Los Alamos
NATIONAL LABORATORY

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

Date: June 12, 2001
In Reply Refer To: ESH-18/WQ&H:01-192
Mail Stop: K497
Telephone: (505) 665-1859

HSWALANL G/M/01
TA-5

Ms. Phyllis Bustamante
Ground Water Protection Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, New Mexico 87502

Mr. John Young
Hazardous Materials Bureau
New Mexico Environment Department
P.O. Box 26110
Santa Fe, New Mexico 87502

SUBJECT: NOTICE OF INTENT TO DISCHARGE (NOI) FOR DEVELOPMENT WATER AND PURGE WATER FROM THE MCOBT 4.4 AND 8.5 OBSERVATION WELLS

Dear Ms. Bustamante and Mr. Young:

Los Alamos National Laboratory is submitting the enclosed NOI to the New Mexico Environment Department (NMED) for the discharge of water from the MCOBT 4.4 and 8.5 observation wells pursuant to Section 1201 of the New Mexico Water Quality Control Commission Regulations. These wells are part of the Laboratory's New Monitoring Well Installation Project under the Hydrogeologic Workplan. The MCOBT wells will be located in Mortandad Canyon at the confluence with Ten Site Canyon. A map showing the location of the MCOBT wells is enclosed (Enclosure 1). The estimated depth for the MCOBT wells is approximately 750 feet, but the actual total depth may vary as the investigation progresses to ensure that the characterization objectives are adequately addressed.

The total estimated discharge from the two wells would consist of up to 100,000 gallons of development and purge water. The proposed methods of discharge will include one or more of the following: land application to the drilling site for re-vegetation purposes; land application to the surrounding grass covered canyon bottom out of the flood plain; and/or the water may be used as dust suppression on the entry road leading to the drilling site.

The Laboratory's Environmental Restoration staff has reviewed the proposed land application area. No SWMU's or PRS's were identified that could be impacted by this discharge. All discharges will be performed in a manner that will eliminate impacts to any watercourse. Best Management Practices (BMPs) including erosion controls will be utilized as required.

Please call Mike Saladen (505) 665-6085 or Steve Veenis (505) 665-9735 of the Laboratory's Water Quality and Hydrology Group (ESH-18) if additional information would be helpful.

Sincerely,

Steven Rae,
Group Leader
Water Quality and Hydrology Group

2807

TC

SR:HD/tml

Enclosures: a/s

Cy: B. Lucas NMED/SWQB, Santa Fe, New Mexico, w/enc.
S. Yanicak, NMED/DOE/OB, w/enc., MS J993
D. Erickson, ESH-DO, w/o enc., MS K491
C. Nylander, ESH-18, w/o enc., MS K497
M. Saladen, ESH-18, w/o enc., MS K497
H. Decker, ESH-18, w/enc., MS K497
S. Veenis, ESH-18, w/o enc., MS K497
D. Broxton, EES-1, w/enc., MS D462
A. Crowder, MK, w/o enc., MS M327
P. Longmire, EES-5, w/o enc., MS J534
D. Hickmott, EES-1, w/o enc., MS D462
R. Bohn, E-ER, w/enc., MS M992
WQ&H File, w/enc., MS K497
IM-5, w/enc., MS A150

NOTICE OF INTENT
METHOD OF LAND APPLICATION OF WATER FROM WELLS MCOBT 4.4 AND 8.5 IN MORTANDAD CANYON

1. **Name and address of facility making the discharge.**
Los Alamos National laboratory
P.O. Box 1663
Los Alamos, New Mexico 87545

2. **Location of the discharge (In Township, Range and Section, if available).**
MCOBT-4.4 and MCOBT-8.5 drill sites are in Mortandad Canyon. Please see enclosed map and photographs for detailed location (enclosure 1). The discharge area will be located out of the flood plain on the mostly flat area near the well. All water developed or purged from the wells will be stored and analyzed/screened for select contaminants. Data from the analysis/screening will be submitted to the NMED prior to any discharge(s).

Los Alamos National Laboratory, Mortandad Canyon, near the confluence with Ten site canyon (SE ¼ Sec. 23, T19N, R6E)

3. **The means of discharge. (To lagoon, Flowing stream, Water course, Arroyo, Septic tank, other).**

The sprinkled land application of water will be applied to the surface of the land in the vicinity of the well site. An alternate method for land application of the water is to the well site after drilling is completed to facilitate re-vegetation or for dust suppression on the access road and drill pad. The method of land application and dust suppression is described below:

1. Aluminum piping with sprinkler heads will serve as the conduit for the land application of the approximately 150,000 gallons of development and purge water to be generated from the MCOBT wells (4.4 and 8.5).

2. There will be one aluminum piping run approximately 250 feet in length with 5 sprinkler heads. Spacing of the sprinkler heads is to be approximately 50 feet apart. Each sprinkler head will have an application radius of approximately 20 feet. This will allow an approximately 10 foot buffer area of no water impact between each sprinkler head on the 250-foot line.

3. As prescribed in the SOP 2.01 Surface Water Assessment/Erosion Matrix (enclosure 2) the application area will be located on the generally flat canyon bottom out of the flood plain. Land application will be conducted for 8 to 10 hours a day. The application of water will be monitored periodically each application day by on-site staff to ensure that no ponding or run-off is occurring, to inspect Best Management Practices (BMPs) and to determine when to rotate the area of land application. **Ponding,** is defined as *a body of standing water, often artificially formed.* **Erosion,** is defined as *the process in which, by the actions of wind or water, soil particles are displaced and transported.*

4. Reciprocating type sprinkler heads are to be used in order to maximize evaporation.

5. The rate of application is expected to be approximately 100 gpm. The sprinkled application will be occasionally interrupted in order to transfer pumping equipment from one container to the next. These interruptions will allow previously applied water to disperse and will serve as an additional BMP to help prevent ponding or run-off.

6. The land application site will be monitored during discharge hours. This will allow site

F. The land application site will be monitored during discharge hours. This will allow site staff, as necessary, to rotate the land application areas or stop application if a problem with the sprinkler system occurs. Additionally, if the application area shows signs of ponding or saturation, application operations will be immediately halted. The area will be evaluated for the need of any additional BMPs and the application will not start again until the area is suitable (i.e., no standing water or run-off visible).

G. The alternate method for land application of the water is for dust suppression on the access road to the well. Water used for dust suppression will be applied by water truck. Amounts may vary for this type of application but is estimated to be 2000 to 4000 gallons per day along approximately one mile of access road and the 15,000 square foot drill pad.

H. A SOP 2.01 Surface Water Assessment/Erosion Matrix for the land application location has been performed. An assessment of "minimal" surface/ground water impact for the land application area has been determined for the application described (Enclosure 2).

4. **The estimated concentration of contaminants (if any) in the discharge.**

Analyses from samples collected from nearby well R-15 and MCO 7.2 are enclosed (Enclosure 3).

5. **The type of operation from which the discharge is derived.**

Purge water from well drilling of MCOBT 4.4 and 8.5 for hydrogeologic characterization of perched groundwater systems in Mortandad Canyon and development water from the drilling of these wells. Smaller additional water volumes from sampling activities are also expected to be generated several times per year from each well.

6. **The estimated flow to be discharged per day.**

A total of 100,000 gallons is to be discharged from the drilling and development of the wells.

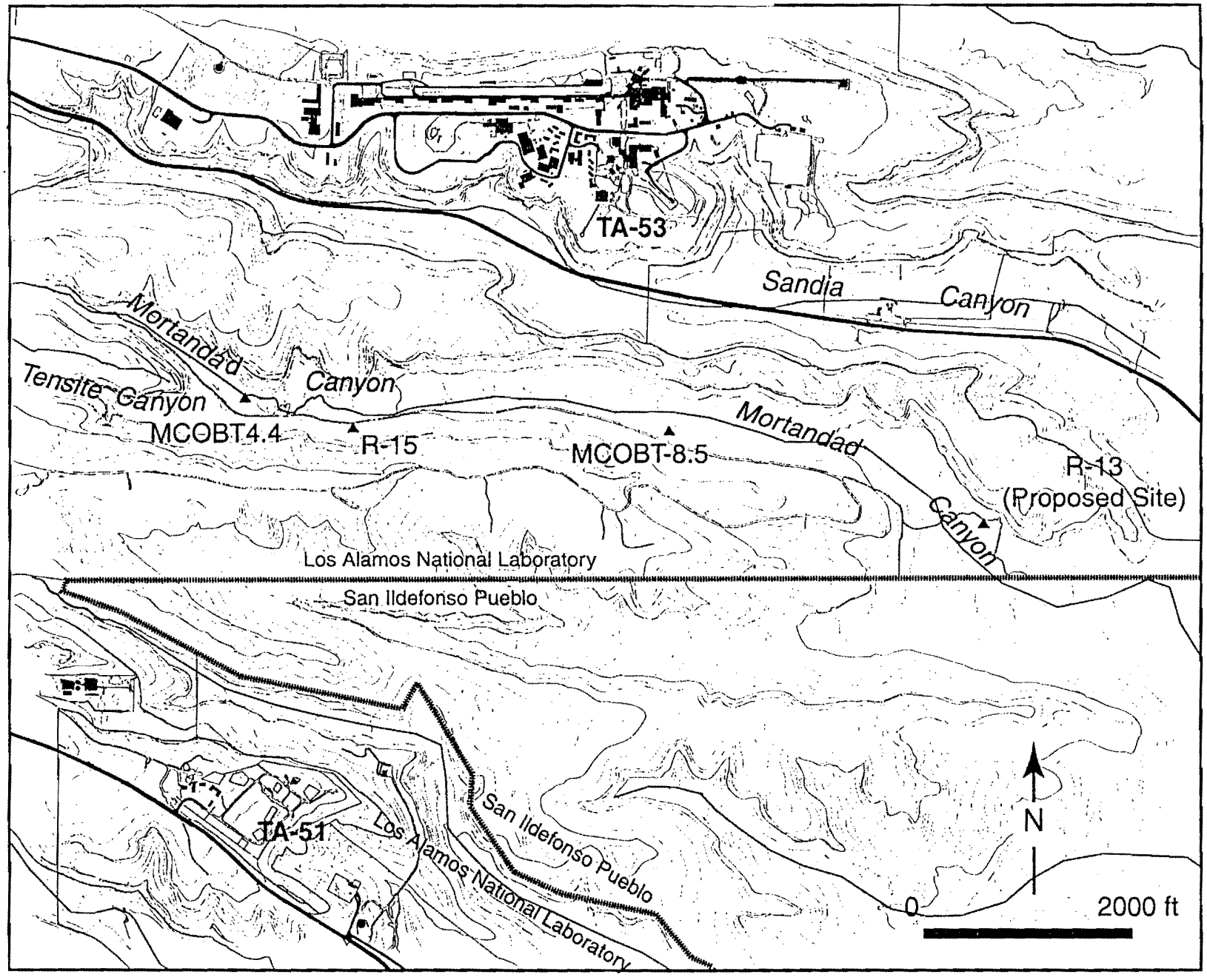
7. **The estimated depth to Ground-Water (if available)**

Approximately 550 ft to perched ground water. Approximately 900 ft to the regional aquifer water table.

Signed: _____ Date: June 12, 2001

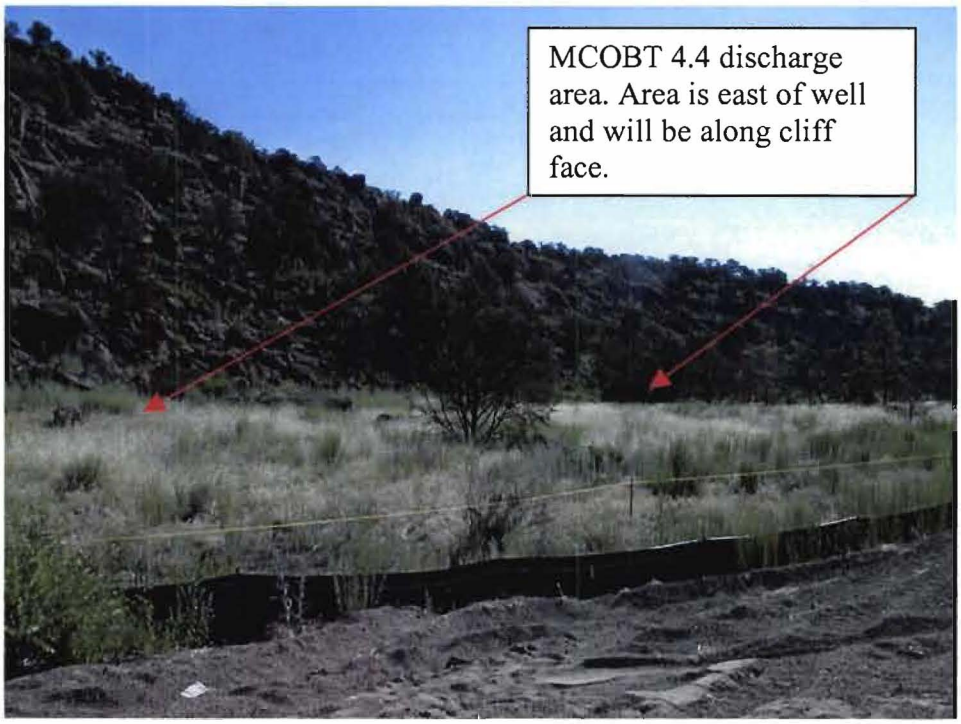
Steven Rae, Group Leader
Water Quality and Hydrology Group (ESH-18)

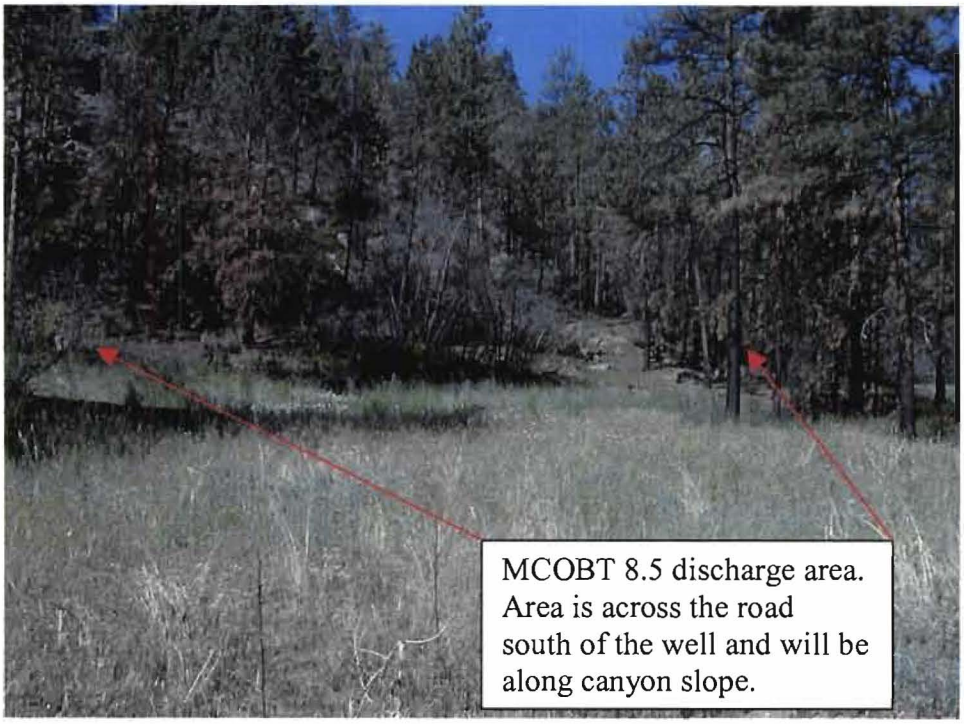
ENCLOSURE 1


TA-53
Sandia
Canyon
Mortandad
Canyon
Tensite Canyon
MCOBT4.4
R-15
MCOBT-8.5
Mortandad
Canyon
R-13
(Proposed Site)
Los Alamos National Laboratory
San Ildefonso Pueblo
TA-51
Los Alamos National Laboratory
San Ildefonso Pueblo
N
0
2000 ft

Enclosure 1

Water discharge areas for MCOBT observation wells 4.4 and 8.5 In Mortandad Canyon





ENCLOSURE 2

Los Alamos National Laboratory

Environment, Safety & Health Division
ESH-18 Water Quality & Hydrology Group

Surface Water Assessment Erosion Matrix for PRS MCO-8.5

CRITERIA EVALUATED	Value	Erosion/Sediment Transport Potential Low 0.1	Medium 0.5	High 1.0	Calculated Score
Site Setting (43)					
On mesa top	1	Defined based on topographic setting			
Within bench of canyon	4				
Within the canyon floodplain but not watercourse	13				13.0
Within bottom of canyon channel in watercourse	17				
Estimated % ground and canopy cover	13	>75%	25-75%	<25%	1.3
Slope	13	0-10%	10-30%	>30%	1.3
Surface Water Factors-Run-off (46)					
Visible evidence of runoff discharging? (Yes/No)	5	If no, score of 0 for runoff section.			0.0
		If yes, score 5 and proceed with section.			
Where does runoff terminate?	19	Other	Bench Setting	Drainage/Wetland	0.0
Has runoff caused visible erosion? (Yes/No)	22	Sheet	Rill	Gully	0.0
		If no, score as 0. If yes, calculate as appropriate.			
Surface Water Factors-Run-on (11)					
Structures adversely affecting run-on (Yes/No)	7*	If yes, score as 7. If no, score as 0.			0.0
Current operations adversely impacting (Yes/No)	4	If yes, score as 4. If no, score as 0.			0.0
Natural drainages onto site (Yes/No)	7*	If yes, score as 7. If no, score as 0.			7.0
**Select either structures or natural drainages.*					
MAX. POSSIBLE EROSION MATRIX SCORE:	**100**			**Total Score**	22.6**

** Indicates BMPs in place. Erosion potential without BMPs may be greater.

Report Printed 6/12/01 10:31:03 AM.

Los Alamos National Laboratory
SURFACE WATER
SITE ASSESSMENT

SITE INFORMATION

1a) PRS Number MCO-8.5 **1b) Structure Number** **1c) FMU Number** ER

2. Date/Time (M/D/Y H:M am/pm) 6/12/01

SITE SETTING (check all that apply)

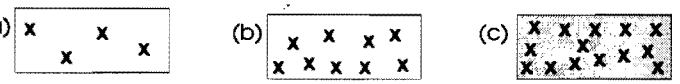
3. ○ **On mesa top (a).** ◉ **In the canyon floor, but not in an established channel (c)**

○ **Within a bench of a canyon (b).** ○ **Within established channel in the canyon floor (d).**

Explanation: Intermediate well MCO-8.5 is located within the floodplain of Mortandad Canyon

4. Estimated ground and/or canopy cover at site: (deciduous leaves, pine needles, rocks, vegetation, trees,

(Illustration) (a) (b) (c)

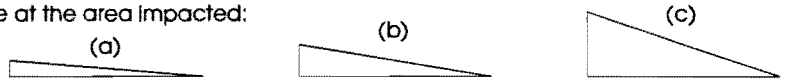


Estimated % of ground/canopy cov ○ 0% to 25% ○ 25% to 75% ◉ 75% to 100%

Explanation: The proposed area for discharging development water is located northeast of the well site. The area is heavily vegetated with mixed grasses and canopy.

5. Steepest slope at the area impacted:

(a) (b) (c)



◉ Less than 10% ○ 10% to 30% ○ 30% and greater

Explanation: The area is relatively flat with a gentle slope to the south.

RUNOFF FACTORS

Y / N

☐ ☑ **6. Is there visible evidence of runoff discharging from site? If yes, answer a) - c) below:**

☐ ☑ 6a) Is runoff channelized? If yes, describ ○ Man-made channel. ○ Natural channel.

Explanation: No evidence of runoff was observed at the site.

RUNOFF FACTORS, CONT'D

6b) Where does evidence of runoff terminate?

- ○ **Drainage or wetland (name)** Mortandad Canyon
- ○ **Within bench of canyon setting (name)**
- ○ **Other (i.e., retention pond, meadow, mesa top)**

Explanation: Water application would infiltrate into local area.

Y / N

☐ ☑ 6c) Has runoff caused visible erosion at the site? If yes, explain below: ○ Sheet ○ Rill ○ Gully

Explanation: None observed.

RUN-ON FACTORS

Please rate the potential for storm water to run on to this site: (Check EITHER #7 or #9)

☐ ☑ **7.** Are structures (i.e., buildings, roof drains, parking lots, storm drains) creating run-on to the site?

Explanation: No structural impacts

☐ ☑ **8.** Are current operations (i.e., fire hydrants, NPDES outfalls) adversely impacting run-on to the site?

Explanation: No operational impacts

☑ ☐ **9.** Are natural drainage patterns directing stormwater onto site?

Explanation: Minimal upslope run-on from canyon wall to the north.

ASSESSMENT FINDING:

☐ ☑ **10. Based on the above criteria and the assessment of this site, does soil erosion potential exist? (REFER TO EROSION POTENTIAL MATRIX.)**

Veenis, Steve

11. Signature of Water Quality/Hydrology Representative

SN Initials of independent reviewer.

Check here when information is entered in database: ☑

This page is for ESH-18 notes, recommendations, and photos.

	Y	N	
12. a)	○	◉	Is there visible trash/debris on the site?
b)	○	◉	Is there visible trash/debris in a watercourse?

Description of existing BMPs:

Silt fencing is installed on the south side of well site to keep sediments out of adjacent drainage.

◉ ○ Are BMPs being properly maintained? If no, describe in "Other Internal Notes."

◉ ○ Are BMPs effectively keeping sediment in place and reducing erosion potential?

OTHER INTERNAL NOTES:

Minimal impacts will occur from the proposed discharges of development water.

ENCLOSURE 2

Los Alamos National Laboratory

Environment, Safety & Health Division
ESH-18 Water Quality & Hydrology Group

Surface Water Assessment Erosion Matrix for PRS MCO-4.4

CRITERIA EVALUATED	Value	Erosion/Sediment Transport Potential Low 0.1	Medium 0.5	High 1.0	Calculated Score
Site Setting (43)					
On mesa top	1	Defined based on topographic setting			
Within bench of canyon	4				
Within the canyon floodplain but not watercourse	13				13.0
Within bottom of canyon channel in watercourse	17				
Estimated % ground and canopy cover	13	>75%	25-75%	<25%	1.3
Slope	13	0-10%	10-30%	>30%	1.3
Surface Water Factors-Run-off (46)					
Visible evidence of runoff discharging? (Yes/No)	5	If no, score of 0 for runoff section.			0.0
		If yes, score 5 and proceed with section.			
Where does runoff terminate?	19	Other	Bench Setting	Drainage/Wetland	0.0
Has runoff caused visible erosion? (Yes/No)	22	Sheet	Rill	Gully	0.0
		If no, score as 0. If yes, calculate as appropriate.			
Surface Water Factors-Run-on (11)					
Structures adversely affecting run-on (Yes/No)	7*	If yes, score as 7. If no, score as 0.			0.0
Current operations adversely impacting (Yes/No)	4	If yes, score as 4. If no, score as 0.			0.0
Natural drainages onto site (Yes/No)	7*	If yes, score as 7. If no, score as 0.			7.0
**Select either structures or natural drainages.*					
MAX. POSSIBLE EROSION MATRIX SCORE:	**100**			**Total Score**	22.6**

** Indicates BMPs in place. Erosion potential without BMPs may be greater.

Report Printed 6/12/01 10:29:04 AM.

Los Alamos National Laboratory
SURFACE WATER
SITE ASSESSMENT

SITE INFORMATION

1a) PRS Number MCO-4.4 **1b) Structure Number** **1c) FMU Number** ER

2. Date/Time (M/D/Y H:M am/pm) 6/12/01

SITE SETTING (check all that apply)

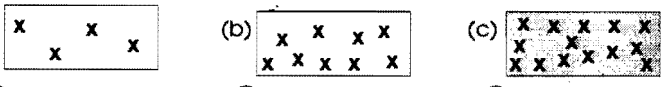
3. ○ **On mesa top (a).** ◉ **In the canyon floor, but not in an established channel (c)**

○ **Within a bench of a canyon (b).** ○ **Within established channel in the canyon floor (d).**

Explanation: Intermediate well MCO-4.4 is located within the floodplain of Mortandad Canyon

4. Estimated ground and/or canopy cover at site: (deciduous leaves, pine needles, rocks, vegetation, trees,

(illustration) (a) (b) (c)

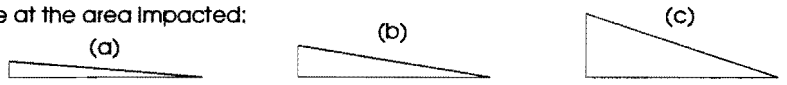


Estimated % of ground/canopy cov ○ 0% to 25% ○ 25% to 75% ◉ 75% to 100%

Explanation: The proposed area for discharging development water is located south of the well site behind the temporary outhouses. The area is heavily vegetated with mixed grasses and canopy.

5. Steepest slope at the area impacted:

(a) (b) (c)



◉ Less than 10% ○ 10% to 30% ○ 30% and greater

Explanation: The area is relatively flat with a gentle slope to the north.

RUNOFF FACTORS

Y / N

☐ ☑ **6. Is there visible evidence of runoff discharging from site? If yes, answer a) - c) below:**

☐ ☑ 6a) Is runoff channelized? If yes, describ ○ Man-made channel. ○ Natural channel.

Explanation: No evidence of runoff was observed at the site.

RUNOFF FACTORS, CONT'D

6b) Where does evidence of runoff terminate?

- ○ **Drainage or wetland (name)** Mortandad Canyon
- ○ **Within bench of canyon setting (name)**
- ○ **Other (i.e., retention pond, meadow, mesa top)**

Explanation: Water application would infiltrate into local area.

Y / N

☐ ☑ 6c) Has runoff caused visible erosion at the site? If yes, explain below: ○ Sheet ○ Rill ○ Gully

Explanation: None observed.

RUN-ON FACTORS

Please rate the potential for storm water to run on to this site: (Check EITHER #7 or #9)

☐ ☑ **7.** Are structures (i.e., buildings, roof drains, parking lots, storm drains) creating run-on to the site?

Explanation: No structural impacts

☐ ☑ **8.** Are current operations (i.e., fire hydrants, NPDES outfalls) adversely impacting run-on to the site?

Explanation: No operational impacts

☑ ☐ **9.** Are natural drainage patterns directing stormwater onto site?

Explanation: Minimal upslope run-on from canyon wall to the south.

ASSESSMENT FINDING:

☐ ☑ **10. Based on the above criteria and the assessment of this site, does soil erosion potential exist? (REFER TO EROSION POTENTIAL MATRIX.)**

Veenis, Steve

11. Signature of Water Quality/Hydrology Representative

SV Initials of independent reviewer.

Check here when information is entered in database: ☑

This page is for ESH-18 notes, recommendations, and photos.

	Y	N	
12. a)	○	◉	Is there visible trash/debris on the site?
b)	○	◉	Is there visible trash/debris in a watercourse?

Description of existing BMPs:

Silt fencing is installed on the north side of well site to keep sediments out of adjacent drainage.

◉ ○ Are BMPs being properly maintained? If no, describe in "Other Internal Notes."

◉ ○ Are BMPs effectively keeping sediment in place and reducing erosion potential?

OTHER INTERNAL NOTES:

Minimal impacts will occur from the proposed discharges of development water.

Table 5.1-1
Radionuclide Activities in Samples of Core and Cuttings from Borehole R-15

Depth (ft)	0–17.0	17.5–20.0	25.0–25.7	40.0–41.5	63.3–64.3	65.0–65.8	68.3–69.3
Geologic Unit	Alluvium	Bandelier Tuff[a]	Bandelier Tuff[a]	Bandelier Tuff[a]	Bandelier Tuff[a]	Bandelier Tuff[a]	Bandelier Tuff[a]
Strontium-90[b]	0.14 ± 0.34	-0.17 ± 0.31	0.13 ± 0.33	0.14 ± 0.32	0.17 ± 0.31	0.02 ± 0.31	0.08 ± 0.30
Cesium-137	-0.023 ± 0.070	0.027± 0.064	0.016± 0.088	0.004± 0.075	0.057± 0.097	-0.00 ± 0.11	-0.03± 0.11
Plutonium-238	0.0059 ± 0.0080	0.0012 ± 0.0066	0.0054 ± 0.0100	0.0018 ± 0.0072	-0.0025 ± 0.0068	-0.0162 ± 0.0116	0.0027± 0.0072
MDA[c]	0.013	0.012	0.021	0.018	0.017	0.039	0.016
Plutonium-239,240	0.0036 ± 0.0074	0.0054 ± 0.0072	0.0004 ± 0.0084	0.0036 ± 0.0074	0.0042 ± 0.0068	-0.0022 ± 0.0092	0.0000 ± 0.0072
MDA	0.013	0.012	0.022	0.013	0.0062	0.027	0.0067
Americium-241	0.0060 ± 0.0080	0.0113 ± 0.0136	0.0299 ± 0.0172	-0.0080 ± 0.0128	0.0097 ± 0.0104	0.035 ± 0.020	0.0146 ± 0.0140
MDA	0.014	0.025	0.014	0.039	0.016	0.019	0.020
Uranium-234	0.775 ± 0.124	0.719 ± 0.114	1.359 ± 0.192	2.24 ± 0.30	2.70 ± 0.36	1.198 ± 0.170	2.00 ± 0.26
MDA	0.019	0.019	0.018	0.0067	0.0069	0.012	0.014
Uranium-235	0.040 ± 0.022	0.071 ± 0.028	0.119 ± 0.036	0.106 ± 0.032	0.134 ± 0.038	0.080 ± 0.028	0.118 ± 0.036
MDA	0.027	0.025	0.018	0.018	0.023	0.012	0.018
Uranium-238	0.761 ± 0.122	0.791 ± 0.122	1.53± 0.22	2.09 ± 0.28	2.88 ± 0.38	1.306 ± 0.184	2.05 ± 0.28
MDA	0.023	0.015	0.0068	0.016	0.022	0.015	0.018
Gross Alpha	2.91 ± 0.79	2.13 ± 0.75	Not analyzed	3.78 ± 0.93	2.85 ± 0.79	9.1 ± 2.0	10.3 ± 1.9
Gross Beta	1.63 ± 0.62	2.43 ± 0.69	Not analyzed	2.23 ± 0.68	1.79 ± 0.66	4.68 ± 0.96	4.96 ± 0.97
Gross Gamma	10.75 ± 1.40	10.54 ± 1.38	Not analyzed	18.12 ± 2.34	19.61 ± 2.52	13.11 ± 1.72	17.79 ± 1.32
MDA	0.32	0.37		0.55	0.43	0.51	0.63
Tritium	0.12 ± 0.03	0.48 ± 0.07	Not analyzed	0.22 ± 0.04	8.6 ± 1.1	12.3 ± 1.6	14.6 ± 1.9
Organic Carbon (wt %)	0.13	0.14	0.07	<0.05	<0.05	<0.05	<0.05

Notes: 1. Activities are reported in picocuries per gram.
2. Error of two standard deviations is reported.

Table 5.1-1 (continued)

Depth (ft)	75.8–76.6	87.0–87.4	90.8–91.6	100.0–101.3	105.0–105.8	112.5–114.5
Geologic Unit	Bandelier Tuff[a]	Cerro Toledo interval	Cerro Toledo interval	Cerro Toledo interval	Cerro Toledo interval	Cerro Toledo interval
Strontium-90[b]	0.01 ± 0.30	0.02 ± 0.28	0.12 ± 0.27	-0.07 ± 0.27	-0.05 ± 0.28	0.09 ± 0.26
Cesium-137	-0.008 ± 0.056	0.02± 0.12	0.07± 0.12	-0.013± 0.053	-0.005± 0.046	-0.040 ± 0.071
Plutonium-238	-0.0042 ± 0.0096	0.0005 ± 0.0098	0.0040± 0.0082	-0.0008± 0.0068	0.0102 ± 0.0122	0.0032 ± 0.0064
MDA[e]	0.031	0.026	0.015	0.013	0.023	0.012
Plutonium-239,240	0.0073 ± 0.0108	-0.0015 ± 0.0078	0.042 ± 0.022	0.0013 ± 0.0068	-0.0053 ± 0.0072	0.0150 ± 0.0112
MDA	0.021	0.022	0.015	0.013	0.023	0.012
Americium-241	0.0061 ± 0.0136	0.0221 ± 0.0154	0.025 ± 0.024	0.0139 ± 0.0140	0.0091 ± 0.0110	0.0054 ± 0.0088
MDA	0.030	0.015	0.046	0.023	0.019	0.018
Uranium-234	1.65 ± 0.22	1.45 ± 0.20	1.58 ± 0.22	0.953 ± 0.146	0.891 ± 0.136	1.49 ± 0.20
MDA	0.026	0.024	0.016	0.019	0.023	0.021
Uranium-235	0.073 ± 0.028	0.102 ± 0.032	0.095 ± 0.032	0.060 ± 0.026	0.047 ± 0.022	0.077 ± 0.030
MDA	0.019	0.018	0.016	0.021	0.021	0.027
Uranium-238	1.70 ± 0.24	1.48 ± 0.20	1.74 ± 0.24	1.190 ± 0.174	0.874 ± 0.132	1.54 ± 0.22
MDA	0.019	0.021	0.020	0.017	0.021	0.023
Gross Alpha	5.2 ± 1.2	Not analyzed	3.71 ± 0.92	1.71 ± 0.62	4.8 ± 1.2	0.91 ± 0.45
Gross Beta	3.09 ± 0.75	Not analyzed	2.68 ± 0.70	1.61 ± 0.58	3.90 ± 0.85	1.17 ± 0.52
Gross Gamma	13.54 ± 1.76	Not analyzed	15.34 ± 2.00	10.22 ± 1.34	9.21 ± 1.20	12.05 ± 1.56
MDA	0.48		0.54	0.37	0.36	0.37
Tritium	11.7 ± 1.5	Not analyzed	12.5 ± 1.7	3.74 ± 0.50	8.6 ± 1.1	4.90 ± 0.65
Organic Carbon (wt %)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Notes: 1. Activities are reported in picocuries per gram.
2. Error of two standard deviations is reported.

Table 5.1-1 (continued)

Depth (ft)	115.0–115.8	120.0–120.8	148.3–149.3	150.0–150.8	170.0–170.8	230.0–231.3
Geologic Unit	Cerro Toledo interval	Bandelier Tuff[d]	Bandelier Tuff[d]	Bandelier Tuff[d]	Bandelier Tuff[d]	Bandelier Tuff[d]
Strontium-90[b]	-0.16 ± 0.28	-0.19 ± 0.26	-0.17 ± 0.26	-0.04 ± 0.27	-0.06 ± 0.42	0.16 ± 0.44
Cesium-137	-0.019± 0.055	0.05 ± 0.12	0.00± 0.11	0.027± 0.084	-0.031± 0.064	-0.066± 0.084
Plutonium-238	-0.0018± 0.0072	-0.0203 ± 0.0100	0.0050 ± 0.0082	0.0010± 0.0078	0.0041± 0.0084	-0.0015 ± 0.0100
MDA[c]	0.016	0.039	0.016	0.021	0.018	0.029
Plutonium-239,240	0.0045 ± 0.0072	-0.0035 ± 0.0078	0.0000 ± 0.0074	0.0029 ± 0.0078	0.0059 ± 0.0080	-0.0034 ± 0.0078
MDA	0.0068	0.026	0.0068	0.017	0.013	0.025
Americium-241	0.0182 ± 0.0160	0.0124 ± 0.0136	0.0298 ± 0.0178	0.0040 ± 0.0082	0.0106 ± 0.0114	0.0127 ± 0.0132
MDA	0.025	0.024	0.017	0.015	0.018	0.021
Uranium-234	0.891 ± 0.136	1.78 ± 0.24	1.96 ± 0.26	1.86 ± 0.26	1.83 ± 0.24	1.73 ± 0.24
MDA	0.020	0.021	0.0067	0.0071	0.013	0.014
Uranium-235	0.059 ± 0.026	0.135 ± 0.038	0.111 ± 0.034	0.067 ± 0.028	0.115 ± 0.034	0.087 ± 0.030
MDA	0.027	0.017	0.018	0.024	0.013	0.019
Uranium-238	0.872 ± 0.134	1.83 ± 0.24	1.90 ± 0.26	1.92 ± 0.26	1.91 ± 0.26	1.77 ± 0.24
MDA	0.016	0.0070	0.032	0.019	0.015	0.019
Gross Alpha	3.59 ± 0.95	2.73 ± 0.81	0.71 ± 0.43	0.98 ± 0.54	0.87 ± 0.56	0.87 ± 0.50
Gross Beta	3.11 ± 0.76	2.26 ± 0.68	1.37 ± 0.56	1.28 ± 0.59	1.62 ± 0.61	1.40 ± 0.57
Gross Gamma	9.75 ± 1.28	15.36 ± 2.00	14.73 ± 1.92	15.82 ± 2.06	14.60 ± 1.88	14.36 ± 1.86
MDA	0.37	0.57	0.52	0.51	0.51	0.46
Tritium	6.59 ± 0.88	7.23 ± 0.96	17.0 ± 2.2	14.6 ± 1.9	21.2 ± 2.8	2.65 ± 0.35
Organic Carbon (wt %)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Notes: 1. Activities are reported in picocuries per gram.
2. Error of two standard deviations is reported.

Table 5.1-1 (continued)

Depth (ft)	270.0–272.5	325.0–327.5	380.0–382.0	380.0–382.0	415.0–419.0	740.0–751.5
Geologic Unit	Bandelier Tuff[d]	Bandelier Tuff[d]	Bandelier Tuff[b]	Bandelier Tuff[b]	Bandelier Tuff[b]	Basalt perching layer[b]
Strontium-90[b]	0.06 ± 0.38	0.20 ± 0.48	0.24 ± 0.44	0.10 ± 0.42	0.18 ± 0.44	Not analyzed
Cesium-137	0.067 ± 0.084	-0.018 ± 0.066	0.015 ± 0.086	-0.025± 0.074	-0.055± 0.081	-0.038± 0.071
Plutonium-238	-0.0010 ± 0.0082	-0.0009 ± 0.0070	-0.0008 ± 0.0068	0.0075 ± 0.0108	0.0033± 0.0088	0.0025± 0.0068
MDA[c]	0.015	0.013	0.013	0.021	0.021	0.015
Plutonium-239,240	0.0040 ± 0.0082	0.0013 ± 0.0070	0.0013 ± 0.0068	0.0033 ± 0.0090	0.0047 ± 0.0102	0.0033 ± 0.0068
MDA	0.015	0.013	0.013	0.0021	0.023	0.013
Americium-241	0.0155 ± 0.0164	-0.0040 ± 0.0092	0.0169 ± 0.0160	-0.0005 ± 0.0108	0.0157 ± 0.0192	0.0355 ± 0.0184
MDA	0.028	0.030	0.026	0.030	0.037	0.014
Uranium-234	1.81 ± 0.24	1.375 ± 0.196	2.85 ± 0.36	2.66 ± 0.34	2.91 ± 0.38	1.088 ± 0.162
MDA	0.027	0.026	0.017	0.020	0.014	0.025
Uranium-235	0.104 ± 0.034	0.061 ± 0.026	0.106 ± 0.034	0.132 ± 0.038	0.115 ± 0.036	0.064 ± 0.026
MDA	0.017	0.017	0.017	0.021	0.019	0.022
Uranium-238	1.80 ± 0.24	1.345 ± 0.192	2.81 ± 0.36	2.76 ± 0.36	2.91 ± 0.38	1.115 ± 0.163
MDA	0.019	0.023	0.021	0.018	0.019	0.022
Gross Alpha	1.42 ± 0.57	1.26 ± 0.61	1.70 ± 0.64	1.32 ± 0.63	1.38 ± 0.60	8.2 ± 1.9
Gross Beta	0.47 ± 0.48	1.77 ± 0.62	1.30 ± 0.57	1.03 ± 0.57	1.35 ± 0.57	4.16 ± 0.93
Gross Gamma	13.83 ± 1.80	14.80 ± 0.52	17.67 ± 0.70	16.74 ± 0.64	17.68 ± 0.62	Not analyzed
MDA	0.53	0.63	0.85	0.79	0.75	
Tritium	4.96 ± 0.66	17.1 ± 2.2	26.5 ± 3.4	28.3 ± 3.7	0.25 ± 0.05	0.495 ± 0.086
Organic Carbon (wt %)	<0.05	<0.05	<0.05	<0.05	<0.05	Not analyzed

Notes: 1. Activities are reported in picocuries per gram.
2. Error of two standard deviations is reported.

[a] Bandelier Tuff–Tshirege Member.
[b] Radionuclides and parameters analyzed by Paragon Analytics, Inc.
[c] MDA = minimum detectable activity.
[d] Bandelier Tuff–Otowi Member.
[e] ICPMS = inductively coupled plasma mass spectrometry.
[f] MDC = minimum detectable concentration.

Table 5.1-2
Tritium Activities and Moisture Contents in R-15 Core Samples

Depth (ft)	Tritium Activity (pCi/g)	Tritium Activity (pCi/L)	Moisture Content (wt %)	Hydrogeologic Unit
22.3	0.665	69.2	9.42	Tshirege Member
39.8	0.077	5.3	6.49	Tshirege Member
59.8	11.64	2374	16.94	Tshirege Member
69.8	7.78	3021	27.97	Cerro Toledo interval
84.8	6.39	1132	15.05	Cerro Toledo interval
104.8	3.99	502	11.18	Cerro Toledo interval
114.8	5.7	621	9.82	Cerro Toledo interval
144.8	12.11	2852	19.06	Otowi Member
169.8	18.3	3199	14.88	Otowi Member
229.8	2.88	567	14.46	Otowi Member
269.8	4.97	952	16.08	Otowi Member
319.8	21.8	5338	19.67	Otowi Member
379.8	22.2	5405	19.58	Otowi Member
414.8	0.216	54.3	20.08	Otowi Member

Concentrations of antimony, mercury, selenium, silver, and thallium in the solid samples are less than detection using ICPES and CVAA methods. Distributions of iron, barium, beryllium, chromium, and lead within the alluvium, Bandelier Tuff, and Cerro Toledo interval at R-15 are shown in Figure 5.1-1. These elements generally are present above analytical detection limits, whereas antimony, arsenic, cadmium, cobalt, copper, iron, lead, mercury, manganese, nickel, selenium, silver, thallium, and vanadium are either not present (U value) or less than quantitation limits (B value). In general, concentrations of most of these elements are less than Laboratory background upper tolerance limits (UTLs) for the Bandelier Tuff. Concentrations of aluminum, barium, chromium, and iron, however, exceed the Laboratory's background UTL values, for the Bandelier Tuff in the R-15 core samples. This probably is due to the presence of clay minerals and hydrous iron oxides at the alluvium/Qbt 1g and Qbt 1g/Tsankawi contacts and within oxidized alteration zones within the Bandelier Tuff and Cerro Toledo interval. These solid phases were visually identified in the field characterized by clay nodules and iron staining. The XRD analyses (Table 3.1-1) show that these clay minerals are illites and smectites with minor amounts of kaolinite. Many transition metals, including cobalt, chromium, zinc, copper, manganese, nickel, and iron, occur naturally within hydrogeologic materials including the Bandelier Tuff, and they can become concentrated or redistributed on solid surfaces through adsorption processes (Langmuir 1997, 56037). Distributions of aluminum, arsenic, barium, calcium, chromium, iron, lead, manganese, and zinc at R-15 may be the result of natural processes, including chemical alteration (hydrolysis) of glass within the Bandelier Tuff. Groundwater zones were not encountered in the Bandelier Tuff at R-15, which, if present, can transport contaminants through the subsurface.

Table 5.1-3
R-15 Anion Pore Water Concentrations

Depth (ft)	Bromide[a]	Chloride[a]	Fluoride[a]	Nitrate[a]	Nitrite[a]	Oxalate[a]	Perchlorate[b]	Phosphate[a]	Sulfate[a]
2	1	34	21	19	13	BD[c]	BD	10	137
5	1	48	15	7	66	BD	BD	7	146
17	BD	53	19	BD	BD	BD	BD	9	125
32	BD	17	30	BD	BD	BD	BD	4	274
49.5	BD	28	37	7	BD	BD	653	3	47
64.5	BD	21	7	135	BD	BD	167	2	18
69.5	BD	21	15	114	BD	BD	136	6	17
74.5	BD	24	8	155	BD	BD	160	2	27
79.5	BD	19	22	120	BD	BD	144	4	26
89.5	BD	13	9	80	BD	BD	107	2	16
99.5	BD	19	7	124	BD	BD	189	1	24
114.5	BD	19	9	111	BD	BD	122	1	31
124.5	BD	17	5	111	BD	BD	140	BD	18
129.5	BD	17	4	108	BD	BD	181	1	21
149.5	BD	23	7	212	BD	BD	261	BD	26
174.5	BD	21	7	254	BD	BD	267	BD	31
199.5	BD	27	8	211	BD	BD	246	BD	42
249.8	BD	42	12	272	BD	BD	403	BD	48
299.5	BD	17	5	142	BD	BD	241	BD	19
349.5	BD	24	11	101	BD	BD	260	1	51
399.6	BD	21	20	4	BD	BD	359	1	46
447	BD	32	27	BD	BD	18	BD	3	128
502	BD	18	68	BD	BD	49	BD	23	176
540	BD	106	80	BD	BD	86	BD	140	206
630	BD	88	15	BD	BD	38	BD	6	363
700	BD	38	523	BD	BD	46	BD	22	101
740	BD	119	69	BD	BD	169	1662	36	574
746	1	14	11	BD	BD	BD	83	1	23

[a] mg/L.
[b] µg/L.
[c] BD = below detection.

Table 5.1-4
MCO-7.2 Anion Pore Water Concentrations

Depth (ft)	Bromide[a]	Chloride[a]	Fluoride[a]	Nitrate[a]	Nitrite[a]	Oxalate[a]	Perchlorate[b]	Phosphate[a]	Sulfate[a]
0.6	7	11	3	320	648	BD[c]	BD	4	125
2.25	18	17	6	12	7	BD	279	4	111
3.7	8	18	21	48	2	BD	BD	21	86
5.4	85	127	47	BD	BD	BD	BD	37	2634
8.8	24	90	39	BD	BD	BD	2821	35	346
15.4	21	21	26	BD	BD	BD	BD	39	45
25.4	15	47	22	BD	BD	BD	BD	34	113
32.9	9	10	11	BD	BD	BD	26	14	26
37.8	1	23	5	30	BD	BD	202	5	28
41.2	6	5	9	5	BD	BD	30	7	6
47.9	5	14	11	63	BD	BD	179	4	24
66.7	3	50	15	71	BD	BD	130	2	96
80.7	4	31	8	82	BD	BD	251	0	27
93.1	26	134	39	584	BD	BD	689	8	212
102.4	8	24	18	70	BD	BD	138	1	33
111.3	2	34	5	177	BD	BD	211	BD	39
121.1	2	26	5	138	BD	BD	186	BD	28
132.5	3	27	5	136	BD	BD	170	BD	28

[a] mg/L.
[b] µg/L.
[c] BD = below detection.

Because perchlorate concentrations are reported in µg/L, they are plotted separately from the other anions (Figures 5.1-8 and 5.1-9). Several samples collected from R-15 had bromide, nitrite, and oxalate below the detection limit (Table 5.1-3). Oxalate concentrations in MCO-7.2 samples were all less than detection, whereas nitrite was detected in three samples (Table 5.1-4). As a result, these anions are not shown in the figures. The lack of detection does not mean that these species are not present in the samples. Instead, the leaching process results in substantial dilution, and when an anion has a low concentration, the dilution can lower the concentration below the detection limit. In general, anion distributions in the two boreholes showed similar behavior with depth and have multipeaked profiles. The increase in anion concentrations in R-15 between 700 and 740 ft are close to the Cerros del Rio basalt/Puye Formation contact and may be related to the perched saturated zone located at 646 to 740 ft.

In the case of both R-15 and MCO-7.2, there are some important observations regarding distributions of nitrate and perchlorate. In R-15, the highest nitrate concentrations occur within the Cerro Toledo interval and Otowi Member (65–400 ft) (Figure 5.1-8). Nitrate concentrations decline substantially below 400 ft and remain at relatively low values throughout the deeper part of the profile. In borehole MCO-7.2, high nitrate concentrations occur in the top 5 ft of the borehole and also within the Cerro Toledo interval and Otowi Member (80–130 ft) (Figure 5.1-9). The concentrations in both boreholes are well above those observed in the vadose zone elsewhere at the Laboratory (Table 5.1-5). These values indicate that the high concentrations are the result of contamination. The TA-50 outfall is a known source of nitrate that flows into Mortandad canyon, and previous studies have noted elevated nitrate in the Mortandad alluvium (Rogers and Gallaher 1995, 49824).