SPOKANE COUNTY
WATER RESOURCES

Groundwater Monitoring Program

Quality Assurance Project Plan

August 2007

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A INTRODUCTION

Spokane County Water Resources staff has prepared this Quality Assurance Project Plan (QAPP) for quarterly sampling of a network of 29 monitoring wells and 17 public supply wells located within the boundary of the Spokane Valley-Rathdrum Prairie Aquifer. Data from this monitoring program are utilized to assess the current water quality of the aquifer and determine if spatial and temporal water quality trends exist. This QAPP was prepared in accordance with Environmental Protection Agency (EPA) and Washington State Department of Ecology (Ecology) guidelines. The purpose of the QAPP is to guide sample collection, laboratory analysis, and data review such that data generated from a sampling event is comparable to past and future sampling events and is representative of actual environmental conditions at the time of sampling.

B PROJECT MANAGEMENT

B.1 Project Organization

Spokane County Utilities Division Director	*Bruce Rawls*
Water Resources Section Manager	*Rob Lindsay*
Water Resources Section Staff:	*Reanette Boese* *Ben Brattebo* *Mike Hermanson* *Bea Lackaff* *Lauri Clift*
Analytical Laboratory:	*TestAmerica, Inc*
Laboratory Project Manager	*Randee Decker*

B.2 Problem Definition and Background

The 1979 *Spokane Aquifer Water Quality Management Plan* (WQMP) recommended establishing a regional ground water monitoring program patterned after the 16-month (May 1977 – August 1978) reconnaissance study conducted for the *Spokane Aquifer Cause and Effect Report*. In the Cause and Effect Report it was shown that the water quality of the Spokane Valley-Rathdrum Prairie (SVRP) Aquifer was being degraded by urbanization within an "Aquifer Sensitive Area." On the basis of that report an Aquifer Protection Plan, the WQMP, was developed to reduce the impacts of urbanization by implementing aquifer protection measures. The monitoring program was recommended as a tool to track the benefits derived from implementing those measures. Figure 1 outlines the Aquifer Sensitive Area defined in the WQMP and Figure 2 locates the monitoring wells used in the 1977-78 monitoring program.

In 1980 the Spokane Regional Health District (Health District) initiated the first of a series of Aquifer wide monitoring programs. This effort involved quarterly sampling of over 70 public water supply wells drawing from the Washington portion of the SVRP Aquifer. Most of the public water supply wells sampled for the Spokane County Water Quality Management Program's reconnaissance monitoring were included in the Health District monitoring. None of the monitoring wells constructed for the 1977 – 78 effort were sampled by the Health District. In November of 1995 Spokane began sampling some of the 2 inch diameter PVC cased monitoring wells installed near or up gradient of public water supply wells as part of data collection for the wellhead protection model created by CH2M Hill. The Health District continued their monitoring program until 2000 when Spokane County renewed monitoring as part of the Regional Wellhead Protection Program.

Over the years the focus of aquifer monitoring has evolved. Originally the program focused on increases in concentrations of contaminants associated with human

development in the aquifer. Nitrate and other contaminants associated with septic tank effluent such as chloride and total dissolved solids were used as indicators of human impact. All of the contaminants mentioned above increased in the aquifer as it flowed east to west beneath the Spokane Valley. Nitrate was the most critical of these because it was found at levels of public health concern. Nitrate is now one of the key analytes of the monitoring program.

As the amount of data collected from specific public supply wells increased, long term trends in contaminant concentrations in some of these wells emerged. The trends were clearest for nitrate and chloride. Chosen as indicators of on-site waste disposal and storm runoff contamination, respectively, these trends confirmed the extent of human impact.

Suitability of the aquifer as a drinking water source has also been a focus of the monitoring effort. All contaminants for which drinking water standards existed in 1977 were examined in the base line study. Many, such as the toxic metals were expected at low concentrations so were tested for in only a small percentage of the samples collected. Since the mid 1990's, when the State's Wellhead Protection Program was implemented, drinking water contaminants became a more important part of the testing package.

More recently, the seasonal low dissolved oxygen concentrations found in Lake Spokane led to establishing a Water Clean Up Plan also know as a Total Maximum Daily Load (TMDL) for point and non-point source pollution discharged to the Spokane River. Using the CE QUAL W2 river quality model the Washington Department of Ecology determined that decomposition of dead algae in the lower levels of Lake Spokane was a major source of oxygen demand. Even low phosphorus discharges to the river stimulated harmful algae growth in the lake according to model runs. Thus, control of both point and non-point sources of phosphorus became important.

B.3 Project Description

For purposes of this Quality Assurance Program Plan the project is defined as Spokane County's program to monitor groundwater from the SVRP Aquifer for establishing ambient water quality conditions. Ambient conditions can be used to describe spatial distribution of contaminants in the aquifer, long – term trends in aquifer water quality and the contaminant loading the aquifer might carry to the Spokane and Little Spokane Rivers.

The present SVRP Aquifer Monitoring Program includes 15 public water supply wells for which extensive historic data are available. Continued testing of these wells allows long-term quality trends to be evaluated. The core of the program is a suite of 28 (26 are routinely sampled) monitoring wells constructed as part of the regions Wellhead Protection Program. Some of these wells were installed up gradient of important public water supply wells and are intended to serve as early warning indicators of potential wellhead contamination. Most of these wells were constructed with screened intervals

situated to allow drawing samples from near the aquifer surface at any point in the water tables normal annual fluctuation.

B.4 Quality Objectives and Criteria

The project quality objective is to collect data that is scientifically valid, of known and documented quality and legally defensible, where appropriate. To ensure that this objective is met data will be reviewed according to Ecology's Credible Data Policy (WQP Policy 1-11).

B.4.1 Data Quality Objectives

Data Quality Objectives (DQOs) are established to ensure confidence in sample collection and analytical results facilitating appropriate detection limits.

Quality assurance objectives are established for this project to control the degree of total error in data results. These objectives are established to achieve an acceptable level of confidence in decisions made from the collected data. The established objectives include the following:

- Implement procedures for field sampling, sample custody, equipment operation and calibration, laboratory sample analysis, data reduction and data reporting that will ensure the consistency and thoroughness of data generation.

- Assess the quality of data generated to ensure that collected data are scientifically valid, of known and documented quality and legally defensible, where appropriate. This will be accomplished by establishing DQOs for parameters such as precision, accuracy, completeness, representativeness, comparability, and by testing generated data against acceptance criteria established for these parameters.

- Ensure that the quality assurance project plan and associated project plans are properly implemented.

- Daily documentation of field conditions, sampling and other activities using appropriate field reports to sufficiently recreate each sampling, analytical, testing, and monitoring event.

B.4.2 Data Quality Indicators

The basis for assessing each of these elements of data quality is discussed in the following subsections. Precision and accuracy QC limits for each analytical method and are identified in Section E1.

B.4.2.1 Precision

Precision measures the reproducibility of measurements. It is strictly defined as the degree of mutual agreement among independent measurements as the result of repeated application of the same process under similar conditions. ***Analytical precision*** is the measurement of the variability associated with duplicate (two) or replicate (more than two) analyses. Laboratory control sample (LCS) determine the precision of the analytical method. If the recoveries of analytes in the LCS are within established control limits, then precision is within limits. In this case, the comparison is not between a sample and a duplicate sample analyzed in the same batch; rather the comparison is between the sample and samples analyzed in previous batches. ***Total precision*** is the measurement of the variability associated with the entire sampling and analysis process. It is determined by analysis of duplicate or replicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate samples and matrix duplicate spiked samples shall be analyzed to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. The formula for the calculation of precision is provided in Table B.4.2-1 as RPD. For replicate analyses, the relative standard deviation (RSD) is determined. The formula for the calculation of RSD is provided in Table B.4.2-1. The required level of precision differs according to the method, and is listed in Section E.

B.4.2.2 Accuracy

Accuracy is a statistical measurement of correctness and includes components of random error (variability due to imprecision) and systemic error. It therefore reflects the total error associated with a measurement. A measurement is accurate when the value reported does not differ from the true value or known concentration of the spike or standard. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into an LCS to a control limit. For volatile and semivolatile organic compounds, surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. Analysis of performance evaluation (PE) samples shall also be used to provide additional information for assessing the accuracy of the analytical data being produced.

The formula for calculation of accuracy is included in Table B.4.2-1 as percent recovery (%R) from pure and sample matrices. Accuracy requirements are listed for each method in Section E.

B.4.2.3 Representativeness

Objectives for ***representativeness*** are defined for each sampling and analysis task and are a function of the investigative objectives. Representativeness shall be achieved through use of the standard field, sampling, and analytical procedures. Representativeness is also determined by appropriate program design, with consideration of elements such as proper well locations, sampling depth, field methods, and sampling frequency. Decisions regarding these elements are documented in Section C.

B.4.2.4 Completeness

Completeness is calculated for the aggregation of data for each analyte measured for any particular sampling event or other defined set of samples. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with an "R" flag (see Section E for an explanation of flagging criteria). The requirement for completeness is 95 percent for aqueous samples. For any instances of samples that could not be analyzed for any reason (holding time violations in which resampling and analysis were not possible, samples spilled or broken, etc.), the numerator of this calculation becomes the number of valid results minus the number of possible results not reported.

The formula for calculation of completeness is presented below:

$$\% \text{ completeness} = \frac{\text{number of valid (i.e., non-R flagged) results}}{\text{number of possible results}}$$

B.4.2.5 Comparability

Comparability is the confidence with which one data set can be compared to another data set. The objective for this QA/QC program is to produce data with the greatest possible degree of comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions and using standard and comprehensive reporting formats. Complete field documentation using standardized data collection forms shall support the assessment of comparability. Analysis of performance evaluation (PE) samples and reports from audits shall also be used to provide additional information for assessing the comparability of analytical data produced among subcontracting laboratories. Historical comparability shall be achieved through consistent use of methods and documentation procedures throughout the project.

Table B.4.2-1 Statistical Calculations

Statistic	Symbol	Formula	Definition	Uses
Mean	$\overline{X}$	$\frac{\left(\sum_{i=1}^{n} x_i\right)}{n}$	Measure of central tendency	Used to determine average value of measurements
Standard Deviation	S	$\left(\frac{\Sigma(x_i-\overline{x})^2}{(n-1)}\right)^{1/2}$	Measure of relative scatter of the data	Used in calculating variation of measurements
Relative Standard Deviation	RSD	$(S/\overline{X}) \times 100$	Relative standard deviation, adjusts for magnitude of observations	Used to assess precision for replicate results
Percent Difference	%D	$\frac{x_1 - x_2}{x_1} \times 100$	Measure of the difference of 2 observations	Used to assess accuracy
Relative Percent Difference	RPD	$\left(\frac{(X_1 - X_2)}{(X_1 + X_2)/2}\right) \times 100$	Measure of variability that adjusts for the magnitude of observations	Used to assess total and analytical precision of duplicate measurements
Percent Recovery	%R	$\left(\frac{X_{meas}}{X_{true}}\right) \times 100$	Recovery of spiked compound in pure matrix	Used to assess accuracy
Percent Recovery	%R	$\frac{\left(\begin{array}{c}\text{value of}\\ \text{spiked}\\ \text{sample}\end{array} - \begin{array}{c}\text{value of}\\ \text{unspiked}\\ \text{sample}\end{array}\right)}{\text{Value of added spike}} \times 100$	Recovery of spiked compound in sample matrix	Used to assess matrix effects and total precision
Correlation Coefficient	r	see SW8000B section 7.5.3		Evaluation of "goodness of fit" of a regression line
Coefficient of Determination	COD	see SW8000B section 7.5.3		Evaluation of "goodness of fit" of a polynomial equation

x = Observation (concentration)
n = Number of observations

B.5 Special Training/Certifications

Samples will be submitted to a Washington Department of Ecology accredited laboratory. A current copy of the laboratory accreditation that states the expiration date and the particular analyses that the laboratory is accredited for will be kept on file.

B.6 Documentation and Records

B.6.1 Field Documentation

Permanently bound field books with waterproof paper will be used. The pages shall be numbered consecutively and shall not be removed for any reason. Entries will be made in waterproof indelible ink.

Logbooks will identify field personnel, site visitors, and document sampling conditions (e.g. the weather). Documentation in the field logbook will be of sufficient detail to explain and reconstruct field activities without relying on recollection by the field team members. Recorded data will be qualified by the calibration results for each field instrument used, the unit of each measurement, and time the data was obtained. Since the logbook is a complete documentation of field procedures, it should contain only facts and observations. Language should be objective, clear, concise, and free of personal interpretation or terminology that might be misconstrued.

No erasures will be performed. If an incorrect entry is made, the information will be crossed out with a single strike mark and the change initialed and dated by the team member making the change. Each page will be dated, legible, and contain accurate and complete documentation of field activities. Field logbooks will be identified by the project name and a project-specific number and stored in the field project files when not in use. After field activities are completed, logbooks will be stored in the permanent project file.

Spokane County staff will document groundwater-sampling activities. In addition to the field logbook, the following field forms shall be utilized for groundwater sampling and disposal activities at this site.

- Monitor Well Purging Form
- Daily Summary Field Sheets

These forms shall include the following information for groundwater sampling: (1) sample type and sampling method; (2) the identity of each sample, (3) well number and/or location; (4) volume and time of each sample collected; (5) sample description (e.g., color, odor, clarity); (6) identification of sampling devices and equipment; and (6) analytical method; (7) preservative; (8) identification of conditions that might affect the representativeness of a sample (e.g., refueling operations, damaged casing); (9) water level measurement; (10) total depth of well; and (11) total volume purged.

Sufficient field records will be maintained to recreate all sampling and measurement activities and to meet all data loading requirements. The requirements listed in this section apply to all measuring and sampling activities; requirements specific to individual activities are listed in the section that addresses each activity. The information will be recorded with indelible ink in a permanently bound logbook with sequentially numbered pages. In addition to the field logbook, the applicable field forms will be used to document the field and sampling activities. Any variances to this QAPP encountered in the field will be documented in the field logbook

B.6.2 Laboratory

The laboratory QA staff shall issue QA reports to the laboratory management, laboratory supervisors and task leaders. These reports shall describe the results of QC measurements, performance audits, systems audits, and confirmation sample comparisons performed for each sampling and analysis task. Quality problems associated with performance of methods, completeness of data, comparability of data (including field and confirmatory data), and data storage, shall be documented with the corrective actions that have been taken to correct the identified deficiencies.

The laboratory shall maintain electronic and hardcopy records sufficient to recreate each analytical event conducted pursuant to the SOW. The minimum records the laboratory shall keep contain the following: (1) COC forms, (2) initial and continuing calibration records, including standards preparation traceable to the original material and lot number, (3) instrument tuning records (as applicable), (3) method blank results, (4) IS results, (5) surrogate spiking records and results (as applicable), (6) spike and spike duplicate records and results, (7) laboratory records, (8) raw data, including instrument printouts, bench work sheets, and/or chromatograms with compound identification and quantitation reports, (9) corrective action reports, (10) other method and project required QC samples and results, and (11) laboratory-specific written SOPs for each analytical method and QA/QC function in place at the time of analysis of project samples.

C DATA GENERATION AND ACQUISITION

C.1 Sampling Process Design

Sampling is conducted quarterly at wells presented in tables C.1-1 and C.1-2. Well locations are shown in figure 2. Static water level, temperature, conductivity, pH, turbidity, and dissolved oxygen data is collected at each well. Samples from each well are submitted for laboratory analysis for analytes presented in table C.1-3.

Field duplicates are collected for each sample delivery group and no less than 1 for every 20 samples. A laboratory supplied field blank will be submitted with each sample delivery group. One equipment blank is collected per sampling event. The equipment blank is deionized water pumped through the sampling pump and tubing.

Table C.1-1 Monitoring Wells

WQMP Well ID	Well Name	Top of Screen	Length of Screen	Well Depth
5304G01	NE Community Center, City monitoring well	182.0	10.0	195.1
5307M01	Trinity School, Adams & Carlisle, City monitoring well	148.3	10.0	161.4
5308H01	Denver & Marietta, City monitoring well	86.0	10.0	99.0
5310Q01	monitoring well at SCC	41.0	55.0	96.0
5311J05	Hale's Ale Nested Site, east	62.8	10.0	75.9
5311J07	Hale's Ale Nested Site, mid	105.1	10.0	118.2
5312C01	Felts Field City monitoring well	68.0	10.0	78.7
5315L01	Olive & Fiske monitoring well	68.0	40.0	106.0
5322A01	Third & Havana Nested Site, east	47.1	10.0	60.2
5322A03	Third & Havana Nested Site, mid	90.0	10.0	103.1
5323E01	6th & Havana monitoring well (MW-2)	40.0	39.0	79.5
5404A01	Plantes Ferry Park monitoring well	109.5	10.0	119.5
5409C02	monitoring well Frederick & Bowdish	80.0	60.0	150.0
5411R02	Sullivan Park North, monitoring well	26.2	40.0	65.0
5411R03	Sullivan Park South, monitoring well	27.3	40.0	66.0
5411R04	Sullivan Road and Centennial Trail, monitoring well	47.8	40.0	85.0
5505D01	Trent & Barker Road, monitoring well	87.0	40.0	123.0
5507A04	Euclid & Barker monitoring well at CID5	69.5	30.0	99.5
5507H01	Barker Road north of river, monitoring well	39.5	40.0	80.0
5508M01	Barker Road Centennial Trail North, monitoring well	64.1	35.0	97.0
5508M02	Barker Road Centennial Trail South, monitoring well	63.3	35.0	96.0
5517D05	Mission & Barker monitoring well at CID 4	85.2	30.0	112.5
6327N04	Fire Station Houston & Regal, No. Spokane WD	185.9	35.0	219.0
6330J01	Holy Cross, Rhoades & Washington monitoring well	207.0	35.0	240.0
6331J01	Franklin Park, City monitoring well	208.5	10.0	221.6
6436N01	East Valley High School monitoring well	104.5	20.0	125.0
6524R01	Idaho Road 1000 ft south of Trent, monitoring well	119.5	45.0	162.5
6525R01	Idaho Road 300 ft south of pipeline, monitoring well	97.0	45.0	140.0
6631M07	Idaho Road - East Farms monitoring well at CID11	112.0	35.0	147.0

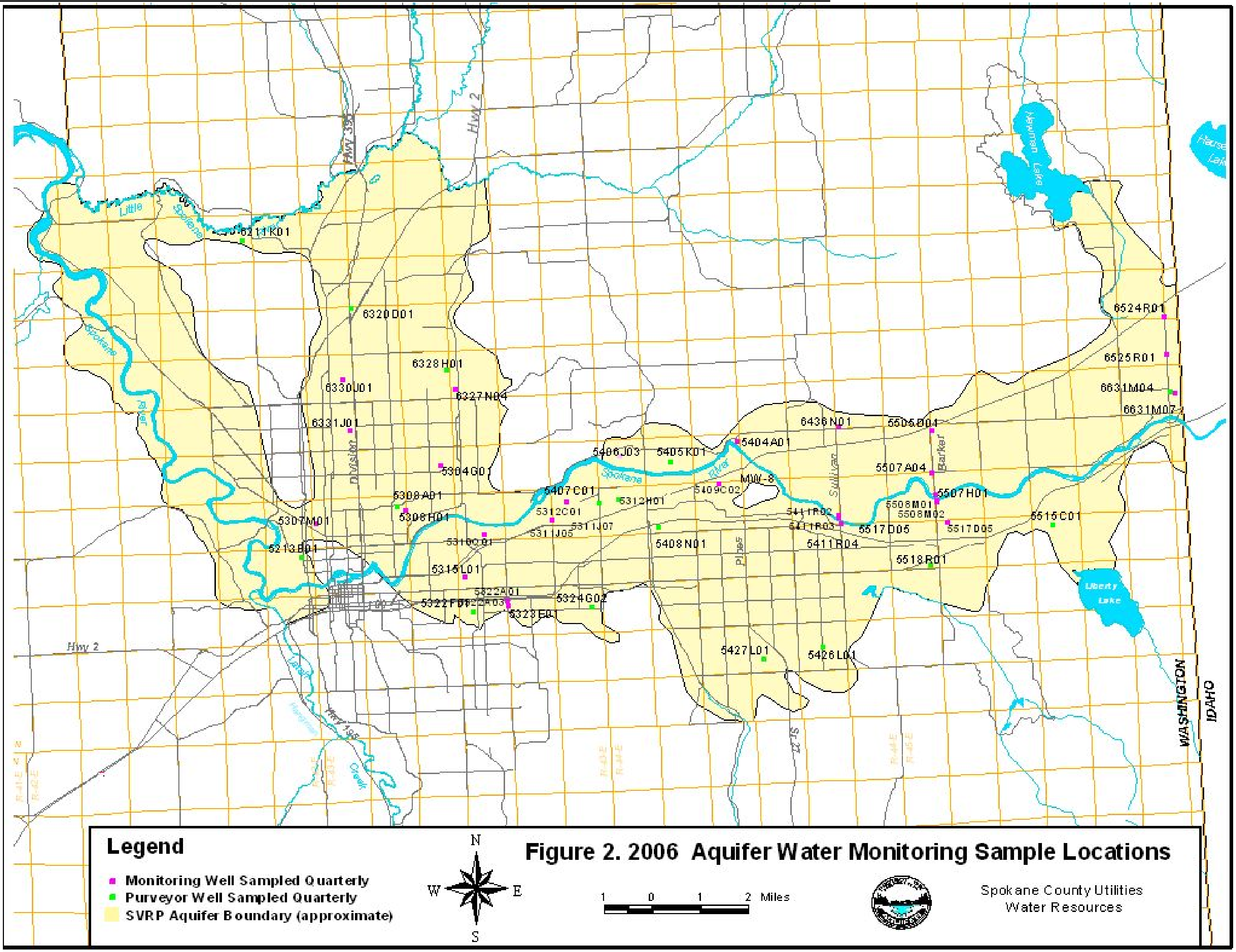


Figure 2. 2006 Aquifer Water Monitoring Sample Locations

Table C.1-2 Public Supply Wells

WQMP Well ID	Well Name	Well Depth	Top of Screen	Length of Screen
5213B01	I.E. Cold Storage	208.00		
5308A02	City Of Spokane-Nevada	126.00		
5312H01	Orchard Ave Irrig Dist, Site 1	96.00	55.00	41.00
5322F01	City Of Spokane-Ray	77.00	54.00	23.00
5324G01	E. Spokane Water Dist, Site 1	147.00		
5405K01	Pasadena Park #2	235.00	105.00	129.00
5407C01	Orchard Ave Irrig Dist, Site 2 Buckeye & Dick	106.00	74.00	27.00
5408N01	Modern Elect Water, Site 6	135.00		
5415E03	Modern Elect Water, Site 11	280.00	0.00	0.00
5426L01	Vera Water & Power, Well 4	163.00	130.00	
5427L01	Spokane Co Water Dist #3, Site 2-5, 26th & Vercler	180.00	140.00	40.00
5515C01	Mission Well, Liberty Lake Sewer Dist	198.00	173.00	25.00
5518R01	Consolidated Irrig Dist 19, Site 2A	190.00	135.00	50.00
6211K01	Spokane Fish Hatchery well	55.00	50.00	5.00
6320D01	Whitworth Water Dist. #2, Well 2a	286.00	253.00	33.00
6328H01	North Spokane Irrig. Dist. # 4, Site 4	274.00	239.00	35.00
6631M04	Consolidated Irrig Dist 19, Site 11b	225.00	181.00	35.00

Table C.1-3 Analytes

Analyte	Method	Reporting limit
Arsenic	200.8	0.00100 mg/L
Cadmium	200.8	0.00100 mg/L
Calcium	200.7	0.0400 mg/L
Chloride	300.0	0.500 mg/L
Chromium	200.8	0.00100 mg/L
Copper	200.8	0.00100 mg/L
Fluoride	340.2	0.100 mg/L
Iron	200.7	0.0200 mg/L
Lead	200.8	0.00100 mg/L
Magnesium	200.7	0.100 mg/L
Manganese	200.8	0.0100 mg/L
Mercury	245.1	0.00100 mg/L
Ortho-phosphate-phosphorous	365.2	0.00200 mg/L
Potassium	200.7	0.500 mg/L
Sodium	200.7	0.500 mg/L
Sulfate	300.0	0.500 mg/L
Total Dissolved Solids	160.1	2 mg/L
Total Nitrate + Nitrite	353.2	0.010 mg/L as N
Total phosphorus	365.2	0.0600 mg/L
Zinc	200.8	0.0100 mg/L
Carbonate Alkalinity (CO_3-)	SM 2320	2.00 mg/L
Bicarbonate Alkalinity (HCO_3)	SM 2320	2.00 mg/L

C.2 Sampling Methods

C.2.1 Sampling Equipment

The following equipment is required for groundwater sampling.

- Key to well locks
- Tool Box (screwdrivers, ½-inch Allen wrench, 9/16 ratchet, hammer)
- Plastic Sheeting
- Tubing
- Nitril and/or latex gloves
- Water level indicator
- Calibrated Water Quality Meter - pH, conductivity, temperature, turbidity and dissolved oxygen
- Stop watch
- Graduated cylinder
- Turkey Baster (used to remove standing water from well monument)
- Sample bottles and materials (labels, preservative, plastic baggies, coolers, ice)
- Decontamination equipment (potable water, deionized water, tubs, brushes, detergent)
- Logbook, sampling forms, COCs, pens, sharpies, calculator
- Cell Phone

C.2.2 Groundwater Level Measurement

Prior to each time a well is sampled, and prior to installing other equipment into the well casing, water level measurements shall be performed to determine the water table or piezometric surface elevation. Any conditions (e.g., precipitation) that may affect water levels shall be recorded in the field log.

The groundwater level shall be measured to the nearest 0.0l foot using an electric water-level indicator. Two or more sequential measurements shall be taken at each well until measurements agree to within + or – 0.01 foot. The probe and attached tape will be rinsed with distilled water before use in each well. The water-level indicator will be constructed of chemically inert materials to prevent equipment damage and cross-contamination between wells. Water levels shall be measured from the notch located at the top of the well casing and recorded on the well sampling form.
All water level and total depth measuring devices shall be routinely checked with a steel tape measure to ensure accurate measurements.

C.2.3 Low-Flow Purging Procedure

The following information shall be recorded each time a well is purged prior to sampling.

- Weather conditions (precipitation, wind and temperature)
- Condition of each well;
- Depth to water before and after purging;
- Flow rate, total volume purged and well bore volume calculation; and
- Field parameters, such as pH, temperature, specific conductance, dissolved oxygen and turbidity collected while purging.

A low-flow, minimal draw down technique will be used for monitoring well purging and sampling. This procedure induces laminar (non-turbulent) flow and is designed to ensure that samples collected from the wells are representative of ground water. The low-flow rates minimize disturbance in the screened aquifer, resulting in: (1) minimal production of artificial turbidity and oxidation; (2) minimal mixing of chemically distinct zones; (3) minimal loss of volatile organic compounds; and (4) collection of representative samples while minimizing purge volume (Puls & Barcelona, 1996).

Low-flow purging typically consists of pumping water from the sampled well at a flow rate of approximately 0.1 to 0.5 L/min. However, the flow rate is dependent upon site-specific conditions. Some extremely coarse-textured formations have been successfully sampled in this manner at flow rates to 1 L/min.

Following water-level measurement (Section C.2.2), the intake will be positioned just below the top of screen. Care will be taken to gently insert the pump to minimize disturbance of any sediment that may have accumulated in the well. Equipment shall not be allowed to free-fall into a well.

Purging will proceed by pumping groundwater from the well at a rate of approximately 0.1 to 0.5 L/min. The flow rate will be measured by filling a 1-liter graduated cylinder and measuring the flow rate using a stopwatch. During purging, the water level in the well will be monitored at least every three to five minutes to ensure that the water level is not receding and allowing water to cascade down the sides of the well screen. Cascading can aerate the groundwater, possibly affecting its chemical characteristics.

During purging, specific conductance, temperature, pH, dissolved oxygen and turbidity of the produced water will be measured every three to five minutes using a multi-parameter water quality meter and flow-through cell. The water-quality meter will be calibrated at the start of each field day, prior to sampling, according to the manufacturer's instructions. All water-quality measurements made during purging will be recorded on a groundwater sampling form. When water-quality readings have stabilized over three measurements, purging may cease and samples may be collected. Stabilization is reached when three successive readings are within ±0.1 for pH, ±3 percent for conductivity and ± 10 percent for dissolved oxygen and turbidity (Puls & Barcelona, 1996). If one or more of the readings have not stabilized within one hour, samples will be collected and the unstable readings will be noted on the sampling form.

C.2.4 Alternative Well Sampling Procedures

An alternative to low-flow purging is to remove at least three well volumes from the well before it is sampled. Groundwater elevation measurement procedures are provided in Section C.2.1. One well volume can be calculated using the following equation (reference: Ohio EPA Technical Guidance Groundwater Investigations, February 2006):

$$V = H \times F$$

where V = one well volume
H = the difference between the depth of well and depth to water (ft)
F = factor for volume of one foot section of casing (gallons) from below.

Volume of Water In One-Foot Section of Well Casing

Diameter of Casing (inches)	F Factor (gallons)
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

F can also be calculated from the formula:

$$F = \Pi (D/2)^2 \times 7.48 \text{ gal/ft}^3$$

where D = the inside diameter of the well casing (inches) and Π is approximated by 3.14.

Wells with yields too low to produce three well volumes before the well goes dry shall be purged to dryness and sampled following water level recovery. This condition shall be noted in the field logbook and well sampling forms.

Purge water temperature, pH, specific conductance, DO and turbidity shall be measured and recorded on the well sampling form after removing each well volume during purging.

C.2.5 Public Water Supply Well Sampling Procedures

1. Purge and collect samples from a sample tap or faucet near the pump and ahead of treatment, storage or pressure systems.
2. Make sure the pump is activated, that water is flowing from the tap for at least five minutes and that the water is a consistent temperature before sample collection.

C.3 Decontamination Procedures

The pump and water level meter will be rinsed with deionized water prior to lowering the equipment into the well. As the pump is lowered into the well the tubing and electric cable will be inspected and wiped down if necessary to ensure no foreign material is introduced into the well.

Due to time and financial constraints it is not feasible to use dedicated sample tubing at each well. Utilizing a detergent to wash the tubing is not advisable because the analytes of interest include phosphorus and do not include any hydrocarbons. Spokane County Water Resources staff conducted field testing with deionized water that demonstrated rinsing 3 times the total volume of the sample tubing is sufficient to remove any residual left in the sample tubing from sampling the previous well and provides adequate decontamination to produce representative results as described in Section C.1

C.4 Sample Handling and Custody

C.4.1 Sample Containers

Sample containers are purchased pre-cleaned and treated according to EPA specifications for the methods. All samples will be collected into glass or plastic containers supplied by the contract analytical laboratory. Containers are stored in clean areas to prevent exposure to contaminants.

C.4.2 Sample Volumes, Container Types, and Preservation Requirements

Required sample volumes, container types, and preservation requirements for the analytical methods performed are listed in Table C.4.2-1.

Table C.4.2-1: Requirements for Containers, Preservation Techniques, Sample Volumes, and Holding Times

Analysis	Specific Method	Container	Preservation	Hold (days)	Sample Volume
Total Metals by EPA 200 Series Methods in Water					
1st-Ca Total ICP	EPA 200.7	500ml poly	Add HNO3 to pH<2	180	500 mls
1st-Fe Total ICP	EPA 200.7	500ml poly	Add HNO3 to pH<2	180	500 mls
1st-K Total ICP	EPA 200.7	500ml poly	Add HNO3 to pH<2	180	500 mls
1st-Mg Total ICP	EPA 200.7	500ml poly	Add HNO3 to pH<2	180	500 mls
1st-Na Total ICP	EPA 200.7	500ml poly	Add HNO3 to pH<2	180	500 mls
1st-Hg Total CVAA	EPA 245.1	500ml poly	Add HNO3 to pH<2	28	500 mls
Total Metals by EPA 200.8 in Water					
As Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Pb Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Cd Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Cr Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Cu Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Zn Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Mn Total ICP/MS	EPA 200.8 ICP/MS	500ml poly	Add HNO3 to pH<2	180	500 mls
Conventional Chemistry Parameters by APHA/EPA Methods in Water					
1st-Solids, TDS 160.1	EPA 160.1	500ml poly	Store cool at 4°C	7	250 mls
NO2-NO3 353.2	EPA 353.2	500ml poly	Add H2SO4 to pH<2	28	250 mls
Orthophosphate-365.2	EPA 365.1	500ml poly	Store cool at 4°C	2	250 mls
1st-P Total SPECT 365.2	EPA 365.2	500ml poly	Add H2SO4 to pH<2	28	250 mls
Anions by EPA Method 300.0 in Water					
1st-Chloride 300.0	EPA 300.0	500ml poly	Store cool at 4°C	28	250 mls
1st-Sulfate 300.0	EPA 300.0	500ml poly	Store cool at 4°C	28	250 mls
Fluoride by EPA Method 340.2 in Water					
1st-Fluoride 340.2	EPA 340.2	500ml poly	Store cool at 4°C	28	250 mls
Physical Parameters by APHA/ASTM/EPA Methods in Water					
1st-HCO3 & CO3	SM 2320	500ml poly	Store cool at 4°C	28	250 mls

Minimum amount needed to run all of the above analyses is as follows:
1-500ml HNO3 preserved poly
1-500ml H2SOr preserved poly
1-500ml unpreserved poly

C.4.3 SAMPLE HANDLING AND CUSTODY

Procedures to ensure the custody and integrity of the samples begin at the time of sampling and continue through transport, sample receipt, preparation, analysis and storage, data generation and reporting, and sample disposal. Records concerning the custody and condition of the samples are maintained in field and laboratory records.

Spokane County shall maintain chain-of-custody records for all field and field Quality Control (QC) samples. A sample is defined as being under a person's custody if any of the following conditions exist: (1) it is in their possession, (2) it is in their view, after being in their possession, (3) it was in their possession and was subsequently locked or, (4) it is in a designated secure area.

The following information concerning the sample shall be documented on the contract laboratory chain of custody (COC) form:

- Spokane County sample identification
- Date and time of sample collection
- Source of sample (including name, location, and sample type)
- Designation of MS/MSD
- Preservative used
- Analyses required
- Name of collector(s)
- Custody transfer signatures and dates and times of sample transfer from the field to transporters and to the laboratory or laboratories

All samples shall be uniquely identified, labeled, and documented in the field at the time of collection. Samples collected in the field shall be transported to the laboratory or field-testing site as expeditiously as possible. When a 4°C requirement for preserving the sample is indicated, the samples shall be packed in ice or chemical refrigerant to keep them cool during collection and transportation. If a sample group is not delivered to the lab on the day the samples are collected a temperature blank (a volatile organics compounds sampling vial filled with tap water) shall be included in every cooler and used to determine the internal temperature of the cooler upon receipt of the cooler at the laboratory. If the temperature of the samples upon receipt exceeds the temperature requirements, the exceedance shall be documented in laboratory records and communicated to Spokane County personnel. The decision regarding the potentially affected samples shall also be documented.

Immediately following the arrival at the laboratory, the samples shall be checked against information on the COC form for anomalies. The condition, temperature, and appropriate preservation of samples shall be checked and documented on the COC form. The occurrence of any anomalies in the received samples and their resolution shall be documented in laboratory records. All sample information shall be entered into a tracking system, and unique analytical sample identifiers shall be assigned. The laboratory shall review a copy of this information for accuracy. Sample holding time tracking begins with the collection of samples and continues until the analysis is complete. Holding times for methods required are specified in Table C.4.2-1.

The laboratory shall maintain standard operating procedures (SOPs) describing sample control and custody.

C.5 Analytical Methods

C.5.1 EPA Method 160.1

Method Number	160.1
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Issued 1971
Method Name	**Descriptive Name:** Filterable Residue by Drying Oven **Official Name:** Residue, Filterable (Gravimetric, Dried at 180 °C)
Media	WATER

Subcategory	Inorganic
Citation	Methods for the Chemical Analysis of Water and Wastes (MCAWW) (EPA/600/4-79/020)
Brief Method Summary	A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is evaporated and dried to constant weight at 180°C
Scope And Application	This method determines filterable residue in drinking, surface, and saline waters; domestic and industrial wastes.
Applicable Conc Range	10 - 20,000 mg/L
Interferences	(A) Mineral Waters: Highly mineralized waters containing significant concentrations of calcium, magnesium, chloride and/or sulfate may be hygroscopic and will require prolonged drying, desiccation and rapid weighing. (B) Bicarbonate: Samples containing high concentrations of bicarbonate will require careful and possibly prolonged drying at 180°C to insure that all the bicarbonate is converted to carbonate. (C) High Residue Levels: Too much residue in the evaporating dish will crust over and entrap water that will not be driven off during drying. Total residue should be limited to about 200 mg.
QC Requirements	None.
Sample Handling	Preservation of the sample is not practical; analysis should begin as soon as possible. Refrigeration to 4°C is recommended to reduce microbiological decomposition of solids.
Max Holding Time	7 days (MCAWW, Table 1).
Source	EPA-NERL

Analyte	**Detection Level**	**Bias**	**Precision**	**Spiking Level**
Total Dissolved Solids (E-10173)	10 mg/L	101.4 % Rec (ML)	10.1 % RSD (ML)	NA
Precision Descriptor Notes	Precision and accuracy values not available.			

C.5.2 EPA Method 200.7

Method Number	200.7
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Revision 4.4, 1994
Method Name	**Descriptive Name:** Metals in Water by ICP-AES **Official Name:** Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Determination of Metals in Environmental Samples, Supplement 1 (EPA/600/R-94/111)
Brief Method Summary	Except for the determination of dissolved analytes, aqueous samples are acid preserved prior to sample processing. For the analysis of dissolved analytes, an acidified portion of the filtrate is analyzed directly. For the determination of total recoverable analytes in aqueous samples containing particulate material as well as solid wastes, samples are subjected to acid pretreatment with nitric and hydrochloric acids and gentle refluxing prior to analysis. The method involves multi-element determination using sequential or simultaneous instruments. The instruments measure characteristic atomic-line emission spectra by optical spectrometry. Sample solutions are nebulized and the resulting aerosol is transported to the plasma torch. Element specific emission spectra are produced by a radio-frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer and the intensities of the lines are monitored at specific wavelengths by a photosensitive device. Photocurrents from the photosensitive device are processed and controlled by a computer system. A background correction technique is required to compensate for variable background contribution to the determination of the analytes. Background must be measured adjacent to analyte lines on samples during analysis. Various interferences are discussed and must be considered and addressed appropriately.
Scope And Application	This method determines 31 analytes, in the dissolved fraction of aqueous samples and for the measurement of total-recoverable analytes in water, wastewater, and solid wastes. Total-recoverable determination data for aqueous samples should be

	reported as total (dissolved + suspended fractions) metal data.
Applicable Conc Range	Unless otherwise noted, the analytical range extends from the laboratory-determined MDL to the upper limit of the linear dynamic range.
Interferences	I. SPECTRAL INTERFERENCES: (1) Background emmission or stray light. (2) Spectral overlap of emissions. II. PHYSICAL INTERFERENCES: High viscosity or high particulate levels of sample can clog nebulizer. III. CHEMICAL INTERFERENCES: (1) Compound formation. (2) Ionization. (3) Solute-vaporization. IV. MEMORY INTERFERENCES: Carry-over from sample.
QC Requirements	The minimum QC requirements consist of an initial demonstration of laboratory capability and on-going checks. The initial demonstration includes determining the linear dynamic range (LDR) for each wavelength utilized, determining the method detection limit (MDL) for each analyte, and analyzing a quality control sample (QCS). On-going checks include periodic analysis of laboratory reagent blanks (LRB), laboratory fortified blanks (LFB), instrument performance check solutions (IPC), calibration blanks (CB), spectral interference check solutions (SIC), and laboratory fortified matrices (LFM).
Sample Handling	For dissolved elements, filter aqueous sample through a 0.45-um pore membrane filter. Adjust the pH of the filtrate to < 2 with (1+1) HNO_3. For total recoverable elements, adjust the pH of the sample to < 2 with (1+1)HNO_3. When determining boron and silica in aqueous samples, only plastic, polytetrafluoroethylene (PTFE) or quartz labware is used from time of sample collection to completion of analysis. If acid preservation in the field is not feasabile, preservation may take place at the laboratory if the sample is received by the laboratory within two weeks and is acidified at pH < 2 for 16 hours.
Max Holding Time	6 Months
Source	EPA-NERL

Analyte	**Detection Level**	**Bias**	**Precision**	**Spiking Level**
Potassium (7440-09-7)	.3 mg/L	57 % Rec (ML)	67 % RSD (ML)	.5 mg/L
Cerium (7440-45-1)	20 ug/L	N/A	N/A	
Mercury (7439-97-6)	7 ug/L	N/A	N/A	
Lithium (7439-93-2)	1 ug/L	N/A	N/A	
Phosphorus (7723-14-0)	60 ug/L	N/A	N/A	
Tin (7440-31-5)	7 ug/L	N/A	N/A	
Strontium (7440-24-6)	.3 ug/L	N/A	N/A	
Beryllium (7440-41-7)	.3 ug/L	91 % Rec (ML)	23 % RSD (ML)	5 ug/L
Lead (7439-92-1)	10 ug/L	109 % Rec (ML)	16 % RSD (ML)	50 ug/L
Silver (7440-22-4)	2 ug/L	48 % Rec (ML)	47 % RSD (ML)	100 ug/L
Sodium (7440-23-5)	30 ug/L	119 % Rec (ML)	26 % RSD (ML)	200 ug/L
Barium (7440-39-3)	1 ug/L	92 % Rec (ML)	27 % RSD (ML)	20 ug/L
Arsenic (7440-38-2)	8 ug/L	106 % Rec (ML)	19 % RSD (ML)	100 ug/L
Aluminum (7429-90-5)	20 ug/L	105 % Rec (ML)	24 % RSD (ML)	200 ug/L
Boron (7440-42-8)	3 ug/L	115 % Rec (ML)	27 % RSD (ML)	100 ug/L
Cadmium (7440-43-9)	1 ug/L	98 % Rec (ML)	12 % RSD (ML)	20 ug/L
Calcium (7440-70-2)	10 ug/L	98 % Rec (ML)	23 % RSD (ML)	50 ug/L
Manganese (7439-96-5)	1 ug/L	98 % Rec (ML)	13 % RSD (ML)	10 ug/L
Chromium	4 ug/L	94 % Rec (ML)	22 % RSD (ML)	20 ug/L

(7440-47-3)				
Copper (7440-50-8)	3 ug/L	60 % Rec (ML)	43 % RSD (ML)	10 ug/L
Cobalt (7440-48-4)	2 ug/L	85 % Rec (ML)	20 % RSD (ML)	20 ug/L
Magnesium (7439-95-4)	20 ug/L	103 % Rec (ML)	31 % RSD (ML)	50 ug/L
Molybdenum (7439-98-7)	4 ug/L	86 % Rec (ML)	30 % RSD (ML)	20 ug/L
Iron (7439-89-6)	30 ug/L	110 % Rec (ML)	34 % RSD (ML)	50 ug/L
Nickel (7440-02-0)	5 ug/L	106 % Rec (ML)	31 % RSD (ML)	20 ug/L
Zinc (7440-66-6)	2 ug/L	99 % Rec (ML)	19 % RSD (ML)	50 ug/L
Vanadium (7440-62-2)	3 ug/L	98 % Rec (ML)	17 % RSD (ML)	20 ug/L
Thallium (7440-28-0)	1 ug/L	96 % Rec (ML)	25 % RSD (ML)	200 ug/L
Silica (7631-86-9)	20 ug/L	67 % Rec (ML)	67 % RSD (ML)	200 ug/L
Selenium (7782-49-2)	20 ug/L	96 % Rec (ML)	23 % RSD (ML)	100 ug/L
Antimony (7440-36-0)	8 ug/L	90 % Rec (ML)	19 % RSD (ML)	100 ug/L

C.5.3 EPA Method 200.8

Method Number	200.8
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Revision 5.4, 1994
Method Name	**Descriptive Name:** Metals in Waters by ICP/MS **Official Name:** Determination of Trace Elements in Waters by Inductively Coupled Plasma - Mass Spectrometry
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Determination of Metals in Environmental Samples, Supplement 1 (EPA/600/R-94/111)
Brief Method Summary	Except for the determination of dissolved analytes aqueous samples are acid preserved prior to sample processing. For the analysis of dissolved analytes, an acidified portion the filtrate is analyzed directly. For the determination of total-recoverable analytes in aqueous samples containing particulate material as well as solid type samples, samples are subjected to acid pretreatment with nitric and hydrochloric acids and gentle refluxing prior to analysis. The method involves multi-element determination by inductively coupled plasma-mass spectrometry. Sample solutions are pneumatically nebulized into a radio-frequency plasma where ionization occurs. The ions are extracted from the plasma through a differentially pumped vacuum interface and separated on the basis of their mass-to-charge ratio by a quadruple mass spectrometer. Separated ions are detected by an electron multiplier or Faraday detector and the ion information processed by a data handling system. Isobaric and polyatomic interferences relating to the technique must be recognized and corrected. Instrument drift and matrix effects must be corrected with the use of internal standards.
Scope And Application	This method determines 21 elements as dissolved elements in ground waters, surface waters, and drinking water, and total recoverable elements in these waters as well as wastewaters, sludges, and soils samples. Total-recoverable determination data should be reported as "total" (dissolved + suspended fractions) metal data.
Applicable Conc Range	The analytical range depends on the type of detector utilized (electron multiplier or Faraday cup) and extends from the laboratory determined MDL to the upper limit of the linear dynamic range.
Interferences	(1) Isobaric elemental interferences caused by isotopes of different elements which form singly or doubly charged ions of the same nominal mass-to-charge ratio and cannot be resolved by the mass spectrometer in use. (2) Signals from relatively abundant isotopes can coalesce at the wings of relatively less abundant isotopes leading to loss of resolution and poorer quantitation.

	(3) Isobaric polyatomic ion interferences are caused by ions consisting of more than one atom with the same nominal charge-to-mass ratio of the isotope of interest. (4) Physical interferences that hinder transport of the sample into the plasma (e.g., viscosity effects, high levels of solids). (5) Memory interferences (carry-over) of isotopes from previous sample runs.
QC Requirements	Calibration Blanks (CBs), Laboratory Reagent Blanks (LRBs), Laboratory Duplicates (LDs), Laboratory Fortified Sample Matrix (LFM), Quality Control Samples (QCSs)
Sample Handling	For dissolved elements, filter aqueous sample through a 0.45-um pore membrane filter. Adjust the pH of the filtrate to < 2 with HNO_3. For total recoverable elements, adjust the pH of the aqueous sample to < 2 with HNO_3.
Max Holding Time	6 months (All metals except Hg - 28 days)
Source	EPA-NERL

Analyte	Detection Level	Bias	Precision	Spiking Level
Mercury (7439-97-6)	.2 ug/L	86 % Rec (SL)	13 % RSD (SL)	1 ug/L
Beryllium (7440-41-7)	.3 ug/L	118.2 % Rec (ML)	7.9 % RSD (ML)	2.8 ug/L
Lead (7439-92-1)	.6 ug/L	100 % Rec (ML)	40.5 % RSD (ML)	4 ug/L
Arsenic (7440-38-2)	1.4 ug/L	108 % Rec (ML)	35 % RSD (ML)	8 ug/L
Barium (7440-39-3)	.8 ug/L	94.6 % Rec (ML)	6.3 % RSD (ML)	8.01 ug/L
Aluminum (7429-90-5)	1 ug/L	125.1 % Rec (ML)	17.4 % RSD (ML)	8 ug/L
Silver (7440-22-4)	.1 ug/L	116.25 % Rec (ML)	15.1 % RSD (ML)	.8 ug/L
Cadmium (7440-43-9)	.5 ug/L	100 % Rec (ML)	5 % RSD (ML)	4 ug/L
Manganese (7439-96-5)	.1 ug/L	107.5 % Rec (ML)	10.5 % RSD (ML)	.8 ug/L
Chromium (7440-47-3)	.9 ug/L	103.3 % Rec (ML)	18.6 % RSD (ML)	8 ug/L
Copper (7440-50-8)	.5 ug/L	97 % Rec (ML)	15.2 % RSD (ML)	4 ug/L
Cobalt (7440-48-4)	.09 ug/L	110 % Rec (ML)	5.7 % RSD (ML)	.8 ug/L
Molybdenum (7439-98-7)	.3 ug/L	93.9 % Rec (ML)	6.1 % RSD (ML)	2.8 ug/L
Nickel (7440-02-0)	.5 ug/L	101 % Rec (ML)	12.5 % RSD (ML)	4 ug/L
Vanadium (7440-62-2)	2.5 ug/L	96.9 % Rec (ML)	6.8 % RSD (ML)	32 ug/L
Zinc (7440-66-6)	1.8 ug/L	104 % Rec (ML)	22.25 % RSD (ML)	8 ug/L
Thorium-232 (7440-29-1)	.1 ug/L	116.25 % Rec (ML)	9.7 % RSD (ML)	.8 ug/L
Thallium (7440-28-0)	.3 ug/L	103.2 % Rec (ML)	7.6 % RSD (ML)	2.8 ug/L
Selenium (7782-49-2)	7.9 ug/L	104.8 % Rec (ML)	4.7 % RSD (ML)	32 ug/L
Uranium-238 (7440-61-1)	.1 ug/L	107.5 % Rec (ML)	10 % RSD (ML)	.8 ug/L
Antimony (7440-36-0)	.4 ug/L	98.2 % Rec (ML)	9.8 % RSD (ML)	2.8 ug/L

C.5.4 EPA Method 245.1

Method Number	245.1
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Revision 3.0, 1994
Method Name	**Descriptive Name:** Mercury by CVAA

	Official Name: Mercury (Manual Cold Vapor Technique)
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Determination of Metals in Environmental Samples, Supplement 1 (EPA/600/R-94/111)
Brief Method Summary	A sample is digested in a glass bottle for 2 hours with a persulfate/permanganate solution under heating. After digestion, the mercury in the sample is reduced to its elemental form with stannous chloride. The concentration of mercury in the sample is determined using a cold vapor atomic absorption (CVAA) spectrometer system.
Scope And Application	This method allows for determination of total mercury in drinking, surface, ground, sea, and brackish waters, and industrial and domestic wastewaters.
Applicable Conc Range	above 0.2 ug/L
Interferences	(A) Ions and metals: Sulfide, chloride, copper, and tellurium are reported interferences. (B) Volatile materials: Chlorine and other volatile compounds which absorb in the range of mercury should be purged from the head space of the digestion vessel before the addition of stannous chloride.
QC Requirements	Quality control requirements include an initial demonstration of laboratory capability through analysis of laboratory reagent blanks (LRB), fortified blanks (LFB), quality control samples (QCS), and an MDL study. Ongoing quality control checks include analysis of laboratory fortified matrices (LFM), (laboratory reagent blanks) LRB, and instrument performance check (IPC) samples.
Sample Handling	For total mercury, preserve samples with (1+1) nitric acid, and hold for 16 hours at a pH < 2 prior to analysis. Samples may be preserved in the field or upon receipt at the laboratory (the latter may minimize the chance of contamination). Use extreme care to minimize sample contamination by checking equipment, and avoiding exposure of the sample to airborne mercury in the laboratory.
Max Holding Time	28 days.
Source	EPA-NERL

Analyte	**Detection Level**	**Bias**	**Precision**	**Spiking Level**
Mercury (7439-97-6)	.2 ug/L	166 % Rec (ML)	89 % RSD (ML)	.21 ug/L

C.5.5 EPA Method 300.0

Method Number	300.0
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Revision 2.1, August 1993
Method Name	**Descriptive Name:** Inorganic Anions by Ion Chromatography **Official Name:** Determination of Inorganic Anions by Ion Chromatography
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/100)
Brief Method Summary	A small volume of sample, typically 50-100 uL, is introduced into an ion chromatograph. The anions of interest are separated and measured, using a system comprised of a guard column, separator column, suppressor device, and conductivity detector.
Scope And Application	Part A of the test method covers the determination of common inorganic anions in drinking water, surface water, mixed domestic and industrial wastewaters, groundwater, reagent waters, solids (after extraction), leachates (when no acetic acid is used). Part B of the test method covers the determination of bromate, chlorate, and chlorite in drinking and reagent waters.
Applicable Conc Range	DL - * (* Upper detection limit is defined as the highest calibration point, as determined by analyst.)
Interferences	(1) Coeluting species (e.g., low-molecular-weight organic acids). (2) High concentration of anions can effect resolution of peaks and elution times. (3) Fluoride is especially sensitive to coeluting species, and "water dip" (corresponding to the

	elution of water) at low concentrations.
QC Requirements	Calibration Blank (CB), Quality Control Sample (QCS), Performance Evaluation Sample (PE), Instrument Performance Check Solution (IPC), Laboratory Duplicate (LD), Field Duplicate (FD), Laboratory Fortified Matrix (LFM), Laboratory Fortified Blank (LFB), Laboratory Reagent Blank (LRB), Linear Calibration Range (LCR)
Sample Handling	Collect enough volume to ensure a representative sample and to allow for replicates. Either glass or plastic bottles may be used. For Part A Analytes: No preservation is required for bromide, chloride, or fluoride. Refrigerate samples at 4 degrees C for nitrate-N, nitrite-N, orthophosphate-P, and sulfate. Samples being tested for nitrate/nitrite should be adjusted to pH < 2 with concentrated H_2SO4 and refrigerated at 4 degrees C until analysis. Analyze samples being tested for bromide, chloride, fluoride, nitrate/nitrite, and sulfate within 28 days. Analyze samples being tested for nitrate-N, nitrite-N, and orthophosphate-P within 48 hours. For Part B Analytes: Samples analyzed for bromate and chlorate may be held for 28 days without preservation. Chlorite should be analyzed for immediately (within 10 minutes). However, if the sample cannot be analyzed immediately, it may be preserved for up to 14 days if treated with ethylenediamine (ClO_2 should be removed prior to this step) and chilled to 4°C.
Max Holding Time	Part A: 48 Hours (NO_2-N, NO_3-N, orthophosphate-P) 28 days (others) Part B: Bromate and Chlorate (28 days) and chlorite (14 days with preservation -- otherwise analyze immediately).
Source	EPA-NERL

Analyte	Detection Level	Bias	Precision	Spiking Level
Bromate (15541-45-4)	.02 mg/L	N/A	N/A	
Chlorate (14866-68-3)	.003 mg/L	110 % Rec (SL)	10 % RSD (SL)	.1 mg/L
Chlorite (14998-27-7)	.01 mg/L	94 % Rec (SL)	20 % RSD (SL)	.05 mg/L
Bromide (24959-67-9)	.01 mg/L	99 % Rec (SL)	2 % RSD (SL)	5 mg/L
Chloride (16887-00-6)	.02 mg/L	96 % Rec (SL)	2 % RSD (SL)	20 mg/L
Fluoride (16984-48-8)	.01 mg/L	91 % Rec (SL)	3 % RSD (SL)	2 mg/L
Nitrite (14797-65-0)	.004 mg/L	97 % Rec (SL)	1.5 % RSD (SL)	10 mg/L
Nitrate (14797-55-8)	.002 mg/L	103 % Rec (SL)	2 % RSD (SL)	10 mg/L
Phosphate (14265-44-2)	.003 mg/L	99 % Rec (SL)	1.7 % RSD (SL)	10 mg/L
Sulfate (14808-79-8)	.02 mg/L	99 % Rec (SL)	2 % RSD (SL)	20 mg/L

C.5.6 EPA Method 340.2

Method Number	340.2
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Issued 1971; Editorial Revision 1974
Method Name	**Descriptive Name:** Fluoride by ISE **Official Name:** Fluoride (Potentiometric, Ion Selective Electrode)
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Chemical Analysis of Water and Wastes (MCAWW) (EPA/600/4-79/020)
Brief Method Summary	Fluoride is determined potentiometrically using a fluoride electrode in conjunction with a standard single junction sleeve-type reference electrode and a pH meter having an expanded millivolt scale or a selective ion meter having a direct concentration scale for fluoride.

Scope And Application	This method determines fluoride in drinking, surface, and salin waters; domestic and industrial wastes.
Applicable Conc Range	0.1 - 1,000 mg/L
Interferences	(A) Extreme pH: Extreme pH interferes. pH should be between 5-9. Polyvalent cations: Polyvalent cations of Si^{4+}, Fe^{3+}, and Al^{3+} interfere by forming complexes with fluoride. A pH 5.0 buffer with a strong chelating agent eliminates interferences.
QC Requirements	None.
Sample Handling	No special requirements.
Max Holding Time	28 days (MCAWW, Table 1).
Source	EPA-NERL

Analyte	**Detection Level**	**Bias**	**Precision**	**Spiking Level**
Fluoride (16984-48-8)	.1 mg/L	101 % Rec (ML)	9 % RSD (ML)	

C.5.7 EPA Method 353.2

Method Number	353.2
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Revision 2.0, August 1993
Method Name	**Descriptive Name:** Nitrate-Nitrite Nitrogen by Colorimetry **Official Name:** Nitrogen, Nitrate-Nitrite (Colorimetric, Automated, Cadmium Reduction)
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Determination of Inorganic Substances in Environmental Samples (EPA/600/R-93/100)
Brief Method Summary	A filtered sample is passed through a column containing granulated copper-cadmium to reduce nitrate to nitrite. The nitrite (that originally present plus that reduced to nitrate) is determined by diazotizing with sulfanilamide and coupling with N-(1-naphthyl)-ethylenediamine dihydrochloride to form a highly colored azo dye which is measured colorimetrically. Separate, rather than combined nitrate-nitrite, values are readily obtained by carrying out the procedure first with, and then without, the Cu-Cd reduction step.
Scope And Application	This method pertains to the determination of nitrite singly, or nitrite and nitrate combined in surface and saline waters; and domestic and industrial wastes.
Applicable Conc Range	0.05 - 10 mg/L
Interferences	(1) Build up of suspended matter in the reduction column will restrict sample flow. Since nitrate-nitrogen is found in a soluble state, the sample may be pre-filtered. (2) High concentrations of iron, copper, or other metals. (3) Large concentrations of oil and grease will coat the surface of the cadmium.
QC Requirements	Not included.
Sample Handling	If analysis can be made within 24 hours, refrigerating samples at 4°C is sufficient. If samples are kept more than 24 hours, preserve with 2 mL of sulfuric acid per liter of sample and refrigerate. Do not preserve sample with mercuric chloride if they will be run through the reduction column.
Max Holding Time	28 Days (nitrate+nitrite) 48 hours (nitrate or nitrite, singly)
Source	EPA-NERL

Analyte	**Detection Level**	**Bias**	**Precision**	**Spiking Level**
Nitrate/nitrite (E-10128)	.05 mg/L	99.2 % Rec (ML)	11.7 % RSD (ML)	1 mg/L
Nitrate (14797-55-8)	N/A	N/A	N/A	
Nitrite (14797-65-0)	N/A	N/A	N/A	

C.5.8 EPA Method 365.2

Method Number	365.2
Method Source	U.S. EPA National Exposure Research Laboratory (NERL) [formerly EMSL]
Revision Information	Issued 1971
Method Name	**Descriptive Name:** Phosphorus by Colorimetry **Official Name:** Phosphorus, All Forms (Colorimetric, Ascorbic Acid, Single Reagent)
Media	WATER
Subcategory	Inorganic
Citation	Methods for the Chemical Analysis of Water and Wastes (MCAWW) (EPA/600/4-79/020)
Brief Method Summary	The sample is pretreated to select the phosphorus forms of interest; the forms are then converted to orthophosphate (which is amenable to the color chemistry of the method). A sample is filtered to select dissolved forms. Polyphosphates are converted to orthophosphate by sulfuric acid hydrolysis. Organic phosphorus is converted to orthophosphate using persulfate digestion. Ammonium molybdate and antimony potassium tartrate react in an acid medium with dilute solutions of phosphorus to form an antimony-phospho-molybdate complex, which is reduced with ascorbic acid to form an intense blue-colored complex. The absorbance of the complex is measured, and is proportional to the orthophosphate concentration.
Scope And Application	This method can determine dissolved and total orthophosphate, hydrolyzable phosphate, and phosphorus (all forms) in drinking, surface and saline waters; domestic and industrial wastes.
Applicable Conc Range	0.01 to 0.5 mg P/L.
Interferences	(A) Metals and silica: Copper, iron, and silica do not interfere at the levels reported in sea water, but excessively high concentrations of iron can cause precipitation and loss of phosphorus. (B) Salt error: Salt error for 5%-20% salt samples was less than 1%. (C) Arsenate: Arsenate can cause a positive interference, but is often at low concentrations.
QC Requirements	None.
Sample Handling	Samples should be collected in plastic or Pyrex glass containers. Samples should be preserved with 2 mL of concentrated sulfuric acid and refrigerated at 4°C. If samples are collected near benthic deposits, take care not to include materials from the deposits.
Max Holding Time	48 hours (orthophosphate, dissolved) 28 days (Hydrolyzable and Total) 24 hours (Total Dissolved). (MCAWW, Table 1).
Source	EPA-NERL

Analyte	Detection Level	Bias	Precision	Spiking Level
Phosphate (14265-44-2)	N/A	97.92 % Rec (ML)	13.7 % RSD (ML)	.056 N/A
Phosphorus (7723-14-0)	.01 mg/L	100 % Rec (ML)	7.6 % RSD (ML)	.5 mg/L

C.5.9 Standard Method 2320

Analytical Parameter	Contract Required Detection Limit (CRDL)	Technical and Contract Holding Times	Preservation
Low-Level Alkalinity: High-Level Alkalinity:	2 mg/L 20 mg/L	Technical: 14 Days from collection; Contract: 12 Days from receipt at laboratory	Cool to 4EC ±2EC*

QC Element	Frequency	Acceptance Criteria	Corrective Action

Method Blank (MB)	One per Batch or SDG a (1 per 20 samples minimum)	< CRDL	1. If lowest sample concentration is more than 10X the blank conc., no action 2. If samples are non-detected, no action 3. If detected sample concentrations are less than 10X blank conc., all associated samples must be prepared again with another method blank and reanalyzed
Duplicate Sample (DUP)	One per batch or SDG (1 per 20 samples Minimum)	RPD <20% for samples >20 mg/L; ± CRDL for samples <20 mg/L	1. Flag associated data with an "*"
Mineral Reference Samples	One set (at two concentration levels, one low, one high) per batch or SDG	± 15% from expected concentration	1. Terminate analysis 2. Identify and document the problem 3. Reanalyze all associated samples

C.6 Quality Control

This section presents QC requirements relevant to analysis of environmental samples. The purpose of this QC program is to produce data of known quality that satisfy the project objectives and that meet or exceed the requirements of the standard methods of analysis. This program provides a mechanism for ongoing control and evaluation of data quality measurements through the use of QC materials.

Laboratory QC samples (e.g., blanks and laboratory control samples) shall be included in the preparation batch with the field samples. An analytical batch is a number of samples (not to exceed 20 environmental samples plus the associated laboratory QC samples) that are similar in composition (matrix) and that are extracted or digested at the same time and with the same lot of reagents and analyzed sequentially. The identity of each analytical batch shall be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated environmental samples.

The type of QC samples and the frequency of use of these samples are discussed below.

Laboratory Control Sample

The ***laboratory control sample*** (LCS) is analyte-free water for aqueous analyses. Each analyte in the LCS shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. (The midpoint is defined as the median point in the curve, not the middle of the range). The LCS shall be carried through the complete sample preparation and analysis procedure. The LCS is used to evaluate each analytical batch and to determine if the method is in control. The LCS cannot be used as the continuing calibration verification.

One LCS shall be included in every analytical batch. If more than one LCS is analyzed in an analytical batch, results from all LCSs analyzed shall be reported. A QC failure of an analyte in any of the LCSs shall require appropriate corrective action, including qualification of the failed analyte in all of the samples, as required.

Whenever an analyte in an LCS is outside the acceptance limit, corrective action shall be performed. After the system problems have been resolved and system control has been reestablished, all samples in the analytical batch shall be reanalyzed for the out-of-control analyte(s). When an analyte in an LCS exceeds the upper or lower control limit and no corrective action is performed or the corrective action was ineffective, the appropriate validation flag shall be applied to all affected results.

C.6.1 Matrix Spike/Matrix Spike Duplicate

A ***matrix spike*** (MS) and ***matrix spike duplicate*** (MSD) is an aliquot of sample spiked with known concentrations of analytes in the QC acceptance criteria for the method. The spiking occurs prior to sample preparation and analysis. Each analyte in the MS and MSD shall be spiked at a level less than or equal to the midpoint of the calibration curve for each analyte. Only Spokane County samples shall be used for spiking. The MS/MSD shall be designated on the chain of custody.

The MS/MSD is used to document the bias of a method due to sample matrix. Spokane County should select the samples for MS/MSDs. The sample replicates will be generated in the field, to be used by the laboratory to prepare appropriate MS/MSDs. They are used to document potential matrix effects associated with the groundwater source. The MS/MSD results and flags must be associated or related to samples that are collected from the same groundwater source from which the MS/MSD set were collected.

Spokane County personnel should designate the MS/MSD and determine if they are site specific based on the project requirements. A minimum of one MS and one MSD shall be designated by Spokane County for each sample day and analyzed with every batch of samples in a sample delivery group of up to 20 field samples (i.e. collect up to 20 field samples followed by 2 additional samples designated as MS and MSD).

The performance of the MS and MSD is evaluated against the QC acceptance limits given in the tables in Section E. If either the MS or the MSD is outside the QC

acceptance limits, the analytes in all related samples shall be qualified according to the data flagging criteria.

C.6.2 Surrogates

Surrogates are organic compounds that are similar to the target analyte(s) in chemical composition and behavior in the analytical process, but that are not normally found in environmental samples. Surrogates are used to evaluate accuracy, method performance, and extraction efficiency.

Surrogates shall be added to environmental samples, controls, and blanks, in accordance with the method requirements. Whenever a surrogate recovery is outside the acceptance limit, corrective action must be performed. After the system problems have been resolved and system control has been re-established, re-extracted and re-analyze the sample. If corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections E, shall be applied to the sample results.

C.6.3 Method Blank

A ***method blank*** is an analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank shall be carried through the complete sample preparation and analytical procedure.

The method blank is used to document contamination resulting from the analytical process. A method blank shall be included in every analytical batch. The presence of analytes in a method blank at concentrations equal to or greater than the RL indicates a need for corrective action. Corrective action shall be performed to eliminate the source of contamination prior to proceeding with analysis, unless the holding time has already expired**.** After the source of contamination has been eliminated, all samples containing the analyte(s) found in the method blank above the RL shall be re-prepped and reanalyzed. No analytical data shall be corrected for the presence of analytes in blanks. When an analyte is detected in the method blank and in the associated samples, and corrective actions are not performed or are ineffective, the appropriate validation flag, as described in Sections E, shall be applied to the sample results.

C.6.4 Equipment Blank

An ***equipment blank*** is a sample of ASTM Type II reagent grade water poured into or over or pumped through the sampling device, collected in a sample container, and transported to the laboratory for analysis. The equipment blank will be collected in the manner described in section C.1

Equipment blanks are used to assess the effectiveness of equipment decontamination procedures. The frequency of collection for equipment blanks is specified in Section C1. Equipment blanks shall be collected immediately after the equipment has been decontaminated. The blank shall be analyzed for all laboratory analyses requested for the

environmental samples collected at the site. When an analyte is detected in the equipment blank, the appropriate validation flag, as described in Section E, shall be applied to all sample results from samples collected with the affected equipment.

C.6.5 Trip Blank

The ***trip blank*** consists of a VOC sample vial filled in the laboratory with ASTM Type II reagent grade water, transported to the sampling site, handled like an environmental sample and returned to the laboratory for analysis. Trip blanks are not opened in the field. Trip blanks are prepared only when VOC samples are taken, and are analyzed only for VOC analytes.

Trip blanks are used to assess the potential introduction of contaminants from sample containers or during the transportation and storage procedures. When an analyte is detected in the trip blank, the appropriate validation flag, as described in Section E, shall be applied to all sample results from samples in the cooler with the affected trip blank.

C.6.6 Field Duplicates

A ***field duplicate*** sample is a second sample collected at the same location as the original sample. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis. The sample containers are assigned a unique identification number in the field such that they cannot be identified (blind duplicate) as duplicate samples by laboratory personnel performing the analysis. Specific locations are designated for collection of field duplicate samples prior to the beginning of sample collection. The frequency of collection for field duplicates is specified in Section C1.

C.7 Instrument/Equipment Testing, Inspection, and Maintenance

The water quality meter will be rented from an environmental field equipment supplier for each sampling event. Upon receipt of the equipment it will be visually inspected to verify all of the correct components were sent and that all of the appropriate fittings were provided. The meter will be checked to ensure no error codes present upon start up of the meter. The water level meter will be checked to ensure that the battery is able to provide adequate power for operation of the instrument. Extra batteries will be standard field equipment

C.8 Instrument/Equipment Calibration and Frequency

Water quality instruments will be calibrated at the beginning of each sampling day and any problems encountered will be documented in the field notes. If any changes are made to the instrument during the sampling day, such as battery or probe replacement, the instrument will be recalibrated.

C.8.1 Horiba™ Water Quality Meter

The Horiba™ Water Quality Meter (or equivalent) will be used to measure the groundwater quality parameters (pH, specific conductance, turbidity, temperature and DO). The Horiba will be calibrated daily according to the manufacturer's instructions using stock pH, conductivity and turbidity standards. Atmospheric oxygen will be used to calibrate the DO element. If the measured calibration concentration is not within 5% of the standard concentration, the meter will be recalibrated according to the manufacturer's instructions. Alternatively, the manufacturer will be contacted for assistance. If these alternatives do not result in a properly calibrated meter, a replacement unit will be obtained. Calibration data will be recorded in the field logbook. The meter calibration will be performed in accordance with manufacturer's instructions.

C.8.2 Water Level Indicator

The water level indicator will be used to measure groundwater levels on a quarterly basis. The 9-volt battery will be replaced as needed.

C.9 Inspection/Acceptance of Supplies and Consumables

Table C.9-1 Summary of Supplies, Inspection Requirements, and Responsible Party

Critical Supplies and Consumables	Inspection Requirements and Acceptance Criteria	Responsible Personnel
Sample bottles	Visually inspected upon receipt for cracks, breakage, cleanliness	Field team
Calibration standard solutions	Visually inspected for proper labeling, expiration dates, appropriate grade	Field team
Water quality monitor/Water level indicator	Functional checks to insure proper calibration and operating capacity	Field team
Sampling equipment (pump, tubing, etc)	Visually inspected for obvious defects, damage, and contamination	Field team

Supplies and consumables not meeting acceptance criteria will initiate the appropriate corrective action, e.g., replacement, return to vendor.

C.10 Non-direct Measurements

In order to provide a consistent water quality database for all Spokane Valley Aquifer analysis, Spokane County also provides a Coordinated Monitoring Program for the areas public water supply system operators. In this program Spokane County collects water

samples for cooperating water suppliers wells as part of the County's quarterly sampling program. These samples are subject to the same quality control procedures and are submitted to the same lab as the Ambient monitoring samples. Aside from the differences in sample origin the data is thus directly comparable to the Ambient Monitoring data. Currently four water suppliers serving nearly 80% of the regions water customers are cooperating with the County in this program.

C.11 Data Management

Field notes, field books, monitoring well purge forms, daily summary field sheets with equipment calibration notes, and chain of custody documentation will be stored by year in file cabinets located in the Water Resources Section of the Spokane County Public Works Building. Copies will also be scanned and stored in the same location as laboratory data on the Spokane County network data drives.

Paper copies of analytical data reports and data validation documentation will be stored by year in file cabinets as described above. Portable Document Format (PDF) copies of the report will be stored on the Spokane County network data drives. The laboratory will also provide the data as an electronic data deliverable (EDD). The EDD will be in a Microsoft Access database. As each EDD is received it will be stored as a stand alone database and be appended to the existing database with all historical aquifer and river data collected by Spokane County. The transfer will be accomplished using macros to minimize transcription errors. Data from the field sheets will be entered into the Access database into the corresponding record. Individual sampling event data will be kept on the Spokane County network data drives for a period of two years at which time they will be stored on CD, DVD, or other appropriate storage mediums. The database containing all data will be kept on the Spokane County network drives.

D ASSESSMENT AND OVERSIGHT

D.1 Assessments and Response Actions

D.1.1 Assessment of Subcontractors

The laboratory as part of their QA Program will conduct laboratory performance and system audits. System audits will be done on an annual basis, at a minimum and will include an examination of laboratory documentation on sample receiving, sample log-in, sample storage, chain-of-custody procedures, sample preparation and analysis, instrument operating records, etc. The laboratory will be certified for the analysis they perform by the Department of Ecology. A copy of the certification letter will be obtained each year.

D.1.2 Assessment of Project Activities

Field audits will include examination of field sampling records, field screening results, field instrument operating records, sample collection, handling, and packaging in compliance with the established procedures, maintenance of QA procedures, chain-of-custody, etc. Follow-up audits will be conducted to correct deficiencies, and to verify that QA procedures are maintained throughout the investigation. The audits will involve review of field measurement records, instrumentation calibration records, and sample documentation. This will occur once during the year.

D.2 Reports to Management

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures or out-of-limit QC performance that can affect data quality. Corrective action can occur during field activities, laboratory analyses, data validation, and data assessment. All corrective action proposed and implemented should be documented in the QA sections of project reports. Corrective action should only be implemented after approval by the Water Resources Manager, or his designee. For noncompliance problems, a formal corrective action program will be determined and implemented at the time the problem is identified. The person who identifies the problem is responsible for notifying the Water Resources Manager. Any nonconformance with the established QC procedures in the QAPP will be identified and corrected in accordance with the QAPP. The nonconformance and corrective action will be documented in project reports.

E DATA VALIDATION AND USABILITY

E.1 Data Review, Verification, and Validation

MDLs and results shall be reported to one decimal place more than the corresponding RL. If possible, samples should be analyzed undiluted and non-detects reported to the specified RLs. RLs for minority constituents in highly contaminated samples may be adjusted for dilutions.

The data methods and associated quality control criteria are identified in table E.1-2 and validation flagging criteria presented in table E.1-1. Validation flagging will be applied according the decision tree presented in figure 3 when the defined quality control criteria are not met and corrective action was not successful or corrective action was not performed.

Flags shall be added by the laboratory to any data not meeting acceptance criteria. Data quality comments shall be added to the definitive data report packages to explain any nonconformance or other issues.

Spokane County personnel shall perform a 100 percent detail checking review of 10 percent of the completed laboratory data packages. Ten percent of samples with at least 1 sample from each sample delivery group will be checked from initial field data sheet through the final consolidated water quality database. One hundred percent of field data will be checked to insure accurate transcription from field data sheets to the final consolidated water quality data base.

Spokane County shall review the entire definitive data report package, and with the field records, apply the final data qualifiers for the definitive data. Spokane County shall review the field QC samples and field logs, and shall then appropriately flag any of the associated samples identified with the field QC sample. Spokane County shall determine if the data quality objectives have been met, and will calculate the data completeness for the project.

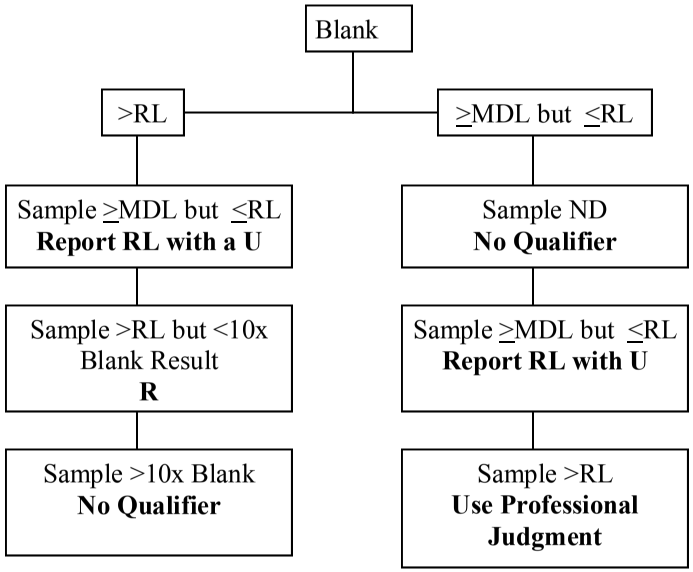
Table E.1-1: Data Qualifiers

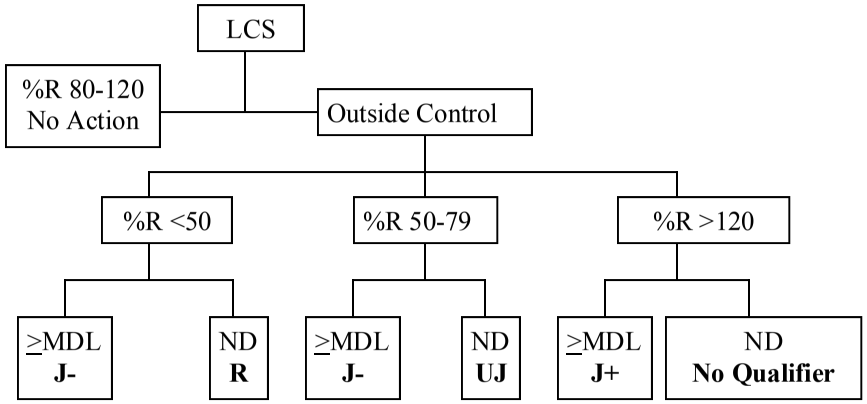
Qualifier	Description
J	The analyte was positively identified; the quantitation is estimated.
U	The analyte was analyzed for, but not detected. The associated numerical value is at or below the MDL.
F	The analyte was positively identified but the associated numerical value is below the RL.
R	The data are rejected due to deficiencies in the ability to analyze the sample and meet QC criteria.
B	The analyte was found in an associated blank, as well as in the sample.
M	A matrix effect was present.

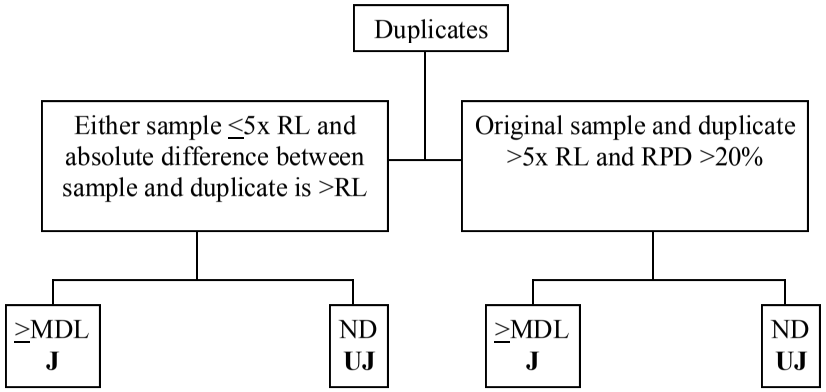
Table E.1-2: Quality Control Limits

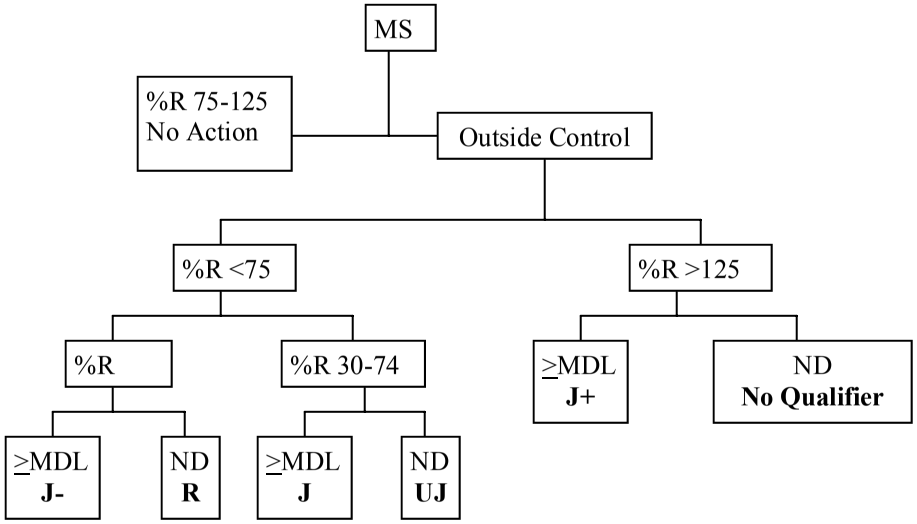
Parameter	Method	Precision of laboratory duplicates (RPD)	Accuracy of matrix spikes %Recovery	Accuracy of Laboratory Control Sample	Holding Times
Temperature					NA
pH					NA
Conductivity					NA
Dissolved Oxygen					NA
Arsenic	200.8	0-20[1]	75-125	± 15 %	6 months
Cadmium	200.8	0-20[1]	75-125	± 15 %	6 months
Calcium	200.7	0-20[1]	75-125	± 15 %	6 months
Chloride	300.0	0-20[1]	75-125	± 10 %	28 days
Chromium	200.8	0-20[1]	75-125	± 15 %	6 months
Copper	200.8	0-20[1]	75-125	± 15 %	6 months
Fluoride	340.2	0-20[1]	75-125	± 10 %	28 days
Iron	200.7	0-20[1]	75-125	± 15 %	6 months
Lead	200.8	0-20[1]	75-125	± 15 %	6 months
Magnesium	200.7	0-20[1]	75-125	± 15 %	6 months
Manganese	200.8	0-20[1]	75-125	± 15 %	6 months
Mercury	245.1	0-20[1]	70-130	± 15 %	28 days
Ortho-phosphate-phosphorous	365.2	0-17	80-117	± 10 %	48 hours
Potassium	200.7	0-20[1]	75-125	± 15 %	6 months
Sodium	200.7	0-20[1]	75-125	± 15 %	6 months
Sulfate	300.0	0-20[1]	75-125	± 10 %	28 days
Total Dissolved Solids	160.1	0-16	71-121	± 10 %	7 days
Total Nitrate + Nitrite	353.2	0-20[1]	NA	± 10 %	48 hours
Total phosphorus	365.2	0-22	NA	± 10 %	28 days
Zinc	200.8	0-20[1]	75-125	± 15 %	6 months
Carbonate Alkalinity (CO_3-)	SM 2320	0-20[1]	NA	NA	14 days
Bicarbonate Alkalinity (HCO_3)	SM 2320	0-20[1]	NA	NA	14 days

Figure 3 - Data Validation Decision Tree









E.1.1 QUALITY ASSURANCE REPORTS

The annual report will include a section on quality assurance. All nonconformances to the QAPP, the corrective action, and the impact to data quality will be discussed. A summary of data validation activities and results will be presented including data completeness, summary of data validation flags, and the usability of the data for its intended purpose.

F ADDENDUM: SEEPS & SPRINGS SAMPLING

In addition to the groundwater monitoring program, Spokane County Water Resources staff will conduct monitoring at locations where the SVRP Aquifer discharges to ground surface. Samples will be collected at locations presented in Table F.1.1. Samples will be submitted for laboratory analysis for the same analytes and will be subject to the same quality assurance and data validation procedures as groundwater samples. As applicable, every effort will be made to sample springs and seeps at the same time as the nearest well to facilitate data comparison. Sample collection will be according to the USGS Nonisokinetic Dip Sampling Methods at Flowing Water Sites detailed in the National Field Manual for the Collection of Water-Quality Data, Revised 2006. Due to the dispersed nature of the discharges flow measurement is impractical. Digital photos and a narrative description of the sampling site and discharge will be taken and stored with field documentation to characterize the flow rate of the seep or spring.

Table F.1.1 – Seeps and Springs Sampling Locations

Location Name	Latitude	Longitude	Sampling Interval
Sullivan Park Spring	47°40'25.54"N	117°11'53.02"W	Yearly (3rd Quarter)
Mirabeau Spring	47°40'50.03"N	117°13'10.68"W	Yearly (3rd Quarter)
Rendering Plant	47°40'33.98"N	117°20'44.12"W	Yearly (3rd Quarter)
Three Springs	47°40'41.43"N	117°26'51.46"W	Quarterly
Waikiki Springs	47°46'34.18"N	117°25'17.27"W	Quarterly
Griffith Springs	47°45'57.01"N	117°27'33.48"W	Quarterly