Prepared in cooperation with the U.S. Department of Energy DOE/ID-22206

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

Open-File Report 2008–1165

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

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By LeRoy L. Knobel, Betty J. Tucker, and Joseph P. Rousseau

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DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director

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Conversion Factors

Multiply	By	To obtain
	Length	
inch (in.)	2.54	centimeter (cm)
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
	Pressure	
inch of mercury at 60ºF (in Hg)	3.377	kilopascal (kPa)
	Radioactivity	
millirem (mrem)	0.01	millisievert
picocurie per liter (pCi/L)	0.037	becquerel per liter (Bq/L)

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).

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

By LeRoy L. Knobel, Betty J. Tucker, and Joseph P. Rousseau

Introduction

Water-quality activities conducted by the staff 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 conducted in cooperation with the U.S. Department of Energy's (DOE) Idaho Operations Office. Results of the water-quality investigations are presented in various USGS publications or in refereed scientific journals. The results of the studies are highly regarded, and they are used with confidence by researchers, regulatory and managerial agencies, and interested civic groups.

In its 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 activities performed by the USGS INL Project Office are to maintain and improve the quality of technical products and to provide formal standardization, documentation, and review of the activities that lead to these products. The principles of this plan are as follows:

1. Water-quality programs will be planned in a competent 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 Resources Discipline (WRD) practices and procedures by qualified and experienced employees who are well trained and supervised. If or when USGS WRD practices and procedures are unspecified or inadequate, data will be collected in a manner such that its quality will be documented.

3. All water-quality activities will be reviewed for completeness, reliability, credibility, and conformance to 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 monitoring network are directly responsible for the day-to-day maintenance of the QAP. The QAP will be formally revised and reprinted every 5 to 7 years; 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.

Scope

The QAP for the water-quality activities of the USGS INL Project Office defines procedures and tasks performed by project-office personnel that ensure the reliability of water-quality data. Virtually all 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 was revised in 1992, 1996 (Mann, 1996), and 2003 (Bartholomay and others, 2003). This revision of the QAP incorporates the revisions made to the water-quality monitoring program since 2003.

A comprehensive list of references that contains guidelines used in data collection is given in the Selected References section. Tasks not described by the references owing to field conditions are detailed in the following sections or in the Idaho Water Science Center Quality-Assurance Plan for Water-Quality Activities (Mark Hardy, U.S. Geological Survey, written commun., October, 2003).

Information on water-quality sampling schedules, data-quality objectives, and water-quality field equipment are included in appendixes A-E.

Description of Water-Quality Monitoring Networks

The USGS has maintained a water-quality monitoring program at the INL since 1949 to define the (1) quality and availability of water for human consumption, (2) usability of the water for supporting construction of facilities and for industrial purposes such as cooling systems and diluting concentrated waste streams, (3) sources of recharge to the eastern Snake River Plain aquifer (ESRPA), (4) processes controlling the origin and distribution of contaminants and naturally-occurring constituents in the ESRPA, (5) 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 ground-water zones, and (6) 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 (Naval Reactors Facility Waste Ditch).

A large network of about 300 wells has been sampled in the past, and the current routine sampling network consists of 159 wells and 7 surface-water sites. Additional monitoring sites will be selected if and when they are needed to better document the distribution and migration of solutes. Most of the 159 wells were constructed as open-borehole wells that are open to the aquifer through their entire 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.

To better identify the vertical distribution of contaminants in the aquifer, multi-depth water-quality sampling, along with pressure and temperature profiling programs, were 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. Additional sites near the southern boundary of the INL will be added to these programs during 2008 and beyond. 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 multi-depth sampling network are sampled annually. The RWMC Production Well also is sampled for volatile organic compounds (VOCs) on a monthly basis. In addition to the routine sampling, some wells may be sampled periodically for other constituents, including chlorine-36, iodine-129, trace metals, VOCs, dissolved gases, and compounds used for age dating. Pressure and temperature measurements at the multi-level sites are made semiannually; however, supplemental measurements are made from time to time to identify seasonal or climatic effects on pressure and temperature in the aquifer.

In addition to the 166 ground-water and surface-water sites sampled for the routine-monitoring program and the sites sampled for vertical definition of contaminants in the aquifer, the USGS INL Project Office staff collects water samples from 13 wells near the Naval Reactors Facility (NRF) on a semiannual basis. The purpose of this data-collection program is to provide the DOE’s 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.

Field Methods for Quality-of-Water Activities

Sample containers, sample preservation methods, field equipment, and well-head decontamination and sample-collection procedures are crucial components in assuring 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 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 Department of Defense Environmental Conservation (DODEC) program are containerized and preserved in accordance with requirements specified by the contract laboratory. 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.

[**Analyzing laboratory:** NWQL, U.S. Geological Survey National Water Quality Laboratory; RESL, U.S. Department of Energy Radiological and Environmental Sciences Laboratory. **Abbreviations:** L, liter; mL, milliliter; N, normal. HCl, hydrochloric acid; HNO_3, nitric acid; °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
Cations, dissolved	Polyethylene, acid rinsed	250 mL	Ultrex HNO_3	2 mL	Filter	NWQL
Metals, dissolved	Polyethylene, acid rinsed	250 mL	Ultrex HNO_3	2 mL	Filter	NWQL
Mercury, dissolved	Glass, acid rinsed	250 mL	6N OmniTrace HCl	2 mL	Filter	NWQL
Mercury, total	Glass, acid rinsed	250 mL	6N OmniTrace HCl	2 mL	None	NWQL
Chromium, dissolved	Polyethylene, acid rinsed	250 mL	Ultrex HNO_3	2 mL	Filter	NWQL
Nutrients, dissolved	Polyethylene, brown	125 mL	None	None	Filter, chill 4°C	NWQL
Volatile organic compounds	Glass, baked	40 mL	None	None	Chill, 4°C	NWQL
Total organic carbon	Glass, baked	125 mL	None	None	Chill, 4°C	NWQL
Gross alpha- and beta-particle radioactivity	Polyethylene, acid rinsed	2 L	HNO_3	4 mL/bottle	Filter	NWQL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Pesticides	Glass, baked	1 L	None	None	Chill, 4°C	NWQL
Tritium	Polyethylene	1 L	None	None	None	NWQL
	Polyethylene	500 mL	None	None	None	RESL
Strontium-90	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	Filter	NWQL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Gamma spectroscopy	Polyethylene, acid rinsed	1 L	HNO_3	4 mL/bottle	Filter	NWQL
	Polyethylene, acid rinsed	500 mL	HNO_3	2 mL	None	RESL
Transuranics	Polyethylene, acid rinsed	1 L	HNO_3	4 mL	None	RESL
Isotopic uranium	Polyethylene, acid rinsed	1 L	Ultrex HNO_3	4 mL	Filter	Eberline
Oxygen-18/oxygen-16 and hydrogen-2/hydrogen-1	Glass	60 mL	None	None	None	Reston Isotope Laboratory
Carbon-13/carbon-12	Glass with Teflon/Silicone septum	250 mL	None	None	None	NWQL
Dissolved gases	Glass with rubber stopper	150 mL	None	None	Relieve pressure with needle	Reston
CFC-Age dating	Glass, white plastic caps with aluminum foil liner	125 mL	None	None	None	Reston
Iodine-129	Glass, amber	1 L	None	None	Filter	PRIME Lab

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 is permanently recorded in the water-quality field logbook (fig. 1) and in the instrument calibration logbook (fig. 2). Changes to equipment—for example, changing batteries or the dissolved oxygen membrane—is recorded in the instrument calibration logbook. An inventory of field equipment is given in appendix E.

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 data is recorded in the instrument calibration logbook (fig. 2). If the calibration is done in the laboratory and the meter is then transported to the well site, the meter is checked with a pH 7 buffer prior to sampling. The pH also is checked for accuracy with a pH 7 buffer before sampling at each subsequent well where water-quality samples are collected that day. The measured value of the pH 7 buffer is recorded in the water-quality field logbook (fig. 1) for the appropriate well site. A pH reading is taken after sampling the last well of the day for the end-of-day check and recorded in the instrument calibration logbook (fig. 2). The pH meter is recalibrated if at any time the meter reading is off by more than ±0.1 pH unit.

Calibration Procedure for Specific Conductance

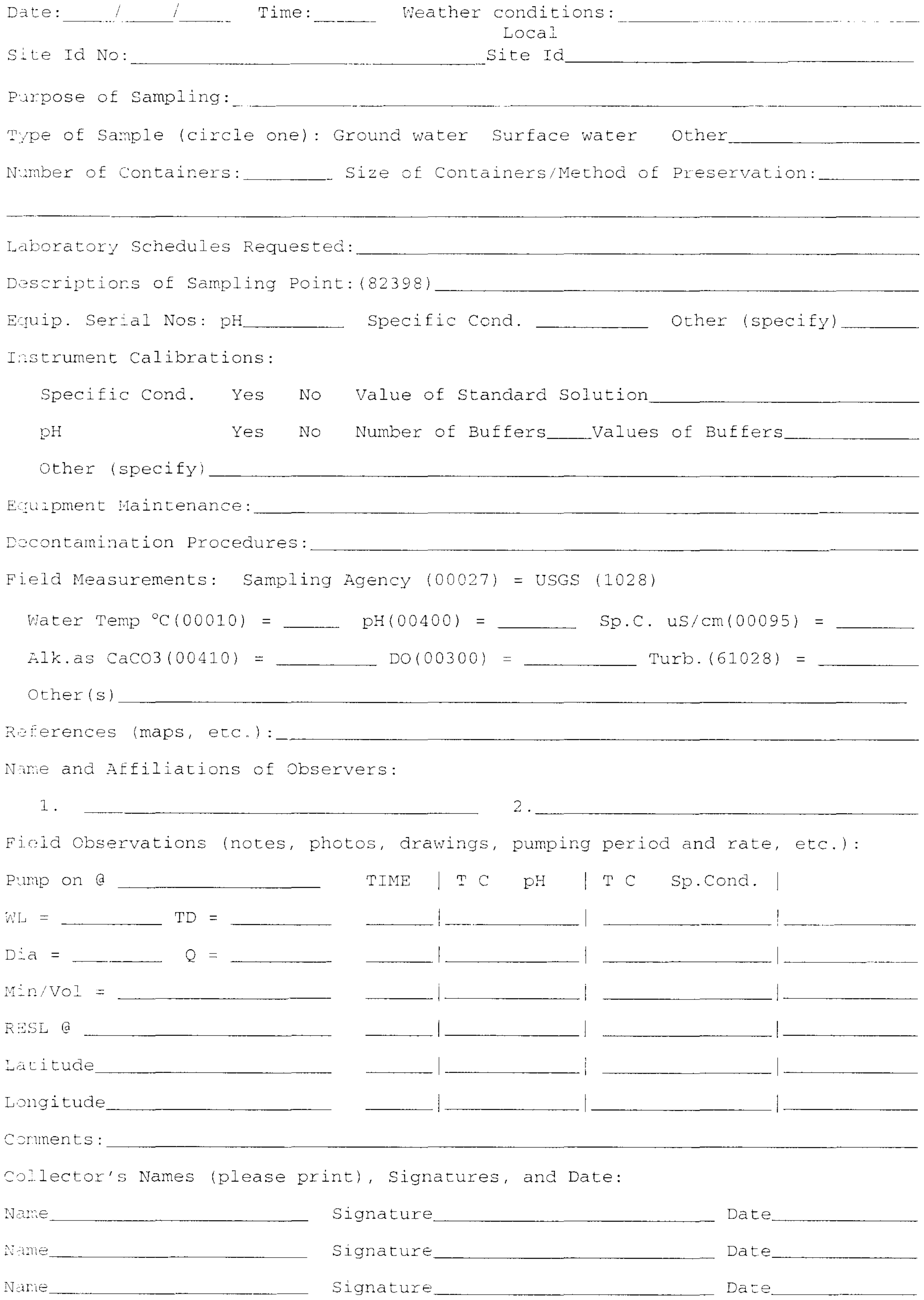
The INL Project Office calibrates specific conductance meters each day during which water-quality samples are collected. Calibration of the meters can be performed in the laboratory or at the first well site where water-quality samples are collected that day. The calibration data is recorded in the instrument calibration logbook (fig. 2). If the calibration is done in the laboratory and the meter is then transported to the well site, the specific conductance meter is checked with the appropriate buffer prior to sampling. The buffer solution should have a specific conductance similar to the water that is being sampled. The specific conductance is checked for accuracy with a buffer before sampling at each subsequent well where water-quality samples are collected that day. The measured value of the buffer is recorded in the water-quality field logbook (fig. 1) for the appropriate well 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. 2). The specific conductance meter is recalibrated if at any time the meter reading 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

After the dissolved oxygen meter is calibrated, it is ready for the day. The temperature at the time of calibration is recorded in the instrument calibration logbook (fig. 2). The temperature and the atmospheric pressure will be used to obtain the solubility of oxygen in water (U.S. Geological Survey, variously dated, table 6.2-6). The meter should be checked throughout the day to make sure that no bubbles are inside the membrane and that no tears or wrinkles are in the membrane. If bubbles are present or the membrane is damaged, the membrane needs to be changed.

Decontamination Procedures at the Well Head

Wells 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.



Date:____/____/____ Time:_____ Weather conditions:________________

Site Id No:____________________ Local Site Id____________________

Purpose of Sampling:____

Type of Sample (circle one): Ground water 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.):

	TIME	T C pH	T C Sp.Cond.	
Pump on @ ____________				
WL = ______ TD = ______				
Dia = ______ Q = ______				
Min/Vol = ____________				
RESL @ ____________				
Latitude____________				
Longitude____________				

Comments:____

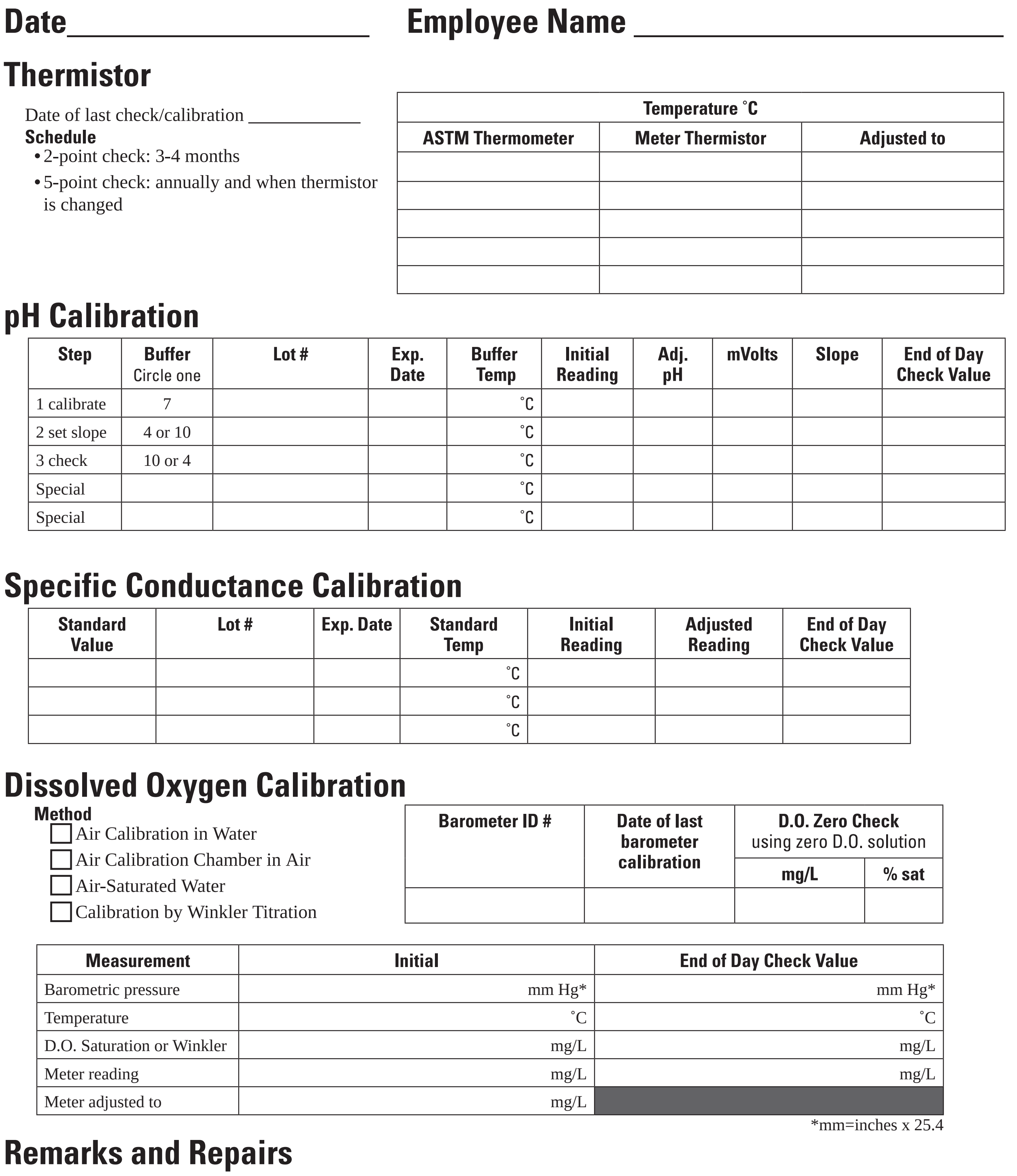
Collector's Names (please print), Signatures, and Date:

Name________________ Signature__________________ Date________

Name________________ Signature__________________ Date________

Name________________ Signature__________________ Date________

Figure 1. 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 2. Sheet from instrument calibration logbook.

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 long. The discharge pipe has a 1.5-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™ 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 ground water 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 use; samples of the rinsate are periodically collected and analyzed to document whether the equipment is contaminated by constituents of interest. At some wells, bailers are dedicated to and stored in the well casing. This eliminates the possibility of cross contamination of samples from different wells.

At the sites sampled for vertical definition of contaminants in the aquifer, stainless-steel thief sampling devices (bottles) are used to collect samples. For some samples, refrigerator-grade copper tubing is attached to the stainless-steel thief sampling bottles to deliver sample water to the appropriate sample containers. For samples that do not require refrigerator-grade copper tubing as part of the sampling process, a sample is 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 and the refrigerator-grade copper tubing (if required for sampling) 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.

Sample Collection

Sample collection by the USGS at the INL generally follows protocols outlined in the U.S. Geological Survey 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., 2003); 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 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. In addition, 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 between 3 and 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 45-micron membrane filter is used at each site. The capsule filter is inverted to clear trapped air bubbles and one liter of deionized water or water from the well is used to rinse the capsule filter prior to sample collection. This removes any surfactants that are adhered to the filter.

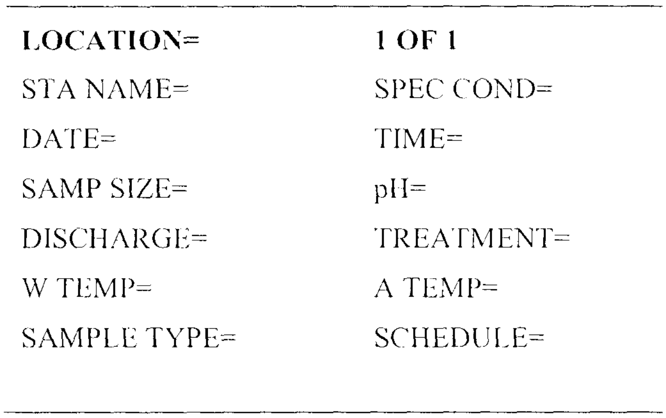
4. For ground-water samples from wells equipped with dedicated pumps, the capsule filter is connected to the sample port with precleaned Tygon™ tubing; unfiltered samples are collected directly from the sample port. For surface-water samples, thief samples, and bailer samples, a grab sample is collected 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.

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 the caps are sealed with laboratory film except for VOC samples (laboratory film interferes with the analytical measurement method for VOC analysis). The bottles are then labeled (see fig. 3 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 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 unit, 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. 4–6 for examples).



LOCATION=	**1 OF 1**
STA NAME=	SPEC COND=
DATE=	TIME=
SAMP SIZE=	pH=
DISCHARGE=	TREATMENT=
W TEMP=	A TEMP=
SAMPLE TYPE=	SCHEDULE=

Figure 3. Label attached to each sample bottle.

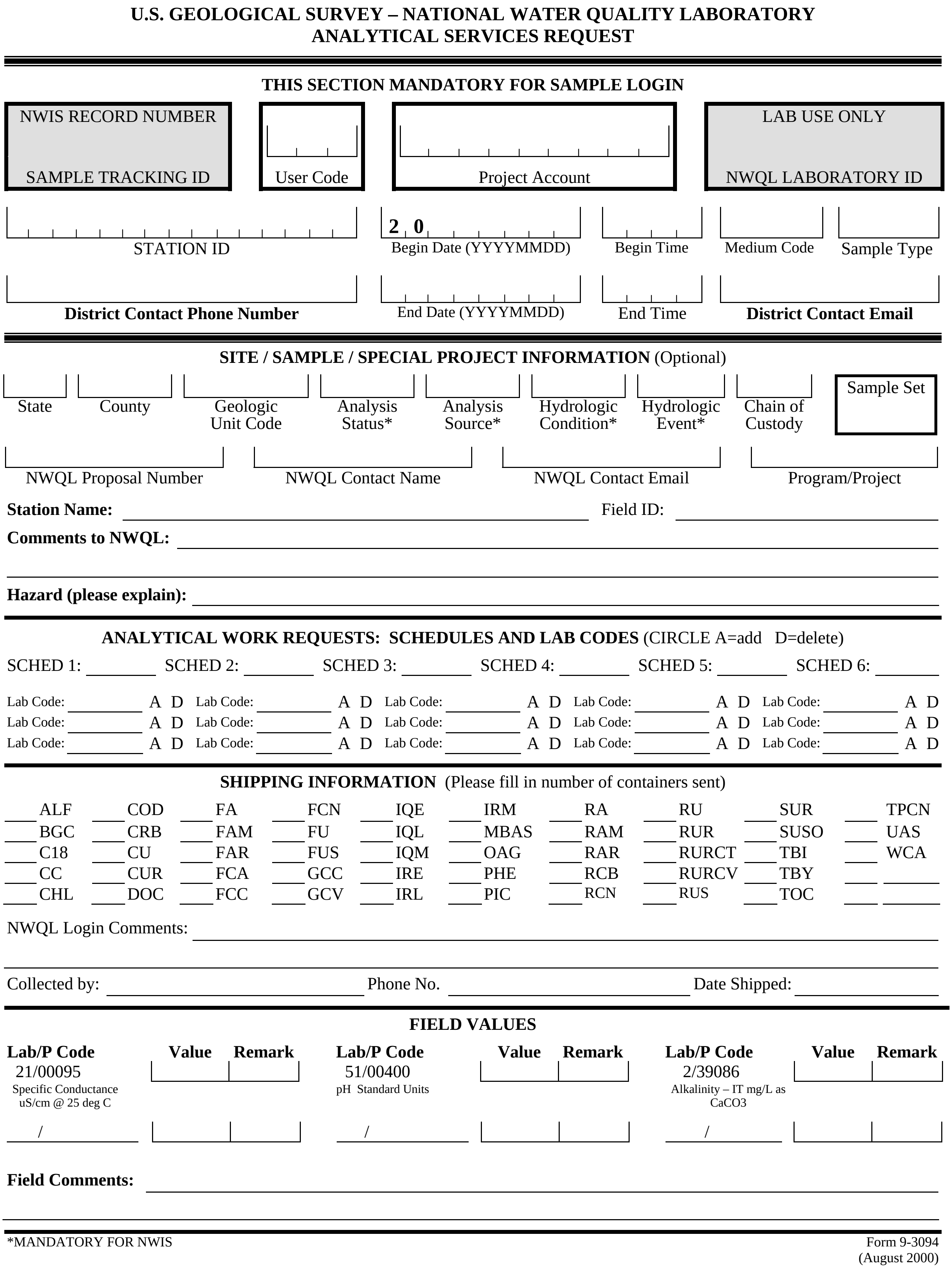
9. The water samples are chilled to 4°C if necessary, and stored in the field laboratory until they can be transferred to a secured storage area. Samples are transported to the analyzing laboratory as soon as reasonably possible. Samples sent to the USGS NWQL for analysis are transported in a sealed ice chest by a contract carrier; overnight delivery is stipulated for water samples for analyses of nutrients, total organic carbon, VOCs, and other time-sensitive constituents. Samples sent to the DOE RESL for analysis are hand carried to the laboratory.

10. All equipment is decontaminated with deionized water and, if necessary, organic-free water.

Some wells completed in the perched-water zones do not contain or produce enough water to be sampled with a pump. For these wells, either a 1,000-mL Teflon™ bailer or a 1,000-mL galvanized 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 step 4 above. 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 steps 6, 8 and 9 above.

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 step 4 above. 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 steps 6, 8, and 9 above. This process is repeated until sufficient water has been collected to fill all required sample containers and to make all necessary field measurements. For some samples, refrigerator-grade copper tubing is attached to the stainless-steel thief sampling bottles to deliver sample water to the appropriate sample containers.

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. In addition, excess purge water is collected at the discharge point and routed through canvas hoses to the trailer-mounted containers. The containerized purge water is subsequently transported to an approved disposal site.



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

District Contact Phone Number

End Date (YYYYMMDD)

End Time

District Contact Email

SITE / SAMPLE / SPECIAL PROJECT INFORMATION (Optional)

State
County
Geologic Unit Code
Analysis Status*
Analysis Source*
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 A=add D=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 (Please fill in number of containers sent)

____ ALF
____ BGC
____ C18
____ CC
____ CHL
____ COD
____ CRB
____ CU
____ CUR
____ DOC
____ FA
____ FAM
____ FAR
____ FCA
____ FCC
____ FCN
____ FU
____ FUS
____ GCC
____ GCV
____ IQE
____ IQL
____ IQM
____ IRE
____ IRL
____ IRM
____ MBAS
____ OAG
____ PHE
____ PIC
____ RA
____ RAM
____ RAR
____ RCB
____ RCN
____ RU
____ RUR
____ RURCT
____ RURCV
____ RUS
____ SUR
____ SUSO
____ TBI
____ TBY
____ TOC
____ TPCN
____ UAS
____ WCA
____ ____
____ ____

NWQL Login Comments: ____

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

FIELD VALUES

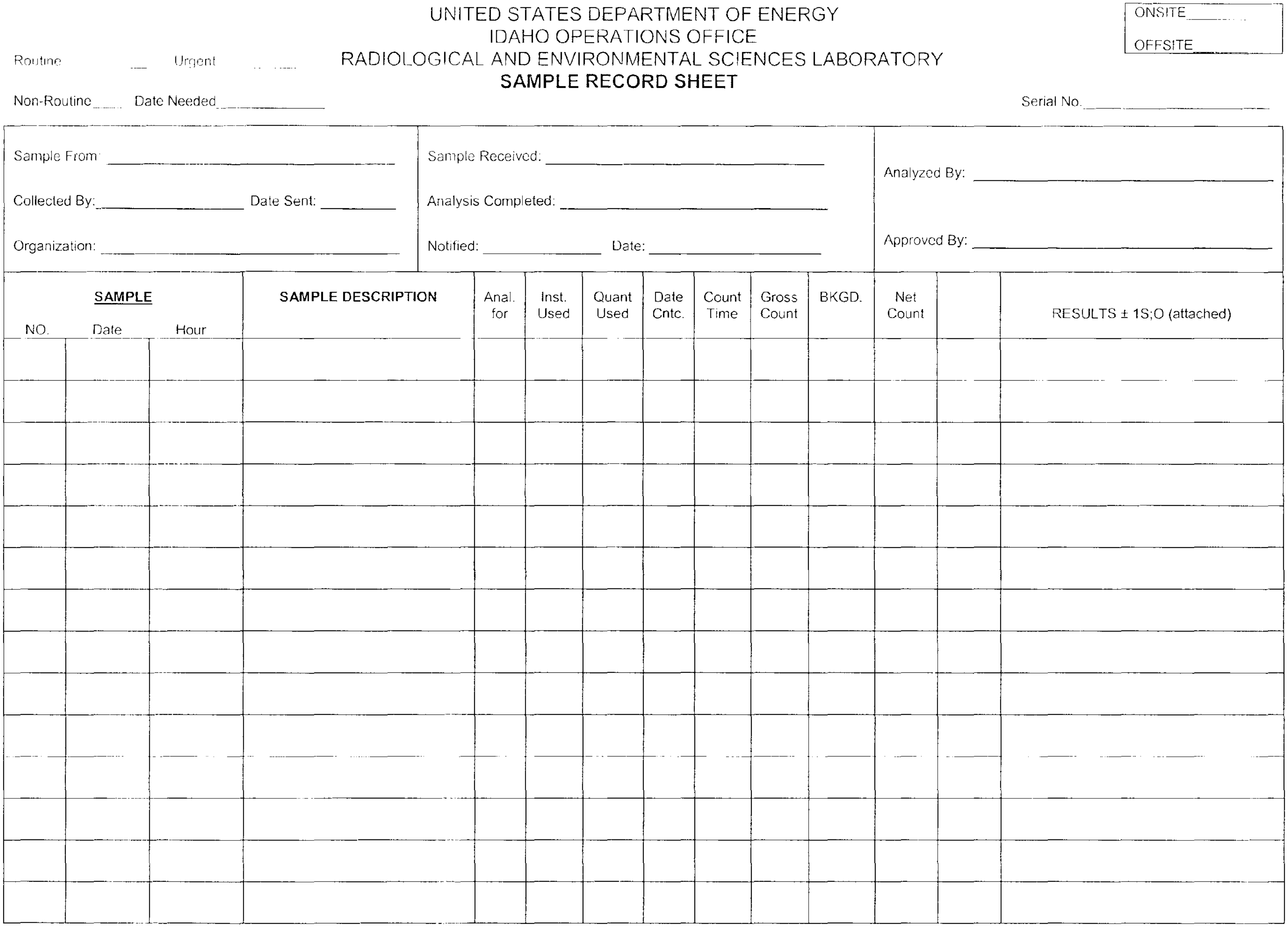
Lab/P Code	Value	Remark	Lab/P Code	Value	Remark	Lab/P Code	Value	Remark
21/00095 Specific Conductance uS/cm @ 25 deg C			51/00400 pH Standard Units			2/39086 Alkalinity – IT mg/L as CaCO3		
/			/			/		

Field Comments: ____

*MANDATORY FOR NWIS

Form 9-3094
(August 2000)

Figure 4. Analytical services request form for the National Water Quality Laboratory.



UNITED STATES DEPARTMENT OF ENERGY
IDAHO OPERATIONS OFFICE
RADIOLOGICAL AND ENVIRONMENTAL SCIENCES LABORATORY
SAMPLE RECORD SHEET

ONSITE_____
OFFSITE_____

Routine ___ Urgent ___

Non-Routine___ Date Needed__________

Serial No.__________

Sample From: __________

Collected By:__________ Date Sent: __________

Organization: __________

Sample Received: __________

Analysis Completed: __________

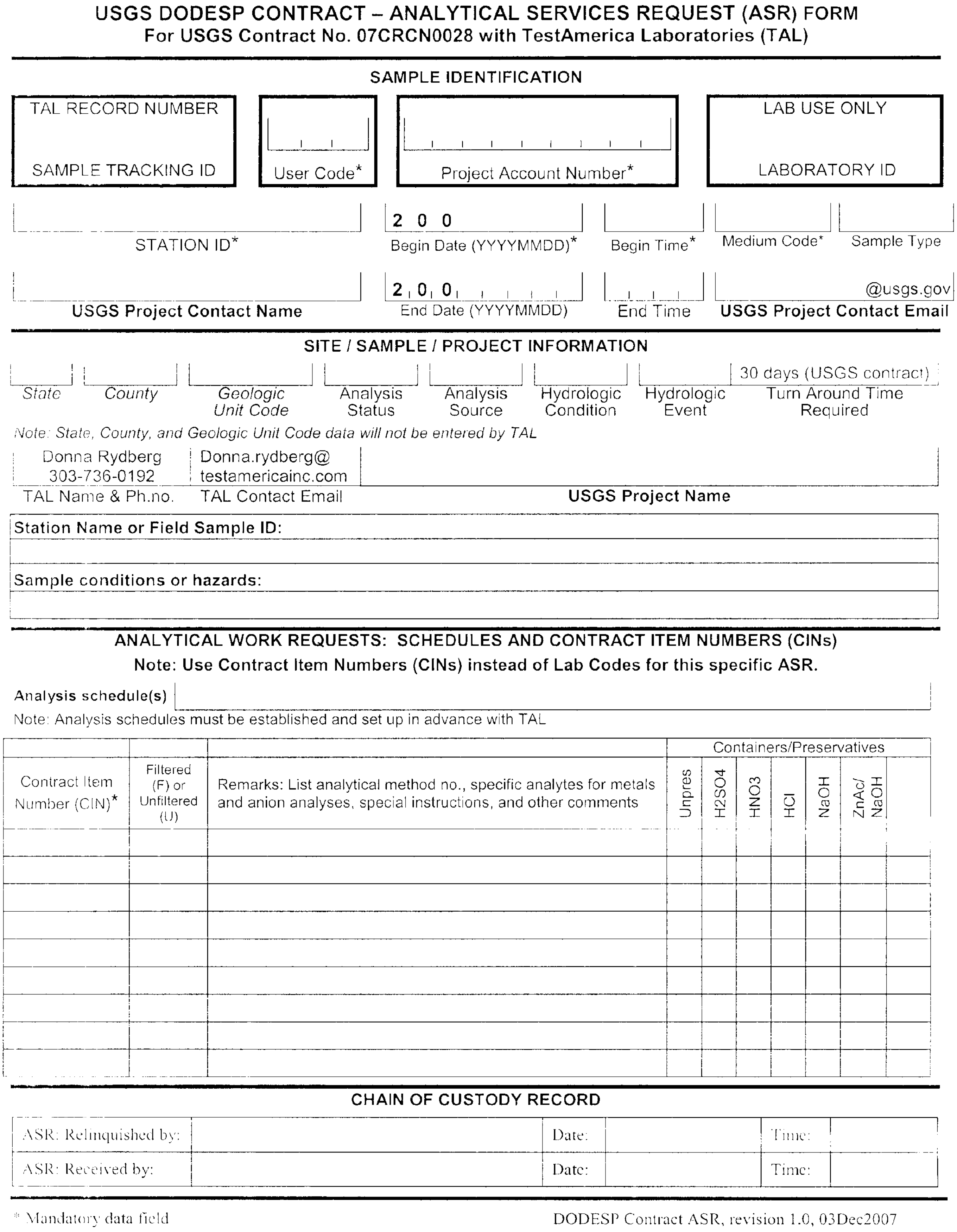
Notified: __________ Date: __________

Analyzed By: __________

Approved By: __________

SAMPLE			**SAMPLE DESCRIPTION**	Anal. for	Inst. Used	Quant Used	Date Cntc.	Count Time	Gross Count	BKGD.	Net Count		RESULTS ± 1S;O (attached)
NO.	Date	Hour											

Figure 5. Sample record sheet for the Radiological and Environmental Sciences Laboratory.



USGS DODESP CONTRACT – ANALYTICAL SERVICES REQUEST (ASR) FORM
For USGS Contract No. 07CRCN0028 with TestAmerica Laboratories (TAL)

SAMPLE IDENTIFICATION

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

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

SITE / SAMPLE / PROJECT INFORMATION

							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 by TAL

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

Station Name or Field Sample ID:

Sample conditions or hazards:

ANALYTICAL WORK REQUESTS: SCHEDULES AND CONTRACT ITEM NUMBERS (CINs)
Note: Use Contract Item Numbers (CINs) instead of Lab Codes for this specific ASR.

Analysis schedule(s)

Note: Analysis schedules must be established and set up in advance with TAL

			Containers/Preservatives						
Contract Item Number (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:	

* Mandatory data field

DODESP Contract ASR, revision 1.0, 03Dec2007

Figure 6. Sample request and chain-of-custody record for the TestAmerica Laboratories.

Wells inside the Reactor Technology 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 after a pH 7 buffer check. In this case, the requirement for a pH 7 buffer check is waived; however, an end of day check must be satisfactory, or the well should be resampled.

An added precaution against cross contamination is used at wells that are sampled with a bailer. The concentrations of most contaminants are greatest in wells nearest disposal sites, and these concentrations decrease with increasing distance. Therefore, when conditions permit, the most distant wells are sampled first. This method of sampling minimizes the potential for cross contamination.

Conditions at the well during sample collection are recorded in a bound water-quality field logbook (fig. 1), and a chain-of-custody record (fig. 7) is used to track samples from the time of collection until delivery to the DOE RESL or until mailing to the USGS NWQL. 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.

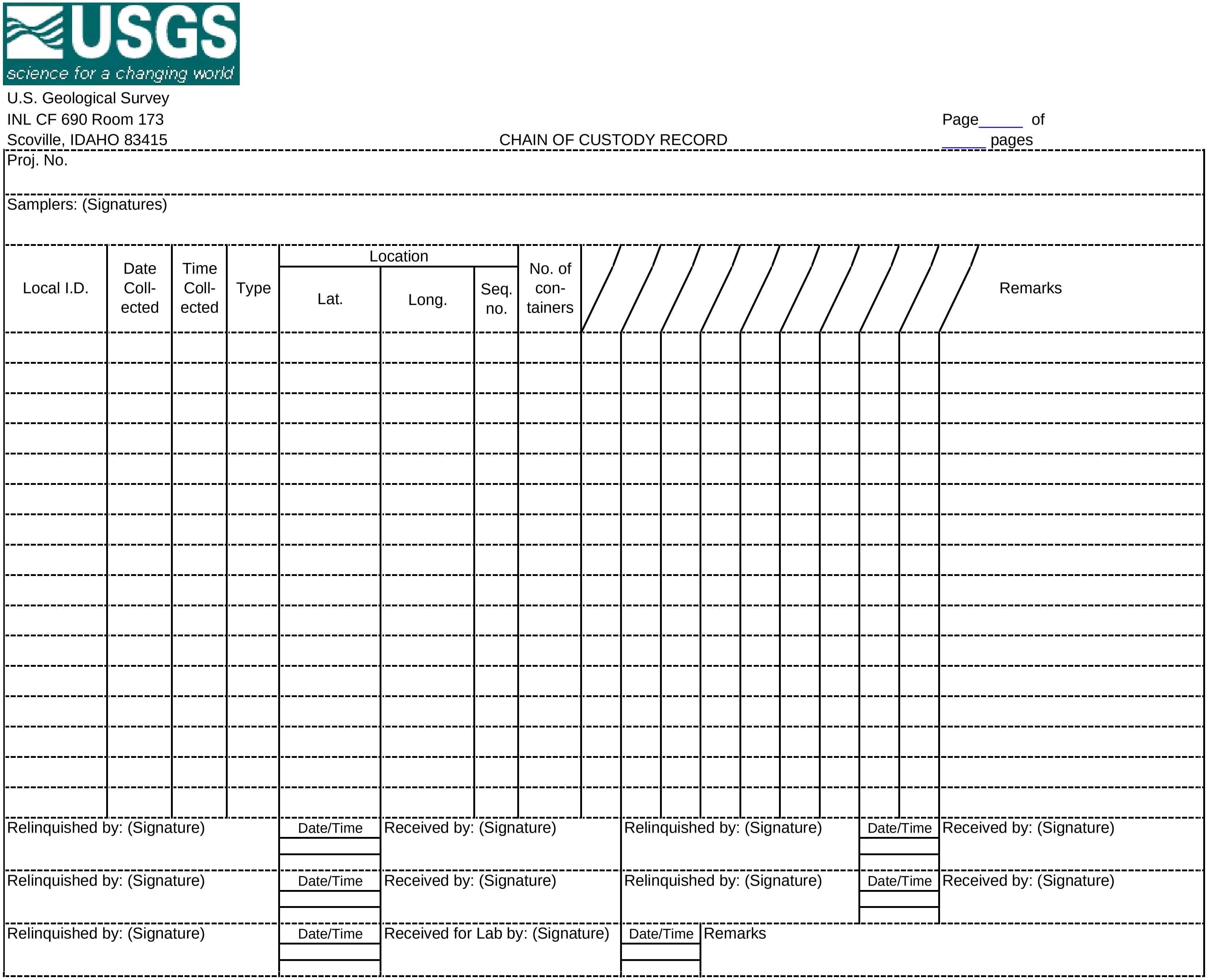
Quality Assurance for Quality-of-Water Activities

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; (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 assure the following: (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

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, 2005) and Ludtke and others (2000). Additional quality assurance instituted 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) blind replicate samples—duplicate samples with different sample identification numbers submitted to a laboratory; (3) replicate samples—samples with the same sample identification numbers submitted to a laboratory; (4) blank samples—samples of deionized water, organic-free water, or inorganic-free water sent to a laboratory and identified as routine samples; (5) equipment blanks—rinsate collected during decontamination procedures; (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. 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 found on the World Wide Web at http://nwql.usgs.gov/pubs-tm.shtml. Other analytical methods from the U.S. Environmental Protection Agency (USEPA) that are currently used at the USGS NWQL can be found on the World Wide Web at http://www.epa.gov/ogwdw/methods/analyticalmethods.html. Analytical methods from ASTM International that are currently used at the USGS NWQL can be found on the World Wide Web at http://www.astm.org. The type of analysis and the analytical procedure are specified on the USGS NWQL analytical services request form (fig. 4).

A discussion of procedures used by the DOE RESL for the analysis of radionuclides in water is provided by Bodnar and Percival [eds.] (1982) and the U.S. Department of Energy (1995). Additional quality assurance implemented by the INL



U.S. Geological Survey
INL CF 690 Room 173
Scoville, IDAHO 83415

CHAIN OF CUSTODY RECORD

Page_____ of _____ pages

Proj. No.

Samplers: (Signatures)

Local I.D.	Date Coll-ected	Time Coll-ected	Type	Location			No. of con-tainers										Remarks
				Lat.	Long.	Seq. no.											

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 for Lab by: (Signature)	Date/Time	Remarks	

Figure 7. Chain-of-custody record.

Project Office for samples sent to the DOE RESL is consistent with procedures used for samples sent to the USGS NWQL. The type of analysis to be performed on a water sample is specified on the DOE RESL sample record sheet (fig. 5).

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 split, or another type of quality-assurance sample. For samples that are to be analyzed for nonroutine constituents, 15 to 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), and Rattray and others (2005). 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 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.

Data-quality objectives for routine water samples analyzed by the USGS NWQL are included in appendix B, and data-quality objectives for radionuclides in water samples analyzed by the DOE RESL are in appendix C.

Review of Analyses

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

- Historical concentration of the solute at the site where the sample was collected;
- Concentration of the solute in replicate, split, blank, or other quality-assurance samples;
- Concentrations of the solute in nearby wells that obtain water from the same aquifer or perched-water zone;
- Review of waste-disposal records and changes in disposal techniques, land use, and recharge that may influence the concentration of a solute(s);
- 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) for that constituent set by the USEPA. If resampling is necessary, replicates or split samples generally are collected to evaluate laboratory precision. Spiked and reference samples are used to measure accuracy. 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 are also evaluated by replicate sampling during the next sample period. If the analytical results for the replicates do not agree, the analyzing laboratory is contacted to resolve the problem.

Table 2. Maximum contaminant levels of types of radioactivity and selected radionuclides in drinking water.

[The maximum contaminant levels (MCL) were established pursuant to the recommendations of the U.S. Environmental Protection Agency (2000, p. 344) 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. **Abbreviation:** pCi/L, picocurie per liter]

Radionuclide or type of radioactivity	MCL
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

Table 3. Maximum contaminant levels, secondary maximum contaminant levels, long term method detection limits, and laboratory reporting levels of selected trace elements in drinking water.

[The maximum contaminant levels (MCL) are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b; 2000, p 343, 421) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels (SMCL)—in brackets—are from U.S. Environmental Protection Agency (2000, p. 613). The long term method detection limits and the laboratory reporting levels are taken from the Laboratory Information Management System (LIMS) used by the National Water Quality Laboratory, U.S. Geological Survey (Mark Hardy, U.S. Geological Survey, oral commun., 2007). Units are in micrograms per liter (µg/L). **Symbols:** .., MCL has not been established; *, lead has an action level of 15 µg/L]

Trace element	MCL or SMCL	Long-term method detection limits	Laboratory reporting levels
Aluminum	[50–200]	0.8	1.6
Antimony	6	.07	.14
Arsenic	10	.06	.12
Barium	2,000	.04	.08
Beryllium	4	.03	.06
Boron	..	4	8
Cadmium	5	.07	.14
Chromium	100	.20	.40
Cobalt	..	.01	.02
Copper	[1,000]	.2	.4
Iron	[300]	3	6
Lead	*	.04	.08
Lithium	..	.5	1.0
Manganese	[50]	.4	.8
Mercury	2	.005	.010
Molybdenum	..	.10	.20
Nickel	..	.10	.20
Silver	[100]	.008	.016
Strontium	..	.4	.8
Thallium	2	.04	.08
Uranium	..	.01	.02
Vanadium	..	.2	.4
Zinc	[5,000]	.9	1.8

Table 4. Maximum contaminant levels, secondary maximum contaminant levels, long term method detection limits, and laboratory reporting levels of selected common ions in drinking water.

[The maximum contaminant levels (MCL) are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b; 2000, p 343, 421) for community water systems and are for comparison purposes only. Secondary maximum contaminant levels (SMCL)—in brackets—are from U.S. Environmental Protection Agency (2000, p. 613). The long term method detection limits and the laboratory reporting levels are taken from the Laboratory Information Management System (LIMS) used by the National Water Quality Laboratory, U.S. Geological Survey (Mark Hardy, U.S. Geological Survey, oral commun., 2007). Units are in milligrams per liter (mg/L). **Symbols:** –, maximum contaminant level has not been established]

Constituent	MCL or SMCL	Long- term method detection limit	Laboratory reporting level
Bromide	–	0.01	0.02
Calcium	–	.01	.02
Chloride	[250]	.06	.12
Fluoride	4 [2]	.05	.10
Magnesium	–	.007	.014
Potassium	–	.002	.004
Silica	–	.10	.20
Sodium	–	.10	.20
Sulfate	[250]	.09	.18

Table 5. Maximum contaminant levels, long term method detection limits, and laboratory reporting levels of selected nutrients, and organic carbon in drinking water.

[The maximum contaminant levels (MCL) are for total measurements and were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b; 2000, p 343, 421) for community water systems and are for comparison purposes only. The long term method detection limits and the laboratory reporting levels are taken from the Laboratory Information Management System (LIMS) used by the National Water Quality Laboratory, U.S. Geological Survey (Mark Hardy, U.S. Geological Survey, oral commun., 2007). Units are in milligrams per liter (mg/L). **Symbols:** –, maximum contaminant level has not been established]

Constituent	MCL or SMCL	Long- term method detection limit	Laboratory reporting level
Ammonia (as nitrogen)	–	0.01	0.02
Nitrite (as nitrogen)	1	.001	.002
Nitrite plus nitrate (as nitrogen)	10	.030	.060
Orthophosphate (as phosphorus)	–	.003	.006
Dissolved organic carbon	–	.2	.4
Total organic carbon	–	.20	.40

Table 6. Maximum contaminant levels and minimum reporting levels of selected volatile organic compounds in drinking water.

[Analyses performed by the U.S. Geological Survey National Water Quality Laboratory using an analytical method equivalent to U.S. Environmental Protection Agency method 524.2. **Abbreviations:** MCL, maximum contaminant level; MRL, minimum reporting level. MCL's were established pursuant to the recommendations of the U.S. Environmental Protection Agency (1994b; 2000, p. 419) for community water systems and are included for comparison purposes only. Long term method detection limits are not applicable to volatile organic compounds. MRL's are from the Laboratory Information Management System (LIMS) used by the National Water Quality Laboratory, U.S. Geological Survey (Mark Hardy, U.S. Geological Survey, oral commun., 2007). 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, 2000, p. 343)]

Compound	MCL	MRL
Acrylonitrile	--	2.5
Benzene	5	.1
Bromobenzene	--	.2
Bromochloromethane	--	.2
Bromoform	*	.2
Bromomethane	--	.3
n-Butylbenzene	--	.2
sec-Butylbenzene	--	.2
tert-Butylbenzene	--	.2
Carbon tetrachloride (Tetrachloromethane)	5	.2
Chlorobenzene	100	.1
Chlorodibromomethane (Dibromochloromethane)	*	.2
Chloroethane (Xylenes)	--	.2
Chloroform	*	.1
Chloromethane	--	.2
2-Chlorotoluene	--	.2
4-Chlorotoluene	--	.2
1,2-Dibromo-3-chloropropane	.2	5
1,2-Dibromoethane	.05	.2
Dibromomethane	--	.2
1,2-Dichlorobenzene	600	.1
1,3-Dichlorobenzene	600	.1
1,4-Dichlorobenzene	75	.1
Dichlorobromomethane (Bromodichloromethane)	*	.2
Dichlorodifluoromethane	--	.2
1,1-Dichloroethane	--	.1
1,2-Dichloroethane	5	.2
cis-1,2-Dichloroethene (*cis*-1,2-Dichloroethylene)	70	.1
1,1-Dichloroethene (*cis*-1,2-Dichloroethylene)	7	.1
trans-1,2-dichloroethene (*trans*-1,2-dichloroethylene)	100	.1
1,2-Dichloropropane	5	0.1
1,3-Dichloropropane	--	.2
2,2-Dichloropropane	--	.2
cis-1,3-Dichloropropene	--	.2
trans-1,3-Dichloropropene	--	.2
1,1-Dichloropropene	--	.2
Ethylbenzene	700	.1
Hexachlorobutadiene	--	.2
Isopropylbenzene	--	.2
p-Isopropyltoluene (4-Isopropyl-1-methylbenzene)	--	.2
Methylene chloride (Dichloromethane)	--	.2
Methyl *tert*-butylether (*tert*-Butyl methyl ether)	--	.2
Naphthalene	--	.5
n-Propylbenzene	--	.2
Styrene	100	.1
1,1,1,2- Tetrachloroethane	--	.2
1,1,2,2-Tetrachloroethan	--	.2
Tetrachloroethylene	5	.1
Toluene	1,000	.1
1,2,3-Trichlorobenzene	--	.2
1,2,4-Trichlorobenzene	70	.2
1,1,1-Trichloroethane	200	.1
1,1,2-Trichloroethane	5	.2
Trichloroethene (Trichloroethylene)	5	.1
Trichlorofluoromethane	--	.2
1,2,3-Trichloropropane	--	.2
1,1,2-Trichloro 1,2,2-trifluoroethane	--	.1
1,2,4-Trimethylbenzene	--	.2
1,3,5-Trimethylbenzene	--	.2
Vinyl chloride	2	.2
Xylenes, total ortho, meta, and para	10,000	.2

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's checklist is shown in appendix F. 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.

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 Regional Hydrologist, Western Region, 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 Western Region Office of the Water-Quality Specialist and by the Headquarters Office of Water Quality take place at 2- to 3-year intervals. The reviews are summarized in writing, and the reports distributed to the USGS INL Project Office, Western Region Office of the Regional Hydrologist, 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 Regional 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 publicly 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 National Water Information System (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's Department of Health and Welfare and the USEPA, 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.

Training Requirements and Site Safety

Training and site safety are important components of the USGS INL Project Offices 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 (J. Rousseau, U.S. Geological Survey, written commun., 2008).

USGS INL Project Office personnel are called on from time to time to sample 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 noted 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.

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.

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.

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.

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.

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.

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

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.

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.

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.

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.

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.

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.

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.

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.

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.

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.

Hem, J.D., 1985, Study and interpretation of chemical characteristics of natural water: U.S. Geological Survey Water-Supply Paper 2254, 264 p.

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.

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.

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.

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.

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.

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, 9 November 2005, chapters and appendixes variously paged.

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.

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.

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.

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.

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.

Severn Trent Laboratories, 2007, Laboratory Quality Manual, STL Denver, Revision 2: Severn Trent Laboratories [variously paged].

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.

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.

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.

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.

Timme, P.J., 1995, National Water Quality Laboratory, 1995 services catalog: U.S. Geological Survey Open-File Report 95-352, 120 p.

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

U.S. Environmental Protection Agency, 1994b, EPA drinking water regulations and health advisories: U.S. Environmental Protection Agency, Office of Water, Report No. 822R-94-001, 11 p.

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, 2000, Protection of environment, Code of Federal Regulations 40: Office of the Federal Register, National Archives and Records Administration, pts. 136-149, 901 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,. Available online at URL: 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.

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.

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.

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

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)		RESL			NQWL	Field value		
						Apr	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper- ature	pH	SC
		ANP 6	Pump 45 gpm	10	305	10								
		ANP 9	Pump 20 gpm	8	322		24							
		Arbor Test	Pump 20 gpm	10	790	2								
		AREA II	Pump 18 gpm	16	877		10							
		Atomic City[1]	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.) *	Surface water			3								
		BLR (Dairy Farm) *	Surface water			3								
		Birch Creek*	Surface water				1							
		CFA 1*	Pump 1,000 gpm	16	639	10								
		CFA 2*	Pump 1,400 gpm	16	681		10							
		CFA LF 2-10	Pump 8.3 gpm	6	716	20								
		CPP 1	Pump 3000 gpm	16	586	21								
		CPP 2	Pump 3000 gpm	16	605		28							
		CPP 4	Pump 400 gpm	16	700		28							
		Crossroads Well	Pump 35 gpm	8	607									
		CWP 1	Bail @55 feet	6	58.0		4							
		CWP 3	Bail @50 feet	6	55.0	4								
		CWP 8	Bail @63 feet	6	64.0		4							
		EBR-I	Pump 25 gpm	10	1,075	26								
		[1]Highway 3	Spigot	8	750		26							
		ICPP-MON-A-166	Pump 6 gpm	6	527	31								
		ICPP-MON-A-167	Pump 4 gpm	6	504		31							
		IET Disp	Pump 46 gpm	12	324		10							
		Leo Rogers 1	Pump 20 gpm	20	720		11							
		Little Lost River	Surface water				1							
		MTR Test	Pump 26 gpm	8	588	8								
		Mud Lake*	Surface				1							
		Middle 2050A^	Multi-depth thief sampler	//	1,376									
		Middle 2051^	Mutli-depth thief sampler	//	1,175									
		No Name 1 (Tan Expl.)	Pump 42 gpm	12	550	24								
		NRF 6***	Pump 30 gpm	8	417									

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.—Continued

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)		RESL			NQWL	Field value		
						Apr	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper-ature	pH	SC
		NRF 7***	Pump 2.5 gpm[#]	10	417									
		NRF 8***	Pump 30 gpm	8	423									
		NRF 9***	Pump 30 gpm	8	422									
		NRF 10***	Pump 30 gpm	8	427									
		NRF 11***	Pump 30 gpm	8	417									
		NRF 12***	Pump 30 gpm	8	421									
		NRF 13***	Pump 1 gpm[#]	8	425									
		NPR Test	Pump 28 gpm	6	599		26							
		PSTF	Pump 44 gpm	10	319		24							
		P&W 2*	Pump 35 gpm	10	386	19								
		PW-1	Bail @ 115	6	117	9								
		PW-4	Bail @ 126	6	150		9							
		PW-6	Bail @125 feet	6	125		9							
		PW-8	Pump 8 gpm	6	166	13								
		PW-9	Pump 5 gpm	6	200		13							
		Rifle Range Well	Pump 25 gpm	5	620		13							
		RWMC M1SA	Pump 3.4 gpm	6	638		29							
		RWMC M3S	Pump 3.7 gpm	6	633		18							
		RWMC M7S	Pump 4.1 gpm	6	628		18							
		RWMC M11S	Pump 6 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**	Pump 200 gpm	14>658 10<658	685		17							
		Site 4	Pump 500 gpm	8	495		7							
		Site 9	Pump 25 gpm	10	1,057	10								
		Site 14*	Pump 40 gpm	8 >313 12 <313	717		19							
		Site 17	Pump 25 gpm	15	600	10								
		Site 19	Pump 30 gpm	8>550 10<550	860		7							
		SPERT 1	Pump 400 gpm	14	653	6								
		TRA 1	Pump 3,400 gpm	18	600	7								

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.—Continued

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)		RESL			NQWL	Field value		
						Apr	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temperature	pH	SC
		TRA 3	Pump 3,800 gpm	20	602		7							
		TRA 4	Pump 2,000 gpm	16>705 18<705	965	7								
		TRA A-13	Bail from bottom of well	2	59	13								
		TRA A-77	Bail from bottom of well	2	34		13							
		TRA Disp.	Pump 25 gpm	6>1114 8<1114	1,267		14							
		W.S. for INEL-1	Pump 30 gpm	6	490	7								
		USGS 1	Pump 19 gpm	5	636		19							
		USGS 2	Pump 16 gpm	5	686	10								
		USGS 4	Pump 40 gpm	6	553		19							
		USGS 5	Pump 5 gpm$^{\#}$	6	494	26								
		USGS 6	Pump 25 gpm	4	620		10							
		USGS 7	Pump 45 gpm	4 >760 6 <760	903	24								
		USGS 8*	Pump 16 gpm	6	812	19								
		USGS 9	Pump 19 gpm	6	632		19							
		USGS 11*	Pump 23 gpm	6	704	19								
		USGS 12***	Pump 32 gpm	10	563	22								
		USGS 14*	Pump 16 gpm	5	751		3							
		USGS 15	Pump 40 gpm	10	610		10							
		USGS 17	Pump 32 gpm	5 >365 6 <365	498	19								
		USGS 18	Pump 30 gpm	4	329	10								
		USGS 19*	Pump 33 gpm	6	399	19								
		USGS 20	Pump 30 gpm	6	658	10								
		USGS 22	Pump 2.5 gpm$^{\#}$	6	657	5								
		USGS 23	Pump 25 gpm	5>430 6<430	463		19							
		USGS 26	Pump 40 gpm	6	266	24								
		USGS 27*	Pump 20 gpm$^{\#}$	6	312	19								
		USGS 29	Pump 32 gpm	6	426		10							
		USGS 31	Pump 40 gpm	10 >306 8 <306	428	10								

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.—Continued

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)		RESL			NQWL	Field value		
						Apr	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper-ature	pH	SC
		USGS 32	Pump 28 gpm	5.5 >324 6 <324	392	10								
		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	573		15							
		USGS 38	Pump 4 gpm$^{\#}$	4	612	21								
		USGS 39	Pump 25 gpm	8	493		10							
		USGS 40	Pump 8 gpm	4	483	15								
		USGS 41	Pump 25 gpm	6	674		10							
		USGS 42	Pump 25 gpm	6	678	10								
		USGS 43	Pump 6 gpm	6	676		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	652		15							
		USGS 48	Pump 29 gpm	6	750	10								
		USGS 50	Pump 0.5 gpm$^{\#}$	6	405		12							
		USGS 51	Pump 4 gpm	6	647	10								
		USGS 52	Pump 30 gpm	6	602		10							
		USGS 53	Bail	6	71	13								
		USGS 54	Pump 4 gpm	6	91		13							
		USGS 55	Pump 1 gpm	6	81	13								
		USGS 56	Pump 1 gpm	6	80		13							
		USGS 57	Pump 30 gpm	6	582		12							
		USGS 58	Pump 26 gpm	6	503	13								
		USGS 59	Pump 1 gpm	6	657	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	97		13							
		USGS 65*	Pump 8 gpm	4	498	25								
		USGS 66	Bail @ 214 feet	4	475		13							

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.—Continued

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)		RESL			NQWL	Field value		
						Apr	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper-ature	pH	SC
		USGS 67	Pump 8 gpm	4>465 6<465	694		10							
		USGS 68	Pump 1 gpm#	10	128	30								
		USGS 69	Pump 5 gpm	4	115		13							
		USGS 70	Pump 6 gpm	8	100	13								
		USGS 71	Bail @ 165 feet	5	171		13							
		USGS 72	Pump 1 gpm	4	175	30								
		USGS 73	Pump 6 gpm	6	127		13							
		USGS 76	Pump 29 gpm	6	718	14								
		USGS 77	Pump 25 gpm	6	586		21							
		USGS 78	Bail @ 160 feet	7	204		13							
		USGS 79	Pump 30 gpm	6	702	7								
		USGS 82	Pump 25 gpm	6	693	10								
		USGS 83	Pump 28 gpm	6	752	26								
		USGS 84	Pump 5 gpm	6	505		25							
		USGS 85*	Pump 23 gpm	6	614	10								
		USGS 86	Pump 19 gpm	8	691		19							
		USGS 87*	Pump 2 gpm	4	673	23								
		USGS 88	Pump 2 gpm	4	662		17							
		USGS 89	Pump 5 gpm	6	637	17								
		USGS 92	Bail @ 213 feet	3.5	214	16								
		USGS 97***	Pump 27 gpm	4	510	25								
		USGS 98***	Pump 25 gpm	4	505		25							
		USGS 99***	Pump 25 gpm	4	440		7							
		USGS 100*	Pump 10 gpm#	6	750	7								
		USGS 101	Pump 13 gpm	4>750 6<750	842		19							
		USGS 102***	Pump 29 gpm	6	445	10								
		USGS 103^	Multi-depth thief sampler	//	1,297									
		USGS 104*	Pump 26 gpm	8	700		6							
		USGS 105	Pump 24 gpm	4	800		19							
		USGS 106	Pump 24 gpm	8	760		5							
		USGS 107	Pump 30 gpm	8	690	26								
		USGS 108	Pump 24 gpm	8	760	19								

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.—Continued

Date	Time	Local site identifier	Method of sampling	Hole diameter (inches)	Total depth (feet)	Analysis type (see code)		RESL			NQWL	Field value		
						Apr	Oct	500 mL RU	500 mL RA	1000 ml RA	SH. or lab code	Temper-ature	pH	SC
		USGS 109	Pump 22 gpm	4	800	19								
		USGS 110A	Pump 24 gpm	6	644		19							
		USGS 111	Pump 15 gpm#	8	560	10								
		USGS 112*	Pump 30 gpm	8	563		10							
		USGS 113	Pump 25 gpm	6	564	12								
		USGS 114	Pump 10 gpm#	6	560		10							
		USGS 115*	Pump 5 gpm	6	581		10							
		USGS 116	Pump 20 gpm	6	572	10								
		USGS 117	Pump 12 gpm#	6.5	655	17								
		USGS 119	Pump 3 gpm#	6.5	705	17								
		USGS 120*	Pump 27 gpm	6.5	705		23							
		USGS 121	Pump 8 gpm	6	475	10								
		USGS 123	Pump 3 gpm	6	481		10							
		USGS 124*	Pump 19 gpm	4	800	6								
		USGS 125*	Pump 21 gpm	5	774		19							
		USGS 126A	Pump	5	648	19								
		USGS 126B	Pump	6	452		19							
		USGS 127	Pump 25 gpm	6	596	20								
		USGS 128	Pump 23 gpm	4.5	615		18							
		USGS 131	Pump	6	797	32								
		USGS 132^	Multi-depth thief sampler	//	1,238									
		USGS 133^	Multi-depth thief sampler	//	798									
		USGS 134^	Multi-depth thief sampler	//	894									

*Well is sampled with someone from the State of Idaho's INL Oversight Program

**Well is sampled monthly for organics - SH1380

***Well is sampled 2 times a year for the NRF study—May and November.

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

^Site sample schedules for the mutli-depth sampler are subject to change from year to year so no code will be used.

// Hole diameter is not required for bore hole volumn calculations with Multi-depth thief samplers.

Appendix A. Field schedule showing well and pump information and sampling schedules for selected wells and streamflow sites.

	Codes for types of analyses (number of bottles needed in parenthesis)
1.	3H, Cl^- (2)
2.	3H, Cl^-, Cr (3)
3.	3H, Cl^-, α, β, Υ Spec (4)
4.	^{3}H, ^{90}Sr, Cl^-, Cr, SO_4^{-2} (4)
5.	^{3}H, Cl^-, Na^+ (3)
6.	^{3}H, Cl^-, Na^+, NO_3^- (4)
7.	^{3}H, Cl^-, Cr, Na^+,SO_4^{-2} (3)
8.	^{3}H, Cl^-, Cr, Na^+, NO_3^-, SO_4^{-2} (4)
9.	^{3}H, ^{90}Sr, Υ Spec, Cl^-, Na^+, SO_4^{-2} (4)
10.	^{3}H, ^{90}Sr, Cl^-, Na^+, NO_3^-, SO_4^{-2} (5)
11.	^{3}H, α, β, Υ Spec, Cl^-, Na^+ (5)
12.	^{3}H, ^{90}Sr, Υ Spec Cl^-, Na^+, NO_3^-, SO_4^{-2} (5)
13.	^{3}H, ^{90}Sr, Υ Spec, Cl^-, Cr, Na^+, SO_4^{-2} (4)
14.	^{3}H, ^{90}Sr, Υ Spec, Cl^-, Cr, Na^+, NO_3^-, SO_4^{-2} (5)
15.	^{3}H, ^{90}Sr, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, Na^+, NO_3^-, SO_4^{-2} (5)
16.	^{3}H, ^{90}Sr, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, VOC's (6)
17.	^{3}H, ^{90}Sr, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, Na^+, NO_3^-, VOC's, SO_4^{-2} (8)
18.	^{3}H, ^{90}Sr, Cl^-, NO_3^- (4)
19.	^{3}H, α, β, Υ Spec, Cl^-, Na^+, Cr, NO_3^-, TOC (7)
20.	^{3}H, ^{90}Sr, α, β, Υ Spec, Cl^-, Na^+, Cr, NO_3^-, TOC (7)
21.	^{3}H, ^{90}Sr, α, β, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, Na^+, Cr, NO_3^-, SO_4^{-2}, F^-, VOC's, TOC (10)
22.	^{3}H, α, β, Υ Spec, Cl^-, Na^+, Cr, NO_3^-, SO_4^{-2}, VOC's, TOC (10)
23.	^{3}H, ^{90}Sr, α, β, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, Na^+, Cr, NO_3^-, VOC's, TOC, SO_4^{-2} (10)
24.	^{3}H, ^{90}Sr, α, β, Υ Spec, Cl^-, Na^+, NO_3^-, VOC's, TOC, Sb, Ar, Cr, Pb, Hg, Ni, Tl, Zn (13)
25.	^{3}H, ^{90}Sr, α, β, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, Na^+, NO_3^-, SO_4^{-2}, VOC's, TOC, Al, Ar, Ba, Cd, Cr, Pb, Mn, Ni, Hg, Se, Ag, Zn (13)
26.	^{3}H, α, β, Υ Spec, Cl^-, Na^+, Cr, NO_3^-, TOC, VOC's (10)
27.	VOC's (3)
28.	^{3}H, ^{90}Sr, Cl^-, Cr, Na^+, NO_3^- (5)
29.	^{241}Am, ^{238}Pu, $^{239,240}Pu$ (1)
30.	^{3}H, ^{90}Sr, α, β, Υ Spec, Cl^-, Na^+, SO_4^{-2}, + SH 1281 metals: Ar, Ba, Cd, Cr, Pb, Hg, Se, Ag (8)
31.	^{3}H, ^{90}Sr, Υ Spec, Cl^-, Cr, Na^+, SO_4^{-2}, NO_3^-, TOC (6)
32.	^{3}H, ^{90}Sr, α, β, Υ Spec, ^{241}Am, ^{238}Pu, $^{239,240}Pu$, Cl^-, Na^+, Cr, NO_3^-, SO_4^{-2}, TOC (7)

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	1L	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
Cl^- (FU)[2]	NWQL	250 mL; LC 1571	Filtered, unacidified, rinse poly bottle
Cr (FA)[1]	NWQL	250 mL; LC 722	Filtered, preserved with 2mL Ultrex HNO_3, rinse poly bottle
Na^+ (FA)[1]	NWQL	250 mL; LC 675	Filtered, preserved with 2 mL Ultrex HNO_3, rinse poly bottle
NO_3^- (FCC)	NWQL	125 mL; SH101	Filtered, chilled, brown poly bottle, rinse bottle
VOC's (GCV)	NWQL	(3) 40 mL; SH1380	Raw water, chilled, unacidified, rinse glass bottle, amber
SO_4^{-2} (FU)[2]	NWQL	250 mL; LC 1572	Filtered, unacidified, rinse poly bottle
F^- (FU)[2]	NWQL	250 mL; LC 31	Filtered, unacidified, rinse poly bottle
TOC (TOC)	NWQL	125 mL; LC 114	Raw water, chilled, unacidified, amber glass bottle, no rinse
Sb, Cr, Pb, Ni, Zn (FA) Ar, 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
Hg (FAM)	NWQL	250 mL; LC 2707	Filtered, preserved with 2 mL 6N HCl, rinse, clear glass bottle
Al, Ba, Cd, Cr, Pb, Mn, Ni, Ag, Zn (FA) Ar, 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
^{129}I	PRIME	1 L	Filtered, unacidified, rinse, polyseal cap, no head space, amber glass
^{36}Cl	EML	l L	Raw water, unacidified, polyseal cap, amber glass
SH 1254 metals (FU, FA, RU)	NWQL	250 mL; SH 1254 250 mL; SH 1254+LC 3122, 1794, + 3134 125 mL; SH 1254	Filtered, unacidified, rinse poly bottle Filtered, preserved with 2 ml Ultrex HNO_3, rinse poly bottle Raw water, unacidified, rinse poly bottle
SH 1281 TLCP metals (RA, 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

[1] Analysis can be requested from the same bottle.

[2] Analysis can be requested from the same bottle.

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

Table B1. Data-quality objectives for routine water samples analyzed by the National Water Quality Laboratory.

[**Accuracy:** coefficient of variance measured by replicate analysis; precision at 10 percent level. **Abbreviations:** N, nitrogen; P, phosphorus]

Constituent	Laboratory reporting level (micrograms per liter)	Precision (+/- percent)	Accuracy (percent)	Lab code/schedule
I. Volatile organic compounds	Variable	30	70-130	SH 1380
II. Organic carbon	400	10	90-110	LC 113/LC 114
III. Inorganic compounds (filtered)				
Aluminum	1.6	10	90-110	SH 1050
Antimony	0.14	10	90-110	SH 1050
Arsenic	0.12	10	90-110	LC 3122
Barium	0.08	10	90-110	SH 1050
Beryllium	0.06	10	90-110	SH 1050
Cadmium	0.14	10	9-110	SH 1050
Calcium	20	10	90-110	SH 1254
Chromium	0.40	10	90-110	LC 722
Cobalt	0.02	10	90-110	SH 1050
Copper	0.4	10	90-110	SH 1050
Fluoride	100	10	90-110	LC 31
Iron	6	10	90-110	SH 1254
Lead	0.08	10	90-110	SH 1050
Magnesium	14	10	90-110	SH 1254
Manganese	0.8	10	90-110	SH 1050
Molybdenum	0.2	10	90-110	SH 1050
Nickel	0.20	10	90-110	SH 1050
Potassium	4	10	90-110	SH 1254
Selenium	0.04	10	90-110	LC 3132
Silica	200	10	90-110	SH 1254
Silver	0.016	10	90-110	SH 1050
Sodium	200	10	90-110	LC 675
Thallium	0.08	10	90-110	LC 2508
Uranium	0.02	10	90-110	SH 1050
Zinc	1.8	10	90-110	SH 1050
Mercury	0.010	10	90-110	LC 2707
Sulfate	180	10	90-110	LC 1572
Chloride	120	10	90-110	LC 1571
Nitrate (as N)	40	10	90-110	SH 101
Nitrite (as N)	2	10	90-110	SH 101
Phosphate (as P)	6	10	90-110	SH 101
Ammonia (as N)	20	40	60-140	SH 101

Appendix C. 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 pCi/L (picocuries per liter), there is a 67-percent probability that the true concentration is in the range of 0.8 to 1.2 pCi/L. Some laboratories report the analytical uncertainty as 2s, at which there is a 95-percent probability that the true concentration is in the range of 0.6 to 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 1.6s meet this criterion; at 1.6s, 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 1.6s, 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 1.6s has been defined, the minimum detectable concentration may be established. Radionuclide concentrations that equal 3s represent a measurement of the minimum detectable concentration. For true concentrations of 3s 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 3s, 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 3s criterion reduces the probability of a false negative to 5 percent or less.

True radionuclide concentrations between 1.6s and 3s 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 1.6s and 3s, and although the selected radionuclide might not have been detected, such nondetection may not be reliable; at 1.6s, 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 1.6s and 3s 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 0.5 to 0.2 pCi/mL.

Detection limits for selected types of radioactivity and nuclides as a function of sample size and detection method are shown in table C1; 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 C1. Data-quality objectives for radionuclides in water samples analyzed by the Radiological and Environmental Sciences Laboratory.

[Data source: Doug Carlson, U.S. Department of Energy, written commun., 2007. **Abbreviation:** bkgd, background]

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	100	60	Alpha Scintillation	3×10^{-3}
Gross beta	Water	250	20	Low bkgd counter	5×10^{-3}
	Water	100	20	Low bkgd counter	4×10^{-3}
	Water	5	20	Low bkgd counter	0.1
Sr-90	Water	400	50	Liquid Scintillation	2×10^{-3}
Tritium	Water	10	20	Liquid Scintillation	0.5
Th-230	Water	500	1,000	Alpha Spectrometry	4×10^{-5}
U-234	Water	500	1,000	Alpha Spectrometry	4×10^{-5}
Pu-238 + Pu-239/240	Water	500	1,000	Alpha Spectrometry	2×10^{-5}
Am-241	Water	500	1,000	Alpha Spectrometry	3×10^{-5}
Tc-99	Water	400	100	Liquid Scintillation	1.0
Te-132	Water	400	60	Ge(Li)	6×10^{-2}
Pb-212	Water	400	60	Ge(Li)	0.1
Se-75	Water	400	60	Ge(Li)	8×10^{-2}
Sb-125	Water	400	60	Ge(Li)	0.2
Ru-103	Water	400	60	Ge(Li)	1×10^{-2}
Tl-108	Water	400	60	Ge(Li)	0.2
Sb-124	Water	400	60	Ge(Li)	0.1
Co-60	Water	400	60	Ge(Li)	6×10^{-2}
K-40	Water	400	60	Ge(Li)	1.0
La-140	Water	400	60	Ge(Li)	7×10^{-2}
Ce-144	Water	400	60	Ge(Li)	0.4
Ce-141	Water	400	60	Ge(Li)	9×10^{-2}
Cr-51	Water	400	60	Ge(Li)	0.6
I-131	Water	400	60	Ge(Li)	6×10^{-2}
Ba-140	Water	400	60	Ge(Li)	0.2
Ru-106	Water	400	60	Ge(Li)	0.5
Cs-137	Water	400	60	Ge(Li)	6×10^{-2}
Bi-212	Water	400	60	Ge(Li)	1.0
Nb-95	Water	400	60	Ge(Li)	6×10^{-2}
Cs-134	Water	400	60	Ge(Li)	6×10^{-2}
Mo-99	Water	400	60	Ge(Li)	5×10^{-2}
Hg-203	Water	400	60	Ge(Li)	6×10^{-2}
Kr-85	Water	400	60	Ge(Li)	21
Bi-214	Water	400	60	Ge(Li)	0.4
Zr-95	Water	400	60	Ge(Li)	9×10^{-2}
Co-58	Water	400	60	Ge(Li)	6×10^{-2}
Mn-54	Water	400	60	Ge(Li)	5×10^{-2}
Ag-110	Water	400	60	Ge(Li)	7×10^{-2}
Ac-228	Water	400	60	Ge(Li)	0.2
Fe-59	Water	400	60	Ge(Li)	0.1
Zn-65	Water	400	60	Ge(Li)	0.1

Appendix D. Data-Quality Objectives for Water Samples Analyzed by Test America Laboratories

The U.S. Environmental Protection Agency (1994a) 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 Severn Trent Laboratories (2007, revision 2). The method of analyses, minimum reporting levels, and method detection limits for constituents analyzed by TAL for the U.S. Geological Survey Idaho National Laboratory Project Office are given in table D1.

Table D1. Data-quality objectives for water samples analyzed by TestAmerica Laboratories.

[**Abbreviation:** N, nitrogen]

Constituent	Method for analyses	Minimum reporting level (micrograms per liter)	Method detection limit (micrograms per liter)
Volatile organic compounds	524.2	Variable	Variable
Semi-volatile organic compounds	525.2	Variable	Variable
Total organic halogens	9020B	10	30
Inorganic compounds			
Aluminum	6010B	100	20
Antimony	6010B	10	0.15
Arsenic	6010B	15	4.9
Barium	6010B	10	0.37
Beryllium	6010B	5	0.41
Cadmium	6010B	5	0.27
Calcium	6010B	200	76
Chloride	300.0A	3,000	1,000
Chromium	7191	2	0.23
Copper	6010B	20	0.97
Iron	6010B	100	19
Lead	6010B	9	2.1
Magnesium	6010B	200	27
Manganese	6010B	10	0.54
Mercury	7470A	0.2	0.025
Nickel	6010B	40	4.2
Potassium	6010B	5,000	460
Selenium	6010B	15	4.6
Silver	6010B	10	0.7
Sodium	6010B	5,000	1,100
Sulfate	300.0A	5,000	500
Thallium	6010B	1	0.047
Zinc	6010B	20	7.1
Nitrate (as N)	354.1	10	1,000
Nitrite (as N)	353.2	100	1.3

Appendix E. Inventory of Water-Quality Field Equipment

Table E1. Inventory of water-quality field equipment.

Type of meter	Model	Manufacturer	Serial number
Conductivity	122	Orion	0905040
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	61733069
Digital thermometer	Traceable Memory Data-log 50	Fisher Scientific	72068284
Multi-parameter	Quanta	Hydrolab	QD01427
Multi-parameter	Quanta	Hydrolab	QD02191
Multi-parameter	Quanta	Hydrolab	QD02194
pH	250A+	Orion	014620
pH	250A+	Orion	016070
pH	250A+	Orion	015522
Turbidity	2100P	Hach	971200016277

Appendix F. 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 _______________________________________

			Steel tape	**Electric tape**
4. Water-level measurement?	Yes	No	Hold1 __________	Depth1 below MP______
			Cut1 __________	Tape correction1 ______
Recorded on WL sheet or			Hold2 __________	Depth2 below MP______
Personal Data Assistant (PDA)?	Yes	No	Cut2 __________	Tape correction2 ______
			MP __________	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	Site-safety Plan?	Yes	No
Bucket?	Yes	No	QA Plan?	Yes	No
First-Aid Kit?	Yes	No	Body-fluids Kit?	Yes	No
Fire Extinguisher?	Yes	No	Safety Vest (If required)?	Yes	No
Eye-wash Kit?	Yes	No	Pager and Cell Phone?	Yes	No
Hearing Protection?	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 books?	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 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:

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