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**Los Alamos  
National Laboratory**

**Waste and Environmental Services (WES)**

**Quality  
Assurance  
Project  
Plan**

for the

**Soil,  
Foodstuffs,  
and Nonfoodstuffs  
Biota  
Monitoring  
Project**

Prepared by:  Signature on file  _____ Phil Fresquez, Soils, Foodstuffs, and Biota Project Leader	Date:  1-25-2008
Approved by:  Signature on file  _____ Laura Ortega, QA Officer	Date:  1-25-2008
Approved by:  Signature on file  _____ Craig Eberhart, Group Leader	Date:  2-5-2008

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## General Information

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**Appendixes** This plan has the following appendix:

Appendix	Title	No. of pages
A	References	1

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**History of revision**

The following table lists the revisions, dates, and changes to this document.

Revision	Date	Description of Changes
0	9/30/02	New document, issued as ECO-CMT-QAPP.
1	8/18/03	Revised to address comments from reviewers.
2	12/12/05	Revised to incorporate new DQOs with new sampling schedule. Issued as ENV-WES-SFB, R2.
0	1/30/08	Changed title, organization name, SOP references, and number to QAPP-0001.

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**Revising and distributing this plan**

The Waste and Environmental Services (WES) Group Leader and a chosen reviewer will approve all revisions to this plan.

This Quality Assurance Project Plan is a controlled document. It is reviewed annually and revised if necessary, and it is distributed in accordance with the WES document control program (EP-DIR-SOP-4001, "Document Control")

## Section 1

# Quality Program

## Organization

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**Background** The purpose of the Soil, Foodstuffs, and Nonfoodstuffs Biota Monitoring (SFB) programs are to measure radionuclides, target analyte list (TAL) elements, and organic contaminants, determine trends over time and dose and risk. This data is collected to comply with DOE Order 450.1, “Environmental Protection Program”; and DOE Order 5400.5, “Radiation Protection of the Public and the Environment”. The work is part of the Environmental Surveillance Program and the data is made available as part of the annual LANL Environmental Surveillance Report (ENV-MAQ-232, Preparation of the Annual Environmental Surveillance Report)

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**What is the SFB program?** The institutional monitoring of soils, foodstuffs, and nonfoodstuffs biota (plants and animals) is accomplished to determine the impacts of Laboratory operations on human health (via the food chain) and the environment. These activities include: the collection of surface soil, foodstuffs, and (nonfoodstuff) biota samples on a rotating basis from on-site, perimeter (Los Alamos, White Rock, and surrounding Pueblos) and off-site regional background locations; sample preparation, analytical chemistry, data analysis, V&V, data management, and report writing.

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**What is monitored?** Samples of surface soils; foodstuffs like crops, fish, honey, milk, eggs, and meats; and nonfoodstuffs like vegetation, small mammals, and bees are collected at selected locations within and around LANL. They are analyzed for radionuclides, radioactivity, heavy metals, and organic constituents to determine source terms in soils and potential uptake by plants, animals, and humans; radiation doses to humans and biota; and changes in contamination levels over time.

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**Purpose of this plan** This QA project plan describes the policies and requirements that ensure Soil, Foodstuffs, and Biota data are collected, analyzed, and reported in a consistent, agreed-upon manner.

## Organization, continued

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### **Project organization**

WES is organized by project teams under the line-management direction and responsibility of the group leader. See the WES organizational structure at <http://int.lanl.gov/orgs/wes/org.shtml>. The Soil, Foodstuffs, and Biota Monitoring Project Leader is responsible for this monitoring effort.

Other Laboratory organizations and subcontractors will be utilized, as necessary, to facilitate the performance of monitoring activities in accordance with this plan.

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### **Structure of the quality program**

Implementing procedures provide detailed instructions for performing specific processes. The following documents provide requirements to ensure the project is operated in accordance with the above regulatory drivers:

- Quality Assurance Plan for the Environmental Programs (EP-DIR-QAP-0001, R1)
  - WES Soil, Foodstuffs, and Biota Monitoring Project QAPP (this document)
  - Implementing procedures
- 

### **Plan format**

This quality assurance project plan (QAPP) uses the format recommended in Department of Energy (DOE) Order 414.1C, but elements of the data quality objective process from the Environmental Protection Agency (EPA) QA/R-5 document are also included.

The DOE and LANL require compliance with DOE Order 414.1C (Quality Assurance) for all organizations. This plan is structured to address the 10 criteria of the Order, and each section explains the group's requirements for compliance with the corresponding criterion.

## Requirements

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### Regulatory drivers

The drivers for the development and implementation of this monitoring project are

- DOE O 450.1, General Environmental Protection Program Requirements
  - 10 CFR Part 834, Radiation Protection of the Public and the Environment (draft)
  - DOE O 5400.5, Radiation Protection of the Public and the Environment
  - DOE O 231.1, Environmental Surveillance Reporting Requirements
  - New Mexico Environment Department DOE Oversight Bureau Agreement in Principle ([http://www.nmenv.state.nm.us/DOE\\_Oversight/doetop.html](http://www.nmenv.state.nm.us/DOE_Oversight/doetop.html)).
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### Other drivers

Other drivers for WES include

- University of California (UC) commitment measures (Appendix F of the UC/DOE contract) for outstanding relations with stakeholders and neighbors in northern New Mexico,
  - WES commitment to improve service delivery and customer satisfaction,
  - Responding to requests for technical assistance in meeting surrounding community needs for environmental monitoring and information,
  - Addressing general community concerns related to ecological and environmental issues, and
  - Providing tools to line management for implementation of Integrated Safety Management and Integrated Safeguards and Security Management principles.
- 

### Other requirements

The following documents impose additional requirements for how to document and conduct the monitoring program.

- DOE/EH-0173T, Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, describes the elements of an acceptable environmental surveillance program.
- DOE Order 414.1C, Quality Assurance.
- DOE Order 151.1 provides the framework for development, coordination, control, and direction of all emergency planning, preparedness, readiness assurance, response, and recovery for the DOE Emergency Management System.

## ***Section 2***

### **Personnel Development**

#### **Personnel Training and Qualification**

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**Personnel requirements** Qualified team members will be hired and trained as prescribed in the EP-DIR-SOP-2011, R2 “Personnel Training and Qualification.”

Personnel are required to have knowledge of the following:

- Environmental soil and plant science
  - Radioecology
  - Pathway analysis
  - Environmental monitoring
  - Sample collection, processing, and chain-of-custody
  - Statistics
  - Report writing skills
- 

#### **Training**

All personnel performing project-related work are required to obtain appropriate training before performing work governed by a procedure. Training for WES personnel, and for other persons performing WES work, will be performed and documented according to EP-DIR-SOP-2011, R2 “Personnel Training and Qualification.” Training of personnel in other groups will be performed and documented according to each group’s training procedure.

Contractor analytical laboratories are required to have training and training documentation systems in place that comply with the training requirements of DOE Order 414.1C, Criterion 2.

## ***Section 3***

### **Quality Improvement**

#### **Corrective actions**

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**Performance reports**

Personnel assigned to perform monitoring activities provide periodic updates, either verbal or written, to the Soil, Foodstuffs, and Biota Monitoring Team Leader. The Team Leader provides periodic updates, either verbal or written, to the WES Group Leader.

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**Corrective actions within WES**

Corrective actions for all WES projects are initiated, tracked, corrected, and documented.

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**Quality improvement**

Contaminant monitoring activities will adhere to the policy for continuous improvement.



## Section 4

# Documents and Records

## Documents and Records

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### Policy

The Soil, Foodstuffs, and Biota Monitoring Project will generate and retain sufficient records to ensure compliance with the monitoring requirements of DOE Orders 450.1 and 5400.5. Specific guidelines for soil monitoring can be found in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T). The type and extent of records to be maintained are determined through this plan and its implementing procedures.

Additionally, data that are maintained in electronic form (e.g., databases and spreadsheets) will be maintained in a manner that ensures defensibility and accuracy.

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### Document control

This plan is controlled through the WES document control procedure (EP-DIR-SOP-4001, Document Control). The following personnel will receive controlled copies of this plan:

- WES Division Leader
  - WES Group Leader
  - Soil, Foodstuffs, and Biota Environmental Surveillance Project Leader
  - LANL personnel assigned to work for the project
  - WES Quality Assurance Officer
  - Assistant Area Manager, Office of Environment and Projects, DOE Los Alamos Site Office.
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### Procedures

Procedures will be developed as necessary and in accordance with the policy in the SOP-05-0001, "Preparation, Review, Approval, Revision and Cancellation of Procedures."

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### Disposition and retention

Active files are maintained and kept by assigned project personnel according to EP-DIR-SOP-4004, "Records Transmittal and Retrieval Processes." After files have been finalized and all documentation is complete, these files are submitted as records to the records coordinator. Records are archived in compliance with Laboratory and DOE requirements for records retention, storage, and management.

## Electronic Media

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### Policy

The Soil, Foodstuffs, and Biota Monitoring Project will utilize electronic means as necessary to maintain data and perform calculations on these data. Electronic means will not replace paper copy. All records that must be maintained to meet the requirements of the orders will be kept in hard copy as the official record.

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### Databases

Backups -- All databases used to hold data and generate reports to be used in demonstrating compliance will be maintained on a common drive of a server. These databases will be backed up daily to minimize potential losses of data.

Verification of data -- All compliance-related data uploaded into a database will be verified to be accurate against the original paper copy. Data that are uploaded through electronic means will undergo 10% verification. Data that are uploaded through manual means will undergo 100% verification. The 100% review must be performed by someone other than the data entry person. This review will be documented and forwarded to the appropriate record series.

Verification of calculations -- All compliance-related calculations performed in a database through queries will be reviewed for accuracy by a person other than the person who generated the query. This review will be documented and forwarded to the appropriate record series.

Software control -- The integrity of all databases will be ensured by maintaining them on a common server. This will enable the database administrator to control access to these databases, allowing only trained, authorized persons access to the databases.

## Electronic Media, continued

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**Spreadsheets**    Backups -- All spreadsheets used to hold data and generate reports to be used in demonstrating compliance will be maintained in a secure location. The preferred location is on the group server. Spreadsheets will be backed up at least weekly.

Verification of data -- All compliance-related data uploaded into a spreadsheet will be verified to be accurate against the original paper copy. Data that are uploaded through electronic means will undergo 10% verification. Data that are uploaded through manual means will undergo 100% verification. The 100% review must be performed by someone other than the data entry person. This review will be documented and forwarded to the appropriate record series.

Verification of calculations -- All compliance-related calculations performed in a spreadsheet will be reviewed for accuracy by a person other than the person who generated the spreadsheet. This review will be documented and forwarded to the appropriate record series. Modifications to the function of these spreadsheets will also be verified in this manner.

Software control -- The integrity of spreadsheets will be ensured by limiting access to these spreadsheets to only trained, authorized personnel. Additionally, at least once per year, the function of the spreadsheets will be verified by hand calculations. Documentation of this review will be forwarded to the appropriate record series.

## ***Section 5***

### ***Work Processes***

#### **Planning and Performing Work**

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**Overview** LANL is required to comply with DOE Orders 450.1 and 5400.5. The guidelines to be followed can be found in the Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T).

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**Purpose of contaminant monitoring work processes** The project is used to gauge the impact on human health and the environment as influenced by Laboratory operations. The work processes described in this section are the methods that will be used to meet the quality assurance requirements for the monitoring of soil, foodstuffs, and nonfoodstuffs biota for the purpose of determining concentrations, trends, and dose. The main purpose of the work processes is to ensure consistency and quality of work involved.

## Data Quality Objectives

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**Background** The project's data objectives were developed using the EPA's data quality objective (DQO) process as a guide as described in Guidance for the Data Quality Objectives Process (EPA QA/G-4).

DQOs are statements of the uncertainty level a decision maker is willing to accept in results derived from environmental data. As such, they comprise a management tool used to limit the chance of data leading to an incorrect conclusion. The DQO process must also define the required level of data defensibility and hence the level of documentation desired. DQOs must strike a balance between time, money, and data quality.

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**Problem statement** The lab has emitted and continues to emit constituents that can cause a chemical or radiation dose to humans and the environment. DOE Order 450.1 and 5400.5 require LANL to:

- conduct environmental monitoring, as appropriate,
- to detect, characterize, assess impacts, and respond to releases from DOE activities,
- estimate dispersal patterns in the environment,
- characterize the pathways of exposure to members of the public,
- characterize the exposures and doses to individuals, to the population, and to evaluate the potential impacts to the biota in the vicinity of the DOE activity.

## Data Quality Objectives, continued

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### Decision

The project has identified three major questions to address the problem statement:

1. Is the lab in compliance with Federal (DOE orders 450.1 and 5400.5) and State (Consent Order) Regulatory Standards?
  - a. As a result of Laboratory operations, are radionuclides, trace elements and organic constituents in soils, foodstuffs, and nonfoodstuffs biota higher than historic regional concentrations?
  - b. Is there a potential to approach or exceed the limit of 100 mrem/yr all-pathway radiation exposure as defined by the DOE to humans? (From DQOs in RRES-MAQ-Dose, QAPP for Environmental Dose Assessment)
  - c. Is there a potential to approach or exceed the limit of  $10^{-5}$  risk as defined by NMED Consent Order from the exposure of metals (e.g., Be, Hg, Pb) and organics (e.g., PCBs, VOCs, SVOCs, HE, PEST) to humans?
  - d. Is there a potential to approach or exceed limit of 0.1 rad/day radiation dose to terrestrial animals and 1 rad/day to terrestrial plants and aquatic biota? (From DQOs in RRES-MAQ-Biota, QAPP for Biota Dose Assessment).
  - e. Are constituents behaving as expected in the environment?
  - f. Are constituents increasing or decreasing over time (trends)?
2. Is the concentration of radionuclides or chemicals in burnable biota high enough to cause a health hazard to emergency personnel or the public during a fire?
  - a. Can emergency personnel safely go into an area in the event of a fire?
  - b. Should LANL ask for an evacuation of areas if there is a fire across certain potentially contaminated areas?
3. The project may be asked by LANL management to perform special sampling on Pueblo or other community lands to quantify contaminant levels.

### Actions to take

The following actions will be taken based on the answers to the above questions.

- 1a. If yes, document results in the Environmental Surveillance Report and notify the appropriate manager for their awareness.
- 1b,c,d. If yes, notify managers at LANL to take actions to reduce impact.
- 1e. If no, notify managers at LANL to take actions to reduce impact.
- 1f. If upward trend, notify managers at LANL to take actions to reduce impact.
- 2. If yes, notify managers at LANL to take actions to reduce impact.
- 3. If results show LANL contaminants are present on other lands, actions resulting from such studies may be driven by political or public relations needs and are not predictable.



## Data Quality Objectives, continued

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### Inputs to decision

To answer the questions above, the following data are needed:

- For 1.a,b,c,d,e: Concentrations of radionuclides, organics, and trace elements in soils, foodstuffs, and (non-foodstuffs) biota collected from on-site, perimeter, and regional (background) areas.
  - For 1.f: Average historical levels of radionuclides, organics, and trace elements.
  - For 2: Concentrations of radionuclides in burnable biota over the most-contaminated areas on LANL property.
  - For 3: Special study data, as determine by the purpose of the special study.
- 

### Analytes

The following radionuclides, heavy metals, and organic contaminants require monitoring under DOE requirements:

- Radionuclides:  $^3\text{H}$ ,  $^{234}\text{U}$ ,  $^{235}\text{U}$ ,  $^{238}\text{U}$ ,  $^{238}\text{Pu}$ ,  $^{239,240}\text{Pu}$ ,  $^{241}\text{Am}$ ,  $^{90}\text{Sr}$ ,  $^{137}\text{Cs}$ , and total U;
  - Metals: Ag, As, Ba, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, and Tl (and other TALs); and
  - Organics: volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), high explosives (HE), and/or organochlorine pesticides (OCPs).
- 

### Study boundaries

This step defines and describes the statistical, spatial, and temporal boundaries of the contaminant concentrations we wish to sample.

Sample population: The sample population is the concentration of each analyte in each media in the following regions:

- Onsite (within the LANL boundary),
- Perimeter (around the LANL boundary), and
- Offsite (regional background or control location that is over 15 km distant from the site).

Spatial boundaries: The boundaries extend up to 80 km away from LANL. DOE requires an assessment of the dose to the Maximally Exposed Individual at the boundary and to the population up to 80 km away.

Population groups: The statistical population groups of interest are the concentrations in soils, foodstuffs, and biota in the following regions:

- On-site (within LANL boundaries)
- Perimeter (up to 2 mi from boundary)
- At a background or control location (over 9 mi distant from the site)



## Data Quality Objectives, continued

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Timeframe to which the decision applies: The data will be used to identify the dose and environmental impacts on an on-going basis.

When to collect data: Samples will be collected generally in the summer when snows are not a factor and the sample materials (e.g., foodstuffs) are available.

Scale of decision-making: Decision-making is limited to locations within 80 km of the Laboratory.

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**Characteristics of samples** The following portions of the samples are of interest to answer the identified questions:

- Soils: concentrations of radionuclides in soil two inches deep, to represent portion with highest levels of radionuclide and trace element contaminants deposited on surface from air emissions and fugitive dust; concentrations of organics in soil six inches deep to capture more-mobile and volatile constituents.
  - Foodstuffs: concentrations of metals, PCBs, and radionuclides in edible portions, to represent the portions that humans consume.
  - (Non-foodstuffs) Biota: concentrations of metals, PCBs, and radionuclides in portions representative of whole plant or animal.
- 

**Sample types** The sample types for biota and foodstuffs will include

- biota:
  - vegetation
  - small and medium sized mammals
- foods:
  - milk
  - vegetables
  - meat
  - eggs
  - honey
  - grain
  - fruit
  - wild game
  - deer
  - elk
  - game birds
  - fish
  - bottom-feeding fish
  - predator fish

## Data Quality Objectives, continued

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**When to sample**

- Soils: collect when snow is not covering ground.
  - Foodstuffs: collect at harvest time.
  - (Non-foodstuffs) Biota: collect throughout year.
- 

**Constraints on sample collection**

There are different types of foodstuffs than listed in the guidance document because of differences in types of food that can be grown or found in NM climate. Many types of samples may not be available each year due to:

- access issues (e.g., permission denied to enter private or tribal lands to collect biota)
- lack of permission to collect certain types of samples (e.g., some farmers unwilling to donate produce)
- inability to obtain sufficient sample quantities of some foodstuffs or biota (e.g., fish not biting)
- relying on a few sources of some foodstuffs in some areas (e.g., single honey producer in Los Alamos County, one goat farmer in LA County)

Background levels of contaminants can vary by elevation (i.e., a function of precipitation and parent material), so background samples should be collected at the same elevation as samples to be compared.

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**Available analytical methods and detection limits**

There are no DOE requirements for detection limits. In order to characterize any Laboratory impact, detection limits would ideally be set at or below environmental background levels. Although the analytical techniques are available, it is frequently not cost effective or technically feasible to request limits so low for all contaminants (the latter would be accomplished simply by analyzing a larger sample mass). Historically, the project has requested detection limits from the analytical laboratories as close to background concentrations as practically possible.

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**Sources of information**

Sources of information will include professional papers on the behavior and accumulation of analytes in the environment and analytical results from analysis of sample types described above. Data from historical levels of contaminants from past 10 years or more will also be used.

## Data Quality Objectives, continued

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### Determining action levels

For each of the questions identified above, the following contaminant levels would trigger taking the actions identified above:

- 1a. Concentrations of constituents above the regional statistical reference levels (RSRLs) at the 99% confidence level (mean plus three standard deviations) based on at least the last five years of data.
- 1b. Concentrations of radionuclides in soils and foodstuffs that would cause a 15 mrem/y dose (from report LA-UR-01-990) and a 1 mrem/y dose (from Dose Assessment QAPP), respectively.
- 1c. Concentrations of nonradionuclides (metals and organics) in soils that would cause a risk of  $10^{-5}$  (from NMED/LANL Order on Consent).
- 1d. Concentrations of radionuclides in biota that would cause a 0.01 rad/d to terrestrial animals and 0.1 rad/d to terrestrial plants and aquatic biota (from Dose Assessment Project Leader).
- 1e. No numerical action level consistent with literature.
- 1f. Significant ( $p=0.05$ ) increasing trend using at least five consecutive sample times.
- 2. During a fire, the following concentrations in burnable biota would result in approximately 1 mrem/hour: transuranics: 1 nCi/g,  $^{90}\text{Sr}$  1 micro-Ci/g,  $^{137}\text{Cs}$  10 micro-Ci/g.
- 3. When sampling has been directed by LANL management, action level will be decided by managers on a case-by-case base.

## Data Quality Objectives, continued

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**Decision rule  
and action  
levels**

This step describes the actions that will be taken to assess the Laboratory's impact on human health and the environment when the measured concentration reaches certain levels.

- 1a,b,c,d. If the SLs are exceeded, then notify management and investigate reasons for the increase. If the regulatory standards are exceeded, then notify management and recommend limiting access (soil postings) and cleanup. If there is an upward trend, then notify lab managers of possibility of need for further studies or other actions.
  - 1e. If contaminants have not behaved as expected (e.g., moved faster or farther than expected), then notify LANL management that actions or further studies may be necessary.
  - 2. If the biota levels are found to be: transuranics: 1 nCi/g, <sup>90</sup>Sr 1 micro-Ci/g, <sup>137</sup>Cs 10 micro-Ci/g in burnable plants, then notify management that a plan is needed to deal with high levels in biota and/or soil (e.g., removal or plan for SCBAs for firefighters in the area).
  - 3. If management decides that special studies are necessary, then management will provide input on future actions.
- 

**Expected  
concentration  
ranges**

Radionuclides: Average concentrations of radionuclides of interest range from a background of zero to the action level concentrations. Outside the boundaries of the historical TAs, the average concentrations of radionuclides are unlikely to exceed any of the decision levels. Average concentrations in soil, vegetation, greater than the decision levels have only been observed in Pratt Canyon, Mortandad Canyon, Los Alamos Canyon (especially hillside 138), DP Canyon, and Area G.

Trace metals: Average concentrations of trace metals of interest range from a background of zero to the action level concentrations. Outside the boundaries of the historical TAs, the average concentrations of trace metals are unlikely to exceed any of the decision levels. Average concentrations in soil, foodstuffs, and vegetation, greater than the decision levels have only been observed for Hg in fish in the Rio Grande.

Organics: Average concentrations of organics of interest range from a background of zero to the action level concentrations. Outside the boundaries of the historical TAs, the average concentrations of organics are unlikely to exceed any of the decision levels. Average concentrations in soil, foodstuffs, and vegetation, greater than the decision levels have only been observed for PCBs in fish in the Rio Grande.

## Data Quality Objectives, continued

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**Consequences of analytical errors** False positives will likely result in time-consuming arguments with Lab critics; false negatives are not likely to have significant impacts on human health or compliance. Dose limit is 100 mrem and LANL has selected action level of 1 mrem from any one pathway for humans (see table in DQOs set at 0.1 mrem in DOSE QAPP). These levels are above the RSRL for most analytes so there should be few false positives or false negatives (for exceptions see footnotes to the Table in the Dose Assessment QAPP).

For organics, false positives result in bad press and need for confirmatory sampling. Analytical limits are close to the action level so some false positives are expected. Confirmatory sampling will be done for most organic and perchlorate positives. Action level is  $10^{-5}$  for humans. Action levels are significantly higher than historical sample results, so there should be few false positives or false negatives.

Trace metals: Limit is the TRV for biota and  $10^{-5}$  for humans.

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**Precision** Precision is a measure of mutual agreement among individual measurements of the same property, usually under prescribed conditions, expressed generally in terms of the standard deviation. It refers to the uncertainty that occurs if the same analysis was performed again on the same sample with no change in conditions, or the degree to which repeated measurements on the same sample agree. Results of repeated analyses of standard or duplicate samples provide an estimate of laboratory or instrument precision.

The regulation 40 CFR Part 61.93 requires that the system be able to readily detect a dose of 0.1 mrem above background. Therefore, the project will use 0.1 mrem as the target precision for all measurements.

## Data Quality Objectives, continued

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### Accuracy

Accuracy is the degree of agreement of a measured value with the true or expected value of the quantity of concern. Biases of field sampling and sample preparation cannot be effectively estimated because the underlying, true mean values cannot be known for the population from which the samples are drawn without sampling the entire population. Estimated sample mean values are associated with intervals within which there is 95% confidence that the true mean lies.

Increased sample sizes would reduce the estimated confidence intervals, but even with this variability, the sample numbers are sufficient to detect differences corresponding to less than 1 mrem effective dose equivalent per year. Therefore, the additional samples appear unwarranted.

The accuracy of the concentrations of each measured radionuclide will be sufficient to distinguish a dose contribution from each radionuclide of 0.1 mrem (target minimum).

Any bias (known inaccuracy) will be corrected for if it is known or estimated. Unknown bias will be presumed to be zero because this is usually the best estimate.

Analytical accuracy is addressed in quality assurance documentation from the analytical laboratory. Where possible, replicates or blanks are submitted with samples for analysis at a rate of about one per 10 to 20 environmental samples.

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### Representativeness

Representativeness is a measure of the degree to which the data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition.

Since there are many potential contamination sources within LANL, 12 on-site stations were strategically located, mostly downwind of major facilities, to try to capture the general contaminant levels. Similarly, 10 perimeter stations, mostly situated in the two major communities, were located around LANL and the three regional background sites were located to the north, southwest and southeast of LANL.

Samples of foodstuffs are collected during periods when the public can be reasonably expected to collect these foods for consumption. Therefore, fish are collected during the summer months and produce and honey are collected during the fall. Thus, the samples are generally representative of what the public would consume.

## Data Quality Objectives, continued

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**Comparability** Comparability is a measure of the confidence with which one data set can be compared to another.

Comparability of the sampler data is ensured because of the use of the same equipment, processes, and analytical methods at all sampler locations.

However, a number of factors influence sample results that are beyond the Laboratory's control. These include inherent variation of the sampled populations, variation in meteorological and hydrological dispersion characteristics, variation in growing conditions, variation in background levels, and variation in the availability of sampled populations. These factors operate in both spatial and temporal frameworks and affect the comparability of data from different locations and from different years. The procedures for sample collection, preparation, analysis, and interpretation are the same for each sample location per year and are the same as in previous years. Thus, comparisons of data from Los Alamos and vicinity can be drawn among locations and years with some reasonable but unquantifiable confidence. Direct comparisons of Los Alamos data with data from other DOE facilities is compounded by even greater differences among sampling and natural factors that affect estimated values for the food-chain pathway's contribution to exposure of the public and the environment.

Despite these factors, WES will sample and analyze the soil in the same manner each year to provide as much consistency as possible.

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**Completeness** Data may be lost due to instrument malfunction, power failure, sample destruction, human error, loss in shipping or analysis, analytical error, exceeding the hold time for the sample, failure to collect an adequate sample mass during the sampling period, inability to gain access to the site, or unacceptable precision or accuracy.

Completeness is a measure of the amount of valid data obtained compared to the amount expected under normal conditions. Completeness requirements for each of the following measurements have been identified:

Sample collection – The requirement for completeness of sample collection will be >90% for soil. This includes all samples lost due to equipment malfunction, personnel error, and sample damage up to the point of delivery to the analytical laboratory. This measure will be evaluated at least annually.

Sample analysis – The requirement for completeness of sample analysis will be >90% for soil. This includes all samples and data lost after delivery of samples to the analytical laboratory. This measure will be evaluated at least annually.

## Sample Location and Design Rationale

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### Soils

Based the long-term results, radionuclide concentrations in soils within and around the LANL boundary are low and are mostly decreasing in concentrations over time. Also, inorganic and organic constituents in soils are not at significant levels.

Thus, a three year rotating sampling scheme is warranted for radionuclides and nonradionuclides. However, to maintain the integrity of the past institutional program and to investigate specific areas of concern, we will alternate the sampling scheme to:

- The (historical) institutional program (last sampled in 2003, thus the next sampling is scheduled for 2006):
  - 12 onsite samples will be collected downwind of major operations and activities at LANL from undisturbed soils free from wind or precipitation influences.
  - 10 perimeter samples will be collected around the LANL facility, especially in the predominant wind direction.
  - 4 background samples should be located a minimum distance of nine miles from the LANL site. Control stations should also be place in areas typical of local geology and at similar elevations
  - For radionuclides and trace elements, five sub-samples will be collected from a 10m by 10m square with one in the middle. For organics, samples will be collected using grab samples.
  
- Selected sites of concern. Sampling at these locations will be based on past historical results or potential release site (the next sampling is scheduled for 2006). Example: soil concentrations on Hillside 138, Mortandad Canyon, and Nuclear Environmental Sites.

### Historic soil sampling locations

The following table lists the historic soil sampling locations.

Station Name	Station Name
Regional (Background) Stations	Onsite Stations
Santa Fe (Rowe Mesa)	TA-21 (DP Site)
Youngsville	East of TA-53
Jemez	West of TA-53
Santa Cruz lake (Borrego Mesa)	TA-50



Station Name	Station Name
<b>Perimeter Stations</b>	TA-51
Los Alamos Sportsman's Club	Two-Mile Mesa
North Mesa	East of TA-54
Technical Area (TA) 8 (GT Site)	R-Site Road East
Near TA-49 (Bandelier National Monument)	Potrillo Drive/TA-36
White Rock (East)	TA-16 (S-Site)
Tsankawi/PM-1	Near Test Well DT-9
Otowi	Near TA-33
East Airport	
West Airport	
San Ildefonso	

## Vegetation

Based the long-term results, radionuclide concentrations in vegetation within and around the LANL boundary are low and are not increasing over time. Also, because of the local soil pH, inorganic elements are not readily taken up by vegetation and organic constituents are not analyzed in vegetation because of the many interferences that exist with this media. Thus, a three year rotating sampling scheme only for radionuclides is warranted under the following conditions:

- Two types of vegetation for radionuclide analysis will be collected: understory (grasses and forbs) and overstory (trees). Composite samples (2 lb) will be collected from the historic soil sampling sites.
- Background samples should be collected at a minimum of nine miles from the LANL site.
- To maintain the integrity of the past institutional program and to investigate specific areas of concern, we will alternate the sampling scheme to:
  - the historical program (last sampled in 2003; thus the next sampling is scheduled for 2006).
  - selected sites of concern; sampling at these locations will be based on past historical results or PRS's (the next sampling is scheduled for 2006). For example, vegetation concentrations on Hillside 138, Mortandad Canyon, and from Nuclear Environmental Sites.

## Sample Location and Design Rationale, continued

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### Foodstuffs domestic crops

Based on the long-term trends, radionuclides in the crops surrounding LANL are low and not increasing over time. Because of the local soil pH, inorganic elements are not readily taken up and only a few exceed the detection limits. Also, organic constituents are not normally analyzed in crops because of the many interferences. Thus, a three year rotating sampling scheme is warranted for radionuclides and a few trace elements using the following criteria:

- Samples will be collected from the Los Alamos town-site, White Rock town-site and from San Ildefonso Pueblo. In addition, since a pathway exists from LANL to the Rio Grande and thus to downstream (irrigation) users, crops will be sampled from these areas (e.g., Cochiti, Pena Blanca, Sile areas). Background samples will be collected a minimum of nine miles away from the LANL site.
  - Crops to be considered should include vegetables, grains and fruits.
- 

### Foodstuffs wild foods

The main driver for sampling wild foods is based on the closeness and needs of San Ildefonso Pueblo. A portion of San Ildefonso Pueblo borders the LANL site near the Laboratory's primary low-level waste site and a pathway from Mortandad canyon may exist. Therefore, the following criteria for radionuclide and trace elements will be used:

- Samples will be collected within the Sacred Area of San Ildefonso Pueblo in Mortandad Canyon nearest to the LANL boundary to determine worst-case effects.
- 

### Foodstuffs fish

As suggested in DOE/EH-0173T "when the dose is between 1 and 0.1 mrem, then sufficient surveillance *should* be done to show that the radionuclides are behaving in the environment as expected." Also, mercury and PCBs are major contaminants detected in the Rio Grande and their source is in question. Thus, a three year rotating basis to determine radionuclide, mercury, and PCB concentrations in fish will be sufficient to detect any adverse trends, if any, using the following criteria:

- Samples will be collected from Cochiti reservoir, downstream of LANL, and from Abiquiu reservoir, which is upstream from LANL (Background).
- Predator fish, because they are the mostly used for human consumption, and bottom-feeding fish, because they eat off the bottom sediments where contamination is mostly found, will be collected.
- Samples will be collected from different parts of the reservoirs so that they are representative of the lake.

## Sample Location and Design Rationale, continued

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### Foodstuffs game animals

As per DOE/EH-0173T, “if animals such as deer, rabbits, and game birds are components of the diets of certain individuals and if the dose is less than 1 mrem then annual sampling and analysis of two or three representative species will be sufficient to determine whether or not this pathway is still insignificant.”

Based on past results, however, there have been no indication that radionuclides are increasing in game animals collected within LANL. Therefore, a three year sampling scheme is warranted and the following criteria will be employed:

- Elk and deer will be collected as road kills from LANL lands.
- Background samples will be collected from areas located a great distance from LANL.
- Samples will be collected throughout the year, processed, and stored until it is time for submittal.

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### Foodstuffs honey

As per DOE/EH 073T, “representative samples of the pathway significant agricultural products grown near the site *should* be collected and analyzed for radionuclides potentially present from site operations”.

Honey is produced in the area surrounding the Laboratory, but based on past results the radionuclide concentrations in honey are low and are not increasing over time. Thus, a three year sampling scheme is warranted and the criteria to be used will include:

- Samples will collected from the Los Alamos and White Rock areas.
- Background will be from areas a great distance from LANL.

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### Foodstuffs milk

As per DOE/EH 073T, if dairy herds or “family cows (or goats) are present in the vicinity of the site, representative milk samples *should* be taken and analyzed for radionuclides potentially present from site operations”.

Goat milk is produced in the area surrounding the Laboratory, but based on past results the radionuclide concentrations in goat milk are low and are not increasing over time. Thus, a three year sampling scheme is warranted and the criteria to be used will include:

- Samples will collected from the Los Alamos and White Rock areas.
- Background will be from areas a great distance from LANL.

## Sample Location and Design Rationale, continued

Location	Matrix	Sampling Frequency
<b>Regional Stations</b>		
Española (San Pedro)	Honey	Infrequent
Española/Santa Fe/Jemez/Northern NM	Produce Eggs Piñon, Herbs	Every third year Infrequent Infrequent
Abiquiu	Fish: Surface Feeders Bottom Feeders	Every third year
Albuquerque	Milk	Infrequent
<b>Perimeter Stations</b>		
Los Alamos	Produce Eggs Piñon, Herbs Milk Honey	Every third year Infrequent Infrequent Infrequent Infrequent
White Rock/Pajarito Acres	Produce Eggs Piñon, Herbs Milk Honey	Every third year Infrequent Infrequent Infrequent Infrequent
Cochiti	Fish: Surface Feeders Bottom Feeders	Every third year
Cochiti/Santo Domingo/Peña Blanca	Produce	Every third year
San Ildefonso	Produce Eggs Piñon, Herbs Domestic Animals	Every third year Infrequent Infrequent Infrequent
<b>Onsite Stations</b>		
LANL-Wide	Game Animals, Produce	Infrequent

## Sample Collection

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**Frequency of collection** Samples will be collected and analyzed on a three year cycle basis, as described in previous chapter.

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**Soil** Soil samples for radionuclide and metal analysis will include the topsoil at a depth of 0 to 5 cm (0 to 2 inches). For organic constituents, the samples will consist of samples collected at the 0 to 6-inch depth.

See SOP-5132, Collection of Soil and Vegetation Samples for the Environmental Surveillance Program.

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**Produce** Produce, for purposes of the foodstuffs monitoring project, is defined as any fruit, vegetable, and/or grain that could be consumed directly from a garden or an orchard after simple washing. Produce will be collected from late summer to early fall from onsite, perimeter, and regional background locations, as available. The types of produce collected may include garden-variety squash, cucumbers, chile, sweet corn, lettuce, melons, pumpkins, tomatoes, peaches, apricots, plums, and apples.

Composite samples should be obtained to reach a two lb weight to meet radionuclide detection limits.

See SOP-5134, Produce Sampling.

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**Fish** Fish samples are collected between May and September from Abiquiu Reservoir (upstream of LANL) and Cochiti Lake (downstream of LANL). The fish collected will include at least three species of bottom-level feeders (nongame or bottom-feeding fish) and at least three species of higher-level feeders (game or predator fish). Nongame fish should include channel catfish (*Ictalurus spp.*), suckers (*Catostomus spp.*), and carp (*Cyprinus spp.*). Game fish should include white crappie (*Pomoxis annularis*), trout (*Salmo spp.*), salmon (*Oncorhynchus spp.*), bass (*Micropterus spp.*), and walleye (*Stizostedion vitreum*).

Five composite samples of at least 5-10 fish from each trophic level will need to be collected to meet detection limits.

See SOP-5135, Fish Sampling.

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**Honey**

Honey will be collected directly from the producers in the fall from perimeter and background locations.

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**Milk**

Milk will be collected directly from the producers in the summer from the closest milk-producing animal; in recent years this has been from goats in the Los Alamos and White Rock areas.

## Sample Collection, continued

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**Game animals** Game animals such as elk and deer will be collected; the frequency of these studies will be based on samples collected from (fresh) road kills.

See SOP-5136, Game Animal Sampling.

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**Eggs** Fresh eggs will be collected directly from the producer from free-ranging chickens from the Los Alamos and White Rock town site areas and from the Pueblo of San Ildefonso.

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**Domestic animals** Cattle owned by residents of the Pueblo of San Ildefonso graze the boundaries of LANL on a regular basis and are offered by the Pueblo for sampling and analysis; however, the donation of meat is very infrequent.

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**Piñon** Piñon nut and tree shoot tips will be collected from three perimeter areas surrounding the Laboratory: Los Alamos on the north, White Rock on the southeast, and Pueblo of San Ildefonso lands on the east as a special study project.

See SOP-5132, Collection of Soil and Vegetation Samples for the Environmental Surveillance Program and SOP-5134, Produce Sampling.

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**Herbs and tea** Navajo tea (Cota) will be collected directly from the producers from three perimeter areas surrounding the Laboratory: Los Alamos town site on the north, White Rock on the southeast, and Pueblo of San Ildefonso lands on the east as a special study project.

Composite samples should be obtained to reach a two lb weight amount to meet radionuclide detection limits.

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**Vegetation**

Unwashed overstory and understory vegetation from 25 locations (onsite, perimeter, and offsite soil sampling stations).

Composite samples will be collected from the historic soil sampling sites to reach a two lb weight amount to meet radionuclide detection limits.

See SOP-5132, Collection of Soil and Vegetation Samples for the Environmental Surveillance Program.

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**Small and  
medium sized  
mammals**

Small mammals like rodents are collected by the ENV-EAQ group according to RRES-ECO-BIO-HCP/OP-035, Rodent Trapping, and medium sized mammals like raccoons, lions, and coyotes are collected as roadkills. See SOP-5136, Game Animal Sampling.



## Sample Handling, Packaging, Transportation and Preparation

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### Sample protocols

Samples are handled, packaged and transported according to EP-ERSS-SOP-5056 (Sample Containers and Preservation) and EP-ERSS-SOP-5057 (Handling, Packaging, and Transporting Field Samples), under strict Chain of Custody procedures (EP-ERSS-SOP-5085).

All samples are given to the Sample Management Office according to EP-ERSS-SOP-5095 (Shipping of Environmental Samples by the ERSS Sample Management Office) where they are shipped directly to the analyzing laboratory.

At the laboratory samples are processed (prepped) according to SOP-5137, Processing Biota Samples for Analysis. In general, water will be first distilled from the samples for tritium analysis. Biota samples will be split for TAL metals, radionuclides and organic analysis. For radionuclides, the samples will be ashed to concentrate radionuclides and reduce uncertainty. A sub-sample from these media are taken and dried and grinded for trace element analysis. For organic and heavy metal analysis in fish, the entire sample will be shipped to the analytical laboratory.



Media	Radio-nuclides	Trace metals	Organics (all)	PCB	HE	Pesti-cides	VOLs	Semi-vols	PAH	Diox-ins	Perchlo rate
Domestic livestock	X										
Eggs	X										
Tea	X										

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**Calibration of analytical equipment** Analytical equipment will be maintained and calibrated by the analytical laboratory. The frequency of these activities and the supporting documentation will be maintained and will be made available for audit and inspection.

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**Detection limits** There are no DOE requirements for detection limits. In order to characterize any Laboratory impact, detection limits would ideally be set at or below environmental background levels. However, it is frequently not cost effective or technically feasible to request limits so low for all contaminants. Historically, the project has requested detection limits from the analytical laboratories as close to background concentrations as practically possible.

## Sample Tracking

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**Chain-of-custody during sample preparation and retrieval**

Positive control of samples will be maintained during sample preparation and retrieval according to the chain-of-custody requirements in EP-ERSS-SOP-5085, RO. All persons (other than analytical personnel) performing sample preparation and collection will be trained to sample collection procedures and must adhere to the chain-of-custody requirements therein. Identification and documentation of each sample will be established and maintained to assure that each sample is traceable and identifiable. Chain-of-custody requirements are given in implementing procedures.

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**Chain-of-custody during analysis**

Any analytical laboratory that is contracted to perform sample analysis on samples will maintain sufficient procedures to ensure positive control of samples.

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**Chain-of-custody during storage/disposal**

Retained samples or sample portions will be maintained under chain-of-custody by the analytical laboratory until reanalysis, return to WES, or ultimate disposal.

## Data analysis

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**Data analysis** Sample analytical results will be analyzed to evaluate the following hypotheses. (these tests correspond to the decision statements defined in the chapter *Data Quality Objectives*):

1a. Radionuclides, trace elements, and organic constituents in soils, foodstuffs, and (nonfoodstuffs) biota collected from on-site and perimeter locations are similar to regional background at the 99% confidence level.

- A detectable value will be determined by comparing the result with the total propagated uncertainty at the 99% confidence level. (i.e., is the result greater than three times the TPU).
- A detectable value will be compared to the regional statistical reference level (RSRL). The RSRL is the average background concentration plus three standard deviations.
- Samples from on-site and perimeter will be compared to background samples using a (nonparametric) t-test at the 0.01 probability level.

1b. The radiation dose from the ingestion of soil and foodstuffs is lower than the DOE limit of 100 mrem/yr.

- Data will be provided to the Dose Assessment Project personnel for evaluation.

1c. The chemical dose from the ingestion of soil and foodstuffs is lower than the NMED limit of  $10^{-5}$ .

- Data will be compared to NMED Consent Order values.

1d. The radiation dose to terrestrial plants and aquatic biota and to terrestrial animals impacted by Laboratory operations is lower than the DOE limit of 1 rad/day and 0.1 rad/day, respectively.

- Data will be provided to the Dose Assessment Project personnel for evaluation.

1e. Constituents like Pu in soils are not significantly being taken up by plants and animals at the 99% confidence level.

- T-test will be employed to compare differences.

1f. Constituents, based on at least the last five year of data, are not statistically increasing over time at the 99% confidence level.

- Trend analysis test is employed.

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**Actions to take**

If the results of the above tests are positive, actions will be taken as specified in the chapter *Data Quality Objectives*.

## Process Verification and Peer Review

### Verification and peer review methods

Through a process of peer review and verification, LANL helps ensure that these activities meet project requirements. These methods are described below for each process.

Process	Method(s)
Data Quality Objectives	<p>Representatives from WES will determine the initial DQOs and will approve any modifications to these DQOs.</p> <p>At least once per year, WES will determine adherence to the DQOs. Failure to meet any of the DQOs will be addressed as deficiencies.</p>
Sample collection	<p>Before the collection of new samples, review all sample locations.</p> <p>Periodically review the collection schedule of the differing media to ensure the frequency continues to be acceptable. Basically, frequency is set as a function of the dose defined by DQOs in WES-Dose (“Environmental Dose Assessment”) as they pertain to requirements in DOE/EH-0173T.</p>
Sample analysis	<p>As data are received they are verified and validated to be complete, reasonable, and meet the requirements of this QAPP and any applicable Statements of Work. This V&amp;V will follow ENO-MAQ-712, “Analytical Chemistry Data Management and Review for Soil, Foodstuffs and Biota.”</p>
Sample tracking	<p>At least once during the year, review chain-of-custody documentation for sample collection personnel and analytical laboratories. This may be accomplished through routine audits and assessments.</p>

## ***Section 6***

### **Design**

#### **Program Design Activity**

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**Design**

This project requires no hardware design activity.

## ***Section 7***

### **Procurement**

#### **Procurement of Items and Services**

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**Procurement  
of items and  
services**

The SFB project will procure services from qualified persons and/or organizations as needed to accomplish project goals. Procurement of items and services used in the Soil Monitoring Project will follow the Laboratory procurement process.

Most items and services required for the project are commercial grade in nature and no special procurement requirements or needs are necessary. For items and all services for which special requirements are necessary, the Project Leader and project members will identify such items or services. Such items and services include analytical services.



## ***Section 8***

### **Inspection and Acceptance Testing**

#### **Inspection and Acceptance Testing**

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**Acceptance of materials and services** Any materials or services will be inspected and/or tested before acceptance for use in monitoring. Most supplies used during performance of monitoring are commercial grade in nature and require no special acceptance practices or procedures. Inspection and acceptance of analytical deliverables is addressed in Section 5.

## ***Section 9***

### **Management Assessment**

#### **Project Management Assessments**

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**Internal assessments**

WES conducts internal management assessments of all projects and programs in the group.

The group leader will perform an assessment of the effectiveness of the project effort periodically. Assessments of the project are documented and filed as records.

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**Responding to assessments**

When violations of requirements are found during a management assessment, a deficiency report is initiated to document the violation.

## ***Section 10***

### **Independent Assessments**

#### **Independent Project Assessments**

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**Policy**

The Soil, Foodstuffs, and Nonfoodstuffs Biota Monitoring Project will undergo audits and assessments by persons not responsible for the performance of the work.

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**Internal audits**

Independent assessments (audits) will be conducted throughout the group, as specified by the group leader, to verify compliance with all project requirements and all aspects of the group QMP.

Periodic performance audits of the measurement component of the project may be conducted by a qualified contractor at the discretion of the project leader and the group leader.

## Assessing Suppliers

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### Policy

The Project Leader (in coordination with the Group Quality Assurance officer) will ensure that periodic assessments are conducted to determine whether required information from the following organizations meets quality specifications:

- Analytical laboratories supplying data and
- Organizations supplying services (such as KSL).

If problems are found with a supplier's product, WES will work with that supplier until the problem is corrected or will obtain alternate suppliers.

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### Analytical laboratories

WES Division will perform periodic audits of analytical laboratories that provide analytical data used in compliance calculations. These audits will be conducted by the WES Analytical Chemistry Coordinator in conjunction with the WES Quality Assurance Officer and/or any other persons the coordinator deems appropriate.

[Using a CRYPTOCARD, click here to record "self-study" training to this procedure.](#)

If you do not possess a CRYPTOCARD or encounter problems, contact the ERSS training specialist.

## ***Appendix A***

### **References**

Requirements and guidance documents:

DOE/EH-0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance," US Department of Energy, January 1991

DOE Order 231.1, "Environment, Safety, and Health Reporting," US Department of Energy

DOE Order 450.1, "General Environmental Protection Program," US Department of Energy

DOE Order 5400.5, "Radiation Protection of the Public and the Environment," US Department of Energy

DOE Order 414.1C, "Quality Assurance," US Department of Energy

EPA QA/R-5, "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations," Interim Final, January 1994

EPA QA/G-9, "Guidance for Data Quality Assessment," External Working Draft, March 27, 1995

10 CFR Part 834, Radiation Protection of the Public and the Environment, Code of Federal Regulations

DOE Order 151.1

EPA 2000: US Environmental Protection Agency, "Human Health Medium Specific Screening Levels," Region 6, Multimedia Planning and Permitting Division, [www.epa.gov/region6/6pd/rcra6/pd7/screen.htm](http://www.epa.gov/region6/6pd/rcra6/pd7/screen.htm).

ENV-IMP, "Integrated Management Plan for the Environmental Stewardship Division," RRES Division controlled document (July).

New Mexico Environment Department DOE Oversight Bureau Agreement in Principle ([http://www.nmenv.state.nm.us/DOE\\_Oversight/doetop.html](http://www.nmenv.state.nm.us/DOE_Oversight/doetop.html))