PNNL-15014

Pacific Northwest National Laboratory
Operated by Battelle for the U.S. Department of Energy

The Groundwater Performance Assessment Project Quality Assurance Plan

January 2005

Prepared by
Pacific Northwest National Laboratory
Richland, Washington
for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

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The Groundwater Performance Assessment Project Quality Assurance Plan

Project # 28023

Prepared by
Pacific Northwest National Laboratory
Richland, Washington 99352

Issue Date: January 2005

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Summary

U.S. Department of Energy (DOE) has monitored groundwater on the Hanford Site since the 1940s to help determine what chemical and radiological contaminants have made their way into the groundwater. As regulatory requirements for monitoring increased in the 1980s, there began to be some overlap between various programs. DOE established the Groundwater Performance Assessment Project (groundwater project) in 1996 to ensure protection of the public and the environment while improving the efficiency of monitoring activities. The groundwater project is designed to support all groundwater monitoring needs at the site, eliminate redundant sampling and analysis, and establish a cost-effective hierarchy for groundwater monitoring activities.

This document provides the quality assurance guidelines that will be followed by the groundwater project. This QA Plan is based on the QA requirements of DOE Order 414.1A, *Quality Assurance,* and 10 CFR 830, Subpart A--*General Provisions/Quality Assurance Requirements* as delineated in Pacific Northwest National Laboratory's Standards-Based Management System. In addition, the groundwater project is subject to the *Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003, QA/R-5). The groundwater project has determined that the *Hanford Analytical Services Quality Assurance Requirements Documents (*HASQARD, DOE/RL-96-68*)* apply to portions of this project and to the subcontractors. HASQARD requirements are discussed within applicable sections of this plan.

Contents

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1.0 Quality Assurance Plan Distribution

Pacific Northwest National Laboratory (PNNL) Document Control will distribute this Quality Assurance (QA) Plan internally to PNNL, the U.S. Department of Energy (DOE) Reading Room and Technical Library. The project manager will determine the distribution list. Also, the QA Plan will be published in accordance with the Standards-Based Management System (SBMS) subject area, *Publishing Scientific and Technical Information* (PNNL 2002b).

2.0 Introduction

2.1 Title

The Groundwater Performance Assessment Project Quality Assurance Plan.

2.2 Client

U.S. Department of Energy, Richland Operations Office, Richland, Washington.

2.3 Authorizing Document

PBS# RL-0030 WBS# 4.2.2.20 – Groundwater Performance Assessment Project

This project has been ongoing since fiscal year (FY) 1996. Work has been authorized by the specified multi-year program plans.

2.4 Quality Assurance Requirements

The project Quality Assurance Program is based on the QA requirements of DOE Order 414.1A, *Quality Assurance,* and 10 CFR 830, Subpart A--*General Provisions/Quality Assurance Requirements* as delineated in the PNNL's SBMS. In addition, the project is subject to the *Environmental Protection Agency (EPA) Requirements for Quality Assurance Project Plans* (EPA/240/B-01/003, QA/R-5). Additionally, the Groundwater Performance Assessment Project has determined that the *Hanford Analytical Services Quality Assurance Requirements Documents (*HASQARD, DOE/RL-96-68*)* apply to portions of this project and to the subcontractors. HASQARD requirements are discussed within applicable sections of this plan.

2.5 Special Requirements or Specifications

DOE Orders 435.1, *Radioactive Waste Management*, and 450.1, *Environmental Protection Program*, apply to the project to implement requirements of the *Atomic Energy Act of 1954*. Compliance and waste-cleanup timetables and implementation milestones are established in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement [TPA]; Ecology et al. 1989) to achieve compliance with remedial action provisions of the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) and the treatment, storage, and disposal (TSD) unit regulation and corrective action provisions of the *Resource Conservation and Recovery Act* (RCRA).

RCRA groundwater monitoring is driven by 40 CFR 264, 40 CFR 265, and WAC 173-303. Monitoring is also conducted to support the Washington State Waste Discharge Permit Program (WAC 173-216) and for solid waste landfills (WAC 173-304).

CERCLA groundwater monitoring is implemented by 40 CFR 300 and lower level agreements with the U.S. Environmental Protection Agency (EPA) via work plans, records of decisions, and TPA change control forms.

Selected groundwater monitoring plans (see Section 4.0) are based on applying the Data Quality Objectives Process, in accordance with *Guidance for the Data Quality Objectives Process* (EPA/600/R-96/055). Geostatistics have been used to evaluate monitoring networks. Sampling and Analysis Plans are reviewed and approved by regulatory agencies, and are reviewed annually and updated as necessary.

RCRA monitoring system design is fairly prescriptive for most TSD units, which are still in interim status. Quarterly sampling is required to establish background, semiannual sampling is required for indicator evaluation (detection), and quarterly sampling is required for sites that have impacted groundwater quality. Monitoring under final-status regulations allows site-specific constituents of concern to be evaluated. These regulations also allow provisions for alternative statistics that account for site conditions. The Tri-Party Agreement provides schedules for incorporating TSD units into the Hanford Facility RCRA Permit (Ecology 1994). Sites in final status have monitoring requirements stipulated in permit conditions. Notice-of-Deficiency comments are provided by Washington State Department of Ecology (Ecology), and are addressed in workshops with technical and permit staff. Selection of well locations are negotiated and made through TPA Milestone agreements.

The two pie chart graphs (Figures 1 and 2) show the number of wells sampled by location and number of analyses conducted in FY 2003 (considered a typical year).

2.6 Project Scope

DOE has monitored groundwater on the Hanford Site since the 1940s to help determine what chemical and radiological contaminants have made their way into the groundwater. As regulatory requirements for monitoring increased in the 1980s, there began to be some overlap between various programs. DOE established the Groundwater Performance Assessment Project (groundwater project) in 1996 to ensure protection of the public and the environment while improving the efficiency of monitoring activities. The groundwater project is designed to support all groundwater monitoring needs at the site, eliminate redundant sampling and analysis, and establish a cost-effective hierarchy for groundwater monitoring activities.

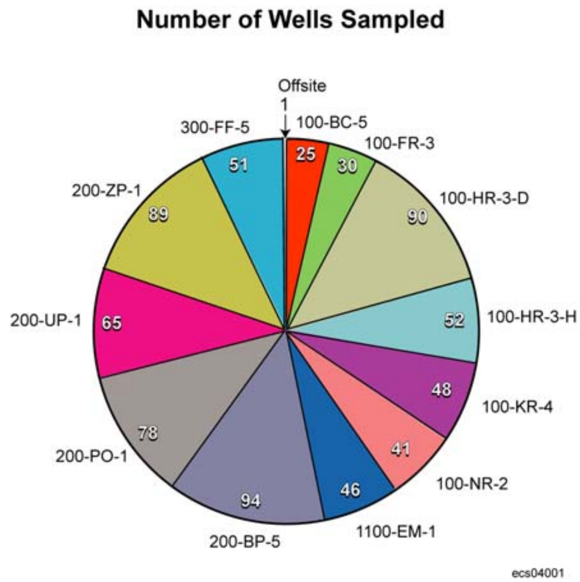


Figure 1. Number of Wells Sampled

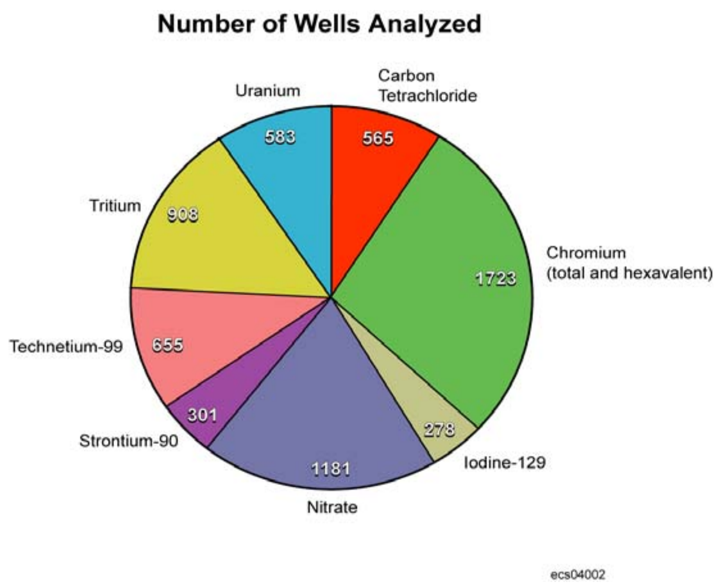


Figure 2. Number of Wells Analyzed

Contamination may reach the Columbia River by moving down through the vadose zone, into the groundwater, and then into the river. The analysis of groundwater samples helps determine the potential effects that contaminants could have on human health and the environment. DOE works with the regulatory agencies, such as EPA and Ecology, to make cleanup decisions based on sound technical information and the technical capabilities available.

A map of the Hanford Site showing groundwater interest areas is shown in Figure 3. The ground-water interest areas are roughly comparable to groundwater operable units identified under CERCLA. Figure 4 shows the regulated units requiring groundwater monitoring under RCRA.

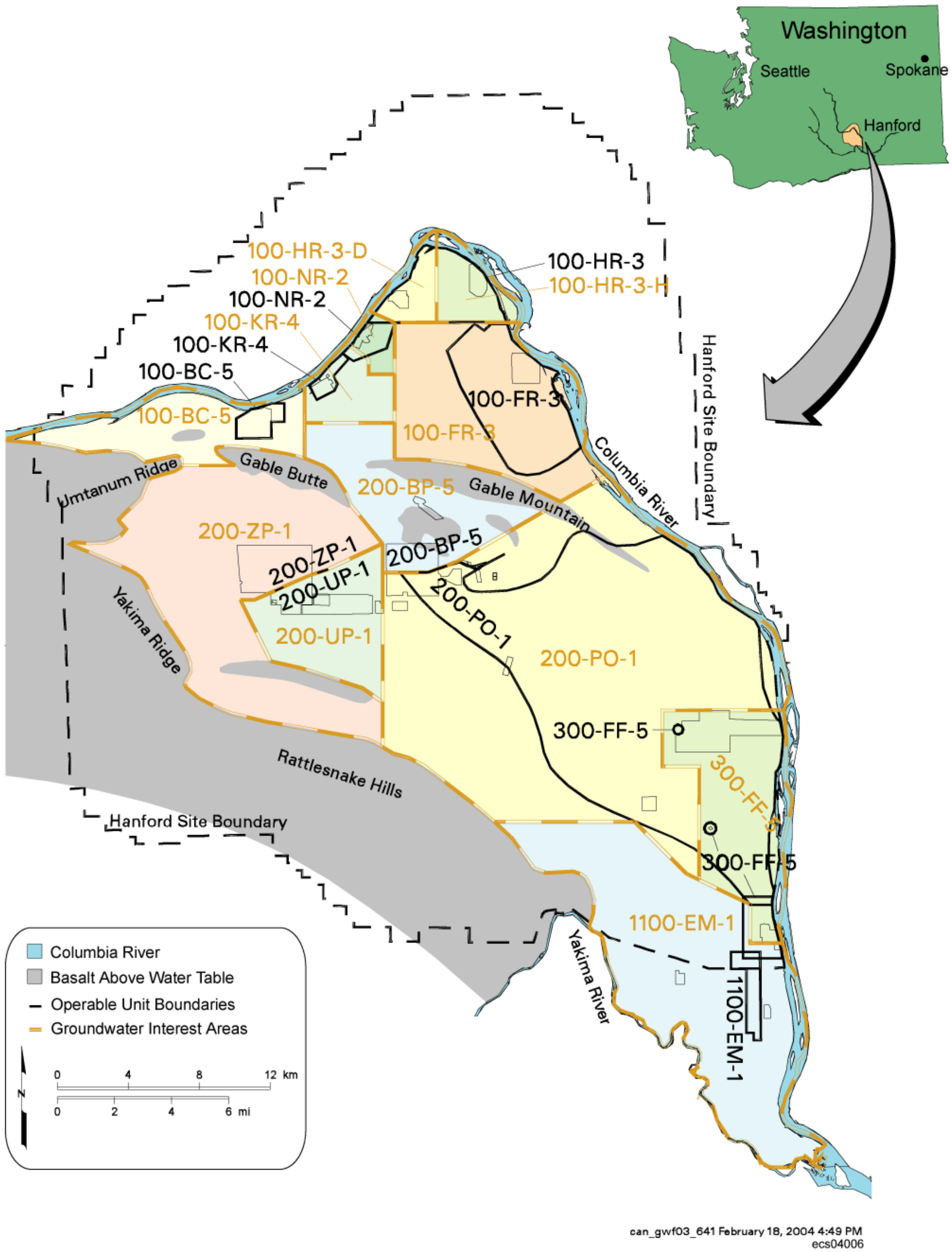


Figure 3. Hanford Site Groundwater Interest Areas (roughly comparable to the groundwater operable units)

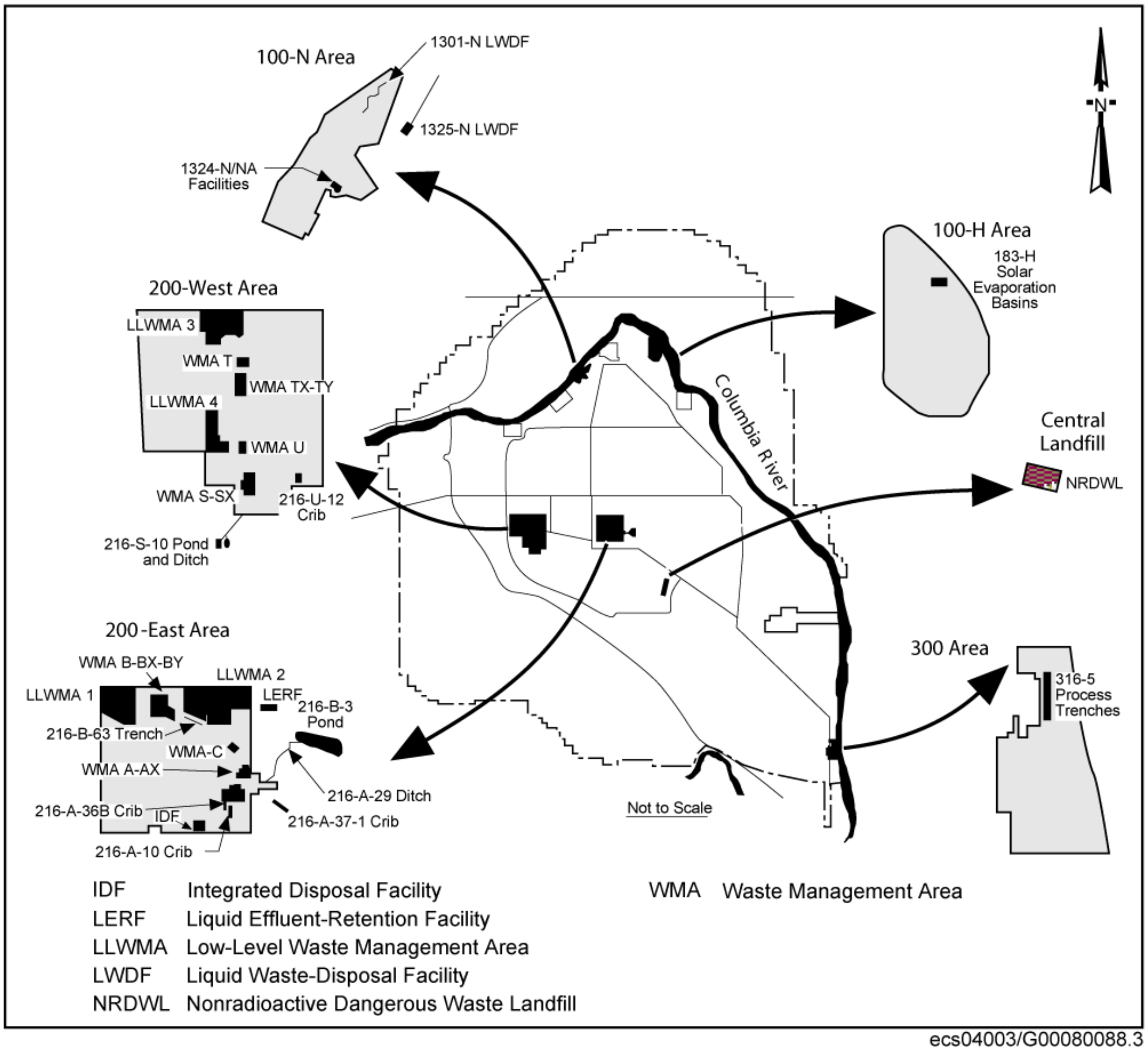


Figure 4. Regulated Units on the Hanford Site Requiring Groundwater Monitoring under the *Resource Conservation and Recovery Act*

Groundwater monitoring includes groundwater sampling, sample analyses, data processing, data interpretation and reporting, and strategic planning for RCRA, CERCLA, long-term monitoring, operating facilities, and site-wide surveillance. Integration of these functions will occur in all areas so sampling events, analyses, and data processing is performed to optimize the efficiency of each activity, while data interpretations and reporting are integrated into consistent plume interpretations.

Geohydrologic services include activities that support monitoring including water-level monitoring, hydraulic testing as needed, technical justifications, and specifications for well drilling and miscellaneous well support. Seismic monitoring is also conducted to meet DOE requirements and Hanford Site needs.

2.7 Change Control (Scope, Schedule, Budget)

The project scope, schedule, and budget baseline are compiled, tracked, and reported using a project control system in accordance with DOE direction.

Changes in work scope, schedule, or budget may be necessary during the year. Changes may be requested of subcontractors by PNNL that will result in a change to the statement of work (SOW) due to revisions of work scope, schedule, and/or budget. These changes will be documented in revisions or addendums to the existing SOW and a PNNL Subcontracts Supplement Form shall be completed.

Administrative changes requested of subcontractors that are approved by Task Leaders may be made by verbal or electronic message authorization. Written documentation of the verbal changes and electronic messages should be maintained in the permanent project files. These changes may only be made if technical work scope and budget are not affected significantly.

3.0 Project Organization and Responsibilities

Line authority, quality assurance authority and support within PNNL, and client interfaces are shown organizationally in Figure 5. The responsibilities of key PNNL personnel are summarized in Section 3.1.

Changes to organizational/interface structures shown in Figure 5 that do not reflect a change in the overall scope of the activities or a change of requirements will not require a QA Plan revision but will be incorporated into the next required revision of the QA Plan.

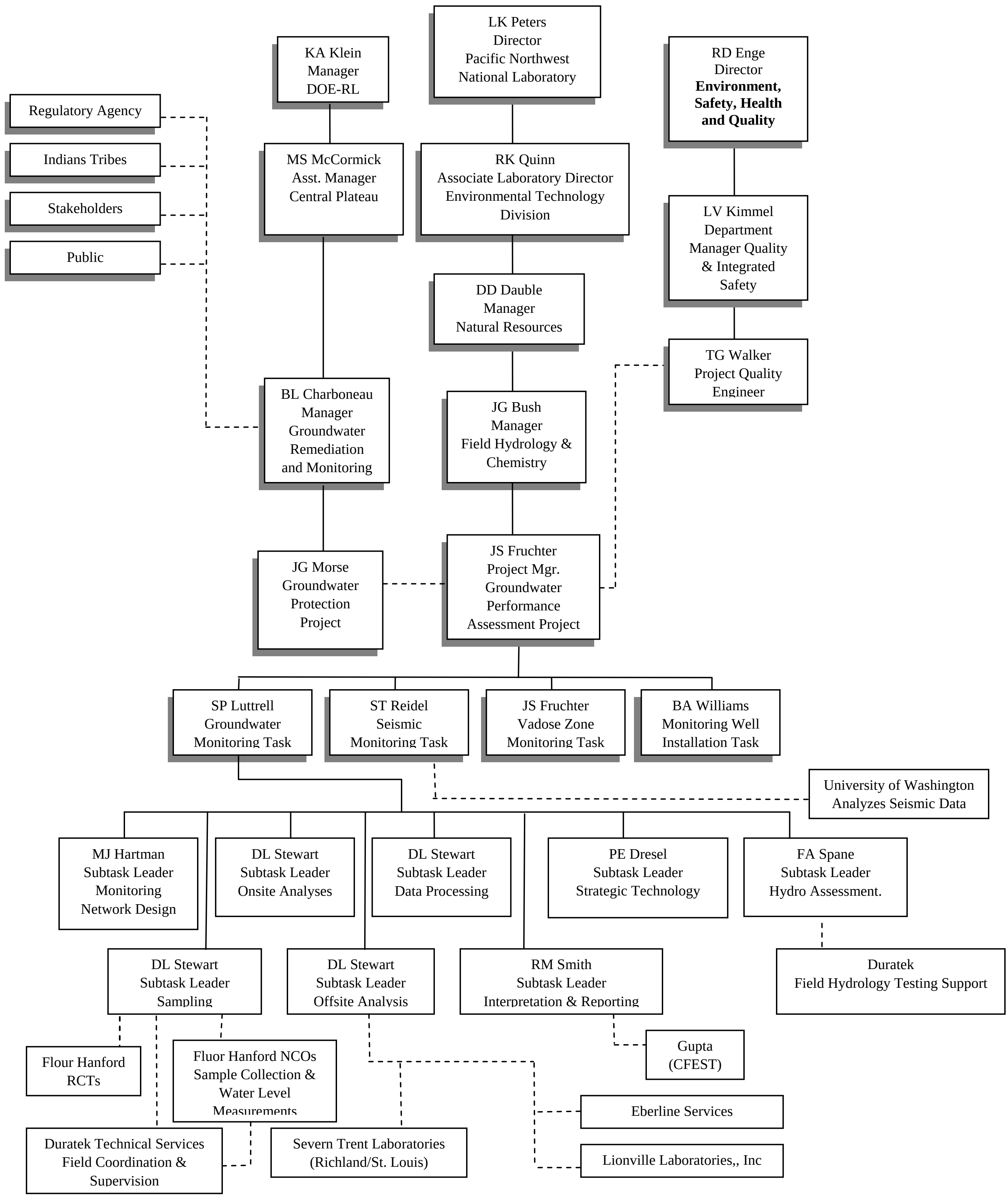
3.1 Responsibilities of Key Personnel

- ***Project Manager*** — provides overall direction to task managers and project personnel within PNNL necessary to accomplish all project objectives, including development and completion of technical work scope; coordinates and executes project controls associated with scope, schedule, and budget baselines; reports on project status; assures that the project is properly staffed with technically qualified personnel; serves as client interface for the project to assure that customer expectations are met in terms of quality, cost, and schedule; assures the QA Plan is implemented by project staff.

- ***Groundwater Monitoring Task Leader*** — oversees planning, control, communications, and progress reporting for the Monitoring Task; prepares task plan that includes work scope, resource requirements, cost baseline, and deliverables; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly reporting and support to the Project Manager in carrying out project management responsibilities; assigns and prioritizes responsibilities to sub-task managers for each of the sub-tasks; interfaces with DOE, other contractors, subcontractors, other Task Leaders, and the Groundwater Protection Program.

- ***Monitoring Network Design Sub-Task Leader*** — prepares and/or revises site-specific groundwater monitoring plans and assessment plans; coordinates RCRA, operational, site-wide surveillance, and CERCLA groundwater monitoring; identifies groundwater-monitoring plans and assessment plans that need to be written or revised, and provides the scope, cost baseline, and schedule for the work; assigns staff to produce the reports, coordinate schedules, and review plans; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly reports to the Task Leader.

Figure 5. Project Interfaces



- ***Sampling Sub-Task Leader*** — oversees planning, control, communications, and progress reporting for the Sampling Sub-Task; provides work scope, resource requirements, cost baseline, and deliverables to the Task Leader; requires subcontractor to comply with HASQARD (DOE/RL-96-68) Volumes 1, 2, and 3; oversees subcontractors providing sample collection; assures quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly report to the Task Leader.

- ***Onsite Analyses Sub-Task Leader*** — oversees planning, control, communications, and progress reporting for the Onsite Analyses Sub-Task; provides work scope, resource requirements, cost baseline, and deliverables to the Task Leader; requires subcontractor to comply with HASQARD Volumes 1 and 4; oversees Hanford Site subcontractors providing analytical services; assures quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly report to the Task Leader.

- ***Offsite Analyses Sub-Task Leader*** — oversees planning, control, communications, and progress reporting for the Offsite Analyses Sub-Task; provides work scope, resource requirements, cost baseline, and deliverables to the Task Leader; requires subcontractor to comply with HASQARD Volumes 1 and 4; oversees offsite subcontractors providing analytical services; assures quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly report to the Task Leader.

- ***Data Processing Sub-Task Leader*** — oversees planning, control, communications, and progress reporting for the Data Processing Sub-Task; provides work scope, resource requirements, cost baseline, and deliverables to the Task Leader; assures sampling schedules are prepared, data verification and tracking activities are conducted, and data are loaded into the Hanford Environmental Information System (HEIS) with appropriate checks; assures data are provided to the data users as requested; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly reports to the Task Leader.

- ***Interpretation and Reporting Sub-Task Leader*** — identifies groundwater characterization, assessment, and annual reports that need to be written or revised, and provides the scope, cost baseline, and schedule for the work; assigns staff to produce the reports, coordinate schedules, and review reports; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly reports to the Task Leader.

- ***Strategic Monitoring Sub-Task Leader*** — identifies and applies innovative technologies, in cooperation with DOE; assigns staff to produce the reports and support strategy development; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; provides monthly reports to the Task Leader.

- ***Hydrologic Assessment Sub-Task Leader*** — characterizes the groundwater hydraulics in support of other project needs; prepares plans and reports of results; develops the scope, cost baseline, and schedule for the work; assigns staff to produce the reports, coordinate schedules, and review plans and reports; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures.

- ***Well Installation Sub-Task Leader*** — plans wells to be installed and recommends wells for decommissioning; prepares data quality objectives (DQO) report and description of work for well installation and associated characterization needs; provides documentation of completed wells; provides direction for this task including direction of activities to accomplish task objectives and coordination of planning and organizing; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures.

- ***Seismic Monitoring Task Leader*** — provides direction of activities to accomplish task objectives and coordinates planning; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; interfaces with DOE, other Hanford contractors, subcontractors, and the Emergency Response Team in planning and responding to a significant seismic event.

- ***Vadose Zone Monitoring Task Leader*** — provides direction of activities to accomplish task objectives and coordinates planning; assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; interfaces with DOE, other Hanford contractors, subcontractors, and the Project Manager for the Groundwater Remediation Project.

- ***Project Quality Engineer –*** provides guidance and direction to Project Manager, Task Leads, and project personnel within PNNL on PNNL QA Program requirements and other regulator QA requirements; performs surveillances on the sampling subcontractor activities to assure quality of their work; develops, updates, and approves QA Plan; reviews and approves appropriate work authorizing documents and applicable procedures; performs and reports self-assessments as directed by the Project Manager. A quality engineer certified to perform analytical laboratories audits will perform audits of analytical subcontractors on a periodic basis.

- ***Project Staff*** — assures technical quality of the work and that it is performed on schedule, within budget, and in accordance to plans, policies, and procedures; reports concerns such as mismanagement, waste, fraud, or abuse, or unsafe conditions and stops work as necessary.

3.2 Subcontractors and Associated Services

Subcontracted services are used for various portions of project work. Work requirements, specifications, and quality assurance requirements are communicated via a contracting mechanism to various subcontractors (see Section 14.0). Following is a list of subcontractors and the scope of their work for this project. Any change to this list not resulting in a change to scope, schedule, budget, or quality will be updated during the annual revision to the QA Plan. SOW to subcontractors used for groundwater sampling and analysis will require compliance with the HASQARD (DOE/RL-96-68). The SOW will include instructions for inspecting/accepting supplies and consumables used for this project in accordance with HASQARD.

The current subcontractors are listed below:

- Duratek Federal Services Northwest (Duratek) — provides daily coordination of groundwater sampling and water measurements, and support to hydrologic testing upon request.

- Fluor Hanford, Inc. — performs routine groundwater sampling and water-level measurements, purgewater containment and disposal, radiological control technician support, and miscellaneous solid waste disposal.

- Severn Trent Laboratories (Richland/St. Louis) — provides analytical services (primary provider).

- Eberline Services — provides analytical services (secondary provider).

- Lionville Laboratories — provides analytical services (secondary provider).

- University of Washington — analyzes and reports seismic data for the Eastern Washington Seismic Array.

3.2.1 Analytical Subcontractor Deliverables

The analytical laboratories are responsible for preparing data reports that summarize the results of analyses and detailed data packages that include the following:

- Sample receipt and tracking documentation, including identification of the organization and individuals performing the analysis; names and signatures of the responsible analysts; sample holding time requirements; references to applicable chain-of-custody procedures; and dates of sample receipt, extraction (if applicable), and analysis.

- Quality control data, as appropriate for the methods used, including matrix spike/matrix spike duplicate data, recovery percentages, precision and accuracy data, laboratory blank data, and identification of any nonconformances that may have affected the laboratory’s measurement system during the time period in which the analysis was performed.

- Analytical results or data deliverables, including reduced data and identification of data qualifiers and contractually defined reporting comments.

These requirements are specified in the SOW to the analytical laboratories. Also, the requirements for the hard copy and electronic data received from the analytical laboratories are specified in respective analytical subcontractor SOW.

3.2.2 Sampling Subcontractor Deliverables

The sampling organization is responsible for (1) delivering samples to the laboratory, (2) delivering completed sampling and water-level paperwork to PNNL, and (3) preparing a monthly report summarizing the number of both successful and unsuccessful well trips, noting any problem with wells during the month, including deviations from schedule, and providing an estimate of costs by project for services performed. All activities associated with the sample collection, sample handling, sample labeling, and custody of the samples in the field shall be consistent with the recommendations and protocol provided in Chapter 4, Section 4.2 through 4.4 in *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (National Water Well Association 1986), SW-846 (EPA/SW-846), and the *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA-600/4-79/019). One exception is that in most cases, subsamples for total metals are passed through 0.45 micron filter and collected in a bottle containing a small amount of nitric acid (pH < 2), a non-filtered subsample is not collected.

3.3 Sample Analysis by Project Staff

Analytical activities conducted by the project staff in support of groundwater monitoring shall be conducted in accordance with in-house written standard operating procedures. Field analytical methods may be used for specific activities not fulfilling requirements of monitoring plans, such as sampling and analysis during well drilling for indication purposes.

4.0 Data Quality Objectives

The QA objectives for measurements generally applicable to groundwater and vadose monitoring investigations under the purview of this QA Plan are primarily related to (1) the definition of appropriate methods for chemical analysis of the analytes of interest and (2) the definition of limits and values for analytical precision and accuracy appropriate for the purposes of groundwater monitoring investigations at the Hanford Site. Detailed discussions of these analytical objectives and analytical methods with corresponding target values for detection limits, precision, and accuracy are provided in the Appendix of this plan. Specific data quality needs for individual investigations that are different than the minimum requirements established herein shall be addressed within individual groundwater monitoring plans. However, the groundwater monitoring plans must meet the minimum data quality requirements established within the Appendix to this plan. Other measurement considerations, accuracy requirements, units, and data recording and reporting protocols for instruments supporting stratigraphic characterization, aquifer testing and other types of field investigations shall be as specified in the applicable plans and/or procedures.

DQO developed in accordance with *Guidance for the Data Quality Objectives Process* (EPA/600/R-96/055, QA/G-4) will be applied when preparing the following: groundwater monitoring plans for TSD units incorporated into the Hanford Facility RCRA Permit (Ecology 1994); groundwater quality assessment plans for RCRA TSD units that have impacted groundwater quality; and sampling and analysis plans for CERCLA groundwater operable units. A strawman DQO report will be developed by the responsible project scientist prior to review/discussion with regulatory agency staff. The final DQO report will be documented via a letter report and placed in the project file for the respective site.

5.0 Procedures

5.1 Test Planning and Performance

Test plans will be used to document a single experimental or test (e.g., hydrologic field tests, colloidal borescope investigation, vertical sampling) work activity.

5.1.1 Developing the Test Plan

The test plan shall contain the following information:

- A title and/or number including date or revision.
- Dated signatures of the Preparer, Technical Lead, Project Manager or Task Lead, and Quality Representative.
- Individual page identification (page ___ of ___).

The content of each test plan will depend on the scope of the test. The following is a brief description of mandatory and optional items to be considered in the preparation of the test plan:

- **Purpose/Description (mandatory)** – Provide a short narrative on the purpose of the experiment/test/activity.
  Example: The purpose of this test is to provide hydrologic property data at newly constructed monitoring wells located in the 200 West and 200 East Areas using slug testing, tracer-dilution testing, tracer-pump back testing, and pumping recovery testing.
- **Prerequisites (mandatory)** – List items, conditions, or other concerns that must be satisfied prior to beginning the test.
  Example: Prior to beginning the work activity, the staff must complete special training on other plans or procedures that will be used in conjunction with the test plan, special handling or storage requirements, special access or permits, and required records that need to be generated as the result of the work activity.
- **Safety (mandatory)** – Describe the hazards associated with the work such as physical agents (e.g., temperature, pressure, noise, electrical); hazardous environments (e.g., confined spaces, remote locations, heat/cold stress); and hazardous materials (e.g., flammables, corrosives, highly toxic, carcinogens). Describe the methods used to mitigate the hazards that were identified (e.g., personal protective equipment, time periods away from the hazard, alarms, location of nearest aid station).
- **Materials and Equipment (optional) –** List the materials and equipment that are necessary to complete the work.
- **Measuring and Test Equipment (mandatory)** – List the equipment that will be used to make the measurements; include the calibration requirements, system checks, and quality control checks in this section or in the work instructions section of the test plan.
- **Pretest Verification (mandatory)** – Determine if certain items of a test require verification prior to their use and indicate how the verification will be done.
  Example: A tracer solution containing Br will be used throughout the test and the initial concentration shall be known. The solution shall be measured by the calibrated probe (as described above) and the concentration shall be recorded prior to injection.

- **Documentation and Reporting (mandatory)** – Describe where the data collected during the test should be documented (e.g., field record forms, laboratory record books, entered into a computer, downloaded from computer to hardcopy) or entered into HEIS. Additionally, describe what will be reported, to whom, and the due date(s).

- **Work Instructions (mandatory)** – Provide step-by-step instructions and/or non-sequential instructions (whichever is more appropriate to the activity). Each step or instruction shall be as simple as possible but with sufficient detail so that individuals experienced in the technology or activity involved can easily understand. The following types of information should be considered for inclusion: administrative control hold points (i.e., where quality, radiological, or other approvals or actions are required before proceeding); cautions that indicate potentially hazardous situations which, if not avoided, may result in death, injury, or damage to facilities or equipment; and notes that call attention to supplemental information that assist the user in making decisions or improving work performance.

5.1.2 Test Performance

Tests will be performed in accordance with the test plans, which shall be available at the work location. The Technical Lead is responsible for assuring that the current version is used to perform the work.

If changes to the test plan are required during the execution of the work, the Technical Lead shall document the deviation and the justification or rationale for the change.

5.2 Sampling Procedures

Sampling will be done by Fluor Hanford Nuclear Chemical Operators (NCOs) under the supervision of Duratek. Quality requirements for sampling activities, including requirements for procedures, containers, transport, storage, chain of custody, and record requirements, are specified in a SOW to Duratek.

Procedures are designed to reduce variability between sampling events and obtain representative samples, thereby maintaining consistent quality during groundwater sampling. The quality of the sampling operations is important to the ultimate quality of the data that the laboratory will obtain by following standard analytical procedures.

To assure that samples of known quality are obtained, Fluor Hanford, Inc. and Duratek will be required to use controlled procedures based on standard methods for groundwater sampling whenever possible. The PNNL Sampling and Analysis Sub-Task Leader will assure that reviews are performed on procedures for technical quality and consistency. Assessments will be performed by PNNL to further assure that procedures are followed to maintain sample quality and integrity (see Section 8).

5.3 Data Processing Procedures

Procedures will be developed in accordance with SBMS subject area, *Procedures, Permits, and Other Work Instructions* (PNNL 2004c). Project staff will perform scheduling, data verification, data processing, and data management as described in Section 6 and by following the applicable internal technical procedures or instructions.

5.4 Water Level Procedures

Procedures for water levels measurements shall be in accordance with industry accepted standards, such as guidelines prepared by the U.S. Geological Survey (1977), updated as required for the latest advances in measuring equipment.

5.5 Analytical Procedures

The sampling and analysis plan for each site identifies the sample constituents that need to be analyzed. An internal PNNL procedure generates the sampling package (e.g., chain-of-custody form, groundwater sampling report), which identifies the analytical methods, sample identification, etc. on the chain-of-custody form. The chain-of-custody form and samples are provided to the appropriate analytical laboratory. The analytical methods required may be contained within the following references:

- Test Methods for Evaluating Solid Waste (EPA/SW-846, as amended)
- Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020)
- Methods for the Determination of Organic Compounds in Drinking Water(EPA-600/4-88-039)
- Prescribed Procedures for Measurement of Radioactivity in Drinking Water(EPA-600/4-80-032)
- Procedures for Radiochemical Analysis of Nuclear Reactor Aqueous Solutions(EPA-R4-73-014)
- Radiochemical Analytical Procedures for Analysis of Environmental Samples(EMSL-LV-0539-17)

Many radiochemical methods have not been standardized, but the procedures are documented in the laboratory specific standard operating procedures. These analytical methods requirements were passed on to the analytical laboratory in their SOW.

Potential chemical constituents to be analyzed for, specific analytes of interest, as well as the corresponding standard analytical methods on which the primary analytical laboratory bases its procedures are shown in the Appendix, Table A.3 of this plan. The contract to the analytical laboratories, which is administered by Fluor Hanford, Inc., specifies the use of these procedures.

Method detection limits (MDLs) shall be determined for all non-radiochemical methods required by the project. For soil, MDLs shall be determined using the calculation provided in Chapter One of EPA/SW-846, as amended. Water MDLs shall be determined per 40 CFR, Part 136, Chapter 1, Appendix B (July 1, 2001). The laboratory provides MDL studies results to the PNNL Contract Administrator when new MDLs have been determined. Required detection limits for radiochemical methods are provided in the analytical laboratory contract.

Administrative quality assurance processes and procedures (e.g., chain of custody, custody logs, sample handling, storage and disposal, training) will be required of the onsite and offsite analytical laboratories and will be specified in the SOW.

5.6 Calibration Procedures

The requirements for calibrating field and analytical laboratory instruments and maintain traceability to national or international standard (e.g., National Institute of Standards and Technology) is in accordance with *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, EPA/SW-846 and HASQARD (DOE/RL-96-68). These requirements are passed to the subcontractors by a SOW. PNNL will periodically assess the use and effectiveness of procedures and systems for calibration of equipment with the subcontractors.

Instruments used by project staff that requires calibration by client or Category 1 instruments shall be calibrated in accordance with PNNL's SBMS subject area, *Calibration* (PNNL 2002a).

6.0 Data Reduction, Verification, and Reporting

6.1 Data Reduction

Groundwater data measured during groundwater sampling and from laboratory analysis of samples along with results of modeling are compiled, evaluated, and placed in the interpretive groundwater report described in Section 6.3.

Seismic data are acquired and processed in accordance with WHC Environmental Activities Procedure Manual (WHC-CM-7-8), Procedure 3.1, *Installation and Maintenance of Seismic Arrays*, and Procedure 3.2, *Seismic Data Analysis and Record Processing*. These procedures will be converted to PNNL procedures and placed in the internal procedure manual.

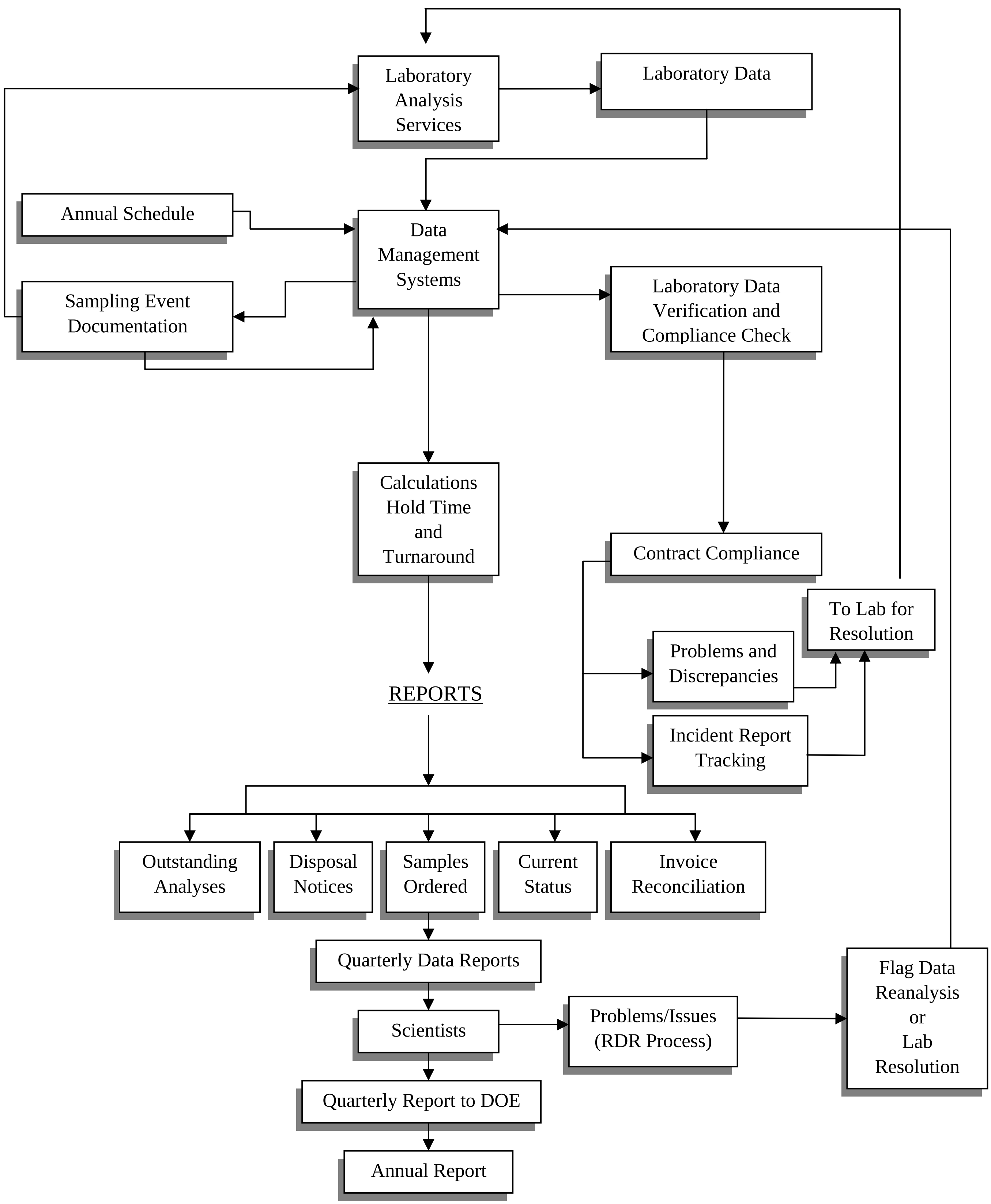
6.2 Sample Data Tracking and Verification

The process for tracking and scheduling sampling and analysis requirements, sampling field activities, chains of custody, and laboratory analysis is managed using a variety of electronic data management tools. Data is received from the analytical laboratories in electronic and hard copy form. The generalized process for verifying and logging in data, use of data by scientists, and reporting is shown in a schematic form in Figure 6.

Databases used by the project to maintain the groundwater data are the following:

- Hanford Environmental Information System (HEIS) — Database maintained by Fluor Hanford, Inc. This includes the core HEIS tables and the Sample Data Tracking subject area tables.
- Hanford Well Information System (HWIS) – Database maintained by Fluor Hanford, Inc. that is used to maintain status on well construction.

Figure 6. Data Flow Diagram



- HydroDat — Microsoft SQL Server database maintained by PNNL that is used to store, disseminate, and provide quality control for water-level measurements.

Other key databases and custom applications used by the project for sample data tracking and verification of groundwater data are the following:

- Scheduling Database — Microsoft SQL Server database maintained by PNNL. PNNL to schedule sampling of wells and requests for laboratory analysis.

- Sample Data Tracking (SDT) — Microsoft Access tool used to manage sample and analysis scheduling information in HEIS (SDT tables) and to generate field paperwork for sampling and data tracking.

- SDT-Apps2k (Posting) – Microsoft Access tool used to enter field data from sampling activities into HEIS.

- DataCapture — Microsoft Access database and application maintained by PNNL that supports the scheduling, collection, and data entry of water-level data.

- Mr. EDD — Microsoft Access/SQL Server tool used to process electronic data deliverables (EDD) received from analytical laboratories, maintained by PNNL. Data processing includes automated data verification checking and loading into HEIS.

- Request for Data Review (RDR) — Microsoft Access application used to document and manage data review process and places results into a database and tracks status.

Verification of analytical data provided by subcontracted laboratories is performed on both hard copy and EDDs. The hard copy is manually checked to assure the following items are included: results for all requested analyses, required laboratory quality control (QC) results, sample shipping documents, completed chain-of-custody forms, and a case narrative that describes any problems related to the sample analyses. EDDs are processed using Mr. EDD, a custom software application that facilitates the loading of analytical results into the HEIS database. Prior to loading, the data is translated (i.e., copied from the original EDD file to a database table), and numerous automated checks are performed on the data to assure the data is (1) reported in the correct format, (2) complete (i.e., all requested analyses are included along with the appropriate laboratory QC data), (3) consistent with laboratory detection/reporting limits, and (4) qualified correctly. Errors identified during the verification process are documented and classified by Mr. EDD as "fatal" or "non-fatal." Fatal errors must be resolved (generally by having the laboratory correct and re-report the results) before the data can be loaded into HEIS. Examples include incorrect sample numbers or method names, major formatting problems, and multiple results reported for the same sample, method, and constituent. Non-fatal errors (e.g., incorrect detection limits, missing qualifiers) are considered minor in nature and do not prevent data from being loaded into the database. Typically, non-fatal errors are resolved within 2 weeks of the initial load date.

The groundwater data are reviewed quarterly to assure that the reliability and validity of the field and laboratory measurements for groundwater samples collected. The reliability and validity of the measurements are based on accuracy, precision, and detection limits. Representativeness, completeness, and comparability may also be evaluated for overall quality. These parameters are evaluated through laboratory QC checks (e.g., matrix spikes, laboratory blanks), replicate sampling and analyses, analysis of blind standards and blanks, and interlaboratory comparison. Acceptance criteria are established for each of these parameters in the appendix of this plan. When a parameter is outside the criteria, corrective actions are taken to prevent a future occurrence and any data impacted is appropriately flagged. A summary of the QC evaluation is provided to the project scientists quarterly and annually for their use in data review. Reports documenting the QC evaluation results are discussed in Section 6.3.

Groundwater data are provided to project scientists twice per month for an initial data review. The data are formally reviewed quarterly by the project scientists assigned to specific sites to assure the data are complete and representative, and meet the data quality requirements of the respective monitoring plans. The review takes into account results of the quality control evaluation provided by the QC team, and a technical review by a scientist familiar with the hydrogeology of a particular site. This process is defined in the project internal procedure QC-5, *Groundwater Data Validation and Process*, and results of the review are put in the project records.

When the initial or quarterly data review by a scientist identifies suspect data, those data are investigated to establish whether they reflect true conditions or an error. A RDR is initiated in accordance with the project internal procedure DA-3, *Data Review Procedure*. If there are any limitations noted on the data, a flag will be added to the data in HEIS.

6.3 Data Reporting

An interpretive groundwater report is prepared annually to meet the reporting requirements of RCRA and CERCLA regulations and applicable DOE orders. The report includes descriptions of groundwater flow and groundwater chemistry on the Hanford Site. A discussion of the QC results is included that documents the reliability and validity of the field and laboratory measurements for groundwater samples collected. The report is coordinated and prepared by PNNL and contains contributions from other Hanford contractors. Staff from DOE, PNNL, and Fluor Hanford, Inc. review the report before it is finalized. The PNNL report has a wide distribution including regulatory agencies, the Tribal Nations, and stakeholders.

Quarterly reports are prepared to meet an agreement with the regulatory agencies. Summary results of RCRA and CERCLA statistical evaluations and groundwater quality assessments are provided in these reports to DOE, which are then transmitted to Ecology and EPA. The quarterly QC evaluation reports are included in these quarterly reports. Samples that were not collected according to the monitoring plan requirements are documented, and acceptance criteria that were not met are discussed.

Significant changes in groundwater chemistry, such as new exceedances of drinking water standards or derived concentration guides, or other results of potential concern as determined by the project manager, are reported to DOE as necessary.

Seismic data are reported in three quarterly reports and an annual report published by PNNL.

7.0 Analytical Quality Control Checks

Analytical QC checks are performed on internal and external samples as discussed in the following sections.

7.1 Internal Quality Control Samples

A summary of QC check samples is outlined in the Appendix of this plan. Internal QC data are generated when the analytical laboratory prepares QC samples to monitor the quality of their analyses.

7.2 External Quality Control Samples

Performance evaluation (PE) samples are standards of known concentrations used to assess accuracy and to monitor the performance of the analytical laboratories. The PE program administered to the laboratories is described in the Appendix to this plan.

8.0 Assessments

Assessments are performed to gather results that can be evaluated to measure the effectiveness of the quality systems and processes implemented by the project. Assessments will be planned each year for this purpose. Assessments will be performed periodically during the year.

The following types of assessments may be used at varying frequencies during the year:

- Management self assessment — an assessment performed by those immediately responsible for overseeing and/or performing the work to establish whether policies, practices, and procedures are adequate for assuring results needed.

- Management independent assessment — an assessment performed by an individual or group independent of the work performed to assure that policies, practices, and procedures are adequate for assuring results needed.

- Technical independent assessment — an assessment performed by an individual or group technically competent to do the work but independent of the work being performed to assure qualitative and quantitative aspects of the work are accomplished according to documented specifications.

8.1 Assessment Planning

Assessment planning is done by the project management team (including Project Manager, Task Leaders, and appropriate project staff) in consultation with the project Quality Engineer. An assessment schedule will be developed by the project Quality Engineer with Project Manager approval. Assessments may be accomplished by the project staff, project management, and/or the Quality Engineer in accordance with the SBMS subject area, *Planning and Assessment,* Section 4 *Conduct a Specific Assessment* (PNNL

2004b). The assessor plans the assessment by completing a Self-Assessment Planning Form where the scope of the assessment, topic and supporting references are documented on the plan. A unique identification number is assigned to the plan and entered on an Assessment Log Sheet. The Task Manager approves the plan. Figure 7 shows the form that should be used for self-assessment planning.

Scope & Location: (*General: Maintenance, Operations,*	**I.D. Number:** (*ATS Number or other Unique Tracking Number)*
Topic: (*Describe what will be assessed*)	**Date:** (*Date planning form is prepared*)
References: (*Cite Source Documents for Performance Expectations i.e.*, Regulation, Environmental Permit, DOE Order, A-Manual, Standards Based Management System [SBMS], Requirements, Procedures and Guidelines [RPG]).	

Performance Expectations

Criteria developed from Source Documents that will be applied throughout the assessment. Each criteria/expectation will have the reference enclosed in parenthesis at the end of the criteria/expectation statement (e.g., DOE Order 5480.19, SBMS, RPG). Performance expectations should be limited to six maximum to allow the assessment to remain focused. Additional Planning Forms can be completed to expand the scope of a particular assessment.
1.
2.
3.
4.
5.
6.

Procedure: (*Perform the following as applicable for the assessment*)
Review assessment planning form
- Review applicable procedure/requirements. (references)
- Conduct performance tests and data validation.
- Observe the activity controlled by the procedure.
- Interview appropriate personnel about requirements and practices.
- Record observations based on comparison to plan.
- Document the results after receiving final information on the Self-Assessment Results form.

Basics for the Assessment: [ ] Planned [ ] Lessons Learned [ ] Responsive [ ] Other

Work Package Number (optional):

Assessment Requestor/Authorizing Person:

Assessor(s):

Figure 7. Self-Assessment Planning Form

Documentation of assessments will be documented on a *Self-Assessment Results* form (see Figure 8). The corrective action and action owner will be documented on the assessment report. The action owners will be assigned by the Task Manager. An action item log will be maintained by the project Quality Engineer to track and close out actions. The Project Manager will prioritize the corrective actions. The corrective actions will be verified by the project Quality Engineer. When the corrective actions have been closed, the Project Manager will sign the assessment report. The assessment plan and report will distributed to the appropriate Task Managers, Project Manager and project records.

Assessor:	**I.D. Number:**
Assessment Location:	**Date:** (*Date assessment performed*)

Results
(*Related to Associated Performance Expectations*)

(*Use additional pages if necessary*.) Concise and objective statements are the goal. Subjective comments may be added at the end and must be based upon a series of facts that supports the comments. Include strengths and improvement opportunities. Include date the information is obtained and list of line manager or points-of-contact during assessment.
Summary
1.
2.
3.
4.
5.

Subsequent Actions
(*Related to Associated Results*)

Assigned Action	Action Owner	Due Date
1.		
2.		
3.		
4.		
Actions Assigned By:		Date:
Completion (*To be signed by Lead Assessor when assessment is completed.*) **Signature:** **Date:**		
Completion (*To be signed by Manager when assessment is completed and all actions have been entered into ATS*) **Signature:** **Date:**		

Figure 8. Self-Assessment Results

8.2 Subcontractor Assessments

Periodic assessments of the analytical subcontractors are performed as an oversight function or prior to contract award in accordance with the internal acquisition quality procedures. Provisions are made in the SOW to subcontractors for oversight assessment activities to be performed as necessary.

The results of all analytical subcontractors' assessments (including surveillances and audits) will be made available to project and line management, individuals contacted, and the client as requested. The corrective action tracking, corrective action and closure response will be in accordance with the internal acquisition quality procedures. The official assessment report files and responses (audits and surveillances) are maintained in the PNNL Suppliers History File by the Quality Assurance Services group.

Surveillances of the sampling subcontractor activities will be performed by the project Quality Engineer in accordance with the internal acquisition quality procedures. A fiscal year surveillance schedule will be developed by the project Quality Engineer and approved by the Sampling Subtask Leader. The results will be documented in a source verification report and a copy of the report is provided to the sampling subcontractor in accordance with the internal acquisition quality procedures. Also, the original report will be maintained in the PNNL Suppliers History File. A corrective action will be supplied by the sampling subcontractor and approved by the project Quality Engineer. The corrective action will be verified by a follow-up surveillance. The corrective action response letter, the corrective action acceptance letter, and the final closure letter will be maintained in the PNNL Supplier History File. The corrective action will be tracked by the project Quality Engineer.

9.0 Preventive Equipment Maintenance

Subcontracted organizations will be required to implement preventive maintenance on their equipment to mitigate the possibility of down time affecting cost and schedule. This will be specified in the SOW to the respective organizations.

10.0 Specific Routine Procedures Used to Assess Data Precision, Accuracy, and Completeness

The evaluation of laboratory precision, accuracy, and completeness is accomplished during the verification process performed by the Data Processing Sub-Task at PNNL upon receipt of data (see Section 7 of this plan).

11.0 Corrective Action

11.1 Project Corrective Actions Resulting from Assessments

As part of the continuous improvement processes initiated by the project management team, assessments will be tracked and improvement actions identified and prioritized. If immediate corrective action is required, the quality problem will be directly entered into the Assessment Tracking System (ATS) and resultant corrective action as specified in Section 11.2.

11.2 Unplanned Deviations

Corrective action must be initiated by the Project Manager or cognizant Task Leader when unplanned deviations from procedural, contractual, regulatory requirements, or construction specifications occur. These deviations will be documented by documenting the quality problem information directly into the ATS in accordance with SBMS subject area, *Resolving Quality Problems* (PNNL 2004d). The assessment must describe the problem, the cause of the deviation, the impact of the problem, and corrective action needed to remedy the immediate problem and to prevent recurrence.

Subcontractors will be required to have a system in place to identify, correct and prevent recurrence of contractual, procedural or regulatory requirement(s) deviations and to notify the PNNL point-of-contact specified when such an event occurs. These requirements will be passed on in a SOW to the subcontractors.

11.3 Planned Deviations

Planned deviations from procedure, documented (including justification) and approved by the Project Manager or Task Leader in advance, do not constitute a deficiency and do not require generation of an assessment item. Documentation may consist of a hard copy e-mail or memo to the Project Manager or Task Leader. This documentation must include either an approval signature if on a memo or electronic approval via a reply to the e-mail indicating such approval.

11.4 Measuring and Test Equipment Calibration Discrepancies

Subcontractors will be required to maintain a system for identifying calibration discrepancies and tracing data or samples that may have been affected. Subcontractors will be required, via a SOW, to notify the PNNL point-of-contact as soon as possible when such an incident occurs. PNNL will perform periodic assessments to assess the effectiveness of subcontractor procedures and processes for calibration control.

Project staff must investigate instruments or equipment found to be operating outside acceptable operating ranges (as specified in the applicable technical procedure or manufacturer's instructions) and issues must be addressed in accordance with SBMS subject area *Resolving Quality Problems* (PNNL 2004e). When it is determined from calibration verification that Category 1 Measuring and Test Equipment is out of tolerance, proceed with the evaluation to determine impact on data and document the results with justification.

12.0 Quality Assurance Reports to Management

Quality activities, such as project improvement efforts, significant deficiencies identified and corrective actions, and summary of assessment results of project activities will be reported to the Project Manager. When major quality problems are identified, they shall be reported to the Project Manager. Surveillance plans and results of the surveillances are provided to the Project Manager and Task Manager monthly or after a surveillance event. QC results are provided to the Project Manager and Groundwater Monitoring Task Manager every quarter.

Quality-related problems identified by project personnel must be reported to project management immediately for resolution. Any problems involving data quality, sample integrity, or test measurements will be thoroughly documented by a RDR and/or a *Problem and Discrepancies* form and communicated to the appropriate Task Leader and Project Manager for resolution.

Monthly and quarterly reports are provided to DOE that summarize accomplishments, describe the cost and schedule status, the sampling and analysis status, and variances. An annual groundwater monitoring report is generated reporting the groundwater monitoring results to the client, regulatory agencies, Tribal Nations, and the public. A quarterly report summarizing the results of sampling, analysis, and data evaluation in support of RCRA monitoring is provided to DOE for transmittal to the regulatory agencies.

Significant quality-related problems that may affect customer satisfaction shall be communicated to the Product Line Manager by the Project Manager.

13.0 Records

13.1 Records Control

Records that document the sampling subcontractor activities, analytical results, verification and compliance checks, quarterly and annual reports, test plans, groundwater monitoring plans, and assessment reports will be maintained as project records. Project records will be legible, identifiable and maintained in accordance with PNNL internal procedures. The Project Records Specialist prepares and submits a Records Inventory and Disposition Schedule/File Index (RIDS) for review and approval by the records management representative and Quality Engineer. The records custodian reviews and updates the RIDS annually at a minimum, or major change to the program. Records retention schedules shall be based on requirements of TPA (Ecology et al. 1989), which requires the retention of records for 10 years after termination of the TPA.

13.2 Records Transfer to Storage

On an annual basis, the records custodian will transfer to storage inactive records as identified by the Task/Subtask Manager that are not required for day-to-day operations. Sampling and analysis plans, assessments, and special project correspondences as identified by the Task/Subtask Manager will be maintained by the project until the completion of the activity or project. The PNNL project staff member originating the transfer should complete the appropriate internal form (e.g., *Records Transfer/Data Input* (RTDI) form). The records management representative will sign the RTDI form as acknowledging receipt of the records and return a copy of this form to the records custodian. The RTDI form is then placed in project records.

Within 90 days of project completion or termination, records shall be transferred to storage and/or the client.

14.0 Procurement Control

For this project, the majority of procurements will result in purchases of services such as analytical, sampling, support to hydrologic testing, and geophysical logging of boreholes. All procurements will be obtained in accordance with SBMS subject area, *Purchasing Goods and Services* (PNNL 2004d). SOWs for purchasing services shall be reviewed and signed by the project Quality Engineer to assure consistency of quality assurance requirements specified to subcontractors with project quality standards in this plan.

14.1 Analytical Services

Work package authorizations (WPAs), work orders (WOs), or purchase orders (POs), as applicable, shall be used to obtain analytical services. A letter of instruction (LOI) or SOW must accompany each WO, WPA, or PO. A review must be performed by the Quality Engineer during the planning stages and preparation of the SOW/LOI. The work authorization document must define the data quality and any additional project requirements associated with the service requested. The data quality requirements should include a description of the QC samples for each analysis for determining the level of possible contamination from preparation and analysis. The project requirements should include information on analysis method, calibration standards traceable to the National Institute of Standards and Technology, sample turnaround time and reporting requirements, and disposal requirements for remaining sample material and the waste from the process.

15.0 Staff Training

Staff performing activities affecting quality shall be issued documented training assignments including applicable project administrative and technical procedures and this plan.

1. Task Leaders and staff members will assess project specific training needs. The assessment will include evaluating cumulative training records of the staff.

2. Task Leaders will assign reading /or briefings of procedures as needed. If training is assessed and the need for formalized training identified, the staff member will be scheduled to attend a formal training class.

3. Task Leaders and staff will document training on a *Briefing Document*, an individual *On-the-Job Training* (OJT) or *Reading Assignment Documentation* form, or a *Group OJT* or *Reading Assignment Documentation* form. These forms are available internally to PNNL staff. Documentation shall be sent to the PNNL Laboratory Training Coordinator for input into the training database. The training database will contain the record copy of project staff training.

Subcontractors are responsible for special training of their staff in accordance with the respective SOW.

16.0 Software Control

Various tasks of the project require the use of databases and software, which are managed, controlled, and operated by entities that are outside PNNL. The project also requires the use of databases and software that are developed, managed, controlled and operated by PNNL. A graded approach is used to establish software requirements based on the identified risk.

Fluor Hanford, Inc. is responsible for the management, operation, and maintenance of HEIS (including SDT tables) and HWIS. However, PNNL is responsible for the integrity, accuracy, and traceability of the data that PNNL collects.

The project has developed and uses databases and custom applications to support various business processes including but not limited to development of sample scheduling and collection, data tracking, data verification and loading and reporting (see Section 6.2). These databases, custom applications, software, spreadsheets, and queries used to generate reportable results shall be documented in accordance with the SBMS subject area, *Software* (PNNL 2004f). This documentation is maintained in project files.

17.0 Nonconformances and Deficiencies

For procured materials found to be in nonconformance with specifications or where the quality of an activity found not to be in compliance, the quality problem will be documented into the ATS in accordance with the SBMS subject area, *Resolving Quality Problems* (PNNL 2004e). Corrective actions are documented by using ATS in accordance with the SBMS subject area, *Assessment Management* (PNNL 2004a).

If a deficiency is found where a procedure or process is not followed or the activity is not in compliance with a procedure or process, the deficiency will be documented into the ATS in accordance with the SBMS subject area, *Resolving Quality Problems* (PNNL 2004a). Corrective action will be documented using ATS in accordance with the SBMS subject area, *Assessment Management* (PNNL 2004a).

When the analytical data (hard copy or electronic data) is found to be incomplete or deficient in data by the data processing staff verification, a *Problem and Discrepancies* form is filled out in accordance with the PNNL internal procedure DM-3, *Verification of Analytical Data*. Also, when the technical staff performs the initial data review and/or a comparison of the recent data to historical trends, any suspect data is submitted to the verification group by a RDR.

Subcontractors will be required to have a system for identifying and dispositioning nonconforming items, procedure deficiencies, process not followed, or activities not in compliance to a procedure or a process. This requirement will be specified in a SOW.

18.0 Document Control

18.1 Project QA Plan Control

Distribution and control of this QA Plan shall be performed in accordance with SBMS *Document Control* subject area**.** Modifications to this plan shall be made either by revision or by issuing an Interim Change Notice (ICN). See Figure 9 for the ICN form and instructions. This plan will be revised after four ICNs. Any PNNL staff member may request a change to this QA Plan at any time by submitting the requested change in writing to the Project Manager and Quality Engineer. All reviewers listed on the signature page and affected by the change will approve the revision. The ICN will be placed in front of the signature page and the individual pages will be placed or the necessary correction will be lined out and correction added with initial and date.

18.2 Technical Procedure Control

Technical procedures referenced by this QA Plan and used by PNNL staff will be contained in an PNNL internal procedure manual, *Procedures for Ground-Water Investigations*. Technical procedures will be distributed and controlled in accordance with SBMS subject area, *Document Control* (PNNL 2001). Modifications to any of the internal procedures shall be made either by revision or by issue of an ICN. There are minor or major changes and their definitions are described in Section 18.1. Figure 9 shows the form and instructions.

Procedures will be revised after two major ICNs. Any PNNL staff member may request a change to procedures at any time by submitting the requested change in writing to the author, Sampling and Analyses Task Manager, and Quality Engineer. The author, technical reviewer, groundwater project Task Manager, and project Quality Engineer will review and approve the ICN. The ICN will be placed in front of the signature page and the individual pages will be placed or the necessary correction will be lined out and correction added with initial and date. Contact the Project Quality Engineer for the electronic copy of the ICN. New or revised technical procedures, whether they will be included in the internal procedures manual or not, must be developed in accordance with SBMS subject area, *Procedures, Permits, and Other Work Instructions* (PNNL 2004c). The procedure owner is required to review the procedure at least every 3 years in accordance with the subject area.

INSTRUCTIONS FOR ICN FORM

HEADER:

The ICN number is identified as ICN No.-____.

For a published groundwater monitoring plan, each page of the ICN shall have a header on the right upper corner that includes the report number, the date and the pagination. The number of the ICN must be placed after the PNNL number. The second line of the header should show the date and pagination. The cover sheet needs to identify how many pages in the ICN packet.

Example header: PNNL-xxxxx-ICN-x
Month, day, year; Page x of xx

SECTION A.

Self-explanatory.

SECTION B.

Include all actions that the document holder must take to update the procedure or instruction. Possible actions include: replacing pages of the document with pages that are distributed with the ICN and marking up the document (in ink) to reflect the changes identified on the ICN or attach the ICN cover sheet to the front of the document.

For a "Published" groundwater monitoring plan include the following statement: "Attach this ICN to the front of the document, just before the title page."

SECTION C.

Identify, by title, all personnel whose job functions will be affected by the change and include a brief description of the effect. If there is no effect on personnel (e.g., the change was made to clarify the intent of the procedure or to correct a typographical error) this block should be marked "N/A."

SECTION D.

State the reason for the change followed by a description of the change (including the affected paragraph, information which is deleted, and the actual wording of any replacement test) for each change included on the ICN.

SECTION E.

The Cognizant Manager shall document the reason for not obtaining original reviewers approval and/or any other decisions that must be documented. Additionally, list the individuals who will receive the document (distribution list).

SECTION F.

Identify type of change and document required approvals.

Figure 9. Interim Change Notice

INTERIM CHANGE NOTICE
(ICN)

Page ___ of ___

A. Document No.: **Revision No.:** **Document Title:** **Document's Original Author:**	**Implementation Date of ICN:** __/__/
	Change Requested By:
B. Action:	
C. Effect of Change:	
D. Reason for Change/Description of Change: **Reason for Change**: **Description of Change**:	
E. Document Management Decisions:	
F. Groundwater Monitoring Task Manager Approval Signatures (Please Sign and Date)	

Project Quality Engineer Approval: ____Date: ___________________________

Author Approval: ____Date: ___________________________

Other Approvals: ____Date: ___________________________

Figure 9. (contd)

18.3 Administrative Procedure /Instruction Preparation and Control

Administrative procedures/instructions used by PNNL staff will be developed, approved, and controlled to ensure consistent application by those staff performing the defined task(s). These procedures/instructions will be developed, approved, and controlled in a manner that has been approved by appropriate project management and Quality Engineer.

18.4 Groundwater Monitoring Plans

Groundwater monitoring plans are generally released (published) through PNNL's information release process (ERICA), with the exception of RCRA final-status plans that are a chapter of the Hanford Facility RCRA Permit (Ecology 1994). Different types of monitoring plans have different document change control requirements, as discussed in the following sections. Change control will include internal as well as external (e.g., DOE) requirements.

18.4.1 RCRA Interim-Status Plans

These plans are PNNL documents and are released through ERICA. Modifications to these plans shall be made using an ICN or by revising the plan. (Figure 9 shows the ICN form and instructions.) The number of ICNs that may be written for a single plan is not limited so long as revision control is maintained and the working version of the plan and ICN is not in question. Distribution and control of the ICN shall be through ERICA. The author, Groundwater Monitoring Task Manager, and the project Quality Engineer will review and approve the ICN.

Project change control for these plans in the interim period between ICNs or revisions is maintained by the sampling and analysis change request process. These changes are approved by project management, attached to the current plan in project records, and implemented via the project scheduling system.

18.4.2 RCRA Final-Status Plans

Final-status plans may be stand-alone documents that are cited in the Hanford Facility RCRA Permit (Ecology 1994), or contained in the Permit itself. Final-status monitoring plans are revised through the Permit Modification process, which is described in the TPA (Ecology et al. 1989) and in the Hanford Facility RCRA Permit (Ecology 1994). Depending on the magnitude (or class) of the changes, they will require contractor and DOE review and approval, regulatory agency review and approval, and/or public review and participation.

Change control for these plans in the interim period between Permit revisions is maintained by the *Sampling and Analysis Change Request* process. These changes are approved by project management, attached to the current plan in project records, and implemented via the project scheduling system.

18.4.3 CERCLA Sampling and Analysis Plans

Monitoring plans supporting CERCLA groundwater operable units are referred to specifically as sampling and analysis plans (SAPs) and are released as DOE documents. The SAPs are reviewed and, if necessary, revised annually; this requires DOE and regulatory agency review and approval. The SAPs may have temporary (duration less than one year) additions (adding constituents, wells, or increasing frequency), or unavoidable changes (such as dry wells, missed or delayed samples); these require notification to project management and DOE, as well as notification to the regulatory agency via email messages or Unit Manager Meeting minutes. Permanent changes (for duration more than one year) are identified to DOE and regulatory agencies for approval prior to documenting them in the revised SAPs. Distribution and control of the revised SAPs shall be by the project editor.

Project change control in the interim period between SAP revisions is maintained by the *Sampling and Analysis Change Request* process. These changes are approved by project management, attached to the current plan in project records, and implemented via the project scheduling system.

18.4.4 Other Monitoring Plans

Other monitoring plans may include plans for AEA monitoring (e.g., 100-K Basins). These plans are PNNL documents and are released and distributed via ERICA. Modifications to these plans shall be made using an ICN or by revising the plan, as discussed in Section 18.4.1.

Project change control for the plans in the interim period between ICNs or revisions is maintained by the Sampling and Analysis Change Request process. These changes are approved by project management, attached to the current plan in project records, and implemented via the project scheduling system.

19.0 References

10 CFR 830. U.S. Department of Energy. "Energy/Nuclear Safety Management, Subpart A--Quality Assurance Requirements." *U.S. Code of Federal Regulations.*

40 CFR 136, Chapter 1, Appendix B (7/1/01). U.S. Environmental Protection Agency. "Guidelines Establishing Test Procedures for the Analysis of Pollutants." *U.S. Code of Federal Regulations.*

40 CFR 264. U.S. Environmental Protection Agency. "Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." *U.S. Code of Federal Regulations.*

40 CFR 265. U.S. Environmental Protection Agency. "Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities." *U.S. Code of Federal Regulations*.

40 CFR 300. U.S. Environmental Protection Agency. "National Oil and Hazardous Substances Pollution Contingency Plan." *U.S. Code of Federal Regulations*.

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Appendix

Groundwater Performance Assessment Project
Quality Control Plan

Appendix

Groundwater Performance Assessment Project
Quality Control Plan

A.1 Introduction

This appendix describes the basic methods and procedures to implement a groundwater monitoring quality control task for sampling and analysis conducted in association with the Groundwater Performance Assessment Project. The quality control (QC) practices described in this plan help to evaluate whether samples free of contamination are obtained during sampling and that the laboratory performed sample analyses within the accuracy and precision limits required by the project.

The primary objectives of this plan are listed below:

1. Identify the QC elements selected for the Groundwater Performance Assessment Project.
2. Provide data quality objectives (DQO) for reporting limits, precision, accuracy, and completeness.
3. Indicate actions that are to be taken for out of tolerance data.

Data quality needs for certain *Resource Conservation and Recovery Act* (RCRA) facilities may be more stringent that the QC criteria defined in this plan. DQOs for those units are defined in the groundwater monitoring plans specific to those sites.

A.2 Technical Requirements

The technical requirements for QC are divided into two types – components that provide checks on field and laboratory activities (Field QC) and factors that help to monitor laboratory performance (Laboratory QC). Each type of QC sample has required frequencies and acceptance criteria.

The following guidance documents were used as aids in determining the QC elements necessary for the Groundwater Performance Assessment Project:

1. *Quality Assurance Manual for the Waste Management Branch Investigations* (EPA 910/9-86-00).

2. *Resource Conservation and Recovery Act (RCRA) Groundwater Monitoring Technical Enforcement Guidance Document* (EPA/OSWER-9950.1).

3. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, SW-846, Third Edition* (EPA/SW-846).

4. *Handbook for Analytical Quality Control in Water and Wastewater Laboratories* (EPA-600/4-79-019).

5. *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD) (DOE/RL-96-68).

QC elements were selected based on the needs of the project and the value the results from each type of sample will add to the data.

A.2.1 Field Quality Control

To indicate whether groundwater samples are collected in a consistent manner and are properly preserved and transported to the analytical laboratory, four types of QC samples are collected before or during sampling:

1. **Full Trip Blanks (FTB)** — These samples are prepared by the sampling team before traveling to a sampling site. A preserved bottle set, identical to the set that will be used for sample collection in the field, is filled with reagent water (carbon free, deionized water). Dead water from well 699-S11-E12AP is used for low-level tritium FTBs. The FTB bottles are sealed by the sampling team and transported unopened to the field in the same storage container that will be used for the samples collected that day. These samples are typically analyzed for the same constituents as the samples from the associated well.

2. **Field Transfer Blanks (FXR)** — Preserved volatile organic analysis (VOA) sample bottles are filled at the sample collection site with reagent water that has been transported to the field. The samples are prepared during the sampling of a well to evaluate potential contamination caused by conditions in the field. After collection, the FXR bottles are sealed and placed in the same sample storage container as the rest of the samples. The FXR bottles are not removed from the storage container until delivery to the analytical laboratory. FXR samples are typically analyzed for volatile organic compounds only.

3. **Equipment Blanks (EB)** —Reagent water is passed through the pump or manifold after decontamination (sometimes just prior to sampling) to collect blank samples identical to a set that will be collected in the field. Preserved bottles are used. The EB bottles are placed in the same container as the associated field samples. EB samples are not removed from the container until delivery to the analytical laboratory.

4. **Field Duplicates (DUP)** — A replicate sample that is collected at one well. After each type of bottle is filled, a second, identical bottle is filled for each type of analysis as directed by chain-of-custody requirements. Both sets of samples are stored and transported together.

Using several types of field blank samples provides checks on bottle cleanliness, preservative purity, equipment decontamination, proper storage and transport of samples, and reveals whether or not samples collected for volatiles may have been contaminated during collection. Sampling in replicate provides information about sampling reproducibility. Field QC sample frequencies are shown in Table A.1. In addition to the evaluation characteristics described in Table A.1, the field QC samples also provide a check on the analytical laboratory. The field QC data are designed to give an overall impression of the performance of the sampling and analysis of the Groundwater Performance Assessment Project; however, individual data points associated with field QC samples that are outside of the acceptance criteria are flagged in the HEIS database.

Table A.1. Quality Control Samples

Sample Type	Primary Characteristics Evaluated	Frequency
Field QC		
Full Trip Blank (FTB)	Contamination from containers or transportation	1 per 20 well trips
Field Transfer Blank (FXR)	Contamination from sampling site	1 each day VOCs sampled
Equipment Blank (EB)	Contamination from non-dedicated equipment	As needed[(a)]
Replicate/Duplicate Samples	Reproducibility	1 per 20 well trips
Laboratory QC		
Sample Type	Primary Characteristics Evaluated	Frequency
Method Blanks	Laboratory Contamination	1 per batch
Lab Duplicates	Laboratory Reproducibility	[(b)]
Matrix Spikes	Matrix Effect and Laboratory Accuracy	[(b)]
Matrix Spike Duplicates	Laboratory Reproducibility/Accuracy	[(b)]
Surrogates	Recovery/Yield	[(b)]
Laboratory Control Samples	Method Accuracy	1 per batch

(a) For portable Grundfos pumps, equipment blanks are collected one per ten well trips. Whenever a new type of non-dedicated equipment is used, an equipment blank shall be collected every time sampling occurs until it can be shown that less frequent collection of equipment blanks is adequate to monitor the decontamination procedure for the non-dedicated equipment.
(b) As defined in the laboratory contract or QA plan and/or analysis procedures.
QA = Quality assurance.
QC = Quality control.
VOC = Volatile organic compound.

The results of each type of field QC sample are evaluated according to criteria defined in Table A.2.

Table A.2. Field and Laboratory QC Elements and Acceptance Criteria

Method	QC Element	Acceptance Criteria	Corrective Action
General Chemical Parameters			
Alkalinity - EPA 310.1	MB[a]	< MDL	Flagged with "C"
Chemical Oxygen Demand - EPA 410.4	LCS	80-120% recovery[b]	Data reviewed[c]
Conductivity - EPA 120.1	DUP	± 20% RPD[b]	Data reviewed[c]
Oil and Grease - EPA 413.1	MS[d]	75-125% recovery[b]	Flagged with "N"
pH - EPA 150.1	EB, FTB	< 2X MDL	Flagged with "Q"
Total Dissolved Solids - EPA 160.1	Field Duplicate	± 20% RPD[e]	Flagged with "Q"
Total Organic Carbon - EPA 9060			
Total Organic Halides - EPA 9020			
Ammonia and Anions			
Ammonia - EPA 350.1	MB	< MDL	Flagged with "C"
Anions by IC - EPA 300.0	LCS	80-120% recovery[b]	Data reviewed[c]
Cyanide - EPA 9012	DUP	± 20% RPD[b]	Data reviewed[c]
	MS	75-125% recovery[b]	Flagged with "N"
	EB, FTB	< 2X MDL	Flagged with "Q"
	Field Duplicate	± 20% RPD[e]	Flagged with "Q"
Metals			
Arsenic - EPA 7060	MB	< CRDL	Flagged with "C"
Cadmium - EPA 7131	LCS	80-120% recovery[b]	Data reviewed[c]
Chromium - EPA 7191	MS	75-125% recovery[b]	Flagged with "N"
Lead - EPA 7421	MSD	± 20% RPD[b]	Data reviewed[c]
Mercury - EPA 7470	EB, FTB	< 2X MDL	Flagged with "Q"
Selenium - EPA 7740	Field Duplicate	± 20% RPD[e]	Flagged with "Q"
Thallium - EPA 7841			
ICP Metals - EPA 6010			
ICP/MS Metals - EPA 6020			
Volatile Organic Compounds			
Volatiles by GC/MS - EPA 8260	MB	< MDL	Flagged with "B"
Total Petroleum Hydrocarbons by GC	LCS	Statistically derived[f]	Data reviewed
	MS	Statistically derived[f]	Flagged with "N"
	MSD	Statistically derived[f]	Data reviewed[c]
	SUR	Statistically derived[f]	Data reviewed[c]
	EB, FTB, FXR	< 2X MDL[g]	Flagged with "Q"
	Field Duplicate	± 20% RPD[e]	Flagged with "Q"
Semivolatile Organic Compounds			
Herbicides by GC - EPA 8151	MB	< 2X MDL	Flagged with "B"
PCBs by GC - EPA 8082	LCS	Statistically derived[f]	Data reviewed[c]
Pesticides by GC - EPA 8081	MS	Statistically derived[f]	Flagged with "N"
Phenols by GC - EPA 8041	MSD	Statistically derived[f]	Data reviewed[c]
Semivolatiles by GC/MS - EPA 8270	SUR	Statistically derived[f]	Data reviewed[c]
	EB, FTB	< 2X MDL[g]	Flagged with "Q"
	Field Duplicate	± 20% RPD[e]	Flagged with "Q"

Table A.2. (contd)

Method	QC Element	Acceptance Criteria	Corrective Action
Radiological Parameters			
Gamma Scan	MB	< 2X MDA	Flagged with "B"
Gross Alpha - EPA 9310	LCS	70-130% recovery	Data reviewed[c]
Gross Beta - EPA 9310	DUP	± 20% RPD	Data reviewed[c]
Iodine-129	MS[h]	60-140% recovery	Flagged with "N"
Plutonium (isotopic)	EB, FTB	< 2X MDA	Flagged with "Q"
Strontium-89/90	Field Duplicate	± 20% RPD[5]	Flagged with "Q"
Technetium-99			
Tritium - EPA 906.0			
Tritium (low-level)			
Uranium (isotopic)			
Uranium (total)			

(a) Does not apply to pH.
(b) Laboratory-determined, statistically derived control limits may also be used. Such limits are reported with the data.
(c) After review, corrective actions are determined on a case-by-case basis. Corrective actions may include a laboratory recheck or flagging the data as suspect (Y flag) or rejected (R flag).
(d) Applies to total organic carbon and total organic halides only.
(e) Applies only in cases where one or both results are greater than 5X the detection limit.
(f) Determined by the laboratory based on historical data. Control limits are reported with the data.
(g) For common laboratory contaminants such as acetone, methylene chloride, 2-butanone, toluene, and phthalate esters, the acceptance criteria is < 5X MDL.
(h) Applies only to technetium-99 and total uranium analyses.

Data Flags:
B, C = Possible laboratory contamination (analyte was detected in the associated method blank).
N = result may be biased (associated matrix spike result was outside the acceptance limits).
Q = problem with associated field QC sample (blank and/or duplicate results were out of limits).
DUP = Laboratory matrix duplicate.
EB = Equipment blank.
FTB = Full trip blank.
FXR = Field transfer blank.
GC = Gas Chromatography.
ICP = Inductively coupled plasma.
ICP/MS = Inductively coupled plasma-mass spectrometry.
LCS = Laboratory control sample.
MB = Method blank.
MDA = Minimum Detectable Activity.
MDL = Method detection limit.
MS = Matrix spike.
MSD = Matrix spike duplicate.
PCBs = Polychlorinated biphenyls.
RPD = Relative percent difference.
SUR = Surrogate.

Bias is assessed by comparing a measured value to a known or accepted reference value or the recovery of a known amount of spiked contaminant into a sample (i.e., a matrix spike). For a matrix spike (MS) bias caused by matrix effects is calculated as follows:

$$B = (X_s - X_u) - K$$

where X = measured value of spiked sample
X_u = sample or miscellaneous contribution
K = known value of spike

Using the following equation yields percent recovery (%R):

$$\%R = 100\,(X_s - X_u)/\,K$$

Analytical precision is determined by analyzing duplicates (field or lab). Precision is expressed as either percent relative standard deviation (RSD) or relative percent difference (RPD). Duplicate results are flagged if the results of both samples are quantifiable (i.e., the result is greater than the 5 times the instrument detection limit [IDL]/method detection limit [MDL]/minimum detectable activity [MDA]) and the RPD is greater than 20%. The RPD is calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

where D_1 = original sample value
D_2 = duplicate sample value

When more than two data values are present, calculate precision by the RSD:

$$RSD = \frac{\text{standard deviation}}{\text{mean}} \times 100$$

A.2.2 Quality Control in the Laboratory

The ability of the laboratories to perform sample analyses within the limits established by the project is monitored in several ways. Internal quality assurance programs are maintained by laboratories utilized by the Groundwater Performance Assessment Project. In addition, the laboratories are periodically reviewed and audited both internally and externally. PNNL participates in external audits. Laboratory quality assurance includes a comprehensive quality control program, which includes the use of matrix spikes (MS), matrix duplicates (MD), matrix spike duplicates (MSD), laboratory control samples (LCS), surrogates, tracers, and blanks. These samples are recommended in the guidance documents and are required by U.S. Environmental Protection Agency (EPA) protocol.

Matrix Duplicate (MD) — An intra-laboratory split sample that is used to evaluate the precision of a method in a given sample matrix.

Matrix Spike (MS) — An aliquot of a sample spiked with a known concentration of target analyte(s). The MS is used to assess the bias of a method in a given sample matrix. Spiking occurs prior to sample preparation and analysis.

Matrix Spike Duplicate (MSD) — A replicate spiked aliquot of a sample that is subjected to the entire sample preparation and analytical process. MSD results are used to determine the bias and precision of a method in a given sample matrix.

Laboratory Control Sample (LCS) — A control matrix spike (e.g., deionized water) spiked with analytes representative of the target analytes or a certified reference material that is used to evaluate laboratory accuracy.

Method Blank — An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank is carried through the complete sample preparations and analytical procedure. The method blank is used to quantify contamination resulting from the analytical process.

Surrogates — A compound added to all samples in the analysis batch (field samples and QC samples) prior to preparation. The surrogate is typically similar in chemical composition to the compound or analyte being determined, yet not normally encountered in most samples. Surrogates are expected to respond to the preparation and measurement systems in a manner similar to the analytes of interest. Because surrogates are added to all standards, samples, and QC samples, they are a useful tool in evaluating overall method performance in a given matrix. Surrogates are utilized only in organic analyses.

Tracers — A tracer is a known quantity of radioactive isotope that is different from that of the isotope of interest but is expected to behave similarly and is added to an aliquot of sample. Sample results are generally corrected based on tracer recovery.

The laboratories are required to analyze samples within the holding times specified by the analysis procedure. In some instances, constituents in samples not analyzed within the holding time may be compromised by volatilization, decomposition or other chemical changes. Data from samples analyzed outside the holding time are flagged in the HEIS database with an H. The holding times for constituents frequently analyzed by the Groundwater Performance Assessment Project are listed in Table A.3.

Other tools are used by the project to evaluate the laboratories. Double-blind standards of the constituents of concern are submitted to the primary laboratory in triplicate or quadruplicate on a quarterly basis. Because the results of double-blind standards provide information on laboratory precision and accuracy, these standards are useful tools to verify that the project DQOs is being met. Table A.4 lists the typical blind-standard constituents and their submission frequencies. Due to the occasional need to investigate potential problems at the laboratories, the list of constituents is subject to change. Specific information about the constituents used and their spiking levels will be maintained in the project files.

Table A.3. Groundwater Performance Assessment Project Holding Times

Constituents	Methods	Holding Times
Volatile organics	SW-846,[a] 8010/8020/8260	14 days
Semivolatile organics	SW-846, 8270	7 days before extraction 40 days after extraction
Pesticides	SW-846, 8080	7 days before extraction 40 days after extraction
Polychlorinated biphenyls	SW-846, 8080	7 days before extraction 40 days after extraction
Chlorinated herbicides	SW-846, 8150	7 days before extraction 40 days after extraction
Phenols	SW-846, 8040	7 days before extraction 40 days after extraction
ICP metals	SW-846, 6010	6 months
ICP-MS	SW-846, 6020	6 months
Arsenic	SW-846, 7060	6 months
Lead	SW-846, 7421	6 months
Mercury	SW-846, 7470/7471	28 days
Selenium	SW-846, 7740	6 months
Thallium	SW-846, 7841	6 months
Alkalinity	EPA 600 Series, 310.1	14 days
Cyanide	SW-846, 9010/9012	14 days
Bromide	EPA 600 Series, 300.0	28 days
Chloride	EPA 600 Series, 300.0	28 days
Fluoride	EPA 600 Series, 300.0	28 days
Nitrate	EPA 600 Series, 300.0	48 hours
Nitrite	EPA 600 Series, 300.0	48 hours
Phosphate	EPA 600 Series, 300.0	48 hours
Sulfate	EPA 600 Series, 300.0	28 days
Total organic carbon	SW-846, 9060	28 days
Total organic halides	SW-846, 9020	28 days
Chemical oxygen demand	EPA 600 Series, 410.4	28 days

(a) EPA/SW-846, as amended.

Table A.4. Blind-Standard Constituents and Schedule

Constituents	Frequency	Recommended Recovery (%)[a]	Precision (%RSD)[a]
Carbon Tetrachloride	Quarterly	±25 %	±25 %
Chloroform	Quarterly	±25 %	±25 %
Trichloroethylene	Quarterly	±25 %	±25 %
Fluoride	Quarterly	±25 %	±25 %
Nitrate	Quarterly	±25 %	±25 %
Cyanide	Quarterly	±25 %	±25 %
Chromium	Annually	±20 %	±20 %
Total Organic Carbon[b]	Quarterly	Varies according to spiking compound	Varies according to spiking compound
Total Organic Halides[c]	Quarterly	Varies according to spiking compound	Varies according to spiking compound
Gross alpha[d]	Quarterly	70 - 130 %	±20 %
Gross beta[e]	Quarterly	70 - 130 %	±20 %
Tritium	Annually	70 – 130 %	±20 %
Tritium (low level)	Semi-annual	70 – 130 %	±20 %
Cobalt-60	Annually	70 – 130 %	±20 %
Strontium-90	Quarterly	70 – 130 %	±20 %
Technetium-99	Quarterly	70 – 130 %	±20 %
Iodine-129	Semi-annually	70 – 130 %	±20 %
Cesium-137	Annually	70 – 130 %	±20 %
Uranium	Quarterly	70 – 130 %	±20 %
Plutonium-239/240	Quarterly	70 – 130 %	±20 %

(a) If the results are less than 5 times the required detection limit, then the criteria is that the difference of the results of the replicates is less than the required detection limit.
(b) The spiking compound generally used for total organic carbon (TOC) is potassium phthalate. Other spiking compounds may also be used.
(c) Two sets of spikes for total organic halides (TOX) will be used. The spiking compound for one set should be 2,4,5-trichlorophenol. The spiking compound for the second set should include the constituents used for the volatile organic compounds (VOA) sample (carbon tetrachloride, chloroform, trichloroethylene).
(d) The gross alpha sample will be prepared from Pu-239.
(e) The gross beta sample will be prepared from Sr-90.
RSD = Relative standard deviation.

Blind standards are prepared by spiking matrix groundwater and deionized water with known concentrations of constituents of interest. Spiking concentrations range from MDA or MDL, depending on the constituent measured, to the upper limit of concentration determined in groundwater on the Hanford Site. The matrix groundwater wells chosen are 699-49-100C for radiochemical analytes, and total organic halides (TOX); and 699-19-88 for cyanide, anions, inductively coupled plasma (ICP) metals, and total organic carbon (TOC). Deionized water is used to prepare volatile organic compounds (VOA). Well 699-49-100C is located to the west of the Hanford Site. Well 699-19-88 is a southern boundary well. Both wells are considered free of the contaminant migration zone. Dead water from well 699-S11-E12AP is used to prepare low-level tritium blind standards.

Blind-standard results are evaluated by comparing the laboratory results to the actual spike values. Laboratory precision also is considered as the samples are sent to the laboratory in replicate. Laboratory results are evaluated based on the recovery and precision criteria listed in Table A.4. Results outside of these control limits are investigated and appropriate actions are taken, if necessary.

The laboratories also participate in the nationally based studies conducted by Environmental Resources Associates, New York State Department of Health, and DOE to evaluate laboratory performance for chemical and radiological constituents. Reports from these performance evaluation studies are reviewed quarterly by the QC sub-task manager. These reports provide an independent check on laboratory performance. If a laboratory has results that are outside of the acceptance range for one of these studies, the laboratory proposed corrective actions are requested and evaluated. The QC sub-task manager will respond to the corrective actions as appropriate.

A.3 Data Quality Objectives

DQOs are defined for reporting limits, precision, accuracy, and completeness. Groundwater monitoring plans or sampling analysis plans specify whether or not a particular site has more stringent DQOs than those specified in this plan.

Limits for precision and accuracy for chemical analyses are based on criteria stipulated in the methods (e.g., EPA/SW-846, EPA 600 series). Precision and accuracy limits for radiochemical results are specified in the laboratory contract.

Completeness is defined as the percentage of data points judged to be valid. The percent complete each quarter should be at least 85%.

Reporting limits for radiochemical constituents are defined in the laboratory contract. Reporting limits as low as one third the derived 4-mrem-dose requirement are preferred, but not always achievable. Preferred reporting limits and actual reporting limits are listed in Table A.5 for radiochemical constituents. For chemical constituents, MDLs as low as one third the EPA drinking water standards are preferred. In some cases, MDLs that are one third the regulatory limit are not feasible (e.g., pentachlorophenol and cadmium). Because MDLs change frequently, these values are not provided in this document.

Table A.5. Reporting Limits for Radiochemical Constituents

Constituent of Concern	Method	CAS #	DWS	1/3 DWS	RDL
Gross Alpha	Gross Alpha - GA	12587-46-1	15 pCi/L*	5 pCi/L*	3 pCi/L
Gross Beta	Gross Beta - GB	12587-47-2	N/A	N/A	4 pCi/L
Cobalt-60	Gamma Spec	10198-40-0	100 pCi/L	33 pCi/L	25 pCi/L
Cesium-137		10045-97-3	200 pCi/L	67 pCi/L	15 pCi/L
Europium-152					50 pCi/L
Europium-154			200 pCi/L	67 pCi/L	50 pCi/L
Europium-155			600 pCi/L	200 pCi/L	50 pCi/L
Tritium	H-3	10028-17-8	20,000 pCi/L	6700 pCi/L	400 pCi/L
Tritium	H-3 (LL)	N/A	N/A	N/A	10 pCi/L
Iodine-129	I-129	10043-66-0	1 pCi/L	0.33 pCi/L	5 pCi/L
Iodine-129	I-129 (LL)	N/A	N/A	N/A	1 pCi/L
Strontium-90	Sr-89/Sr-90	10098-97-2	8 pCi/L	2.7 pCi/L	2 pCi/L
Technetium-99	Tc-99	14133-76-7	900 pCi/L	300 pCi/L	15 pCi/L
Plutonium-238	Isotopic Plutonium		1.6 pCi/L	0.5 pCi/L	1 pCi/L
Plutonium-239/240	Pu-AEA		1.2 pCi/l	0.4 pCi/L	1 pCi/L
Uranium-234	Isotopic Uranium	13966-29-5	20 pCi/L	6.7 pCi/L	1 pCi/L
Uranium-235	Uranium-AEA	15117-96-1	24 pCi/L	8 pCi/L	1 pCi/L
Uranium-238		U-238	24 pCi/L	8 pCi/L	1 pCi/L
Total alpha energy emitted from Radium	Total Radium	N/A	N/A	N/A	1 pCi/L
Uranium (elemental)	Total Uranium	N/A	30 µg/L	10 µg/L	0.1 µg/L

* Excluding uranium
CAS# = Chemical abstract service number.
DWS = Drinking water standard.
N/A = Not applicable.
RDL = Required detection limit.

A.4 Reporting and Deliverables Requirements

The results of the blind standards and the field QC samples will be provided through current analytical reporting procedures. The QC analytical results will be reviewed by the QC sub-task manager and compiled in a database for statistical analysis and trending.

Compiled QC data will be submitted annually for the Hanford Site groundwater monitoring report (e.g., PNNL-14548).

A.4.1 Quarterly Progress Reports

Previous quarter results will be provided to the Groundwater Performance Assessment Project staff for review and assessment. The schedule for each quarterly report is determined by the reporting sub-task manager.

A.4.2 Washington State Department of Health

The Washington State Department of Health (DOH) is responsible for verifying the adequacy and accuracy of environmental radiation monitoring programs in Washington. As part of this oversight, DOH requests that the Groundwater Performance Assessment Project split well and blind spike samples with the DOH laboratory at regular intervals throughout the year. The results from these split samples are summarized in the Washington State Environmental Radiation Program Annual Reports (e.g., DOH 1990). This arrangement helps to assure that the commercial laboratories used for radiochemical analysis of Hanford groundwater samples are performing satisfactorily.

A.4.3 Project Records

All project records associated with quality control are maintained in accordance with the RIDs for the Groundwater Performance Assessment Project.

A.5 References

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