42	A				S									1.85	NA
USGS 43	A										S			1.35	NA
USGS 44	A				S									1.64	NA
USGS 45	A										S			2.61	NA
USGS 46	A				S									5.58	NA
USGS 47 No wl sample only	A										S			0.66	NA
USGS 48	A				S						AS			1.31	NA
USGS 51	A				S									3.96	NA
USGS 52	A										S			2.23	NA
USGS 53 (6to4 in @30ft)	P				PS						S			1.60	NA
USGS 54	P	PQ		PQ				PQ			S			1.67	NA
USGS 55	P	PQ			S			PQ			PQ			1.72	NA
USGS 56	P										S			1.58	NA
USGS 57	A	AQ		AQ				AQ			S			2.21	NA
USGS 58	A	AQ			S			AQ			AQ			1.82	NA
USGS 59	A				S						AQ			2.01	NA

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
USGS 60	P	PQ			PQ			PQ			S			2.06	NA
USGS 61	P	PQ			S			PQ			PQ			0.66	NA
USGS 62	P	PQ			S			PQ			PQ			1.86	NA
USGS 63	P	PQ			PQ			PQ			S			1.76	NA
USGS 65	A	AQ			S			AQ			AQ			0.83	NA
USGS 66	P	PM	PM	PM	PM	PM	PM	PM	PM	PM	S	PM	PM	1.80	NA
USGS 67	A			AS							S			2.42	NA
USGS 68	P	PQ			S			PQ			PQ			3.16	NA
USGS 69	P	PQ			PQ			PQ			S			2.47	NA
USGS 70	P	PQ			S			PQ			PQ			2.16	NA
USGS 71	P	PQ			PQ			PQ			S			1.52	NA
USGS 72	P	PQ			S			PQ			PQ			2.00	NA
USGS 73	P	PQ			PQ			PQ			S			3.90	NA
USGS 76	A				S						AS			1.60	NA
USGS 77	A										S			2.58	NA
USGS 78	P	PM	PM	PM	PM	PM	PM	PM	PM	PM	S	PM	PM	1.04	NA
USGS 79	A				S						AS			2.58	NA
USGS 82	A	AQ			S			AQ			AQ			1.77	NA
USGS 83	A	AQ			AQ			AQ			AQ			2.67	NA
USGS 84	A	AQ			AQ			AQ			S			1.96	NA
USGS 85	A	AQ			S			AQ			AQ			2.53	NA
USGS 86	A	AQ			AQ			AQ			S			2.23	NA
USGS 87	A				S									2.31	NA
USGS 88	A										S			2.13	-0.30
USGS 89	A	AQ			S			AQ			AQ			1.88	NA
USGS 92	P	PQ			S			PQ			PQ			10.61	NA
USGS 97	A	AM	AM	AM	S	SBA	AM	AM	AM	AM	AM	ANRF	AM	1.78	NA
USGS 98	A				AS	SBA					S	ANRF		2.25	-2.41
USGS 99	A			AS		SBA					S	ANRF		2.28	NA
USGS 100	A	AQ			S			AQ			AQ			2.19	NA
USGS 101	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	S	AM	AM	2.20	-0.54
USGS 102	A				S	S						S		2.40	NA
USGS 104	A	AQ			AQ			AQ			S			2.99	NA
USGS 106	A			AS							S			1.75	NA

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
USGS 107	A				S						AS			1.95	NA
USGS 109	A				S						AS			2.65	NA
USGS 110A	A				AS						S			2.84	NA
USGS 111	A				S									2.27	-5.24
USGS 112	A	AQ		AQ				AQ			S			2.56	-2.61
USGS 113	A				S									2.35	-6.46
USGS 114	A										S			2.29	-4.70
USGS 115	A										S			2.27	-2.23
USGS 116	A	AQ			S			AQ			AQ			2.55	NA
USGS 117	A	AQ			AQ			AQ			S			2.12	-1.03
USGS 118	A			AQ			AQ			AQ			AQ	3.24	NA
USGS 119	A				S									2.10	-0.85
USGS 120	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	S	AM	AM	1.65	-0.83
USGS 121	A				S						AS			1.81	-1.50
USGS 123	A										S			3.08	NA
USGS 124	A				S						AS			2.15	-1.27
USGS 125	A	AQ			AQ			AQ			S			2.20	NA
USGS 126B	A	AQ			AQ			AQ			S			1.20	NA
USGS 127	A	AQ			S			AQ			AQ			1.79	NA
USGS 128	A			AQ							S			1.27	NA
USGS 129	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	0.87	NA
USGS 130	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	S	AM	AM	1.44	NA
USGS 131	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	1.53	NA
USGS 136	A										S			2.19	-0.22
USGS 138	A		R			R			R			R		2.66	NA
USGS 139	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	0.56	NA
A11A31	A			AA										2.55	NA
ANL OBS A 001	A			AA										2.85	NA
ANL MON A 014	A			AA										3.07	NA
ANP 5	A				AA									2.39	NA
ANP 6	A				AS						S			2.58	NA
ANP 7	A				AA									2.50	NA
ANP 9	A	AQ			AQ			AQ			AQ			2.18	NA
ANP 10	A				AA									1.55	NA

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
ARA-MON-A-002	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	S	AM	AM	3.01	NA
ARBOR TEST	A	AQ			AQ			AQ			AQ			2.00	NA
AREA 2	A				AS						S			1.53	NA
CERRO GRANDE	A			AQ			AQ			AQ			AQ	1.30	NA
CFA 1932	A			AS							AS			2.61	NA
CFA LF 2-10	A	AQ			S			AQ			AQ			2.02	-0.73
CFA LF 2-11	A			AA										2.00	NA
COREHOLE 1	A	AQ		AQ				AQ			AQ			2.52	NA
COREHOLE 2A	A	AQ			AQ			AQ			AQ			1.17	NA
CWP 1	P				S									2.80	NA
CWP 2	P				PA									2.50	NA
CWP 3	P				S									3.10	NA
CWP 4	P				PA									2.60	NA
CWP 5	P				PA									3.10	NA
CWP 6	P				PA									3.90	NA
CWP 7	P				PA									2.90	NA
CWP 8	P				S									3.10	NA
CWP 9	P				PA									3.10	NA
DH 1B	A			AQ			AQ			AQ			AQ	3.23	NA
DH 2A	A			AQ			AQ			AQ			AQ	0.50	NA
FIRE STATION 2	A			AQ			AQ			AQ			AQ	1.46	NA
GIN 1	A			AA										1.45	NA
GIN 2	A			AS							S			1.51	NA
GIN 3	A			AA										2.29	NA
GIN 4	A			AA										1.84	NA
GIN 5	A			AA										1.80	NA
HWY 1A PIEZO 3	A			AQ			AQ			AQ			AQ	1.18	NA
HWY 1B PIEZO 2	A			AQ			AQ			AQ			AQ	1.18	NA
HWY 1C PIEZO 1	A			AQ			AQ			AQ			AQ	1.18	NA
HWY 2	A			AQ			AQ			AQ			AQ	1.63	NA
ICPP-MON-A-166	A	AQ			S			AQ			AQ			2.38	NA
ICPP-MON-V-200	P	PQ			PQ			PQ			S			3.48	NA
IET 1 DISP	A			AS							AS			4.50	NA
INEL 1	A			AA										0.75	NA

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
MTR TEST	A	AM	AM	AM	S	AM	AM	AM	AM	AM	AM	AM	AM	1.30	NA
NO NAME 1	A	AQ			S			AQ			AQ			1.73	NA
NPR TEST	A	AQ			AQ			AQ			S			2.10	NA
NRF 2	A					ANRF						ANRF		2.34	NA
NRF 3	A					S						S		1.95	NA
NRF 5	A					ANRF						ANRF		2.68	NA
NRF 6	A					S						S		1.80	NA
NRF 7	A					S						S		2.28	NA
NRF 8	A					S						S		2.82	NA
NRF 9	A					S						S		2.68	NA
NRF 10	A					S						S		3.08	NA
NRF 11	A					S						S		2.78	NA
NRF 12	A					S						S		2.46	NA
NRF 13	A					ANRF						ANRF		2.98	NA
NRF 14	A					S						S		1.94	NA
NRF 15-A	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	2.13	NA
NRF 15-B	A	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	AM	2.03	NA
NRF 16	A					S						S		1.97	NA
PandW 1	A				AA									1.53	NA
PandW 2	A				S						AS			1.91	NA
PandW 3	A				AA									1.94	NA
PBF-MON-A-003	A			AS							S			2.16	NA
PSTF TEST	A				AS						AS			1.88	NA
PW 8	P	PQ			S			PQ			PQ			1.88	NA
PW 9	P	PQ			PQ			PQ			S			1.85	NA
RWMC M1SA	A										S			3.44	NA
RWMC M3S	A				AS						S			1.37	NA
RWMC M4D	A				AA									2.83	NA
RWMC M6S	A				AA									3.22	NA
RWMC M7S	A				AS						S			2.36	NA
RWMC M11S	A				AS						S			1.44	NA
RWMC M12S	A				AS						S			1.80	NA
RWMC M13S	A				AS						S			1.77	NA
RWMC M14S	A				AS						S			2.76	NA

WELL NAME (C190)	Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	MP (C323)	DEV COR
SITE 6	A			AA										2.20	NA
SITE 9	A	AQ			S			AQ			AQ			2.00	NA
SITE 14	A	AQ			AQ			AQ			S			2.23	NA
SITE 15	A				AA									0.60	NA
SITE 16	A			AA										2.68	-0.31
SITE 17	A	AM	AM	AM	S	AM	AM	AM	AM	AM	AM	AM	AM	1.63	NA
SITE 19	A			AS							S			1.95	NA
TAN CH 2 piezo B	A			AQ			AQ			AQ			AQ	0.97	NA
TAN 14	A			AQ			AQ			AQ			AQ	1.60	NA
TAN 15	A			AQ			AQ			AQ			AQ	1.64	NA
TAN 17	A			AQ			AQ			AQ			AQ	3.02	NA
TAN 18	A			AQ			AQ			AQ			AQ	1.41	NA
TRA DISP	A				AS						S			3.10	NA
WS INEL 1	A				S						AS			2.08	NA
2ND OWSLEY	A				AA									1.51	NA
04N 35E 31DAA1	A				AA									0.50	NA
01S 23E 26CCC1	A				AA									2.12	NA
02N 26E 22DDA1	A				AA									2.09	NA
02N 26E 22DDA2	A				AA									2.12	NA
03S 27E 24DDA1	A				AA									2.70	NA
05S 25E 22DAD1	A				AA									2.74	NA
Monthly totals		77	21	66	131	39	35	77	21	36	128	39	35		
Sampled wells		0	0	0	61	11	0	0	0	0	64	11	0		
W/L's only		77	21	66	70	30	35	77	21	36	64	37	35		
TOTAL PERCHED	29														
TOTAL AQUIFER	177														
TOTAL WELLS	206														

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

[**Accuracy:** coefficient of variance measured by replicate analysis. **Abbreviations:** SH, schedule; LC, lab code; N, nitrogen; P, phosphorus; µg/L, micrograms per liter]

Constituent	Reporting level (µg/L)	Precision (± percent)	Accuracy (percent)	Lab code/ schedule
I. Volatile organic compounds	variable	30	70-130	SH 1380
II. Inorganic compounds (filtered):				
Aluminum	2.2	10	90-110	SH 1050
Antimony	0.027	10	90-110	SH 1050
Arsenic	0.10	10	90-110	LC 3122
Barium	0.25	10	90-110	SH 1050
Beryllium	0.02	10	90-110	SH 1050
Boron	2.0	10	90-110	SH 1254
Bromide	0.03	10	90-110	SH 1254
Cadmium	0.03	10	90-110	SH 1050
Calcium	20	10	90-110	SH 1254
Chloride	20	10	90-110	LC 1571
Chromium	0.6	10	90-110	LC 722
Cobalt	0.05	10	90-110	SH 1050
Copper	0.8	10	90-110	SH 1050
Fluoride	10	10	90-110	LC 651
Iron	4.0	10	90-110	SH 1254
Lead	0.04	10	90-110	SH 1050
Magnesium	11	10	90-110	SH 1254
Manganese	0.40	10	90-110	SH 1050
Mercury	0.010	10	90-110	LC 2707
Molybdenum	0.2	10	90-110	SH 1050
Nickel	0.20	10	90-110	SH 1050
Potassium	30	10	90-110	SH 1254
Selenium	0.04	10	90-110	LC 3132
Silica	18	10	90-110	SH 1254
Silver	0.02	10	90-110	SH 1050
Sodium	200	10	90-110	LC 675
Strontium	0.8	10	90-110	SH 1254
Sulfate	20	10	90-110	LC 1572
Thallium	0.08	10	90-110	LC 2508
Uranium	0.014	10	90-110	SH 1050
Zinc	2.0	10	90-110	SH 1050
Ammonia (as N)	10	40	60-140	SH 101
Nitrite (as N)	1	10	90-110	SH 101
Nitrite + Nitrate (as N)	10	10	90-110	SH 101
Orthophosphate (as P)	4	10	90-110	SH 101

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

For each radionuclide concentration, an associated 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 picocuries per liter (pCi/L), there is a 67-percent probability that the true concentration is in the range of 0.8–1.2 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 the analysis for a selected radionuclide, laboratory measurements are made on a target sample and a prepared blank. Instrument signals for the sample and the blank vary randomly. Therefore, it is essential to distinguish between two key aspects of the problem of detection: (1) the instrument signal for the sample must be greater than the signal observed for the blank to make the decision that a selected radionuclide was detected; and (2) an estimation must be made of the minimum radionuclide concentration that will yield a sufficiently large observed signal to make the correct decision of detection or nondetection of that radionuclide most of the time. The first aspect of the problem is a qualitative decision based on an observed signal and a definite criterion for detection. The second aspect of the problem is an intuitive estimation of the detection capabilities of a given measurement process.

In the laboratory, instrument signals must exceed a critical level to make the qualitative decision whether a selected radionuclide was detected. Radionuclide concentrations that equal 1.6*s* meet this criterion; at 1.6*s*, there is a 95-percent probability that the correct decision—not detected—will be made. Given a large number of samples, up to 5 percent of the samples with true concentrations greater than or equal to 1.6*s*, which were concluded as being detected, might not contain the selected radionuclide. These measurements are referred to as false positives and are errors of the first kind in hypothesis testing.

Once the critical level of 1.6*s* has been defined, the minimum detectable concentration may be established. Radionuclide concentrations that equal 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. Given a large number of samples, up to 5 percent of the samples with true concentrations greater than or equal to 3*s*, which were concluded as being nondetected, 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. 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, such 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 and 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 do 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.

Bodnar and Percival (1982) summarized detection limits normally available from the Radiological and Environmental Sciences Laboratory. Special arrangements can be made to achieve smaller detection limits for selected constituents. For example, by using a 5-fold counting time for tritium in water, that is, increasing the counting time from 20 to 100 minutes, the detection limit can be reduced from 500 to 200 pCi/L.

Detection limits for selected types of radioactivity and nuclides as a function of sample size and detection method are shown on table D1; 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 D1. Detection limits for selected types of radioactivity and nuclides measured by the Radiological and Environmental Sciences Laboratory.

[**Data source:** Guy Backstrom, U.S. Department of Energy, written commun., 2014. **Abbreviations:** bkgd, background; Ge(Li), Germanium lithium]

Type of radioactivity or nuclide	Sample material	Size of sample (milliliter)	Counting time (minutes)	Detection method or instrument	Detection limit (picocuries per milliliter)
Gross alpha	Water	250	100	Low bkgd counter	3×10^{-3}
Gross beta	Water	250	100	Low bkgd counter	2×10^{-3}
Strontium-90	Water	400	200	Liquid Scintillation	2×10^{-3}
Tritium	Water	10	100	Liquid Scintillation	0.2
Thorium-230	Water	500	1,000	Alpha Spectrometry	4×10^{-5}
Uranium-234	Water	500	1,000	Alpha Spectrometry	4×10^{-5}
Plutonium-238 + Plutonium-239/240	Water	500	1,000	Alpha Spectrometry	2×10^{-5}
Americium-241	Water	500	1,000	Alpha Spectrometry	3×10^{-5}
Technicium-99	Water	400	100	Liquid Scintillation	$1x10^{-3}$
Tellurium-132	Water	400	60	Ge(Li)	6×10^{-2}
Lead-212	Water	400	60	Ge(Li)	0.1
Selenium-75	Water	400	60	Ge(Li)	08×10^{-2}
Antimony-125	Water	400	60	Ge(Li)	0.2
Ruthenium-103	Water	400	60	Ge(Li)	1×10^{-2}
Thallium-108	Water	400	60	Ge(Li)	0.2
Antimony-124	Water	400	60	Ge(Li)	0.1
Cobalt-60	Water	400	60	Ge(Li)	6×10^{-2}
Potassium-40	Water	400	60	Ge(Li)	1.0
Lanthunum-140	Water	400	60	Ge(Li)	7×10^{-2}
Cerium-144	Water	400	60	Ge(Li)	0.4
Cerium-141	Water	400	60	Ge(Li)	9×10^{-2}
Chromium-51	Water	400	60	Ge(Li)	0.6

Type of radioactivity or nuclide	Sample material	Size of sample (milliliter)	Counting time (minutes)	Detection method or instrument	Detection limit (picocuries per milliliter)
Iodine-131	Water	400	60	Ge(Li)	6×10^{-2}
Barium-140	Water	400	60	Ge(Li)	0.2
Ruthenium-106	Water	400	60	Ge(Li)	0.5
Cesium-137	Water	400	60	Ge(Li)	6×10^{-2}
Bismuth-212	Water	400	60	Ge(Li)	1.0
Niobium-95	Water	400	60	Ge(Li)	6×10^{-2}
Cesium-134	Water	400	60	Ge(Li)	6×10^{-2}
Molybdenum-99	Water	400	60	Ge(Li)	5×10^{-2}
Mercury-203	Water	400	60	Ge(Li)	6×10^{-2}
Krypton-85	Water	400	60	Ge(Li)	21
Bismuth-214	Water	400	60	Ge(Li)	0.4
Zirconium-95	Water	400	60	Ge(Li)	9×10^{-2}
Cobalt-58	Water	400	60	Ge(Li)	6×10^{-2}
Manganese-54	Water	400	60	Ge(Li)	5×10^{-2}
Silver-110	Water	400	60	Ge(Li)	7×10^{-2}
Actinium-228	Water	400	60	Ge(Li)	0.2
Iron-59	Water	400	60	Ge(Li)	0.1
Zinc-65	Water	400	60	Ge(Li)	0.1

Appendix E. Data-Quality Objectives for Water Samples Analyzed by the TestAmerica Laboratories and Brigham Young University Laboratory of Isotope Geochemistry

The U.S. Environmental Protection Agency (EPA) (1994) has established six primary analytical data-quality objectives for environmental studies. These objectives are precision, accuracy, representativeness, completeness, comparability, and detectability. TestAmerica Laboratories' (TAL) approach to each data-quality objective is given in a report by TestAmerica (2013, revision 5). The method of analyses, minimum reporting levels, and method detection limits for constituents analyzed by TAL, and for tritium analysis done at the Brigham Young University Laboratory of Isotope Geochemistry, for the U.S. Geological Survey Idaho National Laboratory Project Office are given in table E1.

Table E1. Methods for analyses, minimum reporting levels, and method detection limits for constituents analyzed by the Test America Laboratories and Brigham Young University Laboratory of Isotope Geochemistry.

[Tritium analyses is done by Brigham Young University laboratory of isotope geochemistry. **Abbreviations:** N, nitrogen; µg/L, micrograms per liter; pCi/L, picocuries per liter]

Constituent	Method for analyses	Reporting level (µg/L)	Method detection limit (µg/L)
Volatile organic compounds	524.2	variable	variable
Semi-volatile organic compounds	525.2	variable	variable
[Inorganic compounds]			
Aluminum	6010B	100	18.0
Antimony	6020	2	0.400
Arsenic	6020	5	0.330
Barium	6010B	10.0	0.576
Beryllium	6010B	1.00	0.474
Cadmium	6010B	5.00	0.452
Calcium	6010B	0.200	0.0345
Chloride	300.0A	3,000	254
Chromium	6020	2	0.500
Cobalt	6010B	10.0	1.23
Copper	6010B	15.0	1.36
Iron	6010B	100	22.0
Lead	6010B	9.00	2.61
Magnesium	6010B	0.200	0.0107
Manganese	6010B	10.0	0.253
Mercury	7470A	0.200	0.0270
Nickel	6010B	40.0	1.29
Potassium	6010B	3.00	0.237
Selenium	6010B	15.0	4.86
Silver	6010B	10.0	0.933
Sodium	6010B	1.00	0.933
Sulfate	300.0A	5,000	232
Thallium	6020	1	0.0500
Zinc	6010B	20.0	4.53
Nitrite (as N)	300.0A	500	49.0
Nitrate Nitrate (as N)	353.2	0.100	0.0190
[Radionuclides]			
Tritium	Liquid scintillation	0.64 pCi/L	
Gamma	901.1	20 pCi/L	
Nickel-59	STL-RC-0055	5 pCi/L	
Nickel-63	STL-RC-0055	5 pCi/L	
Strontium-90	905	3 pCi/L	

Appendix F. 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 for 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 they are less than the reporting level for that analysis, or
4. one replicate measurement of a constituent is censored or estimated and 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. 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.

Variability results are investigated if variability for a constituent does not meet the criteria for acceptable reproducibility or reliability because of small constituent concentrations (relative to instrument detection levels). Variability is known to increase as concentration decreases, and the criteria for acceptable variability are not intended to apply to small concentrations.

Contamination bias, rather than instrument background uncertainty (sometimes referred to as “noise”), is considered present in a blank (and potentially water-quality samples) when a detectable concentration of a constituent is measured from a blank. This corresponds to a concentration exceeding the reporting level of $3s$ (appendix D) for radiochemical constituents and the reporting level for inorganic and organic constituents (tables 3–6). If a constituent is detected in a blank, then the results for that constituent are investigated.

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

Type of meter	Model	Manufacturer	Serial number
Multi-parameter	Quanta	Hydrolab	QD01427
Multi-parameter	Quanta	Hydrolab	QD02191
Multi-parameter	Quanta	Hydrolab	QD02194
Multi-parameter	Quanta	Hydrolab	QD03469
pH	Orion 3 Star	Thermo Scientific	A16054
Turbidity	2100P	Hach	971200016277
Conductivity	122	Orion	0905040
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	61733096
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	72068284
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	80320036
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	101476820
E-tape-1	Water level Indicator – 1,000ft	Durham Geo Slope Indicator	None
E-tape-2	Water level Indicator – 1,000ft	Durham Geo Slope Indicator	19161
E-tape-3	Water level Indicator – 1,000ft	Durham Geo Slope Indicator	19192
E-tape-4	Water level Indicator – 700ft	Durham Geo Slope Indicator	19193
E-tape-5	Water level Indicator – 1,250ft	Durham Geo Slope Indicator	36539
E-tape-6	Water level Indicator – 1,000ft	Durham Geo Slope Indicator	25361
Stainless steel tape	Calibration tape – 800ft	Cooper Tools	None
Stainless steel tape	Calibration tape – 1,000ft	Cooper Tools	None
Stainless steel tape	Calibration tape – 1,200ft	Cooper Tools	None

Appendix H. 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
Personal Data Assistant (PDA)? Yes No

Electric tape
Depth1 below MP______
Tape correction1 ______
Depth2 below MP______
Tape correction2 ______
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
Well-bore volume calculated? Yes No = _________ 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
Pager and 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? Yes No
Recorded in log book? 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?	Yes	No	Value = ____________
Other (Specify)?	Yes	No	Value = ____________

12. Sample Collection:

Time started ____________________________

Gloves			Yes	No
Filter rinsed with sample water or DI (Circle type of rinsate)?			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?	
Logbook or PCFF sheet?	Yes	No	Yes	No
Custody forms?	Yes	No	Yes	No
Analytical request forms?	Yes	No	Yes	No
Water-level sheet?	Yes	No	Yes	No
Calibration logbook sheets?	Yes	No	Yes	No
Other? (Specify______________)	Yes	No	Yes	No

18. Comments:

Publishing support provided by the U.S. Geological Survey
Publishing Network, Tacoma Publishing Service Center

For more information concerning the research in this report, contact the
Director, Idaho Water Science Center
U.S. Geological Survey
230 Collins Road
Boise, Idaho 83702
http://id.water.usgs.gov

Bartholomay and others—**Field Methods and Quality-Assurance Plan for Water-Quality Activities and Water-Level Measurements, Idaho National Laboratory, Idaho**—Open-File Report 2014–1146

ISSN 2331-1258 (online)
http://dx.doi.org/10.3133/ofr20141146