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FileFolder: POST-CERRO GRANDE FIRE ENVIRONMENTAL SAMPLING DATA RECORDS PACKAGE #633 SUBMITTAL #3/PAJARITO CANYON ALLUVIAL GROUNDWATER SAMPLES

Correction: (Y/N) N *Corrected No.* 0 *Corrected By Number:* 0

Administrative Record: (Y/N) Y

Refilmed: (Y/N) N *Old ER ID Number:* 0 *New ER ID Number:* 0

Miscellaneous Comments:

N/A

14238

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(26)

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PRS# 633

Document Catalog Number ER2000-0646 (Please prefix the name of all electronic versions of this document with this number.)

* Required Field

*Document Title / Subject	Post-Cerro Grande Fire Environmental Sampling Data: Pajarito Canyon Alluvial Groundwater Samples Collected in June 2000
PRSs	None
Associated Document Catalog Number(s)	None
*Author	Katzman, Danny 667-0599 katzman@lanl.gov
*Author Organization	Analysis & Assessment
Document Team	None
*Document Type	Misc. External Document wo/Peer Review Former OU N/A
Date Due	Date Final Complete Date Sent to DOE
Date Sent to NMED	Date Sent to RPF (Paper & Electronic)
Received Per RPF	RPF ER ID Number
CT No	LA-UR Number 00-5491
Performance Measure No	
AA Deliverable	Certification Required Force Peer Review
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Document Catalog Number ER2000-0646

[redacted]

environmental restoration project

A Department of Energy
Environmental Cleanup Program

LA-UR-00-5491
January 2001
ER2000-0646

Post-Cerro Grande Fire Environmental Sampling Data: Pajarito Canyon Alluvial Groundwater Samples Collected in June 2000

Los Alamos
NATIONAL LABORATORY
Los Alamos, NM 87545

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Acronyms

DOE	US Department of Energy
EPA	US Environmental Protection Agency
ER	environmental restoration
MCL	maximum contaminant level
MW	monitoring well
NMED	New Mexico Environment Department
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalency factor
WQCC	Water Quality Control Commission

1.0 INTRODUCTION

The Los Alamos National Laboratory's (the Laboratory's) Environmental Restoration (ER) Project collected alluvial groundwater samples in Pajarito Canyon on June 26 and June 27, 2000 (after the Cerro Grande fire). This report summarizes the analytical results of those sampling efforts.

Sampling was conducted before the summer monsoon season and before significant postfire flooding occurred in Pajarito Canyon. This sampling provided baseline data for later comparison with data from samples collected during the monsoon season, because the chemistry of the floodwater could affect groundwater quality in the canyon. For more information, see the conceptual model at http://erproject.lanl.gov/Fire/Data/datahome.html#CE_Model. These groundwater sample locations were selected to represent potential spatial variability in water quality in Pajarito Canyon and were chosen from existing alluvial groundwater monitoring wells.

2.0 SAMPLING AND ANALYSIS

Sampling

A total of 10 alluvial groundwater samples were collected from 4 alluvial wells located in Pajarito Canyon. The well locations are shown on Figure 2.0-1. Table 2.0-1 provides well locations, sampling dates, and numbers of samples collected for each well.

Table 2.0-1
Description of Pajarito Canyon Alluvial Wells Sampled in June 2000

Well	Description of Location	Date Sampled	Number of Samples Collected
BG-1	Approximately 100 ft west of criticality laboratory 1 (Building 23) at TA-18, Pajarito Canyon	6/27/00	1 filtered, 1 nonfiltered
MW-7	Adjacent to criticality laboratory 1 (Building 23) at TA-18, Pajarito Canyon	6/27/00	1 filtered, 1 nonfiltered
MW-8	Adjacent to and east of criticality laboratory 2 (Building 32) at TA-18, Threemile Canyon	6/26/00	2 filtered, 2 nonfiltered (includes 2 field duplicate samples)
MW-12	Adjacent to Building 30 at TA-18, approximately 400 ft northeast of confluence of Threemile and Pajarito Canyons	6/26/00	1 filtered, 1 nonfiltered

Both filtered and nonfiltered water samples were collected to characterize the difference in results caused by the presence of suspended solids. Filtered samples are used to evaluate the dissolved chemicals in samples. Nonfiltered samples are used to evaluate chemicals associated with the suspended sediment in addition to the dissolved chemicals. Filtered samples were prepared in the field by filtration through a 0.45-micron filter. All water samples were analyzed by analytical laboratories that are approved by the ER Project and that are external to the Laboratory.

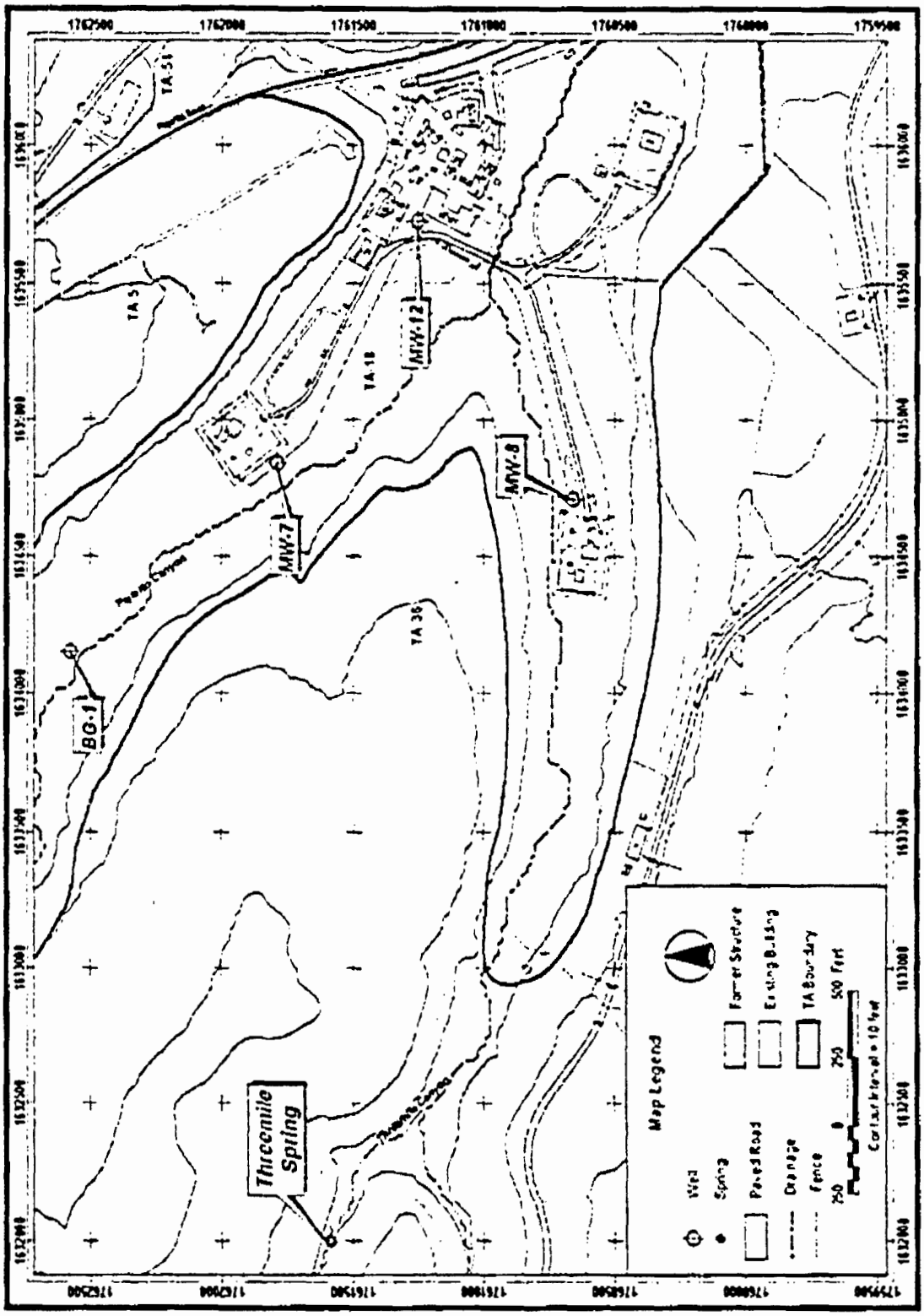

Figure 2.0-1. Post-Cerro Grande fire alluvial groundwater monitoring well and surface water sampling locations in Pajarito Canyon

The first major storm event after the Cerro Grande fire occurred on June 2, 2000. That event produced minor runoff in Pajarito Canyon that contained ash and possibly fire-fighting chemicals. Therefore, ash-related chemicals and fire-fighting chemicals may be present in these samples. Because some chemicals or chemical concentrations not related to Laboratory operations have been identified in ash and flood-transported ash (muck), the results should be evaluated in that context. Data summaries for baseline ash and muck samples collected by the ER Project in June 2000 are provided at http://erproject.lanl.gov/Fire/Data/ash-muck.html.

Analysis

Filtered and nonfiltered samples were analyzed for the following inorganic chemicals and radionuclides: 24 trace metals, uranium, ammonia, nitrite and nitrate, oxalate, perchlorate, total cyanide, total Kjeldahl nitrogen, total phosphorus, americium-241, isotopic plutonium (plutonium-238 and plutonium-239), isotopic thorium (thorium-228, thorium-230, and thorium-232), isotopic uranium (uranium-234, uranium-235, and uranium-238), gamma-emitting radionuclides, tritium, and strontium-90.

Only filtered samples were analyzed for the following parameters: alkalinity, chloride, fluoride, sulfate, and total dissolved solids.

Nonfiltered samples from each of the four alluvial wells and one filtered sample from monitoring well (MW) 12 were analyzed for the following organic chemicals: high explosives, semivolatile organic compounds, and volatile organic compounds. Two nonfiltered samples from MW-8 and MW-12 and one filtered sample from MW-12 were analyzed for organochlorine pesticides and polychlorinated biphenyl compounds. One nonfiltered sample collected from monitoring well BG-1 was analyzed for dioxins and furans. One filtered sample collected from BG-1 was analyzed for humic substances.

3.0 DATA SUMMARY TABLES

The inorganic and radionuclide chemical data for the water samples are summarized in two separate tables (Tables 3.0-1 and 3.0-2, respectively). Table 3.0-3 summarizes detected organic parameters. Each table lists the chemical analyte, the number of samples analyzed, the number of detected results, and the minimum, mean, and maximum values for the detected results.

The summary tables compare the analytical results with US Environmental Protection Agency (EPA) and New Mexico Environment Department (NMED) drinking water maximum contaminant levels (MCLs). The current EPA drinking water MCLs, along with the supporting information, are available at http://www.epa.gov/safewater/mcl.html. The NMED MCLs are available under "Environmental Protection Regulations, Regulations by Subject, Drinking Water–20NMAC7.1" at http://www.nmenv.state.nm.us/.

The drinking water MCLs are used only as screening levels for the purposes of reviewing the alluvial groundwater sampling results. An exceedance of its screening level by a chemical does not necessarily mean that immediate action is necessary; an exceedance means only that further evaluation should be undertaken. That evaluation may include additional sample collection leading to a risk assessment, in order to accurately assess the potential risk from exposure.

For radionuclides that do not have a drinking water MCL, Table 3.0-2 compares sample results with screening levels that are 4% of the derived concentration guide value provided in DOE Order 5400.5, "Radiation Protection of the Public and Environment." The screening levels represent a dose limit of 4 millirem per year from the ingestion of water, consistent with the NMED drinking water regulations (20NMAC7.1). DOE Order 5400.5 is available at http://tis.eh.doe.gov/oepa/guidance/risk/54005.pdf.

Table 3.0-1
Pajarito Canyon Alluvial Groundwater Samples, June 2000: Data Summary for Inorganic Parameters

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (µg/L)	Mean of Detects (µg/L)	Maximum of Detects (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects >MCL[b]	NMED[a] Groundwater Standard[c] (µg/L)	Frequency of Detects >NMED Groundwater Standard[c]
Alkalinity (total)	F[d]	4	4	47000	49000	52000	—[e]	—	—	—
Aluminum	F	5	5	340	1554	5300	50	0.5	5000	1.5
Aluminum	NF[f]	4	4	28000	68750	143000	—	—	—	—
Ammonia (expressed as N)	F	5	1	700	700	700	—	—	—	—
Ammonia (expressed as N)	NF	4	1	620	620	620	—	—	—	—
Antimony	F	5	0	—	—	—	6	0.5	—	—
Antimony	NF	4	0	—	—	—	—	—	—	—
Arsenic	F	5	0	—	—	—	50	0.5	100	0.5
Arsenic	NF	4	4	6.5	18	37	—	—	—	—
Barium	F	5	5	53	72	95	2000	0.5	1000	0.5
Barium	NF	4	4	290	630	1200	—	—	—	—
Beryllium	F	5	5	0.034	0.106	0.157	4	0.5	—	—
Beryllium	NF	4	4	2.14	8.94	15.5	—	—	—	—
Boron	F	5	5	23	27	32	—	—	750	0.5
Boron	NF	4	4	32	38	43	—	—	—	—
Cadmium	F	5	2	0.162	0.195	0.228	5	0.5	10	0.5
Cadmium	NF	4	4	0.447	1.43	2.61	—	—	—	—
Calcium	F	5	5	11000	12200	13000	—	—	—	—
Calcium	NF	4	4	16000	22000	29000	—	—	—	—

Table 3.0-1 (continued)

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (µg/L)	Mean of Detects (µg/L)	Maximum of Detects (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects >MCL[b]	NMED[a] Groundwater Standard[c] (µg/L)	Frequency of Detects >NMED Groundwater Standard[c]
Chloride	F	4	4	16000	17000	15000	250000	0.4	250000	0.4
Chromium	F	5	5	0.69	2.2	4.3	100	0.5	50	0.5
Chromium	NF	4	4	15	40	79	—	—	—	—
Cobalt	F	5	2	0.65	1.15	1.7	—	—	50	0.5
Cobalt	NF	4	4	7.8	18	36	—	—	—	—
Copper	F	5	3	0.63	2.8	4.4	1300	0.5	1000	0.5
Copper	NF	4	4	13	39	77	—	—	—	—
Cyanide (total)	F	1	0	—	—	—	200	0.1	200	0.1
Cyanide (total)	NF	5	0	—	—	—	—	—	—	—
Fluoride	F	4	4	100	135	170	4000	0.4	1600	0.4
Iron	F	5	5	180	1150	3420	300	4.5	1000	1.5
Iron	NF	4	4	20000	55000	110000	—	—	—	—
Lead	F	5	5	0.169	0.539	0.818	15	0.5	50	0.5
Lead	NF	4	4	18.3	76.5	141	—	—	—	—
Magnesium	F	5	5	3700	3900	4700	—	—	—	—
Magnesium	NF	4	4	6900	11900	17000	—	—	—	—
Manganese	F	5	5	6	22	75	50	1.5	200	0.5
Manganese	NF	4	4	510	1450	2900	—	—	—	—
Mercury	F	5	0	—	—	—	2	0.5	—	—
Mercury	NF	4	2	0.053	0.077	0.100	—	—	2	0.4
Nickel	F	5	4	0.58	3.5	8.1	100	0.5	200	0.5

Table 3.0-1 (continued)

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (µg/L)	Mean of Detects (µg/L)	Maximum of Detects (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects >MCL[b]	NMED[a] Groundwater Standard[c] (µg/L)	Frequency of Detects >NMED Groundwater Standard[c]
Nickel	NF	4	4	14	35	65	—	—	—	—
Nitrate + nitrite (expressed as N)	F	5	5	130	490	870	10000	0.5	—	—
Nitrate + nitrite (expressed as N)	NF	4	4	220	500	810	—	—	—	—
Oxalate	F	1	0	—	—	—	—	—	—	—
Oxalate	NF	4	0	—	—	—	—	—	—	—
Perchlorate	F	1	0	—	—	—	—	—	—	—
Perchlorate	NF	4	0	—	—	—	—	—	—	—
Phosphorus (total)	F	5	2	55	93	130	—	—	—	—
Phosphorus (total)	NF	4	1	340	340	340	—	—	—	—
Potassium	F	5	5	2500	2920	3500	—	—	—	—
Potassium	NF	4	4	6100	9900	16000	—	—	—	—
Selenium	F	5	0	—	—	—	50	0.5	50	0.5
Selenium	NF	4	1	4.3	4.3	4.3	—	—	—	—
Silver	F	5	0	—	—	—	100	0.5	50	0.5
Silver	NF	4	1	0.92	0.92	0.92	—	—	—	—
Sodium	F	5	5	12000	12400	13000	—	—	—	—
Sodium	NF	4	4	14000	15000	18000	—	—	—	—
Sulfate	F	4	4	6700	8300	9800	250000	0.4	600000	0.4
Thallium	F	5	1	0.093	0.093	0.093	2	0.5	—	—
Thallium	NF	4	4	0.259	0.953	1.82	—	—	—	—

Table 3.0-1 (continued)

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (µg/L)	Mean of Detects (µg/L)	Maximum of Detects (µg/L)	Drinking Water MCL[b] (µg/L)	Frequency of Detects >MCL[b]	NMED[a] Groundwater Standard[c] (µg/L)	Frequency of Detects >NMED Groundwater Standard[c]
Total dissolved solids	F	3	3	140000	220000	380000	500000	0/3	1000000	0/3
Total Kjeldahl nitrogen	F	1	0	—	—	—	—	—	—	—
Total Kjeldahl nitrogen	NF	4	3	700	830	900	—	—	—	—
Uranium	F	5	5	0.024	0.060	0.109	—	—	5000	0/3
Uranium	NF	4	4	1.66	8.06	13.3	—	—	—	—
Vanadium	F	5	5	0.64	2.1	5.4	—	—	—	—
Vanadium	NF	4	4	27	76	160	—	—	—	—
Zinc	F	5	5	4.4	7.6	17	5000	0/5	10000	0/5
Zinc	NF	4	4	69	177	320	—	—	—	—

[a] NMED = New Mexico Environment Department

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] State of New Mexico groundwater standards are from New Mexico Water Quality Control Commission Regulations, Ground and Surface Water Protection, 20 NMAC 6.2.

[d] F = Filtered

[e] — = Value is not available or not applicable.

[f] NF = Nonfiltered

Table 3.0-2
Pajarito Canyon Alluvial Groundwater Samples, June 2000: Data Summary for Radionuclides

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (pCi/L)	Mean of Detects (pCi/L)	Maximum of Detects (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects >MCL	DCG[a] Screening Level (pCi/L)	Frequency of Detects >DCG Screening Level
Americium-241	F[c]	5	0	—[e]	—	—	15[d]	0.5	1.2	0.5
Americium-241	NF[f]	5	0	—	—	—	—	—	—	—
Cesium-134	F	1	0	—	—	—	—	—	80	0.1
Cesium-134	NF	5	0	—	—	—	—	—	—	—
Cesium-137	F	1	0	—	—	—	—	—	120	0.1
Cesium-137	NF	5	0	—	—	—	—	—	—	—
Cobalt-60	F	1	0	—	—	—	—	—	200	0.1
Cobalt-60	NF	5	0	—	—	—	—	—	—	—
Europium-152	F	1	0	—	—	—	—	—	800	0.1
Europium-152	NF	5	0	—	—	—	—	—	—	—
Plutonium-238	F	5	0	—	—	—	15[d]	0.5	1.6	0.5
Plutonium-238	NF	5	0	—	—	—	—	—	—	—
Plutonium-239	F	5	0	—	—	—	15[d]	0.5	1.2	0.5
Plutonium-239	NF	5	0	—	—	—	—	—	—	—
Ruthenium-106	F	1	0	—	—	—	—	—	240	0.1
Ruthenium-106	NF	5	0	—	—	—	—	—	—	—
Sodium-22	F	1	0	—	—	—	—	—	400	0.1
Sodium-22	NF	5	0	—	—	—	—	—	—	—
Strontium-90	F	5	0	—	—	—	8	0.5	—	—
Strontium-90	NF	5	0	—	—	—	—	—	—	—
Thorium-228	F	4	1	0.157	0.157	0.157	15[d]	0.4	15	0.4

Table 3.0-2 (continued)

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (pCi/L)	Mean of Detects (pCi/L)	Maximum of Detects (pCi/L)	Drinking Water MCL[b] (pCi/L)	Frequency of Detects >MCL	DCG[a] Screening Level (pCi/L)	Frequency of Detects >DCG Screening Level
Thorium-228	NF	5	5	0.76	3.3	6.7	—	—	—	—
Thorium-230	F	4	0	—	—	—	15[e]	0.4	12	0.4
Thorium-230	NF	5	4	0.382	2.03	3.68	—	—	—	—
Thorium-232	F	4	0	—	—	—	15[e]	0.4	2	0.4
Thorium-232	NF	5	5	0.60	2.9	6.4	—	—	—	—
Tritium	F	1	1	107	107	107	20000	0.1	—	—
Tritium	NF	5	5	80	90	100	—	—	—	—
Uranium-234	F	5	1	0.104	0.104	0.104	—	—	20	0.5
Uranium-234	NF	5	5	0.46	2.14	5.03	—	—	—	—
Uranium-235	F	5	0	—	—	—	—	—	24	0.5
Uranium-235	NF	5	3	0.037	0.145	0.239	—	—	—	—
Uranium-238	F	5	0	—	—	—	—	—	24	0.5
Uranium-238	NF	5	5	0.359	1.87	4.66	—	—	—	—

[a] DCG = Derived concentration guide. DCG screening levels are based on the ingested water DCGs published in DOE Order 5400.5, *Radiation Protection of the Public and Environment* (January 1993). The DCG screening levels presented in this table are calculated as 4% of the ingested water DCGs and represent a dose limit of 4 millirem per year from the ingestion of water.

[b] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[c] F = Filtered.

[d] — = Value is not available or not applicable.

[e] Based on an MCL of 15 pCi/L for gross alpha particle activity (including radium-226 but excluding radon and uranium)

[f] NF = Nonfiltered

Table 3.0-3
Pajarito Canyon Alluvial Groundwater Samples, June 2000: Data Summary for Detected Organic Parameters

Analyte	Field Preparation	Number of Analyses	Number of Detects	Minimum of Detects (µg/L)	Mean of Detects (µg/L)	Maximum of Detects (µg/L)	Drinking Water MCL[a] (µg/L)	Frequency of Detects >MCL
Butanone[2-]	NF[b]	5	1	7	7	7	—[c]	—
Carbon, dissolved organic	F[d]	1	1	2700	2700	2700	—	—
Humic substances, hydrophilic acids	F	1	1	700	700	700	—	—
Humic substances, hydrophilic bases	F	1	1	100	100	100	—	—
Humic substances, hydrophilic neutrals	F	1	1	1100	1100	1100	—	—
Humic substances, hydrophilic total	F	1	1	1900	1900	1900	—	—
Humic substances, hydrophobic acids	F	1	1	500	500	500	—	—
Humic substances, hydrophobic bases	F	1	1	100	100	100	—	—
Humic substances, hydrophobic neutrals	F	1	1	300	300	300	—	—
Humic substances, hydrophobic total	F	1	1	800	800	800	—	—
RDX	NF	5	1	1	1	1	2	0.5
Dioxins and furans								
Octachlorodibenzodioxin[1,2,3,4,6,7,8,9]	NF	1	1	0.354	0.354	0.354	—	—
Octachlorodibenzofuran[1,2,3,4,6,7,8,9]	NF	1	1	0.0093	0.0093	0.0093	—	—
Heptachlorodibenzodioxin[1,2,3,4,6,7,8-]	NF	1	1	0.0363	0.0363	0.0363	—	—
Heptachlorodibenzodioxins (total)	NF	1	1	0.0693	0.0693	0.0693	—	—
Heptachlorodibenzofuran[1,2,3,4,6,7,8-]	NF	1	1	0.0069	0.0069	0.0069	—	—
Heptachlorodibenzofurans (total)	NF	1	1	0.0069	0.0069	0.0069	—	—
Hexachlorodibenzofurans (total)	NF	1	1	0.0118	0.0118	0.0118	—	—
Summed 2,3,7,8-TCDD equivalent[e]	NF	—	—	0.0008	0.0008	0.0008	0.00003	1.1

[a] MCL = Maximum contaminant level. US Environmental Protection Agency (EPA) MCLs are from *National Primary Drinking Water Regulations*, 40 CFR Part 141. US EPA secondary MCLs are from *National Secondary Drinking Water Regulations*, 40 CFR Part 143. State of New Mexico MCLs are from *Drinking Water Regulations*, 20 NMAC 7.1.

[b] NF = Nonfiltered

[c] — = Value is not available or not applicable.

[d] F = Filtered

[e] The 2,3,7,8-TCDD toxicity equivalent concentration is determined by multiplying the concentration of individual congeners by their respective TEFs, and then summing the normalized values. Further information about the TEFs for dioxins and furans is available at http://www.epa.gov/iris/subst/0418.htm.

The filtered and nonfiltered results for inorganic parameters are also compared with NMED Water Quality Control Commission (WQCC) groundwater standards. These standards apply only to filtered samples, with the exception of the mercury standard, which applies to nonfiltered samples. The WQCC groundwater standards are available under "Environmental Protection Regulations, Regulations by Subject, Ground and Surface Water Protection, 20NMAC6.2," at http://www.nmenv.state.nm.us/.

For the dioxin and furan results reported in the organic summary table (Table 3.0-3), the 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) risk equivalent value was derived using EPA's toxicity equivalency factor (TEF) methodology for dioxin and related compounds. Several dioxin and furan congeners are thought to have dioxin-like toxicity because they have chlorine substitutions in at least the 2, 3, 7, and 8 positions. For risk assessment purposes, a toxicity equivalency procedure has been developed to describe the cumulative toxicity of mixtures of dioxin and furan congeners. The TEFs assigned to the individual congeners are based on 2,3,7,8-TCDD, which has a TEF value of 1.0. The TEF values have had international and national endorsement and are reviewed every five years to account for new toxicity information. In Table 3.0-3, the 2,3,7,8-TCDD toxicity equivalency for each sample was determined by multiplying the concentration of individual congeners by their respective TEFs, and then summing the normalized values. The 2,3,7,8-TCDD toxicity equivalent concentration is compared to the drinking water MCL for 2,3,7,8-TCDD to estimate potential risk from exposure to dioxin. Further information about the TEF values for dioxin and furans is available at http://www.epa.gov/nceawww1/dchem.htm.

4.0 REFERENCES

DOE (US Department of Energy) Order 5400.5, "Radiation Protection of the Public and Environment," January 1993, http://tis.eh.doe.gov/oepa/guidance/risk/54005.pdf.

EPA (US Environmental Protection Agency), National Primary Drinking Water Standards, http://www.epa.gov/safewater/mcl.html.

EPA (US Environmental Protection Agency), The US EPA TEF Values, http://www.epa.gov/nceawww1/dchem.htm.

Environmental Restoration Project, http://erproject.lanl.gov/Fire/Data/ash-muck.html.

NMED (New Mexico Environment Department), Environmental Protection Regulations, Regulations by Subject, Drinking Water–20NMAC7.1, http://www.nmenv.state.nm.us/.

NMED (New Mexico Environment Department), Environmental Protection Regulations, Regulations by Subject, Ground and Surface Water Protection–20NMAC6.2, http://www.nmenv.state.nm.us/.

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