Chapter 10: Quality Assurance of Environmental Surveillance Monitoring Programs

CHAPTER 10

Quality assurance (QA) consists of planned and systematic activities that give confidence in the results of environmental surveillance monitoring programs (NCRP 2012). The environmental surveillance monitoring programs conducted at the Idaho National Laboratory (INL) Site in 2024 include air (e.g., air filters, quarterly composites), atmospheric moisture, precipitation, drinking water, surface water, effluents, groundwater, agricultural products (e.g., milk, alfalfa, lettuce, potato, wheat), big game, soil, bats, and direct radiation. These environmental surveillance monitoring programs should provide data of known quality for assessments and decision-making efforts. QA and quality control (QC) programs were maintained by INL Site contractors and laboratories performing environmental analyses.

GEL Laboratories, LLC (GEL), was rigorously assessed and audited in 2024 by the U.S. Department of Energy Consolidated Audit Program-Accreditation Program (DOECAP-AP). No major audit findings were identified by DOECAP-AP third-party accreditation bodies that would influence the defensibility or quality of laboratory data in 2024. Analytical laboratories who seek and maintain accreditation from DOECAP-AP must acquire and analyze proficiency testing (PT) samples from an accredited PT provider. In 2024, GEL acquired and analyzed samples from PT programs sponsored by the Environmental Resource Associates and Eckert & Ziegler Analytics, Inc. Overall, these programs showed acceptable results.

The environmental surveillance monitoring programs sent performance evaluation (PE) samples representing a variety of media in demonstrating that a laboratory can successfully analyze samples within the performance criteria during 2024. The INL Site contractors had a total of 299 analytes from various PE samples that were evaluated with 89% receiving an agreement evaluation. The nonagreements were reviewed and any unusual conditions were addressed, identified, and, when necessary, corrective actions were prepared to improve processes. The results of these nonagreements are summarized in Subsection 10.4.

The multifaceted approach to QA and QC used by the INL Site contractors provide confidence that all laboratory data reported for 2024 are reliable and of acceptable quality.

10. QUALITY ASSURANCE OF ENVIRONMENTAL SURVEILLANCE MONITORING PROGRAMS

This chapter describes the specific measures that have been taken to ensure adequate data quality, as well as the summarization of performance by the INL Site contractors in 2024.

10.1 Quality Assurance Policy and Requirements

INL Site contractors incorporate appropriate QA requirements and elements from 10 CFR 830, Subpart A, and DOE Order 414.1D, Change 2, to ensure any environmental samples are representative and complete and that the data are reliable and defensible. Additional QA program requirements in 40 CFR 61, Appendix B, Method 114, must be met for all new point sources of radiological air emissions, as required by 40 CFR 61, Subpart H.

10.2 Program Elements and Supporting Quality Assurance Process

According to the National Council on Radiation Protection and Measurements (NCRP 2012), QA is an integral part of every aspect of an environmental surveillance monitoring program from the reliability of sample collection through sample transport, storage, processing, and measurement to calculating the results and formulating the report. Uncertainties in the environmental surveillance monitoring process can lead to the misinterpretation of data and errors in decisions based on the data.

Every step in radiological environmental surveillance monitoring should be evaluated for integrity, and actions should be taken to evaluate and manage data uncertainty.

Meeting the requirements of state regulations, United States (U.S.) Environmental Protection Agency (EPA) directives, and DOE mandates are an important part of developing an environmental sampling program. Gathering quantitative and qualitative environmental data is unique to each surveillance monitoring program. All data from planning, sample collection and handling, sample analysis, data review and evaluation, and reporting is complete, precise, and representative to ensure defensibility. Approved, detailed procedures are maintained, adequate training is given, and documents are controlled by the INL Site contractors and analytical laboratories to ensure that data are of acceptable precision and accuracy.

The main elements of the environmental surveillance monitoring programs implemented at the INL Site, as well as the QA processes/activities that support them, are discussed in this chapter.

10.2.1 Planning

Environmental surveillance monitoring activities are conducted by the following:

- INL contractor
- Idaho Cleanup Project (ICP) contractor
- U.S. Geological Survey (USGS).

Each INL Site contractor determines the requirements for sampling using the EPA Data Quality Objective (DQO) process (EPA 2006) or its equivalent. During the DQO process, the project manager determines the type, amount, and quality of data needed to meet DOE O 458.1, "Radiation Protection of the Public and the Environment," state and federal regulatory requirements, support decision-making, and address stakeholder concerns. These plans include:

Sitewide Monitoring Plans. The "Idaho National Laboratory Site Environmental Monitoring Plan" (DOE-ID 2021b), "Technical Basis for Environmental Monitoring and Surveillance at the Idaho National Laboratory Site" (DOE-ID 2023), and "Idaho National Laboratory Groundwater Monitoring and Contingency Plan Update" (DOE-ID 2021a) summarize the various monitoring programs at the INL Site, including surveillance monitoring for air, water (e.g., surface, drinking, ground), soil, biota, agricultural products, external radiation, ecological, and meteorological monitoring on and near the INL Site, as well as surveillance/compliance monitoring programs for effluent on the INL Site. These plans include the rationale for monitoring, the types of surveillance media, where the sampling is conducted, and information regarding access to the analytical results.

QA Project Plan. Implementation of QA elements for sample collection and data assessment activities are documented by each INL Site contractor using the recommended EPA approach. The EPA policy on QA plans is based on the national consensus standard ANSI/ASQC E4-1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs." DQOs are project-dependent and determined based on the needs of data users and the purpose for which the data are generated. DQOs, sampling and analysis plans, and the "Technical Basis for Environmental Monitoring and Surveillance at the INL Site" (DOE-ID 2023) are integrated into the QA project plans of the INL Site contractors. Quality elements applicable to environmental surveillance and decision-making efforts are specifically addressed in the "EPA Requirements for Quality Assurance Project Plans" (EPA 2001).

QA project plans are developed for environmental surveillance monitoring media by each INL Site contractor to ensure that the collected data meets the requirements of all applicable federal and state regulations and DOE orders.

What is the difference between Quality Assurance and Quality Control in an environmental program?

- Quality assurance (QA) is an integrated system of management activities designed to ensure quality in the processes used to produce environmental data. The goal of QA is to improve processes so that the results are within acceptable ranges.
- Quality control (QC) is a set of activities that provide program oversight (i.e., a means to review and control the performance of various aspects of the QA program). QC provides assurance that the delivered results are what is expected.

10.2.2 Sample Collection and Handling

Defensible laboratory data is a critical component of any environmental program. Field sample collection and handling coupled with a chain-of-custody that shows unique sample identification, weight, sample preservation, volume, holding time, approved procedures, and request of laboratory analysis are important steps of defendable data.

Strict adherence to program procedures is an implicit foundation of QA. In 2024, samples were collected and handled by trained personnel according to documented program procedures. Sample integrity was maintained through a system of sample custody records. Work execution assessments were routinely conducted by personnel independent of the work activity. Deficiencies were addressed by follow-up and corrective actions. Quality assessments are tracked in contractor-maintained systems.

QC sampling elements are used by INL Site contractors to validate the collection process and verify the quality of laboratory preparation and analysis. These elements include the collection of trip blanks, field blanks, equipment blanks, split samples, sample duplicates, and PE samples. Click here to see definitions for these elements/terms.

10.2.3 Sample Analysis

Table 10-1 provides the list of analytical laboratories that were used by the INL Site contractors in 2024 to analyze their collected environmental surveillance samples.

Table 10-1. Analytical laboratories used to analyze surveillance media (2024).

ANALYTICAL LABORATORY	MEDIA					
	AIR	WATER	AGRICULTURAL PRODUCTS	BIOTA	SOIL	ENVIRONMENTAL OSLDs
GEL Laboratories, LLC	X[a]	X[b]	X	X	—[c]	—
Landauer	—	—	—	—	—	X
Radiological and Environmental Sciences Laboratory (RESL)	—	X	—	—	—	—

a. Includes atmospheric moisture.
b. Includes precipitation.
c. Not sampled in 2024.

Laboratories used for routine analyses of radionuclides in environmental media were selected based on a laboratory's capabilities to meet program objectives, such as the ability to meet the required detection levels, and past results in PT programs. The DOECAP-AP, which consists of third-party accreditation bodies, issues an annual accreditation certificate to laboratories seeking and maintaining accreditation. The rigorous accreditation process reviews each method, media, and analyte analyzed at the laboratory. An annual audit is performed to evaluate a laboratory's technical capability and competence, along with their proficiency in complying with DOE QA requirements as outlined in the Quality Systems Manual (QSM 2021). For more information on DOECAP-AP, visit the DOE Analytical Services Program webpage.

No major audit findings were identified by DOECAP-AP third-party accreditation bodies for GEL that would influence the defensibility or quality of laboratory data in 2024. GEL maintained accreditation for 2024.

GEL participates in accredited PT programs as outlined in the Quality Systems Manual (QSM 2021). The laboratory is responsible for reviewing their PT results and correcting potential quality concerns identified by the PT provider. DOECAP annual accreditation is maintained by achieving two successful studies (e.g., acceptable scores) out of their most recent three attempts. Results for the PT programs are provided in Section 10.3.

Laboratory data quality is continually verified by QC samples, and includes calibration verifications, blanks, replicates/duplicates, and intra-laboratory and PT samples.

An analytical laboratory may use several of the laboratory QC measurement elements. Results of the laboratory QC are presented to the INL Site contractors as a data package and provide assurance that the reported data are usable and defensible.

10.2.4 QC Data Review and Evaluation

Data generated by INL Site contractors are routinely evaluated to understand and sustain the quality of the data. This enables programs to determine whether the DQOs established in the planning phase were achieved and whether the laboratory is performing within its QA/QC requirements.

Environmental data may be subject to verification, validation, and quality assessment.

The Environmental Data Warehouse is the official warehouse for the long-term management and storage of environmental data collected in support of the INL Site contractors. Data stored in the Environmental Data Warehouse is used to support compliance reporting, decision-making efforts, trending, and modeling. Appropriate testing is completed in the event that any significant changes are made to the Environmental Data Warehouse database, or the server operating system on which the data system reside, in accordance with the "Software Configuration Management Plan for INL Site Environmental Data Systems" (ICP 2023).

The INL Site contractors send media-specific PE samples to the analytical laboratories for testing their ability to successfully analyze the samples within the performance criteria. These media-specific samples are compared with the PT results and can provide valuable indicators that further QC testing may be required.

Figure 10-1 shows the decision tree for the environmental surveillance field sampling data PE review process. When the PE sample results are in agreement for the INL Site contractors, a review of the remaining data continues. If no issues are identified, the data package is approved. If the PE result is identified as a nonagreement, the INL Site contractor reviews all the available PE and PT data.

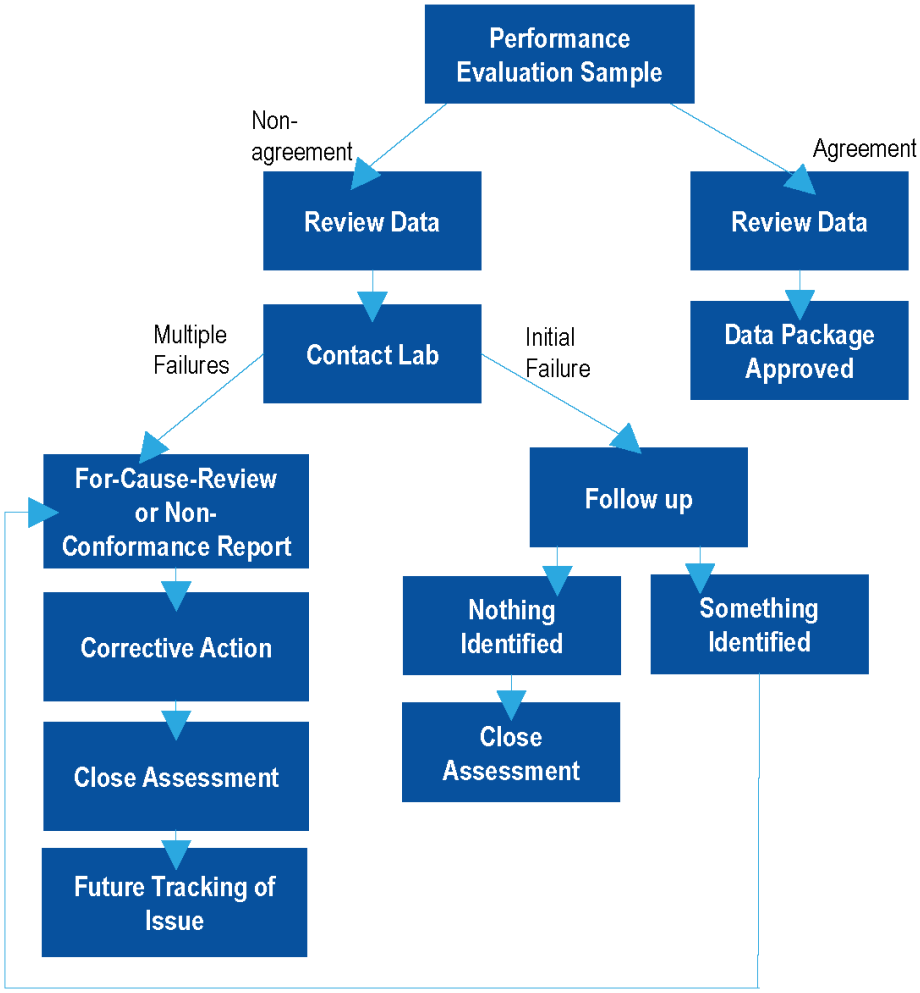

Figure 10-1. Environmental surveillance field sampling data PE review process.

A variety of items that may be considered for review include, but are not limited to, the following questions:

- Did the PE sample provider prepare the single-blind or double-blind sample within the range specified by their customer? If yes, begin looking into the other PE and PT results. If not, the PE sample may not be an accurate representation of the project-specific field conditions or field results. If the equipment is calibrated for the field concentration range, and the PE sample is not within that range, then the accuracy and representativeness of the PE sample may be called into question.
- Did the laboratory perform all required program- and method-specific QC analyses using laboratory measurement elements? Are these QC results within the acceptable parameters?
- What does a review of the long-term project results indicate? Are all project-specific and analytic-method-specific PE results within specification? If not, does the laboratory have a history of out-of-specification QC results for a specific analyte?

Upon reviewing the entire body of PE evidence and using both objective and subjective professional judgment, the INL Site contractor will determine if the nonagreement result is a one-time anomaly or if the laboratory needs to perform a review.

A "Follow-Up" review occurs after a single failure and may result in the analytical laboratory not identifying any issues leading to the nonagreement result. At this point, if the analytical laboratory passed all their qualifying criteria, the data package has good defensible data. If a laboratory qualifying criterion is not met, the analytical laboratory will prepare and analyze the samples a second time. However, if there is not enough of a sample available, the analytical laboratory may flag the data when the "QC is Not Within Criteria." When the "Follow-Up" review identifies issue(s), either a "For-Cause-Review" or a "Non-Conformance Report" may be requested.

A "For-Cause-Review" and/or "Non-Conformance Report" may be requested when multiple PE sample issues occur consecutively (e.g., a nonagreement evaluation for the same radionuclide in the same matrix) or as a result of a "Follow-Up" review. The analytical laboratory would perform an investigation (e.g., review/verify sample units, weights, calculations) during a "For-Cause-Review." Whereas a "Non-Conformance Report" would generate a rigorous analytical laboratory review (e.g., interview analysts, historical results). Both the "For-Cause-Review" and the "Non-Conformance Report" could result in a "Corrective Action" being issued, which may resolve the problem and prevent future issues from occurring. Upon acceptance of the "Corrective Action," the assessment would be closed, and the issues discussed would be monitored in future data packages.

If the analytical laboratory cannot identify issues following a "For-Cause-Review" and/or a "Non-Conformance Report" resulting from multiple PE nonagreement evaluations, the INL Site contractor will work with the laboratory to assist in the investigative process. For example, additional PE samples may be provided to the analytical laboratory to determine whether any problems arise from sample preparation, data calculations, data entry into a database, etc. As a result, the analytical laboratory will provide an acceptable "Corrective Action" to the INL Site contractor. The issue will be monitored for future PE samples. Depending on the severity, the contractor may hold onto the samples until the issue is resolved and may send a letter-of-concern to the analytical laboratory. Based on the outcome of the investigation, the INL Site contractor could terminate the contract and seek the services of another laboratory.

10.3 2024 Interlaboratory Program PT Evaluations

GEL maintained accreditation and had no major findings identified by DOECAP-AP in 2024. GEL also acquired and analyzed samples from PT programs sponsored by Environmental Resource Associates and Eckert & Ziegler Analytics, Inc. Overall, these programs showed acceptable results.

10.4 2024 INL Site Contractors QC Programs

Individual QC programs include the use of several QA and laboratory measurement elements, respectively, to evaluate the performance of a laboratory. Not all QC measurement elements are required unless specifically called out in each INL Site contractor program's contract with the laboratory, or as required by the specific analytical method.

Field QC samples are sent to laboratories along with routine environmental samples to be analyzed in tandem. The samples are prepared in a way that the QC samples are analogous to the field samples. The laboratory is not aware of which samples are blanks, duplicates, or PE samples. Blanks are submitted along with the regular samples to test for the

introduction of contamination during the process of field collection, laboratory preparation, and laboratory analysis. Duplicate/replicate samples are submitted with the regular samples to assess field collection, homogeneity, reproducibility, laboratory preparation, laboratory analysis, and precision.

A PE sample where the activity is known by the INL Site contractors, but not the analytical laboratory, is called a "single-blind" PE sample; whereas a PE sample where the activity is unknown to both the INL Site contractors and the analytical laboratory is referred to as a "double-blind" PE sample. PE samples are sent to the laboratory throughout the year. Evaluations of these samples are used to improve data accuracy by following the process identified previously in Figure 10-1.

In addition to the INL Site contractors' PE program, the Mixed Analyte Performance Evaluation Program (MAPEP) is an interlaboratory program that uses evaluations to test the ability of the laboratories to correctly analyze radiological, nonradiological, stable organic, and stable inorganic constituents' representative of those at DOE sites. MAPEP provides QA oversight for environmental analytical services by performing a semiannual evaluation of commercial laboratories. GEL participated in the MAPEP Series 50 and 51 during 2024. Laboratories publish MAPEP results in quarterly QA reports. These reports are reviewed by the INL Site contractors and compared with the internal PE results.

In the event a data quality or trending issue is identified, the concern will be documented in an Issues Management System (e.g., LabWay) to track resolutions and/or corrective actions.

10.4.1 INL Contractor QC Program

INL Contractor Blanks

A total of 192 analytes were analyzed by GEL in various media. The analyzed media included air filters, quarterly air filter composites, atmospheric moisture, precipitation, drinking water, and milk. No concerns were identified in blanks that would indicate data quality or trending issues with sampling, handling, shipment, or analysis by the laboratory contributed to the actual sample results in 2024.

INL Contractor Replicate/Duplicate

A total of 710 analytes were analyzed by GEL Laboratories. The analyzed media included air filters, quarterly air filter composites, milk, produce, surface water, effluent, and groundwater. No concerns were identified in duplicates/replicates that would indicate data quality or trending issues with sampling, handling, shipment, homogeneity, reproducibility, or preparation and analysis by the laboratory contributed to the actual sample results for 2024.

INL Contractor PE

In 2024, the INL contractor used GEL and Landauer laboratories to provide analytical results for air (e.g., air filters, quarterly composites), atmospheric moisture, precipitation, drinking water, surface water, effluents, groundwater, agricultural products (e.g., milk, alfalfa, lettuce, potato, wheat), big game, soil, bats, and direct radiation.

Of the PE samples analyzed in 2024 by GEL and Landauer, 153 (91%) PE analytes were in agreement with 15 (9%) PE analytes categorized as nonagreements.

How do these discrepancies between expected and actual PE sample results relate to field sample values? If a PE sample registers a result below the anticipated value, it indicates a low bias in the reference sample. This could imply that the true values for field samples from the same batch are understated in the laboratory's reports. On the other hand, if a PE sample records a result above the expected value, it points to a high bias. In this scenario, it is possible that the true values for field samples in the batch exceed the results reported by the laboratory.

When PE nonagreements indicate low or high biases, it is not standard practice to correct the laboratory field sample results. Such discrepancies typically do not influence decision-making efforts endeavors regarding that particular analyte in that media, and the data are not discarded due to nonagreement.

The INL contractor worked with GEL on the nonagreements in 2024 to identify processes, procedures, and methods that will lead to the improved accuracy of data.

10.4.2 ICP Contractor QC Program

ICP Contractor Blanks

A total of 266 analytes were analyzed by GEL in perched water and groundwater media. No concerns were identified in blanks that would indicate data quality or trending issues with sampling, handling, shipment, or analysis by the laboratory contributed to the actual sample results in 2024.

ICP Contractor Replicate/Duplicate

A total of 215 analytes were analyzed by GEL Laboratories in perched water and groundwater media. No concerns were identified in duplicate/replicates that would indicate data quality or trending issues with sampling, handling, shipment, homogeneity, reproducibility, or preparation and analysis by the laboratory contributed to the actual sample results for 2024. Six duplicate samples were flagged in validation and use was discouraged based on detectability criteria.

ICP Contractor PE

In 2024, the ICP contractor used GEL to provide analytical results for air filters, quarterly composite air filters, perched water, ground water, liquid effluent, and wastewater.

Of the 131 PE samples analyzed in 2024 by GEL, 112 (85%) PE analytes were in agreement with 19 (15%) PE analytes categorized as nonagreements. The ICP contractor is working with GEL to identify processes, procedures, and methods that will lead to improved accuracy of the data.

In cases of nonagreements, the ICP contractor requests the laboratory to investigate and provide possible reasons for the failures. The laboratory and ICP work together to help identify potential issues to prevent recurrence.

10.4.3 USGS QC Program

In 2024, the USGS used RESL to provide analytical results for groundwater monitoring wells. USGS submits field blanks along with environmental samples to test for the introduction of contamination during the process of field collection, laboratory preparation, and laboratory analysis (Bartholomay and others, 2021).

USGS Blanks

A total of 16 analytes were measured in three groundwater samples by RESL to evaluate blank data quality. No concerns were identified in the blanks that would indicate data quality or trending issues with the sampling, handling, shipment, or analysis by the laboratory contributed to the actual sample results in 2024.

USGS Replicate/Duplicate

A total of 20 analytes were measured in eight groundwater samples by RESL to evaluate reproducibility between environmental and sequentially collected replicates. No concerns were identified in duplicates/replicates that would indicate data quality or trending issues with sampling, handling, shipment, homogeneity, reproducibility, or preparation and analysis by the laboratory contributed to the actual sample results for 2024.

10.5 Conclusions

The quality elements presented in Figure 10-1 were implemented in 2024. The field sampling elements, laboratory measurements, and PE samples were reviewed and evaluated for each INL Site contractor and are summarized in Subsection 10.4. It has been determined that all laboratory data presented in this report are valid, reliable, and defensible.

10.6 References

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