Los Alamos National Laboratory
Hydrogeologic Characterization Program
Quarterly Meeting/EAG Semi-Annual Meeting

October 3-5, 2000

Los Alamos National Laboratory
Hydrogeologic Characterization Program
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Agenda

Tuesday, October 3, 2000; Cities of Gold Hotel

8:00 Welcome and Introductions (C. Nylander)
8:15 Groundwater Integration Team (GIT) Subcommittee Reports
  Information Management (K. Henning)
  Well Construction (S. Pearson)
  Geochemistry (B. Newman)

9:45 Break

10:00 Groundwater Integration Team (GIT) Subcommittee Reports
  Hydrology (D. Rogers/B. Stone)
  Modeling (B. Robinson)

11:30 Lunch

1:00 Modeling Demonstration (B. Robinson)
2:00 Modeling Workplan (C. Nylander)

2:30 Break

2:45 Detailed Description of Los Alamos-Pueblo Canyon Model (B. Robinson/B. Carey)
3:45 Groundwater Investigation Focus Area (D. Daymon)
4:15 Quality Assurance (A. Gallegos)
4:45 Adjourn
5:15 Discussion session on modeling

Agenda

Wednesday, October 4, 2000; Cities of Gold Casino and Hotel

8:00 FY00 Performance Review (C. Nylander)
8:30 Regulatory Review
RCRA/HSWA Permit Revisions (A. Barr)
Well Construction Issues (D. Broxton)

9:30 Break

9:45 Uranium Chemistry Modeling in Los Alamos-Pueblo Canyon (B. Robinson)
10:00 Los Alamos Canyon Low Head Weir Monitoring (G. Bussod)
10:15 Cerro Grande Fire impact on surface water chemistry (B. Gallaher)
10:45 Risk Assessment (D. Hollis)

11:30 Lunch

1:00 EAG/Stakeholder session

3:00 Break

3:15 LANL Response to stakeholder concerns
4:45 Adjourn

Thursday, October 5; LATA Conference Room

9:00 Modeling Demonstration (B. Robinson)
9:30 EAG Debriefing for Managers

10:00 Break

10:15 EAG Debriefing for GIT

11:30 Lunch

1:00 EAG Working Session

GIT Information Management Subcommittee Status Report

Water Quality Database

October 3rd, 2000

Primary Efforts in Past Quarter

- Hardware/Infrastructure
- Software Development
- Report Development
- Web Access to Fire Data
- Legacy Data Migration
- Lookup Table Standardization

Hardware/Infrastructure

- Database, Forms & Reports Server Behind the Firewall (Yellow)
- Database, Forms & Reports Server In Front of the Firewall (Green)

Software Development

- **Data Import/Entry Software**
  - **Stations/Locations**
  - **Samples Taken**
  - **Data Steward QA/QC Tools**
  - **Lookup Table Maintenance**
  - **Application Security & Infrastructure**
  - **Import Routines for Chemistry and Flow Datafiles**

Report Development

- Locations/Stations
- Chemistry – tabular & ESR-style
- Chemistry Results Screening
- Lookup Tables

Web Access to Fire Data

http://www.esh.lanl.gov/~esh18/teams/CGFire/index.html

Links to **Flow Data** and **Chemistry Data**

Legacy Data Migration

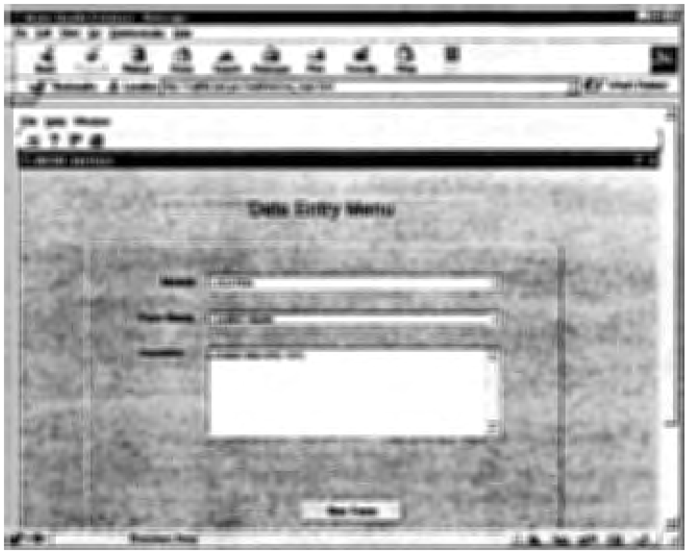
- Storm water Locations (~ 60)
- Hydrology Team "All Stations" (~ 800)
- Legacy Chemistry – Runoff
- Legacy Chemistry – All Other
- Flow Data – Fire-related stations

Lookup Table Standardization

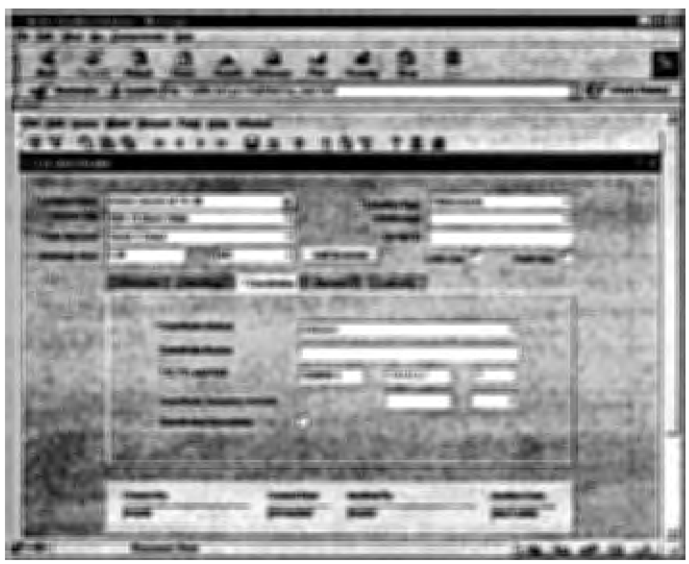
- Chemistry
  - Suites, Analytes, Methods

Main Menu

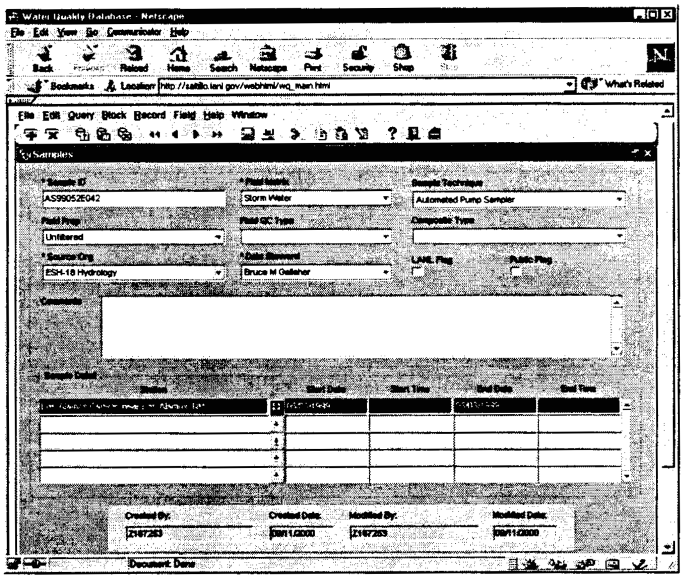
Data Entry Menu



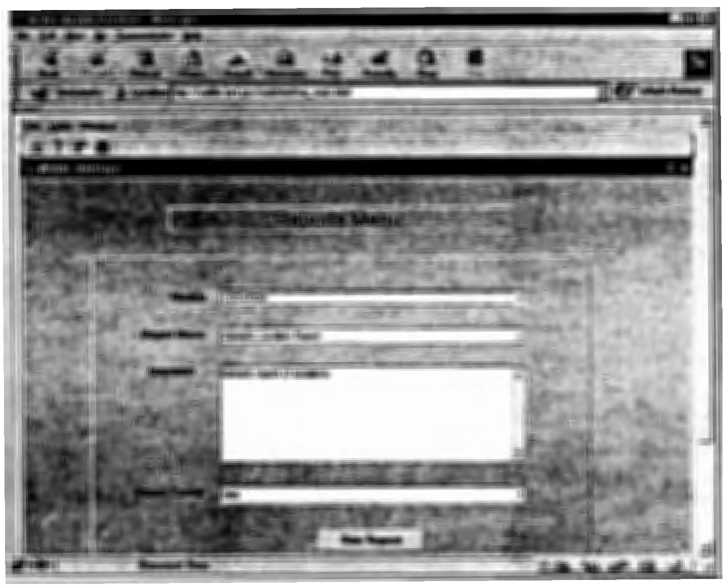
Data Entry - Locations



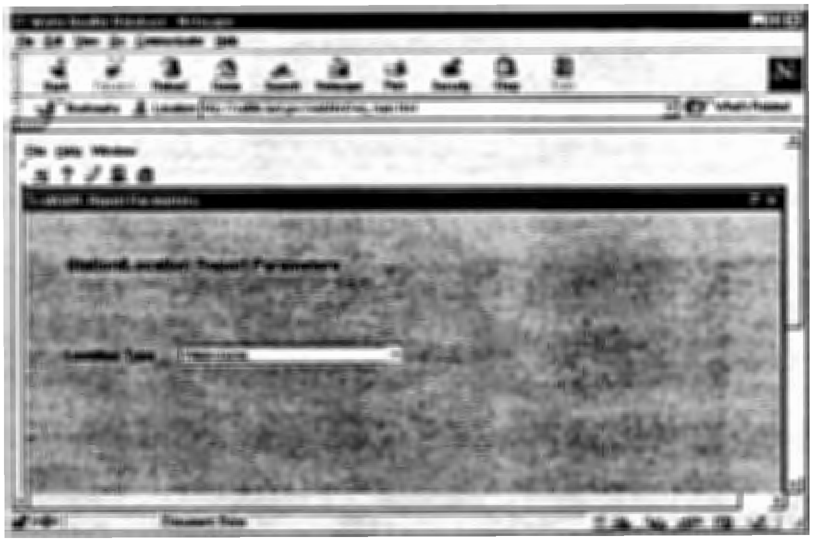
Data Entry – Samples Taken



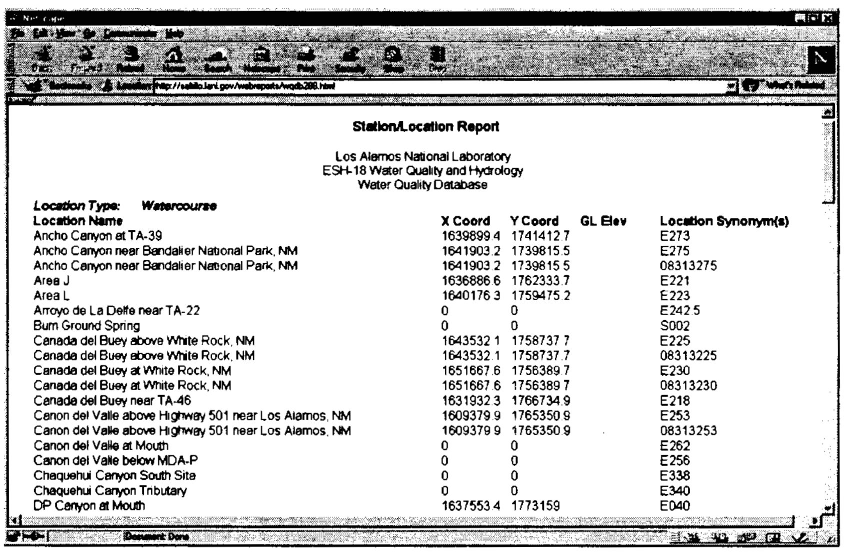
Reports Menu



Report Parameter Form



Report Output – Locations - HTML



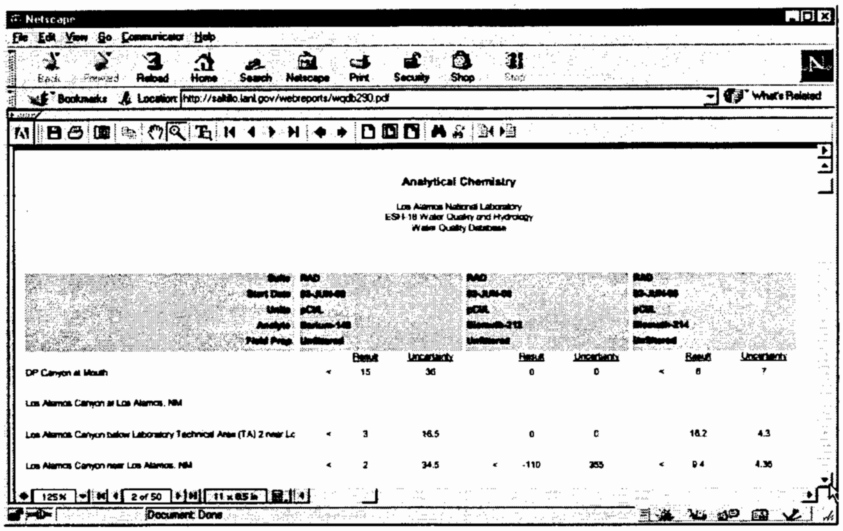
Station/Location Report

Los Alamos National Laboratory
ESH-18 Water Quality and Hydrology
Water Quality Database

Location Type: Watercourse

Location Name	X Coord	Y Coord	GL Elev	Location Synonym(s)
Ancho Canyon at TA-39	1639899.4	1741412.7		E273
Ancho Canyon near Bandalier National Park, NM	1641903.2	1739815.5		E275
Ancho Canyon near Bandalier National Park, NM	1641903.2	1739815.5		08313275
Area J	1636886.6	1762333.7		E221
Area L	1640176.3	1759475.2		E223
Arroyo de La Delfe near TA-22	0	0		E242.5
Bum Ground Spring	0	0		S002
Canada del Buey above White Rock, NM	1643532.1	1758737.7		E225
Canada del Buey above White Rock, NM	1643532.1	1758737.7		08313225
Canada del Buey at White Rock, NM	1651667.6	1756389.7		E230
Canada del Buey at White Rock, NM	1651667.6	1756389.7		08313230
Canada del Buey near TA-46	1631932.3	1766734.9		E218
Canon del Valle above Highway 501 near Los Alamos, NM	1609379.9	1765350.9		E253
Canon del Valle above Highway 501 near Los Alamos, NM	1609379.9	1765350.9		08313253
Canon del Valle at Mouth	0	0		E262
Canon del Valle below MDA-P	0	0		E256
Chaquehui Canyon South Site	0	0		E338
Chaquehui Canyon Tributary	0	0		E340
DP Canyon at Mouth	1637553.4	1773159		E040

Report Output - Chemistry - PDF



Goals for Next Quarter

- System In Production on Yellow and Green
- User Orientation Session(s)
- Continued Software Development
- Continued Report Development
- Continued Data Migration

Question & Answer

Well Construction Subcommittee Report

Deba Daymon

Hydrogeologic Workplan Semi-Annual Meeting

October 3, 2000

R-9

•Total Depth	771 ft
•Drilling Completed	9/29/99
•Well Constructed	10/18/99
•Well Developed	2/13/00
•Number of Screens	1

R-9 (cont)

•Quarterly Sampling	2/28/00 & 9/30/00
•Rig Used	T-4/DR-24#1
•Geophysics	2/11/00 (S)
•Pump Installation	8/30/00
•Completion Report	9/28/00

R-12

•Total Depth	886 ft
•Drilling Completed	1/10/00
•Well Constructed	1/24/00
•Well Developed	2/6/00
•Number of Screens	3

R-12 (cont)

•Westbay Installed	3/21/00
•Quarterly Sampling	9/21/00
•Rig Used	T-4/DR-24#1
•Geophysics	2/8/00 (S)
•Completion Report	9/28/00

R-15

•Total Depth	1107 ft
•Drilling Completed	9/7/99
•Well Constructed	9/20/99
•Well Developed	2/21/00
•Number of Screens	1

R-15 (cont)

•Quarterly Sampling	2/24/00
•Rig Used	DR-24#1
•Geophysics	2/11/00
•Pump Installed	9/30/00
•Completion Report	9/28/00

R-25

•Total Depth	1942 ft
•Drilling Completed	2/24/99
•Well Constructed	5/25/99
•Well Developed	2/1/00 & 5/7/00
•Number of Screens	9

R-25 (cont)

•Westbay Installed	9/30/00
•Quarterly Sampling	FY01
•Rig Used	DR-24#1
•Geophysics	9/16/98 (L)
10/14/98(L), 4/21/99(S),	2/10/00 (S)
•Completion Report	FY01

R-31

•Total Depth	1103 ft
•Drilling Completed	2/6/00
•Well Constructed	3/4/00
•Well Developed	3/25/00
•Number of Screens	5

R-31 (cont)

•Westbay Installed	4/7/00
•Quarterly Sampling	FY 01
•Rig Used	DR-24#2
•Geophysics	2/9/00 (L) 3/17/00 (S)
•Completion Report	FY01

R-9(i)

•Total Depth	323 ft
•Drilling Completed	3/9/00
•Well Constructed	3/11/00
•Well Developed	4/7/00
•Number of Screens	2

R-9(i) (cont)

•Westbay Installed	4/13/00
•Quarterly Sampling	9/15/00
•Rig Used	DR-24#2
•Geophysics	3/18/00 (S)
•Completion Report	9/28/00

R-19

•Total Depth	1903 ft
•Drilling Completed	3/12/00
•Well Constructed	4/27/00
•Well Developed	8/16/00
•Number of Screens	7

R-19 (cont)

•Westbay Installed	9/11/00
•Quarterly Sampling	9/30/00
•Rig Used	DR-24#1
•Geophysics	3/14/00 (L) 3/16/00 (S)
•Completion Report	9/28/00

R-22

•Total Depth	1800 ft
•Drilling Started	9/08/00
•Current Depth	846 ft
•Drilling Completed	FY01

STATUS REPORT FOR THE GEOCHEMISTRY SUBCOMMITTEE, GROUNDWATER INTEGRATION TEAM

BY

PATRICK LONGMIRE[1], BRENT NEWMAN[2], DALE COUNCE[1], ROBERT HULL[3], RANDALL RYTI[4], AND FRASER GOFF[1]

OCTOBER 3, 2000

1. EES-1, 2. EES-15, LOS ALAMOS NATIONAL LABORATORY,
3. LATA, AND 4. NEPTUNE AND COMPANY

ENVIRONMENTAL RESTORATION PROJECT

OBJECTIVE OF PRESENTATION

Present a status report for the geochemistry subcommittee for the fourth quarter of FY2000.

Topics of interest include:

- **R-19, residual EZMUD and total organic carbon,**
- **LANL background hydrochemistry investigation,**
- **TA-16 Investigations,**
- **R-15, Completion Report, and**
- **Surface water and groundwater, Post Cerro Grande Fire.**

EZMUD CHEMISTRY

EZMUD consists of a long-chain polymer containing many functional groups, which include polyacrylamide/polyacrylate (PHPA) copolymer and hydrocarbon molecules.

Some molecules tentatively identified in EZMUD include undecane ($C_{11}H_{24}$), 2,6-dimethyl-undecane ($C_{13}H_{28}$), 2-methyl-decane ($C_{11}H_{24}$), tridecane ($C_{13}H_{28}$), and tetradecane ($C_{14}H_{30}$).

EZMUD adsorbs onto aquifer material to enhance borehole stability.

EZMUD has a negative charge density of 30% (0.3 mol per mol of polymer), which may enhance the polymer's ability to adsorb cations (Sr^{2+}, PuO_2^{1+}, UO_2^{2+}, and $AmCO_3^{1+}$).

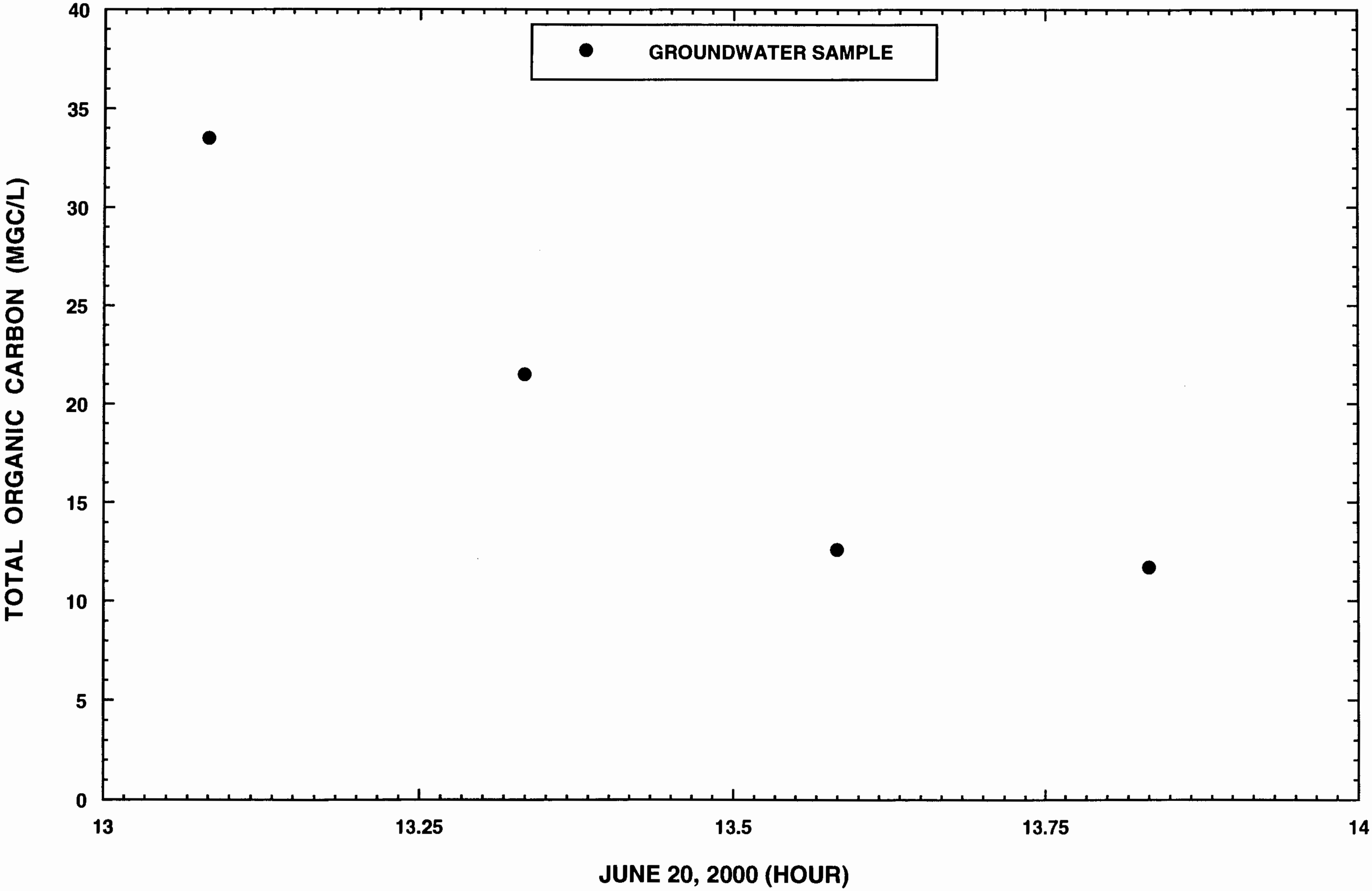
EZMUD CHEMISTRY

EZMUD is strongly hydrophobic (high molecular weight polymer), which probably has the ability to adsorb organic compounds such as RDX, HMX, and TNT.

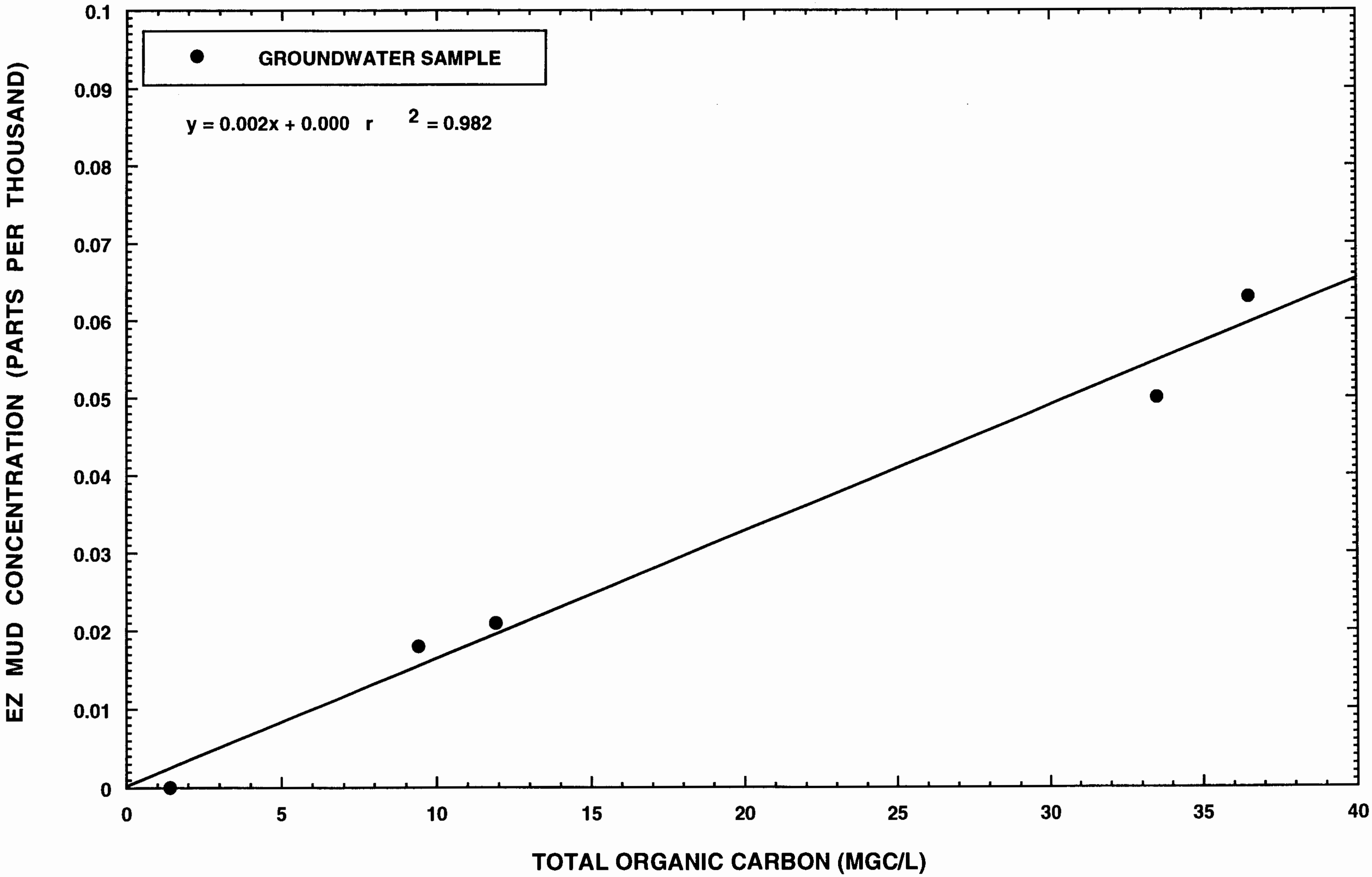
EZMUD has a low aqueous solubility under near-neutral pH conditions. Nitric acid (pH1), sulfuric acid (pH1), and sodium hypochlorite (bleach) (oxidizing agent, electron acceptor) can be used to break down EZMUD.

Aggressive well development helps dissociate EZMUD without adding additional chemicals to the well.

TIME VERSUS TOTAL ORGANIC CARBON CONCENTRATION FOR R-19, SCREEN SEVEN (1,830-1,840 FT).



TOTAL ORGANIC CARBON (MGC/L) VERSUS EZ MUD CONCENTRATION (PARTS PER THOUSAND) FOR R-19, SCREEN SEVEN (1,830 -1,840 FT) AND TAP WATER. WATER SAMPLES COLLECTED ON 06/20-21/00.



EZMUD CHEMISTRY-RECOMMENDATIONS AND SUMMARY OF RESULTS

Remove EZMUD from borehole(s) during well development prior to Westbay installation.

Measure pH, turbidity, and TOC and perform polymer titration to evaluate dissociation of EZMUD polymer.

Minimize use EZMUD in boreholes where chemical and hydrologic data and information are collected in contaminated canyons.

Small amounts (10^{-5} to 10^{-4}) of EZMUD remain in R-19 and residual TOC concentrations are generally less than 10 mgC/L. Residual amounts of EZMUD should breakdown (biodegrade) over time.

R-19 and CDV-15 shall be monitored for EZMUD, TOC, and other analytes.

ENVIRONMENTAL RESTORATION PROJECT

LANL BACKGROUND HYDROGEOCHEMISTRY INVESTIGATION

TOPICS OF INTEREST FOR FY2000

I. DATA QUALITY OBJECTIVES

II. QUALITY ASSURANCE AND DATA VALIDATION

III. STATISTICAL ANALYSES

IV. HYDROGEOLOGIC SETTING

V. GENERAL HYDROCHEMICAL TRENDS

ENVIRONMENTAL RESTORATION PROJECT

Alluvial	Perched Intermediate	Regional Aquifer
Well LAO-B, upper Los Alamos Canyon	Apache Spring, west of Laboratory	Spring 1, White Rock Canyon, San Ildefonso
	Seven Springs, Jemez Mountains	Sacred Spring, north of lower Los Alamos Canyon, San Ildefonso
	Water Canyon Gallery, west of Laboratory	La Mesita Spring, White Rock Canyon, San Ildefonso
	Upper Canon de Valle Spring, west of Laboratory	Water Supply Well O-4, Los Alamos Canyon
	Pine Spring, north of Laboratory	Water Supply Well G-5, Guaje Canyon north of Laboratory
	Well LAOI-1.1, Los Alamos Canyon	
	Doe Spring, White Rock Canyon	
	Spring 9B, White Rock Canyon	
	Spring 4A (Pajarito Spring), White Rock Canyon	

FY2000 WORK ACTIVITIES-LANL BACKGROUND HYDROGEOCHEMISTRY INVESTIGATION

Validate groundwater data for major ions, trace elements; trace metals, radionuclides, and DOC fractionation.

Identify additional data needs (ICPMS) for selected trace elements and trace metals (Sb, Be, Cd, Pb, Tl, and U).

Perform additional groundwater sampling in FY2000 (pre and post Cerro Grande fire, Sierra de los Valles springs).

Perform statistical analyses on groundwater samples.

Prepare draft LANL background hydrochemistry report in FY2000.

ANALYTES OF INTEREST FOR LANL BACKGROUND HYDROCHEMISTRY INVESTIGATION

Major ions, trace elements, and trace metals.

Dissolved organic carbon fractionation (naturally occurring organic compounds).

Radionuclides
(^{234}U, ^{235}U, ^{238}U, ^{238}Pu, $^{239,240}Pu$, ^{241}Am, ^{90}Sr, ^{137}Cs, and ^{3}H).

Stable isotopes (H, O, and N).

ENVIRONMENTAL RESTORATION PROJECT

RESULTS OF TA-16 INVESTIGATIONS

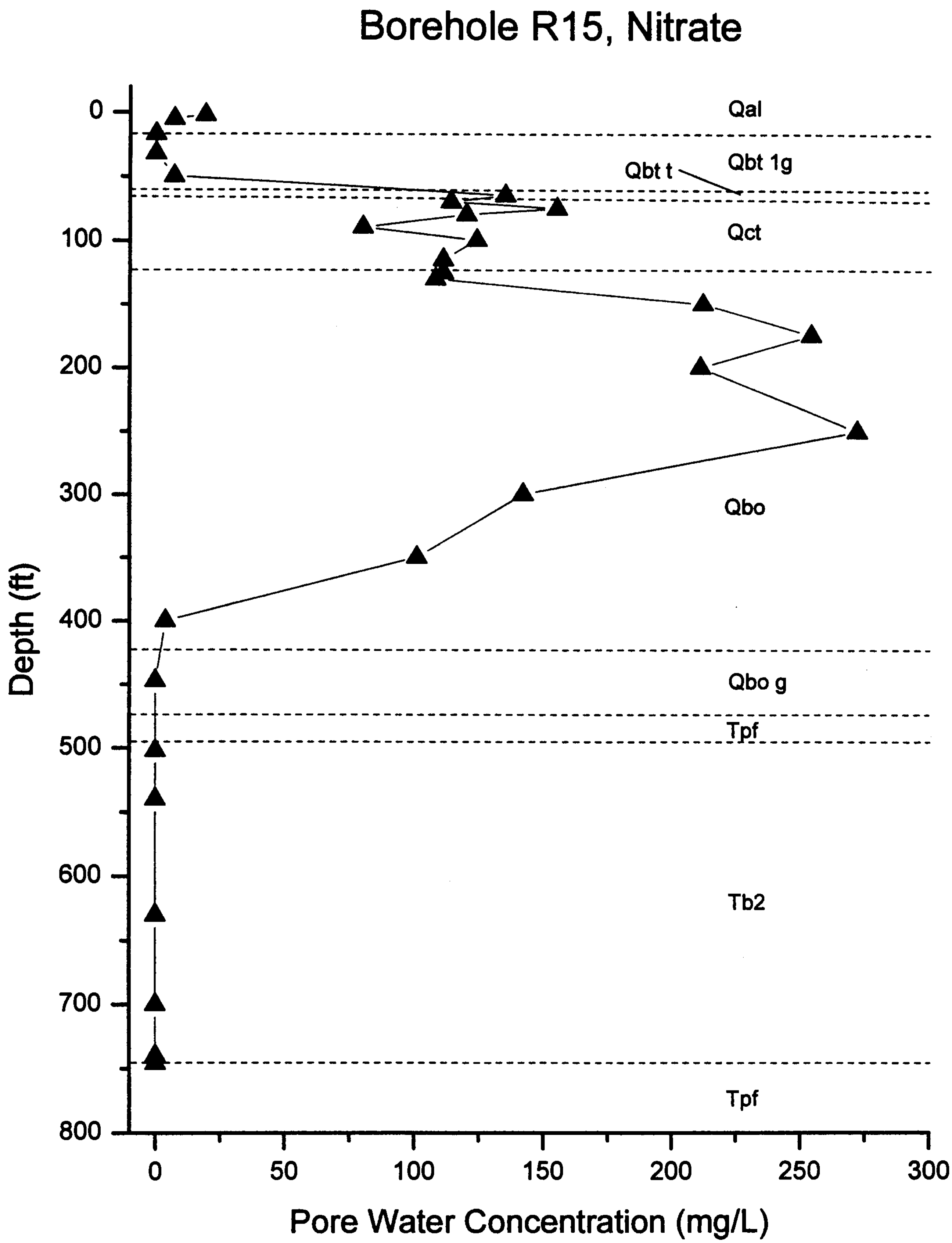
Temporal and spatial variability in contaminant concentrations and other geochemical parameters/species are observed.

Barium concentrations in groundwater and surface water are controlled by mineral solubility with $BaSO_4$ (oversaturation) and $BaCO_3$ (saturation).

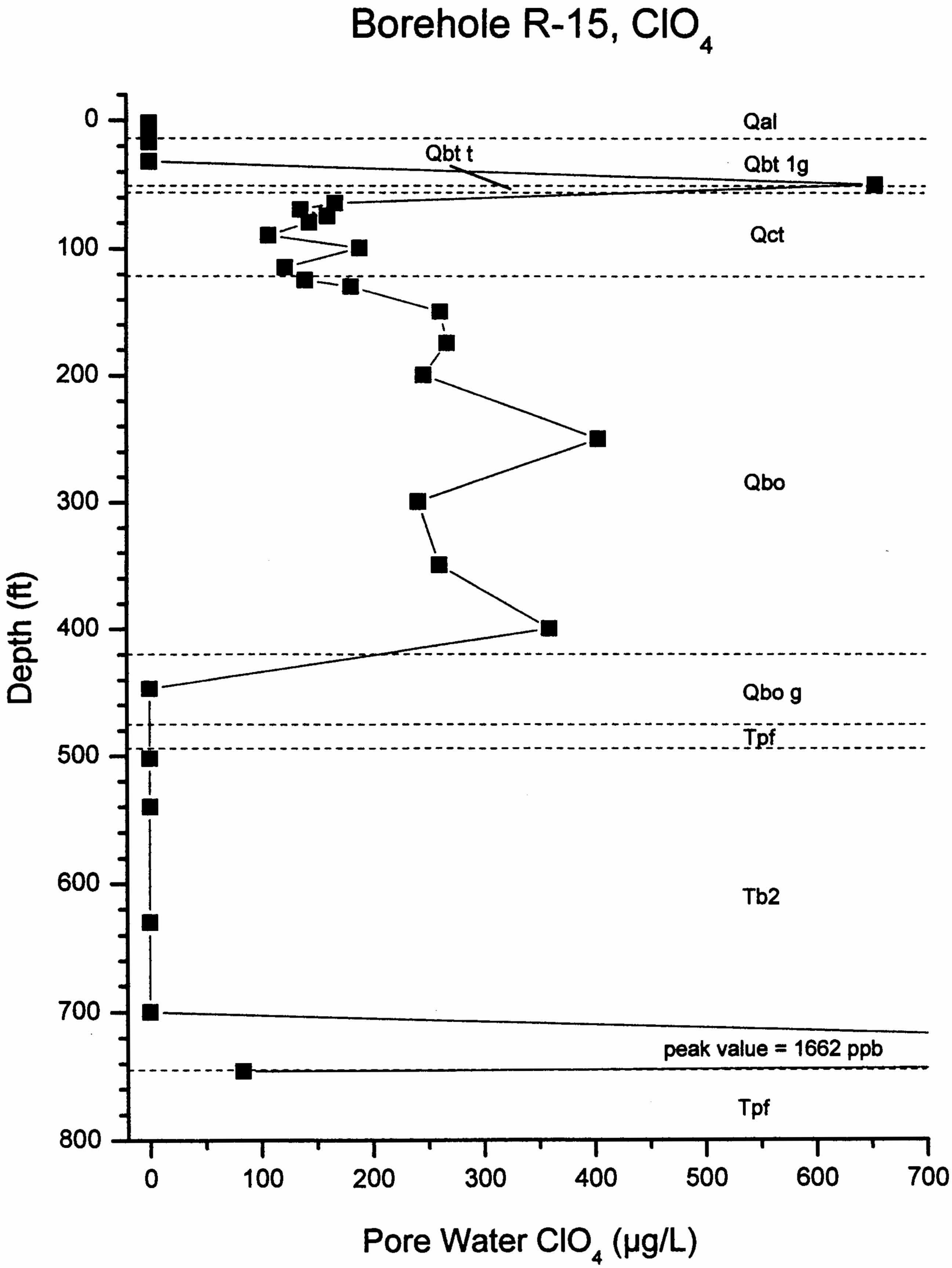
Precipitation and dissolution could be controlled by evapotranspiration.

Variation of high explosive concentrations in the subsurface are controlled by fractures and high permeable units such as surge beds.

Variations in nitrogen isotope ratios within Canon de Valle suggest that there are multiple sources of nitrogen species.

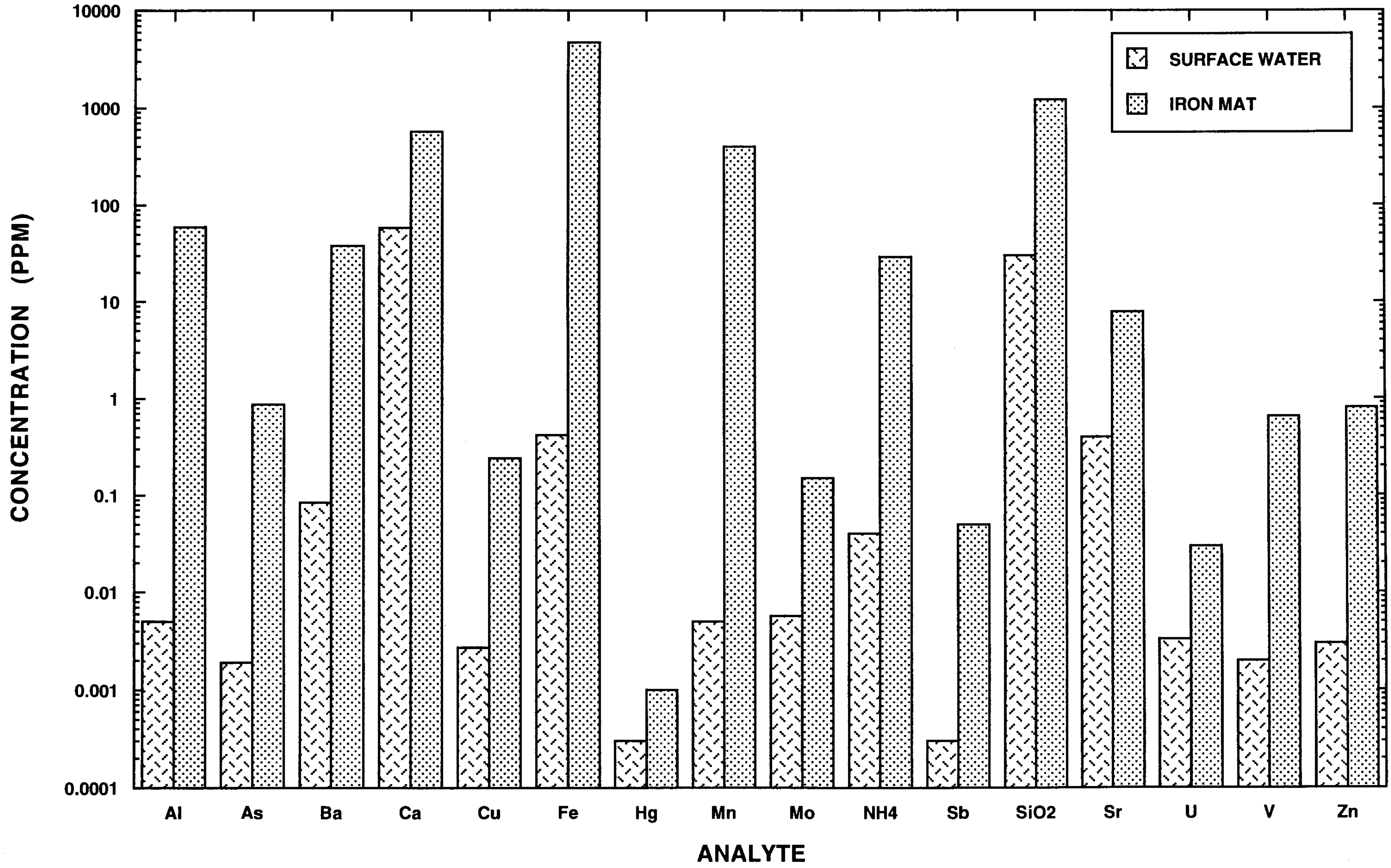


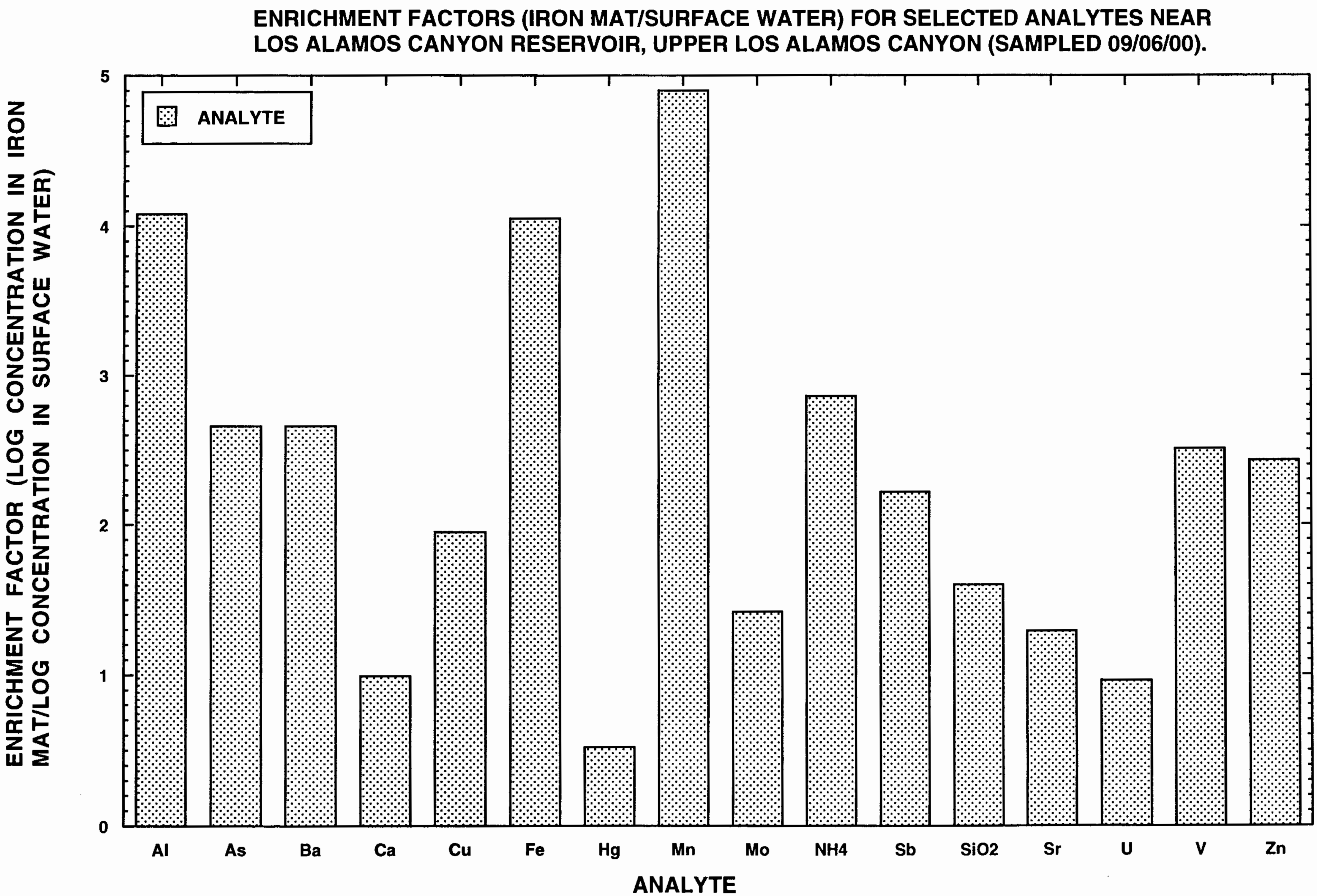
Borehole R15, Nitrate
Qal
Qbt 1g
Qbt t
Qct
Qbo
Qbo g
Tpf
Tb2
Tpf
Depth (ft)
0
100
200
300
400
500
600
700
800
0
50
100
150
200
250
300
Pore Water Concentration (mg/L)



Borehole R-15, ClO_4
Depth (ft)
Pore Water ClO_4 (µg/L)
Qal
Qbt t
Qbt 1g
Qct
Qbo
Qbo g
Tpf
Tb2
peak value = 1662 ppb
Tpf
0
100
200
300
400
500
600
700
800
0
100
200
300
400
500
600
700

ANALYTICAL RESULTS FOR SELECTED TRACE ELEMENTS, AMMONIUM, AND SILICA IN SURFACE WATER AND IN IRON MATS NEAR LOS ALAMOS CANYON RESERVOIR, UPPER LOS ALAMOS CANYON (SAMPLED 09/06/00).




ENRICHMENT FACTORS (IRON MAT/SURFACE WATER) FOR SELECTED ANALYTES NEAR
LOS ALAMOS CANYON RESERVOIR, UPPER LOS ALAMOS CANYON (SAMPLED 09/06/00).
ANALYTE
ENRICHMENT FACTOR (LOG CONCENTRATION IN IRON MAT/LOG CONCENTRATION IN SURFACE WATER)
0
1
2
3
4
5
Al
As
Ba
Ca
Cu
Fe
Hg
Mn
Mo
NH4
Sb
SiO2
Sr
U
V
Zn
ANALYTE

SUMMARY

Geochemistry subcommittee members analyzed and interpreted data and information collected from TA-16, R-15, R-19, CDV-15, and background groundwater stations.

Background hydrochemical data and information are collected for regulatory purposes and applied scientific investigations. A final report shall be released in FY2001.

Based on available water chemistry data, the Cerro Grande fire did not impact most of the springs discharging in the Sierra del los Valles, excluding Pine Spring.

Since the fire, elevated concentrations of manganese, iron, bicarbonate, TDS, major ions, and trace elements are associated with surface water and shallow groundwater.

ENVIRONMENTAL RESTORATION PROJECT

SUPPLEMENTAL MATERIAL FOR GEOCHEMISTRY SUBCOMMITTEE STATUS REPORT, FY2000

Type of Data	Existing Data	New Data Required
Water quality data	Analyses of groundwater samples are available from Laboratory surveillance program, ER Project, NMED-OB studies, National Uranium Resource Evaluation (NURE) Project, consultant reports, and the US Geological Survey.	Analyses of additional groundwater samples representing each mode of groundwater occurrence.
Sample handling (filtered/ nonfiltered)	Existing data from filtered samples are adequate for use. However, non-filtered samples that have been collected by other programs have cation-anion charge balance greater errors than ± 10%; therefore not of adequate quality.	Analyses of filtered and non-filtered samples (low turbidity), except for total suspended solids, which requires a non-filtered sample.
Analytes	Assessment of the existing data set (of 55 filtered samples) showed good agreement between cation sum and anion sum. Ten samples had laboratory duplicates and the laboratory variation is less than 20% relative standard deviation. Therefore this data can be used in the establishing background. However, most of the major cations and anions are frequently detected, but many of the trace elements have low detection rates.	Major cations (Ca, Mg, Na, K); major anions (HCO_3, Cl, SO_4); trace elements (Ag, Al, As, B, Ba, Be, Br, Cd, ClO_3, Co, Cr, Cs, Cu, F, Fe, Hg, I, Li, Mn, Mo, NH_4, Ni, NO_2, Pb, PO_4, Rb, Sb, Se, S_2O_3, Sn, Sr, Ti, Tl, U, V, Zn); SiO2; total dissolved solids, fallout radionuclides (^{241}Am, ^{137}Cs, ^{238}Pu, ^{239,240}Pu, ^{90}Sr, ^{3}H, ^{234}U, ^{235}U, and ^{238}U); dissolved organic carbon, and stable isotopes ($^{18}O/^{16}O$, $^{15}N/^{14}N$, and D/H).
Analytical methods	Samples analyzed by SW 846 methods are acceptable for use in determining background	SW 846 methods by ICPES, ICPMS, CVAA, ETVAA, AA, SIE, IC, colorimetry, and MS. Analysis of fall-out radionuclides by alpha spectrometry, gamma spectrometry, liquid scintillation, gases proportional counting, electrolytic enrichment/gas proportional counting. Field parameters include temperature, pH, specific conductance, turbidity, carbonate alkalinity.

FIGURE 13.1-1. PINE SPRING (PUYE FORMATION AND LAVAS OF POLVADERA GROUP, GARCIA CANYON).

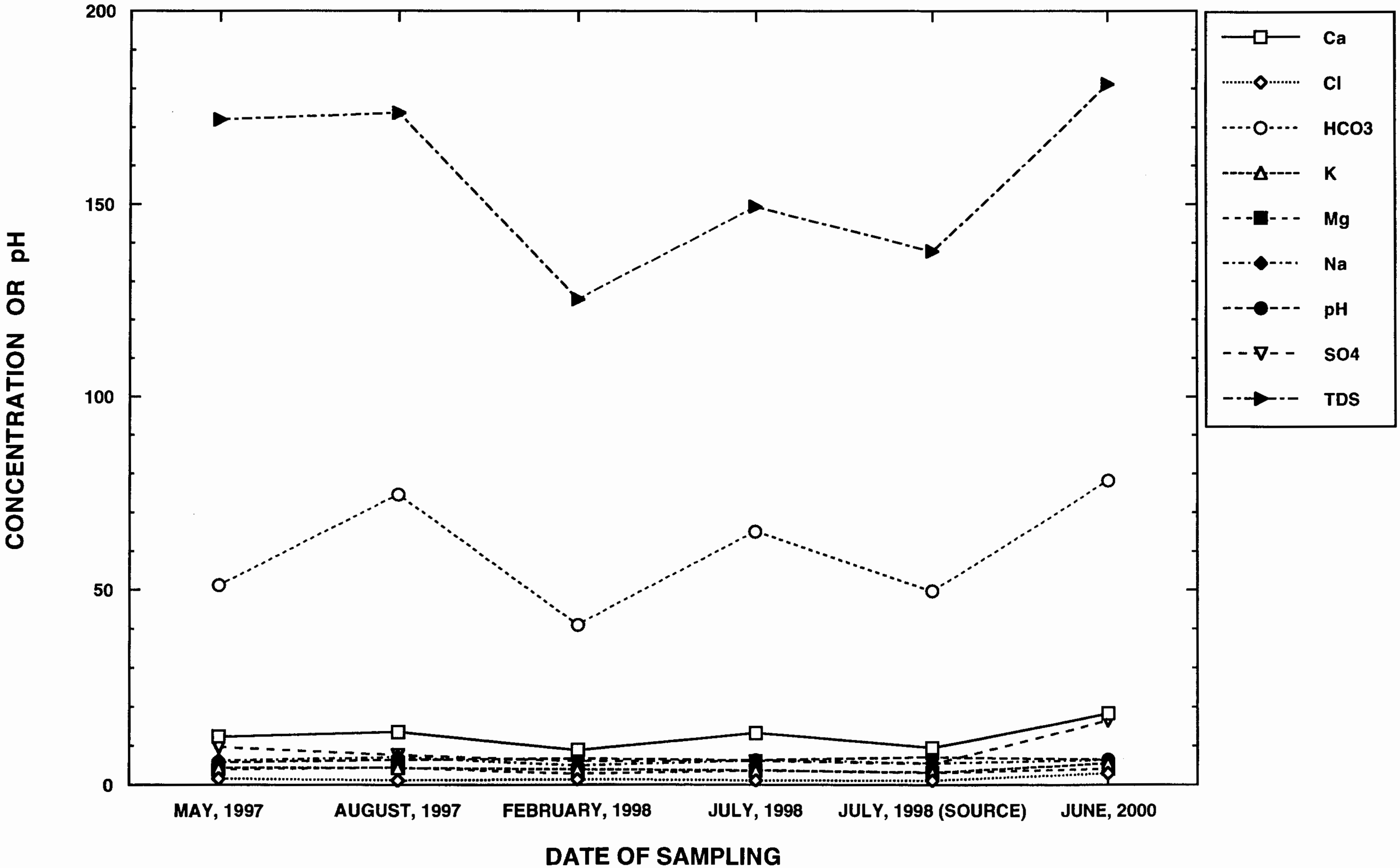
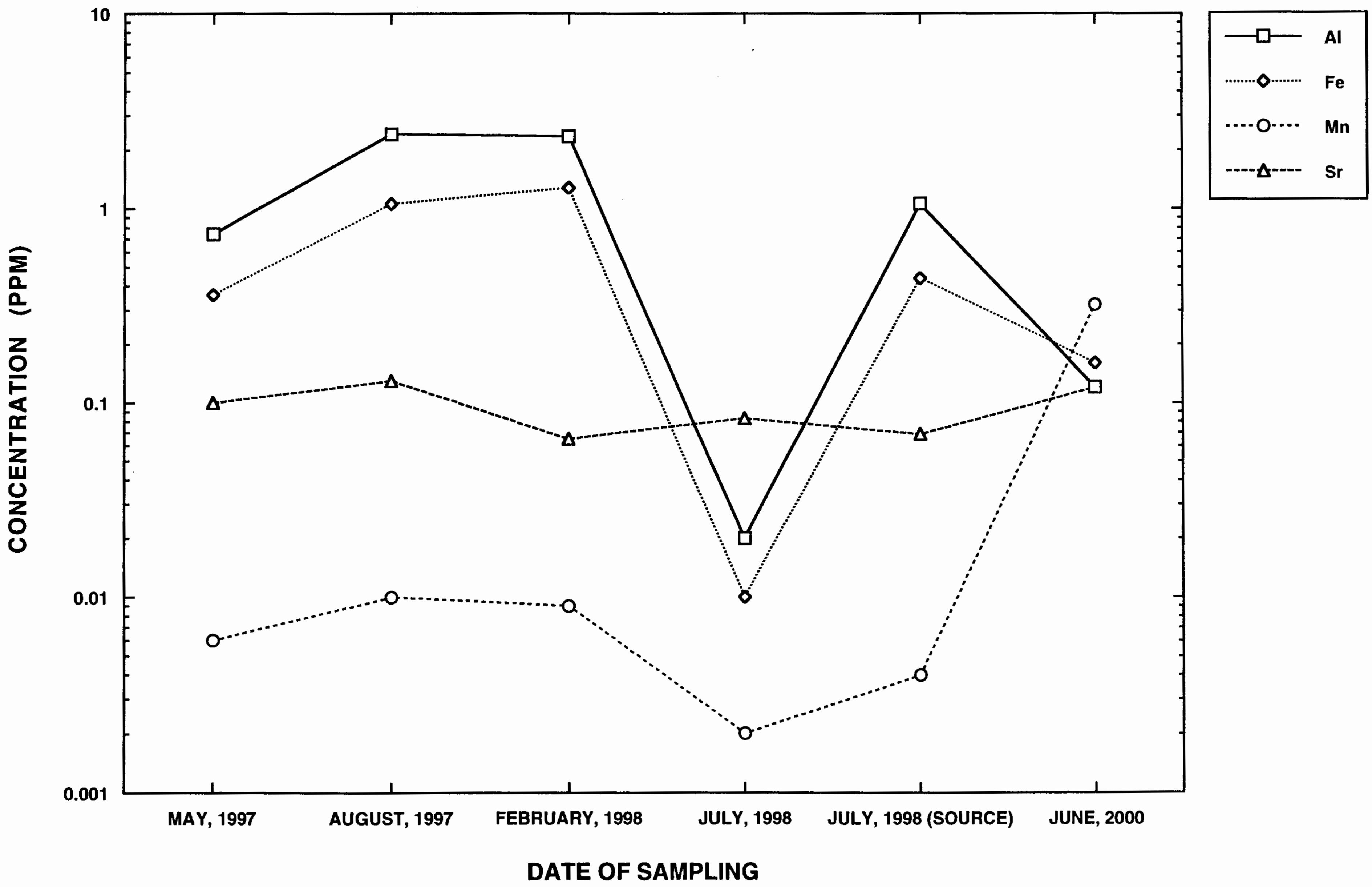
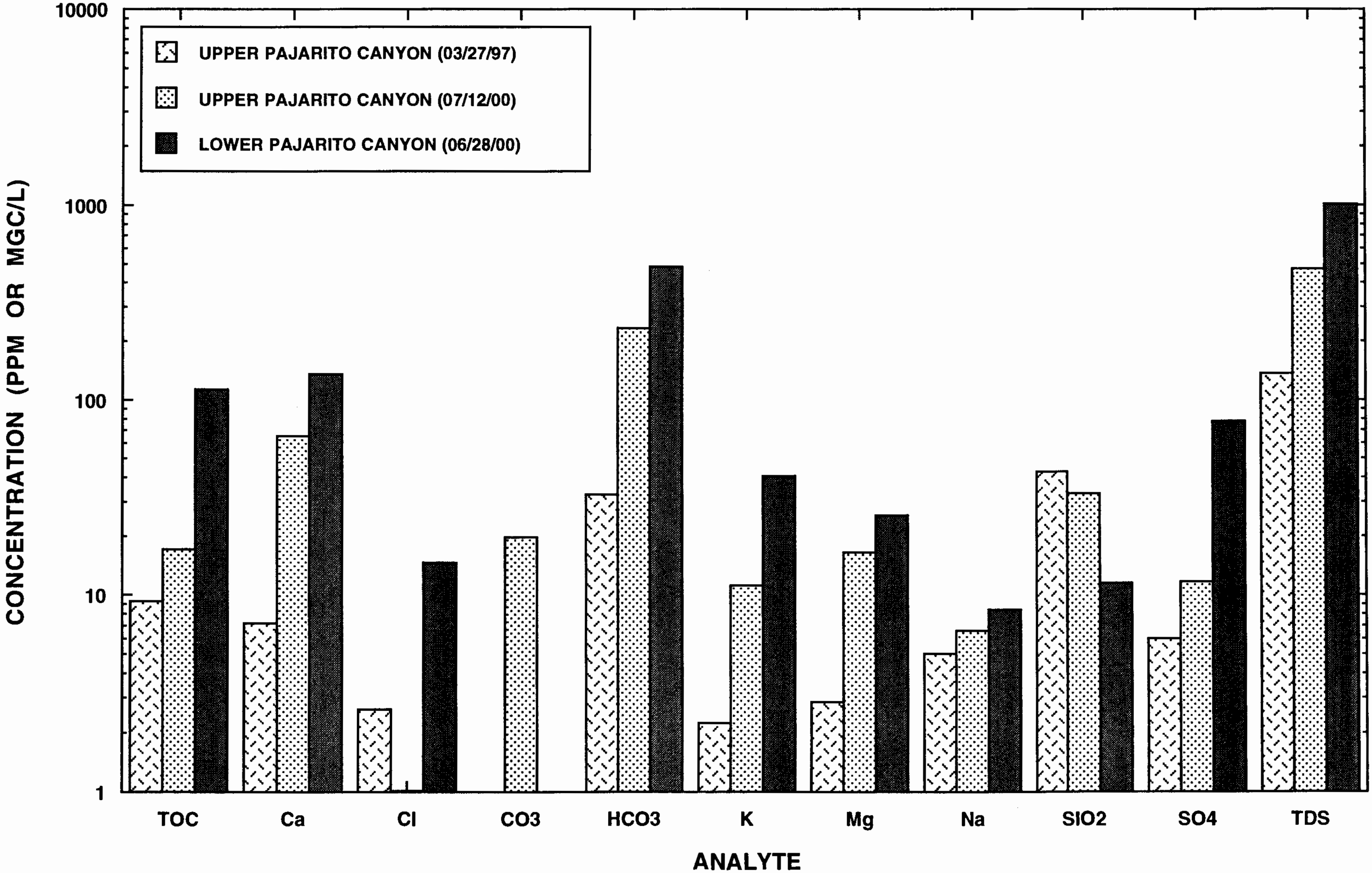


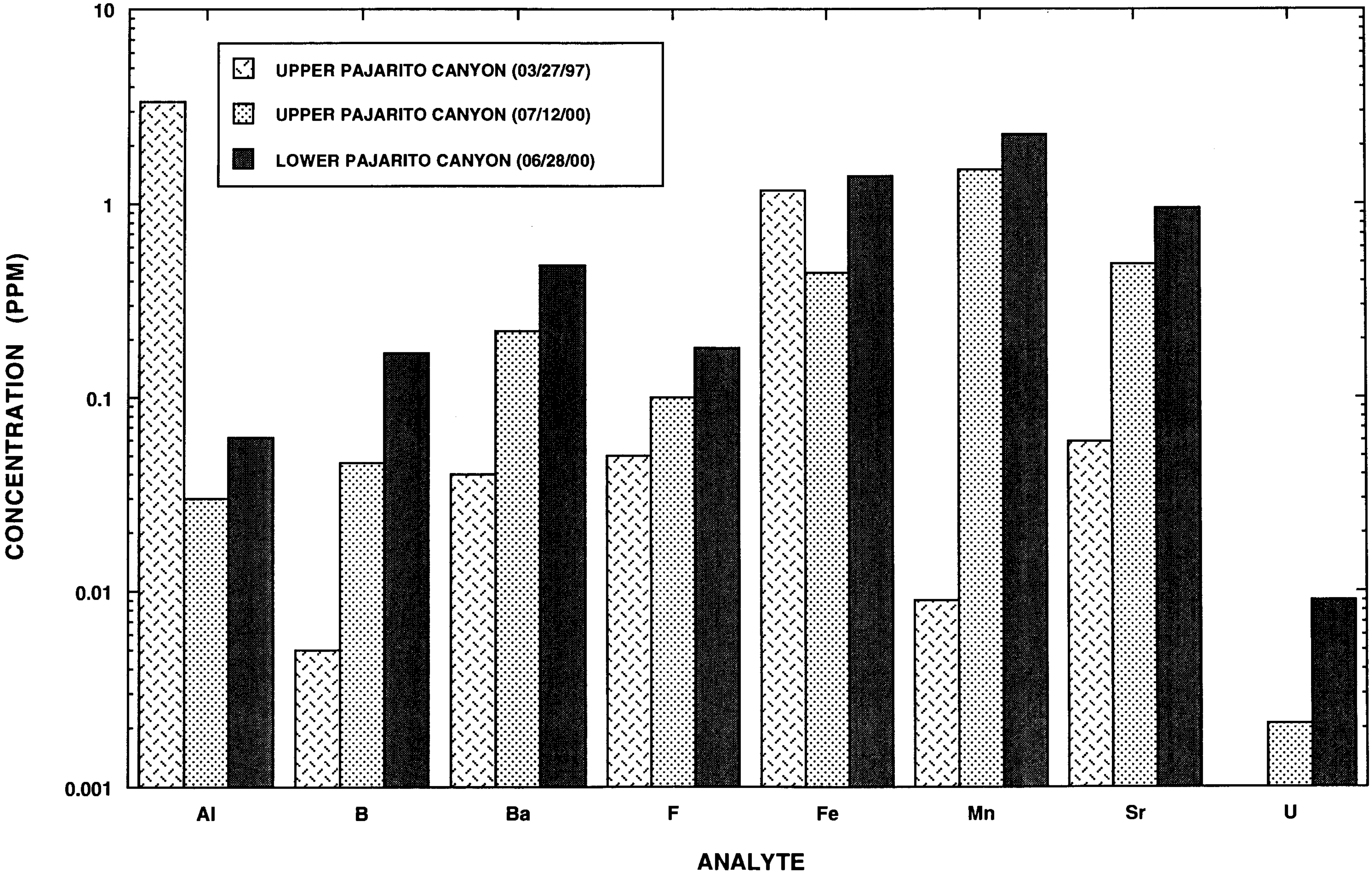
FIGURE 13.1-2. PINE SPRING (PUYE FORMATION AND LAVAS OF POLVADERA GROUP, GARCIA CANYON).

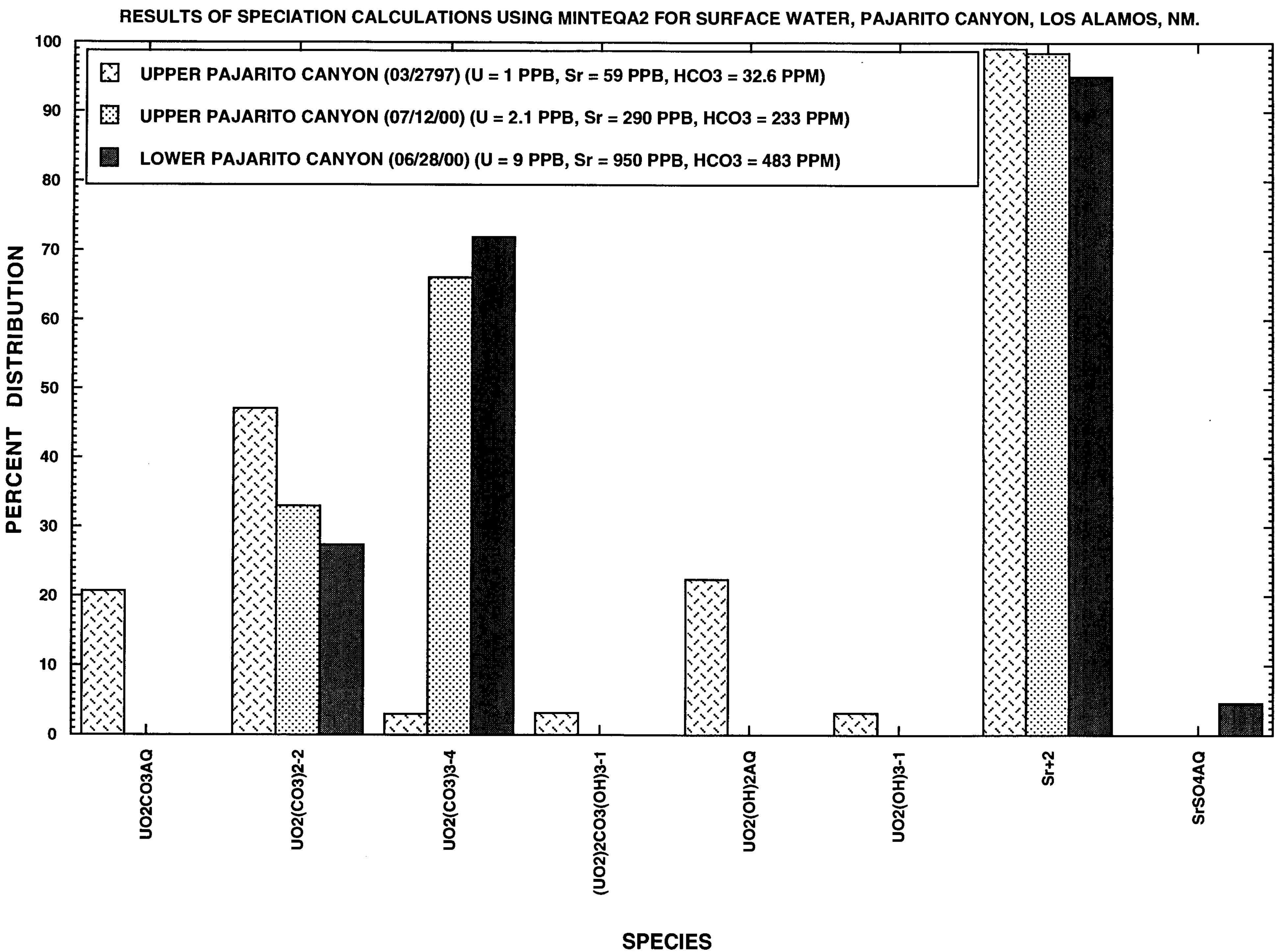


MAJOR ION CHEMISTRY AND TOTAL ORGANIC CARBON FOR PRE-CERRO GRANDE FIRE (03/27/97) AND POST-CERRO GRANDE FIRE (06/28/00 AND 07/12/00), PAJARITO CANYON, LOS ALAMOS, NM.



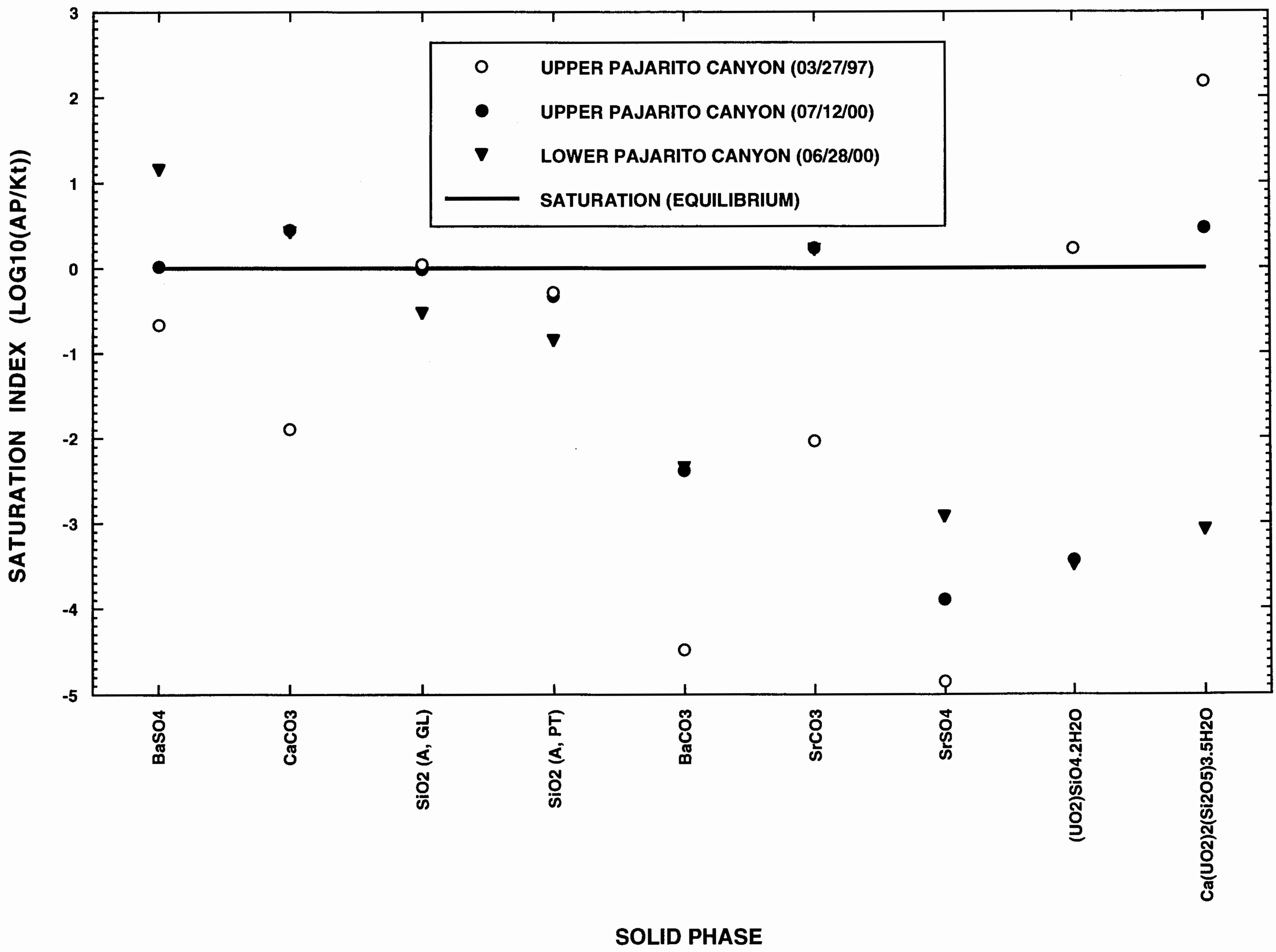
TRACE ELEMENT (SOLUTE) CHEMISTRY FOR PRE-CERRO GRANDE FIRE (03/27/97) AND POST -CERRO GRANDE FIRE (06/28/00 AND 07/12/00), PAJARITO CANYON, LOS ALAMOS, NM.





RESULTS OF SPECIATION CALCULATIONS USING MINTEQA2 FOR SURFACE WATER, PAJARITO CANYON, LOS ALAMOS, NM.
UPPER PAJARITO CANYON (03/2797) (U = 1 PPB, Sr = 59 PPB, HCO3 = 32.6 PPM)
UPPER PAJARITO CANYON (07/12/00) (U = 2.1 PPB, Sr = 290 PPB, HCO3 = 233 PPM)
LOWER PAJARITO CANYON (06/28/00) (U = 9 PPB, Sr = 950 PPB, HCO3 = 483 PPM)
PERCENT DISTRIBUTION
0
10
20
30
40
50
60
70
80
90
100
UO2CO3AQ
UO2(CO3)2-2
UO2(CO3)3-4
(UO2)2CO3(OH)3-1
UO2(OH)2AQ
UO2(OH)3-1
Sr+2
SrSO4AQ
SPECIES

RESULTS OF SATURATION INDEX CALCULATIONS USING MINTEQA2 FOR PAJARITO CANYON, LOS ALAMOS, NM.



Groundwater Integration Team Subcommittee Report
Hydrology

D. Rogers, B. Stone

October 3, 2000

WELL DEVELOPMENT
UNDER THE HYDROGEOLOGIC WORKPLAN

William Stone

DEFINITION

Making a well ready for use by forcing water into and out of the saturated formation through the well screen (and filter pack, if present).

THREE PURPOSES:

1. To remove fines or drilling fluid from behind the screen,
2. To create a stable zone of filtration between the screen and formation and
3. To increase hydraulic conductivity near the well.

DEVELOPMENT METHODS USED TO DATE

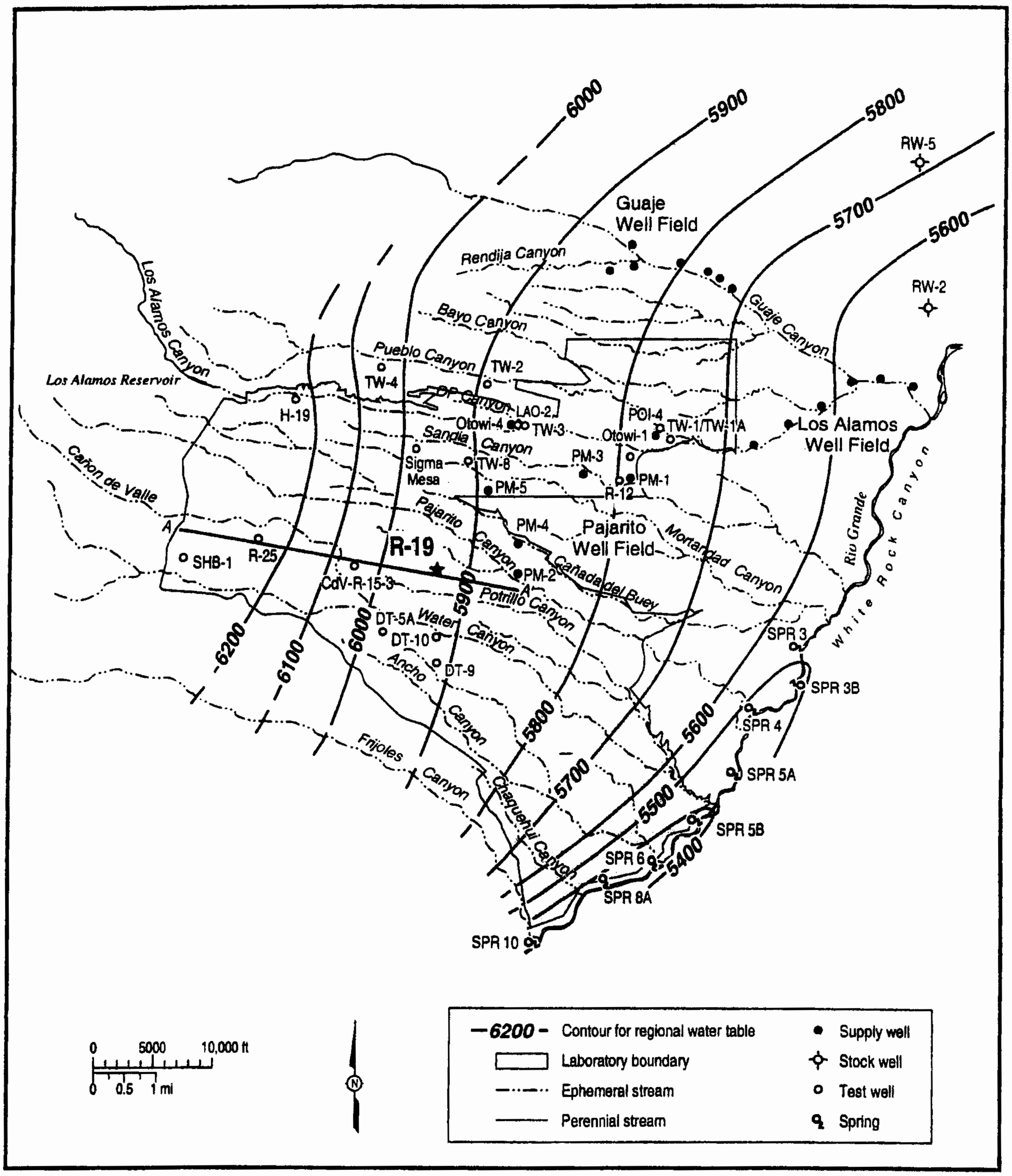
Various combinations of four methods:

Jetting – water flowed *into* screen (by gravity)
Bailing – water mechanically lifted *from* well
Airlifting – water blown *from* well by air pressure
Pumping – water removed *from* well by a submersible pump

A two- or three-stage protocol is formulated from these methods for each well.

COMPARISON OF METHODS

Method	*Advantages*	*Disadvantages*
Jetting		
	Water into formation Screen-specific	Water introduced Must be removed No field parameters Low pressure (ours)
Bailing		
	Field parameters Some surging action	Not screen-specific
Airlifting		
	Field parameters Can surge	Not screen-specific
Pumping		
	Field parameters Can pulse	Not screen-specific



Source: Purtymun 1984, 6513.

F1.0-1 / R-19 WELL COMPLETION RPT / 081200 / PTM

Figure 1.0-1. Locations of well R-19 and line of section for Figure 3.0-2

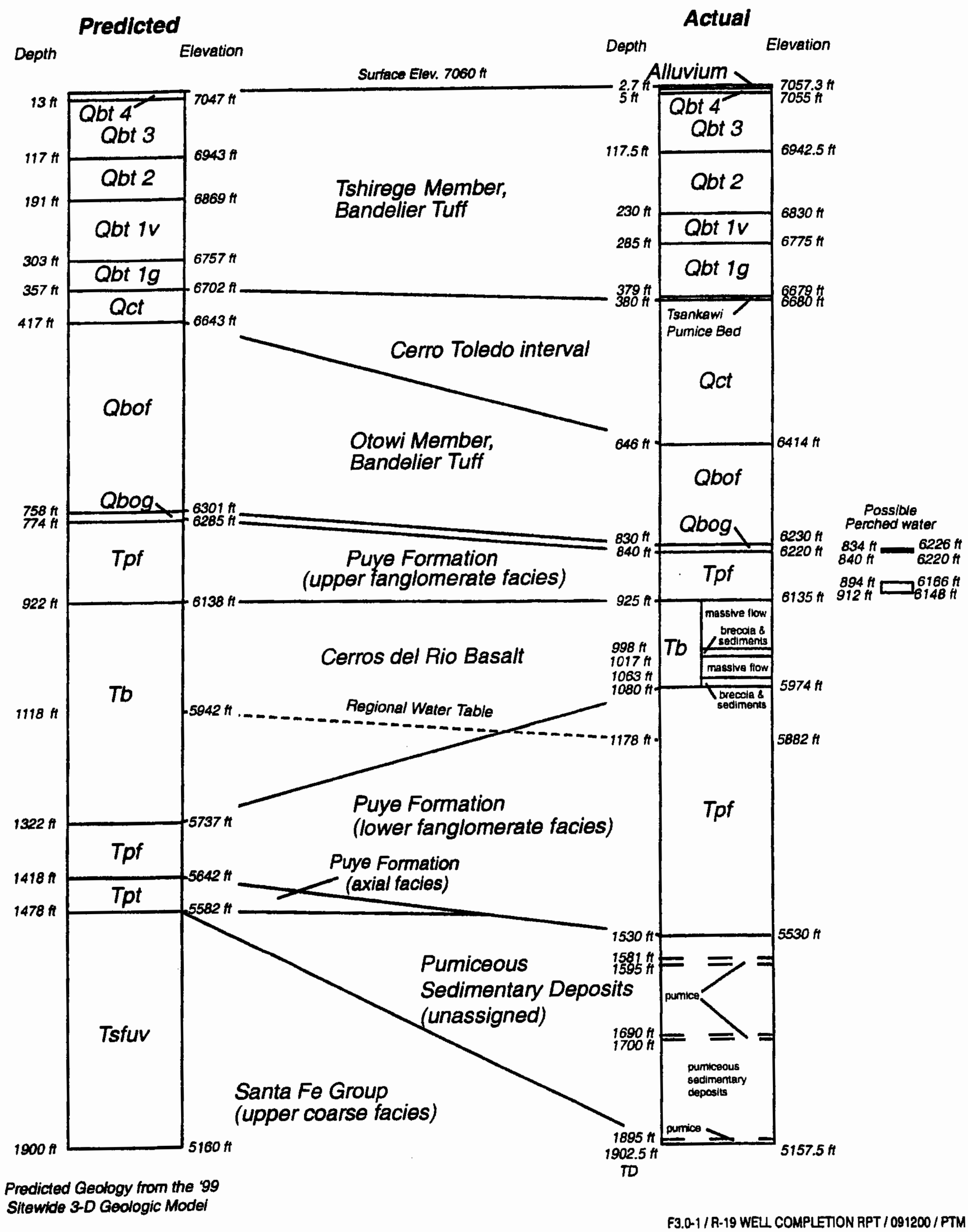
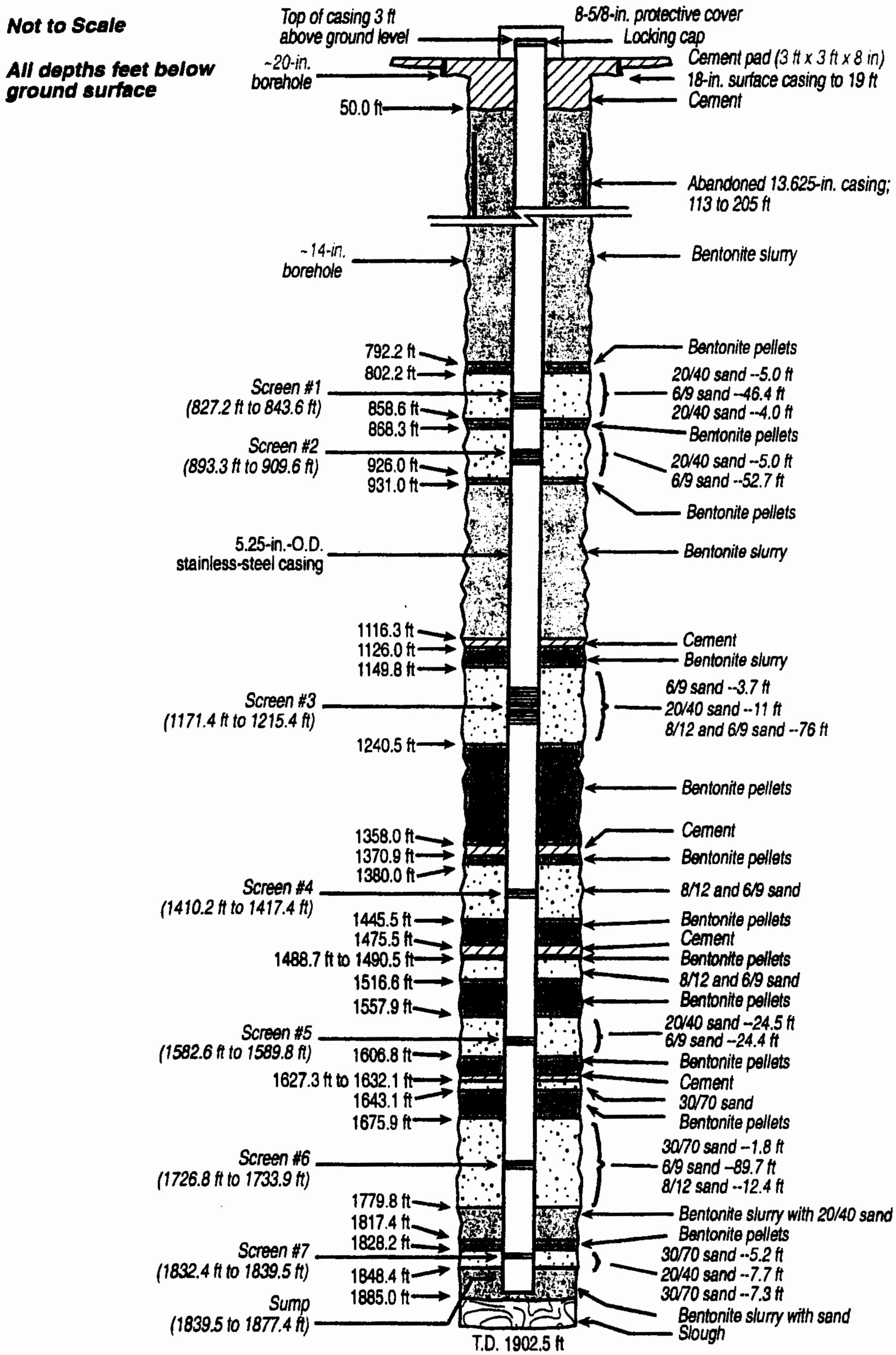


Figure 3.0-1. Comparison of actual and predicted geologic contacts in R-19



Note: The screen intervals list the footages of the pipe perforations, not the tops and bottoms of screen joints.

F8.2-1 / R-19 WELL COMPLETION RPT / 083000 / PTM

Figure 8.2-1. As-built well-completion diagram of well R-19

R-19 Development Procedure

Equipment Required:

pH meter
SC/Temperature meter
Turbidity meter
TOC meter
beakers
TOC bottles

Protocol:

1. Wash/air jet each screen
   start at the top screen and work down
   work each screen for 15 minutes
   no water is discharged, so field parameters cannot be checked

2. Airlift each screen
   collect an initial sample for polymer titration before further development
   collect samples for and check field parameters (pH, SC/Temp, turbidity, TOC) at 15-minute intervals
   continue process until field parameters acceptable or cannot be improved
   go to next screen

3. Pump each screen (with packers?)
   collect sample for and check field parameters at 15-min intervals
   continue process until field parameters acceptable or cannot be improved
   cease pumping for 15 minutes
   then check field parameters again to see if still acceptable
   repeat this (cease/check process) three times
   collect final sample for polymer titration
   go to next screen

Documentation:

Record all times and values for field parameters for each screen in the field book.

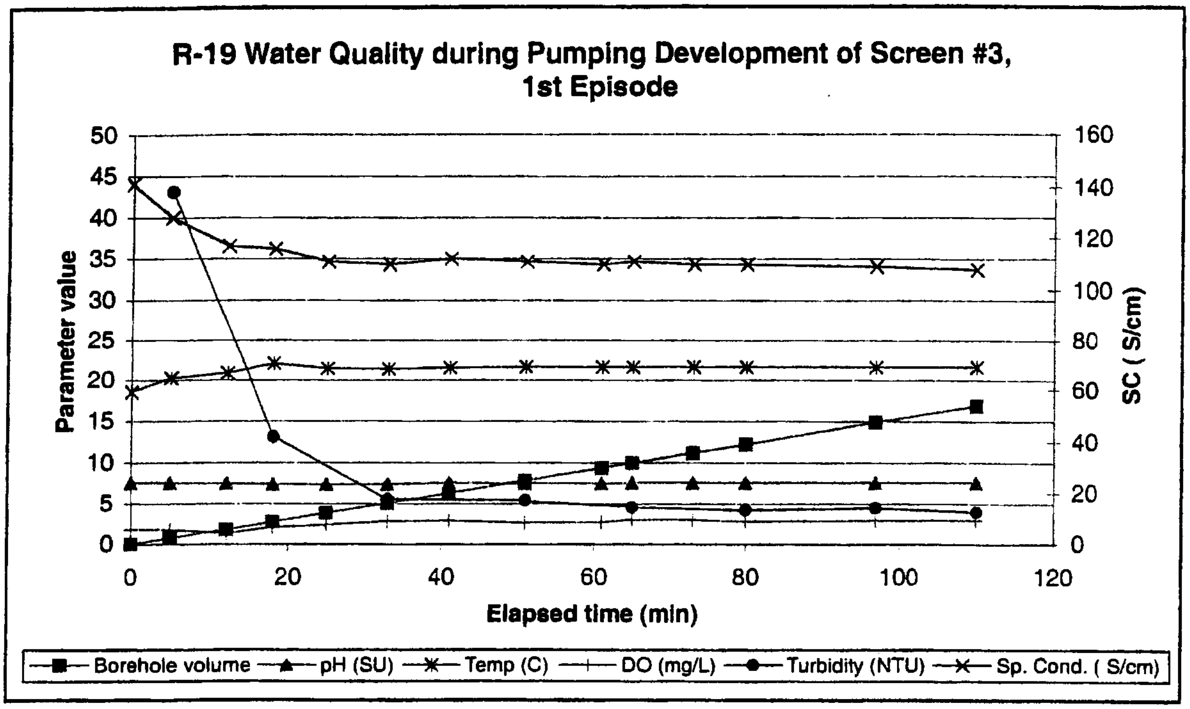
As soon as possible after development is completed, use these records back in the office to prepare tables and graphs of all results for each screen (in electronic form).

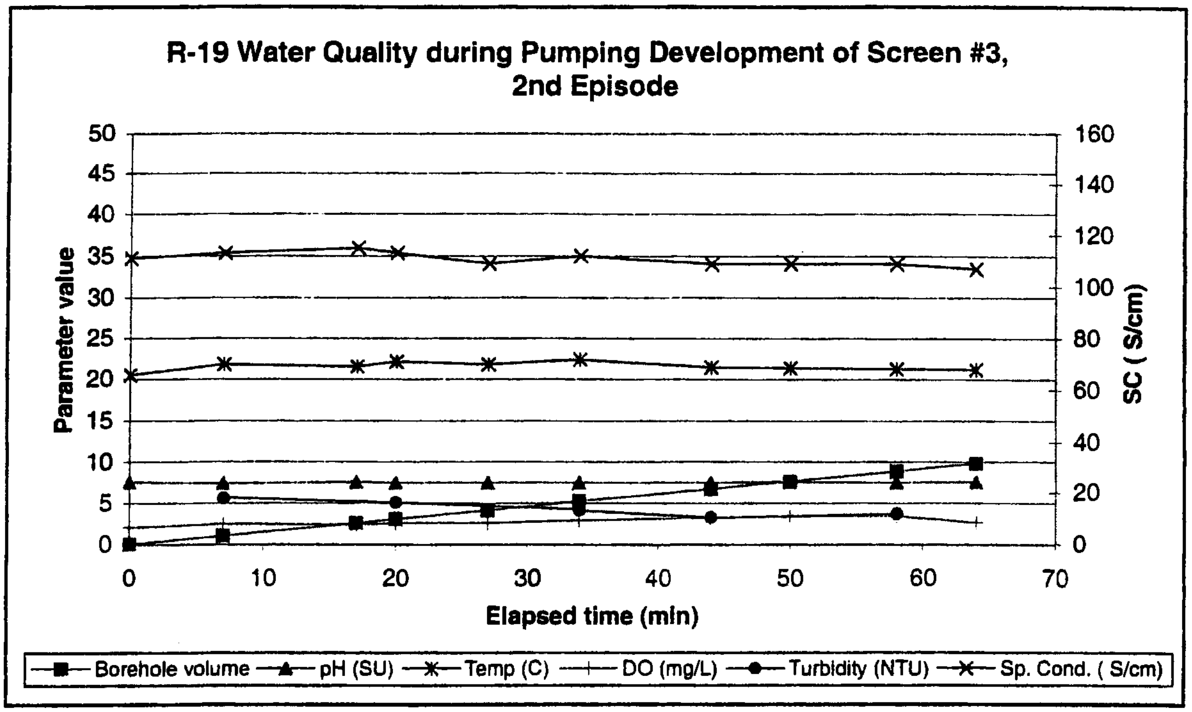
Water Quality Stabilization Record

Project:	R-19 Development Screen #3
Well:	R-19
Date:	6/25/00
Field Personell:	M. Benak, G. Goetz
Field Conditions:	Sunny, Hot
Location:	TA-15
Focus Area:	CA
Signature:	
Calculated Borehole Volume (gal.):	7 (see attached Water Quality Sampling Record)
Three Borehole Volumes Calculated (gal):	21

Date	Time	Elapsed Time (min)	Pump Rate (gpm)	Flow Meter Reading (gal.)	Produced Volume: Gallons	Produced Volume: Borehole volume	Parameter Measurements: pH (SU)	Sp. Cond. (uS/cm)	Temp (C)	DO (mg/L)	Turbidity (NTU)	Comments
6/25/00	6:45	0	0.25		0	0.0						Airlift start
	7:00	15	0.25		3.75	0.2	7.86	130	17.60		45.40	Flow to surface
	7:30	45	0.25		11.25	0.5	7.80	118	20.60		69.20	Collected initial samples
	7:50	65	0.25		16.25	0.8	7.77	121	20.30		39.50	
	8:20	95	0.25		23.75	1.1	7.79	117	20.00		53.60	
	8:45	110	0.25		27.5	1.3	7.83	117	19.30		37.70	
	9:05	130	0.25		32.5	1.5	7.87	119	20.80		24.70	
	9:20	145	0.25		36.25	1.7	7.77	117	21.10		20.70	
	9:35	160	0.25		40	1.9	7.89	113	20.20		18.90	
	9:50	175	0.25		43.75	2.1	7.82	116	20.20		18.50	
	10:05	190	0.25		47.5	2.3	7.87	117	20.50		30.10	
	10:20	205	0.25		51.25	2.4	7.89	116	20.80		30.50	
	10:35	220	0.25		55	2.6	7.98	120	21.00		28.20	
	10:50	235	0.25		58.75	2.8	7.97	116	21.40		25.80	
	11:20	265	0.25		66.25	3.2	8.01	118	21.50		21.90	
	11:50	295	0.25		73.75	3.5	7.97	119	21.80		22.50	
	12:20	325	0.25		81.25	3.9	7.92	119	21.50		20.20	
	12:50	355	0.25		88.75	4.2	7.95	116	21.70		12.90	collected final samples
	13:00	365	0.25		91.25	4.3						shut down compressor

Comments:
Airlift flow rate approximate





F8.3-1 / R-19 WELL COMPLETION RPT / 091200 / PTM

Figure 8.3-1. Results of final development (pumping) for screen #3

Summary of Final (Pumping) Phase of Development at R-19

Screen #	Elapsed Time (min)	Range of Field Parameters[a]				
		Water Produced/Rate (gpm)	pH	Specific Conductance (uS/cm)	Temperature (C)	Turbidity (NTU)
3	365	91.25 (0.25)	7.86–7.95	130–116	17.6–21.7	45.40–12.90
4	235	1175 (5)	N.A.[b]	117–109	19.4–221.1	62.25–4.64
5	350	3500 (10)	6.85–7.72	130–122	17.8–20.8	47.40–4.61
6	240	2400 (10)	7.76–7.94	126–127	21.10–20.60	142.10–5.09
7	275	5050 (15–20)	7.46–8.09	125–126	17.9–21.6	27.00–4.90

[a] Values at beginning and end of development; intermediate values may be higher than at beginning.

[b] N.A. = not available.

DEVELOPMENT PROBLEMS/RECOMMENDATIONS

PROBLEM 1

Development should induce flow not only out of but also into the screened interval, but available methods provide for little or no flow into the formation and are not that aggressive.

Recommendation – The feasibility of surging (with the block on rods not wireline), swabbing (surging plus flushing) or pressure jetting should be investigated.

PROBLEM 2

Available development methods are not screen-specific.

Recommendation – use methods that are more screen specific (surging, swabbing, pumping between packers).

If off-the-shelf assemblies with a pump between two packers are not compatible with current well design, redesign the wells or construct such equipment in-house.

PROBLEM 3

Pipe base screen is strong, but provides a tortuous path for water in development (and testing).

Recommendation –evaluate use of alternative styles.

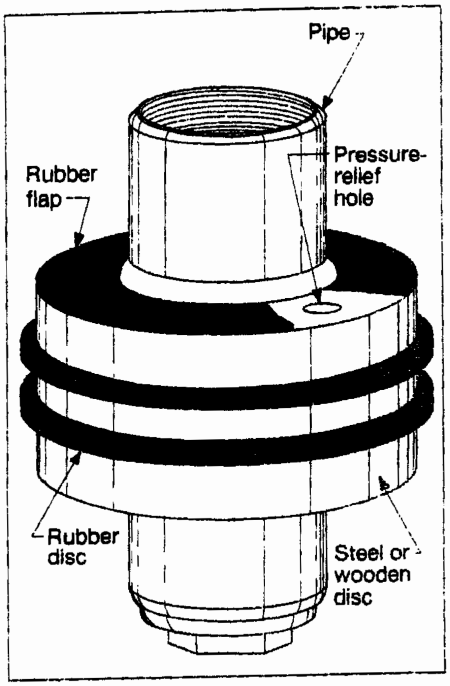


Figure 15.6. Typical surge block consisting of two leather or rubber discs sandwiched between three steel or wooden discs. The blocks are constructed so that the outside diameter of the rubber lips is equal to the inside diameter of the screen. The solid part of the block is 1 in (25.4 mm) smaller in diameter than the screen.

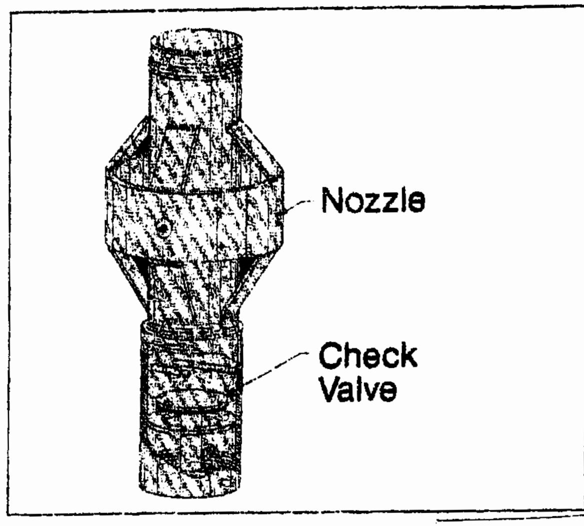


Figure 15.17. Four-nozzle jetting tool

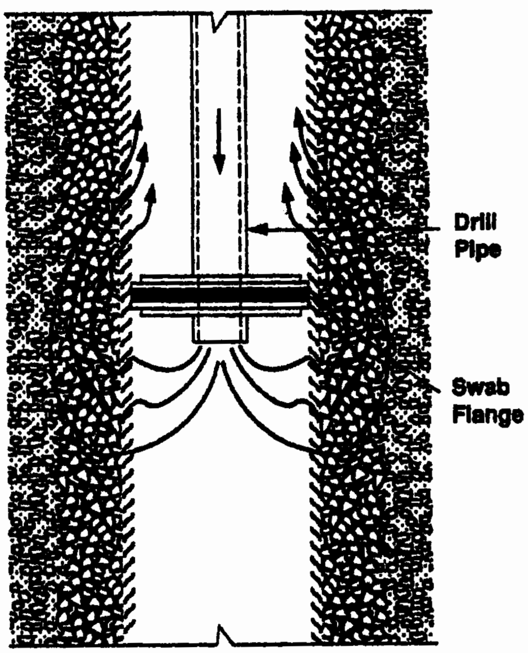


Figure 14.1. Single-swab development.

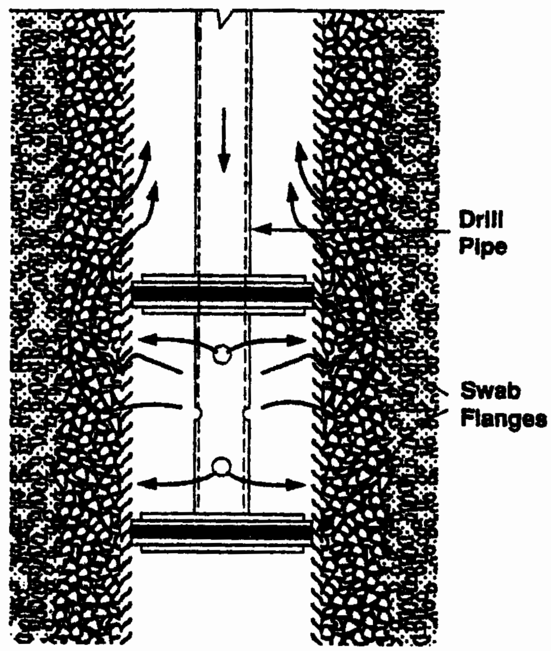


Figure 14.2. Double-flanged swab without bypass.

PROBLEM 4

When hydrologic testing (after development) indicates poor performance of a screened interval, is it simply due to low permeability or might improper well construction or incomplete well development be to blame?

Recommendation – avoid placing screens in low permeability zones by utilizing all available geologic, geophysical and hydrologic observations.

Facilitate proper well construction by making accurate pipe tallies and possibly enlarging the size of the hole, annulus and tremie to permit more confident placement of annular fill.

Assure complete development by allotting adequate time to do it and using sufficiently vigorous methods.

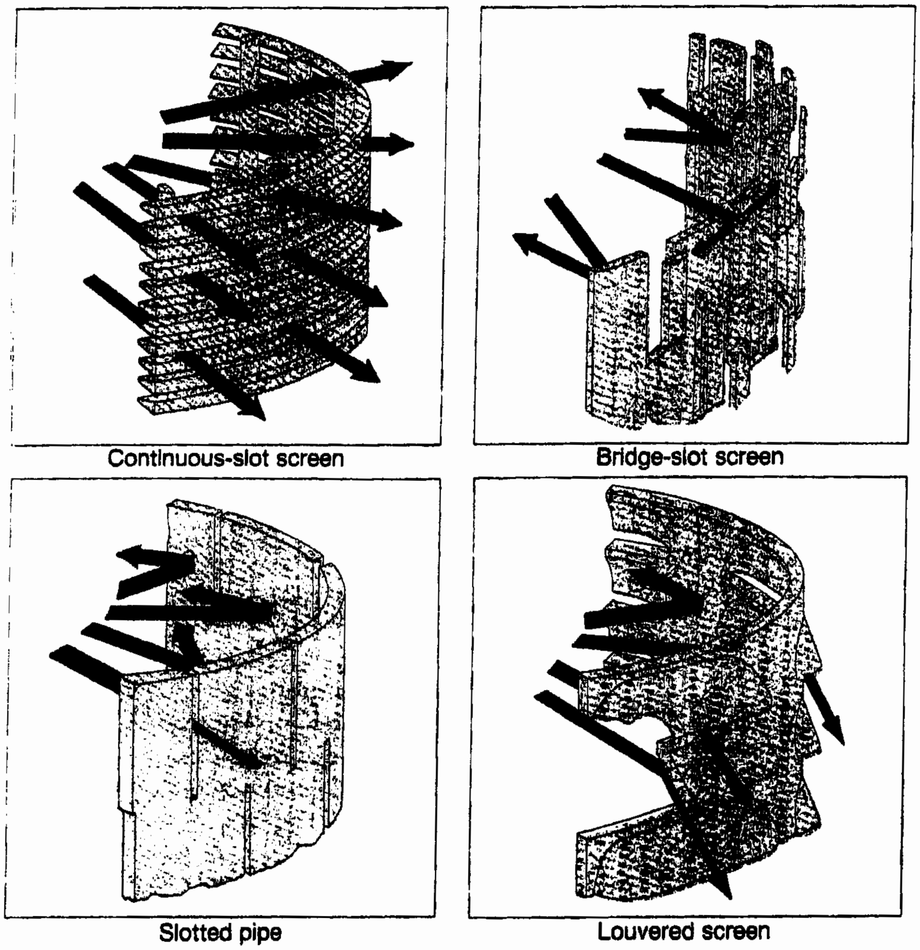


Figure 15.18. The open area of the screen and the configuration of the slot openings are important factors controlling the effectiveness of development procedures using water jetting.

GIT Subcommittee Report
Modeling

Bruce A. Robinson

Earth and Environmental Sciences Division

Los Alamos National Laboratory

Topics of Discussion

- Responses to EAG Comments
- Modeling Accomplishments
  - Regional Aquifer
  - MDAs and Canyons
  - TA-16 HE Transport Modeling
  - Post-Fire Refocusing

Responses to EAG Comments

EAG Comment	Action Plan
Links between hydrologic modeling and water quality data base less well established	Progress is occurring in this area – at this meeting with the EAG we are providing a modeling demonstration to clarify the links between the modeling and the data bases.
It is difficult to evaluate the appropriateness, effectiveness, adequacy, and efficiency of the modeling studies from the brief summaries given	To provide more detail, we will distribute our written reports to some or all members of the EAG when the documents are approved for distribution.
EAG should be provided with the modeling plan so that they can provide input at the planning stage	This is being done, and we will present the plan at this meeting.
Clarify how the modeling results are being relied on to make decisions, and how modeling interfaces with the DQO process	This linkage will be covered in our modeling reports, and a detailed presentation on one model is at this meeting that will demonstrate the approach taken in general.
Los Alamos Canyon model – goals should be clarified and ties made to the DQOs	This will be presented in the detailed modeling presentation at this meeting.
TA-50 Water Injection Test model – EAG questioned the need for more modeling (discrete fracture and dual permeability) given the positive results obtained from the initial modeling	Any new modeling will be limited in scope and designed to bolster the conclusions already obtained.
Geochemical modeling – significant progress, but EAG suggests a brief synthesis report to pull together the data and other information	Preparation of a synthesis report is under consideration.

Overview of the Modeling Plan

- The writeup replaces the original chapter in the Workplan
- The new plan is more detailed and comprehensive
- Schedules are provided for most tasks

Modeling Accomplishments

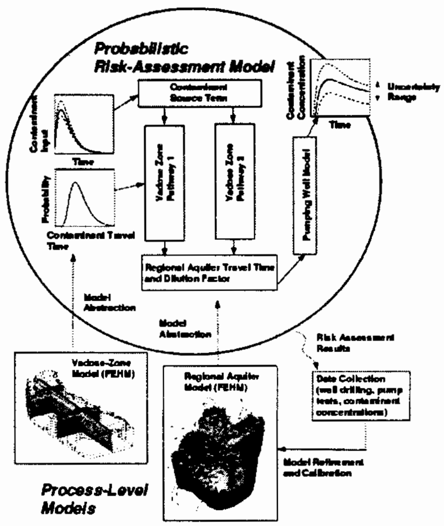
Regional Aquifer Model

- Pump test simulations and recommendations for the siting of R-5
- 2D simulations of stable isotope transport
- Initial modeling of major ion chemistry as influenced by advection, dispersion, and mineral weathering reactions
- Interpretations of permeability data
  - correlation to long term aquifer water level response to pumping
  - Relation between permeability data and geologic model
- Simulation results for HE transport from TA-16 - ongoing

Modeling Accomplishments
MDA and Canyons

- Report on vapor-phase organic transport at MDA L completed (Stauffer et al., 2000, LA-UR-00-2080)
  - model construction and calibration
  - model predictions and recommendations
- Los Alamos Canyon
  - 2D and 3D Los Alamos Canyon updated flow models completed
  - Source term data on U and Sr compiled, geochemical modeling performed
  - Initial three-dimensional transport simulations completed
- HE Transport from TA-16

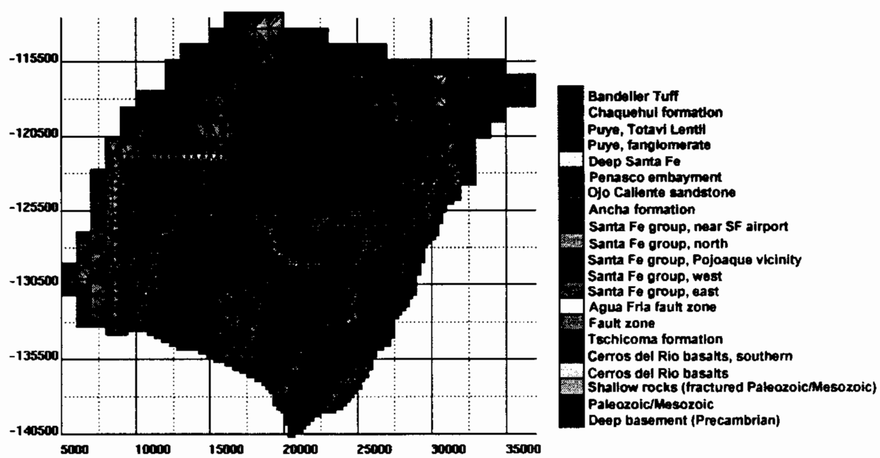
Probabilistic Approach for Groundwater Risk Assessment



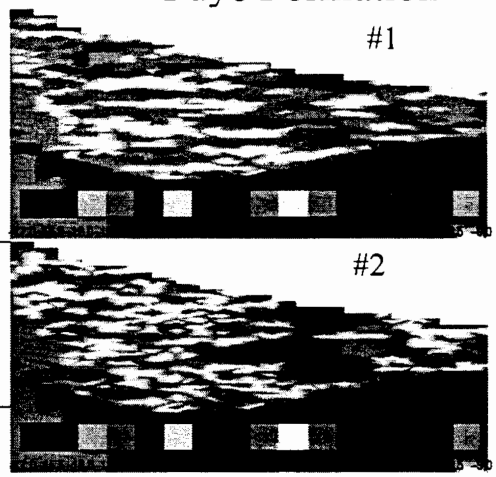
HE Migration From TA-16

- Probabilistic risk assessment approach accompanied by process-level models
- Process Models
  - 3D vadose zone model understand HE transport to the regional aquifer
  - Transport model for the regional aquifer
- Risk assessment model - GoldSim
  - Source term
  - Simplified vadose zone and regional aquifer models
  - Pumping well for estimating risk of contamination and uncertainty

Regional Aquifer Geology and Refined Grid for Transport Calculations



Heterogeneous Property Distributions for the Puye Formation



Post-Fire Refocusing of ER Groundwater Modeling

- Los Alamos Canyon modeling effort has been refocused to address fire-related issues
  - Modeling of ponded conditions in the canyon bottom
  - Influence of temporary high infiltration events due to flooding
  - Surface contaminant redistribution and the impact on subsurface migration
  - Geochemical effects on transport
- Modeling team has participated in planning sessions for possible field efforts
  - Post-fire, pre-flooding measurements of subsurface contaminant profiles
  - Initial planning of instrumented infiltration measurement site

Draft Hydrogeologic Workplan Section 3 Revision: Modeling

Charles Nylander
Program Manager
ESH-18

Background

- NMED sent a letter requesting information on groundwater modeling (3/27/00)
- Request discussed at the EAG/Managers session at the Annual Meeting (3/30/00)
- Format of deliverable, revision to existing work plan chapter determined at meeting with LANL, DOE, NMED (4/26/00)
- Draft Section 3 Hydrogeologic Workplan revision submitted

Hydrogeologic Workplan - Section 3

- Information Management and Interpretation
- Hydrogeologic Characterization and Information Management
  - Water Quality Database
  - ER Database
- Hydrogeologic Workplan Modeling Tasks
  - Geologic Data Model
  - Geochemical Model
  - Groundwater Process Models

Modeling Tasks - Introduction

- Groundwater models used to assimilate and interpret data
- Useful for siting and prioritizing wells
- Necessary to accomplish goal of HWP: understand hydrogeologic setting
- Geologic Data Model and Geochemical Model support vadose zone and regional aquifer process models
- Coupled systems model to integrate in probabilistic framework

Geologic Data Model

- 3-D interpretation of geology in the LANL region
- Provides continuous surfaces from discrete data points
- Based on conceptual model of geologic processes, geologic expertise, and numerical procedures
- Updated yearly to incorporate new data

Geochemical Model

- Geochemical modeling to interpret observed trends in groundwater chemistry
- Geochemical conceptual model developed
- Analytical geochemical computer codes used with collected data to test and refine conceptual model
- Determine sources of recharge and quantify geochemical processes along pathways

Groundwater Process Models

- Suite of numerical simulations of subsurface flow and transport
- Based on complex mechanisms of fluid flow and solute advection, dispersion, and chemical reaction.
- Reproduces available hydrologic, geochemical, and contaminant data
- Code: Finite Element Heat and Mass (FEHM)

Vadose Zone Process Model

- Modeled processes: capillary suction, gravity-driven flow, diffusion, and dispersion
- Inputs: stratigraphy, boundary conditions, hydrologic properties
- Calibrated by comparing predicted fluid saturation to measured moisture content

Regional Aquifer Model

- Most important inputs: hydrologic properties, recharge, withdrawal
- Outputs: head distribution, fluxes to Rio Grande, pathways and velocities
- Calibrate to measured water levels and outflow to Rio Grande

Coupled Systems Model

- Couples surface water infiltration, vadose zone and regional aquifer flow and transport processes
- Using GoldSim, a probabilistic code
- Framework for incorporating uncertainties
- Outputs are in probability distributions of multiple possible values with different probabilities of occurrence

Schedule: Vadose Zone

Model	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06
Vadose Zone	Develop LA Canyon model Update MDA G model Complete MDA AB model Determine approach for intermediate saturated zone model	Update LA Canyon model Complete MDA L model Initiate TA-16 model Develop approach for infiltration model	Develop Mortandad Canyon model Evaluate models with new data; update models as necessary Refine TA-16 model	Link canyon and MDA models to regional model Evaluate models with new data; update models as necessary Apply canyons model to priority aggregates Apply MDA model to priority MDAs	Evaluate models with new data; update models as necessary Couple contaminant transport results with to regional-aquifer model			

Schedule: Regional Aquifer

Model	FY99	FY00	FY01	FY02	FY03	FY04	FY05	FY06
Regional Aquifer	*On annual basis:* 1. Recalibrate regional model using new data collected during drilling 2. Use model/data comparisons to re-evaluate conceptual model 3. Provide modeling support to well siting decisions 4. Provide contaminant transport simulations, if requested, to address unexpected issues of concern					Final model update/calibration; pathway analysis		
	Preliminary steady-state and transient model development and calibration	Incorporate water chemistry data in flow calibration; develop facies model for permeability heterogeneity	Implement probabilistic capabilities; Determine impact of local recharge on pathways and travel times		Evaluate future water quality and quantity in regional aquifer	Final model update/calibration; pathway analysis	Preliminary monitoring well network design	
			Design two-well forced-gradient tracer test	Evaluate tracer test data; incorporate results into model				

Schedule: Coupled Systems Model

Model	FY99	FY00	FY01	FY02	FY03
Coupled System	Abstract MDA G process models to RIP	Abstract MDA G and MDA L (mesa) process models into GoldSim	Complete sensitivity and uncertainty analysis of GoldSim mesa model Abstract LA Canyon and Mortandad (canyon) vadose zone model into GoldSim Complete sensitivity and uncertainty analysis of GoldSim canyon model	Couple abstracted regional aquifer model into GoldSim canyon and mesa models Complete sensitivity and uncertainty analysis of coupled GoldSim model	Calculate cumulative plume impacts for priority aggregates using GoldSim

Detailed Description of the Los Alamos Canyon Flow and Transport Model

Presentation to External Advisory Group
October 3, 2000

Bruce Robinson

Bill Carey

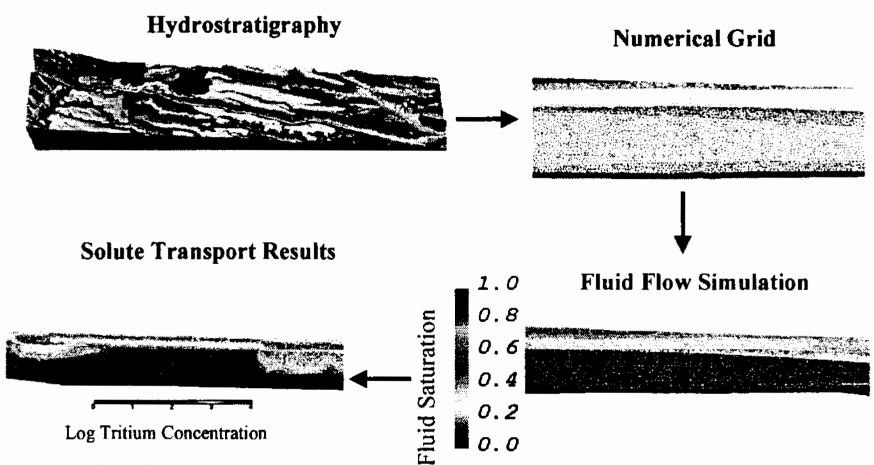
Earth and Environmental Sciences Division

Los Alamos National Laboratory

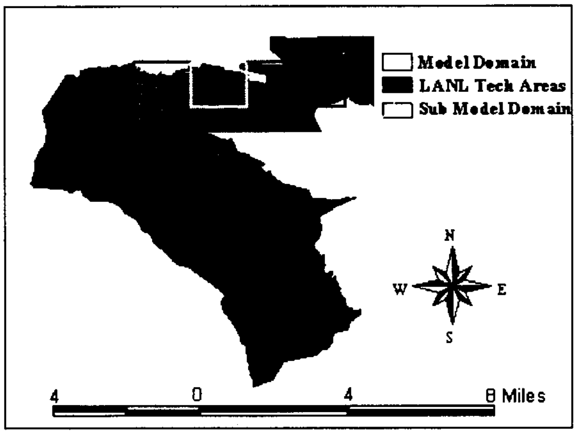
Outline

- Description of model-building process
- Geologic model description
- Grid generation
- Data sources
- Model calibration
- Tritium transport
- Impact of Cerro Grande fire

Modeling Approach



Outline of Los Alamos Canyon Models



environmental restoration project

LA Canyon 2000
(3)

Los Alamos
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Site-wide Geologic Model for Los Alamos National Laboratory

- A 3-dimensional model of the geology in the Los Alamos area covering 138 square miles
- Provides geology at the surface, the water table, and at depth for an area bounded by
  - the Pajarito fault zone to the west
  - the Rio Grande to the east
  - the Guaje Canyon to the north
  - and Frijoles Canyon to the south
- The geologic model supports drilling efforts, hydrologic modeling, and contaminant transport modeling

environmental restoration project

LA Canyon 2000
(4)

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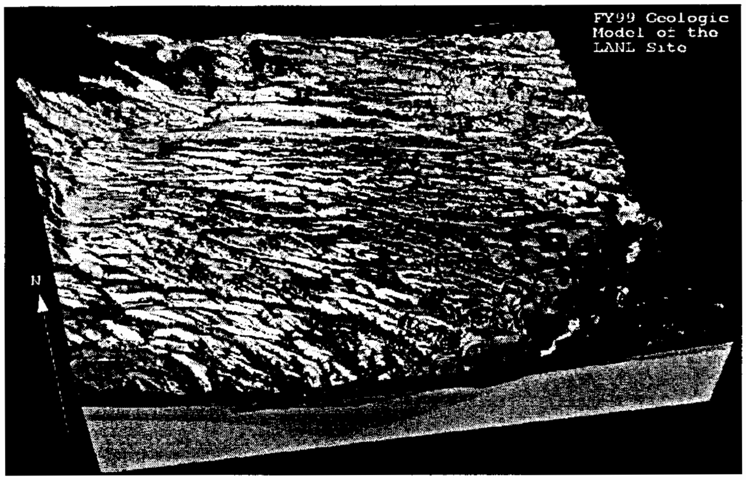
FY99 Geologic Model of the LANL Site



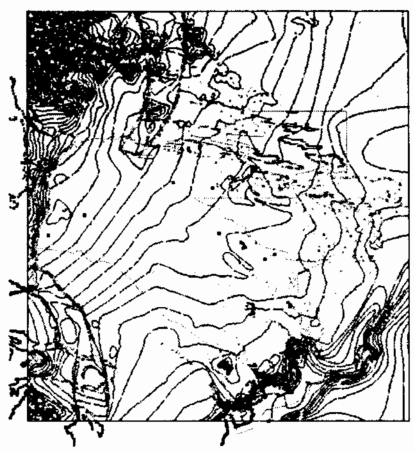
Construction of the Geologic Model

- Integration of 4 elements:
  - Source data
  - Conceptual model
  - Application of geologic expertise
  - Numerical modeling
- Source data
  - Well data
  - Total station survey data
  - LANL geologic mapping
  - Published geologic maps

Construction (cont.)

- Source data (cont.)
  - ~50,000 data values covering 20 geologic units
  - All data are subject to a qualification process
  - Data integrity are maintained in an Oracle database and organized by fiscal year
- Conceptual model
  - The geologic model incorporates a conceptual model of the tectonic (volcanism, faulting) and geomorphologic (alluvial fans, fossil river channels, etc.) events that shape the thickness and extent of geologic units

Source Data for the Base of the Tshirege Member, Bandelier Tuff

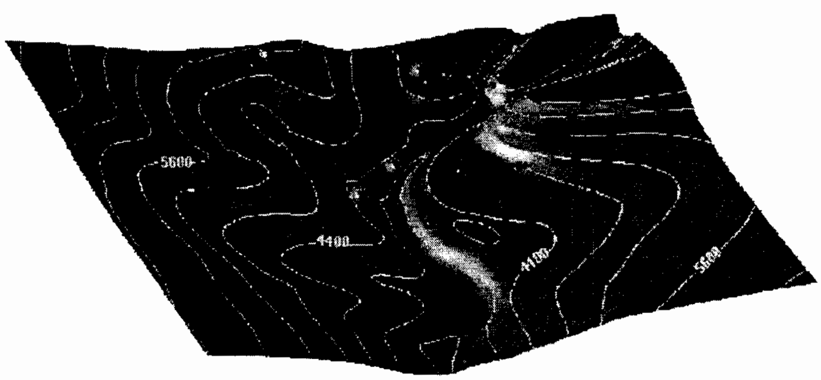


abtt basal elevations (fv00) Seuto

Construction (cont.)

- Application of geologic expertise
  - Geologists use the conceptual model to guide the creation of the geologic units
  - For example, knowledge of the existence of a paleo-canyon can be used to shape the expected thickness of a lava flow
- Numerical modeling
  - All of the elements are incorporated into a numerical model that produces the final 3-dimensional geologic model
  - 2-dimensional data sources (e.g., map data) are converted to 3-dimensional data using digital elevation models
  - The primary numerical tools are gridding processes used in the commercial GIS system, Arc/Info

The Base of the Los Alamos Aquifer Unit



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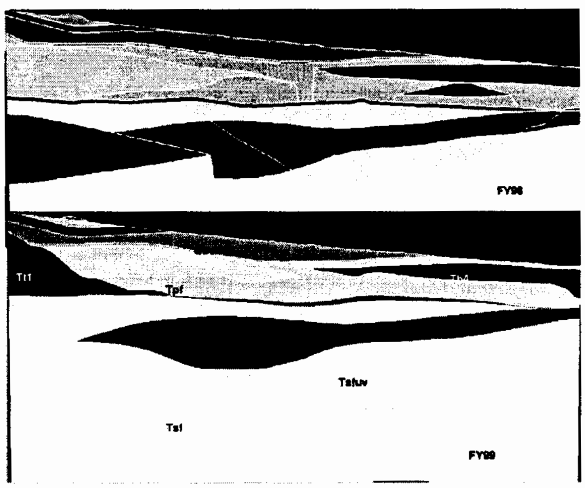
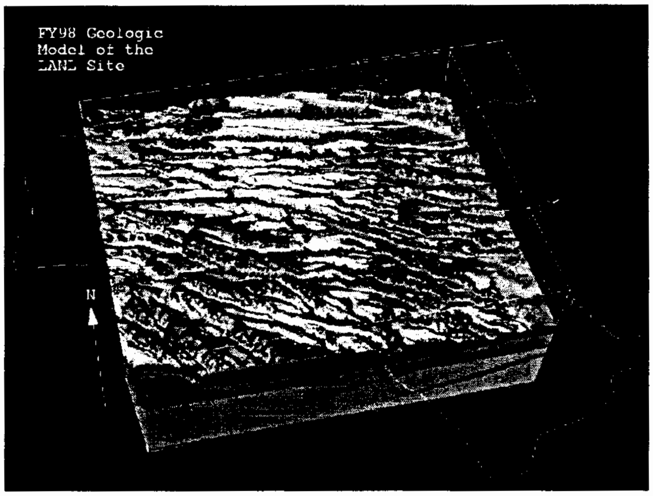
Geologic Model Maintenance

- Each year, the model is updated with new well data and geologic mapping and is modified by improvements in the conceptual model for the region
- All versions of the model and supporting data are stored and archived at LANL with the Facility for Information and Data Management (FIMAD)

Cross-sections from the FY98 and FY99 Models of LA Canyon



FY98 Geologic Model of the LANL Site



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LA Canyon 2000
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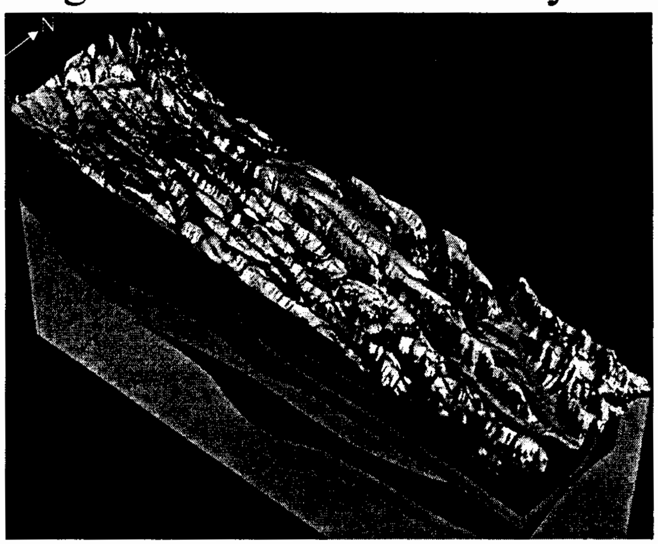
Geologic Model of the LA Canyon Area



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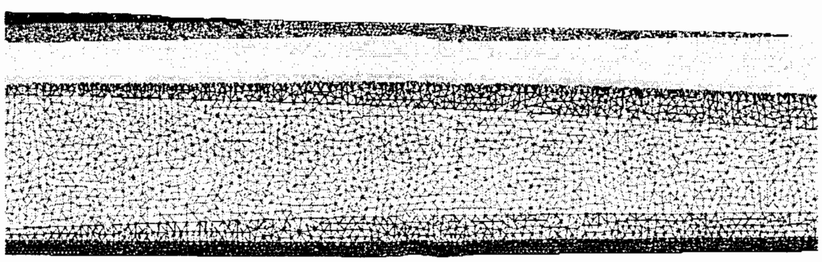
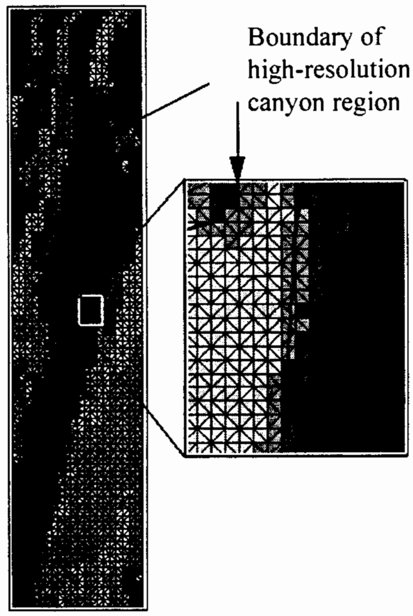
Well Data in the LA Canyon Area

Los Alamos Canyon 2D Numerical Grid



- Hydrostratigraphic model is converted directly to a numerical grid
- LANL software is used to generate grids suitable for flow and transport calculations
- 2D and 3D grids were used in the development of the flow model

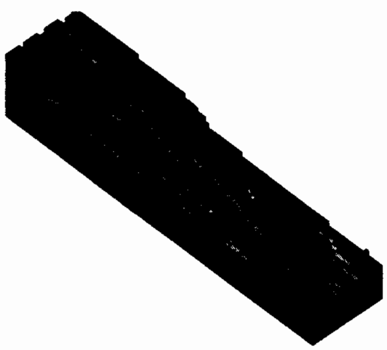
Plan View of 3D Grid



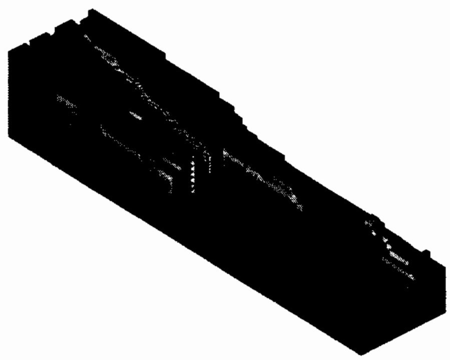
340,415 nodes
1,910,348 elements

3D Grid of Los Alamos Canyon

Full View



Cut-away View



Data Sources for Vadose Zone Model

- Boundary Conditions
  - Infiltration - Gray (1997) water budget provides constraints, uncertainty is explored through sensitivity studies
- Hydrologic Properties
  - Geologic model is the basis for populating the model with hydrologic properties
  - Unsaturated hydrologic property data are taken from compilations of historic data sets (e.g. Rogers and Gallaher, 1995) augmented by recent data
- Contaminant Data
  - Records of historic releases and measurements in alluvial goundwater

Numerical models enter into the assignment of properties and infiltration rates through the iterative process of simulation, comparison to data, and revision of the range of possible results

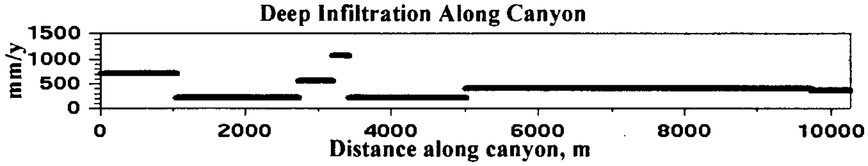
Synthesis of Water Budget Studies

Gray (1997) prepared a water budget analysis for Los Alamos canyon during 1993-1995 based on the following data sets:

- precipitation and snowpack measurements
- streamflow discharge
- Latent heat energy measurements (for ET estimates)
- Head measurements in alluvial aquifer wells

$$I = P - R - ET + \Delta S$$

Los Alamos Canyon Fluid Infiltration Boundary Condition

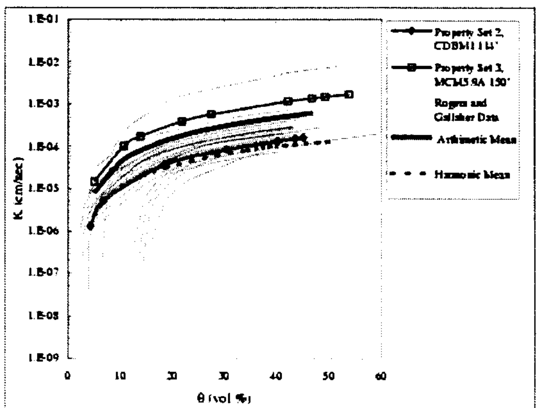


From Gray (1997)

Mesas: estimates range from <0.01 mm/y (Area G) to 1 mm/y (excluding ponded areas on mesas)

Uncertainty in both mesa and canyon infiltration requires that sensitivity analyses be performed to assess the impact of the uncertainty on travel times, predictions of moisture data, etc.

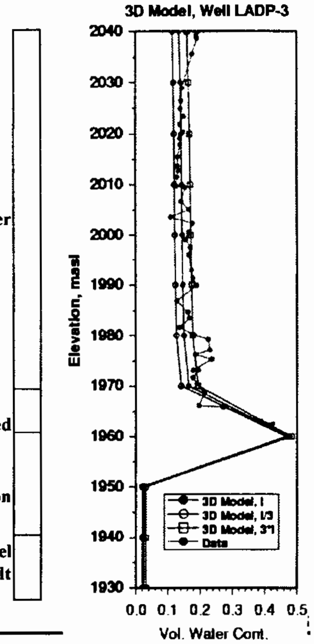
Unsaturated Hydraulic Properties



Raw data: saturated K, moisture retention curve (capillary pressure vs. water content)
Unsat. K: computed based on the van Genuchten model (unsaturated K is not actually measured)

Comparison of model results to data

Water content measurements in Well LADP-3



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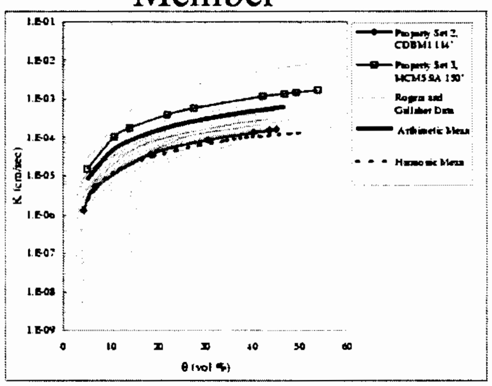
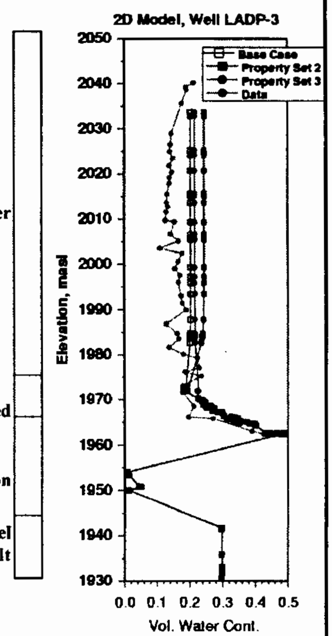
LA Canyon 2000
(23)

Sensitivity to Hydrologic properties: Otowi Member





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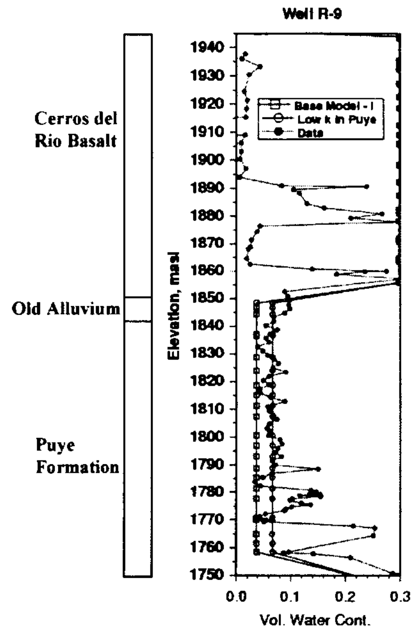
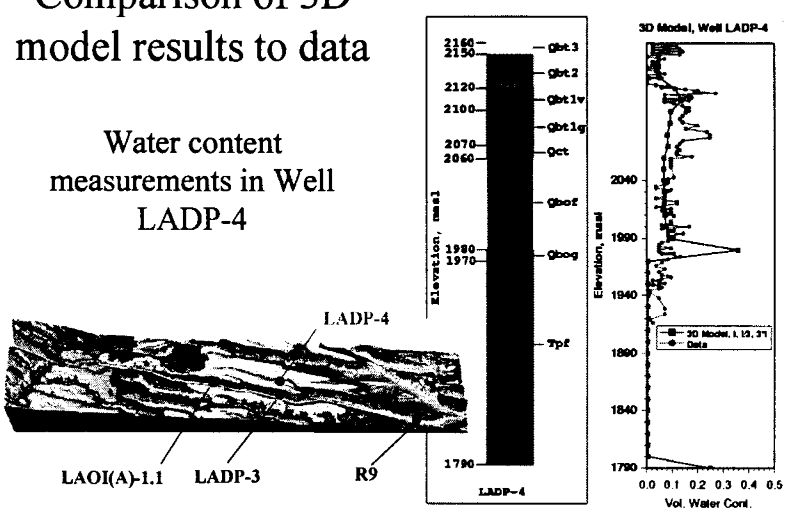
Sensitivity to Hydrologic properties: Puye Formation

Reduction of the permeability by one order of magnitude from the base-case value yields a good fit to the water content data in the Puye formation. This value is within the range of measurements compiled in the regional aquifer modeling study.



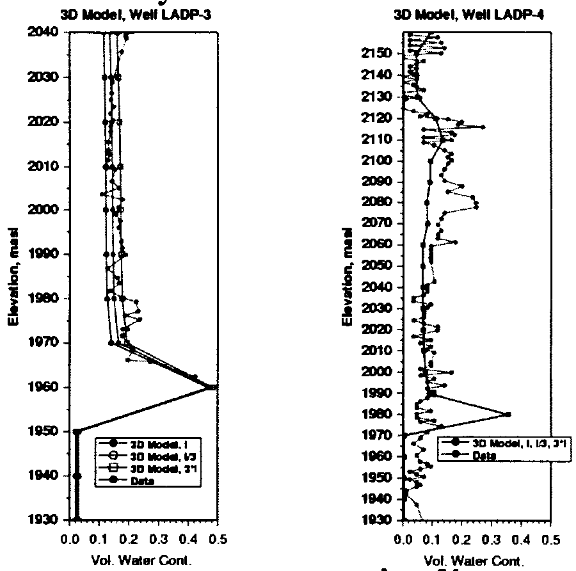
Comparison of 3D model results to data

Water content measurements in Well LADP-4



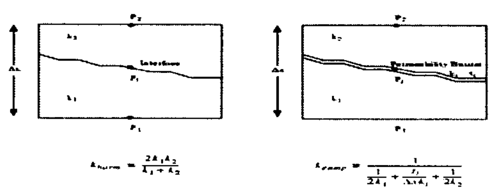
3D Model Result - Canyon Versus Mesa Well

The model captures the wetter conditions in Los Alamos canyon through a spatially varying recharge rate. This approach yields a good fit to the water content data in both the canyons and mesas.



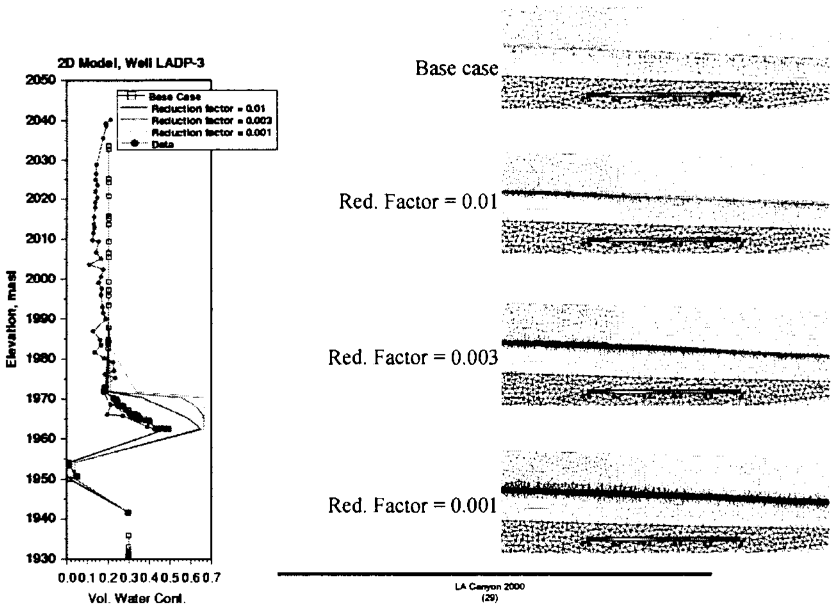
Perched Water Conceptual Model

Low-permeability barriers at the interfaces of specific hydrostratigraphic units exist that provide barriers to downward migration of fluid. These barriers are such that small percolation fluxes may pass through them, but at high enough rates, local saturation and lateral diversion occurs.

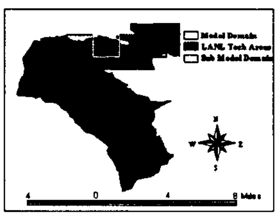


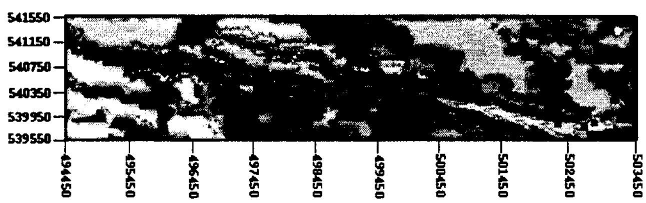
Code implementation: a reduction factor to the saturated hydraulic conductivity is specified at unit interfaces defined by the user.

Perched Water Model Results



Particle Tracking Results - 3D Model

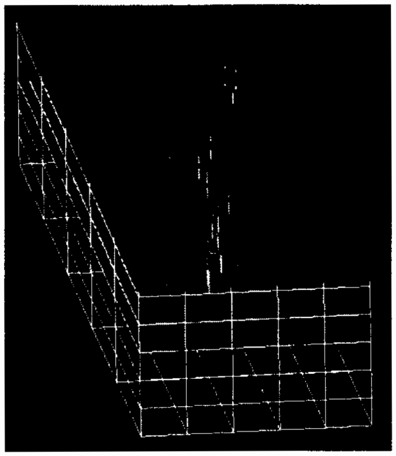




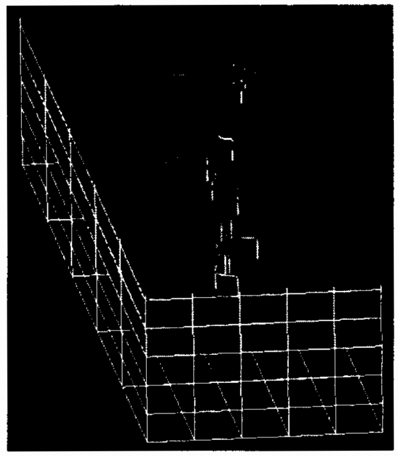
Particle tracking allows the flow patterns and transport times predicted in a model to be revealed and visualized

Particle Tracking Results - 3D Model

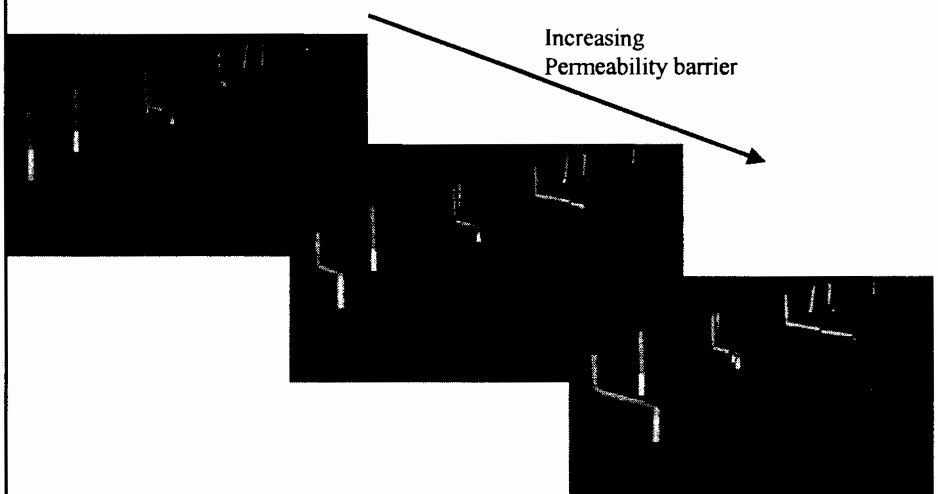
No permeability barrier



Permeability barrier



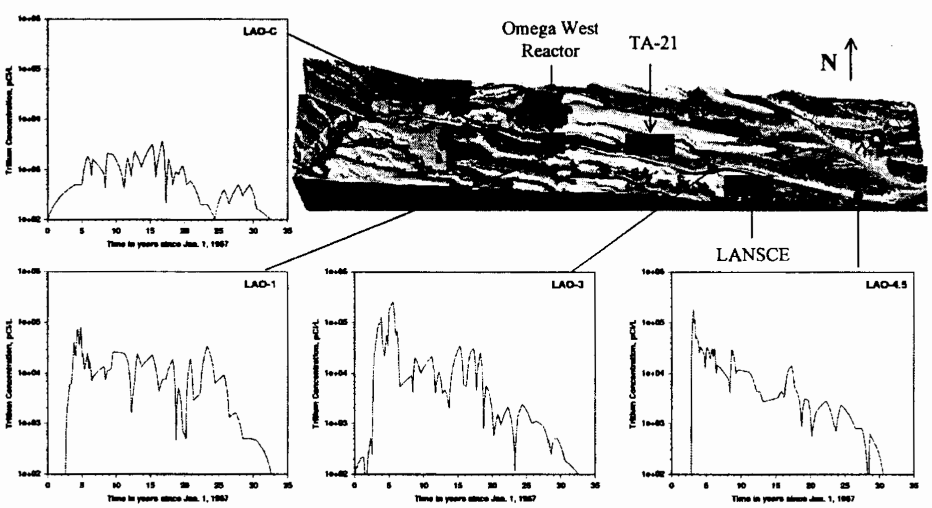
Particle Tracking Results - 3D Model



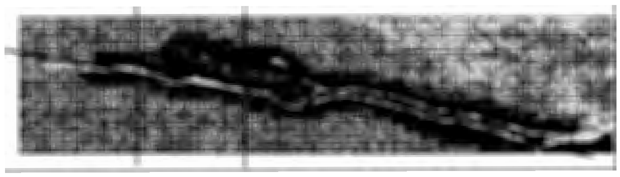
Contaminant Source Term Studies

- Use time-varying contaminant concentrations in shallow alluvial aquifer wells as input to model
- Use known release locations to deduce the direction and velocities of subsurface pathways
- Tritium information has been explicitly simulated in 3D, other contaminants to follow

Tritium Concentrations in Alluvial Groundwater



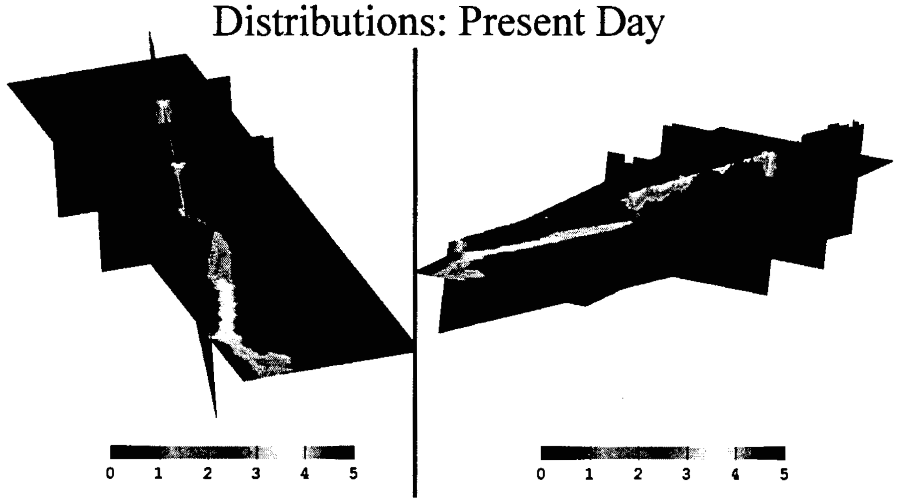
Simulated Tritium Concentrations: Maximum Surface Concentration



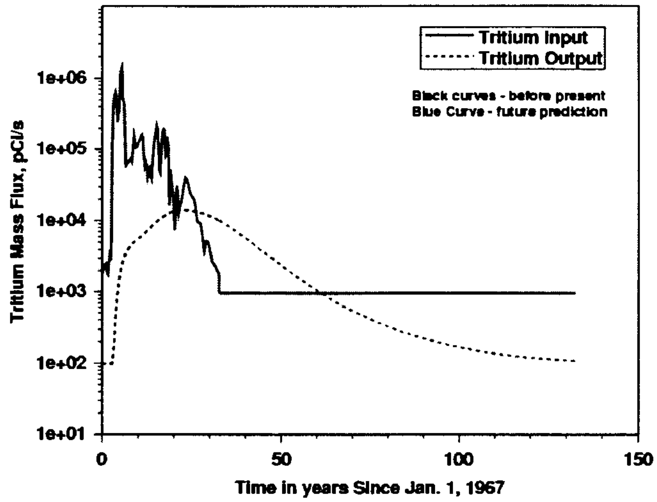
Log Tritium concentration, pCi/L

0 1 2 3 4 5

Simulated Tritium Concentration Distributions: Present Day

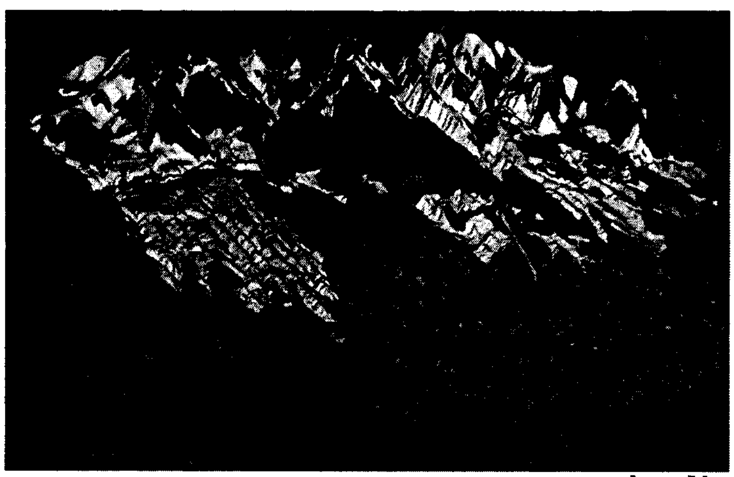


Simulated Tritium Vadose Zone Input and Output Mass Flux



Impact of the Cerro Grande Fire

Burn Severity



Los Alamos Canyon at the Reservoir

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LA Canyon 2000
(39)

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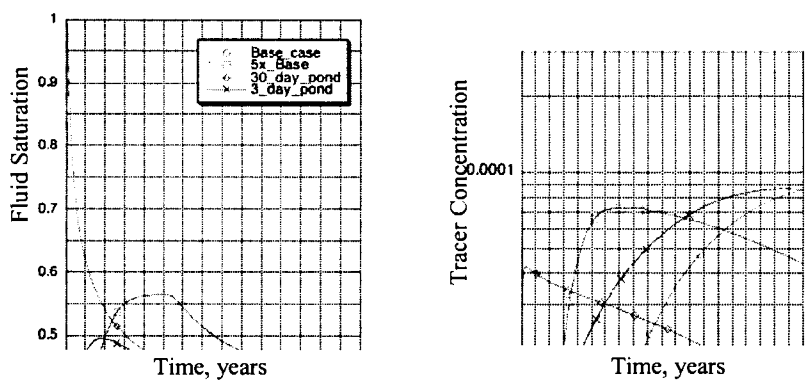
Saturation and Tracer Profiles for Enhanced Infiltration Scenarios: 50 m depth



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(40)

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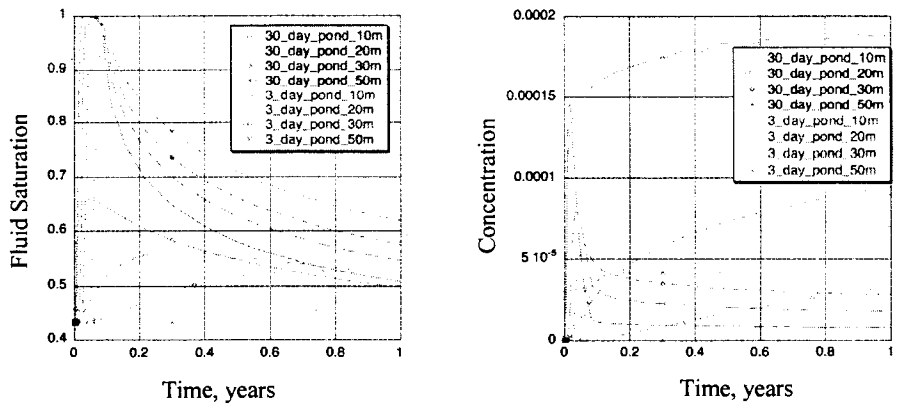
Near-Surface Saturation and Tracer Profiles Under Ponded Conditions



Conclusions

- Process for constructing numerical model involves the synthesis of a variety of data sources:
  - geologic model
  - water budget study
  - moisture content data
  - hydrologic property data
  - contaminant transport (tritium)
  - location of perched zones
- Flow model calibration allows the critical properties to be bounded
- Tritium travel times of 40 years or less through the vadose zone are explained by the model
- Cerro Grande fire may influence subsurface contaminant migration if increased infiltration persists for several years or if ponding occurs

Groundwater Investigations Focus Area

Deba Daymon

October 4, 2000

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VG-00-001(1)

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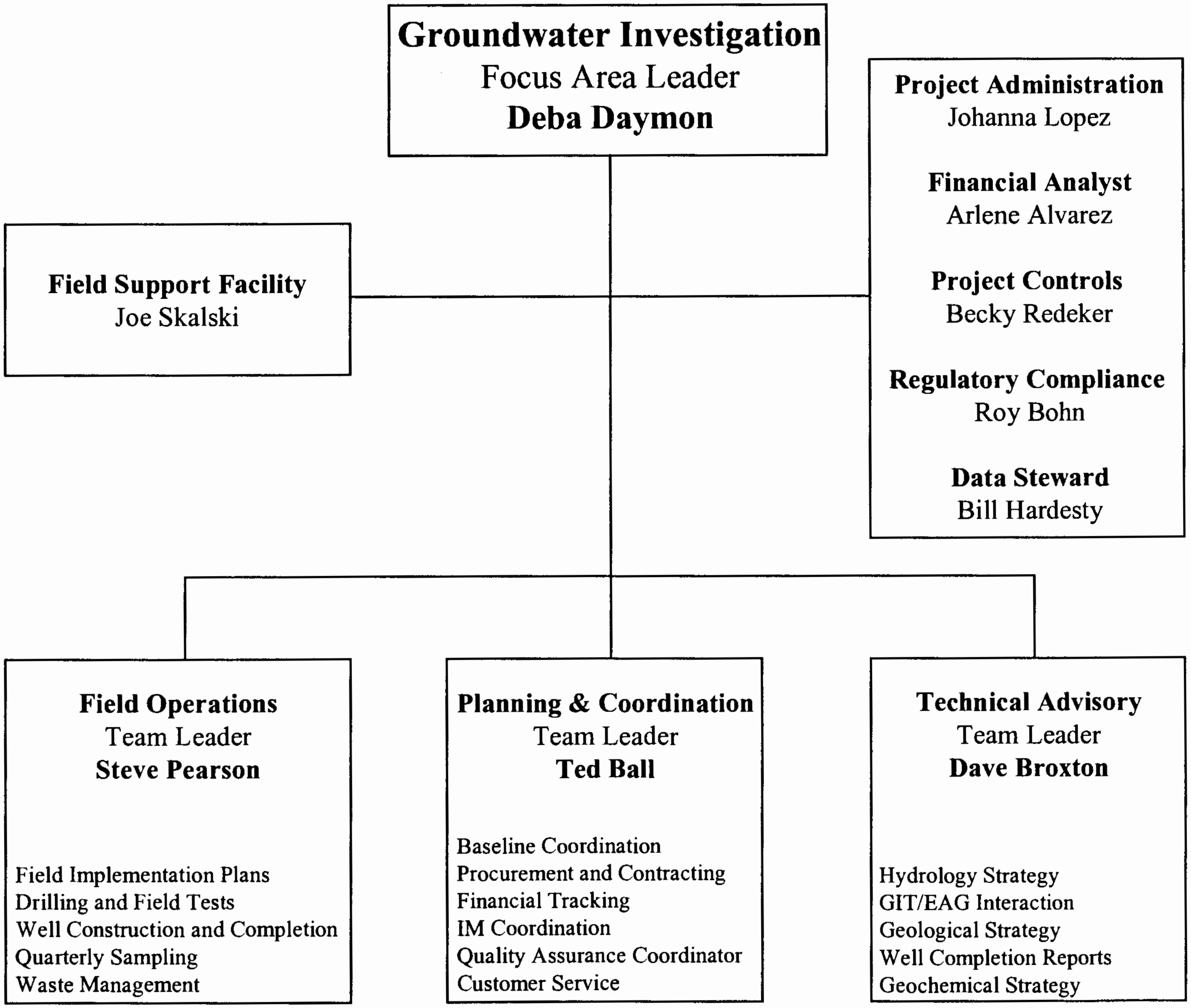

Groundwater Investigation
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Field Support Facility
Joe Skalski
Project Administration
Johanna Lopez
Financial Analyst
Arlene Alvarez
Project Controls
Becky Redeker
Regulatory Compliance
Roy Bohn
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Bill Hardesty
Field Operations
Team Leader
Steve Pearson
Field Implementation Plans
Drilling and Field Tests
Well Construction and Completion
Quarterly Sampling
Waste Management
Planning & Coordination
Team Leader
Ted Ball
Baseline Coordination
Procurement and Contracting
Financial Tracking
IM Coordination
Quality Assurance Coordinator
Customer Service
Technical Advisory
Team Leader
Dave Broxton
Hydrology Strategy
GIT/EAG Interaction
Geological Strategy
Well Completion Reports
Geochemical Strategy

New Drilling Contract

- New task order to ER prime contract
- Awarded August 22, 2000 to MK/PMC
- Opportunities for performance based incentives
- Less liability for UC
- More accountability by the SubKor

FY 01 Drilling Plans

- R-5, -7, -8, -13, -22, and -27
- CDV-R-37-2
- MCOBT -1 and -2

R-5

- NWT funded well
- Located in lower Pueblo Canyon between Otowi-1 and the LA County STP
- LA/Pueblo Watershed
- TD approximately 1200 ft
- Multiple screen completion

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VG-00-001(3)

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R-5 (cont)

- Purpose is to further define the western limit of the intermediate perched zone and provide information about hydraulic head, flow direction, and saturated thickness of this zone.
- Also provides detection of contamination approaching a water supply well.

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VG-00-001(4)

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R-7

- ER funded well
- Located in upper LA Canyon south of TA-21
- LA/Pueblo Watershed
- TD approximately 1500 ft
- Multiple screen completion

R-7 (cont)

- Purpose is to monitor for contaminants in the regional aquifer, to verify possible intermediate perched zones, and to identify any additional perched zones above the regional aquifer.
- Located in suspected recharge area and will provide information about stratigraphic and structural controls on infiltration.

R-8

- NWT funded well
- Located in LA Canyon near the confluence of DP Canyon (near Otowi-4)
- LA/Pueblo Watershed
- TD approximately 1420 ft
- Multiple screen completion

R-8 (cont)

- Purpose is to monitor for contaminants in the regional aquifer, to verify possible intermediate perched zones, and to identify any additional perched zones above the regional aquifer.
- Also provides detection of contamination approaching a water supply well.

R-13

- ER funded well
- Located in Mortandad Canyon downstream of the TA-50 outfall
- Mortandad Watershed
- TD approximately 1900 ft
- Multiple screen completion

R-13 (cont)

- Purpose is to determine the presence and quality of intermediate perched water and the regional aquifer downgradient of the TA-5o outfall.
- Investigate the potential for direct infiltration into the Bandelier Tuff.

R-22

- ER funded well
- Located in Pajarito Canyon near the SE Laboratory boundary
- Pajarito Watershed
- TD approximately 1800 ft
- Multiple screen completion

R-22 (cont)

- Purpose is to determine the presence and quality of intermediate perched water and the regional aquifer downgradient of the TA-54 disposal areas.
- Information will support MDA G PA and the TA-54 RFI/CMS/CMI.

R-27

- ER funded well
- Located near the confluence of Water Canyon and Canon de Valle
- Water/Valle Watershed
- TD approximately 1840 ft
- Multiple screen completion

R-27 (cont)

- Purpose is to assess nature and extent of potential GW contamination in intermediate perched zones and the regional aquifer.
- Also will reduce hydrologic uncertainties for this area.

CDV-R37-2

- ER funded well
- Located SE of TA-16-260 in the TA-11 area
- Water/Valle Watershed
- TD approximately 1950 ft
- Multiple screen completion

CDV-R37-2 (cont)

- Purpose is to provide contaminant plume, water quality, and water level data for potential intermediate perched zones and for the regional aquifer in a downgradient from the 260 outfall and R-25.
- Data used to model the GW plume.

Intermediate Wells

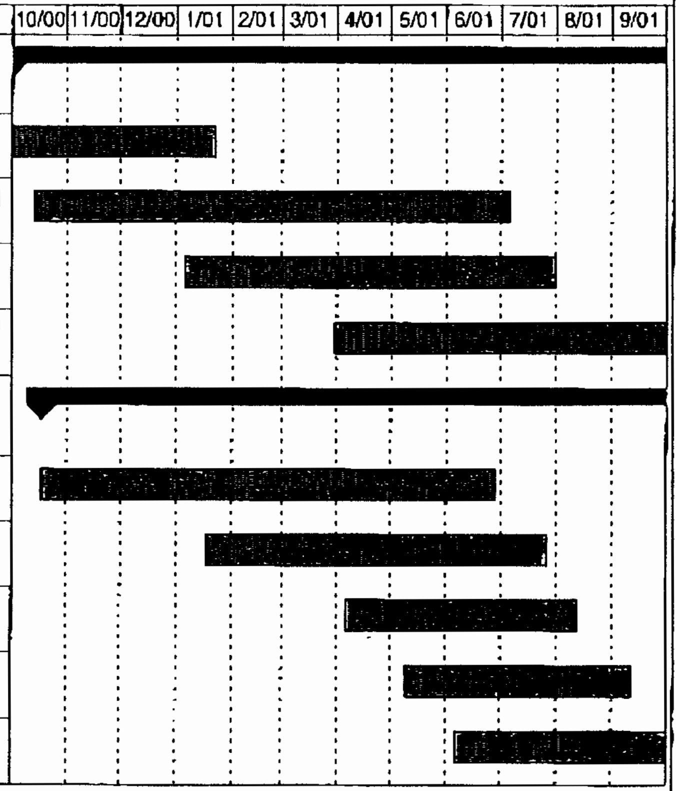
- ER funded wells
- 2 located in Mortandad Canyon
- Mortandad Watershed
- TD approximately 600 - 700 ft
- Multiple screen completion

Intermediate Wells (cont)

- Purpose is to identify and characterize intermediate perched zones
- Also looking at the effects of the TA-50 RLWTF and its discharges to the canyon

Proposed Well Drilling Schedule FY01

Task Name	Duration	Start	Finish
Barber Rig #1	**381 days**	**Sun 10/1/00**	**Tue 10/16/01**
R-22, Regional Well, ER, 1800 ft.	114 days	Sun 10/1/00	Mon 1/22/01
R-7, Regional Well, ER, 1500 ft	265 days	Sat 10/14/00	Thu 7/5/01
Well CdV-R-37-2, 1850 ft	207 days	Sat 1/6/01	Tue 7/31/01
R-13, Regional Well, ER, 1900 ft	200 days	Sat 3/31/01	Tue 10/16/01
Barber Rig #2	**409 days**	**Wed 10/18/00**	**Fri 11/30/01**
R-27, Regional Well, ER, 1850 ft.	253 days	Wed 10/18/00	Wed 6/27/01
R-5, Regional Well, DP, 1200 ft	190 days	Thu 1/18/01	Thu 7/26/01
MCOBT-1, Intermediate Well, ER, 700 ft	129 days	Fri 4/6/01	Sun 8/12/01
MCOBT-2, Intermediate Well, ER, 740 ft	125 days	Thu 5/10/01	Tue 9/11/01
R-8, Regional Well,DP, 1300 ft	178 days	Wed 6/6/01	Fri 11/30/01



Quality Assurance

A. Gallegos

October 3, 2000

Review of LANL Hydrogeologic Characterization Program FY00

Charles Nylander
Program Manager
ESH-18

Performance Review Outline

- Program Description
- Regulatory Framework
- FY00 Accomplishments and Issues
- FY00 Budget Performance
- FY01 Proposed Budget

Program Description

- **Goal:** Develop a refined understanding of the hydrogeologic setting adequate to implement detection monitoring or groundwater monitoring waivers
- **Scope:** described in the Hydrogeologic Workplan:
  - **32 regional aquifer wells; 51 alluvial wells**
  - **Data management/stakeholder data access**
  - **Hydrologic modeling**

Regulatory Framework

- **1990 EPA/NMED RCRA Operating Permit:** Task III, Section A.1 requires evaluations of hydrogeologic conditions
- **1995 GWPMP**: recognize groundwater issues due to inadequate characterization
- **1995 NMED letters**: inadequate characterization and denial of groundwater monitoring waiver

FY00 Accomplishments

- Drilled and constructed four wells (R-19, R-9i, CDV-15, and R-31); completed four wells (R-15, R-25, R-9, R-12); started drilling R-22
- Conducted two rounds of quarterly sampling (R-9, R-9i, R-12, R-15) → No Completion Reports
- Completed Well Completion Reports for R-9, R-9i, R-12, R-15, R-19

FY00 Accomplishments (cont.)

- Produced the FY99 Groundwater Protection Program Annual Status Report, published as a LANL Status Report (LA-13710-SR)
- GIT participated in ESH Division Review and the presentation was rated as "outstanding" and received Los Alamos Achievement Award

FY00 Accomplishments (cont.)

- Developed a stochastic approach to modeling variations in hydraulic conductivity within the Puye Formation for the regional aquifer model
- Evaluated pump test simulations for possible O-1/R-5 cross-hole testing in support of R-5 siting decision
- Analyzed site-wide hydraulic conductivity trends using hydraulic conductivity data, water levels and inverse modeling

FY00 Accomplishments (cont.)

- Updated Los Alamos Canyon model, including predicting potential impacts of the Cerro Grande fire
- Completed Area L organic vapor plume study, documented in a written report and web-based presentation.
- Hosted a field trip of characterization activities for the National Groundwater Association

FY00 Accomplishments (cont)

- External Advisory Group produced two reports and Groundwater Integration Team (GIT) responded with two action plans
- GIT Risk-Based Decisions Subcommittee formed
- Underwent a Management Assessment for compliance with ER Project QA Plan

FY00 Accomplishments (cont)

- Database runoff flow and chemistry modules available to public at: **http://www.esh.lanl.gov/~esh18/teams/GCFire/index.html**
- Incorporated DP Monitoring Well Project into ER Project Project Planning and Control System (PP&CS)
- Produced monthly joint DP/ER status reports

FY00 Accomplishments (cont)

- Held GIT bi-weekly meetings, 3 quarterly meetings and the Annual Meeting
- Successfully awarded a task order for ER Project Groundwater Investigation Focus Area field support and drilling
- Underwent an audit for compliance with LIRs by the Project Management Division

FY00 Accomplishments (cont.)

- Prepared data reports on the mechanical testing of hydrologic properties on samples from R-9, R-12, R-25
- Produced an expanded Hydrogeologic Atlas
- Implemented well head protection after Cerro Grande fire
- Developed a proposal for monitoring at Los Alamos Canyon low-head weir

Issues

- R-25 Repairs
- Cerro Grande Fire
- Well Construction Problems
- Drilling Subcontract Re-bid
- Budget Shortfall
- Early FY00 Delayed Start
- Quarterly Sampling

Issue: R-25 Repairs

- Repair of Screens 3 and 9 and well development completed in September 2000
- Well screens were impacted by bentonite and clay from the Puye Formation
- Schedule impacts of 19 months and cost increase of about $1.5 million

R-25 Repair Issue Resolution

- Micromatrix cement brushed from screens to restore hydrologic connection
- R-25 developed three times to minimize turbidity
- EAG reviewed video log after second development and concurred on well completion
- Actions have been taken to prevent similar incidents

Issue: Cerro Grande Fire

- Cerro Grande Fire started May 7 and closed the Laboratory for 2 weeks; field operations finally resumed June 1.
- Work in canyons can not be scheduled during rainy season (July-September)
- Chemical changes in runoff may affect groundwater
- Engineered flood control structures may affect hydrogeologic system

Cerro Grande Fire Issue Resolution

- Re-schedule wells in canyons for non-rainy season (Exchanged R-22 for R-7 in FY00)
- Modeling used to assess potential effects of changes in runoff chemistry
- Installed well head flood protection structures

Cerro Grande Fire Issue Resolution

Downstream Face of Los Alamos Low Head Weir

Planned instrumented wells to be installed near flood control structures to quantify effects on hydrogeology

Issue: Well Construction Problems

- R-19: packer assembly dropped down the well and required two weeks to retrieve. Video log showed no damage
- CDV-15: Filter pack/bentonite seals offset 10 feet. Bentonite against some portions of screened intervals.
- NMED expressed concerns regarding usability of data from R-25 and CDV-15

Well Construction Problem Issue Resolution

- Drilling Company paid for time to recover packer
- Bentonite is not expected to interfere with HE, so CDV-15 and R-25 are usable for monitoring HE
- New drilling contract anticipated to increase quality of well drilling and installation
- Develop response to NMED concerns

Issue: Drilling Contract Re-Bid

- RFP for field support services, well drilling, and well installation released in ER Project contractors in December 1999
- Task Order awarded 9 months later, resulting in insufficient time to plan FY01 activities in FY00
- Intended to provide services of multiple drilling companies

Re-Bid Drilling Contract Issue Resolution

- Work with management and BUS for more timely task order award process
- Allow for innovative ideas and approaches in proposals
- Consider future re-bid of drilling contract
- Implement lessons learned from this task order process

Issue: Budget Shortfall

- NW Program allocated $300,000 less budget for FY00
- R-25 required about $1.5 million more than expected
- R-5 had to be pushed into FY01
- NW Program closed cost codes because MWIP was over-run
- Modeling activities were delayed in last quarter
- ER funding for wells diverted to fire recovery

Budget Shortfall Issue Resolution

- Utilize the ER Project PP&CS to estimate annual DP funding needs
- NW Program allocations should based on budget requests that reflect estimated cost of annual work
- Continue to provide cost efficiencies in program execution
- Improve planning for contingencies

Issue: Early FY00 Delayed Start

- Planning for FY00 activities had not been accomplished in FY99 because of decision in October not to drill with mud rotary
- Procurement paperwork delays prevent prompt utilization of subcontractors
- Long-lead time drilling materials ordered in FY00
- New well drilling did not begin until the second quarter
- Impacted the program accomplishments for FY00

Early FY00 Delayed Schedule Issue Resolution

- ER Project reorganized and established a Groundwater Investigations Focus Area
- Funding for planning of next year activities has been added to the ER Project baseline
- New field support/drilling task order is in place
- Drilling materials ordered six months ahead of time when budget allows
- Recognize the need for orderly transition between fiscal years

Issue: Quarterly Sampling

- Quarterly sampling began later than expected due to staffing limitations and training delays
- Sampling schedule impacted by Cerro Grande fire
- Decision making regarding regarding SOPs to be used for quarterly sampling also delayed the start of sampling

Quarterly Sampling Issue Resolution

- Quarterly sampling team in place and two quarterly sampling events have occurred
- New Field Support/Drilling contractor will have responsibility for quarterly sampling - improved consistency
- ER SOPs are used to comply with ER QA plan

Regulatory Review

RCRA/HSWA Groundwater Monitoring Requirements Overviews

(A. Barr)

HSWA Permit Revisions and Well Construction Issues

(D. Broxton)

LANL Hydrogeologic Annual Meeting
Wednesday, October 4, 2000

Overview

Over the past year LANL and NMED have worked in a cooperative manner to improve the language of the LANL's Hazardous Waste Facility Permit. This talk deals specifically with attempts to clarify permit requirements for drilling and well construction.

The permit was prepared at a time when groundwater investigations focused mostly on perched alluvial groundwater conditions.

Construction of intermediate-depth and regional aquifer wells as part of the Hydrogeologic Workplan requires reassessment of permit language.

LANL's Hazardous Waste Facility Permit (1994)

- Guidance for Borehole and Well Construction for Groundwater Investigations is covered in Special Permit Conditions under Module VIII of LANL's Hazardous Waste Facility Permit. The sections applicable to well construction are:

  Section 1. Perched Water Monitoring, and
  Section 4. Protection of the Main Aquifer

- Section 1 of Special Permit Conditions required the Laboratory to install 14 observation wells to monitor water quality in perched saturated alluvium in seven canyon systems.

- The permit language for well construction was designed specifically for these 14 new observation wells, but the permit language is such that it becomes the guidance for any new monitoring well, including intermediate-depth and regional wells.

From Module VIII of LANL's Hazardous Waste Facility Permit

Current Permit Language
Section C.1.Perched Zone Monitoring

"The boreholes for casings and screens shall be a minimum of six (6) inches greater in diameter than the well casing or screen outer diameter."

Proposed Replacement Language

The casings and screens shall be two (2) to six (6) inches in outside diameter (O.D.) with a minimum of two (2) inches annular space in the borehole.

Current Permit Language
Section C.1.Perched Zone Monitoring

"Well screen lengths shall be no more than (10) ten feet in length."

Proposed Replacement Language

Well screen lengths shall be a minimum of five (5) feet in length and shall not be more that sixty (60) feet in length, excluding joints.

Current Permit Language
Section C.1.Perched Zone Monitoring

"The filter pack shall extend not more than (2) two feet above the top of the screen and shall not cross any clay layers which may act as aquitards."

Proposed Replacement Language

The filter pack shall extend a minimum of two (2) feet, but not more than <u>five (5) feet</u>, above the top of each screen. The filter pack shall not cross hydraulically separated geologic units.

Current Permit Language
Section C.4.Protection of the Main Aquifer

"Any boring drilled into the main aquifer that encounters perched water shall set conductor pipe to the top of the main aquifer and hydraulically isolate the main aquifer from the perched aquifer."

Proposed Replacement Language

During drilling and/or well construction, any boring that penetrates the regional aquifer, and is drilled through perched water, shall extend casing (e.g., advanced drill or conductor) to the top of the regional aquifer.

Current Permit Language
Section C.1.Perched Zone Monitoring

"Development procedures shall include purging of the well until contaminants introduced during drilling can be assured of being removed. Development shall also include surging with a surge plug, and either bailing or pumping until the nephelometric turbidity units (N.T.U.) can be consistently measured at five (5) or less, if possible."

Proposed Replacement Language

Efforts shall be made to remove materials and/or contaminants introduced during drilling. Development may include any one, or a combination of methods including, but not limited to bailing, pumping, or surging. Particulate levels in the well will be reduced to five (5) nephelometric turbidity units (N.T.U.) or less, if possible.

Current Permit Language
Section C.1.Perched Zone Monitoring

"Filter pack and screen slot openings shall be sized based on formation grain size and characteristics."

Proposed Replacement Language

The filter pack materials will be appropriately sized for the slot size in each screen with consideration of formation grain size and characteristics.

Current Permit Language
Section C.1.Perched Zone Monitoring

"The monitoring wells installed under this and following sections of this permit shall be constructed using flush-joint, internal upset, threaded (or an equivalent method of joining without rivets, screws and glues) casing manufactured from inert materials."

Proposed Replacement Language

The monitoring wells installed under this and following sections of this permit shall be constructed of materials consistent with those described in appropriate industry-accepted design manuals and guidance documents. Examples include, but are not limited to, the following: "Handbook of Suggested Practices for the Design and Installation of Ground Water Monitoring Wells, 1991" (EPA160014-891034, March 1991).

Summary

LANL and NMED are working together to clarify permit requirements for drilling and well construction in the LANL's Hazardous Waste Facility Permit.

There is generally good agreement between LANL and NMED on proposed permit language for installation of intermediate-depth and regional aquifer wells.

Works on permit language continues in several areas, including filter packs dimensions and use of conductor casing to protect the regional aquifer.

GEOCHEMICAL AND REACTIVE TRANSPORT MODELING OF URANIUM IN UPPER LOS ALAMOS CANYON

BY

PATRICK LONGMIRE[1], BRUCE ROBINSON[2], AND DALE COUNCE[1]

OCTOBER 4, 2000

1. EES-1 and 2. EES-5, LOS ALAMOS NATIONAL LABORATORY,

ENVIRONMENTAL RESTORATION PROJECT

OBJECTIVE OF PRESENTATION

Present a status report on geochemical and transport modeling of uranium in upper Los Alamos Canyon. A more detailed presentation will be provided in March 2001.

We have found uranium in surface sediment, surface water, and alluvial and perched water in Los Alamos Canyon. We need to know how this uranium will move through the environment. We begin with geochemistry and transport models, and use these to guide future data collection efforts.

Topics of interest include:

- **Uranium distributions: How much uranium in what media?**
- **Speciation: What are the chemical forms of the uranium?**
- **Transport: How will the uranium move in water?**

ENVIRONMENTAL RESTORATION PROJECT

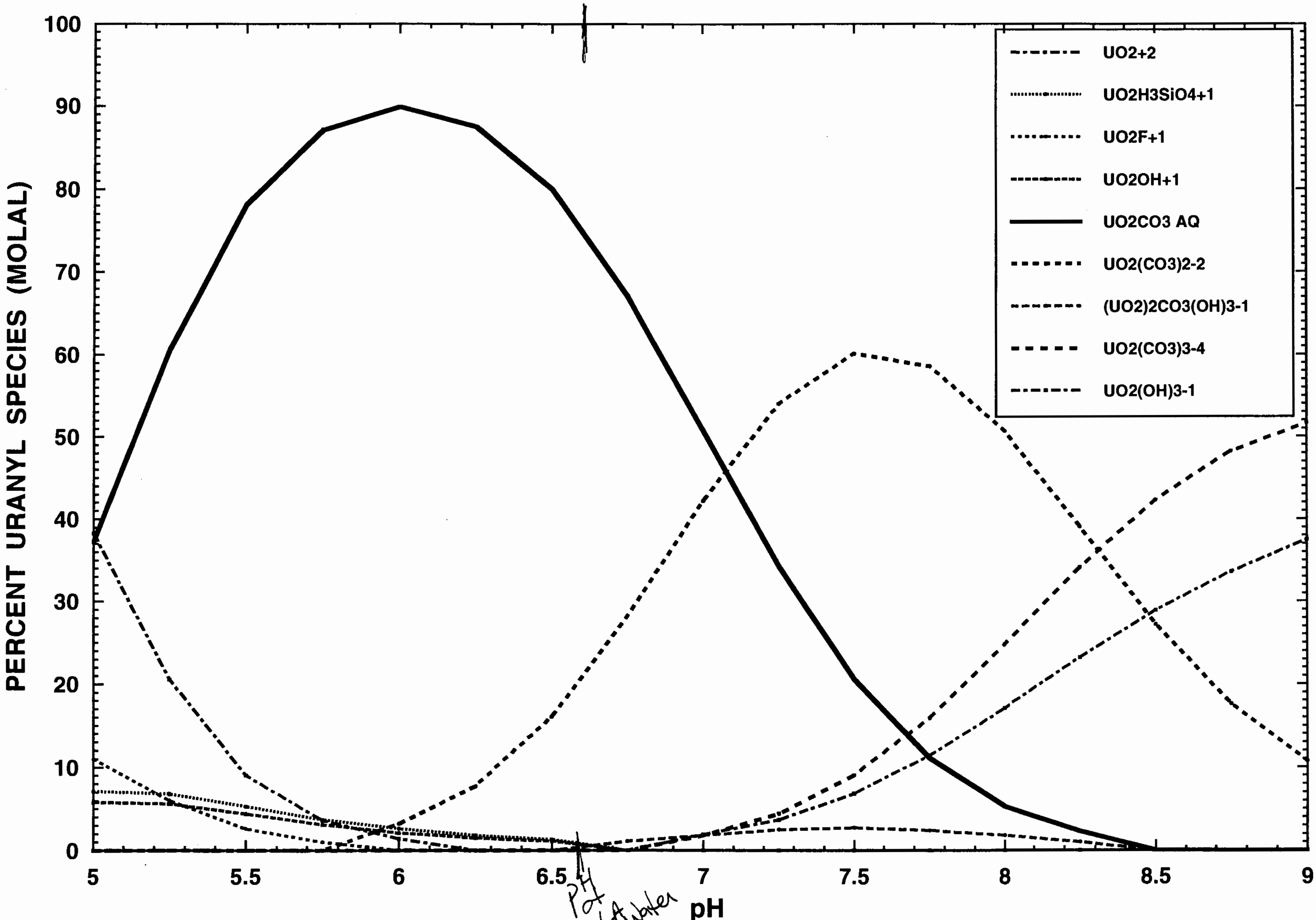


FIGURE 7.3-6. DISTRIBUTION OF URANYL SPECIES IN BACKGROUND ALLUVIAL GROUND-WATER, UPPER LOS ALAMOS CANYON, LOS ALAMOS, NEW MEXICO (LOG UO2 = -9.03 m, LOG TOT CO3 = -3.21 m, LOG F = -5.50 m, LOG H4SiO4 = -3.28 m, TEMPERATURE = 4.4C).

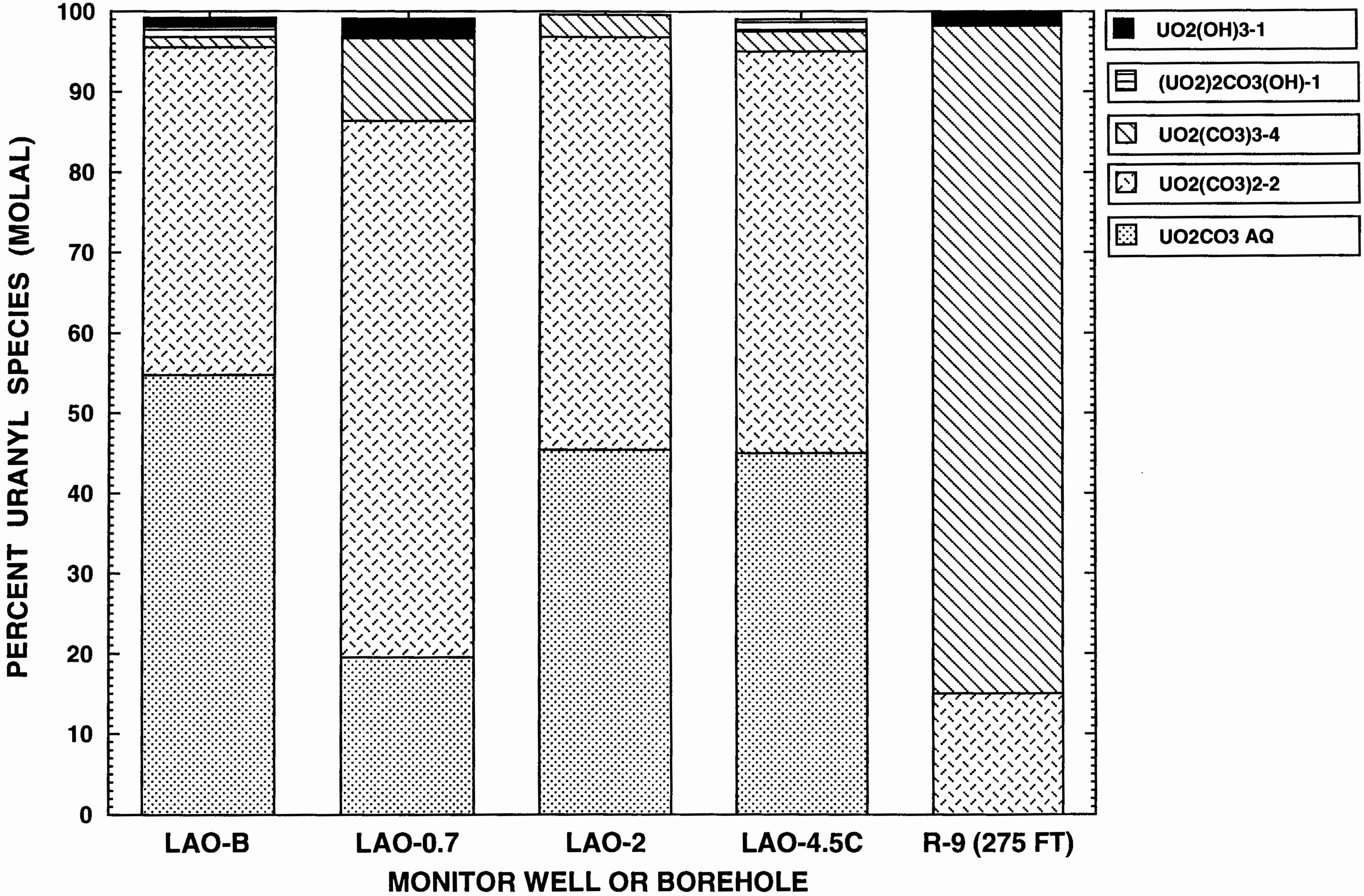
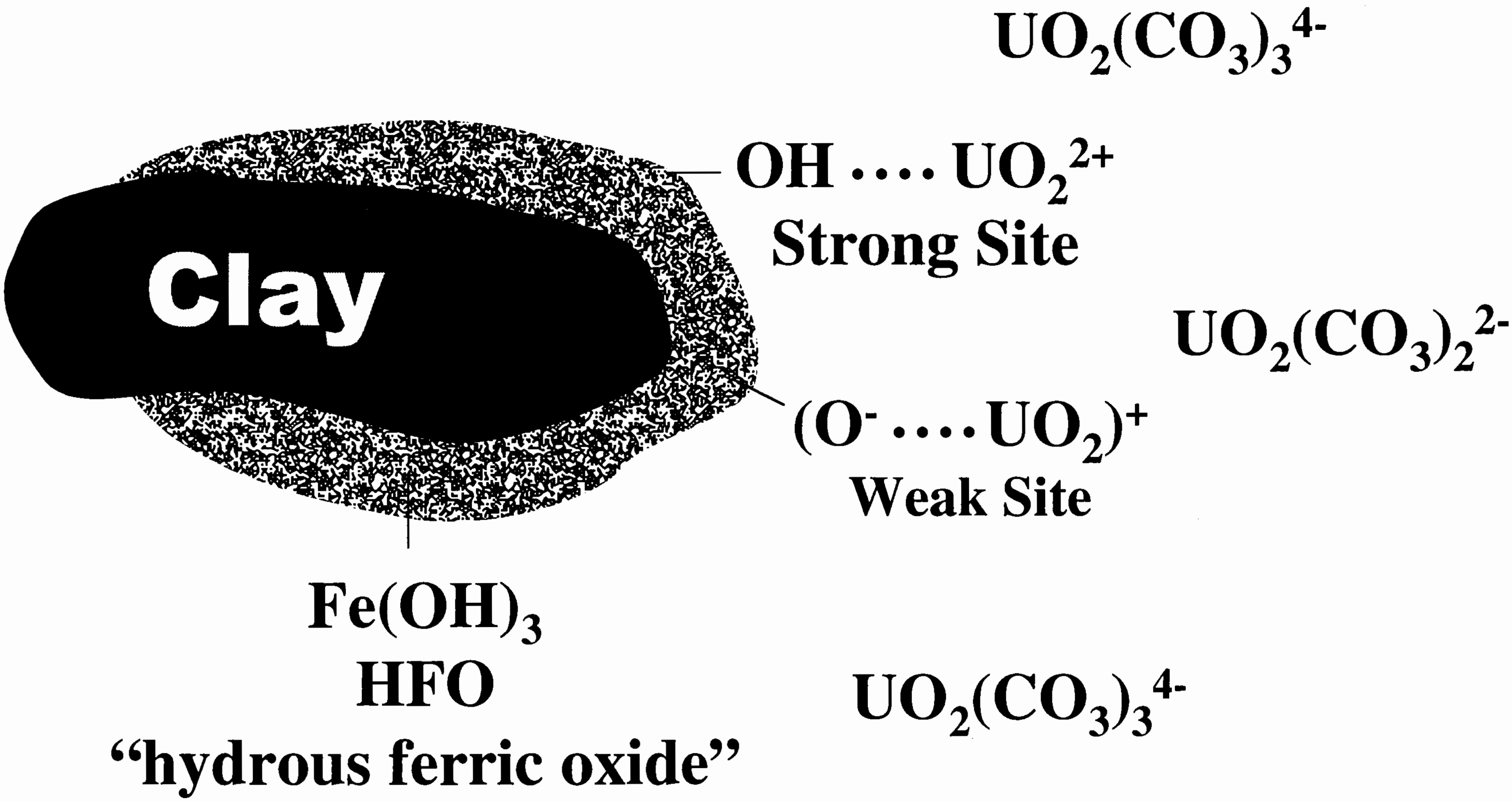


FIGURE 7.3-7. PERCENT URANYL SPECIES IN ALLUVIAL AND BASALT GROUNDWATER, UPPER LOS ALAMOS CANYON, LOS ALAMOS, NEW MEXICO (LAO-B, pH = 6.91, LOG UO2 = -9.03 m, ALKALINITY = 30.5 MG/L CaCO3; LAO-0.7, pH = 7.4, LOG UO2 = -9.26 m, ALKALINITY = 45 MG/L CaCO3; LAO-2, pH = 6.6, LOG UO2 = -9.38 m, ALKALINITY = 91 MG/L CaCO3; LAO-4.5C, pH = 6.9, LOG UO2 = -8.55 m, ALKALINITY = 46 MG/L CaCO3; BOREHOLE R-9, pH = 8.79, LOG UO2 = -6.69 m, ALKALINITY = 97.7 MG/L CaCO3).

Surface Complexation of Uranium(VI) Species



REACTIVE TRANSPORT MODELING (PHREEQC2.2)

- Dissolved uranyl (UO_2^{2+}) in natural and contaminated systems significantly adsorbs onto hydrous ferric oxide (HFO) between pH values 5-8.

- Dissolved uranium (VI) species, in the form of uranyl carbonato complexes ($UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$), does not completely adsorb onto HFO. Increasing alkalinity decreases uranium adsorption under alkaline pH (8 and higher) conditions typical of basalt perched zones.

- Dissolved calcium (Ca^{2+}) strongly competes for sorption sites, which decreases uranyl adsorption onto HFO. This effect is more likely to occur within alluvial groundwater than in sodium-rich perched groundwater within the Cerros del Rio basalt.

REACTIVE TRANSPORT MODELING (PHREEQC2.2)

- Results of modeling simulations suggest that uranyl sorption onto HFO results in formation of colloids, which do not adsorb and move more readily than non-colloidal uranium especially in fractured tuff and basalt.

- The amount of adsorption of uranium onto HFO (and other adsorbents) is an important component of transport modeling.

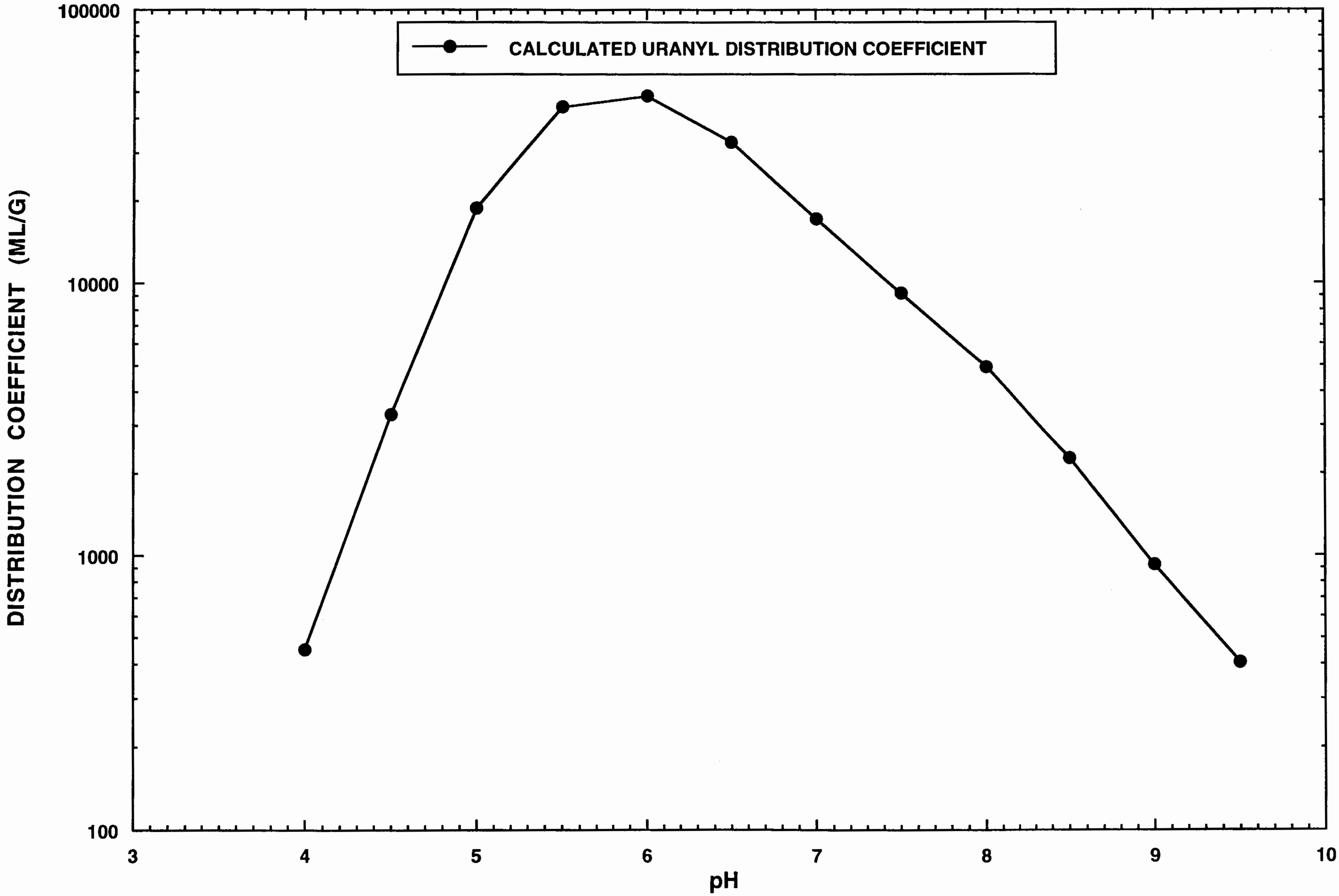


FIGURE 7.4-3. CALCULATED DISTRIBUTION COEFFICIENTS FOR URANYL ADSORPTION ONTO HYDROUS FERRIC OXIDE (1.46 G/L) IN THE PRESENCE OF CALCIUM (2.91 PPM) AT BOREHOLE R-9 (275 FT ZONE) (TOTAL DISSOLVED URANYL = 0.054 PPM, 25 C).

SUMMARY

Members of the Geochemistry and Modeling Subcommittees have developed models for simulating the transport of uranium in upper Los Alamos Canyon.

Dissolved species of uranium (VI) are mobile in groundwater, under alkaline pH conditions, and do not completely adsorb onto HFO. Characterization (Los Alamos Canyon weir site) and monitoring at R-9i shall provide additional geochemical data and information.

Transport of uranyl species under fracture flow conditions is a viable process, based on results of model simulations. Colloid transport is possible in which the uranyl cation (UO_2^{2+}) adsorbs onto HFO under near-neutral pH conditions.

Additional characterization of HFO and other adsorbents (clay minerals) is warranted to further validate model simulations.

SUPPLEMENTAL MATERIALS

THE RETARDATION EQUATION

At R-9, Kd is related to the transport velocity of the adsorbate to that of water by determining the retardation factor, R_f.

The retardation equation is:

$$R_f = 1 + \frac{pKd}{n}$$

Where p = bulk density (2.5 g/cm³), effective Kd = 1.31 cm³/g (field measured at R-9), and n = effective porosity (0.30 V_{void}/V_{total})(assumed value).

$$R_f = 1 + \frac{2.5 g/cm^3 (1.31\ cm^3/g)}{0.30}$$

R_f = 12. *Uranium is predicted to migrate 1/12 (0.08) the rate of average groundwater flow at R-9.*

SURFACE COMPLEXATION MODELING OF R-9 GROUND WATER: DIFFUSE LAYER MODEL

The diffuse-layer adsorption model considers solution speciation and aqueous ion activities. The model uses the electric double-layer (EDL) theory. EDL theory assumes that the + or – surface charge of a sorbent in contact with solution generates an electrostatic potential that declines rapidly away from the sorbent surface. The potential is the same at the zero (sorbent surface) and d (solution) planes.

The concentration of hydrous ferric oxide (HFO) at 275 ft is 1.46 g/L.

The specific surface area of HFO is 600 m^2/g.

Model uranyl sorption with one surface containing two sites, high energy (s) (8.2×10^{-5} mol active site HFO/L) and low energy (w) (0.003 mol active site HFO/L). The estimated intrinsic constants for uranyl sorption (Langmuir, 1997) include:

$Fe^{s}OH + UO_2^{2+} = Fe^{s}OHUO_2^{2+}$ ($\log K_1 = 5.2$) and

$Fe^{w}OH + UO_2^{2+} - H^{+} = Fe^{w}OUO_2^{+}$ ($\log K_2 = 2.8$).

SURFACE COMPLEXATION MODELING OF R-9 GROUND WATER: DIFFUSE LAYER MODEL

The DLM predicts that 112 ppb total uranium (nitric acid digestion) in the 275 ft perched zone at pH 9.0 occurs as:

57.5 percent uranyl bound as $SO2UO_2^+$ (64 ppb sorbed U),

5.1 percent uranyl bound as $UO_2(CO_3)_2^{2-}$ (7 ppb dissolved U), and

36.6 percent uranyl bound as $UO_2(CO_3)_3^{4-}$ (41 ppb dissolved U) (calculated total dissolved U is 48 ppb, measured dissolved U is 48.4 ppb).

The Kd, based on the DLM, is

(U sorbed M)/(U dissolved M) X (10^3mg/g)/(1.46 mg/ml),

($10^{-6.57}$ M)/($10^{-6.70}$ M) X (10^3mg/g)/(1.46 mg/ml),

$Kd_{(DLM)}$ = 926 ml/g. This calculated Kd value is very large and invokes colloid transport of HFO with adsorbed uranyl cation.

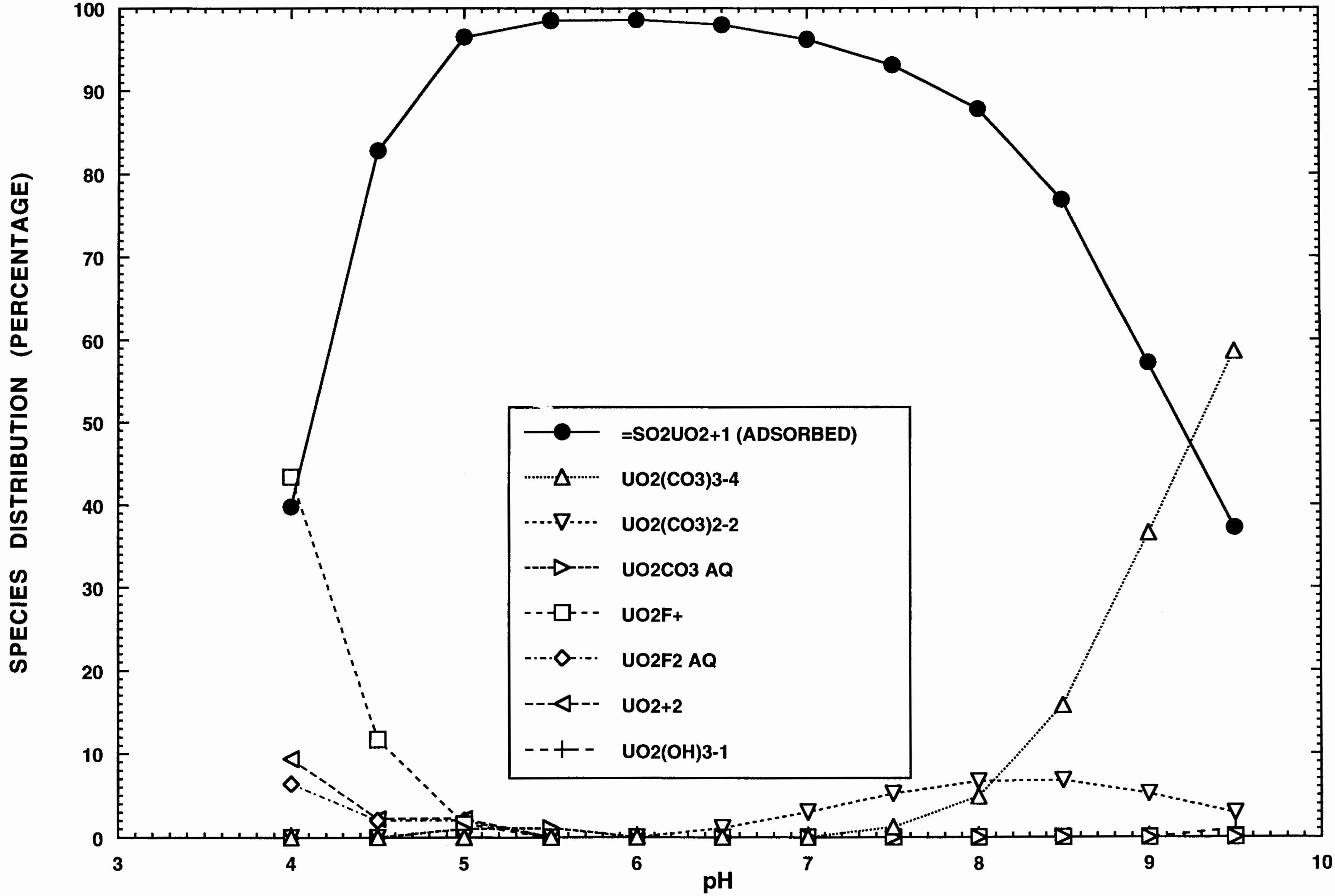


FIGURE 7.4-2. CALCULATED DISTRIBUTIONS OF ADSORBED AND DISSOLVED URANYL SPECIES FOR R-9 (275 FT ZONE) (HYDROUS FERRIC OXIDE = 1.46 GRAMS PER LITER AND TOTAL DISSOLVED URANYL = 0.054 PPM, 25 C).

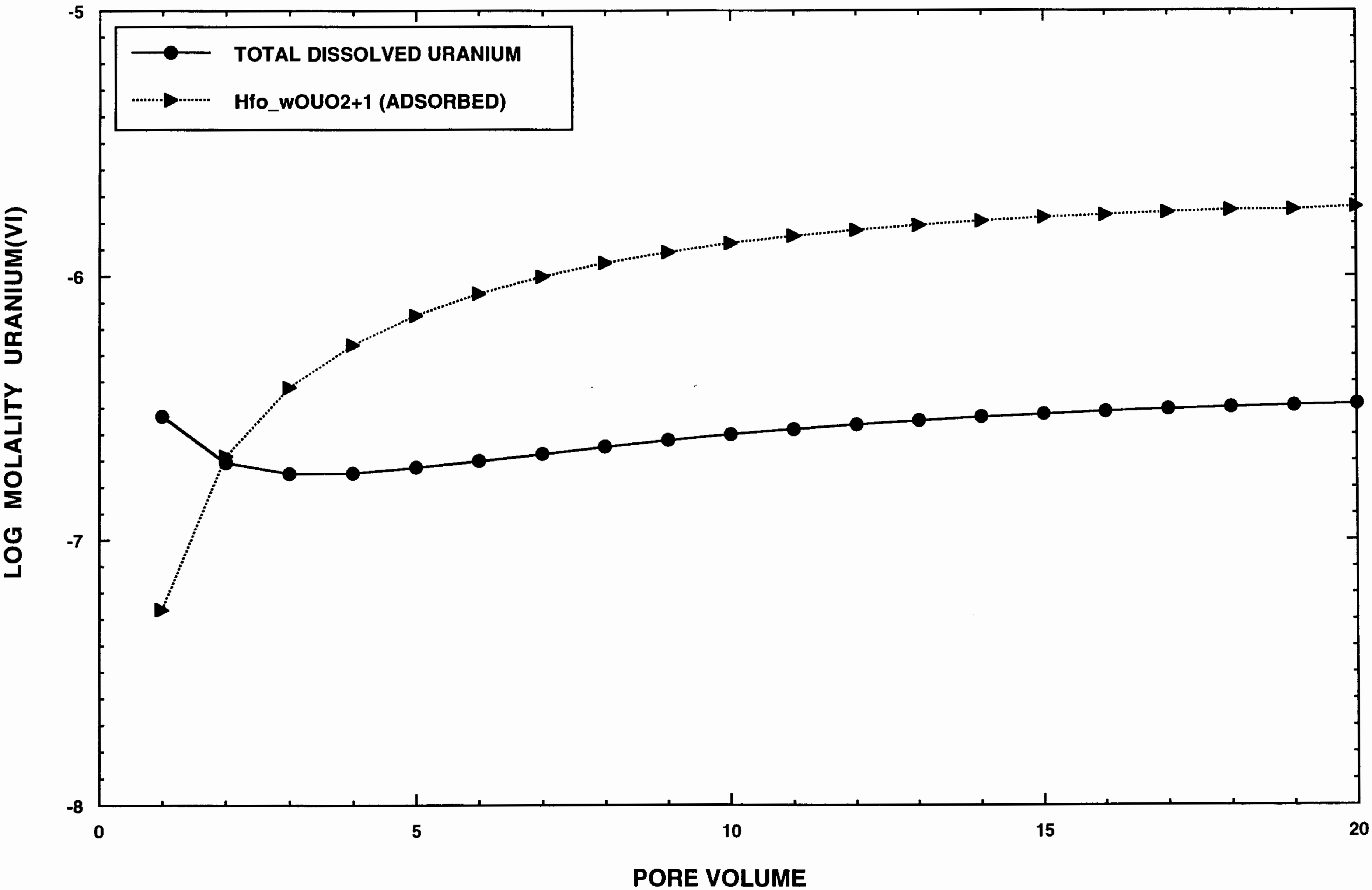


Figure 7.4-6. Results of advective transport modeling using PHREEQC2.2 to simulate adsorption of the uranyl cation onto hydrous ferric oxide (Hfo) (1.46 g/L). (Time step = 1.33e08 seconds, recharge rate = 0.2 m/yr, and fracture porosity estimated at 0.01).

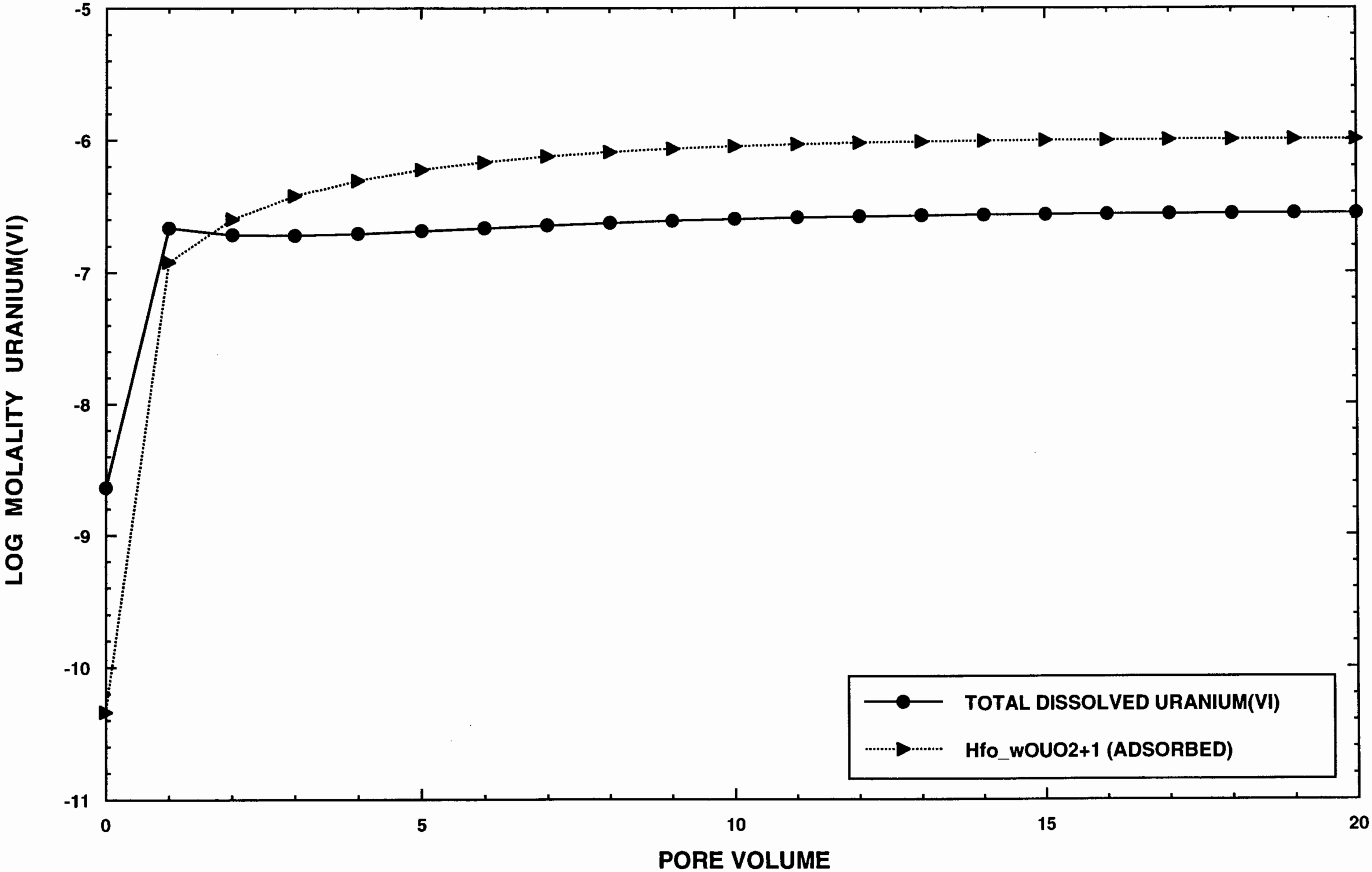


Figure 7.4-5. Results of transport modeling using PHREEQC2.2 to simulate adsorption of the uranyl cation onto hydrous ferric oxide (Hfo) (1.46 g/L). (Dispersivity = 0.10 m2/sec, time step = 1.33e08 seconds, recharge rate = 0.2 m/yr, and fracture porosity is estimated at 0.01).

AQUEOUS GEOCHEMISTRY INVESTIGATIONS AND MODELING, UPPER LOS ALAMOS CANYON, LOS ALAMOS, NEW MEXICO

By

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ABSTRACT

Hydrochemical characterization of alluvial and perched groundwater systems and the regional aquifer within upper Los Alamos Canyon, Los Alamos, New Mexico is required for environmental investigations. The groundwater pathway is one of the primary mechanisms for migration of solutes, including uranium, ^{90}Sr, tritium, nitrate, and other solutes. Prior to the Cerro Grande fire, alluvial groundwater varied from native calcium-sodium-bicarbonate to sodium-calcium-bicarbonate-chloride ionic composition, with increasing uranium, ^{90}Sr, bicarbonate, and other solute concentrations occurring downgradient of facility discharges. Since the fire, increasing concentrations of calcium, potassium, bicarbonate, manganese, Iron, uranium, dissolved organic carbon, and other solutes have been observed in surface water and alluvial groundwater. Calcium carbonate has precipitated within the ash as a result of the oxidation of CaC_2O_4 evolving CO gas. Rock-water interactions, including precipitation/dissolution reactions of reactive silicates and silica glass, partially control major-ion chemistry for the silica-rich solutions. Hydrolysis of volcanic glass containing silica, aluminum, and calcium, may result in the formation of amorphous $Al(OH)_3$, kaolinite, and smectite over long periods of time.

Uranium and ^{90}Sr are partially removed from solution through adsorption processes, including cation exchange and surface complexation. Hydrous ferric oxide (HFO) and hematite are stable under oxidizing conditions characteristic of alluvial and perched groundwater zones and provide active sorption sites for uranium and possibly ^{90}Sr. Smectite, kaolinite, and solid organic matter provide active surface sites for cation exchange of $^{90}Sr^{2+}$ with other divalent metals. Sorption coefficient (Kd) values for strontium measured on Los Alamos Canyon soils and channel sediments range from 15.8 to 67.7 ml/g and from 8.8 to 41.3 ml/g, respectively, suggesting that this cation is a non-conservative solute. This solute is partially removed from solution through cation exchange and surface complexation onto HFO. Distribution coefficients for strontium measured on the Bandelier Tuff, ranging from 12.3 to 34.8 ml/g, were lower than those measured

on surficial material due to smaller amounts of solid organic carbon. Calcium (Ca^{2+}), however, effectively competes for adsorption sites present on smectite and HFO, potentially decreasing the amount of $^{90}Sr^{2+}$ and uranium(VI) species available for adsorption.

Results of geochemical modeling using the computer program MINTEQA2 suggest that alluvial groundwater is undersaturated with respect to $SrCO_3$ and $SrSO_4$ and precipitation of these two minerals is unlikely from a thermodynamic basis. The isotope ^{90}Sr is considered likely to be the most important radionuclide for risk assessment in Los Alamos Canyon because of its widespread distribution in the alluvium in upper Los Alamos Canyon. Uranium(VI) species, in the forms of $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_4)_3^{4-}$, are semisorbing under alkaline pH conditions typical of alluvial and perched groundwater systems in upper Los Alamos Canyon. Elevated concentrations of dissolved uranium (48.4 µg/L) were observed in the lower perched zone (275ft-depth) within the Cerros del Rio basalt at R-9. This groundwater is characterized by a sodium-bicarbonate composition and has a pH of 8.8.

Adsorption of UO_2^{2+} onto HFO was evaluated using the computer programs MINTEQA2 and PHREEQC2.2 and applying the diffuse layer model (DLM) to the lower perched zone encountered at R-9. Approximately 57.5% (64.4 ppb) of uranium(VI), in the form of UO_2^{2+}, is predicted to adsorb onto HFO at pH9.0, which is in excellent agreement with measured suspended uranium concentrations (63.6 ppb). Dissolved uranium concentrations (47.6 µg/L) predicted by the model simulations were in very close agreement with measured uranium concentrations. Movement of uranium(VI) through a simulated column was evaluated by one-dimensional (advective and dispersive) transport modeling using PHREEQC2.2. Model results suggest that uranium(VI), in the forms of $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_4)_3^{4-}$ complexes, is capable of migrating 83 m depth to the lower perched zone within 8.3 yr under fracture flow conditions in the basalt. The results for this time step are in close agreement with suspended (adsorbed fraction) and dissolved uranium concentrations observed at borehole R-9. Colloidal transport of uranium(VI) is a viable hypothesis to explain observed distributions of uranium and its adsorption onto HFO at R-9.

Los Alamos Canyon Low Head Weir Monitoring

G. Bussod

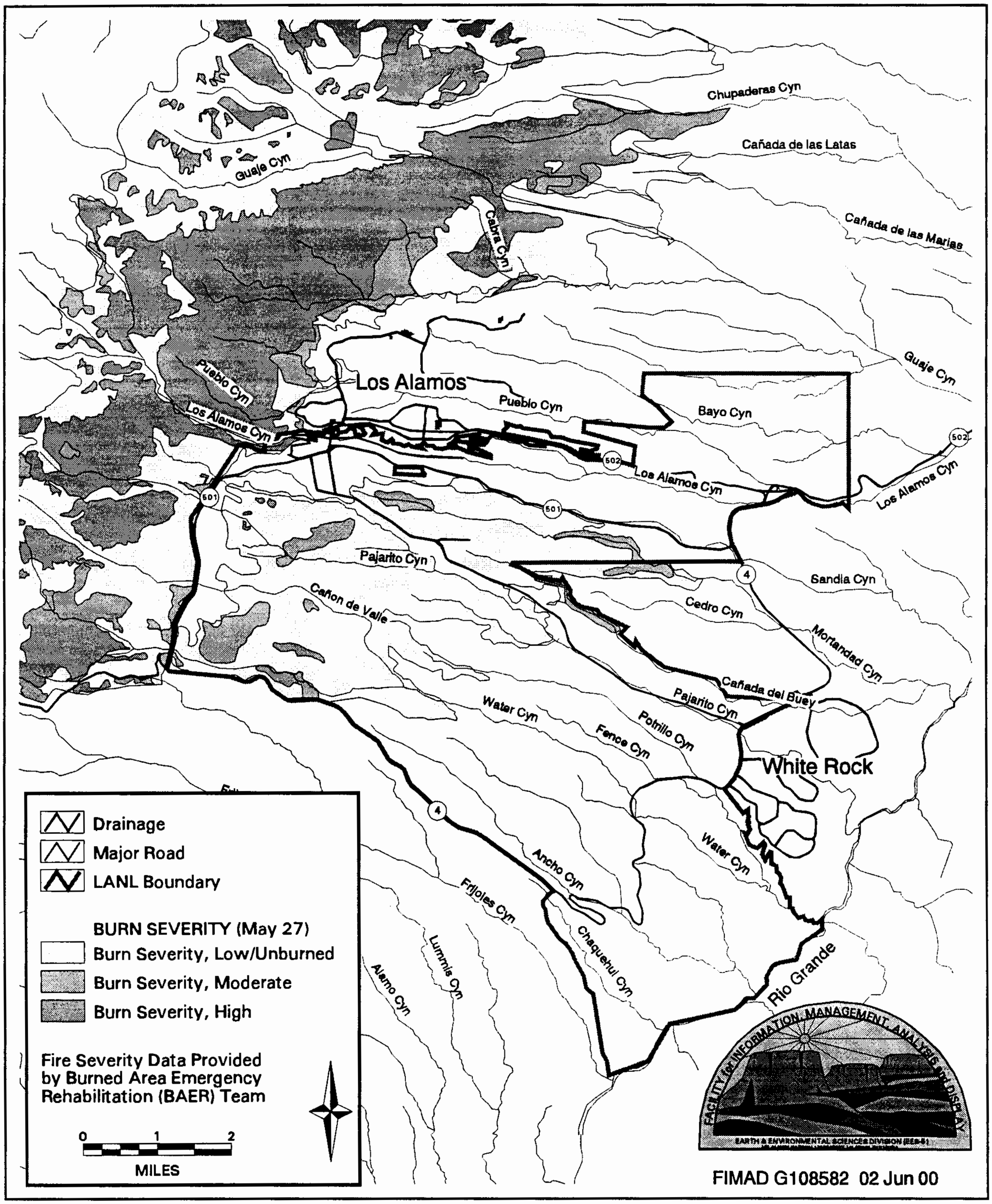
October 4, 2000

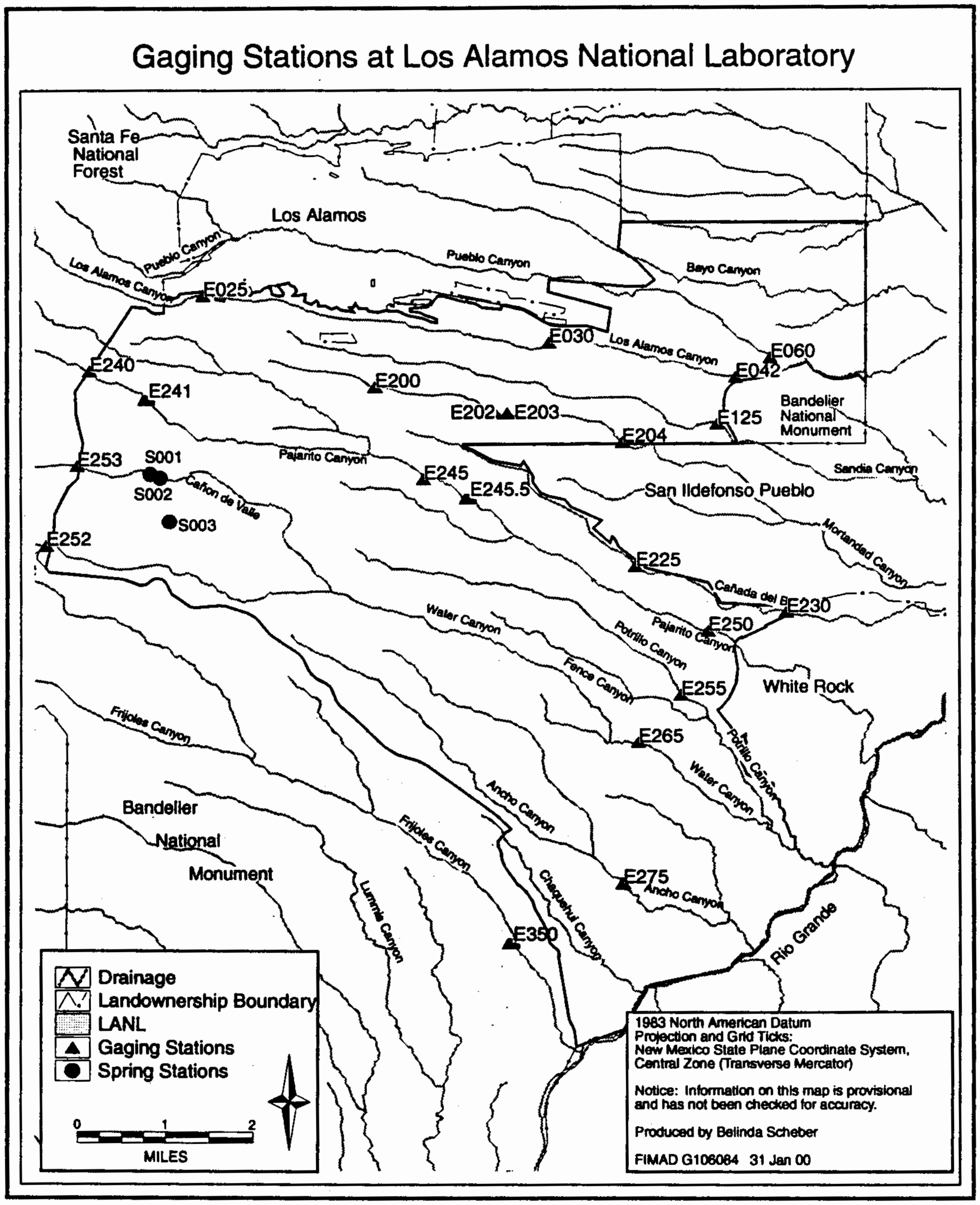
Water Quality of Post-fire Stormwater

Bruce Gallaher and Ken Mullen
Water Quality and Hydrology Group
Rich Koch
Science Applications, Inc.

Hydrogeologic Characterization
Quarterly Meeting, Oct.2000

Cerro Grande Fire Burn Severity Boundaries



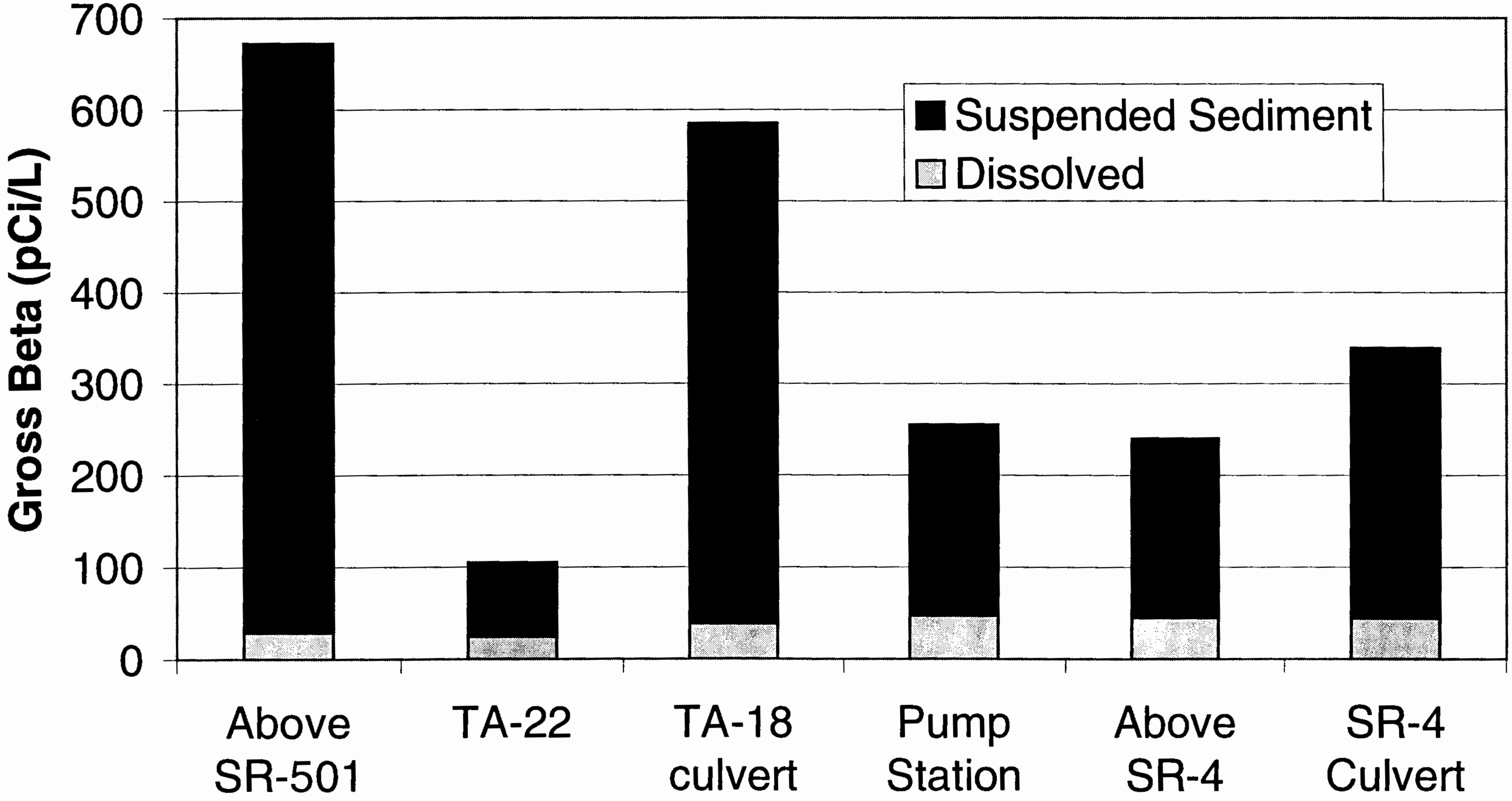


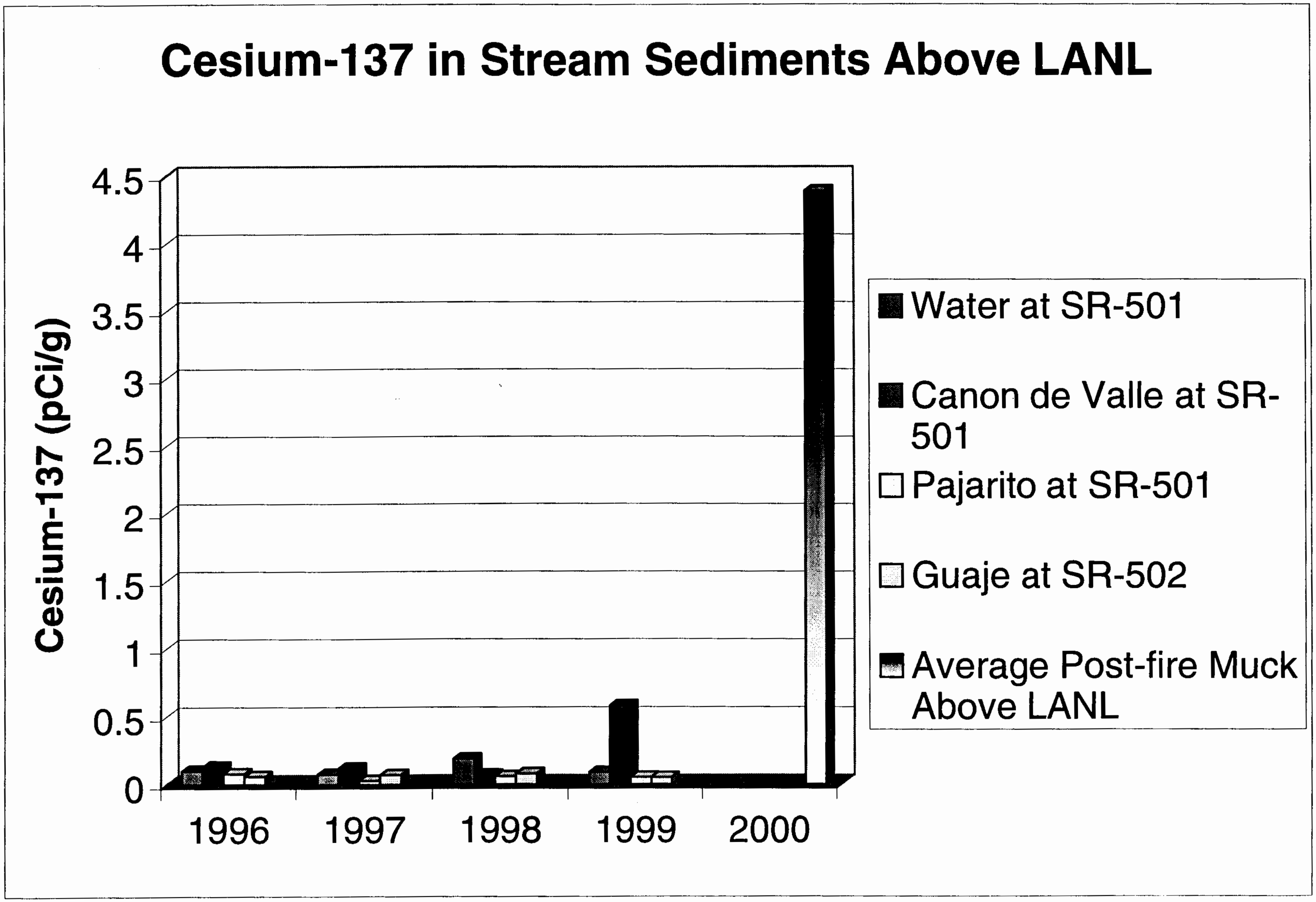
Gaging Stations at Los Alamos National Laboratory
Santa Fe National Forest
Los Alamos
Pueblo Canyon
Los Alamos Canyon
Bayo Canyon
E025
E030
E060
E042
E240
E241
E200
E202
E203
E125
Bandelier National Monument
E204
E253
S001
S002
S003
Pajarito Canyon
Cañon de Valle
E245
E245.5
San Ildefonso Pueblo
Sandia Canyon
Mortandad Canyon
E252
E225
Cañada del Buey
E230
E250
Water Canyon
Potrillo Canyon
Fence Canyon
E255
White Rock
E265
Frijoles Canyon
Ancho Canyon
Bandelier National Monument
E275
Chaquehui Canyon
Lummis Canyon
E350
Rio Grande
Drainage
Landownership Boundary
LANL
Gaging Stations
Spring Stations
0 1 2
MILES
1983 North American Datum
Projection and Grid Ticks:
New Mexico State Plane Coordinate System,
Central Zone (Transverse Mercator)
Notice: Information on this map is provisional and has not been checked for accuracy.
Produced by Belinda Scheber
FIMAD G106084 31 Jan 00

Key Trends Seen Through mid-August

- Not Detected So Far in Runoff
  - High Explosives, mercury, dioxins and furans, benzo(a)pyrene, hexachlorobenze, PCBs
- Few Organic Chemicals
- Metals and Minerals Elevated
  - for example: Mn, Ca, K, P, SO_4
- Radioactivity Dissolved in Water Comparable to Pre-fire
- Radioactivity in Sediments Elevated
  - Pu-239,240, Pu-238, Cs-137
- Cyanide detected

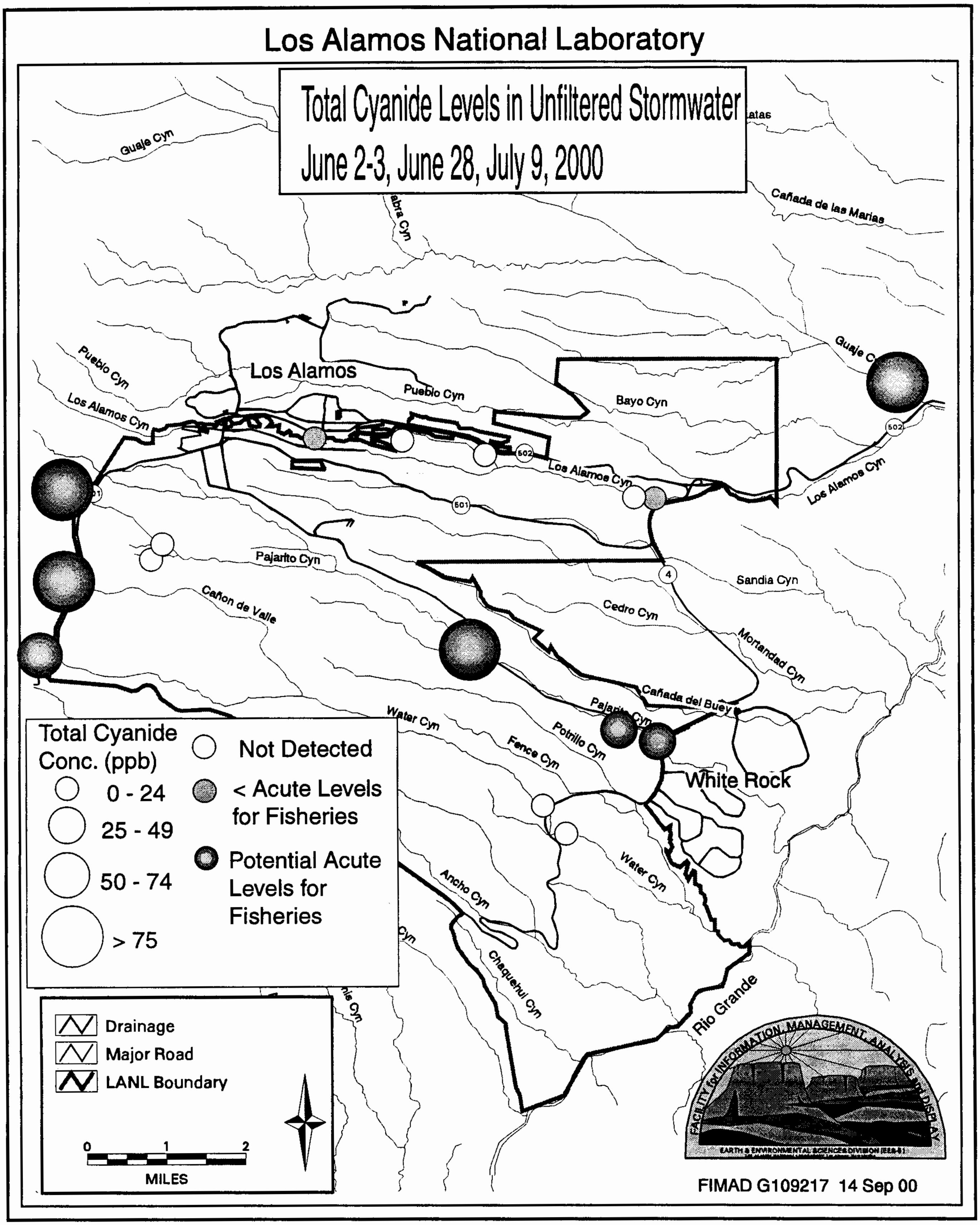
Beta Activities in Pajarito Canyon Runoff
6/28/00




Cesium-137 in Stream Sediments Above LANL
Cesium-137 (pCi/g)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
1996
1997
1998
1999
2000
Water at SR-501
Canon de Valle at SR-501
Pajarito at SR-501
Guaje at SR-502
Average Post-fire Muck Above LANL

Cyanide

- Widespread detection
  - Sediment/ash
  - Runoff
  - Below NM groundwater standards
- Source Under Study
  - Fire Retardant, Natural Combustion
  - Not LANL
- Is it persistent and biologically available?



Los Alamos National Laboratory
Total Cyanide Levels in Unfiltered Stormwater
June 2-3, June 28, July 9, 2000
Guaje Cyn
Cañada de las Marias
Pueblo Cyn
Los Alamos Cyn
Los Alamos
Bayo Cyn
Guaje C
Los Alamos Cyn
Pajarito Cyn
Cañon de Valle
Sandia Cyn
Cedro Cyn
Mortandad Cyn
Cañada del Buey
Water Cyn
Fence Cyn
Potrillo Cyn
White Rock
Ancho Cyn
Chaquehui Cyn
Rio Grande
Total Cyanide Conc. (ppb)
0 - 24
25 - 49
50 - 74
> 75
Not Detected
< Acute Levels for Fisheries
Potential Acute Levels for Fisheries
Drainage
Major Road
LANL Boundary
0
1
2
MILES
FACILITY for INFORMATION MANAGEMENT, ANALYSIS and DISPLAY
FIMAD G109217 14 Sep 00

Risk Evaluation

- All data will be reviewed by multi-agency Flood Risk Assessment Team
  - NM Environment Dept., NM Department of Health, LANL with help from pueblos and other agencies
- NM Environment Dept. DOE Oversight Bureau
  - Has hired outside contractor

Unknowns

- Changes over time
  - Literature says likely several years of recovery
  - Will monitor shallow groundwater and runoff
    - Water levels
    - Contaminants

Risk Assessment

D. Hollis

October 4, 2000