ENV-RCRA-QP-010.3		Los Alamos NATIONAL LABORATORY EST 1943
Effective Date: July 12, 2012	Next Review Date: June 12, 2014	

Environment, Safety, Health Directorate

Environmental Protection – Water Quality and RCRA

Quality Procedure

Title: Land Application of Groundwater

Reviewers:

Name:	Organization:	Signature:	Date:
Melanie Lamb	ENV-QPMO, QA Specialist	Signature on file	6/18/12
Name:	Organization:	Signature:	Date:
Mike Alexander	CAP-FS	Signature on file	7/12/12

Derivative Classifier: ☒ **Unclassified**

Name:	Organization:	Signature:	Date:
Anthony Grieggs	ENV-RCRA	Signature on file	7/12/12

Approval Signatures:

Subject Matter Expert:	Organization:	Signature:	Date:
Bob Beers	ENV-RCRA	Signature on file	6/26/12
Responsible Line Manager:	Organization:	Signature:	Date:
Mike Saladen	ENV-RCRA, Team Lead	Signature on file	7/12/12
Responsible Line Manager:	Organization:	Signature:	Date:
Anthony Grieggs	ENV-RCRA, Group Leader	Signature on file	7/12/12

CONTROLLED DOCUMENT

This copy is uncontrolled. The controlled copy can be found on the ENV Division Web page.
Users are responsible for ensuring they work to the latest approved version.

History of Revisions

Document Number *[Include revision number, beginning with Revision 0]*	**Effective Date** *[Document Control Coordinator inserts effective date]*	**Description of Changes** *[List specific changes made since the previous revision]*
0	05/07	New Document.
1	05/08	Annual Revision
2	06/10	Biennial Revision (extensive)
2	06/10	Quick Change—editorial
2	08/10	Quick Change—editorial: Clarified order of signatures on Attachment 2.
3	07/12	Biennial review/revision (extensive), new template implemented.

Table of Contents

1.0 PURPOSE **4**

2.0 SCOPE **4**

2.1 Work Hazard Analysis 4

3.0 RESPONSIBILITIES **4**

3.1 Prerequisites 5

4.0 DOCUMENT CONTROL/RECORDS MANAGEMENT **5**

5.0 WORK PROCESSES **5**

5.1 Generation of Groundwater for Land Application 5

5.2 Drilling Water 6

5.3 Development Water 6

5.4 Rehabilitation Water 6

5.5 Sampling Purge Water 7

5.6 Sampling Pits and Tanks 7

5.7 Tanks Containing Sampling Purge Water 8

5.8 Decision Tree 8

5.9 Radiological Decision Tree 9

5.10 Methods for Land Application of Groundwater 9

5.11 Land Application of Groundwater Decision Tree 10

5.12 Obtain Approval for Land Application of Groundwater 13

5.13 Land Apply Groundwater 13

5.14 Annual Reporting to NMED 14

6.0 DEFINITIONS **15**

7.0 REFERENCES **15**

8.0 ATTACHMENTS **16**

Attachment 1- Decision Tree—01/12/10 Revision 17

Attachment 2- Data Certification Sheet 19

Attachment 3- Table 1.0 and Table 2.0 Water Quality Criteria for Land Application 19

Attachment 4- Radiological Decision Tree 25

Attachment 5- DOE Derived Concentration Technical Standards (CSs) for Ingested Water 26

Attachment 6- Land Application Field Certification Sheet 27

Attachment 7- ALARA for the Land Application of Groundwater 28

Attachment 8- March 12, 2010 Approval Letter from NMED 333

1.0 PURPOSE

The purpose of this procedure is to describe the criteria for and process to land apply groundwater that has been generated from any of the following activities:

- Drilling, development, or rehabilitation of a groundwater well
- Purging of a groundwater well during sampling

The land application of groundwater may be conducted only if all of the terms and conditions of this procedure are followed as described in this document.

The land application of groundwater that has been generated from well drilling, development, rehabilitation or sampling is subject to regulatory requirements.

NOTE: This Quality Procedure (QP) does not cover pumping tests. Discharges from pumping tests will require an NOI. Contact ENV-RCRA.

NOTE: This Quality Procedure (QP) does not cover the land application of groundwater that has been treated following production from well drilling, development, rehabilitation, and purging. A Notice of Intent (NOI) to discharge must be submitted to the NMED Ground Water Quality Bureau for all pump and treat activities. Contact ENV-RCRA.

NOTE: This is a pre-activity procedure. This QP shall be implemented BEFORE conducting the activity.

2.0 SCOPE

This procedure applies to all ENV-RCRA staff, ADEP staff, and contractor personnel who land apply groundwater.

2.1 WORK HAZARD ANALYSIS

The work described in this procedure is office work only and has a **LOW hazard** rating as documented by submittal of a completed *ENV Low Hazard Verification form* to the Quality Assurance Specialist.

3.0 RESPONSIBILITIES

The following personnel require training before implementing this procedure:

- ENV-RCRA staff, ADEP staff, and contract personnel who land apply groundwater

The training method for this procedure is "self-study" (required read). For ENV-RCRA staff, this is documented in accordance with ENV-DO-QP-115, *Personnel Training*. Other participating groups may require training documentation pursuant to local procedures.

Actions specified within this procedure, unless preceded with "should" or "may," are to be considered mandatory guidance (i.e., "shall", "will", "must").

3.1 PREREQUISITES

None

4.0 DOCUMENT CONTROL/RECORDS MANAGEMENT

The following types of records result from this procedure and are maintained in accordance with ENV-DO-QP-110 *Records Management Program* with the originals on file at ENV-RCRA offices:

- Data Certification Sheet
- Land Application Field Sheet
- Analytical data tables and summaries
- AOC, SWMU, PRS analysis documentation
- E-mail communications
- Memos

5.0 WORK PROCESSES

5.1 GENERATION OF GROUNDWATER FOR LAND APPLICATION

All water produced during the drilling, development, rehabilitation, and purging of groundwater wells will be analyzed and evaluated for compliance with the NMED-approved Decision Tree (Attachment 1) before any discharge occurs.

Containerization on-site will be required for all water produced during drilling, development, and rehabilitation with the exception of drilling fluids, which may initially be managed in a lined pit. Representative samples of the stored water shall be collected and analyzed to determine compliance with the Decision Tree in accordance with the table below:

Source of Produced Water	Acceptable Sources of Water Quality Data
1. Drilling fluids	Direct, representative sampling of fluids in pit
2. Development water	Direct, representative sampling of containerized water or representative aliquots collected during production
3. Rehabilitation water	Direct, representative sampling of containerized water or representative aliquots collected during production
4. Sampling purge water	Direct, representative sampling of containerized water or water quality data collected from the subject well that is <1yr old

5.2 DRILLING WATER

During well drilling, water is produced from three sources.

1. Potable water from the Los Alamos County water supply system.
2. Small quantities of drilling additives (e.g., EZ MUD™, QUIK-GEL™ QUIK-FOAM™, AQF-Z™) may be mixed with potable water during the drilling process to improve efficiency by (1) lifting cuttings out of the borehole, (2) cooling the drill bit, and (3) support the walls of the borehole in unconsolidated formations. Material Safety Data Sheets (MSDS) are available for these products upon request.
3. Groundwater (alluvial, intermediate, and regional) encountered as the borehole penetrates water-bearing strata.

Between 20,000 and 150,000 gallons of drilling water may be produced during the drilling of each intermediate or regional monitoring well. Drilling water containing groundwater, potable water, and drilling additives will be contained in a designated, lined, holding pit where the solids will be settled. Settled solids will be characterized and disposed of in accordance with ENV-RCRA-QP-011, *Land Application of Drill Cuttings*. Representative samples of the drilling water will be collected in accordance with this procedure. Land application of the drilling water contained in the pit may be conducted if compliant with the requirements of the Decision Tree.

5.3 DEVELOPMENT WATER

Following well construction, the well is pumped to remove any fine material that may be blocking the wells screens or ports. Development water is predominantly groundwater with the potential for small quantities of drilling additives.

Between 10,000 and 100,000 gallons of water may be produced during the development of each monitoring well. Development water will be isolated in a large-capacity tank(s). Representative samples of the development water will be collected in accordance with this procedure. Land application of the development water contained in the tank(s) may be conducted if compliant with the requirements of the Decision Tree.

5.4 REHABILITATION WATER

Concerns about the reliability or representativeness of the groundwater quality data obtained from some LANL wells stem from the potential for residual drilling fluids and additives to mask the present and future detection of contaminants. Rehabilitation of a well may be necessary to remove residual drilling fluids and additives. During rehabilitation, each screen may be jetted within the open well using high-pressure potable water. During jetting the well may be simultaneously pumped. Other methods of redevelopment that may be used and that generate groundwater include bailing, swabbing, and pumping. Between 20,000 and 100,000 gallons of groundwater may be produced during well rehabilitation activities. Rehabilitation water will be isolated in a designated, lined, holding pit or large-capacity tank(s) where the solids will be settled. Settled solids will be disposed of at an approved disposal site. Representative samples of the rehabilitation water will be collected

in accordance with this procedure. Land application of the rehabilitation water contained in the pit or tank(s) may be conducted if compliant with the requirements of the Decision Tree.

5.5 SAMPLING PURGE WATER

Once well construction is complete, each well may be routinely sampled. During sample collection it is necessary to purge the well, typically three casing volumes, prior to collecting a sample to ensure that the water sampled is representative of the groundwater in the aquifer. Between 50 and 1500 gallons of water may be produced during each sampling event. Containerization on-site of sampling purge water will be required if representative data meeting the criteria for land application is not available or if the purge water quality does not meet the criteria for land application.

5.6 SAMPLING PITS AND TANKS

Groundwater produced during well drilling, development, and rehabilitation must be containerized on-site in a lined pit or tank(s). A representative sample(s) shall be collected from each pit or tank in order to accurately characterize the water quality to determine compliance with the Decision Tree. Representative samples shall be collected in accordance with ADEP standard operating procedures and with consideration of the following:

- A composite sample shall be collected from each pit and tank at intervals across the entire water column—surface, middle, and bottom. Stratified, vertical sampling is necessary to address NMED's concerns about stratification of contaminants in the pit or tank.

NOTE: If the water freezes, leaving a thin film of ice at the top, a composite sample may still be taken by breaking through the thin film, as long as the stratified vertical composite sampling is maintained.

- The methods available to sample a pit or tank at varying depths include the following:
  - Geotech pump with tubing attached to a weight or pole
  - bomb sampler
  - Coliwasa liquid waste sampler
  - thief sampler
  - bailer depending upon depth of container

Alternatively, an aliquot may be collected during water production and diverted to a smaller container (e.g., clean 55-gallon drum) that can then be sampled. For example, while filling a 21,000 gallon frac tank, a one-gallon sample is collected every 500 gallons and placed in a clean, 55-gallon drum.

Filtered and nonfiltered samples shall be collected in accordance with the table below:

Analytical Suite	Sample Field Prep (Filter/Unfiltered)
General inorganics	Filtered
Metals, except mercury	Filtered
Mercury (Hg)	Unfiltered
Radiologicals, including ^{226}Ra & ^{228}Ra	Unfiltered
SVOCs & VOCs	Unfiltered
Pesticides & Herbicides	Unfiltered
PCBs	Unfiltered
HE	Unfiltered

- Analysis of drilling fluids for organics may require dilution due to the high concentration of suspended solids. Dilution up to 5x may be conducted by the analytical laboratory without prior approval by ENV-RCRA.

5.7 Tanks Containing Sampling Purge Water

Purge water produced during well sampling shall be containerized if representative data meeting the criteria for land application is not available or if the purge water quality does not meet the criteria for land application.

Purge water shall be held in storage until water quality data from the sampling event is evaluated for Decision Tree compliance.

5.8 Decision Tree

In a March 12, 2010, letter (Attachment 8) the NMED approved LANL's Decision Tree (revised March 12, 2010) for the management of drilling, development, rehabilitation, and sampling purge water. The Decision Tree (Attachment 1) provides a detailed process to identify the appropriate disposal pathway for drilling, development, rehabilitation, and sampling purge water. This procedure is limited to the land application pathway. Other LANL guidance documents and QPs should be consulted for disposal pathways outside of land application.

A matrix of questions must be asked and answered to determine if the land application of the produced water is an appropriate disposal option. The decision matrix must be followed rigorously

and documented completely. For purposes of this procedure, criteria D1, D2, D6, P2, and R1 must be met in order to land apply groundwater.

5.9 RADIOLOGICAL DECISION TREE

The Department of Energy (DOE) regulates radiation exposure to the public and the environment through its directive, DOE Order 458.1, "Radiation Protection to the Public and the Environment". DOE regulates radiation exposure by limiting the radiation dose, or effective dose equivalent (EDE), that can be received from routine Laboratory operations. Radionuclide concentrations in water are compared with the DOE's Derived Concentration Technical Standards (DCSs) to evaluate potential impacts to the public.

NOTE: In a December 2011 communication the DOE approved LANL's request to extend the data window for the Radiological Decision Tree to two (2) years. That is, while the NMED-approved Decision Tree for Land Application requires that all data used to assess compliance must be less than one (1) year old, the DOE has approved the use of water quality data up to two (2) years old for assessing compliance with the Radiological Decision Tree.

NOTE: DOE Order 458.1 prohibits the use of soil columns for removing or retaining the suspended or dissolved radionuclides contained within the discharge. Soil columns cannot be employed as a treatment unit to meet the DOE DCSs.

The Radiological Decision Tree (Attachment 4) provides a detailed process to determine if the radiological quality of the produced groundwater is suitable for land application. The following criteria are applicable.

1. Groundwater with radiological concentrations less than the 4 mrem/yr effective dose equivalent (EDE), or 4% of the DOE DCSs, may be land applied without restriction if all other criteria of the NOI Decision Tree are met.
2. Groundwater with radiological concentrations between 4 mrem/yr (4% DOE DCSs) and 15 mrem/yr (15% DOE DCSs) may be land applied if the following restriction, as specified in Attachment 7, ALARA (As Low As Is Reasonably Achievable), is met:
    - Groundwater with radiological concentrations between 4 mrem/yr (4% DOE DCSs) and 15 mrem/yr (15% DOE DCSs) may not be land applied to roads for dust suppression.
3. All groundwater with radiological concentrations greater than 15 mrem/yr (15% DOE DCSs) must be evaluated for disposal pathways other than land application.

5.10 METHODS FOR LAND APPLICATION OF GROUNDWATER

There are four acceptable methods for the land application of groundwater:

Type of Application	Restrictions/Requirements
Direct Discharge to the Land Surface	• Discharge to Watercourse Prohibited • No Single Container Can Exceed 55 Gal. • Immediate Vicinity of Wellhead • No map required w/Attachment 2, Data Certification Sheet
Sprinkling or Spraying to Land Surface	• Discharge to Watercourse Prohibited • Within Same Watershed as Source • No Volume Restrictions • No map required w/Attachment 2, Data Certification Sheet, if land application occurs within the vicinity of the wellhead (source)
Water Truck Application 1. Spraying on Well Pads for Dust Suppression 2. Spraying on Dirt Roads for Dust Suppression 3. Spraying on Roadside Vegetation	• Discharge to Watercourse Prohibited • Within Same Watershed as Source No Volume Restrictions • Rad Content Cannot Exceed 4 mrem/yr (4% DOE DCSs) • Map required w/ Attachment 2, Data Certification Sheet, showing the location of the land application.
Hydromulch/Hydroseed Make-up Water	• Within Same Watershed as Source • Discharge to Watercourse Prohibited • Map required w/ Attachment 2, Data Certification Sheet, showing the location of the land application.

Equipment and tools for this procedure will be supplied by land application personnel.

5.11 LAND APPLICATION OF GROUNDWATER DECISION TREE

Using the Decision Tree (Attachment 1), personnel will perform the following steps to determine if groundwater can be applied:

Step	Action
1	***D1:*** *Is there existing water quality data and is it less than one (1) year old?* Existing water quality data may be used if less than a year old. **YES**: go to Step 2. **NO**: Appropriately containerize produced water. Sample containerized water in accordance with "Background -Sampling Pits and Tanks" section of this document. In the case of sampling purge water, wait for validated analytical results. After water quality data is obtained, return to Step 1.
2	***D2:*** *Does water contain a RCRA hazardous waste or hazardous constituents above RCRA regulatory limits?* Review water quality data for identification of the presence of RCRA hazardous waste or hazardous constituents above RCRA regulatory limits.

	YES: Proceed to Decision Point D3 of Decision Tree. **NO**: Go to Step 3.
3	***D6:*** *Do water quality data meet the following criteria?* (1) <90% of the lower of the NM WQCC 3103 Standards or SDWA MCLs[1] (2) <90% of the 4 ppb level for perchlorate (3) <90% of the EPA Region 6 2012 Regional Screening Levels (RSLs) for Tapwater [2] for NM WQCC listed Toxic Pollutants without a 3103 standard or MCL *[1] If the alluvial background concentration of a contaminant is greater than the 3103 standard or MCL then the background concentration shall be used for this decision point instead of the 3103 standard or MCL* *[2] Adjusted to a 10^{-5} risk level for carcinogens.* Using the table below, compare water quality data to the appropriate standards and groundwater background screening values in Tables 1 and 2 of Attachment 3. Background screening values are from Table 4.3-2a of the *Groundwater Background Investigation Report, Rev. 4* (LA-UR-10-4827, August 2010).

Water Type	Require Analytes
Drilling Water	Full suite, Tables 1 & 2 (Attachment 3)
Development Water	Full suite, Tables 1 & 2 (Attachment 3)
Rehabilitation Water	Full suite, Tables 1 & 2 (Attachment 3)
Sampling Purge Water	Current Interim Facility-Wide Monitoring Plan—all well and/or watershed specific analytes

NOTE: When a required analyte is detected, and a duplicate sample collected during the same sampling event was reported as a non-detect, then the detection will be viewed as the result of field or laboratory contamination. The non-detect result will be used for the purpose of determining Decision Tree compliance.

NOTE: Acceptable Knowledge (AK) may be used when a required analyte is Rejected (R) during focused or secondary validation. Documentation supporting AK must be attached to the Data Certification Sheet (Attachment 2).

YES: Go to Step 4.

NO: Go to Decision Point D7 of Decision Tree.

4.0	*Do the Water Quality Data Meet the Following Radiological Criteria? (Radiological Decision Tree, Attachment 4, and DOE DCSs, Attachment 5)* *Are radiological data <2yrs old?* *Are radiological data <4 mrem/yr effective dose equivalent (EDE) for ingesting water(<4% of the DOE DCS for ingested water,)*

	YES: Go to Step 5 (Disposal Pathway P2 of Decision Tree). Land application may be conducted without ALARA restrictions. **NO**: Go to the Step 4.1.
4.1	*Do the Water Quality Data Meet the Following Radiological Criteria?* *>4mrem/yr EDE, But <15 mrem/yr EDE* **NO:** Go to Decision Point D7 of the Decision Tree. Water cannot be land applied and other disposal options must be evaluated. **YES**: Go to Step 5. Water may be land applied, but with the ALARA restriction that water cannot be applied to roads for dust suppression (see Attachment 7, ALARA for the Land Application of Ground Water).
5	Land application of water can be conducted on-site and in accordance with the terms and conditions of this QP [Note: Groundwater with radiological concentrations between 4 mrem/yr (4% DOE DCSs) and 15 mrem/yr (15% DOE DCSs) may not be land applied by water trucks].
6	Complete Data Certification Sheet (Attachment 2) and obtain appropriate signatures from ADEP and ENV-RCRA SMEs. Signatures **MUST** be obtained in the following order: 1. ADEP 2. ENV-RCRA – D2 3. ENV-RCRA – D1 & D6 **Do not begin land application until data certification signatures are obtained.** Data certification sheet expires one year from the sample date of the analytical results used to determine compliance with the Decision Tree [Example: Data used in a Jan-10 evaluation was collected in Oct-09. Certification for this well will expire in Oct-10].
7	Once a signed Data Certification Sheet is obtained for a ground water well, land application of sampling purge water without containerization may be conducted until the expiration date if the application meets the requirements of ENV-RCRA-QP-010, *Land Application of Groundwater*. However, prior to each land application event, the responsible party shall perform a comprehensive review of any recent analytical data (a "spot check") generated from the ground water well in order to certify that the water purged from the well continues to meet the requirements of the Decision Tree. The findings from these spot checks shall not be reported to ENV-RCRA unless the data show that the ground water quality no

	longer meets the requirements of the Decision Tree; under such circumstances, the approvals for land application are voided, the application of sampling purge water is no longer permitted, and alternate disposal pathways must be evaluated. The responsible party shall notify ENV-RCRA and initiate an investigation into the change in ground water quality. **NOTE:** Alternate disposal may be temporary if additional sampling can demonstrate that the condition is not repeatable (e.g., due to analytical error) and not due to an actual change in groundwater quality.

5.12 Obtain Approval for Land Application of Groundwater

To obtain approval for land application of groundwater, field personnel shall perform the following steps:

Step	Action
1	Complete Data Certification Sheet (Attachment 2).
2	Attach relevant documentation including analytical data summaries/queries.
3	Obtain ENV-RCRA and ADEP SME signatures on the Data Certification Sheet.

5.13 Land Apply Groundwater

Apply produced groundwater to the land surface using the methods specified on page 8 ("Methods" table) and the following criteria:

Step	Action
1	• land application site cannot be located within a watercourse • land application site cannot extend off LANL property without written permission of the land owner • land application site shall not exceed the following slope restrictions: — if the land application site is poorly vegetated (<50% ground cover) then the maximum allowable slope is 2% — if the land application site is well vegetated (>50% ground cover) and/or the site has been seeded and mulched for revegetation then the maximum allowable slope is 5%

	• DO NOT land apply on an Area of Concern (AOCs), Solid Waste Management Unit (SWMUs), or PRSs with the exception of the following canyon-bottom PRSs: C-00-001 through C-00-021. Contact the EP Corrective Actions Program office for additional information. • land apply only during daylight and for a maximum of 10 hours per day • supervise the land application • install BMPs to mitigate site vulnerabilities
2	Monitor land application using the following criteria: • conduct in a manner that will not result in runoff • conduct in a manner that will not create ponds or pools • inspect BMPs routinely to endure integrity of site • inspect for leaks in application system • conduct in a manner to maximize infiltration & evaporation
3	Stop land application if any of the following occurs: • Ponding, pooling, or runoff occurs • BMPs fail • leaks in the application system occur • rain, snow, or hail occurs • duration of application exceeds more than 10 hrs in a day

To document the land application of groundwater, field personnel shall complete and sign the Land Application Field Sheet (Attachment 6), and submit the original to ENV-RCRA SME (Water Quality & RCRA) within 10 days of completing land application activities.

5.14 ANNUAL REPORTING TO NMED

Attachment 1, Decision Tree, contains the following reporting requirements:

R1: *LANL shall report to NMED on an annual basis, the source and type of water, determination of fate based on the pass/fail criteria for land application, dates of disposal volumes discharged and location of discharges. The report shall include a certification stating water was disposed of in accordance with this guidance document.*

1. ENV-RCRA shall prepare an annual report to the NMED in accordance with the reporting requirements specified in R1 of the Decision Tree. Report shall be submitted by March 31 of each year for the previous calendar year.
2. ADEP shall provide ENV-RCRA with completed copies of all Land Application Field Sheets (Attachment 6) within 10 days of completing land application activities.

3. ADEP shall provide annually a Certification Statement per R1 of the Decision Tree certifying that all groundwater land applied under the Decision Tree was fully compliant with the criteria set forth within.

6.0 DEFINITIONS

ADEP: Associate Directorate for Environmental Programs
AOC: Area of Concern
ALARA: "As Low As Is Reasonably Achievable", an approach used for radiation protection to manage and control exposures.
BMP: Best Management Practice
ENV-RCRA: Water Quality & RCRA Group
EPA: Environmental Protection Agency
HE: High explosives
MCL: Maximum Contaminant Level
Mrem: Millirem
NMED: New Mexico Environment Department
NOI: Notice of Intent to Discharge
PCB: Polychlorinated Biphenyls
Ponding: a body of standing water of any size, often artificially formed.
PRS: Potential Release Site
Runoff: water that cannot be adsorbed by the soil and flows over the land surface before reaching a watercourse.
SDWA: Safe Drinking Water Act
SME: Subject Matter Expert
Spot Check: The process of reviewing recent analytical data from a well to certify that water purged from the well continues to meet the criteria for land application.
SWMU: Solid Waste Management Unit
SVOC: Semi-Volatile Organic Compound
VOC: Volatile Organic Compound
Watercourse: means any river, creek, arroyo, canyon draw, wash or any other channel having defined banks and beds with visible evidence of the occasional flow of water.
WQCC: Water Quality Control Commission of New Mexico

7.0 REFERENCES

The land application of groundwater that has been generated from well drilling, development, rehabilitation, and purging is subject to regulatory requirements. These regulations exist on federal, state and LANL administrative levels. The requirements listed in the following regulations must be followed prior to land application of groundwater.

- NM WQCC Notice of Intent to Discharge Regulations (20.6.2.1201 NMAC)
- NM WQCC Regulation 3103 Standards for Groundwater (20.6.2.3103 NMAC)
- NM WQCC Toxic Pollutants (20.6.2.7.vv. NMAC)
- National Primary Drinking Water Regulations

- EPA Region 6 Regional Screening Levels (RSL) April 2012
- DOE Derived Concentration Technical Standards (DOE Order 458.1)
- RCRA Hazardous Waste Regulations, 40 CFR Parts 239 through 299
- Groundwater Background Investigation Report, Rev. 4 (LA-UR-10-4827, August 2010)
- LANL Interim Facility-Wide Groundwater Monitoring Plan 2012 or current version

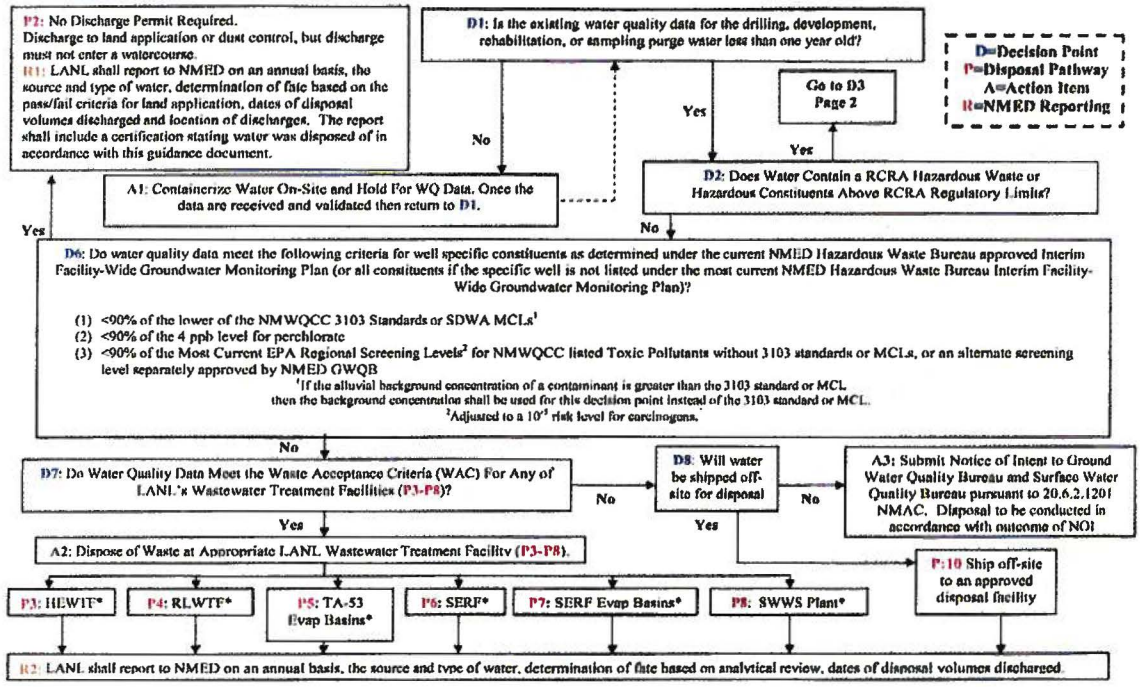
8.0 ATTACHMENTS

Attachment 1- Decision Tree—03/12/10 Revision
Attachment 2- Data Certification Sheet
Attachment 3- Table 1.0 and Table 2.0 Water Quality Criteria for Land Application
Attachment 4- Radiological Decision Tree
Attachment 5- DOE Derived Concentration Technical Standards (CSs) for Ingested Water
Attachment 6- Land Application Field Certification Sheet
Attachment 7- ALARA for the Land Application of Groundwater
Attachment 8- March 12, 2010 Approval Letter from NMED

Click here for "Required Read" credit.

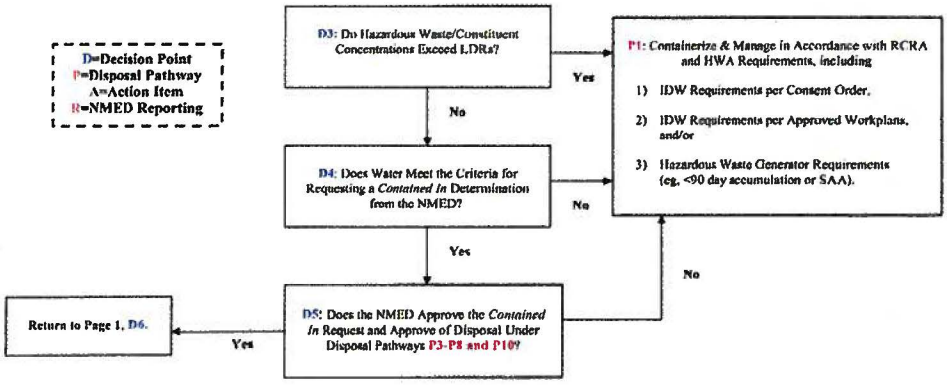
ATTACHMENT 1- DECISION TREE—01/12/10 REVISION

Los Alamos National Laboratory Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree—Revised 03/12/2010



***Nothing in this guidance document shall be construed as relieving the United States Department of Energy or the Los Alamos National Security, LLC, of its obligation to comply with all other applicable federal, state, and local laws, regulations, permits or orders.**

Los Alamos National Laboratory Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree—Revised 03/12/2010



***Nothing in this guidance document shall be construed as relieving the United States Department of Energy or the Los Alamos National Security, LLC, of its obligation to comply with all other applicable federal, state, and local laws, regulations, permits or orders.**

ATTACHMENT 2- DATA CERTIFICATION SHEET

NOI Decision Tree
Land Application of Drilling—Development—Rehabilitation—Sampling Purge Waters
Data Certification Sheet

Discharge ID #:_____ **Well Name:**_____ **Evaluation Date:**_____

Expiration Date (1-yr from D1 sample date):_____ **Prepared By:**_____

General Information

Well Location (Canyon):_____ **TA:**_____

Activity Date— Start: _____ **End:** _____

Activity Type (circle): **Development** **Drilling** **Rehabilitation** **Sampling Purge Water**

NOI Decision Tree—Decision Point Evaluation

DATA CERTIFICATION

I certify that the data submitted is, to the best of my knowledge, true, accurate, and complete.

_____ _____
ADEP management Date

D1: Is Existing water quality data is less than a year old? Yes No

Sample Date:_____ Data Package (Circle)?: full-suite partial

If partial, explain missing data: _____

D1 Certification: _____
Name Org Date

D2: RCRA Hazardous Waste or Hazard Constituents above RCRA Limits? Yes No

If yes, explain: _____

D2 Certification:_____
Name Org Date

D6: Does Water Meet the Water Quality Criteria? Yes No

If no, explain:_____

D6 Certification:_____
Name Org Date

ATTACHMENT 3- TABLE 1.0 AND TABLE 2.0 WATER QUALITY CRITERIA FOR LAND APPLICATION

	20.6.2.3103 NMAC Ground Water Contaminants	CAS #	3103 Standards[1]	Primary SDWA MCLs[1]	Background Screening Values[2]
	A. Human Health Standards				
1	Arsenic (As)	7440-38-2	0.1 mg/L	0.01 mg/L	0.00343 mg/L
2	Barium (Ba)	7440-39-3	1.0 mg/L	2 mg/L	0.127 mg/L
3	Cadmium (Cd)	7440-43-9	0.01 mg/L	0.005 mg/L	0.001 mg/L
4	Chromium (Cr)	7440-47-3	0.05 mg/L	0.1 mg/L	0.00474 mg/L
5	Cyanide (CN)	57-12-5	0.2 mg/L	0.2 mg/L	
6	Fluoride (F)	16984-48-8	1.6 mg/L	4.0 mg/L	0.71 mg/L
7	Lead (Pb)	7439-92-1	0.05 mg/L	0.015 mg/L	0.0005 mg/L
8	Total Mercury (Hg)	7439-97-6	0.002 mg/L	0.002 mg/L	0.00007 mg/L
9	Nitrate (NO3 as N)		10 mg/L	10 mg/L	0.66 mg/L
10	Selenium (Se)	7782-49-2	0.05 mg/L	0.05 mg/L	0.0025 mg/L
11	Silver (Ag)	7440-22-4	0.05 mg/L		0.001 mg/L
12	Uranium (U)	7440-61-1	0.03 mg/L	0.03 mg/L	0.00223 mg/L
13	Radioactivity: Combined Radium-226 & 228		30 pCi/L	5 pCi/L	
14	Benzene	71-43-2	0.01 mg/L	0.005 mg/L	
15	Polychlorinated biphenyls (PCB's)	1336-36-3	0.001 mg/L	0.0005 mg/L	
16	Toluene	108-88-3	0.75 mg/L	1 mg/L	
17	Carbon Tetrachloride	56-23-5	0.01 mg/L	0.005 mg/L	
18	1,2-dichloroethane (EDC)	107-06-2	0.01 mg/L	0.005 mg/L	
19	1,1-dichloroethylene (1,1-DCE)	75-35-4	0.005 mg/L	0.007 mg/L	
20	1,1,2,2-tetrachloroethylene (PCE)	127-18-4	0.02 mg/L	0.005 mg/L	
21	1,1,2-trichloroethylene (TCE)	79-01-6	0.1 mg/L	0.005 mg/L	
22	ethylbenzene	100-41-4	0.75 mg/L	0.7 mg/L	
23	total xylenes	1330-20-7	0.62 mg/L	10 mg/L	
24	methylene chloride (dichloromethane)	75-09-2	0.1 mg/L	0.005 mg/L	
25	chloroform	67-66-3	0.1 mg/L	0.08 mg/L	
26	1,1-dichloroethane	75-34-3	0.025 mg/L		
27	ethylene dibromide (EDB)	106-93-4	0.0001 mg/L	0.00005 mg/L	
28	1,1,1-trichloroethane	71-55-6	0.06 mg/L	0.2 mg/L	
29	1,1,2-trichloroethane	79-00-5	0.01 mg/L	0.005 mg/L	
30	1,1,2,2-tetrachloroethane	79-34-5	0.01 mg/L		
31	vinyl chloride	75-01-4	0.001 mg/L	0.002 mg/L	
32	PAHs: total naphthalene plus monomethylnaphthalenes	65996-93-2	0.03 mg/L		
33	benzo-a-pyrene	50-32-8	0.0007 mg/L	0.0002 mg/L	

Notes:

[1] Decision Point D6(1) specifies <90% of the lower of the 3103 standards or SDWA MCLs.

[2] Perched intermediate aquifer background screening values from Table 4.4-1 of the Groundwater Background Investigation Report, Revision 4, August 2010.

Table 1.0. Decision Tree, Decision Point D6 (1), Water Quality Criteria for Land Application (Revised 6/29/10) (con't).

	20.6.2.3103 NMAC Ground Water Contaminants	CAS #	3103 Standards[1]	Primary SDWA MCLs[1]	Background Screening Values[2]
	B. Other Standards for Domestic Water Supply				
1	Chloride (Cl)	16887-00-6	250.0 mg/L		4.26 mg/L
2	Copper (Cu)	7440-50-8	1.0 mg/L	1.3 mg/L	0.003 mg/L
3	Iron (Fe)	7439-89-6	1.0 mg/L		0.616 mg/L
4	Manganese (Mn)	7439-96-5	0.2 mg/L		0.102 mg/L
5	Phenols	108-95-2	0.005 mg/L		NA
6	Sulfate (SO4)	14808-79-8	600 mg/L		9.83 mg/L
7	Total Dissolved Solids (TDS)		1000 mg/L		220 mg/L
8	Zinc (Zn)	7440-66-6	10.0 mg/L		0.0033 mg/L
9	pH		between 6 and 9		8.80
	C. Standards for Irrigation Use				
1	Aluminum (Al)	7429-90-5	5.0 mg/L		1.460 mg/L
2	Boron (B)	7440-42-8	0.75 mg/L		0.0424 mg/L
3	Cobalt (Co)	7440-48-4	0.05 mg/L		0.001 mg/L
4	Molybdenum (Mo)	7439-98-7	1.0 mg/L		0.00533 mg/L
5	Nickel (Ni)	7440-02-0	0.2 mg/L		0.00298 mg/L
	National Primary Drinking Water Standards[3]	**CAS #**	**3103 Standards[1]**	**Primary SDWA MCLs[1]**	**Background Screening Values[2]**
1	Antimony (Sb)	7440-36-0		0.006 mg/L	0.001 mg/L
2	Beryllium (Be)	7440-41-7		0.004 mg/L	0.001 mg/L
3	Thallium (Tl)	7440-28-0		0.002 mg/L	0.001 mg/L
4	p-Dichlorobenzene	106-46-7		0.075 mg/L	
5	cis-1,2-Dichloroethylene	156-59-2		0.07 mg/L	
6	trans-1,2-Dichloroethylene	156-60-5		0.1 mg/L	
7	1,2-Dichloropropane	78-87-5		0.005 mg/L	
8	Chlorobenzene	108-90-7		0.1 mg/L	
9	o-Dichlorobenzene	95-50-1		0.6 mg/L	
10	Styrene	100-42-5		0.1 mg/L	
11	1,2,4-Trichlorobenzene	120-82-1		0.07 mg/L	

Notes:

[1] Decision Point D6(1) specifies <90% of the lower of the 3103 standards or SDWA MCLs.

[2] Perched intermediate aquifer background screening values from Table 4.4-1 of the Groundwater Background Investigation Report, Revision 4, August 2010.

[3] Primary Drinking Water Standards without a NM WQCC 3103 standard.

Table 2.0. Decision Tree, Decision Point D6 (3), Water Quality Criteria for Land Application (Revised 8/4/10).

		20.6.2.7 NMAC Toxic Pollutants	CAS #	3103 Standards[1] (ug/L)	SDWA MCLs[1] (ug/L)	EPA Regional Screening Levels[1,2] (ug/L)	KEY[3]
1		acrolein	107-02-8			0.041	N
2		acrylonitrile	107-13-1			0.45	C
3		aldrin	309-00-2			0.0021	C
4		benzene	71-43-2	10	5.0	3.9	C
5		benzidine	92-87-5			0.00092	C
6		carbon tetrachloride	56-23-5	10	5.0	3.9	C
7		chlordane	57-74-9		2.0	0.27	C
8		**chlorinated benzenes**					
8	a	monochlorobenzene	108-90-7		100	72.0	N
8	b	hexachlorobenzene	118-74-1		1.0	0.42	C
8	c	pentachlorobenzene	608-93-5			2.3	N
9		1,2,4,5-tetrachlorobenzene	95-94-3			1.2	N
10		**chlorinated ethanes**					
10	a	1,2-dichloroethane	107-06-2	10	5.0	1.5	C
10	b	hexachloroethane	67-72-1			7.9	C
10	c	1,1,2,2-tetrachloroethane	79-34-5	10		0.66	C
10	d	1,1,1-trichloroethane	71-55-6	60	200	7,500.0	N
10	e	1,1,2-trichloroethane	79-00-5		5.0	2.4	C
11		**chlorinated phenols**					
11	a	2,4-dichlorophenol	120-83-2			35.0	N
11	b	2,4,5-trichlorophenol	95-95-4			890.0	N
11	c	2,4,6-trichlorophenol	88-06-2			35.0	C
12		**chloroalkyl ethers**					
12	a	bis (2-chloroethyl) ether	111-44-4			0.12	C
12	b	bis (2-chloroisopropyl) ether	108-60-1			3.1	C
12	c	bis (chloromethyl) ether	542-88-1	Not analyzed for, short-lived (5-min).			
13		chloroform	67-66-3	100	80	1.9	C
14		DDT	50-29-3			2.0	C
15		dichlorobenzene (1,4-)	106-46-7		75	4.2	
16		dichlorobenzidine	91-94-1			1.1	C
17		1,1-dichloroethylene	75-35-4	5	7.0	260.0	N
18		dichloropropenes (1,3-)	542-75-6			4.1	C
19		dieldrin	60-57-1			0.015	C

Notes:

[1]Decision Point D6 Criteria: (1) <90% of the lower of the NMWQCC 3103 Standards or SDWA MCLs, (2) <90% of the 4 ppb level for perchlorate,
and (3) <90% of the EPA Regional Screening Levels without a 3103 standard or MCL.

[2]EPA Regional Screening Levels correspond to a 10^{-6} risk level for carcinogens. Carcinogens in Table 2.0 have been adjusted to a 10^{-5} risk level per D6 of the Decision Tree.

[3]Key: C=Cancer, N=Noncancer.

Table 2.0. Decision Tree, Decision Point D6 (3), Water Quality Criteria for Land Application (Revised 8/4/10) (con't).

		20.6.2.7 NMAC Toxic Pollutants	CAS #	3103 Standards[1] (ug/L)	SDWA MCLs[1] (ug/L)	EPA Regional Screening Levels[1,2] (ug/L)	KEY[3]
20		diphenylhydrazine	122-66-7			0.67	C
21		endosulfan	115-29-7			78.0	N
22		endrin	72-20-8		2.0	1.7	N
23		ethylbenzene	100-41-4	750	700	13.0	C
24		**halomethanes**					
24	a	bromodichloromethane	75-27-4		80	1.2	C
24	b	bromomethane	74-83-9			7.0	N
24	c	chloromethane	74-87-3			190.0	N
24	d	dichlorodifluoromethane	75-71-8			190.0	N
24	e	dichloromethane (methylene chloride)	75-09-2	100	5.0	99.0	C
24	f	tribromomethane (bromoform)	75-25-2		80	79.0	C
24	g	trichlorofluoromethane	75-69-4			1,100.0	N
25		heptachlor	76-44-8		0.4	0.018	C
26		hexachlorobutadiene	87-68-3			2.6	C
27		**hexachlorocyclohexane (HCH)**					
27	a	alpha-HCH	319-84-6			0.062	C
27	b	beta-HCH	319-85-7			0.22	C
27	c	gamma-HCH	58-89-9		0.2	0.36	C
27	d	technical HCH	608-73-1			0.22	C
28		hexachlorocyclopentadiene	77-47-4		50	22.0	N
29		**high explosives (HE)**					
29	a	2,4-dinitrotoluene (2,4,DNT)	121-14-2			2.0	C
29	b	2,6-dinitrotoluene (2,6,DNT)	606-20-2			15.0	N
29	c	HMX	2691-41-0			780.0	N
29	d	RDX	121-82-4			6.1	C
29	e	2,4,6-trinitrotoluene (TNT)	118-96-7			22.0	C
30		isophorone	78-59-1			670.0	C
31		methyl tertiary butyl ether	1634-04-4			120.0	C
32		nitrobenzene	98-95-3			1.2	C
33		**nitrophenols**					
33	a	2,4-dinitro-o-cresol	534-52-1			1.2	N
33	b	dinitrophenols (2,4-dinitrophenol)	51-28-5			30.0	N
34		**nitrosamines**					
34	a	N-nitrosodiethylamine	55-18-5			0.0014	C
34	b	N-nitrosodimethylamine	62-75-9			0.0042	C

Notes:

[1]Decision Point D6 Criteria: (1) <90% of the lower of the NMWQCC 3103 Standards or SDWA MCLs, (2) <90% of the 4 ppb level for perchlorate, and (3) <90% of the EPA Regional Screening Levels without a 3103 standard or MCL.

[2]EPA Regional Screening Levels correspond to a 10^{-6} risk level for carcinogens. Carcinogens in Table 2.0 have been adjusted to a 10^{-5} risk level per D6 of the Decision Tree.

[3]Key: C=Cancer, N=Noncancer.

Table 2.0. Decision Tree, Decision Point D6 (3), Water Quality Criteria for Land Application (Revised 8/4/10) (con't).

		20.6.2.7 NMAC Toxic Pollutants	CAS #	3103 Standards[1] (ug/L)	SDWA MCLs[1] (ug/L)	EPA Regional Screening Levels[1,2] (ug/L)	KEY[3]
34	c	N-nitrosodibutylamine	924-16-3			0.024	C
34	d	N-nitrosodiphenylamine	86-30-6			100.0	C
34	e	N-nitrosopyrrolidine	930-55-2			0.32	C
35		pentachlorophenol	87-86-5		1.0	1.7	C
36		perchlorate	14797-73-0	Consent Order limit =4 ppb			
37		phenol	108-95-2	5.0		4,500.0	N
38		**phthalate esters**					
38	a	dibutyl phthalate	84-74-2			670.0	N
38	b	di-2-ethylhexyl phthalate	117-81-7		6.0	0.71	C
38	c	diethyl phthalate	84-66-2			11,000.0	N
38	d	dimethyl phthalate	131-11-3			365,000	N
39		polychlorinated biphenyls (PCB's)	1336-36-3	1	0.5	1.7	C
40		**PAHs (total)**		30			
40	a	anthracene	120-12-7			1,300.0	N
40	b	3,4-benzofluoranthene	205-99-2			0.29	C
40	c	benzo (k) fluoranthene	207-08-9			2.9	C
40	d	fluoranthene	206-44-0			630.0	N
40	e	fluorene	86-73-7			220.0	N
40	f	phenanthrene	85-01-8	No standard or screening level			
40	g	pyrene	129-00-0			87.0	N
41		tetrachloroethylene	127-18-4	20	5.0	97.0	C
42		toluene	108-88-3	750	1000	860.0	N
43		toxaphene	8001-35-2		3.0	0.13	C
44		trichloroethylene	79-01-6	100	5.0	4.4	C
45		vinyl chloride	75-01-4	1	2.0	0.15	C
46		**xylenes (total)**	1330-20-7	620	10000	190.0	
46	a	o-xylene	95-47-6			190.0	N
46	b	m-xylene	108-38-3			190.0	N
46	c	p-xylene	106-42-3			190.0	N
47		1,1-dichloroethane	75-34-3	25		24.0	C
48		ethylene dibromide (EDB)	106-93-4	0.1	0.05	0.065	C
49		cis-1,2-dichloroethylene	156-59-2		70	28.0	N
50		trans-1,2-dichloroethylene	156-60-5		100	86.0	N
51		naphthalene	91-20-3			1.4	C
52		1-methylnaphthalene	90-12-0			9.7	C
53		2-methylnaphthalene	91-57-6			27.0	N
54		benzo-a-pyrene	50-32-8	0.7	0.2	0.029	C

Notes:

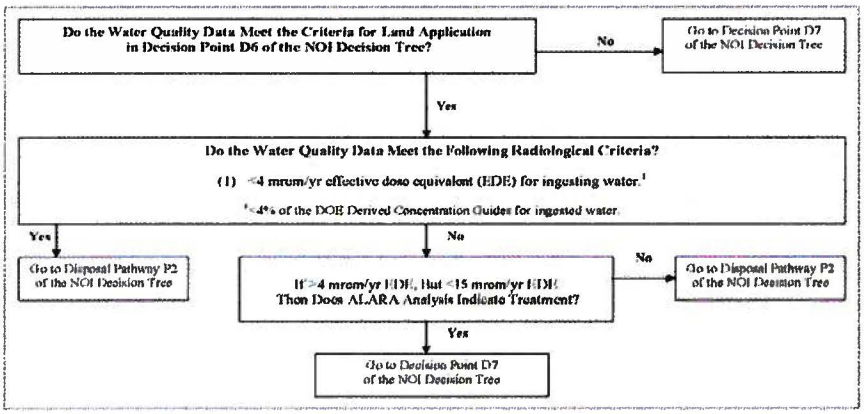
[1]Decision Point D6 Criteria: (1) <90% of the lower of the NMWQCC 3103 Standards or SDWA MCLs, (2) <90% of the 4 ppb level for perchlorate, and (3) <90% of the EPA Regional Screening Levels without a 3103 standard or MCL.

[2]EPA Regional Screening Levels correspond to a 10^{-6} risk level for carcinogens. Carcinogens in Table 2.0 have been adjusted to a 10^{-5} risk level per D6 of the Decision Tree.

[3]Key: C=Cancer, N=Noncancer.

ATTACHMENT 4- RADIOLOGICAL DECISION TREE

Radiological Decision Tree
Drilling, Development, Rehabilitation, and Sampling Purge Water
Revised 2/1/07



Los Alamos
National Laboratory

Page 1 of 1

ATTACHMENT 5- DOE DERIVED CONCENTRATION TECHNICAL STANDARDS (DCSS) FOR INGESTED WATER

DOE Derived Concentration Technical Standards (DCSs) for Ingested Water (DOE Order 458.1)

Radionuclide	4% of the DOE DCSs for Ingested Water	15% of the DOE DCSs for Ingested Water	Units
Americium-241	6.8	25.5	pCi/L
Cesium-137	120	450	pCi/L
Cobalt-60	288	1080	pCi/L
Plutonium-238	6	22.5	pCi/L
Plutonium-239/240	5.6	21	pCi/L
Potassium-40	192	720	pCi/L
Radium-226	3.48	13.1	pCi/L
Radium-228	1	3.75	pCi/L
Sodium-22	400	1,500	pCi/L
Strontium-90	44	165	pCi/L
Tritium	34,400	129,000	pCi/L
Uranium-234	26.4	99	pCi/L
Uranium-235/236	28.8	108	pCi/L
Uranium-238	30	112.5	pCi/L

ATTACHMENT 6- LAND APPLICATION FIELD CERTIFICATION SHEET

NOI Decision Tree
Land Application of Drilling—Development—Rehabilitation—Sampling Purge Waters
Land Application Field Certification Sheet

General Information

Well Name:_____

Sheet Completed by:_____ **Org:**_____ **Phone #:**_____

Land Application Contractor:_____ **POC Name:**_____ **Phone #:**_____

Discharge ID#:_____ **Data Certification Sheet Expiration Date:**_____

Location Certification

Location of Land Application (describe):_____

_____

Will the discharge contact a PRS or SWMU (circle) ? Yes* No If yes, stop now and select a new site.
**The Land Application of Groundwater to canyon bottom PRSs C-00-001 through C-00-021 is permitted without additional approval.*

Does the Land Application site meet the slope restriction of Step 1, page12 (circle)? Yes No

Location Certification by:_____
Name Org Date

Discharge Information

Date(s) of Discharge:_____

Volume:_____gallons **Land Application Method(s):** _____

_____

_____

Post Land Application Certification

Did land application comply with requirements of the ENV-RCRA-SOP-010 for Land Application? Yes No

Were any best management practices (BMPs) needed during the discharge activity? Yes No
If yes, describe below:

Was an inspection conducted of the land application site activity? Yes No
If yes, list findings below:

Land Application Certified by:_____
Name Org Date

ATTACHMENT 7- ALARA FOR THE LAND APPLICATION OF GROUNDWATER

ALARA

For the land Application of drilling, development, rehabilitation, and sampling purge water

Introduction

DOE Order 458.1 (CRD [Contractor Requirements Document], Section 2.d.) requires an ALARA process for all activities that cause public dose. The purpose is to ensure that individual doses are as far below regulatory limits as reasonably achievable and collective doses are minimized.

DOE orders and regulations limit the dose to the maximally exposed individual, MEI. The all-pathway dose is limited to 100 mrem/year, but it is normal DOE practice to apply a dose constraint of 30 mrem/year to a single source or practice (DOE-STD-ALARA1 draft page 11.) In the environment divisions of LANL, it is common to apply a dose constraint of 15 mrem/year.

The EPA (40 CFR 141) further limits the dose from "public drinking water systems," and DOE Order 458.1 (CRD, Section 2.g.(7)) adopts and extends this limit to encompass all radionuclides and to include "private or public drinking water systems." Thus, it is common to use 4% of the Derived Concentration Standards (DCSs) (Note: DCSs have replaced DCGs and are explained and listed in DOE-STD-1196-2011) as a screening level. However, the 4-mrem standard is not a regulatory limit that applies to sampling purge water, for example.

DOE Order 458.1, CRD, Section 2.g. is titled "Control and Management of Radionuclides from DOE Activities in Liquid Discharges" and discusses the use of the DCSs. Section 2.g.(5) in the CRD section of the order only requires implementation of the BAT [best available technology] process for liquid radioactive wastes when the annual average concentration of a radionuclide is greater than the DCS, the discharge results in greater than 10 mrem annual TED to members of the public, or the collective dose from all DOE sources and liquid discharges exceeds certain limits. This raises the question of how the DCS level relates to actual dose.

Dose

The DCSs are derived on the assumption that an individual ingests a specific daily quantity of water based on age range and gender, and so does not apply directly to the subject of this paper. However, it can be applied indirectly by considering a number of scenarios using a daily ingestion rate of 2 L/day, as an example.

An extreme and unlikely scenario would be: direct discharge of 1,000 gallons (4,000 L) of water at the DCS level directly into the Rio Grande. If we assume all this water is eventually ingested (directly or indirectly) by humans (i.e., no sequestration of the contamination), and each individual consumes

$$(2\ \text{L/day})*(365\ \text{days/year}) = 730\ \text{L/person}\cdot\text{year}$$

then the collective dose would be

(0.1 rem/year)*(4,000 L)/(730 L/person·year) = 0.5 person·rem.

This collective dose would be shared by on the order of 100,000 people so the individual dose would be 0.005 mrem.

According to the DOE-STD-ALARA1 draft page 31, a quantitative assessment would not be required for this scenario. Therefore, in the following calculations we use simple but conservative approximations.

Hunter scenario

Suppose the discharge water forms a pool that is ingested by a mammal, and the mammal is then hunted and ingested by humans. If the mammal ingests contaminated water equal to 3% of its body weight (equivalent to 2 L for a 70-kg human, i.e., 1 day of intake), and if the water has a concentration equal to the DCS, then the dose equivalent to the mammal is 100/365 = 0.3 mrem, which is far below the dose of 100 mrad/day allowed by DOE-STD-1153-2002. (This calculation, in units of mrem, includes human tissue-weighting factors and 50-year committed dose, so it is more conservative than the calculation in units of mrad used in DOE-STD-1153-2002.)

Assuming the ingested contamination is spread evenly throughout the mammal's body (assumed to be water) the average concentration is 3% of the DCS. If a human kills the mammal and ingests 2 kg (~ 2 L) of the meat, the human's dose would be 0.03*100/365 = 0.01 mrem (assuming no physical decay or biological elimination of the contaminant while in the mammal). In the case of a 200-kg elk, the collective dose would be 1 person·mrem = 0.001 person·rem.

The assumption that the contamination is evenly spread in the mammal's body is appropriate for tritium and cesium and conservative for the other common contaminants; for example, transuranics and strontium concentrate in the bone, which is not ingested as much or absorbed as efficiently as meat.

More complex pathways are also possible, e.g., the contamination can be taken up into plants, which are then eaten by herbivores, which in turn are then eaten by carnivores. These possibilities are revisited in the section titled "Food Chain", below.

Soil Contamination

Another concern is: build up of contamination in the soil, e.g., in soil columns (DOE Order 458.1, Attachment 2) Assume the discharged water creates mud composed of equal parts of soil and water, and the mud then dries to leave the contamination in the soil.

Referring to the table below, if the water concentration is equal to the DCS or the EPA 100-mrem equivalent (2nd column) the resulting concentrations in the soil are shown in the 3rd column. The 4th column shows the air concentration that would result from evaporation of tritiated water or resuspension of dust; the 5th column is the EPA Clean Air Act standard, and the final column is the ratio of the 5th to the 6th column.

Nuclide	DCS (pCi/L)	Soil (pCi/g)	Air (fCi/m^3)	EPA (fCi/m^3)	Ratio: Air to EPA
tritium (EPA)	500,000		4,000	1,500,000	0.003
Sr-90 (EPA)	200	0.2	0.02	19	0.001
Cs-137	3,000	3	0.3	19	0.015
U-238	750	0.6	0.06	8	0.008
transuranics	140	0.03	0.003	2	0.0015

The soil concentrations are of the same order as natural background together with global fallout, and are much smaller than the existing soil concentrations at the locations of concern.

For evaporation of tritiated water and resuspension of dust, we use the same assumptions as RESRAD: 8 g/m^3 of water vapor and 0.0001 g/m^3 of dust. These values are higher than are usual in New Mexico. We also assume all the water vapor and dust are from the contaminated area. Thus, these are very conservative assumptions. Nevertheless, the air-pathway dose would be about 0.1 mrem/year even for a residential scenario with 100% occupancy. A more realistic estimate for the locations being considered would be 1% of the residential dose, i.e., 0.001 mrem/year to a few individuals.

Food Chains

Contamination is taken up from the soil into vegetation, which is then eaten by herbivores, which are then eaten by carnivores. At some locations, worldwide, contamination can bio-accumulate, in which case the concentration would be greater at the top of the food chain. This possibility has been investigated at LANL (References number 4 through 15) and it has been shown that at LANL the bio-accumulation factors (or transfer factors) are less than 1, i.e., the concentration is less at the top of the food chain than in the underlying media.

Furthermore, extensive testing (References 16 through 18) has consistently shown that no measurable contamination is carried off-site by wide-ranging animals, despite locations where the soil contamination is more than 100 times the concentrations in the table. Any animal with a home range large enough to extend from the contaminated areas to an area where hunting is allowed, spends less than 1% of its time in the contaminated area. When taken together with the small transfer factors, we conclude that the hunter scenario leads to the largest dose.

Summary

In summary, the maximum public dose from drilling, rehabilitation, and sampling purge water would be if a mammal ingested contamination on site, and was later killed and eaten. If the water concentration is equal to the DCS and the animal is a 200-kg elk, the individual dose would be about 0.01 mrem and the collective dose about 0.001 person·rem.

Conclusions

To keep the public dose ALARA:

1. keep discharge water close to the point of origin;
2. do not allow discharge water to flow into streams;
3. do not allow on-site discharge water to flow off site;
4. avoid creating pools of potential drinking water;
5. land application to roads for dust suppression is prohibited.

References

1. DOE Order 458.1, "RADIATION PROTECTION OF THE PUBLIC AND THE ENVIRONMENT", (2011)
2. DOE-STD-1196-2011: "Derived concentration technical standard" (2011).
3. DOE-STD-1153-2002: "A graded approach for evaluating radiation doses to aquatic and terrestrial biota" (2002).
4. DOE-STD-ALARA1draft, "Applying the ALARA Process for Radiation Protection of the Public and Environmental Compliance with 10 CFR part 834 and DOE 5400.5 ALARA Program Discussions," (April 1997+)
5. K. Bennett, J. Biggs, P. Fresquez, "Radionuclide Contaminant Analysis of Small Mammals, Plants, and Sediments within Mortandad Canyon, 1994" LA-13104-MS (1996).
6. PR Fresquez et al., "Radionuclide concentrations in pinto beans, sweet corn, and zucchini squash grown in Los Alamos Canyon at LANL", LA-13304-MS (1997).
7. Fresquez, P.R., D.A. Armstrong, M.A. Mullen, and L. Naranjo, Jr. (The uptake of radionuclides by beans, squash, and corn growing in contaminated alluvial soils at Los Alamos National Laboratory" Journal of Environmental Science and Health B33 (1) 99-115 (1998).
8. Fresquez, P.R. and G.J. Gonzales. "Radionuclide Concentrations in Vegetation at the Los Alamos National Laboratory in 2002/2003," Los Alamos National Laboratory report LA-14160-PR. Los Alamos, NM (2004).
9. T.E. Hakonson, J.W. Nyhan, L.J. Johnson, K.V. Bostick "Ecological Investigation of Radioactive Materials in Waste Discharge Areas at Los Alamos", LA-5282-MS, (1973).
10. LA-UR-04-2714, "Los Alamos and Pueblo Canyons Investigation Report", (2004).
11. LA-UR-06-6752 (EP2006-0843) "Mortandad Canyon Investigation Report" (October 2006).
12. F.R. Miera and T.E. Hakonson, "Radiation dose to rodents inhabiting a radioactive waste receiving area," Health Physics 34, pp 603-609 (1978).
13. S. Salazar, M. McNaughton, PR Fresquez, "Concentration Ratios for cesium and Strontium in Produce Near Los Alamos" LA-14284 (2006).
14. M.W. McNaughton, "Biota Dose Assessment at LANL," LA-UR-05-4699 (2005).

15. W.J. Wenzel, T.S. Foxx, A.F. Gallegos, G. Tierney, J.C. Rodgers, "Cesium-137, plutonium-239,240, total uranium, and scandium in trees and shrubs growing in transuranic waste at Area B", LA-11126-MS (1987).
16. GC White, TE Hakonson, AJ Ahlquist, "Factors affecting radionuclide availability to vegetables grown at Los Alamos" Journal of Environmental Quality volume 10 pp 294-299 (1981).
17. JK Ferenbaugh, PR Fresquez, MH Ebinger, GJ Gonazles, PA Jordan, "Elk and deer study", LA-13596-MS (1999).
18. Soholt, L., G.J. Gonzales, P.R. Fresquez, K. Bennett and E. Lopez, "Estimating Radiological Doses to Predators Foraging on a Low-Level Waste Management Area. Los Alamos National Laboratory report LA-13999. Los Alamos, NM." (2003).
19. Environmental Surveillance at Los Alamos During 2005, and previous years:

1991 LA-12572-ENV

1992 LA-12764-ENV

1993 LA-12973-ENV

1994 LA-13047-ENV

1995 LA-13210-ENV

1996 LA-13343-ENV

1997 LA-13487-ENV

1998 LA-13633-ENV

1999 LA-13775-ENV

2000 LA-13861-ENV

2001 LA-13979-ENV

2002 LA-14085-ENV

2003 LA-14162-ENV

2004 LA-14239-ENV

2005 LA-14304-ENV

ATTACHMENT 8- MARCH 12, 2010 APPROVAL LETTER FROM NMED

NEW MEXICO
ENVIRONMENT DEPARTMENT

Water and Waste Management Division

1190 South St. Francis Drive
P.O. Box 5469, Santa Fe, NM 87502-6110
Phone (505) 827-2900 Fax (505) 827-2965
www.nmenv.state.nm.us

BILL RICHARDSON
Governor
DIANE DENISH
Lieutenant
Governor

RON CURRY
Secretary

IRM RAMSO Record Copy
01000589

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

March 12, 2010

Mr. Gene Turner, DOE/AIP/POC
U.S. Department of Energy
Los Alamos Site Office, MS A316
528 35th Street
Los Alamos, NM 87545

Ms. Tori George, LANL-EP-RS
Los Alamos National Security, LLC
P.O. Box 1663 MS M992
Los Alamos, New Mexico 87545-0001

Re: LANL Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree Revision

Dear Mr. Turner and Ms. George:

The attached "Los Alamos National Laboratory Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree, Revised- 01/29/2010" (Decision Tree) is a guidance document that has been prepared jointly by the New Mexico Environment Department's (NMED) Ground Water Quality and Hazardous Waste Bureaus to provide the Los Alamos National Laboratory (LANL) with direction regarding the discharge of ground water associated with the drilling, development, rehabilitation and routine sampling of monitoring wells located throughout the facility. This document provides a mechanism for determining the appropriate fate of such waters in accordance with NMED regulations. Inadvertent discharges to the environment which do not specifically adhere to the aforementioned Decision Tree and contain water contaminants that may, with reasonable probability, pose a threat to the environment or human health must continue to be reported following the procedures outlined in Section 1203 of the Water Quality Control Commission (WQCC) Regulations (20.6.2 NMAC).

This document contains revisions intended to clarify and/or correct elements of the guidance that have been noted to be problematic by NMED and LANL. On November 2, 2009, NMED received comments from LANL in response to NMED's originally proposed revised Decision Tree that were sent to LANL on October 2, 2009. NMED has reviewed and/or incorporated LANL's comments and hereby issues the revised "Los Alamos National Laboratory Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree" effective immediately.

Please note, this document is not all inclusive and there may be additional reporting requirements to maintain compliance with other regulatory programs. NMED reserves the right to modify, amend or retract this document as it pertains to compliance with the WQCC Regulations (20.6.2 NMAC) or the New Mexico

'10 MAR 19 AM10:20:15

Los Alamos National Laboratory
March 12, 2010
Page 2 of 2

Hazardous Waste Act (74-4 et. seq., NMSA 1978). If you have questions regarding the revised Decision Tree please feel free to contact Robert George at 505-476-3648 or Jennifer Fullam at 505-827-2909. Thank you.

Sincerely,

James Bearzi, Chief
Hazardous Waste Bureau

William C. Olson, Chief
Ground Water Quality Bureau

JB & WO:JF

Enc: Los Alamos National Laboratory Drilling, Development, Rehabilitation and Sampling Purge Water Decision Tree (January 29, 2010)

cc: Mr. Gene Turner, DOE/AIP/POC, Los Alamos Site Office, MS A316, 528 35th Street Los Alamos, NM 87545
Robert Beers, ENV-RCRA, Los Alamos National Laboratory, P.O. Box 1663 MS K497, Los Alamos, New Mexico 87545-0001
Hai Shen, LASO-EO, P.O. Box 1663, MS A316, Los Alamos, New Mexico 87545-0001
Michael Mallory, PADOPS, LANL, LLC, P.O. Box 1663, MS A102, Los Alamos, New Mexico 87545-0001
Chris Cantwell, ADESHQ, P.O. Box 1663, MS K491, Los Alamos, New Mexico 87545-0001
Michael Saladen, ENV-RCRA, LANL, LLC, P.O. Box 1663, MS K490, Los Alamos, New Mexico 87545-0001
Danny Katzman, LWSP, P.O. Box 1663, MS M992, Los Alamos, New Mexico 87545-0001
Tim Goering, WES-RS, P.O. Box 1663, MSM992, Los Alamos, New Mexico 87545-0001
Mike Alexander, WES-RS, P.O. Box 1663, MS K497, Los Alamos, New Mexico 87545-0001
Marcy Leavitt, Director, NMED Water and Waste Management Division
Dave Cobrain, NMED/HWB
Steven Connolly, NMED/HWB
Steve Yanicak, NMED/DOE OB
Ralph Ford-Schmid, NMED/DOE OB
Erik Galloway, NMED/DOE OB
Glen Saums, NMED/SWQB
Richard Powell, NMED/SWQB
Robert George, NMED/GWQB
Jennifer Fullam, NMED/GWQB

Los Alamos
NATIONAL LABORATORY
EST. 1943

Environment, Safety and Health

Electronic Public Reading Room - Posting of Controlled Procedures

Operations Integration Office Management Approval:

Print Name	Signature	Date
Ellena Martinez	Ellena Martinez	3/4/16

Derivative Classifier:

☐ OUO ☐ UCNI ☒ Unclassified ☐ Classified

Print Name	Signature	Date
Larry W. Maassen	Larry Maassen	3/4/16

List of Controlled Documents:

Procedure No.	Title/Description
Air Monitoring (ENV)	
ENV-ES-TPP-003	Technical Project Plan for the Neighborhood Environmental Watch Network (NEWNET)
ENV-ES-TPP-007	Technical Project Plan for the Direct Penetrating Radiation Monitoring Network (DPRNET)
Data Validation (ADESH)	
OIO-TP-5161	Routine Validation of Volatile Organic Compound Analytical Data
OIO-TP-5162	Routine Validation of Semivolatile Organic Compound Analytical Data
OIO-TP-5163	Routine Validation of Organochlorine Pesticide and Polychlorinated Biphenyl Analytical Data
OIO-TP-5165	Routine Validation of Metals Analytical Data
General Field Work	
OIO-TP-222	Shipping/Receiving of Environmental Samples by the Sample Management Office (SMO)
OIO-QP-219	Sample Control and Field Documentation
Soil, Foodstuffs, and Biota Sampling (ENV)	
ENV-ES-TPP-002	Technical Project Plan for Biota Dose Assessment
ENV-ES-TP-003	Collection of Soil and Vegetation Samples for the Environmental Surveillance Program
ENV-ES-TP-004	Produce Sampling
ENV-ES-TP-007	Game Animal Sampling
ENV-ES-TP-006	Sampling Soil and Vegetation at Facility Sites
SOP-5247	Collection of Benthic Macroinvertebrates in the Rio Grande
ENV-ES-TP-008	Collection of Crawfish in the Rio Grande
Well Drilling, Construction, Development, Maintenance, and Abandonment	
ENV-RCRA-QP-010	Land Application of Groundwater