MARCH 1994

LA-12733-MS
Vol. I

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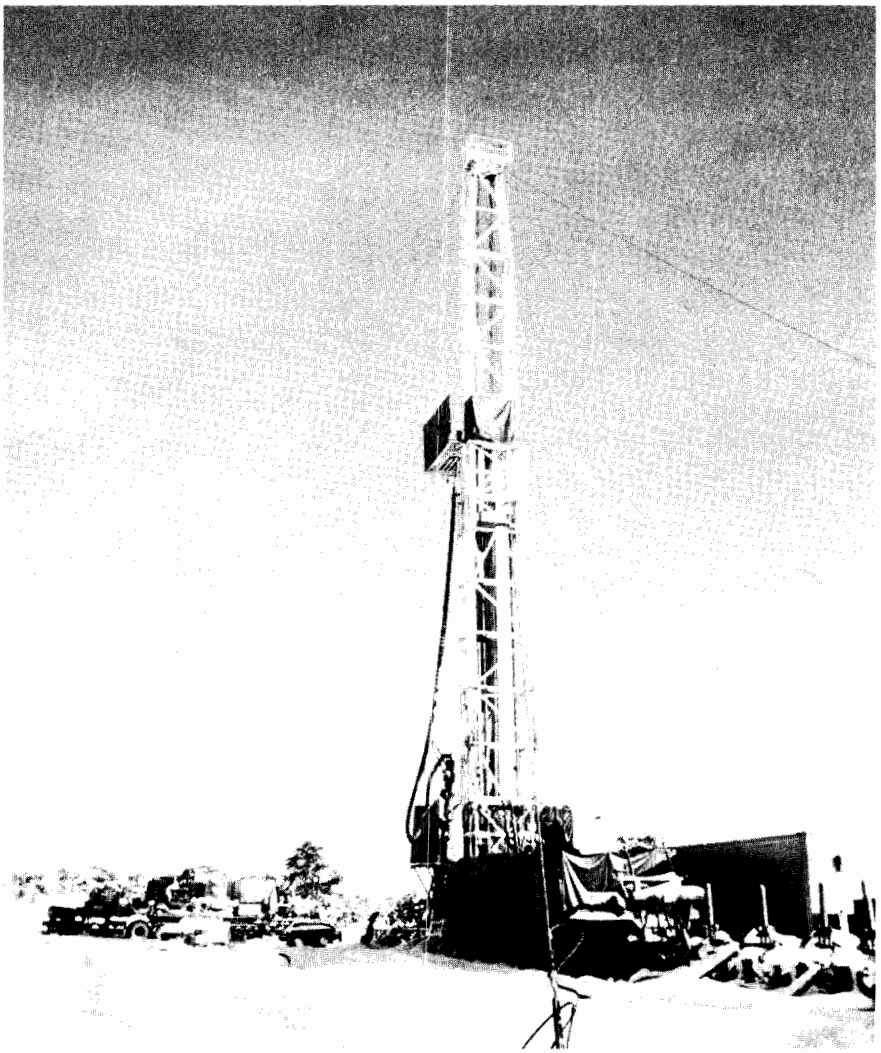

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Cover Photo: *Drilling Supply Well PM-5, January 1982, total depth 3120 feet, completed 3092 feet. Photo taken by W. Purtymun.*

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Vol. I

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Source Document Compilation: Los Alamos Investigations Related to the Environment, Engineering, Geology, and Hydrology

1961–1990

Compiled by
William D. Purtymun

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

SOURCE DOCUMENT COMPILATION: LOS ALAMOS INVESTIGATIONS RELATED TO THE ENVIRONMENT, ENGINEERING, GEOLOGY, AND HYDROLOGY 1961–1990

Compiled by

William D. Purtymun

ABSTRACT

This document is a compilation of informal reports, letters, and memorandums regarding geologic and hydrologic studies and investigations such as foundation investigations for structures, drilling or coring for environmental studies, development of water supply, or construction of test or observation wells for monitoring. Also included are replies requested for specific environmental, engineering, geologic, and hydrologic problems.

The purpose of this document is to preserve and make the original data available to the environmental studies that are now in progress at Los Alamos and provide a reference for and supplement the LAMS report "Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface water stations at Los Alamos: with Reference to the Geology and Hydrology," which is in preparation. The informal reports and memorandums are listed chronologically from December 1961 to January 1990.

Item 208 is a descriptive history of the U.S. Geological Survey's activities at Los Alamos from 1946 through 1972. The history includes a list of published and unpublished reports that cover geology, hydrology, water supply, waste disposal, and environmental monitoring in the Los Alamos area.

Contents

Chapter	Descriptive Title	Date	Page
1.	Bayo Canyon test holes	12/15/61	1-1
2.	Ultra-High Temperature Reactor	8/18/61	2-1
3.	Rocks and mineral of concrete aggregate	10/2/61	3-1
4.	Particle Accelerator Mesita de Los Alamos	11/6/63	4-1
5.	Exploratory holes Mesita de Los Alamos	2/5/64	5-1
6.	Geology at proposed Meson Facility	10/16/64	6-1
7.	Inspection of Pit 3, Area G	2/18/63	7-1
8.	Inspection of Pit 5, Area G	12/9/66	8-1
9.	Geology, loading tests Mesita de Los Alamos	12/16/66	9-1
10.	Seepage pits near Bldg. 35, TA-21	2/20/67	10-1
11.	Quality of water for use at power plant	4/7/67	11-1
12.	Geology of proposed waste pit near Bldg. 40, TA-21	3/7/69	12-1
13.	Sand with pumpage from Pajarito Field	2/18/69	13-1
14.	Hydrologic data for densely welded tuff	4/2/69	14-1
15.	Materials waste pit, Area "A", TA-21	6/30/69	15-1
16.	Geology near Bldg. 257, TA-21	7/19/69	16-1
17.	Induced radiation in tuff, Meson Facility	10/16//69	17-1
18.	Geohydrology of tuff at Mesita de Los Alamos	10/16/69	18-1
19.	Permeability of the tuff to water vapors	11/21/69	19-1
20.	Migration of tritium in tuff Area G, TA-54	7/7/70	20-1
21.	Geologic section at TA-46	2/2/71	21-1
22.	Engineering tests Area C	4/28/71	22-1
23.	Survey of storage pits Area G, TA-21	7/26/71	23-1
24.	Waste Storage Areas H,J, and L, TA-51	0/22/71	24-1
25.	Radiochemical analyses Area G, TA-54	12/2/71	25-1
26.	Logs and casing schedules heat flow holes Fenton Hill	12/22/71	26-1
27.	Geology and hydrology near TA-15	1/7/72	27-1
28.	Conversion of heat flow holes to wells	11/27/72	28-1
29.	Tentative test sites for heat penetrator experiments	4/13/73	29-1
30.	Test holes TA-56 (heat penetrator site)	5/2/73	30-1
31.	Physical and hydrologic of the Bandelier Tuff (from Geohydrology of the Pajarito Plateau with reference to the quality of water - 1949 to 1972)	May 1973	31-1
32.	Moisture content of tuff, Pit 7, Area G	12/12/73	32-1
33.	Moisture content 3 test holes Area G	2/7/74	33-1
34.	Moisture and tritium content in fill material Area G TA-54	2/13/74	34-1
35.	Test holes at Bldg. 260, TA-16	3/19/74	35-1
36.	Geohydrology for supply well at TA-57	2/2/74	36-1
37.	Flood flow and maximum discharge of sixteen drainage areas in the vicinity of Los Alamos	5/74	37-1
38.	Site selection Fusion Test Reactor	9/10/74	38-1
39.	Geologic section at Fusion Test Reactor	10/22/74	39-1

40.	Storm runoff Mortandad Canyon	10/23/74	40-1
41.	Infiltration shafts and sediment traps, Mortandad Canyon	10/25/74	41-1
42.	Inventory and movement of plutonium in Acid-Pueblo, DP- Los Alamos, and Mortandad Canyons	11/14/74	42-1
43.	Up date above memo	12/3/74	43-1
44.	Radiochemical analyses Jemez Area	10/10/74	44-1
45.	Moisture and density logging of basalt hole TA-56	3/3/75	45-1
46.	Geologic section at TA-56	9/19/75	46-1
47.	Stockpile and storage area for proposed laser Bldg. near TA-35	9/19/75	47-1
48.	Designation of sampling stations Jemez area	10/3/75	48-1
49.	Logs of test holes at TA-1	11/7/75	49-1
50.	Logs of test holes at TA-1	11/12/75	50-1
51.	Logs of test holes at TA-1	11/24/75	51-1
52.	Logs of test holes at TA-1	11/26/75	52-1
53.	Logs of test holes at TA-1	12/16/75	53-1
54.	Test holes (heat flow) Jemez Area	1/5/76	54-1
55.	Logs of test holes at TA-1	1/5/76	55-1
56.	Seepage pits DP-East (TA-21-DPE-164)	1/7/76	56-1
57.	Logs of test holes at TA-1	2/3/76	57-1
58.	Field notes hole M-1 (Horizontal holes) Area G TA-54	4/15/76	58-1
59.	Gaging Stations Rio Guadalupe and Jemez River	4/30/76	59-1
60.	Use of Iodine 131 at TA-57	5/19/76	60-1
61.	Safe level of alpha activity in evaporation ponds	5/27/76	61-1
62.	Disposal of sulfuric acid	6/24/76	62-1
63.	Estimated size of disposal ponds or shafts	10/28/76	63-1
64.	Test boring at proposed Bldg. RD-33, TA-52	12/8/76	64-1
65.	Log of test holes TA-45	4/6/77	65-1
66.	Test borings East of TA-48	11/3/77	66-1
67.	Test borings H-Division office Bldg.	11/16/77	67-1
68.	Rockfalls at proposed Tritium Bldg.	12/28/77	68-1
69.	Aquifer tests at supply well Fenton Hill	1/31/78	69-1
70.	Log of test hole near TA-22	2/1/78	70-1
71.	Logs of test holes on 2-Mile Mesa	5/15/78	71-1
72.	Logs of test holes at TA-53	6/2/78	72-1
73.	Location of heat flow hole near El Cajete	6/23/78	73-1
74.	Chemical and radiochemical analyses Bandelier National Monument	6/6/78	74-1
75.	Water temperatures in distribution system	7/20/78	75-1
76.	Log of test hole at TA-46	10/18/78	76-1
77.	Data from deep test hole on Sigma Mesa	5/4/79	77-1
78.	Aquifer, supply well Fenton Hill	5/4/79	78-1
79.	Location of exploratory holes Fenton Hill, water rights	5/14/79	79-1
80.	Foundation holes Fenton Hill	7/17/79	80-1
81.	Test holes at proposed storage pond Fenton Hill	9/7/79	81-1
82.	Test holes Fenton Hill proposed tower	10/29/79	82-1
83.	Logs at proposed site for storage pond Fenton Hill	10/29/79	83-1
84.	Water quality Santa Clara Creek	12/14/79	84-1

85.	Rockfall inspection TA-2	12/14/79	85-1
86.	Water supply Fenton Hill	3/12/80	86-1
87.	Water well #3 Fenton Hill	2/13/80	87-1
88.	Logs of test holes SM-66, TA-3	3/18/80	88-1
89.	Hydrologic characteristics of supply well #2 Fenton Hill	4/4/80	89-1
90.	Test holes at proposed pump station at TA-57 Fenton Hill	5/12/80	90-1
91.	Well location Pueblo Canyon	5/27/80	91-1
92.	Update on activities at TA-49	7/17/80	92-1
93.	Test borings Bldg. SM-200, TA-3	9/3/80	93-1
94.	Test borings Bldg. SM-102, TA-3	9/3/80	94-1
95.	Test borings MPF-16, TA-53	10/6/80	95-1
96.	Test hole near Bldg. M, TA-53	11//14/80	96-1
97.	Test holes Bayo and Pueblo Canyons	11/17/80	97-1
98.	Inspection Pit 27, Area G, TA-54	1/19/81	98-1
99.	Test hole waste demonstration site LS-6	1/19/81	99-1
100.	Rockfall inspection TA-2	2/23/81	100-1
101.	Tests hole near Bldg. M TA-53	4/7/81	101-1
102.	Characteristics of tuff HRL	4/7/81	102-1
103.	Log test holes at Waste Area C	4/8/81	103-1
104.	Inspection, addition to Pit 27, Area G, TA-54	4/29/81	104-1
105.	Test holes proposed solar pond near TA-46	5/15/81	105-1
106.	Generalized geohydrology of TA-22	5/21/81	106-1
107.	Logs of test holes solar evaporation waste ponds on Sigma Mesa	7/27/81	107-1
108.	Test borings Bldg. SM-29, TA-3	8/27/81	108-1
109.	Shaft inspection Area G, TA-54	8/31/81	109-1
110.	Geohydrology of Area L, TA-54	1/19/82	110-1
111.	Test hole west of Omega Reactor Bldg.	1/27/82	111-1
112.	Soil used for dikes around oil storage	3/16/82	112-1
113.	Test borings security and safeguards upgrading TA-41	5/24/82	113-1
114.	Test borings TA-16	7/14/82	114-1
115.	Radium 226 analyses Fenton Hill	8/6/82	115-1
116.	Oil disposal shaft Area L, TA-54	9/23/82	116-1
117.	Rockfall inspection TA-2	9/23/82	117-1
118.	Inspection of Pit 33, Area G, TA-54	10/10/82	118-1
119.	Location of shafts Area G, TA-54	12/1/82	119-1
120.	Test hole LS-6 experimental site	10/26/82	120-1
121.	Inspection of shafts in Area L, TA-54	2/15/83	121-1
122.	Inspection of shafts in Area G, TA-54	2/15/83	122-1
123.	Inspection of shafts in Area G, TA-54	4/1/83	123-1
124.	Test holes at TA-55	4/11/83	124-1
125.	Test holes near Bldg. MD-22, TA-54	5/3/83	125-1
126.	Test borings TA-51	5/25/83	126-1
127.	Test borings at TA-35	7/3/83	127-1
128.	Test holes in upper Canada del Buey	8/19/83	128-1
129.	Test holes for percolation tests at TA-51	8/22/83	129-1
130.	Test borings SM-29, TA-3	8/24/83	130-1
131.	Rockfall inspection TA-2	7/25/83	131-1

132.	Proposed barrow pit Mortandad Canyon	9/24/83	132-1
133.	Test borings in Museum Parking Lot	10//28/83	133-1
134.	Test borings Sigma Mesa	10/31/83	134-1
135.	Test borings visitor entry station Ad Bldg. TA-3	1/5/84	135-1
136.	Shaft inspection Area G. TA-54	10/31/83	136-1
137.	Pit inspection Area G. TA-54	11/16/83	137-1
138.	Location of soil sampling stations related to siting sanitary landfill	2/3/84	138-1
139.	Shaft 29 inspection Area G. TA-54	3/1/84	139-1
140.	Pit 29 excavation Area G. TA-54	3/16/84	140-1
141.	Test borings SM-410. TA-3	4/27/84	141-1
142.	Inspection shaft 31, Area L. TA-54	5/21/84	142-1
143.	Location of decontamination pit	5/21/84	143-1
144.	Test holes Bldg. 210. TA-3	5/30/84	144-1
145.	Rockfall inspection TA-2	6/15/84	145-1
146.	Test holes meteorological tower TA-16	6/28/84	146-1
147.	Inspection shaft 30. Area L. TA-54	6/28/84	147-1
148.	Subsurface investigation TA-16, weapons subsystem	7/9/84	148-1
149.	Log of test holes-Acid Sewer Line Removal	7/13/84	149-1
150.	Inspection of Pit 29-Area G-TA-54	7/13/84	150-1
151.	Test borings TA-46 and TA-55	7/18/84	151-1
152.	Test borings TA-55, Guard Tower Installation	7/18/84	152-1
153.	Test Borings At Ponds GT-2 and EE-1 TA-57	8/2/84	153-1
154.	Test Borings, road realignment near TA-55	9/10/84	154-1
155.	Proposed geohydrologic investigation at Area L	9/19/84	155-1
156.	Inspection Shaft 32, Area L	9/19/84	156-1
157.	Test borings, Kryton Fluoride Project	9/20/84	157-1
158.	Test borings advance laser addition	10/10/84	158-1
159.	Cement storage and handling system TA-55	10/10/84	159-1
160.	Shaft inspection shafts 126, 127, and 128	10/11/84	160-1
161.	Soil borings and subsurface investigation TA-16	10/18/84	161-1
162.	Subsurface investigation, tower installation TA-18	10/29/84	162-1
163.	Inspection shaft 33. Area L	11/19/84	163-1
164.	Test borings Bldg. RC-33 TA-48	11/19/84	164-1
165.	Evaporation and estimated infiltration from ponds at Fenton Hill	1/15/85	165-1
166.	Test borings Bldg. WA-200, TA-46	1/12/85	166-1
167.	Test borings SM-29, TA-3	3/6/85	167-1
168.	Inspection shaft 34 Area L	3/6/85	168-1
169.	Test borings SM-494, TA-3	3/9/85	169-1
170.	Test holes near TD-91, TA-22	7/9/85	170-1
171.	Inspection of shafts 128 through 133 Area G	8/16/85	171-1
172.	Test borings Bldg. SM-141, TA-3	8/16/85	172-1
173.	Test boring cooling tower TA-3	9/3/85	173-1
174.	Inspection shaft C-11, Area G	10/7/85	174-1
175.	Test holes Bldg. SM-200, TA-3	10/16/85	175-1
176.	Rockfall inspection TA-2	10/16/85	176-1
177.	Test borings Bldg. 200, TA-3	2/18/86	177-1
178.	Soil borings at TA-35 and TA-46	4/7/86	178-1

179.	Test hole TA-48	6/13/86	179-1
180.	Test borings Accelerator No.2, TA-53	7/22/86	180-1
181.	Construction of Retention Ponds (sediment traps) in Mortandad Canyon	8/1/86	181-1
182.	Test holes in Potrillo Canyon Rocket Sled Track	7/15/86	182-1
183.	Soil borings storage Bldg. TA-16	5/19/86	183-1
184.	Test holes Meteorological Tower TA-O	5/27/86	184-1
185.	Inspection shafts 136 and 137 Area G	7/14/86	185-1
186.	Mayfield test holes Area G (1979 ?) WDP	1987	186-1
187.	Geologic data, TA-21	5/7/87	187-1
188.	Test holes TA-59	4/23/87	188-1
189.	Test holes strain gage at TA-33	6/9/86	189-1
190.	Root Tomography holes at TA-33	6/11/87	190-1
191.	Rockfall inspection TA-2	6/17/87	191-1
192.	Test hole TA-16 package treatment plant	7/16/87	192-1
193.	Test borings MPF-3, TA-53	3/24/87	193-1
194.	Log of holes at junction SR-4 and main hill road	8/31/87	194-1
195.	Soil borings Pajarito and Puye roads	9/28/87	195-1
196.	Inspection of shafts 140 through 143	10/30/87	196-1
197.	New pump well 1, TA-57	12/2/87	197-1
198.	Test holes East Jemez Road-Telephone duck bank-	3/16//88	198-1
299.	Rockfall inspection TA-2	11/1/88	199-1
200.	Rockfall inspection TA-41	11/10/88	200-1
201.	Test holes meteorological tower north of TA-40	7/7/88	201-1
202.	Inspection of shafts 142 through 149 Area G	5/4/89	202-1
203.	Test holes TA-35 LAPRE reactor	7/7/89	203-1
204.	Rockfall TA-41	12/7/89	204-1
205.	Rockfall TA-2	1/29/90	205-1
206.	Review Installation work plan (with hydrologic properties of Bandelier Tuff and Puye Conglomerate)	6/19/90	206-1
207.	U.S. Geological Survey Ground Water Branch history of operations at Los Alamos	1946-1972	207-1

Ground Water Branch
P.O. Box 4217
Albuquerque, New Mexico
Dec. 15, 1961

Mr. William W. Kennedy
H-6, LASL
P.O. Box 1663
Los Alamos, New Mexico

Dear Bill:

Four test holes were drilled in or near Bayo Site, at your request made to John Abrahams on November 29, 1961. The purpose of these holes was to determine if water was present within the upper 100 feet of tuff, pumice, or conglomerate beneath the site.

The four test holes designated as Bayo Canyon 1, 2, 3, and 4, (see attached logs for location) were drilled with a power auger on December 7 and 8, 1961. Bayo Canyon 1, 3, and 4 penetrated the top of the conglomerate, where drilling was discontinued because of the inability of the auger to penetrate this material.

No water was found in any of the holes. Although a high moisture content in cuttings from Bayo Canyon was noted no perched water was present. The high moisture content probably represents infiltration into the tuff and pumice from flood flow in Bayo stream.

Bayo Canyon 3 and 4 will be utilized in the future for monitoring the moisture content of the tuff and pumice.

Yours very truly,

William D. Purtyman
Geologist

Attachment

cc: D. W. Mueller, GMX-5

Dist Hoyle Spring 1963

Log of Test Holes

Bayo Canyon 1 - Located or near southeast corner of firing pad.

0 - 16	Weathered tuff
16 - 57	Light gray tuff
57 - 85	Light gray pumice
85 - 89	Silt and clay with a few rock fragments

Bayo Canyon 2 - Located about 50 feet east of the southeast corner of firing pad

0 - 5	Weathered tuff
5 - 25	Gray tuff

Drilling discontinued at 25 feet because of the similar material to Bayo Canyon 1 which is near by.

Bayo Canyon 3 - Located about 150 feet northeast of main gate to Bayo Site, south of Bayo stream

0 - 12	Light brown silty sand
12 - 65	Light gray tuff and pumice. The pumice represents the interval of about 40 - 65 feet.
65 - 70	Silt and clay with some rock fragments

Bayo Canyon 4 - Located about 150 feet northeast of firing pad on south bank of Bayo stream

0 - 10	Light brown silty sand
10 - 52	Light brownish tuff
52 - 77	Light gray pumice
77 - 79	Silt and clay with a few rock fragments

Ground Water Branch
P.O. Box 4217
Albuquerque, New Mexico
August 18, 1961

Mr. C. W. Christenson
Group Leader, H-7
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

Dear Mr. Christenson:

The following information is in reply to your request of August 10, 1961. The information was compiled by John Abrahams and Elmer Baltz from data collected during ground-water investigations in cooperation with the Atomic Energy Commission.

The area selected by the Los Alamos Scientific Laboratory for the Ultra-high Temperature Reactor Facility is in the southeast quarter of sec. 23. T. 19 N., R. 6 E at an altitude of about 7,150 feet. This area is about a half mile east-southeast of the site proposed for the new waste-treatment plant, and slightly more than 1,000 feet south-southeast of the present 10-Site facilities. The Reactor facility is to be located on the south wall of 10-Site Canyon, which is immediately south of the 10-Site facilities and is a tributary canyon of Mortandad Canyon. The topographic relief in the upper part of 10-Site Canyon is about 70 feet in the vicinity of the proposed site. The area is on the western half of the Pajarito Plateau which has been dissected into a number of finger-like mesas by eastward flowing intermittent streams tributary to the Rio Grande. Mortandad Canyon and its tributaries, including 10-Site Canyon, drain the immediate area.

The proposed site of the Reactor facility is in the area investigated recently by the Geological Survey for the proposed waste-treatment plant. This part of the Pajarito Plateau is capped by the Bandelier Tuff of Pleistocene Age. The Bandelier is a welded rhyolite tuff consisting of crystal fragments, tuff breccia, and pumiceous material. The Bandelier is about 700 feet thick near 10-Site. The base of the Bandelier was encountered at an altitude of about 6,380 feet at Test Well 8 in Mortandad Canyon, three-quarters of a mile east of the proposed Reactor facility site. No bodies of water were found in the Bandelier at Test Well 8.

In the subsurface the Bandelier Tuff is underlain by the Puye Conglomerate of Pliocene (?) Age. The Puye consists of silt, sand, and gravel composed of pebbles to boulders of volcanic rocks. Basalt flows are interbedded with Puye sediments in the eastern part of the Pajarito Plateau. Test Well 8 was drilled through 575 feet of the Puye Conglomerate but did not reach the base of the formation. Water was not found in the upper part of the Puye, but was encountered in the lower part at a depth of about 985 feet below the floor of the canyon. The water rose about 25 feet in the well. This body of water, which is the main aquifer in the Los Alamos area is

at an altitude of about 5,960 feet in the vicinity of the prop ed Reactor facility.

The average annual precipitation in the vicinity of the proposed Reactor site is about 17 or 18 inches, about 25 percent of which is in the fo of snow. Generally during winter months snowfall is sufficient to maintain a layer of snow on the western part of the plateau, but in the upper parts o the canyons the depth of snow is commonly 1 or 2 feet. Most of the precipitat on here occurs during summer thundershowers, sometimes with as much as 6 o 8 inches during 1 month.

Studies indicate that little of the precipitation falling on the mesa tops filters into the Bandelier Tuff where it is overlain by soil. Probably clay in the alluvium in the canyons also inhibits or retards infiltration into the Bandelier. Data concerning the movement of water through tuff are scanty, but because the upper part of the Bandelier is moderately welded and jointed, some infiltration may occur along joints when water flows on bare rock. These joints commonly extend across and along the canyons.

Generally there is flow on 10-Site Canyon only during spring snow-melt or during summer thundershowers, although an emergency over-flow from 10-Site empties into the canyon. Radioactive liquids discharged accidentally into 10-Site Canyon would flow eastward across the Bandelier Tuff for several hundred yards, then presumably infiltrate into the alluvium in the lower part of 10-Site Canyon and in Mortandad Canyon. However, if the accident occurred during spring runoff or during a heavy summer thundershower, the wastes could be carried as a 'slug' into Mortandad Canyon or conceivably to the Rio Grande. An earth dam near the mouth of 10-Site Canyon, designed to control the release of impounded liquids, would serve as a safety feature to check accidentally discharged liquids, and to facilitate infiltration into the alluvium. Observation wells already constructed in Mortandad Canyon below the mouth of 10-Site Canyon would serve to monitor the liquids in the alluvium.

Concerning seismic conditions a brief report on the seismicity of north-central New Mexico was prepared by Dr. Stuart A. Northrop of the University of New Mexico for a February 1949 meeting of a Reactor Safety Committee at Los Alamos. A copy of this report is probably in the files of the Atomic Energy Commission. A summary of Dr. Northrop's report is as follows:

> About 94 percent of the earthquakes recorded in New Mexico in the last century have originated in the 75-mile strip along the Rio Grande Valley between Socorro and Albuquerque, mainly in the Socorro-Belen area. Most of the earthquakes have been of low intensity, but there have been numerous moderately strong shocks, and a few very strong shocks.
>
> Using the Rossi-Forel intensity scale (I equals microseismic shocks; X equals extreme intensity and general disaster), there have been 4 quakes of intensity VIII plus to IX, 6 of intensity VIII, 15 of intensity VII, 27 of intensity VI, and 33 of intensity V.

An extremely strong shock (intensity IX plus) occurred near Cerrillos on May 28, 1918, at 5:30 am. It was felt over an area of only about 45,000 square miles, with some affects at Santa Fe, Espanola, and several other places. It would have presumably attained intensity VI at Los Alamos, or possibly intensity VII with a deeper-focus quake. A quake of intensity III occurred at Chama in 1939.

Seismologists generally believe that a region of high frequency (such as New Mexico) with quakes of intensity less than VIII may be fairly safe because these frequent shocks act as a safety valve and relieve earth stress before it can accumulate in force to produce a violent shock of intensity IX or X.

However, a shock did occur at Los Alamos on August 17, 1952. The shock was brief and of intensity V, according to the official report published in "Abstracts of earthquake reports for the Pacific Coast and the Western Mountain region", MEA-75, July, August, and September, 1952, issued by the U.S. Coast and Geodetic Survey.

Although few quakes have occurred near Los Alamos, this area is on the Rio Grande structural trough near faults of large magnitude. Thus, earthquakes might be expected to occur at any time, and the Los Alamos area might experience tremors from quakes originating in other parts of the trough. There is no geologic evidence to indicate that intensive earthquakes have occurred recently in this region.

Very truly yours,

William E. Hale
District Engineer

JHA/mwm

cc: Branch Area Chief, GW, Denver

Ground Water Branch
P.O. Box 3217
Albuquerque, New Mexico
Oct. 2, 1961

Mr. George Best
Group K-1
Los Alamos Scientific Laboratory
P.O. Box 1663
Los Alamos New Mexico

Dear Sir:

Following our telephone conversation on September 29, this information on rocks and minerals that make up concrete aggregate for a seal on a disposal area was compiled.

Analyses of average granite, quartzite, "basic" and "acid" volcanics are shown on the attached table. These give approximations of the chemical constituents of these rock types.

The chemical formula for quartz and chert is SiO_2.

The feldspar group of minerals consists of orthoclase and microcline and the plagioclase feldspar series. The formula for orthoclase and microcline is $KAlSi_3O_8$. The plagioclase feldspar series forms an isomorphous series from pure albite $NaAlSi_3O_8$ to anorthite $CaAl_2O_8$. The predominate feldspar probably present in the concrete aggregate is orthoclase because of its resistance to weathering and its abundance as phenocrysts in granite and acid volcanic rocks.

The information was collected from "Rocks and Minerals" by Louis V. Pirsson, "Dana's Manual of Mineralogy" revised by C. S. Hurlbut, Jr. and "Igneous and Metamorphic Petrology" by F. J. Turner and Jean Verhoogen.

Please call us if we can be of further assistance.

Yours truly,

William D. Purtyman
Geologist

WDP/mwm

		SiO_2	Al_2O_3	Fe_2O_3	FeO	MgO	CaO	Na_2O	CO_2	K_2O	P_2O_5	TiO_2	MnO	H_2O	X_yO 1/	Total
Granite	1	77.0	12.0	0.8	0.9	0.0	0.8	3.2		4.9				0.3	0.1	100.3
	2	71.6	14.5	1.5	1.1	0.9	2.0	3.0		4.1				0.8	.5	100.0
Basic Volcanics	3	49.1	15.7	5.4	6.4	6.2	9.0	3.1		1.5				1.6	2.0	100.0
	4	47.26	14.91	2.53	9.59	8.05	9.98	3.13		1.20	0.69	2.48	.18			100.0
Acid Volcanics	5	75.6	12.7	1.2	.34	.12	.59	4.0	<.05	4.6	.05	.18	.04	.46		100
Quartzite	6	97.71	1.39	1.25	-	.13	.18									100.66
	7	74.22	10.61	7.45	.85	1.48	.56	2.12		1.08				1.79		100.15

1/ XyO represents small quantities and traces of other oxides

1. Granite, Sentinel point, Pikes Peak, Colo. (Pirsson, 1948)
2. Average biotite granite, average 90 analyses (Pirsson, 1948)
3. Average 198 analysis of basalt by R.A. Daley (Pirsson, 1948
4. East Otago Pliocene, average 5 olivine basalts (Turner and Verhoogan 1951
5. Rhyolite tuff, Los Alamos County, N. Mex. (U.S. Geological Survey 1960)
6. Pure quartzite, Chickies Station, Penn. (Pirsson, 1948)
7. Impure quartzite, Pigeon Point, Minn., contains small quantities of feldspar, mica, chlorite, and magnetite (Pirsson, 1948)

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
GROUND WATER BRANCH
P.O. BOX 4217
ALBUQUERQUE, NEW MEXICO

Nov. 6, 1963

Mr. C. W. Christenson
Group Leader H-7
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

Dear Chris:

The following information is in response to your verbal request of October 31, 1963. The information was compiled from data collected during ground-water investigations in cooperation with the Los Alamos Scientific Laboratory and the Atomic Energy Commission and is found in the following reports: Griggs, R. L., 1955, Geology and groundwater resources of the Los Alamos area, New Mexico: U.S. Geol. Survey administrative report to the AEC, 219 p., 17 figs.; Weir, J. E., Jr., and Purtymun, W. D., 1962, Geology and hydrology of Technical area 49, Frijoles Mesa, Los Alamos County, New Mexico: U.S. Geol. Survey administrative report to AEC and LASL, 225 p., 62 figs.; and Baltz, E. H., Abrahams, J. H., Jr., and Purtymun, W. D., 1963, Preliminary report on the geology and hydrology of Mortandad Canyon near Los Alamos, N. Mex., with reference to disposal of liquid low-level radioactive waste: U.S. Geol. Survey open-file report, 104 p., 13 figs.

The area selected by the Los Alamos Scientific Laboratory for the new "high speed particle accelerator" is in the northern half of sec. 24, T. 19 N., R. 6 E. on the Mesita de los Alamos which is part of the Pajarito Plateau. The Pajarito Plateau is dissected into a number of finger-like mesas by eastward flowing intermittent streams tributary to the Rio Grande. Mesita de los Alamos is one of these finger-like mesas that is bounded on the north by Los Alamos Canyon and on the south by Sandia Canyon. The width of the mesa ranges from about 800 to 2,200 feet. There is a small east-west ridge along the northern edge of the mesa and the surface of the mesa slopes southward from the ridge at an altitude of about 7,020 feet to an altitude of about 6,920 feet along the southern edge of the mesa. Los Alamos and Sandia Canyons have been cut 200 to 400 feet below the surface of the mesa.

Mesita de los Alamos is capped by the Bandelier Tuff of Pleistocene age. Underlying the Bandelier Tuff are rocks of the Santa Fe Group of Middle (?) Miocene to Pleistocene age. The rocks of the Santa Fe Group in ascending order are the Tesuque Formation and the Puye Conglomerate which contains interbedded basaltic rocks of Chino Mesa.

The Tesuque Formation of the Santa Fe Group is a sequence of light-colored sediments laid down as flood-plain deposits in the Rio Grande depression. It is composed of friable to moderately well-cemented beds of siltstone and sandstone with some conglomerate and clay lenses. The total thickness of the unit in the region exceeds [illegible],400 feet as interpreted from well logs and exposures in lower Los Alamos Canyon.

Overlying the Tesuque Formation is the Puye Conglomerate composed of two members. The lower member is a poorly consolidated channel-fill deposit called the Totavi Lentil which is composed of arkosic and quartzitic debris, from sand to boulder size. The upper member the fanglomerate member is made up of volcanic debris and is interbedded with the basaltic rocks of Chino Mesa. The Totavi Lentil member consists of pebbles, cobbles, and boulders of rhyolite, latite, quartz latite, and pumice in a matrix of silt and sand. The thickness of the Puye Conglomerate and basalts exceeds 640 feet at test well 3 (SE¼SE¼SW¼ sec. 13, T. 19 N., [illegible] 6 E.), in Los Alamos Canyon north of Mesita de los Alamos. Test well 3 bottomed within the Puye Conglomerate at an altitude of [illegible],510 feet. A basalt flow was encountered in the fanglomerate member at a depth of 266 to [illegible] feet or at an altitude of 6,359 to [illegible],237 feet.

The Bandelier Tuff overlies the fanglomerate member and dips gently eastward. It consists of ash-fall and ash-flow rocks that are draped over the older rocks, filling the lows and smoothing out the topography of the older rocks. The Bandelier Tuff is composed of three members. In ascending order they are: the Guaje Member, an ash-fall pumice found in the subsurface at Mesita de los Alamos; the Otowi Member, a friable ash-flow that is exposed in the lower wall of Los Alamos and Sandia Canyons adjacent to Mesita de los Alamos; and the Tshirege Member, a series of ash-flow tuffs which form Mesita de los Alamos.

The Guaje Member of the Bandelier Tuff is composed of lump pumice fragments consisting of glass shards, and quartz and sanidine crystals in a cellular structure of pumice. At test well [illegible], the Puye-Guaje contact is at an altitude of [illegible],450 feet and the Guaje-Otowi contact is at an altitude of [illegible],[illegible] feet, thus the Guaje Member is [illegible] feet thick in that well. The Otowi Member consists of a light-gray pumiceous rhyolite tuff which is friable or partly welded. It contains quartz crystals, glass shards, and minor amounts of mafic minerals and varying amounts of rhyolite, latite, and pumice fragments in a fine-grained ash. The Otowi Member is [illegible] feet thick at Mesita de los Alamos. The Otowi-Tshirege contact occurs at an altitude of [illegible],[illegible]0 feet in the wall of Los Alamos Canyon near test well [illegible]. The Tshirege Member is composed of a series of ash flows of rhyolite tuff which contain quartz and sanidine crystals and fragments, some mafic minerals and rock fragments of gray rhyolite and latite in a fine ash matrix. The ash flows vary from a barely welded to a densely welded tuff. The Tshirege Member is about 300 feet thick under the ridge at Mesita de los Alamos.

The rocks of the Bandelier Tuff at Mesita de los Alamos covers the older rocks and obscures any pre-Bandelier structure. Pajarito Fault Zone is about 5 miles to the east; however, movement in this zone probably occurred shortly after the deposition of the tuff in Pleistocene time. Several small faults in the Tesuque Formation have been noted in Los Alamos and Guaje Canyon about 7 miles to the northwest. The movement on these faults occurred long before the end of Pleistocene time. There is no evidence of post Bandelier faults on the Pajarito Plateau in the area of Mesita de los Alamos.

Concerning seismic conditions, a brief report on the seismicity of north central New Mexico was prepared by Dr. Stuart A. Northrop of the University of New Mexico for a February 1949 meeting of a Reactor Safety Committee at Los Alamos. A copy of this report is probably in the files of the Atomic Energy Commission. A summary of Dr. Northrop's report is as follows:

> About 94 percent of the earthquakes recorded in New Mexico in the last century have originated in the 75-mile strip along the Rio Grande Valley between Socorro and Albuquerque, mainly in the Socorro-Belen area. Most of the earthquakes have been of low intensity, but there have been numerous moderately strong shocks, and a few very strong shocks. Using the Rossi-Forel intensity scale (I equals microseismic shocks; X equals extreme intensity and general disaster) in the Rio Grande Valley there have been 4 quakes of intensity VIII plus to IX, 6 of intensity VIII, 15 of intensity VII, 27 of intensity VI, and 33 of intensity V. An extremely strong shock (intensity IX plus) occurred near Cerrillos on May 28, 1918, at 5:30 am. It was felt over an area of only about 45,000 square miles; however, plaster fell at Santa Fe and people were awakened at Espanola, and several other places. It would have presumably attained intensity VI at Los Alamos, or possibly intensity VII with a deeper-focus quake. A quake of intensity III occurred at Chama in 1934.
>
> Seismologists generally believe that a region of high frequency (such as New Mexico) with quakes of intensity less than VIII may be fairly safe because these frequent shocks act as a safety valve and relieve earth stress before it can accumulate in force to produce a violent shock of intensity IX or X.

A shock did occur at Los Alamos on August 14, 1952. The shock was brief and of intensity V, according to the official report as published in Abstracts of earthquake reports for the Pacific Coast and the Western Mountain region, MSA-4, July, August, and September, 1952, issued by the U.S. Coast and Geodetic Survey.

Although few quakes have occurred near Los Alamos, this area is on the Rio Grande structural trough near faults of large magnitude. Thus, earthquakes might be expected and the Los Alamos area might experience tremors from quakes originating in other parts of the trough.

The streams are intermittent in Sandia and Los Alamos Canyon adjacent to Mesita de los Alamos. The static water level in test well 3 is at an altitude of 5,370 feet and probably coincides with the upper surface of the main ground-water body. This surface is in Puye Conglomerate. Movement of water in the main ground-water body is toward the east. No water was found above the main ground-water body at test well 3.

Sincerely yours,

William D. Purtymun

William D. Purtymun
Geologist

WDP/m

cc: Branch Area Chief, GW, Denver, Colo
Willia Kennel, H-6, LASL
Charles Wenritt, Eng. 1, LASL
Edwin Wingfield, AEC

DM-94

Ground Water Branch
P.O. Box 4217
Albuquerque, New Mexico
February 5, 1964

Mr. Charles R. Wherritt
Engineering 1
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

Dear Mr. Wherritt:

Covering the request of C. W. Trask, Engineering 1, LASL, and of Edwin Wingfield, Chief, Project Support Branch AEC, representatives of the U.S. Geological Survey were present during foundation testing at the proposed Meson factory site on Mesita de los Alamos.

Six exploratory holes were cored or drilled from 30 to 50 feet beneath the proposed foundation level which is at an elevation of 6,970 feet. Core recovery below the foundation level was complete in holes "A" and "B", less than 20 percent recovery in holes "C", "D", and "E" and no recovery in hole "F".

Penetration tests were made by the contractor, Alpha Testing Laboratory of Albuquerque, in holes "C", "D", "E", and "F" to determine the bearing capacity of the tuff where no cores were recovered for testing in the laboratory.

The foundation holes were left open for access with density and moisture measuring equipment. The moisture content and density of the tuff adjacent to the wall of the hole was determined by neutron scattering moisture equipment and gamma ray emitting density equipment respectively.

The moisture content of the tuff was less than 5 percent by volume below the elevation of the proposed foundation level. Study of the distribution of moisture in the tuff in the Los Alamos area indicate that the natural moisture content of the tuff beneath the mesas is generally less than 5 percent by volume in areas where the soil cover and natural drainage have not been disturbed.

The density measurements of the tuff were made to detect any vertical and horizontal density changes which may effect the bearing capacities of the tuff and to make available data to correlate bearing capacities of the tuff as determined by Alpha Testing Laboratory with the zones of varying density in the tuff

The attached figure illustrates a correlation of these different zones. The densities are divided into two classifications: Tuff with density from 95 to 105 lbs/cu. ft. (pounds per cubic foot) and 105 to 115 lbs/cu.ft.

Density measurements were made at four foot intervals in the borings. The zonal changes in density of the tuff are not necessarily abrupt changes but are of a gradual change which can occur over a four to eight foot interval.

Core was not recovered in zones of the tuff with a density of 95 to 105 lbs/cu.ft. while partial recovery to total recovery was made in zones with a density of 105 to 115 lbs/cu.ft.

Correlation of zonal densities of the tuff were uniform (see attached figure). Alternate changes in density occurred in hole "D" which was the deepest hole.

The changes in vertical density are due to different degrees of welding when the tuff was emplaced as a hot ash flow with the denser welding occurring near the center of the flow.

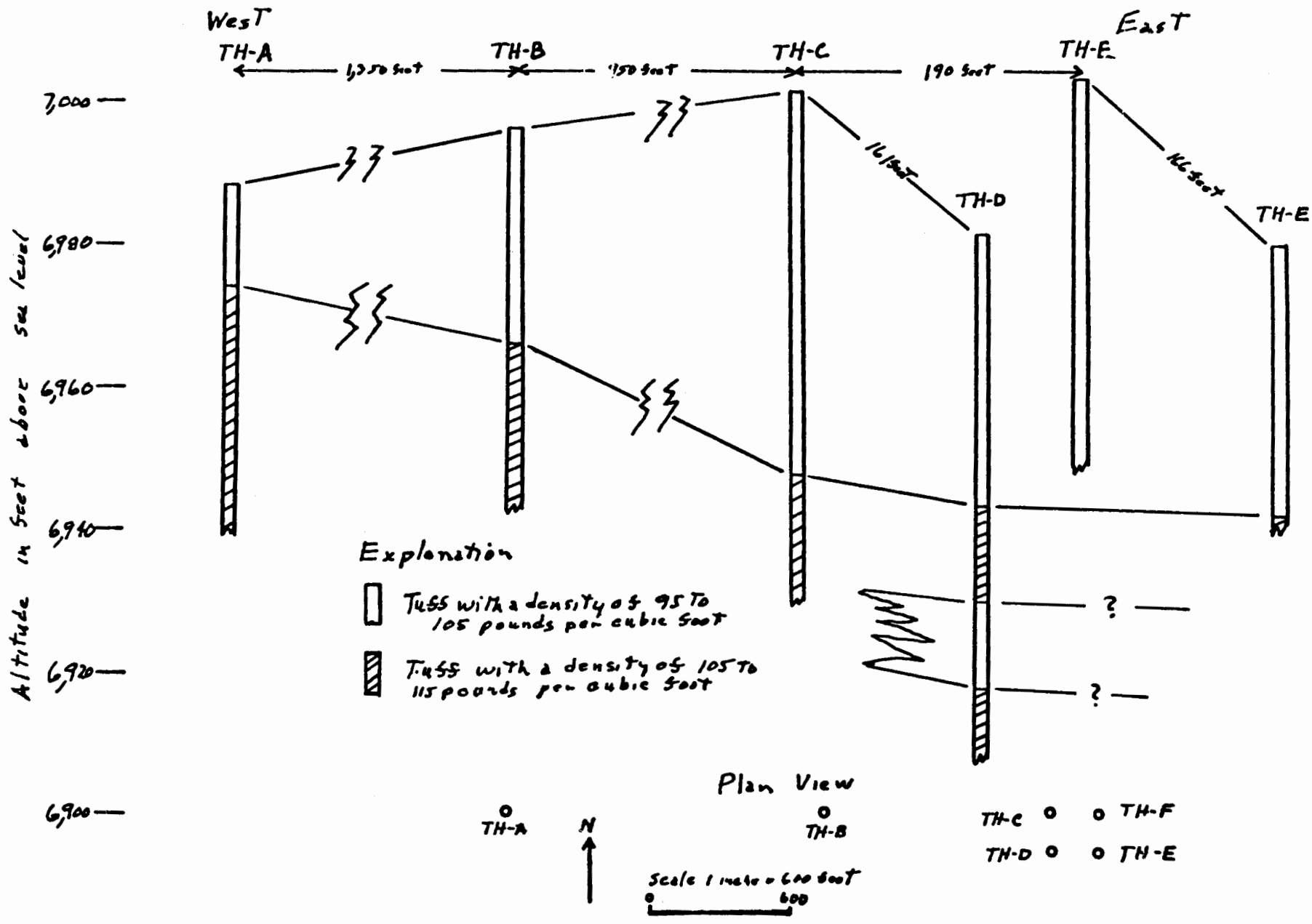
A brief description of the geology in the area of Mesita de los Alamos in a letter report was sent to C. W. Christenson on November 6, 1963 with copies to your office. If we can be of further service please feel free to call on us.

Yours very truly,

William D. Purtymun
Geologist

cc: Branch Area Chief,
Ground W ter Branch, Denver, Colo.

Edwin Wingfield, AEC, Los Alamos



Cross section and plan view of 6 Test holes at Mesita de los Alamos showing density characteristics of The Tuff

nm 94

Ground Water Branch
P.O. Box 4217
Albuquerque, New Mexico
Oct. 16, 1964

Mr. Cecil E. Bingham
Construction Branch
U.S. Atomic Energy Commission
Los Alamos, New Mexico

Subject: Geology at proposed Meson Factory

Dear Mr. Bingham:

The following information is in response to your verbal request of October 13, 1964 concerning the geology at the proposed Meson Factory on Mesita de los Alamos.

The structure is to be built on the Tshirege Member of the Bandelier Tuff. It is about 250 feet thick at the proposed "site" area. The Bandelier Tuff is over 500 feet thick and is a pyroclastic rock made up of a large number of volcanic ash flows and falls that have been subsequently hardened by heat and pressure. The Tshirege Member of the Bandelier Tuff is the upper unit and is composed of a series of hardened ash-flows of rhyolite tuff which contains quartz and sanidine crystals and fragments, some mafic minerals and rock fragmehts of gray rhyolite and latite in a fine ash matrix. This ensemble of materials has been physically bonded in such a way that it became a tough and resistant material shown by the vertical cliffs along the edges of the mesas.

The individual ash flows in the Tshirege Member may range from 20 to 120 feet in thickness. Thin lens-like shapes of pumiceous material may occur between these flows. Preliminary borings (up to 38 feet below the foundation level) did not encounter any of this pumiceous material.

Test borings at the site indicated the unconfined compressive strength tests made on tuff cores ranged from 20 to 60 tons per square foot, while penetration tests (made on the tuff where no cores were recovered) indicate that a bearing capacity of 7,000 pounds per square foot could be used in the design of the foundation. (Alpha Testing Laboratories report to LASL on February 5, 1964).

The following geologic section is for your information. It was interpreted from the Mesita de los Alamos subsurface conditions, from measurements of outcrops of adjacent canyon walls, and from the lithologic log of test well 3 in Los Alamos Canyon immediately north of the area.

Foundation Elevation of proposed structure at Meson Factory
6,970 feet above sea level.

	Thickness (feet)	Depth (feet)
Bandelier Tuff		
Tshirege Member, consisting of hardened volcanic ash-flows partly to densely welded rhyolite tuff.	250	250
Otowi Member consisting of ash-flow of partly welded rhyolite tuff	235	485
Guaje Member consisting of lump pumice	35	520
Puye Conglomerate		
Fanglomerate Member consisting of moderately well consolidated gravels and boulders	91	611
Basalt	122	733
Fanglomerate member consisting of moderately consolidated gravels and boulders. Test well 3 bottomed in this formation at an elevation of 5,810 feet	427	1,160

Wh is at about 1,100 feet

Sincerely yours,

William D. Purtymun
Geologist

cc: Austin McGuire, LASL
Edwin C. Wingfield AEC

Ground Water Branch
P.O. Box 4217
Albuquerque, New Mexico
February 18, 1963

Mr. Dean Meyers
H-1 LASL
P.O. Box 1663
Los Alamos, New Mexico

Dear Dean:

Bill Kennedy, Charles Darnett, and I made a brief inspection on February 6, 1963 of the recently completed disposal pit at Mesita del Buey, (Area "G" pit no. 3). Bill requested that I transmit to you some of my impressions as to the condition of the pit for disposal use.

The soil cover ranges from about 1 to 2 feet thick. The tuff below the soil zone appears to be dry. Investigations in the Los Alamos area have shown that very little water moves into the tuff where the soil cover has not been disturbed.

The lithologic character of the tuff in the pit is the same as that of the tuff in the other pits in the area. The zone of soft pumice fragments at a depth of 20-25 feet in pit number 2 was not as well developed as in the new pit; the pumice fragments are smaller and wider spaced in the tuffaceous matrix.

Numerous joints in the tuff are exposed along the walls of the pit. The joints range from open to closed with clay or alteration products. Most of the joints are near vertical and beneath the soil zone are clay filled. In general the joints appear to be the same type that occur in adjacent pits.

The surface of the mesa slopes toward the east and southeast which makes the east rim the low rim of the pit. Fill from excavation of the pit is piled over the soil zone on the east side of the pit to raise the altitude of that rim. Filling of the pit with waste material should be completed below the soil zone as heavy precipitation may cause erosion of the artificial east rim and expose some of the wastes or allow water to move radioactive contaminants out of the pit on to the surface of the mesa.

There should be little danger of water moving radioactive contamination from the waste material in the pit into the adjacent canyons, if the pit, when filled, is sealed with a material which would restrict infiltration of precipitation.

Little is known of the hydrologic characteristics of the crushed tuff that now is used to seal over waste disposal pits. A field study utilizing the neutron-neutron scattering moisture probes and the access tubes installed in a disposal pit that is filled and sealed is planned in the future to determine the depth of infiltration into the seal material from precipitation and the loss of moisture by evaporation.

The new pit appears to be similar to the adjacent pits, indicating that the new pit is suitable for the disposal of radioactive waste solids.

We plan to make a detailed map of the east and west wall of the pit when the weather permits.

Yours truly,

William D. Purtyman
Geologist

cc: William Kennedy H-6
Ted Russo EHO - 3

Room 115, Federal Building
Santa Fe, New Mexico
87501

December 9, 1966

Mr. Dean Meyers
Group Leader
H-1, LASL
P. O. Box 1663
Los Alamos, New Mexico

Dear Dean,

An inspection of the new disposal pit, Area G Pit No. 5, was made on December 6, 1966. Bill Kennedy requested that I transmit to you some of my impressions as to the conditions of the pit for disposal use.

The disposal pit is about 100 feet wide, 600 feet long, and with a maximum depth of 29 feet. An inner pit is about 50 feet wide, 400 feet long, and has a maximum depth of 5 feet. The long dimension of the pit is east-west.

The pit was constructed into two ash flows of the Bandelier Tuff. The contact between the flows is marked by a pumice zone which is well exposed on the north wall of the pit and along the western half of the south wall. The rim of the eastern half of the south wall has been cut and eroded below the contact. The ash flow units are of rhyolite tuff and are the same units as found in pits Nos. 2 and 4. Both units in this area are of fairly competent rocks that would form a stable cut in the tuff; however, the numerous joints which are near vertical and strike in random directions have caused some large slabs of the tuff to dislodge from the walls of the pit. This is caused by intersection of joints behind the cut face. John Enders has informed me that the pit will not be used until these slabs are scaled from the wall (safety measures have been taken by H-1, as the entrance of the pit roped off and posted). The joints exposed in the walls of the pit range from closed to open as much as 1 inch; however, the joints immediately below the soil zone are filled with clay or altered material. Any open joints in the floor of the pit are filled with crushed tuff due to traffic of equipment used during construction. No open joints that would require filling were noted.

The soil cover exposed in the walls of the pit ranges from about 0.5 foot to about 3 feet. Along the south wall of the pit from about sections 2+75 to 3+90 feet the upper 8 to 4 feet of the wall consists of fill material as the present pit was cut into the ramp leading into Pit No. 3 which is now filled and covered.

The land surface around the pit slopes gently to the southeast from an altitude of 6,678 feet at the northwest corner to an altitude of 6,658 feet at the southeast corner. The bottom of the inner pit is at an altitude of 6,643 which is about 50 feet above the floor of Canada del Buey and Pajarito Canyon.

The disposal pit is suitable for disposal of solid or package wastes as it meets the guidelines for pit construction set forth in a conference between Eng. 3, H-1, H-6, H-7 of the Los Alamos Scientific Laboratory and the U. S. Geological Survey held at Los Alamos on June 23, 1965. The guidelines are summarized in a letter to Mr. Ted Russo, Eng. 3, dated June 30, 1965 from F. C. Koopman, U. S. Geological Survey.

If we can be of any further assistance please feel free to contact us.

Yours truly,

William D. Purtymun

for: W. R. Hale
District Chief, WRD

cc: Wm. Kennedy, Group Leader
LASL, H-6

Salvatore Russo, Group Leader
LASL, Eng. 3

George Hilton, Chief
Construction and Maintenance, AEC

9-213-F
(March 1949)
Cross-Section—Double

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

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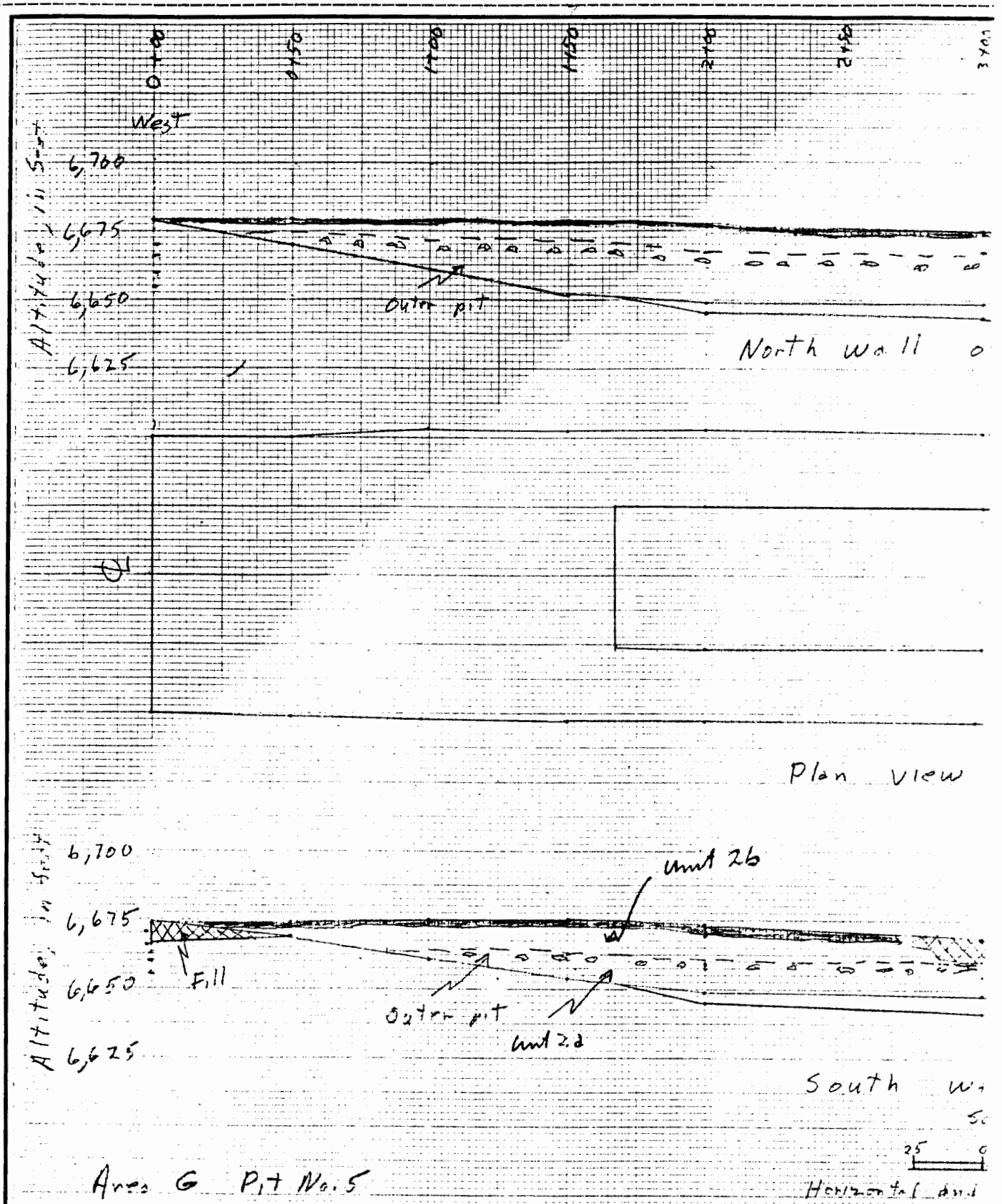

Area G Pit No. 5

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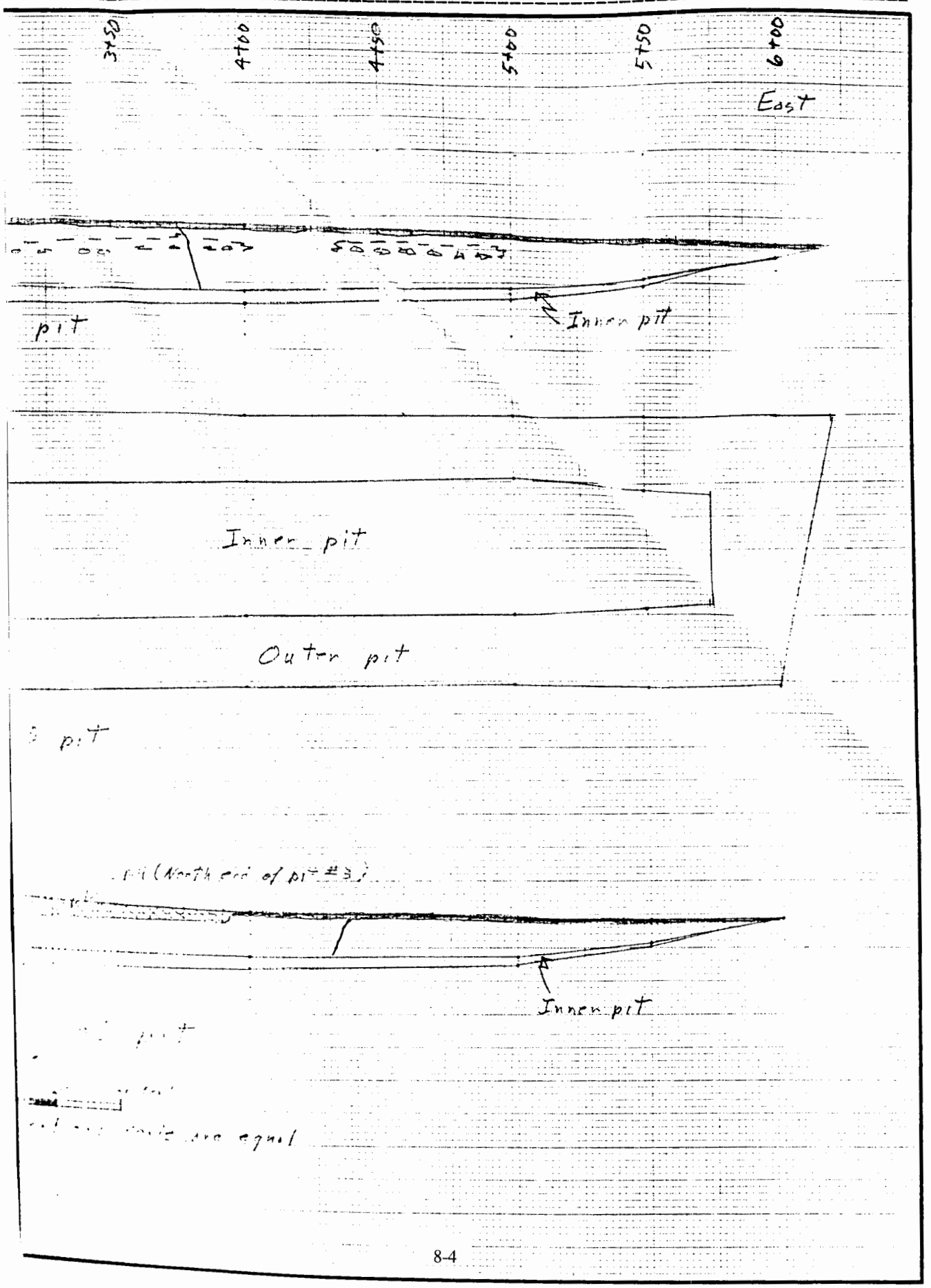


U. S. GOVERNMENT PRINTING OFFICE : 1958 OF—476257

Room 115, Federal Building
Santa Fe, New Mexico

December 16, 1966

Mr. C. W. Trask
Eng. 1, LASL
P. O. Box 1663
Los Alamos, New Mexico

Dear Wes,

Dean Keller, Eng. 1, has kept us advised on the progress of the study to determine the deformation of the tuff by loading tests. The tests being conducted on Mesita de los Alamos and Mesita del Buey are a part of the foundation investigation for the Meson Facility. Dean requested some geologic information on the test areas in accordance with your memorandum to F. R. Tesche, MP-DO, dated July 26, 1966. The following information was compiled from a previous investigation at Mesita de los Alamos. A stratigraphic section was measured at Mesita del Buey at Pajarito Reservoir No. 2. These geologic units were correlated with a similar section at Mesita de los Alamos near the proposed location of the Meson Facility Experimental Building. Correlation of the various geologic units in the sections were made to determine the geology underlying the test areas and the unit in which the tests are being conducted.

General description of the near surface rocks, Mesita de los Alamos and Mesita del Buey are a part of the Pajarito Plateau that is formed by the Tshirege Member of the Bandelier Tuff. The Tshirege Member, a series of ash flows of rhyolite tuff, is composed of quartz and sanidine crystals and crystal fragments, with rock fragments of pumice latite and rhyolite in a fine ash matrix. The amount and size of the quartz sanidine, pumice, latite, and rhyolite vary in each of the ash flows as does the degree of welding of the ash matrix.

The degree of welding is classified at Los Alamos as nonwelded, moderately welded, and welded tuff. The transition between nonwelded (porosity as much as 60 percent) to welded tuff (porosity as small as 15 percent) is due to compaction and fusing by heat of the crystals, crystal fragments, and rock fragments in the ash matrix. The degree of welding and the amounts and size of pumice, latite, and rhyolite rock fragments determine the physical characteristics of the tuff (i.e., porosity, density and bearing capacity).

Units of the Tshirege Member, The Tshirege Member of the Bandelier Tuff has been divided into five geologic units at Mesita de los Alamos. These units correlate with similar units to the south at Mesita del Buey (figure 1). The units from the oldest to youngest are 1a, 1b, 2a, 2b, and 3

Unit 1a is a light orange to light brown pumiceous tuff breccia. It contains numerous pumice fragments which may be as much as 6 inches in length, small quartz crystals and a few small rock fragments of latite and rhyolite. The unit, nonwelded to moderately welded, weathers to a steep slope and in places may form a vertical wall.

Unit 1b is a grayish brown tuff that contains larger quartz crystals but fewer and smaller pumice fragments. It is a nonwelded to moderately welded tuff that weathers to a steep slope.

Unit 2a is a light gray pumiceous tuff that contains some rock fragments of pumice, latite and rhyolite that are as much as 3 inches across. It is a nonwelded to moderately welded tuff that weathers to form a moderate to steep slope.

Unit 2b is a light pink to brownish gray tuff with some pebble size rock fragments of pumice, latite and rhyolite and numerous crystals and crystal fragments of quartz and sanidine. It is a moderately welded to welded tuff and weathers to form ledges, benches, and vertical walls along canyons cut into the plateau.

Unit 3 is a light gray pumiceous tuff that contains numerous pumice fragments. The pumice fragments may be as much as 6 inches across. It also contains a few smaller rock fragments of rhyolite and latite. The unit is a nonwelded to moderately welded tuff, and weathers to form a gentle to moderate slope.

Stratigraphic Sections. A stratigraphic section of the Tshirege Member was measured at Mesita del Buey near Pajarito Reservoir No. 2, and the geologic units of the section were correlated with a section previously measured at Mesita de los Alamos near the proposed location of the Experimental Building (figure 1). Correlations of the geologic units were made by the lithology of the units and their weathering characteristics. The units were also traced southward from Mesita de los Alamos to Mesita del Buey. A datum was established on the prominent marker bed of tuff between Units 1a and 1b which is light orange and weathers to a slight notch. It is a persistent and readily identified geologic feature that is present where the two units are exposed on the plateau.

Units 1b and 2a thicken slightly from Mesita de los Alamos southward to Mesita del Buey (table 1). Unit 2b thins some 47 feet from Mesita de los Alamos to Mesita del Buey. The difference in thickness of Unit 2b on the two mesas may be due to the direction of the ejection of the ash flow that formed Unit 2b and point of origin of the flow (an area west of the Pajarito Plateau) and in part to topography that existed in pre-Bandelier time. The thickness of the Tshirege Member decreases rapidly east of the section at Mesita del Buey to the vicinity of White Rock where the tuff lies directly on basalt.

The basalt formed a topographic high in the area in pre-Bandelier time. The upper part of Unit 3 is eroded on both mesas. The thickness of the remaining part of Unit 3 is 45 feet at Mesita del Buey and 98 feet at Mesita de los Alamos.

Thickness of units at test areas. The two test areas at Mesita de los Alamos are at altitudes of 6,970 feet and 6,990 feet. At Mesita del Buey the test area is at an altitude of 6,935 feet. The test areas on both mesas are in Unit 3 but at different stratigraphic positions in the unit (table 3).

Care should be taken in extrapolation of test data from one area to another because the physical characteristics of a tuff in a single unit varies both vertically and laterally due to the degree of welding and the size and amount of rock inclusions in the tuff. Another factor that may affect the results of the test data is the thickness of the units beneath the test areas. The thickness of the units beneath the test areas vary due, in part, to the location of the test area in the unit and, in part, to thinning or thickening of the units as they were deposited as ash flows.

If we can be of further assistance, please feel free to contact us.

Yours truly,

William D. Purtyman
Geologist

for W. E. Hale
District Chief, WRD

cc: Charles Huff, Project Engineer, AEC
George Hilton, Chief,
Construction and Maintenance Branch, AEC
Wm. Kennedy, Group Leader, H-6 LASL

TABLE 1.

Thickness of geologic units at stratigraphic sections

Geologic Units	Mesita de los Alamos 1/ (Feet)	Mesita del Buey 2/ (Feet)	Remarks
3	98	45	Upper part eroded.
2b	76	29	
2a	51	60	
1b	21	23	
1a	74+	16+	Lower part covered.

1/ Altitude at top of section - 7,034 feet.
2/ Altitude at top of section - 6,935 feet.

TABLE 2.

Thickness of geologic units at test areas

Geologic Units	Mesita de los Alamos 1/ (Feet)	Mesita de los Alamos 2/ (Feet)	Mesita del Buey 3/ (Feet)	Remarks
3	54	34	45	
2b	76	76	29	
2a	51	51	60	
1b	21	21	23	
1a	74+	74+	16+	Lower part covered.

1/ Altitude at test area - 6,990 feet.
2/ Altitude at test area - 6,970 feet.
3/ Altitude at test area - 6,935 feet.

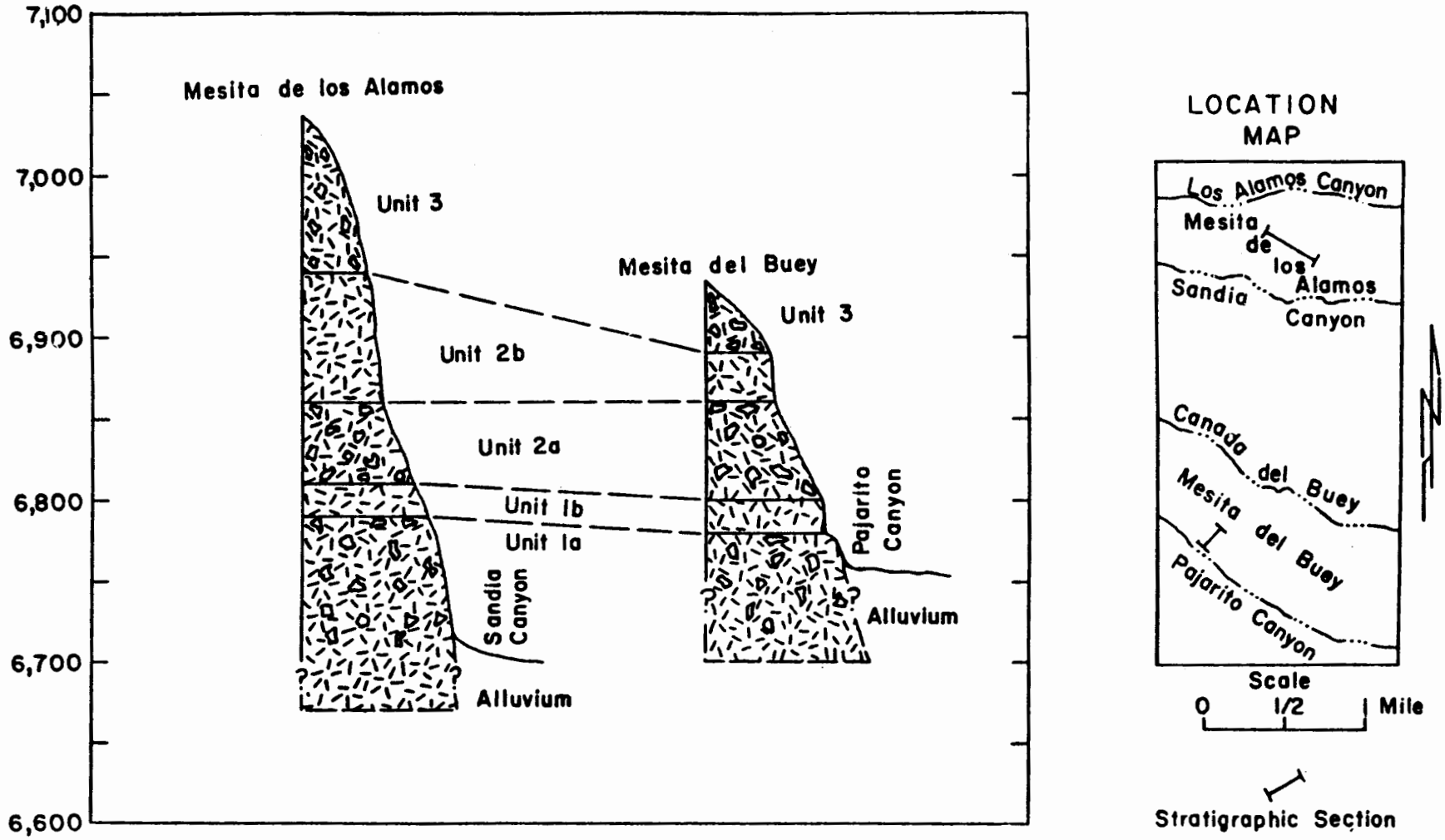


Figure 1.--Stratigraphic sections of the Tshirege Member of the Bandelier Tuff at Mesita de los Alamos (Proposed Meson Facility) and at Mesita del Buey (Pajarito Reservoir No. 2)

IN REPLY REFER TO:

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Room 115, Federal Building
Santa Fe, New Mexico

February 20, 1967

Mr. William Kennedy, Group Leader
Group H-6
Los Alamos Scientific Laboratory
Los Alamos, New Mexico

Dear Bill,

A reconnaissance of the seepage pits near Building 35 in TA-21 was made on January 30, 1967. The distribution of moisture of the tuff in several test holes adjacent to the pits was determined by a neutron-scattering moisture probe. Several water samples and a sample of weathered tuff were collected for radiochemical analyses. This data and data collected from previous studies near the seepage pits that would pertain to the construction of a solid waste disposal pit in the area have been recapped as you requested and are contained in the following letter.

Pit construction and geology

The disposal area consists of 4 pits that are about 120 feet long, 20 feet wide and about 6 feet deep (figure 1). The pits are filled with about 4 feet of sand, gravel and boulders with berms extended around the individual pits. Effluents were released through a distribution system into pits 1 and 2 and through overflow pipes into pits 3 and 4 respectively. In January 1967 the outline of the gravel portion of the pits was obscured by the growth of grasses and weeds and erosion of the berms. A new road has covered part of pit 1 and construction has destroyed some of the berm around pit 3.

The pits are probably excavated in unit 3 of the Tshirege Member of the Bandelier Tuff. The lower part of this unit is nonwelded tuff grading up into a moderately welded tuff which underlies the pits. Joints are more numerous in the upper part of the unit due to the denser welding. Most of the joints are orientated vertical or near vertical. The total thickness of the unit is about 110 feet. It is underlain by a moderate to dense welded tuff.

The total thickness of the Bandelier Tuff underlying the mesa at Building 35 exceeds 800 feet. The tuff is in the zone of areation; the top of the main zone of saturation is about 1,150 feet below the surface of the mesa.

History

The seepage pits near Building 35 are the oldest used for the disposal of liquid wastes at Los Alamos. Wastes from the processing of plutonium at TA-21 were released into pits during the period 1943 to 1952. The use of the pits was discontinued in 1952 when a treatment plant (Building 35) was installed to remove plutonium and other radionuclides. The effluents from the plant are released into DP Canyon, a southeast trending canyon north of the pit area.

The amount of effluents released into the pits during the period 1943 to 1952 has been estimated to range from 2 to 3 million gallons a year. The concentration of plutonium in the effluents during this period has been estimated at 60 c/m/ml (counts per minute per milliter) with an average fluoride concentration (associated with the wastes) of 160 ppm (parts per million). In addition 10,450 gallons of effluent highly concentrated with ammonium citrate was released into the pits from June 1951 to July 1952. The plutonium concentration of this waste averaged about 7,000 c/m/ml and the fluoride concentrations were about 200 ppm.

The pits were not used from 1952 to January 1965. Since January 1965 pits 1 and 2 have received an average of 74.3 thousand gallons a month or a total of 1.8 million gallons of low level radioactive effluent from DP-East.

A study was made in 1953 to determine the retnetion characteristics of the tuff with regard to plutonium (Hermann, 1954). Another study was made in 1961 to determine the movement of plutonium in the tuff (Christenson and Thomas, 1962). The results of these studies are summarized in the following sections.

Retention of plutonium in the tuff

Five test holes were drilled in and around the pits in 1953. Material from the test holes was analyzed to determine the relative amounts of plutonium and the ion exchange capacities of the tuff adjacent to and underlying the pits. Location of test holes are shown in figure 1. The exact location of the TH-3 in pit 1 is unknown. Plutonium and ion exchange capacities of the tuff are shown in table 1.

> Hermann (1954) concluded from the study that plutonium is readily retained by the various earth media (clay, sand, and gravel) and that the retention is greater in the finer materials. The horizontal migration of plutonium is very small within 20 feet of the surface, (TH-1 and TH-2, figure 1 and table 1). Other observations were that the ion exchange capacities of the tuff is inadequate to account for the retention of plutonium. The retention of plutonium in the tuff is mostly due to absorption, and the effect of ion exchange is of secondary importance.

Movement of plutonium

The purpose of the study in 1961 was to determine the movement of plutonium and effluent in the tuff. A shaft (caisson) 30 feet deep, 6 feet wide, and 12 feet long was dug near pit 1 (figure 1). Horizontal holes were cored into the wall of the shaft at 2 foot depth intervals so as to terminate beneath pit 1. A vacuum cup system was placed in the horizontal holes to obtain samples of the effluent moving through the tuff for chemical and radiochemical analyses. Six additional vertical or near vertical holes were drilled to a depth of about 100 feet around pit 1. The vertical holes and some of the horizontal holes in the shaft were used to determine the moisture content of the tuff by use of a neutron moisture-scattering probe. About 211 thousand gallons of tap water was released into pit 1 in July 1961. A month later 178 thousand gallons of effluent containing plutonium was added.

Christenson and Thomas (1962) concluded from the study that plutonium had penetrated to a depth of at least 28 feet in the tuff beneath the pits and that this penetration at depth takes place mainly along joints. Clay formed in joints and in devitrified fragments by weathering will sorb plutonium and result in localized areas of high plutonium concentrations. The low concentrations of aluminum and silica in the effluent in all samples indicated the absence of colloidal clays that might provide a means of transporting plutonium through the tuff. The chemical quality of the effluents through the tuff indicated an inverse relationship between the gross alpha (plutonium) and pH of the effluent (high pH, low concentrations of gross alpha, low pH, high concentrations of gross alpha). Hardness and total dissolved solids increased at depth suggesting the dissolution of materials from the tuff. The movement of effluents through the tuff is predominantly downward beneath the pits aided by open joints.

Of interest in possible construction on a solid waste disposal pit in the area is the amount of plutonium that was reported from cores and rock samples obtained during construction of the facilities for the study in 1961. These data are given in table 2.

Observations January 1967

Effluents from DP-East have at times partially filled the shaft near Pit 1, thus creating a more localized point for infiltration of liquids. Test holes DPW-1A and DPW-3 contained some effluent at the time of observation. It is supposed that the water in DPW-3 moved down the outside of the casing from water ponded in the pit. Radiochemical analyses of water from these holes contained only background amounts of gross alpha and gross beta gamma radioactivity and no plutonium or uranium. Results of analyses of water for tritium shown below are approximations and are subject to revision.

DPW-1A - 462 DPM ^{3}H or 70% of non-occ RPG a/
DPW-3 - Background
Effluent running into shaft - 2,000 DPM ^{3}H or 300% of non-occ RPG

a/ DPM - disintegrations per minute
non-occ RPG - Non-occupation Radiological Protection Guide numbers

A sample of weathered tuff collected beneath the gravel fill of pit 1 near the shaft contained 978 c/m/g (counts per minute per gram) of gross alpha radioactivity.

The moisture contents of the tuff in holes DPW-1, DPW-2, and DPW-5 were logged at selected depths (table 3). A comparison of the moisture content with previous moisture measurements (March 1961 prior to the addition of 389 thousand gallons of tap water and effluents and August 1961 during the study) is shown in table 3.

The January 1967 measurements of hole DPW-1 show the effect of the 1.9 million gallons of effluent from DP-East in which the maximum concentrations of water have moved from a depth of 12 feet (40 percent, August 1961) to 40 feet (41 percent, January 1967). The hole is next to the shaft. The moisture measurements in DPW-2 and DPW-5 show a general decrease in the moisture content of the tuff from August 1961 to January 1967. The indication is that most of the effluents released into pit 1 have moved down in the area of the shaft, a focal point for collection and infiltration of effluents into the tuff.

General statement

The studies have shown that the movement of the effluents in the tuff underlying the seepage pits is mostly downward beneath the pits. The plutonium moves with the effluents and the data indicate that the most of the plutonium is retained by absorption in the upper 20 feet of the tuff (tables 1 and 2). Some, however, may move to greater depths through open joints.

The construction of a solid waste disposal pit in the area may necessitate the drilling of several holes to determine the amount of contamination present as well as the structure and lithology of the underlying rock. The number and depth of the holes would depend on the size, depth and location of the proposed pit.

Source of data

Abrahams, John H., 1963, Geologic and hydrologic environment of radioactive waste disposal sites at Los Alamos, New Mexico: U.S. Geol. Survey Admin. Rept., 35 p., 3 figs.

Christenson, C. W., and Thomas, R. G., 1962, Movement of plutonium through Los Alamos Tuff, in Second ground disposal of radioactive wastes conference: Technical Services, U.S. Dept. of Commerce, TID-7628, p. 249-81.

Hermann, E. R., 1954, Retention of plutonium in waste seepage beds at Los Alamos: Unpublished manuscript in files of U.S. Geol. Survey at Santa Fe, N. Mex.; 14 p., 2 figs.

This recaps all the data we have on the seepage pits near Building 35. The bulk of it is on or near pit 1.

Please contact us if we can be of further assistance.

Yours truly,

William D. Purtyman
For: W. E. Hale, Dist. Chief, WRD

cc: George H. Hilton, Chief
Construction & Maintenance Br.
AEC
C. W. Christenson, Group Leader
H-7, L.A.S.L.

Table 1.--Plutonium concentrations in tuff from test holes, 1953.

TH-1		TH-2		TH-3		TH-4		TH-5	
Depth (feet)	Plutonium (d/m/g)a/	Depth (feet)	Plutonium (d/m/g)a/	Depth (feet)	Plutonium (d/m/g)a/	Depth (feet)	Plutonium (d/m/g)a/	Depth (feet)	Plutonium (d/m/g)a/
Surface	70	Surface	9	Surface	8	Surface	410	Surface	32
2	4	2	3	1	400	1	600	2	9
4	4	4	2	2	36,100	2	10	4	8
6	4	6	2	3	45,600	3	80	6	4
6 to 10	2	8	1	12	1,400	4	3,400	8	3
10 to 14	2	10	4	15	5,000	5	530	10	2
15	4	12	3	16	5,100	6	80	11	2
		14	3	17	720	7	1,800	12 b/	450
		16	4	18	24	8	40	12.5	1,510
		18	2	19	12	9	380	13	1,330
		20	3	20	12	10	2,400		

a/ Disintegrations per minute per gram.
b/ Angle hole, point of intersection with pit.

Note: TH-1 and Th-2 are vertical holes in earth filled berm.
TH-3 and TH-4 are vertical holes in pits.
TH-5 is angle hole at 45 degrees extending under pit.

Ion exchange Capacity

TH-3 at 19 feet	0.7	milliequivalent	per	100 grams
TH-4 at 5 feet	3.2	"	"	"
TH-5 at 12 feet	1.7	"	"	"

(Table modified from Hermann, 1954)

Table 2.--Gross Alpha radioactivity of tuff from test holes, 1960

Horizontal holes in caisson

Depth (feet)	No. Cores	Average Gross alpha-a/	Gross alpha-a/ - All cores (Max.)	(Min.)
6	10	3,003	6,613	4
8	7	1,306	2,850	11
10	8	1,143	1,872	12
12	6	821	1,729	414
14	9	749	2,094	1
16	9	732	1,305	8
18	4	517	923	141
20	7	183	506	45
22	4	15	20	11
24	8	402	1,038	175
26	10	13	88	2
28	6	28	156	2

Vertical or near vertical holes around pit

Hole No.	No. of Samples	Depth (feet)	Gross alpha a/ (Avg.)	(Max.)	(Min.)
1	10	76	2	3	1
1-A	10	83	24	24	9
2	11	93	698	3,722	142
3	11	99	3	7	2
4	13	99	1.5	2	1
5	7	92	3	6	1

a/ Counts per minute per gram.

Note: Hole DPW-1A angled at 11½ degrees toward pit 1.
Hole DPW-2 angled at 19 degrees toward pit 1.

(Tables modified from Christenson and Thomas, 196

Table 3.--Moisture content of tuff adjacent to test holes

DPW-1				DPW-2				DPW-5			
Depth (feet)	Percent Moisture (by volume)			Depth (feet)	Percent Moisture (by volume)			Depth (feet)	Percent Moisture (by volume)		
	3-17-61	8-23-61	1-30-67		3-18-61	8-23-61	1-30-67		3-19-61	8-25-61	1-30-67
1	22	28	34	1	26	34	39	1	20	20	36
5	24	34	37	4	25	38	40	5	16	16	26
8	18	38	39	8	30	24	30	10	19	20	26
12	13	40	22	12	25	>50	30	15	20	25	29
16	14	34	22	16	22	>50	28	20	17	22	25
20	16	35	40	20	16	>50	18	25	13	19	18
24	18	30	34	24	24	>50	28	30	12	16	15
28	16	27	36	28	25	>50	>50	35	13	18	20
32	28	36	39	32	22	>50	>50	40	13	20	18
36	18	29	41	36	20	>50	47	45	11	16	16
40	14	23	41	40	10	44	16	50	13	21	20
44	14	27	36	44	10	46	16	55	12	19	20
48	14	29	30	48	10	42	17	60	12	14	16
52	16	34	30	52	12	44	22	65	12	15	17
56	14	28	19	56	14	40	25				
60	13	23	16	60	15	28	22				
64	13	22	26	64	12	24	17				

Note: Water level DPW-1A 1-30-67 24.2 feet
Water level DPW-3 1-30-67 50.3 feet
DPW-4 Destroyed
Depth of DPW-a, 76 ft; DPW-2, 93 ft; DPW-5, 92 ft.
Logging length of cable - 65 feet in 1967.

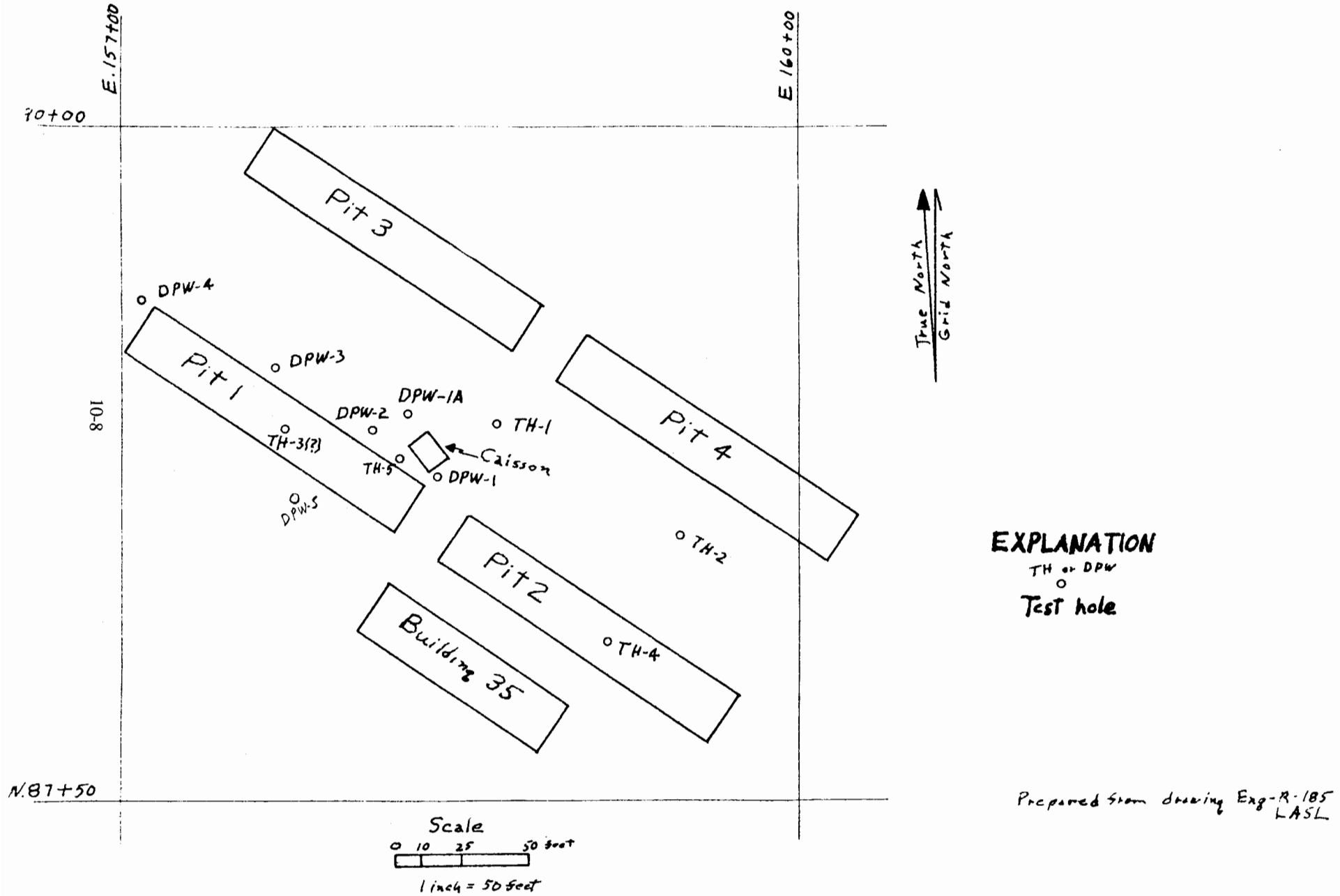


Figure 1.--Sketch map of seepage pits near Building 35 in TA-21, showing location of test holes.

William R. Kennedy, Group Leader, H-6 February 5, 1968

William D. Purtyman, USGS

CUTTING FROM MONITORING HOLES AT DP-WEST NEAR BLDG. 257

USGS

The test hole cuttings described herein were delivered to your laboratory on February 3, 1968. They were collected during the construction of monitoring holes at the sludge disposal area near Building 257 at DP-West. The enclosed sketch shows the lithology penetrated by the holes as well as their approximate location. The sketch is preliminary - subject to reversion.

The following Table gives depth interval of sample collection:

Sample Designation	Sample Interval (ft.)
B-1	0-5, 5-12, thereafter at 5 ft. intervals to a depth of 97 ft.
B-3	" " " "
B-5	" " " "
B-7	" " " "
B-9	" " " "
X-1	0-7, thereafter at 5 ft. intervals to a depth of 47 ft.
X-2	" " " "
X-3	0-7, thereafter at 5 ft. intervals to a depth of 42 ft.
X-4	" " " "

Holes in "B" series are cased with 100 ft. of 2-inch plastic tubing which extends about 3 ft. above land surface.

Holes in "X" series are cased with 40 ft. of 2-inch diameter plastic tubing which extends about 1 foot above land surface.

William D. Purtymun

WDP:mtj

Enc. As noted above

CC: C. W. Christenson, H-7
P. E. Trujillo, Jr., H-6
W. D. Purtymun, USGS

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Room 115, Federal Building
Santa Fe, New Mexico 87501

April 7, 1967

Mr. George Hilton
Construction and Maintenance Branch
U.S. Atomic Energy Commission
Los Alamos, New Mexico

Dear Mr. Hilton:

The following letter presents data on the chemical quality of water from supply wells related to use at the Power Plant (TA-3). It is not a comprehensive study but reviews the chemical quality of water from the supply wells at Los Alamos that pertains to scale forming constituents in the water. The letter also includes a section on water production and distribution, and some of the hydrologic characteristics of the wells. It was prepared at the request of Mr. Henry Strandring at the meeting of members of the U.S. Atomic Energy Commission, Los Alamos Scientific Laboratory, and members of the U.S. Geological Survey held at Los Alamos on January 11, 1967.

Background: The major use of water at the power plant is in generation of steam and in condensers for cooling the steam after is passes through the turbines. Water from the supply wells is used in production of steam in the boilers after it is passed through deionization columns to remove minerals that will cause scale. A major portion of the water supplied to the power plant is used in the condenser and cooling tower. Since 1950 the major amount of water used for cooling has been the effluent from the East Road Sewage Treatment Plant but some water for this use is supplied from the TA-3 Sewage Treatment

Plant and regular water supply (wells). The water used in the condensers has required some chemical treatment; however, the mixture of the effluents and well water on the whole has been satisfactory.

The effluent from the East Road Plant will no longer be available in the spring of 1967. Thus, make-up water for the condensers and cooling tower will be from the supply wells supplemented by effluent from the TA-3 Sewage Treatment Plant. The change in the major source of water for use in the condensers from the East Road Plant to the supply wells may require a different type of treatment to remove or reduce mineral constituents that will cause scale in the condensers and feed lines. The major scale forming constituents in water at Los Alamos are silica, calcium and magnesium.

Water production and distribution: Water supply to the town and technical areas, White Rock, and Pajarito Acres is from the Los Alamos field (6 wells in Los Alamos Canyon), the Guaje field (7 wells in Guaje and Rendija Canyons) and the Pajarito field (2 wells on the Pajarito Plateau). A third well is completed in the Pajarito field and is to be added to the supply system in the summer of 1967. The S-Site area water supply is supplemented by several springs west of the site. Ground water pumpage from the Los Alamos, Guaje, and Pajarito fields from 1960 to 1966 is shown on table 1.

The water supply to the town area is from the wells in the Los Alamos and Guaje fields. White Rock and Pajarito Acres are supplied from wells in Sandia Canyon, PM-1 and PM-3, when it is added to the system. The surplus from these wells is used to supply the town area through the

transmission line from the Los Alamos field. The technical areas south of Los Alamos Canyon are supplied from well PM-2 (Pajarito Canyon). This will include water to the Power Plant at TA-3.

Lithology of rocks related to quality of water: The lithology of rocks yielding water to the wells determine in large part the chemical quality of the water. Rocks yielding water to the supply wells are the Tesuque Formation and the Puye Conglomerate. The Tesuque Formation is composed of siltstone and sandstone with sporadic lenses of clay or pebbly conglomerate. In some wells basalts are interbedded with the sediments. Basalt flows interbedded with the sediments of the Tesuque Formation are sources of silica, calcium, and magnesium and thus may increase the silica, calcium, and magnesium concentrations in the water moving through them. Thus if the major part of the yield to the well is from the interbedded basalts the silica, calcium, and magnesium concentrations may be higher than water from wells developed in other units. The Puye Conglomerate overlies the Tesuque Formation and yields a part of the water to wells completed on the Pajarito Plateau. It is composed of a thin lower unit (about 50 feet thick) of a poorly consolidated conglomerate that is made up of arkosic and quartzitic debris derived from igneous and metmorphic rocks (table 2). The upper unit (saturated thickness from a few feet to more than 500 feet) is a moderately well cemented conglomerate that is composed of volcanic debris, mainly rhyolite, quartz latite, latite, and minor amounts of rhyolitic tuff and pumice. Water from the thin lower unit has higher calcium (about 10 ppm) and magnesium (about 6 ppm) concentrations than water in the upper unit while the silica content is about the same.

General statement: Silica, calcium, and magnesium in water from the supply wells contribute most of the scale to the water feed lines and condensers at the TA-3 Power Plant. Silica, calcium, and megnesium concentrations in and total hardness of water from wells in the three well fields is shown on table 3.

Silica concentrations in water from the well fields range from 27 ppm (parts per million) (LA-1 to 80 ppm (G-1A). Silica concentrations may vary with increased pumpage; however, not enough analyses are available to confirm such a trend. Calcium concentrations range from an average of 4 ppm (LA-6) to 27 ppm (PM-3) and magnesium concentrations range from 0 ppm (LA-6) to 8 ppm (PM-3). The wells in the Los Alamos and Guaje fields show no significant changes in the concentrations of calcium and magnesium after long periods of use. Slight changes in concentration of calcium (1 to 4 ppm) and magnesium (1 to 2 ppm) do occur during periods of light pumpage (winter and early spring) as compared to periods of heavy pumpage (summer). The higher concentrations of these ions occur during periods of lighter pumpage.

Silica, calcium and magnesium concentrations may vary within a well field due to local conditions within the aquifer that yields water to the well. In general, the sediments of the Tesuque Formation (Los Alamos field) yield water with the smaller concentrations of silica, calcium, and magnesium. Wells completed in sediments interbedded with basalts in the Tesuque (Guaje field) yield water with greater amounts of silica, calcium and magnesium.

The silica concentration of water from the wells in the Pajarito field is high (70 to 79 ppm, average, table 3), and calcium and magnesium concentrations are higher in water from wells PM-1 and PM-3 than in water from the other supply wells.

Pajarito field: The wells in the Pajarito field yield water from the Puye Conglomerate and sediments and interbedded basalt flows in the Tesuque Formation (table 2). The sediments in the Tesuque Formation are coarser in the Pajarito field than in the Los Alamos and Guaje fields

and these sediments along with the permeable Puye Conglomerate accounts for higher yields from wells in the Pajarito field (table 2).

The analyses of water prior to February indicate two different types of water being added to the supply system (table 3). Silica concentrations of water from the Pajarito well field range from 70 ppm to 79 ppm, however, the average calcium concentrations of water from wells PM-1 (26 ppm) and PM-3 (27 ppm) are higher than those from well PM-2 (10 ppm). The average magnesium concentrations are higher also (PM-1, 6 ppm; PM-3, 8 ppm; and PM-2, 2 ppm).

Additional water samples were collected from PM-1, PM-2 and PM-3 during February to determine if quality changed with increased pumpage (wells PM-1 and PM-2) and if quality changes occur at depth within the well (PM-3).

Well PM-1 was shut down for 12 days and pumped for 6 days at an average rate of 650 gpm (gallons per minute). Water samples were collected at selected time intervals (table 4). The silica concentration of the water increased from 65 ppm after 15 minutes of pumping to 80 ppm after 22 hours of pumping and then fluctuated between 79 ppm and 84 ppm during the remainder of the test. Calcium and magnesium concentrations remained fairly steady during the test; however, several anomalies were noted in samples collected after 22 and 94 hours of pumping. The temperature of the water increased from 75° after 15 minutes of pumping, to 82° at 121 hours of pumping, and remained at 82° until the end of the test.

Similarly, well PM-2 was shut down for 12 days and then pumped for 2 days with water samples collected at selected time intervals (table 5). The silica concentrations ranged from 78 ppm to 81 ppm,

calcium from 9 ppm to 10 ppm, and magnesium from 2 to 4 ppm during the test. No specific trends in changes of quality were noted. Temperature of the water increased from 72° after 5 minutes of pumping, to 73° after 2½ hours and remained constant during the remainder of the test.

Samples were collected in November 1966 from well PM-3 during development and test pumping (table 6). There was no significant change in calcium and magnesium concentrations in the period the samples were collected. The samples were not analyzed for silica. Water samples were collected at selected depths from well PM-3 in February. Silica concentrations increased from 50 ppm at a depth of 1,000 feet to 74 ppm at 2,000 feet, then decreased to 58 ppm in the sample from 2,400 feet. The higher concentrations of silica occurred in or near interbedded basalt in the Tesuque. There was no significant change in calcium and magnesium concentrations.

The test in well PM-1 indicated that some change in chemical quality of water occurred during the first 22 hours of pumping. This change probably is caused by the initial withdrawal of water from the lower unit of the Puye Conglomerate. Silica increased as the yield from the Tesuque increased. The temperature and the chemical composition of the water remained constant after prolonged pumping of wells PM-1 and PM-3. The wells are located about 7,000 feet apart in Sandia Canyon. They penetrate about the same saturated thickness of the lower unit of the Puye Conglomerate and basalts are interbedded with sediments in the upper part of Tesuque Formation. The major part of the yield to the wells is probably from the basalts interbedded in the sediments in the upper part of the Tesuque and from the thin lower unit of the Puye Conglomerate. No significant change was noted during the test in well PM-2.

The major yield to well PM-2 in Pajarito Canyon is probably from the thick section of saturated sediments in the upper part of the Puye Conglomerate which contains low concentrations of calcium and magnesium.

A review of the chemical quality of water from test wells on the Pajarito Plateau, shows that higher concentrations of calcium and magnesium exist in the water in an area north of Sandia Canyon then to the south. There has been little pumpage from the wells in the Pajarito field, but on the basis of the tests made in February and the quality of water from test wells it is assumed that there will be little change in calcium-magnesium concentrations with increased pumpage; however, periodic analyses should be made on water from the new wells to determine any changes or trends.

Summary: Water supply to the Power Plant (TA-3), according to the distribution plan of water from wells and well fields, will be from well PM-2 in Pajarito Canyon. The silica concentrations in this water is high (average 79 ppm); however, calcium and magnesium concentrations (average 10 ppm and 2 ppm respectively) are about the same as from most wells in the Los Alamos and Guaje fields.

If other data or information are needed please feel free to contact us.

Sincerely yours,

W. D. Purtymun
for W. E. Hale
District Chief, WRD

cc: William Kennedy Group H-6

Table 1.--Ground-water pumpage from the Los Alamos, Guaje, and Pajarito well fields in the years 1960-66.

(pumpage, in millions of gallons)

Year	Los Alamos	Guaje	Pajarito	Total
1960	530	533	-	1,063
1961	547	623	-	1,170
1962	577	597	-	1,174
1963	538	655	-	1,193
1964	627	665	-	1,292
1965	447	573	99	1,119
1966	450	614	127	1,191

Table 2.--Well characteristics and saturated thickness of formations

Well field and Well number	Average pumping rate 1966 (gpm)	Average specific capacity 1966 (gal/ft of draw down)	Average depth to water 1966 (feet)	Saturated Thickness (feet) of formation: Puye Cong. (feet)	Tesuque formation: Sediment (feet)	Tesuque formation: Basalt (feet)
Los Alamos field						
LA-1	--	--	70		800	--
1 B	543	5.1	50		1,700	--
2[a/]	342	1.4	108		762	--
3	350	2.6	81		789	--
4	593	8.4	285		1,680	--
5	476	--	180		1,570	--
6	553	13.8	129		1,661	--
Guaje field						
G-1	423	4.5	269		1,433	298
1-A	562	11.5	306		1,199	14
2	395	11.6	349		1,641	--
3	311	4.7	353		1,354	93
4	231	2.1	392		1,379	159
5[b/]	549	7.4	445		1,085	337
6	392	5.4	585		615	330
Pajarito field						
PM-1	589	15.1	740	55	1,435	270
PM-2[c/]	1,429	22.7	826	586[d/]	756	134
PM-3[e/]	1,400	38.0		50	1,585	175

a/ Jan - June 1966

b/ Jan - Aug 1966

c/ Dec 1966

d/ Includes 16 feet of basalt

e/ Test pumped Nov 1966

Table 3.--Silica, Calcium, Magnesium and hardness of water from supply wells for samples to date (March 1967)

	Number of analyses	Silica[1/] (SiO_2 in ppm)	Calcium (Ca, in ppm) Range			Magnesium (Mg, in ppm) Range			Hardness as $CaCO_3$ (in ppm) Range		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Los Alamos field											
LA-1[2/]	8	27	7	10	8	0	2	0.2	17	30	21
LA-1B	13	40	6	9	7	0	2	.2	17	28	21
LA-2	13	30	5	9	7	0	2	1.0	14	28	20
LA-3	15	32	10	17	13	0	2	.4	28	44	39
LA-4	16	36	7	14	11	0	1	.6	18	40	29
LA-5	14	36	7	13	10	0	2	.2	18	35	27
LA-6	61	30	2	6	4	0	1	0	7	20	11
Guaje field											
G-1	12	66	10	14	12	0	2	1	28	40	34
G-1A	11	80	11	15	12	0	4	2	29	54	38
G-2	10	54	10	17	13	0	4	1	28	56	36
G-3	13	56	9	18	12	1	5	2	29	64	41
G-4	11	50	12	19	16	3	7	5	50	73	59
G-5	13	46	10	21	16	2	7	5	54	76	59
G-6	4	50	8	13	11	2	3	2	36	47	41
Pajarito field											
PM-1	8	70	17	32	26	4	9	6	79	110	89
PM-2	4	79	9	12	10	2	3	2	34	38	36
PM-3	3	74[3/]	26	30	27	7	9	8	98	104	101

1/ 1 or 2 analyses only

2/ No pumpage since 1956

3/ Maximum, _____ in sample from a depth of 2,000 feet (2-14-67)

Table 4.--Hydrologic data from well PM-1, February 14-20, 1967.

Sample interval hours	Pumpage (1,000 of gallons)	Specific capacity (gal/ft of drawdown)	Temperature (°F)	Silica (SiO_2 in ppm)	Calcium (Ca in ppm)	Magnesium (Mg in ppm)	Hardness as $CaCO_3$ (in ppm)
¼ (15 min)	10	31.5	75.0	65	26	7	97
5	197	22.8	78.0	73	26	7	93
22	867	19.6	79.5	80	34	2	92
47	1,853	17.8	81.5	84	26	6	90
72	2,839	16.3	81.5	80	26	7	92
94	3,701	15.4	81.5	80	26	11	108
121	4,768	15.0	82.0	79	26	7	92
144	5,665	14.6	82.0	82.5	26	6	88

Table 5.--Hydrologic data from well PM-2, February 20-22, 1967.

Sample interval hours	Pumpage (1,000 of gallons)	Specific capacity (gal/ft drawdown)	Temperature (°F)	Silica (SiO_2 in ppm)	Calcium (Ca in ppm)	Magnesium (Mg in ppm)	Hardness as $CaCO_3$ (in ppm)
1/12 (5 min)	7	31.3	72	78	9	4	38
2½	213	25.5	73	80	10	2	36
10	860	24.1	--	81	10	3	38
22	1,890	23.2	--	81	10	4	42
34	2,903	23.2	73	78	10	3	38
47	4,034	22.7	73	79.5	10	4	40

Table 6.--Hydrologic data from well PM-3

Test pumping and development October 31, November 1-2, 1966

Sample interval hours	Estimated (pumpage 1,000 of gallons)	Temperature (°F)	Calcium (Ca in ppm)	Magnesium (Mg in ppm)	Hardness as $CaCO_3$ (in ppm)
58	3,060	82	26	9	102
82	4,480	82	30	7	104
95	5,130	82	26	8	98

Samples collected at selected depths, February 16, 1967

Depth of sample (feet)	Temperature (°F)	Silica (SiO_2 in ppm)	Calcium (Ca in ppm)	Magnesium (Mg in ppm)	Hardness as $CaCO_3$ (in ppm)
1,000	74	50	26	8	98
1,500	76	67	25	9	100
2,000	76	74	26	9	101
2,400	76	58	24	8	94

Room 115, Federal Building
Santa Fe, New Mexico 87501

March 7, 1969

Mr. William Kennedy
Group H-6
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87544

Dear Bill:

A brief reconnaissance was made of the proposed burial pit near Building 40 in TA-21 on March 6, 1969.

The mesa at the proposed pit is underlain by Unit 3 of the Tshirege Member of the Bandelier Tuff. The total thickness of this unit is about 120 feet with the lower part consisting of a nonwelded tuff grading up into a moderately welded tuff which forms the surface of the mesa.

Near Building 257 in TA-21 the shafts drilled for disposal of sludges penetrated buried channels cut into the upper surface of Unit 3. These channels were filled with varying amounts of latite and rhyolite boulders which were later covered by a subsequent ash flow firmly welding them in place. Such channels may or may not be encountered in the proposed excavation.

Joints in Unit 3 will be more numerous in the upper moderately welded tuff with most joints orientated vertical or near vertical. These joints may cause large slabs of tuff to fall into the pit endangering personnel during excavation or disposal operations. Hence it may be necessary that the walls be sloped inward about 1 foot for every 4 foot of depth with loose slabs scaled from sloped walls. While this does not solve the whole problem it does minimize the danger to personnel working in the pit. A similar design has been used in construction of the pits at Mesita del Buey.

The total thickness of the Bandelier Tuff underlying the mesa probably exceeds 800 feet. The tuff is in the zone of aeration; the top of the main zone of saturation is at about 1,150 feet below the surface of the mesa.

Existing solid disposal pits and buried stainless-steel storage tanks are located to the east and west of the proposed pit (see Eng. Drawing 6250). The disposal pits are reported to contain plutonium and uranium wastes. The last liquid wastes probably were added to the tanks in 1949. In the early 1950's the tanks were estimated to contain 160 to 1,000 grams of plutonium (Abrahams, 1963, p. 21).

I would like to make a brief visit to the pit when completed to have a look at the geology. Please contact us if we can be of further assistance.

Sincerely yours,

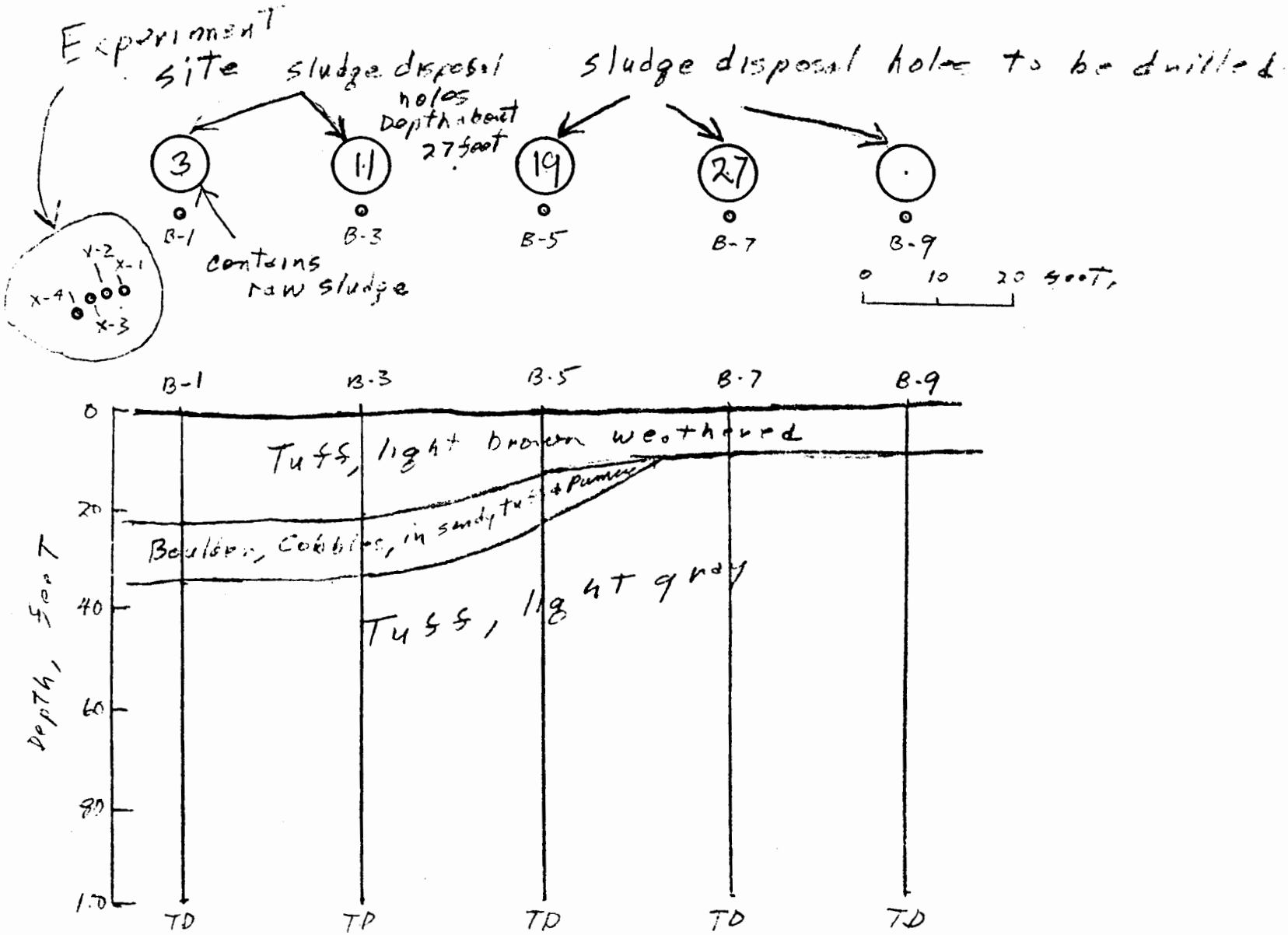
William D. Purtymun

for: William E. Hale, District Chief
WRD, USGS

Reference:

Abrahams, John H., 1963, Geologic and hydrologic environment of radioactive waste disposal sites at Los Alamos, New New Mexico: U.S. Geol. Survey Admin. Rept., 35 p., 3 figs.

cc: F. C. Koopman
Albuquerque, N. Mex.



Sketch showing location of Monitoring holes and Cross-section based on drill cuttings
Preliminary, subject to revision—

Room 115, Federal Building
Santa Fe, New Mexico 87501

March 18, 1969

Mr. Richard Crook
Utilities and Engineering Division
Zia Company
Los Alamos, New Mexico 87544

Subject: Sand produced with pumpage from well in the Pajarito Field

Dear Dick:

I have compiled some data concerning sand produced with pumpage from the three wells in the Pajarito Field. Wells PM-2 and PM-3 produce only trace amounts of sand during the initial part of the pumping period. The largest produce of sand of the three wells is PM-1. Instantaneous measurements during an Inhoff Cone of pumpage from PM-1 and PM-3 yielded sand contents too small to measure. Measurements made by using a Centrifugal Sand Sampler collected by Hal York and John Stump are tabulated on table 1. The centrifugal sampler collects sand over a period of time, thus, amounts collected were enough for measurement.

Table 2 presents data collected during the development and step testing of well PM-1 with notations concerning sand during similar testing of wells PM-2 and PM-3.

Table 3 lists some of the tolerances for sand produced with pumpage. As you see there is a wide variation of limits. Tolerances vary with the distribution system.

Sand concentrations are greater when the well is first started and as pumping continues the concentration decrease. The sand determination shown on table 1, was taken during the initial part of the pumping or after the well has been surged. This does not provide an accurate estimate of sand produced during a normal pumping period; however, by using this data I made a very rough estimate of the sand produced in about a million gallons of water during a pumping period of 27 hours at 620 gpm from PM-1. This amounted to about 0.06 cu ft per million gallons. I intergrated the pumpage with estimated sand contents for the first 5 hours and thereafter assumed only trace amounts of sand in the production (see step test 2-12-65, table 2).

The amount of sand produced during a pumping period or a realistic estimate for a year could be made by installation of theCentrifugal Sand Sampler on a well during a pumping period 4 to 6 times a year. If possible it would be to our advantage to invest in one of these samplers as the one we used was borrowed from Glen Hammock. Collection of data as to sand concentrations with pumpage of various wells would give us some idea of well deterioration as well as the amount of sand wear on pumping equipment. Thus with this information we could regulate pumpage to minimize both.

Hal informed me that you had received numerous complaints from White Rock residents concerning sand in the water. A possible cause would have been the off and on pumping which occurred during installation of the automatic control for the well system. Surge caused by numerous starts and stops of the pump will cause large amounts of sand to be produced with the pumpage. There were over 100 pumping periods of less than 60 minutes at well PM-1 during the year 1968. Most of these occurred during the spring and summer.

If I can be of further assistance please call.

Sincerely yours,

William D. Purtymun
Hydrologist

for: W. E. Hale
District Chief, WRD

Encls:

cc:
George Hilton, AEC, Los Alamos, N. Mex.
F. C. Koopman, USGS, Albuquerque, N.Mex.

Table 1.--Sand content in pumpage of wells PM-1, PM-2 and PM-3, 1969.

	Time since pumping began (Minutes)	Sand Content (ppm)	(cu ft/mg
PM 1 - 620 gpm			
2-26-69	0 - 15	34	4.6
	15 - 30	1	0.14
	Surge		
	0 - 5	8	0.85
3-6-69	0 - 5	-	
	5 - 15	43	5.5
	15 - 16	-	
	16 - 21	8	1.1
	Surge		
	0 - 2	-	
	2 - 12	6	0.8
PM-2 - 1,410 gpm			
2-26-69	0 - 15	Trace	-
	15 - 20	Trace	-
	Surge		
	0 - 10	1	0.14
3- 7-69	0 - 2	-	-
	2 - 12	3.5	0.49
	13 - 14	-	-
	14 - 18	0	0
PM-3 - 1,320 gpm			
2-27-69	0 - 10	3	0.4
	10 - 20	1.5	.2
	Surge	-	-
	0 - 5	2	.26
	5 - 10	1	.14
3- 6-69	0 - 6	-	-
	6 - 16	1.5	.2
	16 - 18	-	-
	18 - 23	0	0
	Surge		
	0 - 1	Motor fail	
	1 - 13	Pump off	
	13 - 14	-	-
	14 - 4	0.8	0.1

Table 2.--Sand contents in pumpage during development and testing of wells PM-1, PM-2 and PM-3.

PM-1 - Development and aquifer tests February 3 to 12, 1965. Shown below are sand contents for select periods during development and step tests.

Development PM-1

Date 1965	Hour	Average pumping Rate (gpm)	Sand Content ppm	Sand Content (cu ft per million gallons)
2- 4	15:20	Start		
	15:30	780	51	7
	16:00	"	160	20
	16:30	"	63	9
	17:00	"	63	9
	17:30	"	86	12
	18:00	"	50	7
	18:30	"	36	4
	19:00	"	16	2
2-6	14:10	Start		
	14:30	857	26	3.2
	15:00	"	9	1.2
	15:30	"	5	.7
	16:00	"	6.5	.9
	16:30	"	5	.7
	17:00	"	3.8	.5
2-8 1/	08:00	Start		
	08:30	784	12	1.7
	09:00	"	3.6	.5
	09:30	"	2.6	.35
	10:00	"	1.3	.18
	10:30	"	.9	.12
2-9	18:45	Start		
2-11	13:20	Start		
	13:25	726	14	1.8
	13:30	"	21	2.7
	13:35	"	11	1.4
	13:50	"	9	1.2
	14:20	"	4	.6
	14:50	"	2.3	.4
	15:20	"	.9	.12

1/ Well not pumped for 24 hours.

Table 2.--Continued

Step test - PM-1

Date 1965	Hour	Average pumping Rate (gpm)	Sand Content ppm	Sand Content (cu ft per million gallons)
2-12	13:00	Start		
	13:05	842	31	4.2
	13:10	"	33	4.8
	13:15	"	17	2.2
	13:30	"	12	1.8
	14:00	"	2.9	.48
	14:30	"	1.8	.25
	15:00	"	1.5	.19
	15:30	"	1.3	.17
	16:00	"	.7	.095
	16:15	726	.7	.095
	16:30	"	.2	.07
	17:00	"	.1	.07
	17:15	636	TSTM 1/	TSTM 1/
	17:30	"	"	"
	18:00	"	"	"
	18:30	"	"	"
	18:45	"	None	None
	19:00	541	"	"
	19:30	"	"	"
	20:00	"	"	"
	20:15	421	None	None
	20:30	"	"	"
	20:45	"	"	"
	21:00	"	"	"

1/ Amount to small to measure.

PM- 2 - Development and aquifer tests June 30 to July 6, 1965. Reported only traces of sand (amounts to small to measure) during step tests, July 6, at pumping rates ranging from 617 gpm to 1,476 gpm.

PM - 3 - Development and aquifer test October 26 to November 5, 1966. Reported only traces of sand (less than 0.1 ppm) during step tests November 4 and 5, 1966 at pumping rates ranging from 899 to 1,401 gpm.

Table 3.--Tolerances for sand produced with pumpage.

A. Sand production shall be less than 30 ppm within 20 minutes after commencement of pumping (Well specifications for wells PM-1, PM-2 and PM-3 during development and test pumping).

B. One ounce of sand per 100 gallons of water (Corps of Engineers, USGS Memo by E. H. Herrick, May 24, 1956).

C. Size and character of sand influence the tolerable sand concentrations; however,where sand concentrations is less than 0.10 cu ft per million gallons, no sand troubles have been found, while where it exceeds 0.3 cu ft, consumer complaints or sanded meters invariably result. A purely arbitrary limit of 0.1 cu ft per million gallons has tentatively been selected ("Control of sand in water systems," by John R. Rossum, p. 132, in Journal of American Water Works Association, Vol. 46, No. 2, February 1954).

D. In some cases, one ppm may be the permissible limit in a system that has many valves and small orifices, such as a water-flood system for secondary recovery of oil. Two or 3 ppm may be tolerable for municipal and industrial supply ("Ground Water and Wells, "p. 373, Published by Edward E. Johnson, Inc. St. Paul, Min., 1st Ed., 1966).

Comparison of Sand Tolerances

Source of Data	ppm	cu ft per million gallons
A 1/	30	4.0
B	50	7.0
C	0.75	0.10
D 2/	1.0	0.14
D 3/	2.0	0.24

1/ After 20 minutes of pumping.
2/ Systems containing many valves and small orifices.
3/ May be tolerable for municipal and industrial supply.

Room 115, Federal Building
Santa Fe, New Mexico 87501

April 2, 1969

Mr. Dean Miller
Utilities and Engineering
Zia Company
Los Alamos, New Mexico 87544

Subject: Hydrologic data for a densely welded tuff.

Dear Dean:

Enclosed is data that John Stump requested. These data were collected during a study at TA-49 where the Bandelier Tuff has similar properties to that at TA-8 and TA-9.

I looked over a section of the tuff within one-half mile east of the septic tank at TA-8 and have estimated from a topographic sheet that the welded tuff is in excess of 150 feet thick in this area. There is some sheeting and breccia in the lower 50 feet but on the whole this section looks harder and denser near the base. Back at the septic tank this unit may be thicker due to faulting to both east and west which may have formed a slight through prior to the emplacement of the unit.

We left a recorder on the hole, if it is in the way call 983-3801, extension 3307 and leave word for Kunkler to remove it.

Sincerely yours,

William D. Purtymun
Hydrologist

Encl:

cc:
F. C. Koopman

Transmitted by:

J. L. Kunkler

Here are some hydrologic properties of a similar tuff at TA-49.

UNIT 2

Depth below top of flow (feet)	Specific retention (percent)	Specific Yield (percent)	Porosity (percent)	Coefficient of Permeability
2	11.3	26.1	37.4	2.0
6	12.3	15.9	28.2	.2
11	17.3	2.0	19.3	.04
10	20.2	.6	20.8	.08
44	20.8	7.6	28.4	.2
75	14.4	-	-	.2
79	13.9	13.9	27.8	.3
97	17.2	12.1	29.3	.2
104	17.3	12.0	29.3	.2

1/ Gallons per day per square foot.
Note: Samples collected from 4 core holes,. The depths are referenced to the contact between Unit 3 and Unit 2 of the Bandelier Tuff.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
Water Resources Division
P. O. Box 4369
Albuquerque, New Mexico 87106

30 June 1969

Mr. William Kennedy
Group Leader, Group H-6
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87544

Subject: Materials Waste Pit, Area "A", TA-21--excavated April 1969

Dear Bill:

A reconnaissance was made of the waste pit at TA-21 on May 9, 1969. At that time the first layer of waste had been placed in the pit and covered with tuff. The wastes are contaminated material from the facilities that are being renovated at TA-21.

General description

TA-21 is on a eastward-trending "finger-like" mesa, a part of the Pajarito Plateau. The land surface in the immediate area of the pit slopes northward about 100 yards then breaks into a series of benches and steep slopes to the channel of DP Canyon about 100 feet below the top of the mesa. The pit was excavated in a near east-west direction leaving steep ramps on each end (figure 1). The excavated tuff was piled over two sealed solid disposal pits (see LASL Eng. Drawing 6250). An access road to the bottom of the pit was cut along the south wall.

Parts of the north and south walls are nearly vertical with the remainder sloping at about 1 to 5. The walls at present are stable, though several small blocks were dislodged during construction.

General Geology and hydrology

The pit is excavated in Unit 3 of the Tshirege Member of the Bandelier Tuff (figures 2 and 3). Total thickness of the unit is about 120 feet with the lower part consisting of a nonwelded tuff grading up into a moderately welded tuff which form the upper part of the mesa. The pit is completed in the moderately welded tuff. The soil cover exposed by excavation ranges from 2 to 5 feet in thickness.

The attitude of most of the major joints are near vertical to vertical ranging from 70 to 90 degrees measured from the horizontal. Some of the joints were slightly curved, open in places and closed in others. All of the joints were filled with dark brown clay beneath the soil zone while at depth were filled or plated with dark brown or gray clay.

The orientation and distribution of the major joints in the horisontal plane of the north and south walls of the pit are shown on a rose diagram (figure 4). Three point sets occur true north to N10°W, N40°E to N60°E and N70°E to N80°E. Though all the joint sets do not intersect at 60 degrees as they would if formed in a homogeneous liquid as it cooled, the predominance of the three joints set and near vertical attitude of the joints suggest that the joints formed as the ash flow tuff of Unit 3 cooled after emplacement.

Surface drainage in the area of the pit is to the north into DP Canyon. Intermittent flow in the canyon is from storm runoff and release of treated-industrial effluents from the waste treatment plant at Building 257, TA-21.

The total thickness of the Bandelier Tuff underlying the mesa probably exceeds 800 feet. The tuff is in the unsaturated zone; the top of the saturated zone in the Puye Formation is at about 1,150 feet below the surface of the mesa.

General statement

A few open joints are exposed in the walls of the pit; however, they should cause no trouble when the pit is sealed. Wastes should be buried below the soil zone within the natural confines of the tuff. The seal (tuff removed from excavation) should be 6 to 8 feet thick over the wastes, extended beyond the edges of the pit, and slightly rounded with adequate surface drainage. It may be necessary to plant the seal material with vegetation, not only to prevent water erosion but to prevent wind erosion which may cause problems in nearby shops and laboratories. If the pit is to be left open any length of time, steps should be taken to prevent summer storm runoff from draining into the wastes in the pit along the south wall (see figure 3).

Consideration is given to the preceding paragraph, the pit is acceptable for disposal of solid wastes as outlined in guidelines set up by the University and Geological Survey (letter to S. E. Russo, Eng. 3, from F. C. Koopman, USGS, June 30, 1965). Please contact us if we can be of further assistance.

Sincerely yours,

For: William E. Hale
District Chief

Prepared by
W. D. Purtymun

Enclosures 4

Copy to:

George Hilton, AEC, Los Alamos
Jim Desilits, Eng. 2, LASL, Los Alamos
Dean Meyers, H-1, LASL, Los Alamos

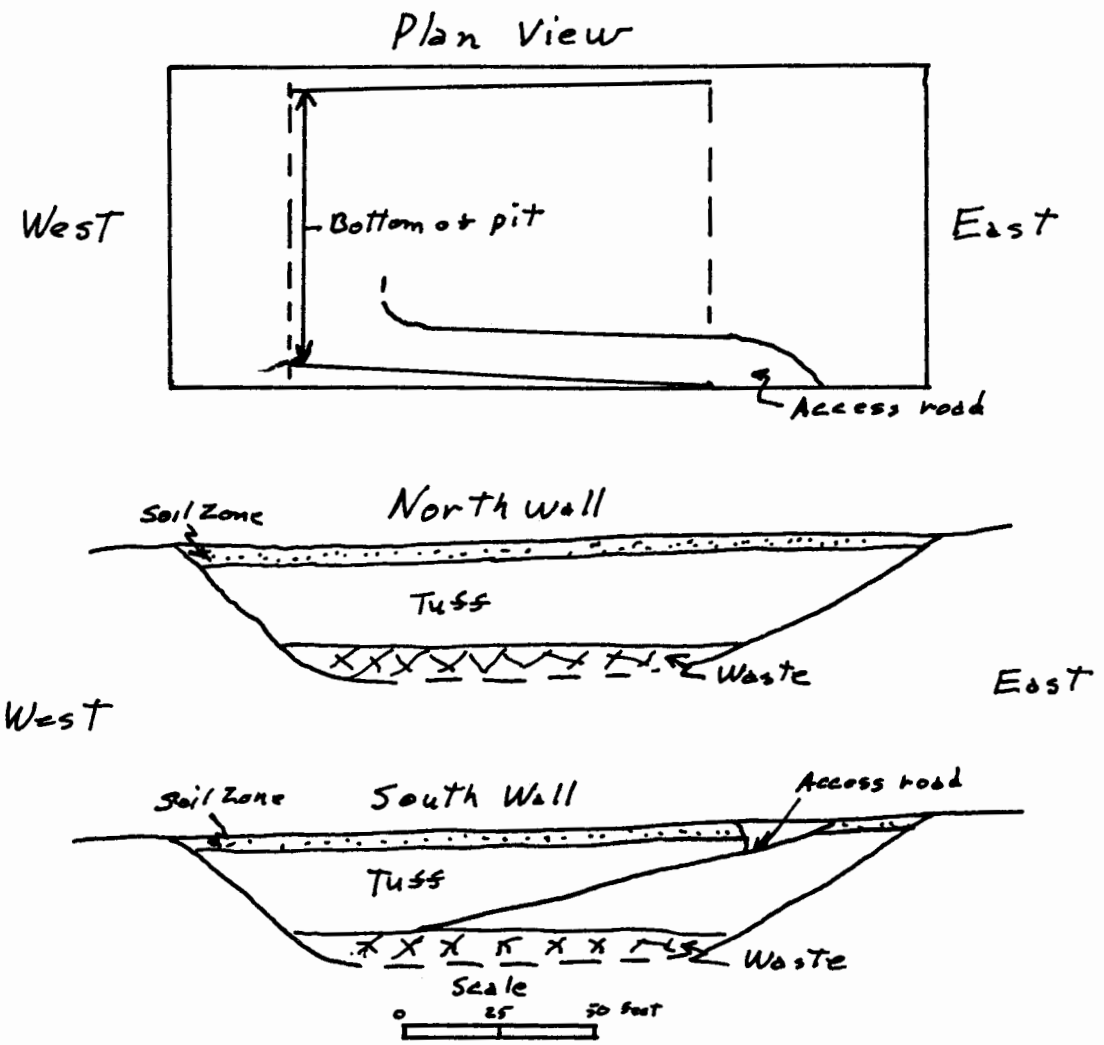
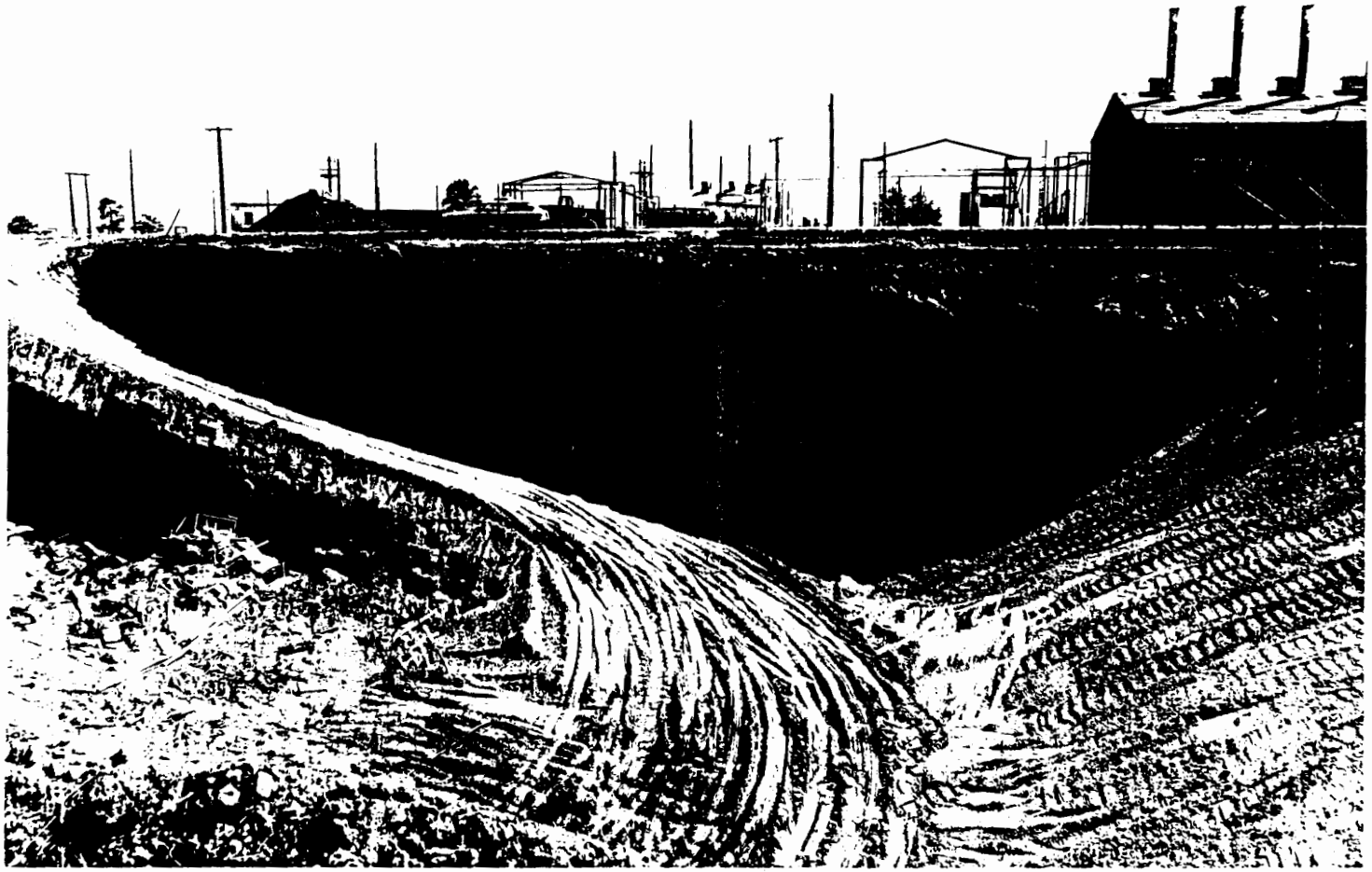


Figure 1.- Sketch of pit showing plan view and North and south walls

Figure 2.--North wall of pit showing soil zone, tuff and joints, and first layer of waste.

Figure 3.--South wall of pit showing soil zone, tuff and joints, first layer of waste and access road.



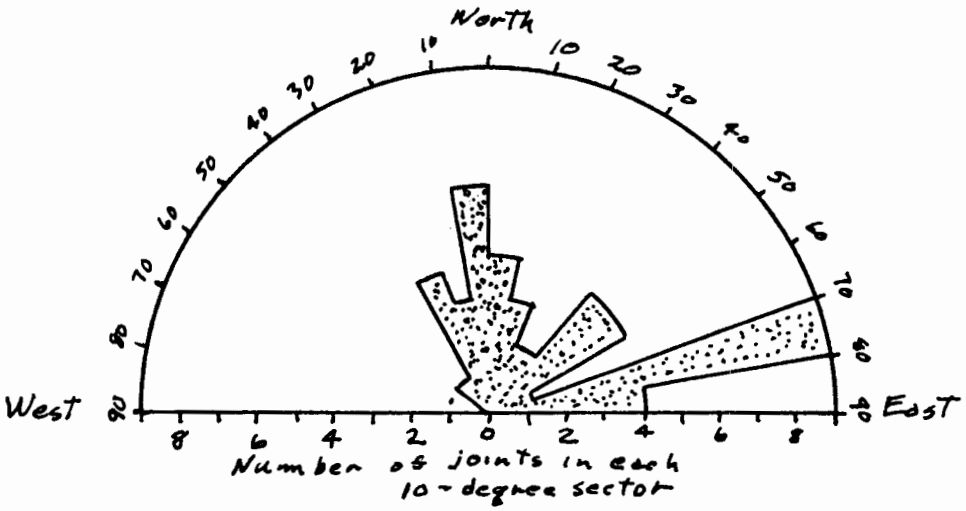


Figure 4.- Orientation of joints in North and South walls of pit

Room 115, Federal Building
Santa Fe, New Mexico 87501

August 19, 1969

Mr. C. W. Christenson, Group Leader
Group H-7
Los Alamos Scientific Laboratory
Los Alamos, New Mexico 87544

Subject: Geology at disposal area near Bldg. 257, TA-21.

Dear Chris:

At your request I have compiled data related to the geology at the disposal area near Bldg. 257 at TA-21. Two sketches showing sections of rock units from pit 3 to 27 and pit 2 to 27 are attached.

The lower unit is a light gray moderately welded tuff with an approximate thickness of 100 feet. It is overlain in part by a reworked tuff which is deposited in a channel or low relief cut into the lower light gray tuff unit. The upper unit forming the surface of the mesa at the disposal area is a light brownish gray moderately welded tuff (see sketch 1 and 2).

The unit that is giving us trouble in drilling additional pit is the reworked tuff and pumice which contains cobbles and boulders in the lower part. The reworked tuff was deposited by gaseous forces accompanying the emplacement of the upper ash flow. The cobbles and boulders occur in tabular shapes or if in mass show faceted sides as if deposited by sliding rather than rolling as one would expect with water-laid material. The blast caused by expanding gases accompanying the emplacement of the upper ash flow deposited the larger materials (cobbles and boulders) into areas of low relief in the upper surface of the lower unit. As the upper unit and reworked tuff were emplaced contemporaneously they have cooled as a single unit thus the contact between the two is gradiational and not very distinct. A sharp contact is found between the reworked tuff and lower light gray unit.

Pit 18 and 26 (sketch 2) were drilled in July 1969. Pit 18 went to a depth of 59 feet (pilot hole 64 ft) passed through the reworked tuff which evidently had few boulders in the lower part. The walls of the pit are rough and irregular in the reworked tuff from a depth of about 14 to 22 feet.

Pit 26 was drilled into a nest of boulders near the base of the reworked tuff and was abandoned at a depth of 15 feet (pilot hole 19 feet). The walls of the pit from the land surface (I was not able to get a ladder long enough to get to the bottom) showed no cobbles or boulders, fairly smooth walls. The only evidence of the reworked unit in the walls was a small patch of reworked sand and tuff at a depth of about 12 feet along the northwest wall of the pit. Evidently the pilot hole (dug with a 3 foot bucket auger to a depth of 19 feet) encountered cobbles and boulders too large to dislodge or pick up thus was probably abandoned several feet above the top of the lower unit of light gray tuff.

Inspection of pits when the rig is setting on the hole to allow access may be of value determining extent of the reworked tuff containing the cobbles and boulders. This would aid in location of future pits. If we can make the inspection for you or if you need additional information please feel free to give us a call.

Sincerely yours,

W. D. Purtymun
Hydrologist

For: W. E. Hale
District Chief, WRD

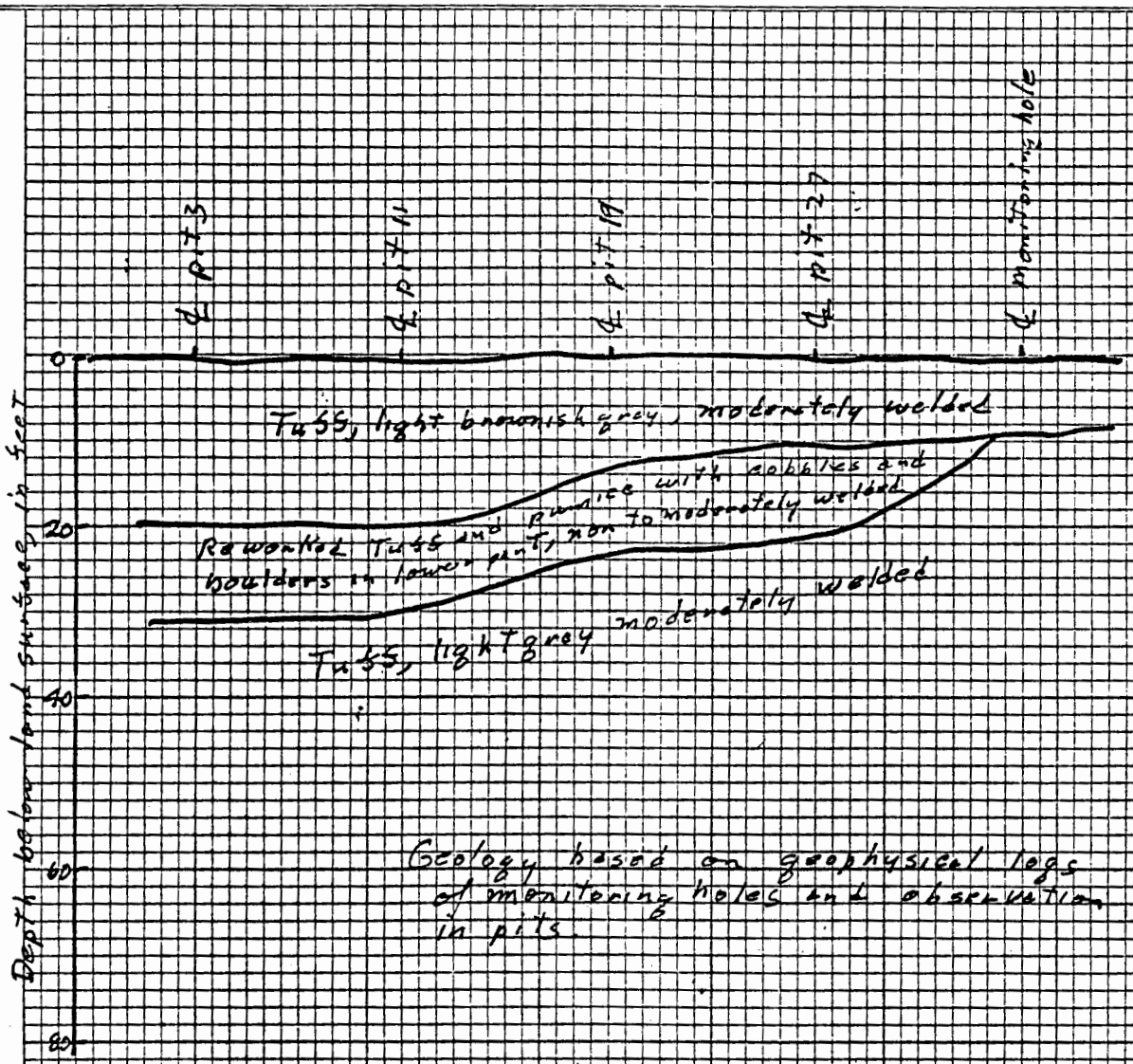
cc: Wm. Kennedy, H-6, LASL
Los Alamos, N.Mex.

F. C. Koopman, USGS
Albuquerque, N. Mex.

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

File Number { Washington ..... District .....

16—13468-2 GPO



Geology based on geophysical logs of monitoring holes and observation in pits.

Sketch 1. – Section pit 3 to pit 27

(DO NOT USE THIS SPACE EXCEPT FOR BINDING PURPOSES)

GPO 846-369

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

OFFICE MEMORANDUM

TO : Paul R. Franke, Jr., MP-6 DATE: October 16, 1969

THRU : William R. Kennedy, Group Leader, H-6

FROM : William D. Purtymun, H-6

SUBJECT: MOVEMENT OF INDUCED RADIATION IN THE TUFF ADJACENT TO THE BEAM CHANNEL AT THE MESON FACILITY

SYMBOL : H-6

The problem expressed to us on October 13, 1969 was the possible movement of induced radiation in the tuff adjacent to the beam channel by precipitation to areas where it would be a health hazard. The following recaps the general hydrology with respect to the problem.

Thickness and depth of rocks underlying the Mesa at the east end of the Meson Facility

Rock Type	Thickness (feet)	Depth (feet)
Tuff	520	520
Conglomerate	90	610
Basalt	120	730
Conglomerate	420	1,160

1) Section based on outcrop and log of TW-3 and foundation elevation of Meson Facility of 6,970 feet.

The main aquifer (zone of saturation capable of water supply) lies at a depth of about 1,100 feet below the surface of the mesa. Recharge to the aquifer is along the

See following Informal Rept Transmitted to MP-6 - Nov 1969

flanks of the mountains to the west and deep canyons cut into the western third of the plateau. Movement of water is eastward toward the Rio Grande at an average of about 450 feet per year (aquifer tests TW-3 and PM-2). No measurable amount of tritium was detected in water from well PM-3 so that it is assumed that water reaching the main aquifer in this area from recharge to discharge has been in transit for more than 50 years.

There was no water in the formations above the main aquifer; however, intermittent streams in Los Alamos and Sandia Canyon (cut to a depth of 200 to 400 feet below the surface of the Mesa) recharge small bodies of water perched in the alluvium along the stream channels. As the water in the alluvium moves eastward some is lost to evapotranspiration while some move into the tuff and conglomerate interbedded with basalt to maintain a body of water perched in the basalt near State Highway 4. Water in the basalt is discharged through springs in lower Los Alamos and Sandia Canyon where the channel has cut through the basalt.

Studies related to distribution of moisture in the soil and tuff on the mesa tops indicate little if any precipitation moves through the soil zone where the soil

cover is undisturbed; however, where water was allowed to pond, it has been observed to move to a depth of 16 feet. Studies made of crushed tuff used as seal material on pits for the disposal of solid wastes have shown precipitation from a single storm has infiltrated to a depth of 6 feet; however, most of this moisture was returned to the atmosphere by evaporation in the dry period following the storm.

The beam channel is constructed in a trench cut into the tuff and back~~ed~~ filled with a cover of about 25 feet of tuff. A roadway is to be constructed on the top of the fill. As the roadway will probably be paved only the slope areas adjacent to the road are areas of possible infiltration into the tuff fill overlying the beam channel.

With adequate drainage along the roadway, it seems improbable that precipitation could infiltrate into the tuff adjacent to the beam channel, or if it did, would be insufficient in volume to move contaminates into the canyon walls thus into the perched water in the canyon floor or downward to the main aquifer 1,100 feet below the surface of the mesa.

Enclosed are two articles that you requested. If you need further information please feel free to contact us.

Enc. (2)

CC: Dean Kelley, ENG-1 17-3
[illegible] 17-1

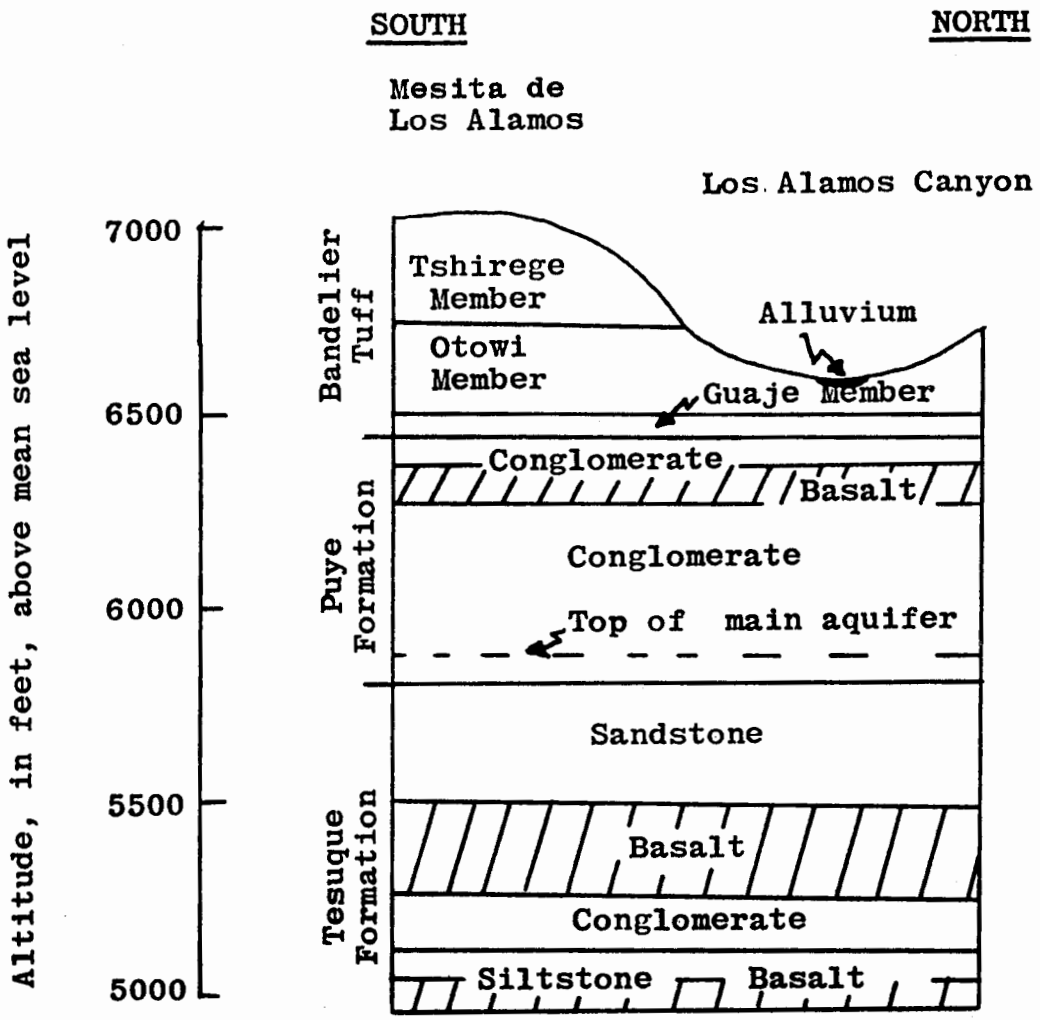


Figure 1 - Generalized Geologic Section

GEOLOGY, HYDROLOGY, AND HYDROLOGIC CHARACTERISTICS OF THE TUFF AT MESITA DE LOS ALAMOS

By William D. Purtymun

Prepared for Meson Physics Group MP-6

By Environmental Studies Group, H-6

See Memo Oct 16, 1969
To Paul Tremke MP-6
From W D Purtymun

CONTENTS

Page

Introduction 1

Geology 1

Hydrology 2

Hydrologic Characteristics of the Tuff..... 5

References..... 7

ILLUSTRATION

Figure 1 - Generalized Geologic Section 3

GEOLOGY, HYDROLOGY, AND HYDROLOGIC CHARACTERISTICS OF THE TUFF AT MESITA DE LOS ALAMOS

INTRODUCTION

This report describes the geology and hydrology of the Meson Facility on Mesita de Los Alamos. It also includes a section on the hydrologic characteristics of the tuff adjacent to the beam channel with reference to movement of radioisotopes by moisture.

Mesita de Los Alamos is an eastward trending "finger-like" mesa which is a part of the larger Pajarito Plateau. The mesa is formed by a series of ashfall and ashflows of rhyolite tuff. It is bounded on the north by Los Alamos Canyon and on the south by Sandia. The surface on the mesa slopes gently eastward. A small east-west ridge lies along the northern edge of the mesa in the area of the Meson Facility. The beam channel and other buildings are located on the southern flank of the ridge.

GEOLOGY

The ashfalls and ashflows of rhyolite tuff that form the mesa are rocks of the Bandelier tuff. In the subsurface beneath the mesa are rocks of the Puye and Tesuque Formations.

The lower-most formation, the Tesuque, is composed of siltstones, sandstones with lenses of clay and pebbly conglomerate with some interbedded basalt. (Spiegel and

Baldwin, 1963). Above the Tesuque is the Puye Formation (Figure 1). The lower part is a poorly consolidate channel fill deposit overlain by a conglomerate composed of volcanic debris (Bailey and others, 1969). Interbedded with the conglomerate is a basalt flow that originated from volcanic centers to the southeast.

The Bandelier tuff overlies the Puye Formation, forming the walls and upper surface of the mesa. It is composed of three members (Griggs, 1964). In ascending order they are: the Guaje Member (an ashfall pumice), the Otowi Member (a friable ashflow tuff), and the Tshirege Member (a series of ashflow and ashfall tuffs). Total thickness of the Bandelier is about 570 feet.

HYDROLOGY

Surface drainage from Mesita de Los Alamos is into Los Alamos and Sandia Canyons which are tributary to the Rio Grande. The intermittent stream in the canyons (cut to depths of 200 to 400 feet below the surface of the mesa) recharge small bodies of water perched in the alluvium along the stream channels. As the water in the alluvium moves eastward some is lost to evapotranspiration while some moves into the tuff and conglomerate and interbedded basalt to maintain a body of perched water in the basalts near State Highway 4. Water in the basalt is discharged through springs in lower Los Alamos and Sandia Canyons where the channel has cut through the basalt.

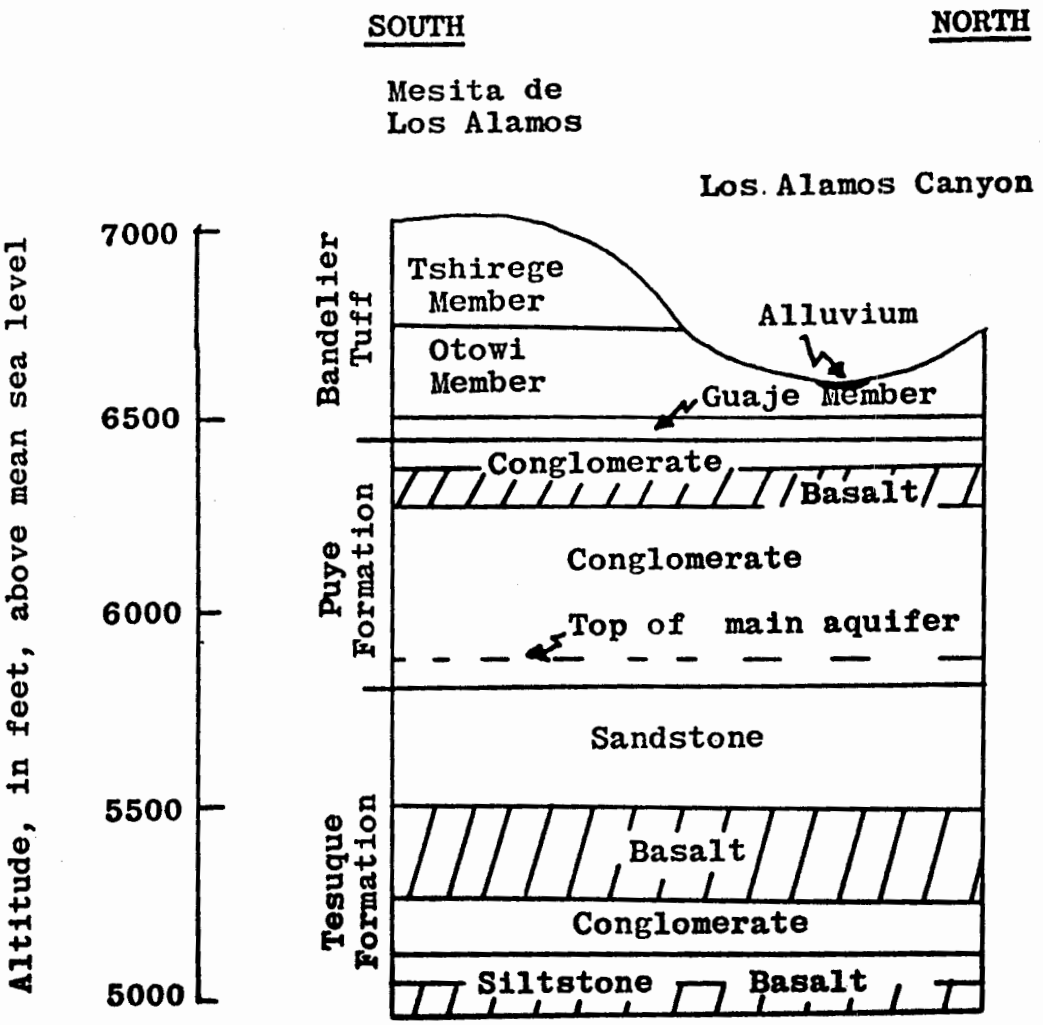


Figure 1 - Generalized Geologic Section

The main aquifer (zone of saturation capable of municipal and industrial water supply) lies at a depth of about 1,100 feet below the surface of the mesa within the Tesuque Formation and lower part of the Puye (Figure 1). The movement of water in the aquifer is eastward toward the Rio Grande where a part is discharged into the river through a series of seeps and springs. At the Meson Facility there is no water perched between the main aquifer and stream connected aquifers in the alluvium in Los Alamos and Sandia Canyons.

Little if any water from precipitation infiltrates into the tuff on the mesas where the normal soil cover is undisturbed due in part to the high evaporation rate and hydrologic characteristics of the soil (Abrahams and others, 1961). As a result there is no recharge to the main aquifer from the mesas.

In trying to date the age of the water at Supply Well PM-3, located about 1.5 miles east of the Experimental Buildings, analyses (electrolysis enrichment method) showed no measurable amount of tritium. It is assumed then that the water in the aquifer has been in transit from the recharge area to the well for more than 50 years. The rate of movement of water in the aquifer is estimated at 450 feet per year (aquifer tests, Test Well TW-3 and Supply Well PM-3). Based on tritium results and rate of movement the, recharge area would be from the west along the flanks of the mountains. Cushman, 1965, also postulated that the

main recharge area to the aquifer was along flanks of the mountains and deep canyons cut into the western part of the plateau.

HYDROLOGIC CHARACTERISTICS OF THE TUFF

In an area where the soil cover or near surface tuff has been disturbed and water was allowed to pond, moisture has been observed to move to a depth of 16 feet in the tuff. The moisture beneath the pond was distributed by gravity and capillarity while on the outer edges movement was by diffusion. The following example illustrates the ability of this tuff to absorb and retain water. Injection of 500,000 gallons of water into a 10 foot, 4 inch diameter zone in the tuff took about 3 months. Five months after the test, the 500,000 gallons of water had assumed a spherical shape of moisture about 180 feet in diameter. The moisture content of the tuff ranged from about 22 percent by volume beneath and adjacent to the injection zone to less than 4 percent by volume at the edges of the sphere. Moisture near the injection zone was being distributed by gravity and capillarity while at the edges movement was by diffusion.

The beam channel is constructed in a trench cut into the tuff and is backfilled with about 25 feet of compacted tuff. The rate and depth of infiltration of water from precipitation can be only approximated from other data. Infiltration from a single storm moved moisture to a depth of about 6 feet in a crushed tuff used as seal material on a filled disposal pit. Most of this moisture was returned to the atmosphere by evaporation in the week that followed the storm.

With adequate drainage along the surface of the beam channel, it seems improbable that precipitation could infiltrate into the backfill and tuff adjacent to the beam channel, or if it did, would be in sufficient volume to move contaminates into the canyon walls or downward to the main aquifer 1,100 feet below the surface of the mesas.

REFERENCES

Abrahams, J. R., Jr., Weir, J. E., Jr., and Purtymun, W. D., 1961, "Distribution of moisture in soil and near surface tuff on the Pajarito Plateau, Los Alamos County, New Mexico," U. S. Geological Survey Prof. Paper 424-D, p. 142-145.

Bailey, R. A., Smith, R. L., and Ross, C. S., 1969, "Strategraphic nomenclature of volcanic rock in the Jemez Mountains, New Mexico," U. S. Geological Survey, Bull. 1274-P, 19p., 2 figs.

Cushman, R. L., 1963, an evaluation of the aquifer and well characteristics of municipal well fields in Los Alamos and Guaje Canyon near Los Alamos, New Mexico: U. S. Geological Survey Water-Supply Paper 1809-D, 50 p., 3 pls., 17 figs.

Griggs, R. L., 1964, Geology and ground-water resources of the Los Alamos Area, New Mexico: U. S. Geological Survey, Water-Supply Paper 1753, 106 p., 1 pl., 20 figs.

Spiegel, Zane, and Baldwin, Brewster, 1963 Geology and water resources of the Santa Fe Area, New Mexico: U. S. Geological Survey Water-Supply Paper 1525, 258 p., 7 pls., 56 figs.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

OFFICE MEMORANDUM

TO : William R. Kennedy, Group Leader, H-6 DATE: November 21, 1969

FROM : Jack W. Aeby, H-6

SUBJECT: PERMEABILITY OF THE TUFF TO WATER VAPOR

SYMBOL : H-6

In order to establish a background bore line for tritium samples taken from test borings around the DP slurry dump holes, advantage was taken of the fact that drillers were in the process of boring a new 8 ft. diameter hole in Area "H", the classified shops disposal area. When we arrived at this area in the afternoon of November 6, we found them bailing out the loose tuff from the 40 ft. depth. We simply bagged a few handfuls of the loose material for our background sample.

Approximately one liter of this material was placed in a two liter beaker and heated to drive off the moisture which was collected on a watch glass cooled with a single ice cube. It required a very high heat to drive off 1 ml of water for our analysis. (This tuff actually gave a slightly negative reading on the moisture balance.) A 500 lambda alliquote of the water was placed in a standard scintillation counting bottle along with 15 ml of scintillation solution for scintillation counting. The counting results showed an activity of 4,586,795.9 ± 8,958.8 dis/min. ml or 69,496.91% RCG. A very surprising result indeed for a background sample. Subsequent repeat counting verified the above values.

The search continues for an adequate background sample. However, our initial failure and subsequent failures have launched us on an interesting experiment to determine the permeability of the local formations to tritium or moisture. The results to date are contained in the enclosed chart.

Even though this sample is 69,496.9% RCG for water, one must remember that it is rather difficult to extract from the tuff. Subsequent air samples taken in this same hole at the 45 ft. depth ran a maximum of 118% RCG air, 100% is the concentration in the air one could tolerate with no measurable effects.

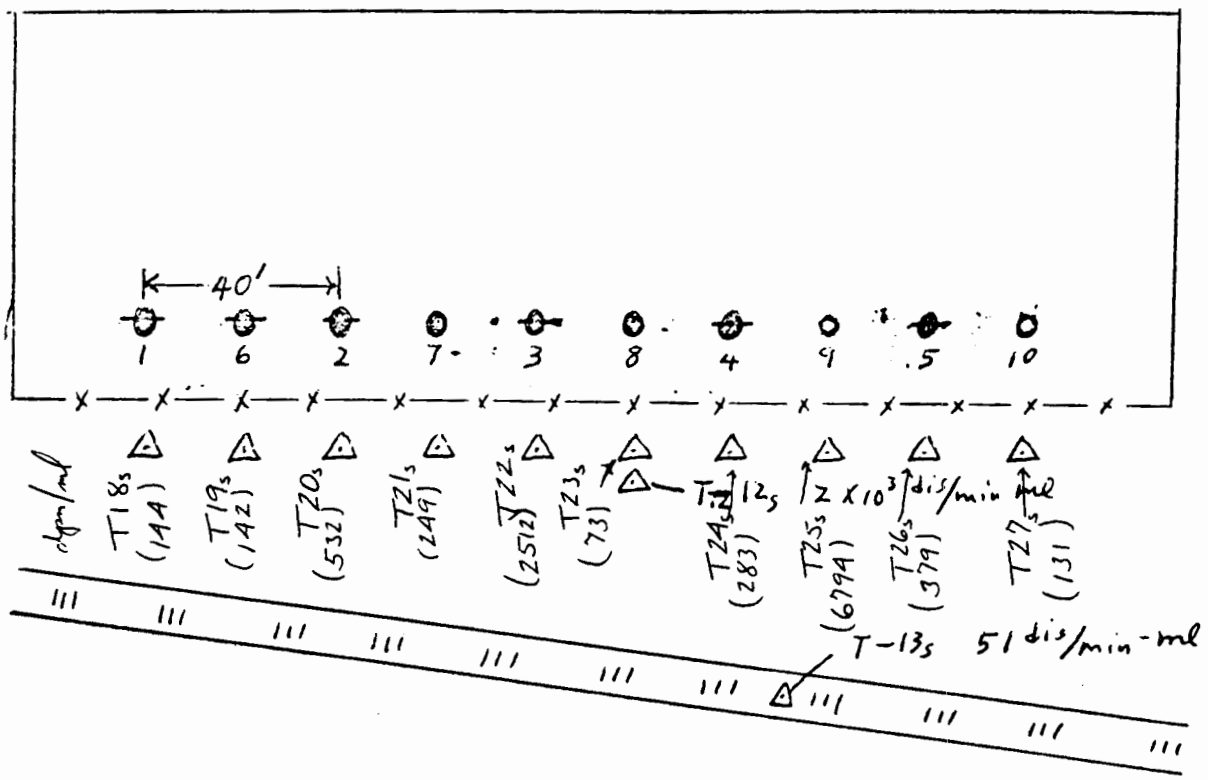
The Boys

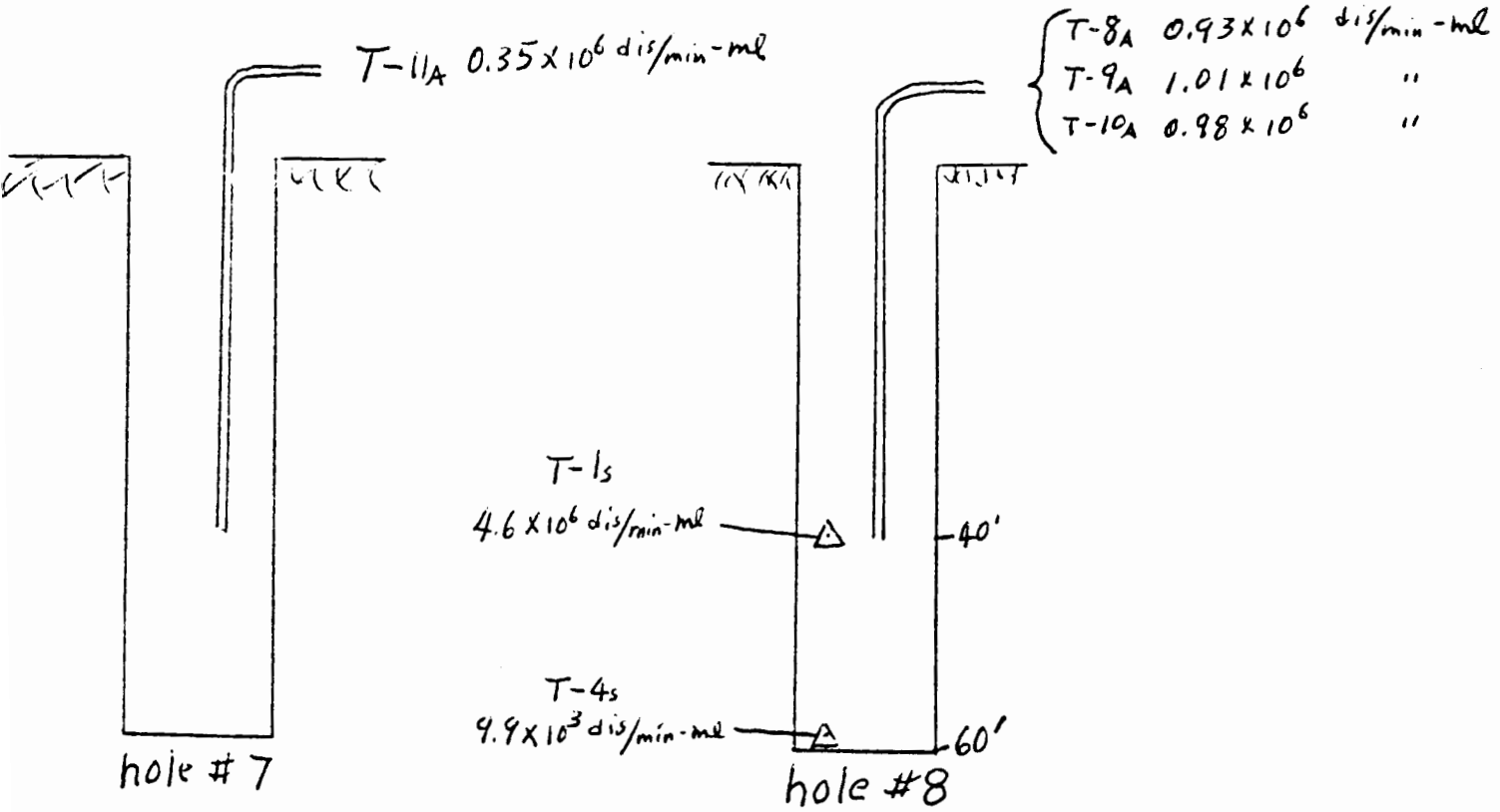
Jack W. Aeby

JWA:mtj

Enc. Chart

Area "H"





Soil sample location △

LASL-AEC-OFFICIAL
LASL-AEC-OFFICIAL

Shaft 9 Area H excavated Sept. 25-26, 1973

Depth		% H_2O by wt.	H^3 content PCi/liter
5'		2.0	$1.35046 \times 10^8 \pm 2.9 \times 10^6$
10'		2.3	$1.33645 \times 10^8 \pm 2.8 \times 10^6$
12'	Pile	2.6	$1.69422 \times 10^8 \pm 3.6 \times 10^6$
12'	loose	2.1	$9.70008 \times 10^8 \pm 2.1 \times 10^6$
12'	rock	2.0	$1.06533 \times 10^8 \pm 2.2 \times 10^6$
15'		1.7	$7.89482 \times 10^8 \pm$
19'	soft	.4	$1.317154 \times 10^9 \pm 2.7 \times 10^7$
20'		.5	$1.610954 \times 10^9 \pm 3.3 \times 10^7$
25'		.8	$1.72580 \times 10^9 \pm 3.7 \times 10^7$
30'		.2	$1.245683 \times 10^9 \pm 2.6 \times 10^7$
35'	Very soft	.5	$8.87258 \times 10^8 \pm 1.9 \times 10^7$
40'		.5	$3.65950 \times 10^8 \pm 7.6 \times 10^6$
45'		.5	$1.86000 \times 10^8 \pm 3.9 \times 10^6$
50'		.3	$1.58442 \times 10^8 \pm 3.3 \times 10^6$
55'		.3	$4.2830 \times 10^7 \pm 1.0 \times 10^6$
60'		.5	$2.5446 \times 10^7 \pm 5.4 \times 10^5$

Area, background & transpiration samples
@ Area H

9-27-73

SOILS	Tritium content – pC./liter
Soil @ fence	$7.7900 \times 10^4 \pm 1.8 \times 10^3$
Soil 20' South of fence	$7.3800 \times 10^4 \pm 1.7 \times 10^3$
Soil 75' S of fence	$3.0800 \times 10^4 \pm 1.1 \times 10^3$
Soil 150' S. of fence	$3.400 \times 10^3 \pm 4.0 \times 10^2$
Background soil	$2.4000 \times 10^4 \pm 7.0 \times 10^2$
TRANSPIRATION	
Mountain Daisy near Shaft 8	$3.412 \times 10^6 \pm 7.2 \times 10^4$
Weed near Shaft 8	$2.789 \times 10^6 \pm 5.9 \times 10^4$
Pinon 60' East of SW corner of fence	$6.100 \times 10^3 \pm 4.0 \times 10^2$
Cedar 60' E of SW corner of fence	$2.181 \times 10^6 \pm 4.6 \times 10^4$
Cedar 65' West of SE corner of fence	$1.397 \times 10^6 \pm 3.0 \times 10^4$
Pinon – Background	$2.400 \times 10^3 \pm 3.0 \times 10^2$
Cedar – Background	$2.300 \times 10^3 \pm 3.0 \times 10^2$
Background Weeds	$2.000 \times 10^3 \pm 3.0 \times 10^2$
Background Mountain Daisy	$2.100 \times 10^3 \pm 3.0 \times 10^2$

Tritium in pile @ Area H in PCi / liter

Date	Surface	0-1 H	1-3 H	3-4 H	0-1 V	1-3 V	3-4 V	Average
9-73								
10-5-73	$7.9803 \times 10^7 \pm 4.0 \times 10^6$	$1.07694 \times 10^8 \pm 2.3 \times 10^6$	$1.88289 \times 10^8 \pm 4.0 \times 10^6$	$1.19081 \times 10^8 \pm 2.5 \times 10^6$	$7.6287 \times 10^7 \pm 1.6 \times 10^6$	$2.20052 \times 10^8 \pm 4.6 \times 10^6$	$2.70317 \times 10^8 \pm 5.7 \times 10^6$	$1.63318 \times 10^8 \pm 3.7 \times 10^6$
10-18-73	$3.0753 \times 10^7 \pm 6.5 \times 10^5$	$5.4444 \times 10^7 \pm 1.2 \times 10^6$	$8.7683 \times 10^7 \pm 1.9 \times 10^6$	$8.2521 \times 10^7 \pm 1.7 \times 10^6$	$5.4573 \times 10^7 \pm 1.2 \times 10^6$	$1.27797 \times 10^8 \pm 2.7 \times 10^6$	$1.90520 \times 10^8 \pm 4.0 \times 10^6$	$9.3754 \times 10^7 \pm 2.0 \times 10^7$
10-30-73		$7.4870 \times 10^7 \pm 1.6 \times 10^6$	$9.0623 \times 10^7 \pm 1.9 \times 10^6$	$1.00212 \times 10^8 \pm 2.1 \times 10^6$	$8.0497 \times 10^7 \pm 1.7 \times 10^6$	1-4 V $1.11947 \times 10^8 \pm 2.4 \times 10^6$		9.6583×10^7

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

OFFICE MEMORANDUM

TO : Dean D. Meyer, Group Leader, H-1 DATE: July 7, 1970

THRU : William R. Kennedy, Group Leader, H-6 WRK.

FROM : William D. Purtymun, H-6

SUBJECT: MIGRATION OF TRITIUM IN SHAFT DISPOSAL AREA, TA-54, AREA "G"

SYMBOL : H-6

Samples of tuff were collected during the drilling of shafts 34 through 48. Tritium analyses of the moisture content from the samples as well as moisture content are shown on the attached table. Also enclosed is a sketch map showing location of shafts.

Laboratory analyses of three samples of tuff from a depth of 25 feet indicated the following hydrologic properties.

Porosity	Specific Retention	Specific Yield
	(percent by volume)	
44	17	27
37	20	17
36	18	18

The moisture content of the tuff ranged from 0.1 to 6.4 % with an average of 1.2 percent by volume.

The tritium concentrations from samples collected from shaft 34 (November 1969) located about 55 feet east of existing shaft 14 ranged from 62 to 454 x 10^{-6} μCi/ml of moisture.

The concentrations in samples from shafts 35 to 38 located about 80 feet south of shaft 14 ranged from 0 to 106 x 10^{-6} μCi/ml of moisture.

High tritium concentrations (range 1,779 to 1,180,630 x 10^{-6} μCi/ml of moisture) were found in samples collected from shafts 39 through 48 which are located in a line about 6 feet east of shafts 4 through 13 that are filled with wastes.

The low moisture content of the tuff indicates that the tritium is being distributed through the pore space of the tuff as well as joints or fractures by diffusion in a water vapor. There is probably some moisture gradient (greater in the wastes themselves) which will aid in the outward movement of the tritium as the volumes of greater moisture seek equilibrium in the tuff. There appears to be little if any pattern in the distribution of the tritium, probably due in part varying concentrations buried at various depths within the shafts and in part to a possible distribution that could be joint controlled.

In talking to Jack Healy there was some question as to if the moisture distilled from the tuff for analyses was in part bound water or water of crystallization. I ran a few tests and as near as I could determine the moisture distilled from the tuff was not in the form of bound water or water of crystallization.

Bill

William D. Purtymun

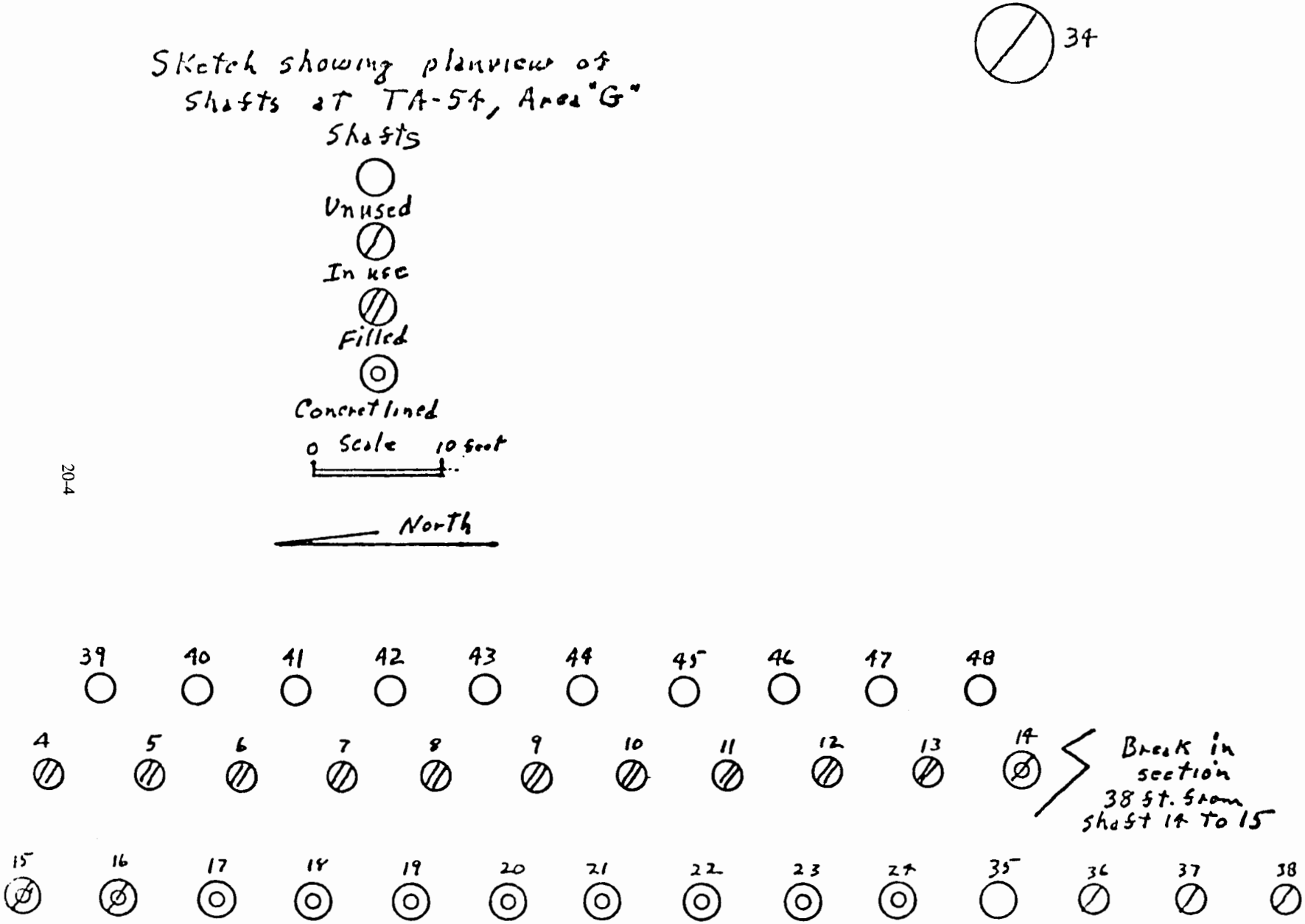
WDP:mtj

Enc. 1 - Table
1 - Sketch

Table shows percent of moisture and tritium content of moisture in samples of tuff collected from shafts in Area "G", TA-54.

Shaft Number	Depth (feet)	Date Collected	Percent Moisture (by weight)	Tritium μCi/ml of moisture ($\times 10^{-6}$)
34	20	11-7-69	0.4	454 ± 8
34	40	11-7-69	0.1	136 ± 6
34	65	11-7-69	0.3	62 ± 5
35	20	5-26-70	6.4	11 ± 5
35	40	5-26-70	1.2	106 ± 6
36	20	5-27-70	.7	37 ± 5
36	40	5-27-70	1.2	83 ± 6
37	20	5-27-70	.2	7 ± 5
37	40	5-27-70	.6	41 ± 5
38	20	5-27-70	.1	27 ± 5
38	40	5-27-70	.6	0 ± 5
39	25	6-9-70	1.2	52,797 ± 104
40	15	6-9-70	2.0	7,374 ± 32
40	25	6-9-70	1.0	15,135 ± 43
41	15	6-9-70	1.1	115,[illegible] ± [illegible]
41	25	6-9-70	1.4	6,833 ± 25
42	15	6-9-70	1.4	70,761 ± 140
42	25	6-9-70	.9	10,633 ± 36
43	15	6-10-70	1.2	3,115 ± 20
43	25	6-10-70	.2	23,029 ± 52
44	15	6-10-70	1.6	4,644 ± 22
44	25	6-10-70	.6	1,779 ± 16
45	15	6-10-70	1.0	211,094 ± 414
45	25	6-10-70	.8	178,198 ± 198
46	15	6-11-70	.9	30,828 ± 61
46	25	6-11-70	.5	6,813 ± 29
47	15	6-11-70	.9	220,966 ± 432
47	25	6-11-70	.7	1,180,630 ± 1995
48	15	6-12-70	2.3	170,824 ± 336
48	25	6-12-70	.8	324,832 ± 187

Sketch showing planview of Shafts at TA-54, Area "G"



June 24, 1970

Reading File

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : C. H. Stevens, Eng-2 DATE: February 2, 1971

THRU: W. R. Kennedy, Group Leader, H-6 WRK

FROM : William D. Purtymun, H-6

SUBJECT: GEOLOGIC SECTION AT TA-46

SYMBOL : H-6

Shown below is anticipated geologic section which would be encountered by drilling a test hole at TA-46.

ANTICIPATED GEOLOGIC SECTION AT TA-46 ELEVATION 7,120 FEET

Geologic Unit	Thickness (Feet)	Depth (Feet)
Bandelier Tuff		
Tshirege Member		
Unit 3 - non to moderately welded tuff	85	85
Unit 2 - Moderately welded tuff	140	225
Unit 1 - non to moderately welded tuff	100	325
Otowi Member		
non to moderately welded tuff	340	665
Guaje Member		
Pumice	35	700
Puye Formation		
Conglomerate	70	770
Basaltic rocks of Chino Mesa		
Basalt and interbedded sediments	190	960
Puye Formation		
Conglomerate	300±	1260±

The section is based on log of Supply Well PM-2 in Pajarito Canyon and Test Well 8 in Mortandad Canyon. A magnetic survey that was run from near Well PM-2 to about 0.5 west of TA-46 did not show any significant anomalies that would indicate a basalt high in the area.

TO: C. H. Stevens, Eng-2 DATE: February 2, 1971

Test drilling on the Pajarito Plateau has not [illegible] ground water in the Bandelier Tuff. The top of [illegible] is estimated to be at a depth of about 1,160 feet [illegible] at TA-46.

W D Purtymun

William D. Purtymun

cc: F. J. Zimmerman, Eng-2

Purtymun

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Vernon J. Stephens, Eng-2 DATE: April 28, 1971

FROM : William D. Purtymun, H-8 WDP

SUBJECT: RESULTS OF TEST DRILLING AND PENETRATION TESTS AT AREA "C"

SYMBOL : H8-M-2124

Twelve test holes ranging in depth from 5 to 25 feet were drilled in Solid Waste Disposal Area "C", on April 14 and 15,1971. Enclosed are the results: geologic logs, penetration tests, moisture content of soil, fill, or tuff, and a particle distribution analyses of the soil.

Tests at the 120 SW guy indicated that the location is underlain by a disposal pit, probably the chemical pit. No holes were drilled at the 240N guy, 120N guy or the 120SE guy.

Robert Sandoval, H-1, monitored cuttings from all holes drilled. No radioactive contamination was detected.

Notes:

1. - "N" is equal to the number of blows required to drive a 2-inch outside diameter by 1.375-inch outside diameter standard split spoon sampler through a vertical distance of one foot using a 140 lb. hammer with a free fall of 30 inches.

2. - Penetration count at 6 inch interval.

3. - Natural or existing moisture content of recovered core of soil, fill, or tuff is listed to right of penetration test results. Moisture contents are circled and are in percent moisture by weight.

4. - General description of soil, fill, and tuff

Soil, weathered in place, light brown, containing small crystal fragments of quartz and sanidine, rock fragments of tuff, pumice, latite, and rhyolite generally less than 1-inch in diameter in soil matrix (see particle size distribution).

Fill, reworked material consisting of pebble, cobble to boulder size fragments of tuff in a matrix of soil.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

TO: Vernon J. Stephens
H8-M2124

DATE: April 28, 1971

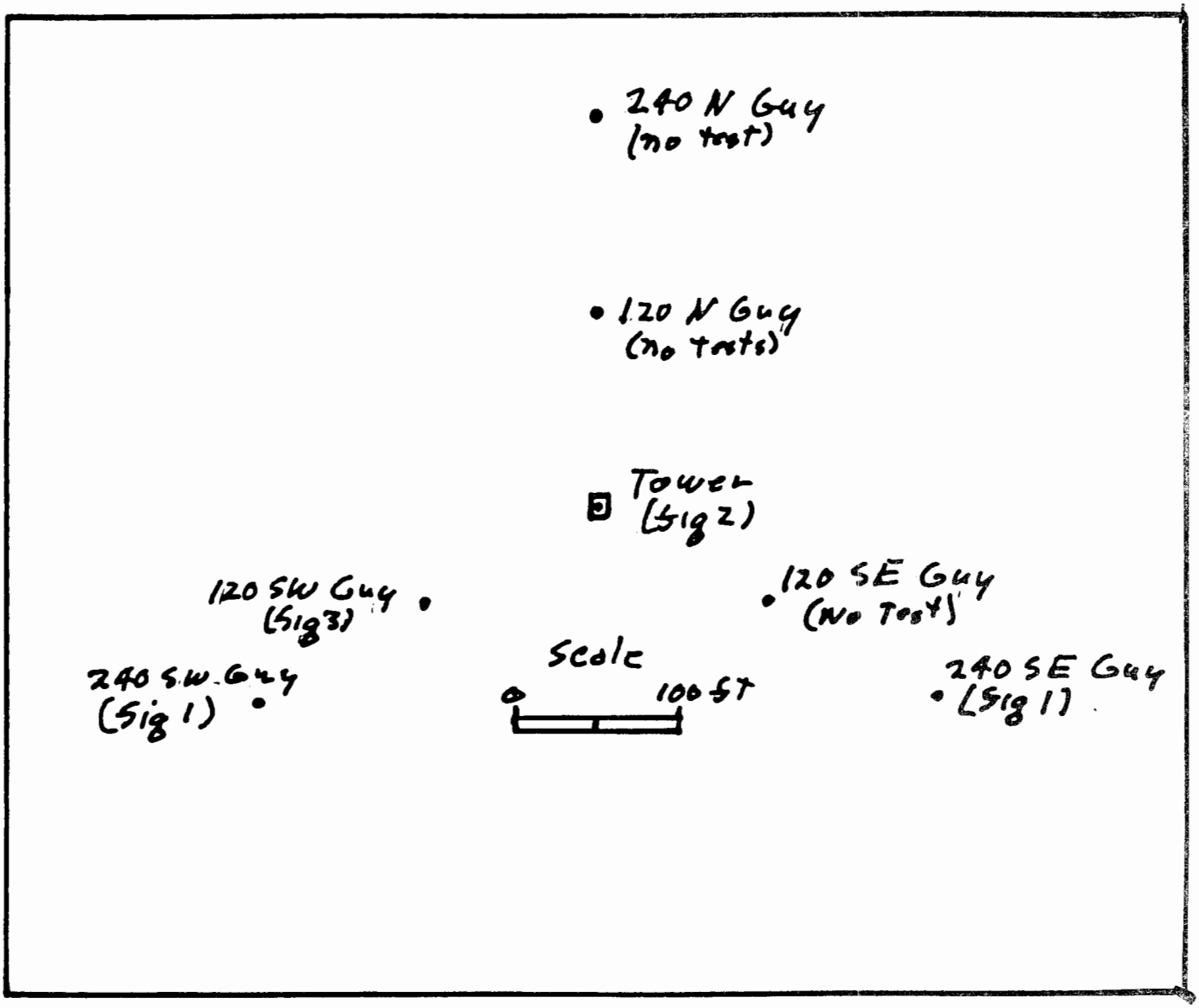
Tuff beneath the soil zone is weathered, consisting of crystal and crystal fragments of quartz and sanidine with small rock fragments of latite, rhyolite and pumice in a light brownish gray ash matrix. Pumice fragments are weathered to a light brown and are less than 1 inch in length. The unweathered tuff at depth (hole C, Fig. 2) same as above except ash matrix and pumice fragments are unweathered; matrix light gray; pumice fragments, dark gray.

5. - Particle size Distribution of Soil

Classification	Particle Diam. mm	Distribution Wt. %
Silt and clay	<0.062	8
Very fine sand	0.062 - 0.125	4
Fine Sand	0.125 - 0.250	7
Medium Sand	0.250 - 0.500	9
Coarse sand	0.500 - 1.00	16
Very coarse sand	1.00 - 2.00	11
Gravel	>2.00	45

WDP:et

cc: Roland Pettitt, Zia Engineering



Lay out of guy and tower
at Area "C"

Index of Tests

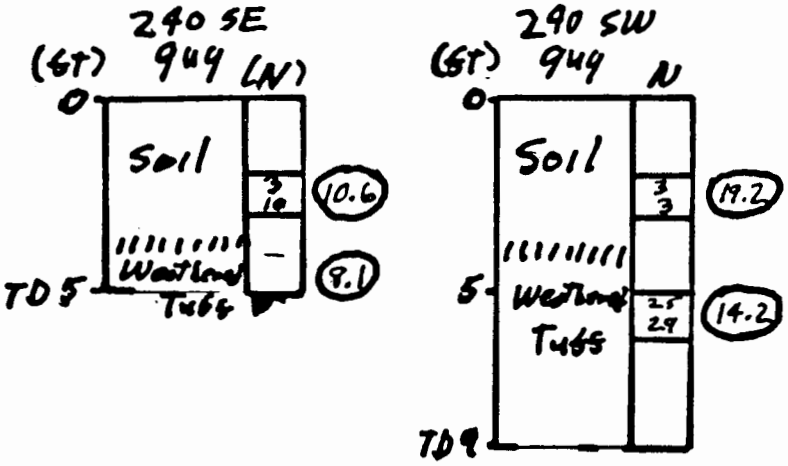
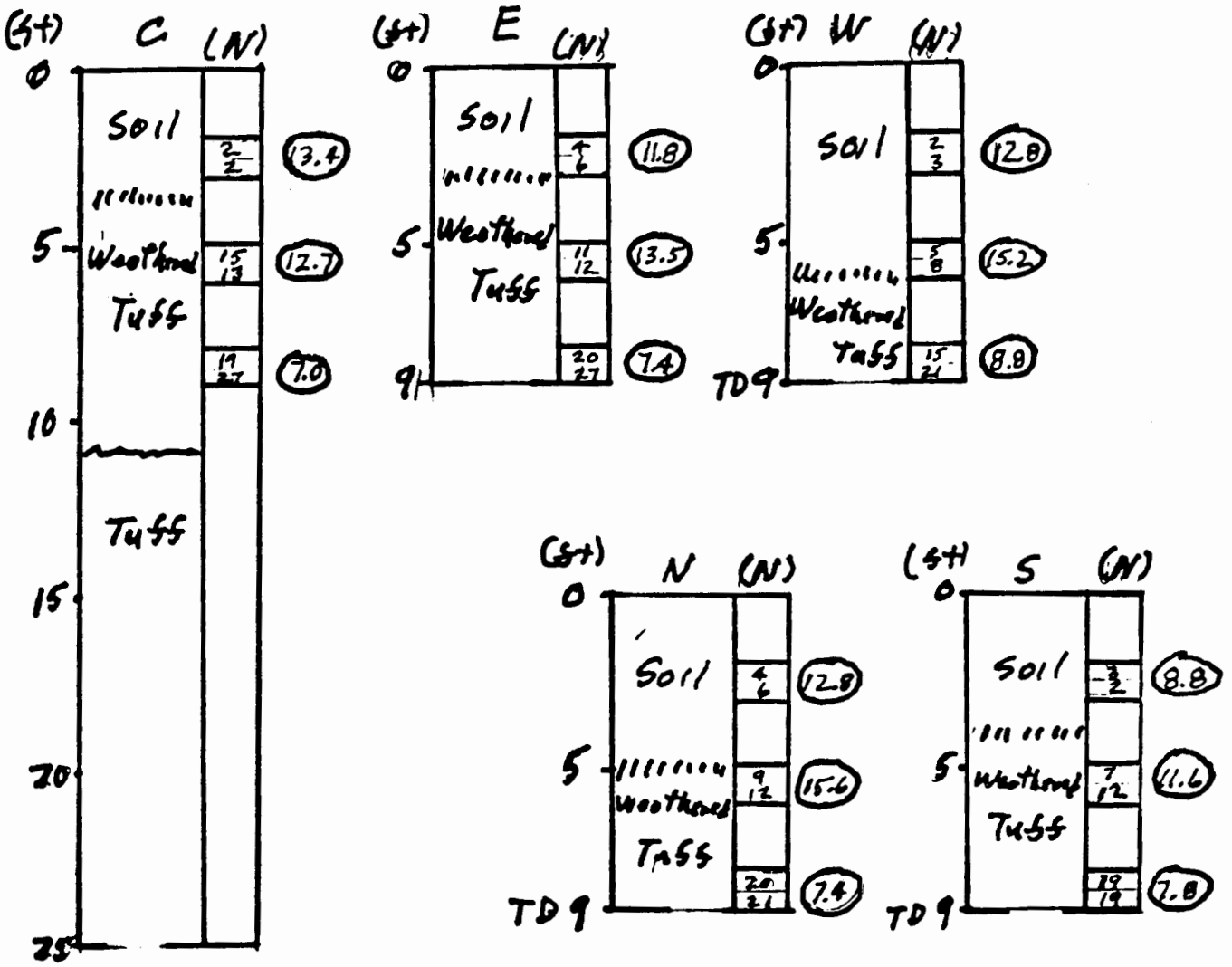
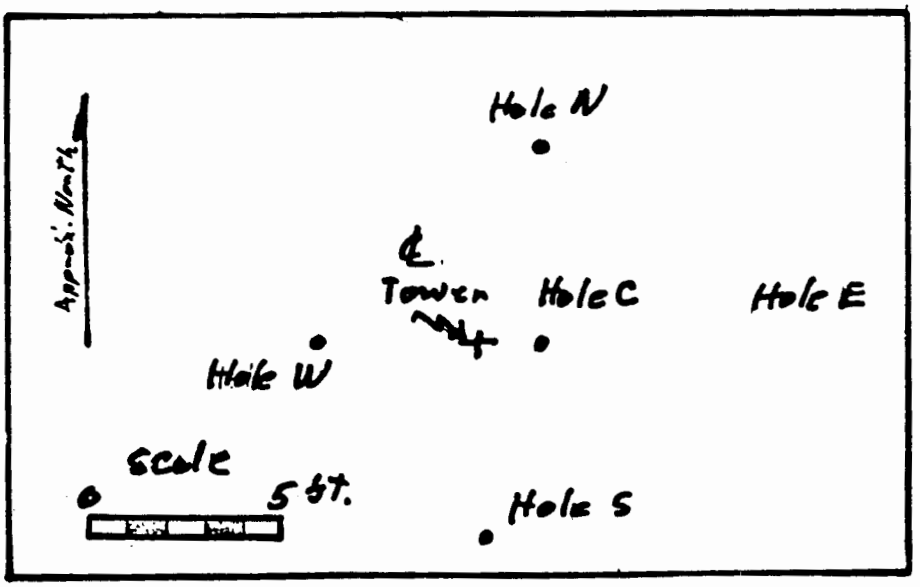


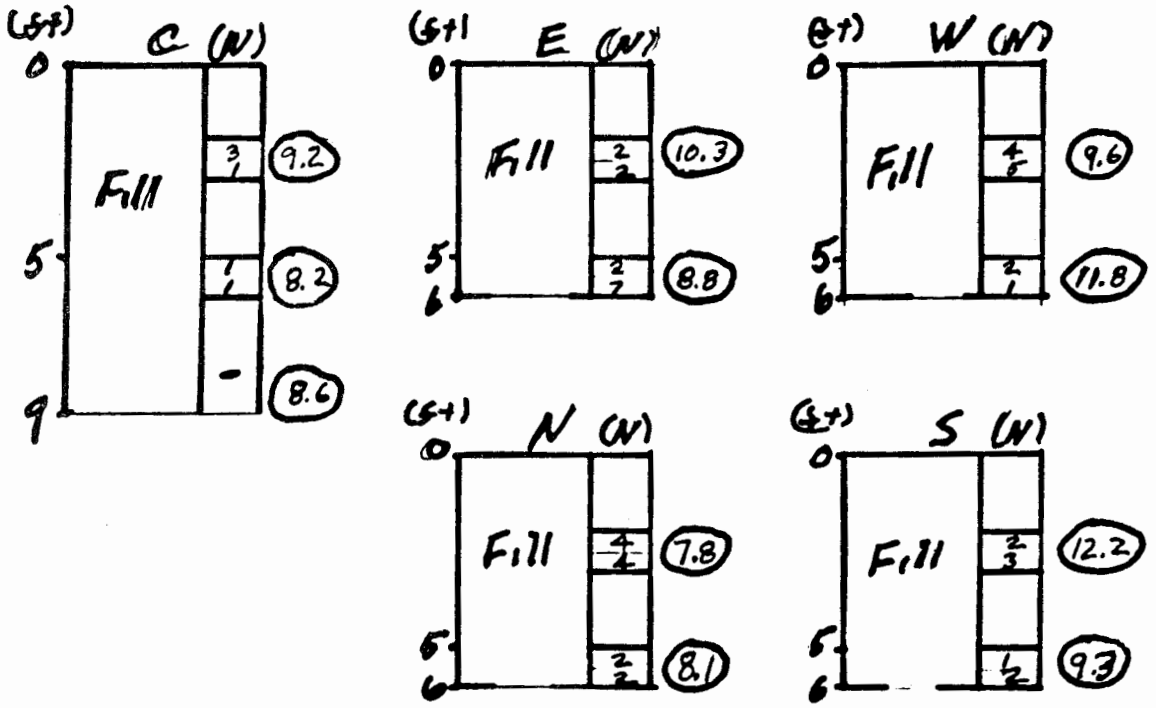
Fig 1.- Details of Tests

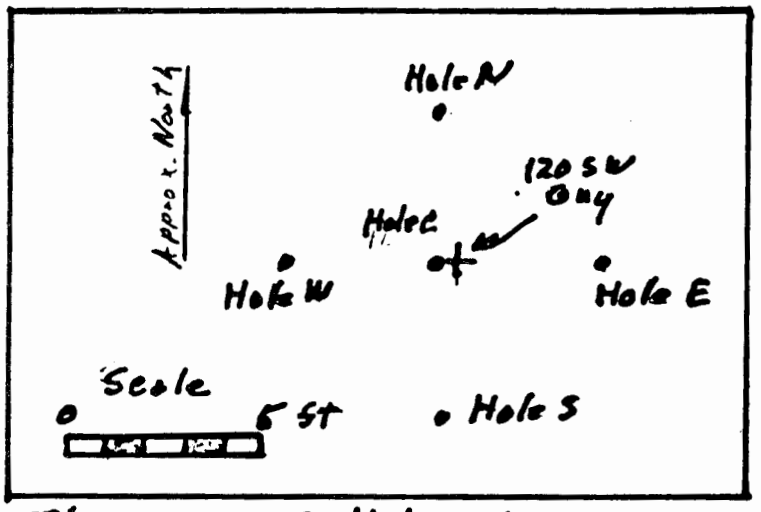




Planview of Hole at Tower Base

Fig. 2 Details of Tests





Plan view of Holes at 120 SW Guy

Figure 3.- Details of testing

S ALAMOS SCIENTIFIC LABORATORY
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LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : John Enders, H-1, CMR Bldg. DATE: July 26, 1971

FROM : Harry S. Jordan, H-8

SUBJECT: SURVEY OF STORAGE PITS, TA-54

SYMBOL : H8-M2210

A survey was made of pits 8, 12, 16, 17, and 21 at TA-54, Area G on July 20, 1971. The survey, in response to your memo June 1, 1971, was made to determine if the pits conformed to guidelines for pit construction as outlined in a memo from F. C. Koopman, USGS to S. E. Russo, Eng-3 dated June 30, 1965.

1. - The pits inspected were 50 feet from the canyon rim.

2. - Maximum depths of the pits were above adjacent canyon floors.

3. - Generally the pits were laid out with long dimension parallel to surface topographic contours. Pit 21, the long dimension is at right angles to the contours. When the pit is filled, a greater thickness of seal material should be used to cover the wastes to prevent erosion from forming gullies down the long dimension.

4. - There are numerous joints and fractures in the walls of the pits. Joint frequency is about 1 joint per 6 ft. of wall in the pits. This is about the same joint frequency as found in other pits in the area. Most of the joints are vertical or near vertical ranging from 70 to 90 degrees from a horizontal plane The joint ranged from clay filled to open. The only joint that will need attention is in pit 17 about 265 ft. from the NW corner on the SW wall. The joint opening, strikes 75° to 80° NW and is open 2 to 5 inches, extends 4 to about 12 ft. below the rim of the pit. Joint opening is near vertical. The opening can be filled and plugged when wastes in the pit are laid up to this level.

Pits 8, 12, 16, and 21, cut through two ashflows in Unit 2b. The contact is characterized by increase in size of pumice fragments and thin layers of reworked sediments. Pit 17 is within the lower ashflow. It was noted in several of the pits that the thin sediments in the contact

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UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

TO: John Enders, H-1 -2- DATE: July 26, 1971

were offset several inches along near vertical joints cutting both ashflows. The offset is probably caused by compaction of the lower flows. This is general information and does not effect the use of the pits for disposal of wastes.

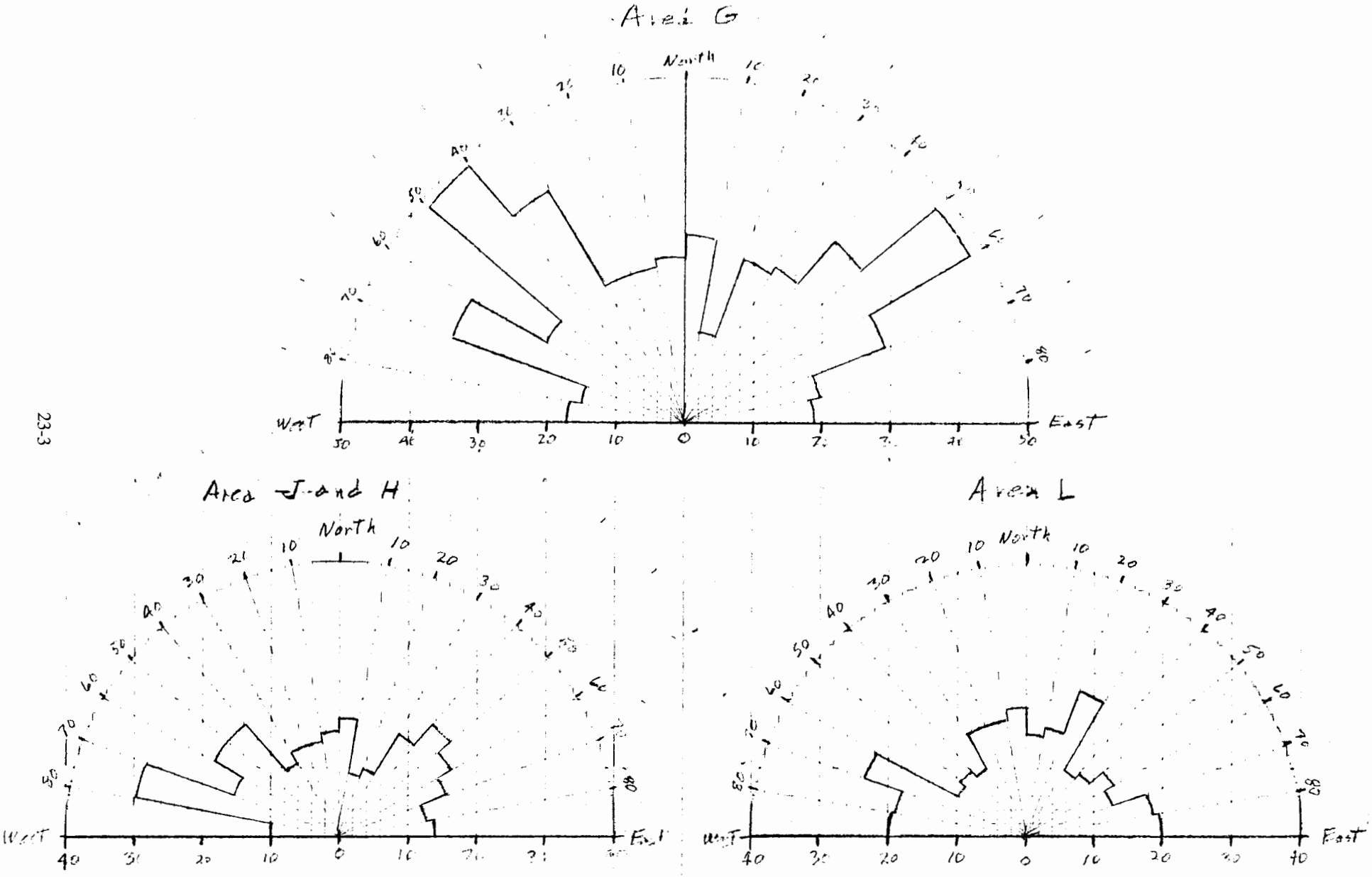
5. - Recent rains have produced small amounts of runoff which has entered the ramp on the NW ends of pits 8 and 17. Runoff should be diverted from the pits. Pit 17 will probably experience some sheet wash runoff into the pit along the SW wall. In the future tuff excavated from the pits should be piled up gradient from the pit to prevent runoff along the walls.

Unless noted, the pit construction meets the suggested guidelines as presented in the letter of June 30, 1965.

As per conversation with W. D. Purtymun on July 20, 1971, photographs of the walls and bottoms of the pits should be obtained for the record prior to the disposal of any wastes in the pits.

Harry S. Jordan
Group Leader H-8

HSJ:WDP:et
cc: W. D. Purtymun



Joint Orientation
Areas G and H, Canal Area L TA-51 7/1970

Waste Storage at Areas H, J, and L, TA-54

Mesita del Buey

H-8

October 22, 1971

Compiled
by

William D. Purtymun

CONTENTS

Introduction 1

Area H..... 4

Area J..... 5

Area L 5

Waste Storage and Geohydrologic Environment 8

References..... 10

Appendix A..... 11

Appendix B..... 13

ILLUSTRATIONS

Figure 1. - Geologic Map and Section of Mesita del Buey 2

Figure 2. - Entrance to TA-54, Area H in background... 3

Figure 3. - Area H enclosed in security fence, shaft covers to right..... 3

Figure 4. - Area H, south of wall of Shaft 8 showing vertical joint from a depth of 30 feet..... 6

Figure 5. - Area J, pit filled and sealed with tuff..... 6

Figure 6. - Area H pit in use, wastes to left, layers of wastes covered with tuff in bottom and sides of pit.... 7

Figure 7. - Area L pit in use water tank for fire protection..... 7

Waste Storage at Areas H, J, and L, TA-54

Mesita del Buey

Introduction

Mesita del Buey is a narrow southeastward trending mesa located about 4 miles southeast of the community of Los Alamos. The main aquifer of the area lies at a depth of about 1,050 feet below the surface of the mesa at Area H and at a depth of about 950 feet at Area L. Surface drainage from the mesa is into Pajarito Canyon to the south and an unnamed canyon to the north that is tributary to Canada del Buey (Fig. 1). Stream flow in Pajarito Canyon and Canada del Buey is intermittent, occurring occasionally during the summer from heavy thunder showers activity. Both canyons are tributary to the Rio Grande.

Pajarito Canyon has a large drainage area as it heads on the mountain to the west. As a result the alluvium in the canyon contains water that is recharged from intermittent flow on the flanks of the mountain. Canada del Buey has a small drainage area and contains no water in the thin alluvium in the canyon. Test drilling indicates no water occurring beneath the mesa and the top of the main aquifer.

The surface of the mesa where the storage area is located is covered with a clay-like soil and is underlain by a series of ashflow and ashfall of dry rhyolite tuff. The tuff is underlain by volcanic flow rocks of basalt and sediments. For a detailed description of the geology and hydrology of the mesa see Los Alamos Scientific Laboratory Report LA-4660.[1/]

Area H is used for the storage of classified materials. Area J is used for storage of material contaminated by explosive chemical while Area L is used for storage and chemical and toxic wastes.

Access to TA-54 is off Pajarito Road about 0.5 west of TA-18. The mesa is fenced from Canyon to Canyon with a 5 strain barb wire fence (Fig. 2). Access is controlled by SP-Division and H-Division.

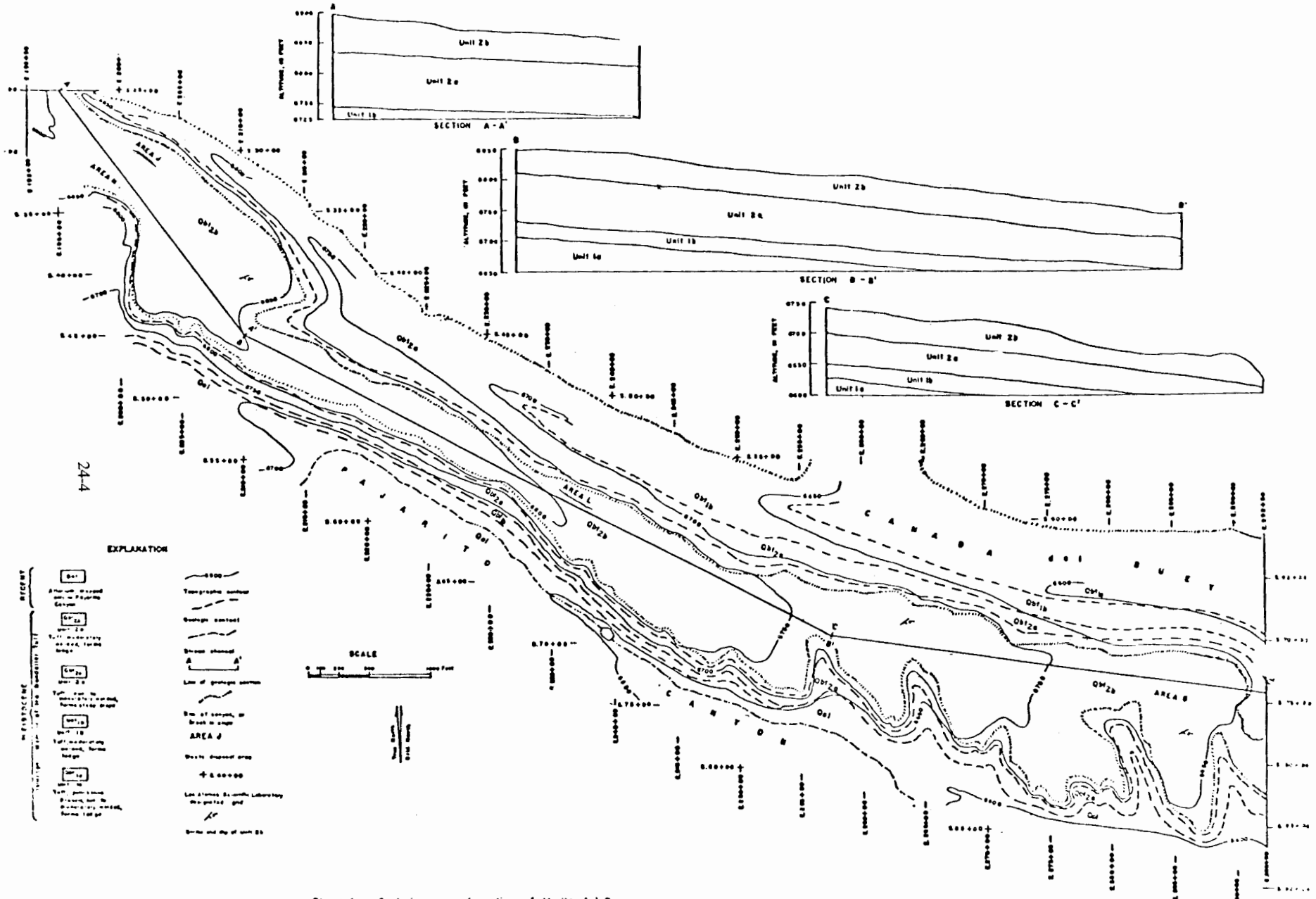


Figure 1.- Geologic map and sections of Mesita del Buey

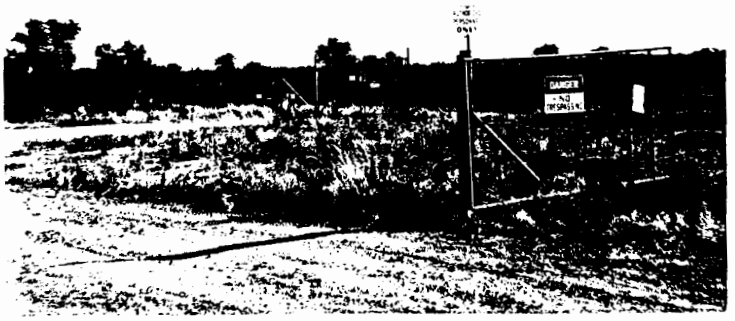


Figure 2. - Entrance to TA-54, Area H in background.

Figure 3. - Area H, enclosed in security fence shaft cover to right.

The purpose of this report is to outline the geologic and hydrologic environment at each of the areas in reference to possible transport of waste material into the environment beyond the storage areas.

Pits and shafts on Mesita del Buey are constructed according to guidelines set up by the H-Division and Eng. Divisionof the Los Alamos Scientific Laboratory and the U. S. Geological Survey. The guidelines cover construction burial of wastes, and surface seal of pits are designed to prevent the migration or transport of waste materials of the environment. Guidelines are found in Appendix A, report LA-4660.[1/]

AREA H

Area H is used for the storage of classified materials. The materials are placed in 6 foot diameter shafts about 60 feet deep.[2/] The shaft currently in use has a cover that is locked except when materials are being placed in the shaft (Fig. 3). The shafts are filled 5 to 6 feet of the surface and then capped with concrete.

The surface of the mesa at Area H slopes gently southeastward with the drainage into Pajarito Canyon. The mesa is underlain by about 590 feet of dry tuff and 460 feet of dry volcanic flow rocks. The main aquifer of the Los Alamos area lies at a depth of about 1,050 feet below the surface of the mesa.

The shafts are completed in the tuff, penetrating Unit 2b and into the top of Unit 2a (Fig 4). Analyses of moisture distilled out of the tuff for tritium indicated that some migration of tritium with water vapors through the tuff (Appendix I). The extent of the migration of tritium or shaft containing the tritium has not been determined. The tritium is migration with the material moisture in the tuff (generally less than 1 percent moisture by weight of the tuff). The 1,050 feet of dry tuff, volcanic rocks and sediments overlying the main aquifer are of sufficient thickness to conclude the migration in the vapor phase from the shafts to the main aquifer will not occur. The tritium is being released to the atmosphere by transpiration through plants and trees as well as evaporation from the surface soil in the area (Appendix II).

The area is enclosed with a security type fence with access controlled by SP Division.

AREA J

Area J is used for the storage of wastes contaminated by explosive chemicals. The waste consists mainly of equipment or solid materials that are contaminated or are suspected to be contaminated. No explosives are placed in the pits. The area contains two pits. One filled and sealed (Fig. 5) and the other in use (Fig. 6). The pits are 50 feet wide, 250 feet long and about 15 feet deep. There are ramps at the long dimension of the pit.

The wastes are buried in layers with each successive layer covered with 0.5 to 1 foot of tuff. This prevents fire and some scourging of the wastes by the public until the final seal is put on the pit.

The surface of the mesa slopes gently to the north with drainage into an unnamed canyon to the north of Mesita del Buey that is tributary to the Canada del Buey to the east. The mesa is underlain by about 575 feet of dry tuff and about 465 feet of dry volcanic flow rocks and sediments. The main aquifer of the Los Alamos Area lies at a depth of about 1040 feet below the surface of the mesa. The pits are completed into the top of Unit 2b of the Tshirege Member of the Bandelier tuff. The soil thickness in the area of the pit ranges from about 0.5 to about 1.5 feet.

The area is open access to the public. The only fence is a locked gate at entrance to TA-54.

AREA L

Area L is used for the storage of chemicals or toxic materials. The wastes consist of solid chemical liquids. Liquid chemicals are usually in laboratory size that have become out of date. The actual quantity of fluid is low. The storage area consists of a pit that is 12 feet wide, 200 feet long and about 12 feet deep with ramps on the long dimension.[4/] One shaft 6 feet in diameter and 60 feet deep is located in the southeast corner of the area (Fig. 7).

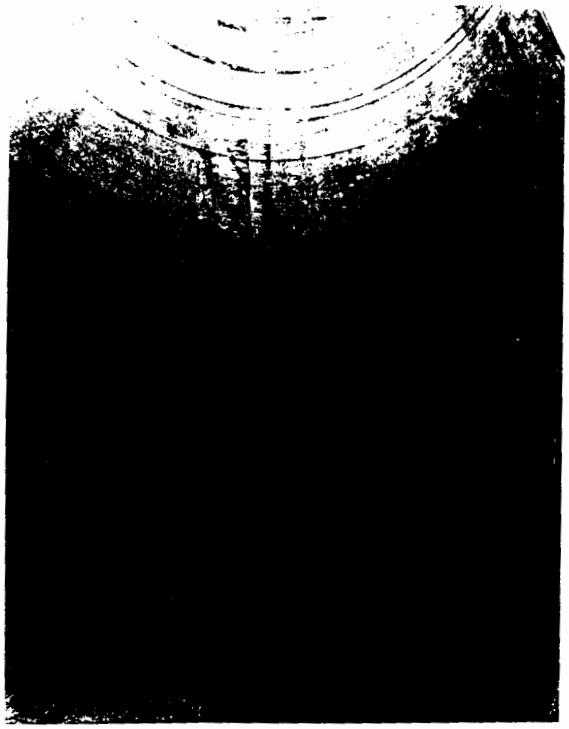


Figure 4. - Area H, South wall of shaft 8 showing vertical joint from a depth of 30 feet.

Figure 5. - Area J, pit filled and sealed with tuff.

Figure 6. - Area H pit in use, wastes to the left, layers of wastes covered with tuff in sides and bottom of pit.

Figure 7. - Area L pit in use, water tank for fire protection.

into an unnamed canyon north of Mesita del Buey that is tributary to Canada del Buey to the east. The mesa is underlain by about 340 feet of dry tuff and 610 feet of dry volcanic flow rocks and sediments. The main aquifer of the area lies at a depth of about 950 feet below the surface of the mesa. The pit is completed into the top of Unit 2b of the Tshirege Member of the Bandelier Tuff while the shaft extends through Unit 2b into the top of Unit 2a. The soil thickness in the pit area averages about 1 foot.

The entire area is enclosed with a security type fence and access is controlled by H-Division.

WASTE STORAGE AND THE GEOHYDROLOGIC ENVIRONMENT[1/]

Total containment of contaminants is of paramount importance in the disposal of wastes at Mesita del buey. Initial containment is accomplished with the burial of wastes in pits or shafts. After burial, the major means of transport of contaminants to the environment would be in the hydrologic cycle.

Transport of contamination by surface runoff on the mesa seems unlikely because the wastes are buried.

Little if any water from precipitation or surface runoff infiltrates through the seal material overlying wastes in filled pits. There is not enough water to leach the contaminants from the wastes and move them into the tuff. The bottoms of the pits are underlain by about 500 feet of tuff at Area H to about 340 feet of tuff at Area J. The hydrologic characteristics and conditions of the soil, seal material, and tuff indicate no recharge to the stream-connected aquifers or main aquifer through the surface soil, buried wastes, or underlying tuff at Mesita del Buey.

The natural moisture content of the unsaturated tuff is in the range in which moisture is redistributed by diffusion. Contaminants may be transported by diffusion if gases or volatile fluids are placed in shafts or pits. Diffusion may take place through the tuff where there are large amounts of pore space, through open joints, or along contacts between ashflows.

The physical and hydrologic characteristics of the tuff are ideal for the storage receptacles for the wastes in Areas L, H, and J. There is no hazard to the environment by use of these storage areas. The wastes are contained within the storage area.

REFERENCES

1/ W. D. Purtymun and W. R. Kennedy, "Geology and Hydrology of Mesita del Buey," Los Alamos Scientific Laboratory Report LA-4660.

2/ Materials Disposal Area H, Los Alamos Scientific Laboratory Eng-R-3647.

3/ Materials Disposal Area J, Los Alamos Scientific Laboratory Eng-R-3648.

4/ Materials Disposal Area L, Los Alamos Scientific Laboratory, Eng-R-3650.

APPENDIX A

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

OFFICE MEMORANDUM

TO : William R. Kennedy, Group Leader, H-6 DATE: November 21, 1969

FROM : Jack W. Aeby, H-6

SUBJECT: PERMEABILITY OF THE TUFF TO WATER VAPOR

SYMBOL : H-6

In order to establish a background bore line for tritium samples taken from test borings around the DP slurry dump holes, advantage was taken of the fact that drillers were in the process of boring a new 8 ft. diameter hole in Area "H", the classified shops disposal area. When we arrived at this area in the afternoon of November 6, we found them bailing out the loose tuff from the 40 ft. depth. We simply bagged a few handfuls of the loose material for our background sample.

Approximately one liter of this material was placed in a two liter beaker and heated to drive off the moisture which was collected on a watch glass cooled with a single ice cube. It required a very high heat to drive off 1 ml of water for our analysis. (This tuff actually gave a slightly negative reading on the moisture balance.) A 500 lambda alliquote of the water was placed in a standard scintillation counting bottle along with 15 ml of scintillation solution for scintillation counting. The counting results showed an activity of 4,586,795.9 ± 8,958.8 dis/min. ml or 69,496.91% RCG. A very surprising result indeed for a background sample. Subsequent repeat counting verified the above values.

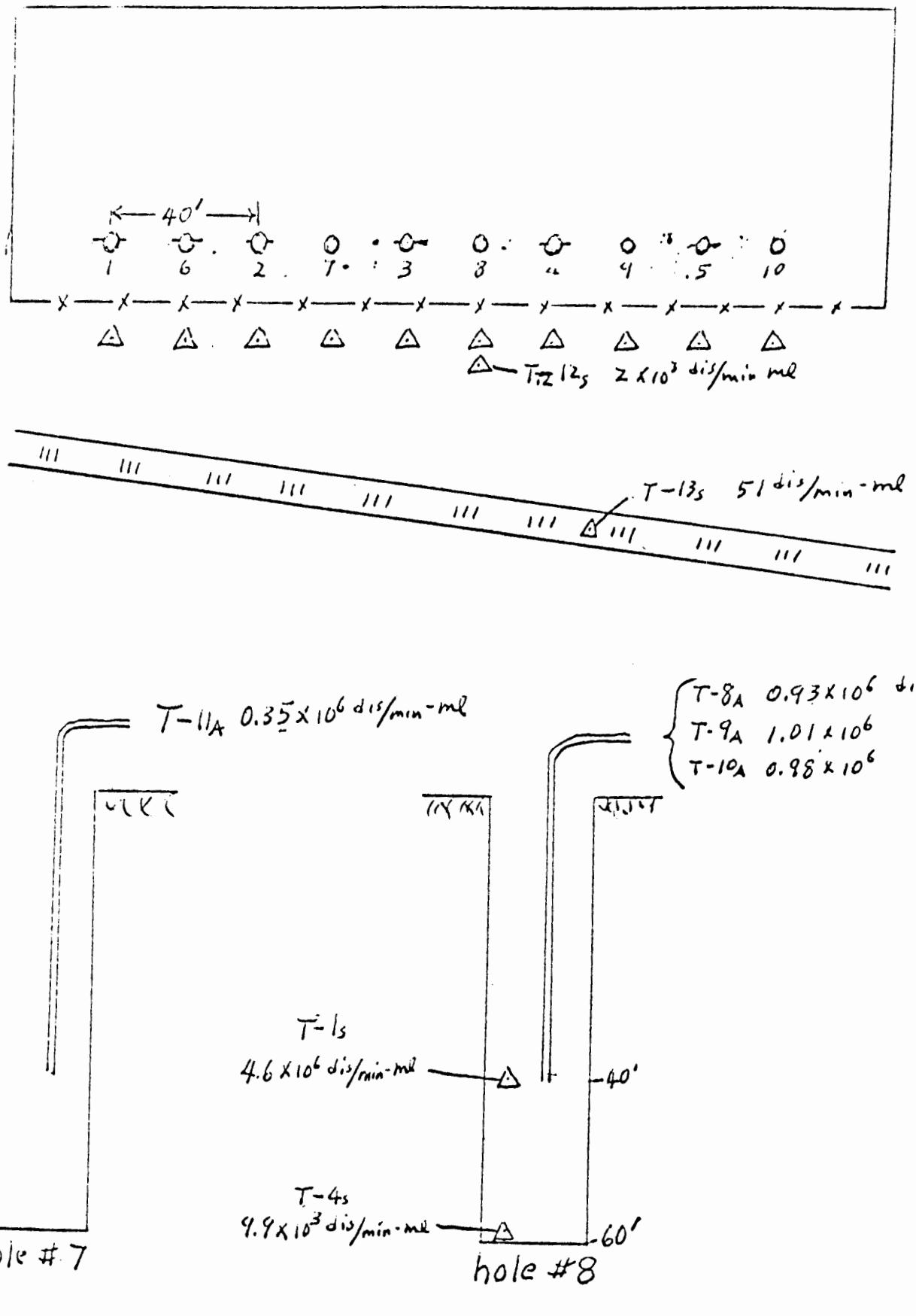
The search continues for an adequate background sample. However, our initial failure and subsequent failures have launched us on an interesting experiment to determine the permeability of the local formations to tritium or moisture. The results to date are contained in the enclosed chart.

Even though this sample is 69,496.9% RCG for water, one must remember that it is rather difficult to extract from the tuff. Subsequent air samples taken in this same hole at the 45 ft. depth ran a maximum of 118% RCG air, 100% is the concentration in the air one could tolerate with no measurable effects.

JWA:mtj

Enc. Chart

Area "H"



Soil Sample location △

EASL-AEC OFFICIAL

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO

OFFICE MEMORANDUM

TO : William R. Kennedy, Group Leader, H-6 DATE: December 23, 1969

FROM : William D. Purtymun, H-6

SUBJECT: APPENDIX TO PERMEABILITY OF THE TUFF TO WATER VAPORS (NOVEMBER 21, 1969)

SYMBOL : H-6

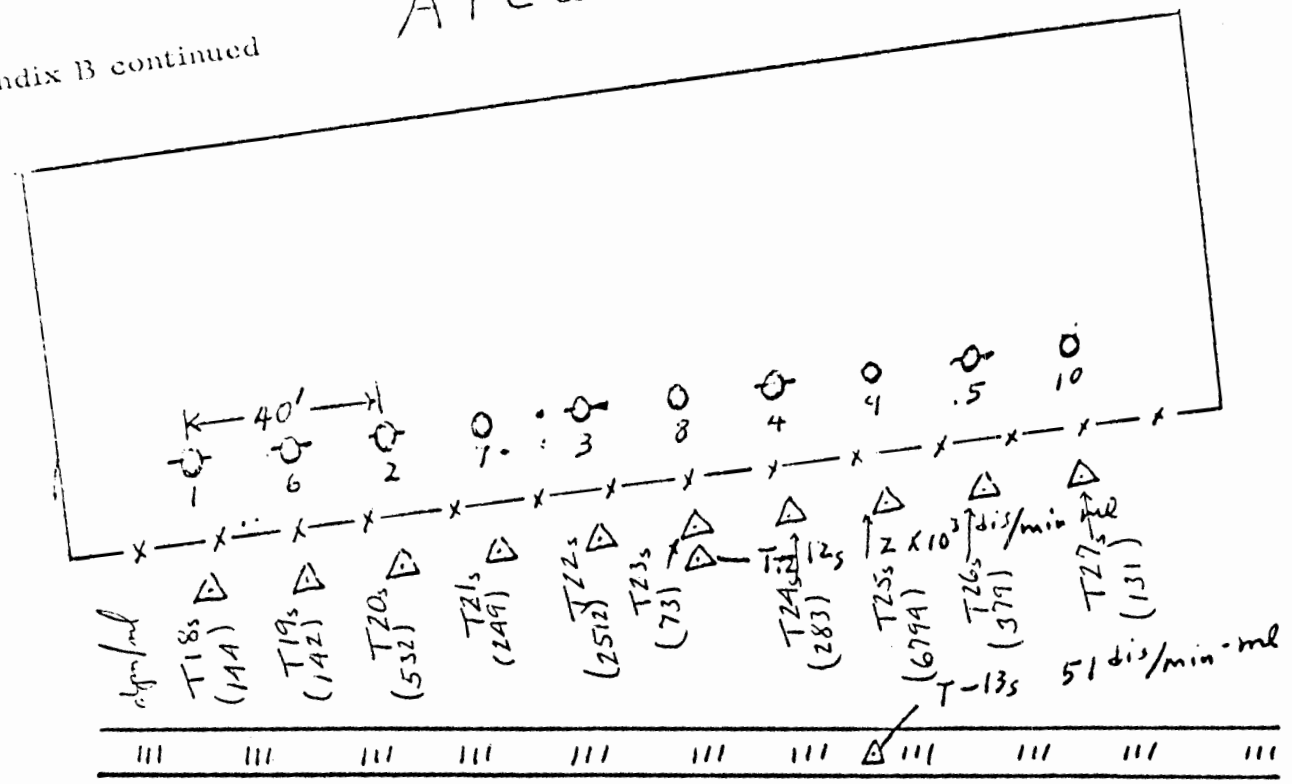
Ten additional soil samples were collected about 5 feet out from the south fence of Area "H" at a depth of 1 foot. These soil samples were analyzed for tritium in the same manner described in the original memorandum.

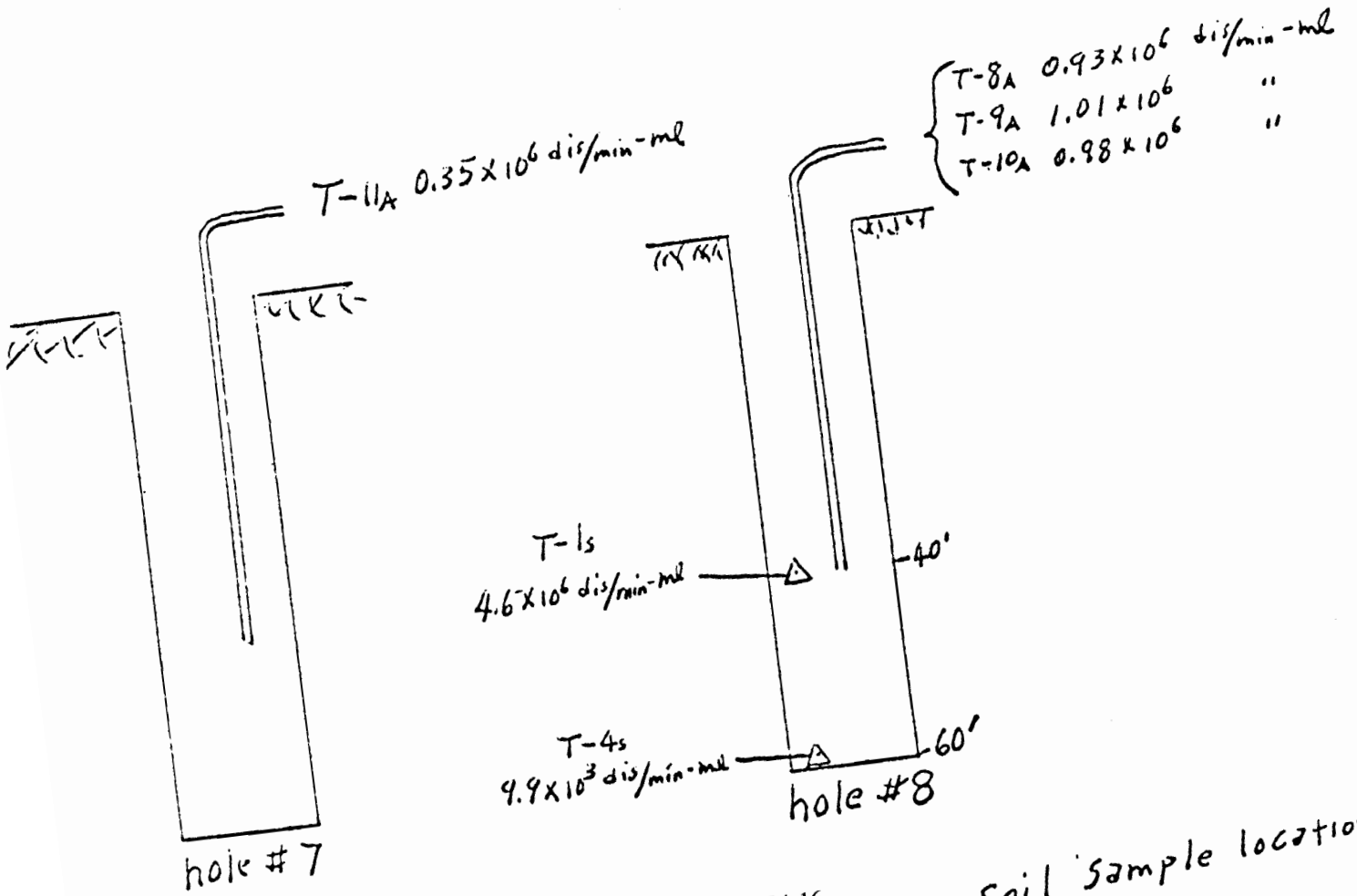
The results in dpm/ml are listed beside sample numbers at sample locations.

Samples are too few and not of sufficient depth to be conclusive and the patterns maybe only a result of chance, however, if a northwest trending joint set occurs in this area as in Area "G" the source maybe shafts 4 and 7.

WDP:mtj

Area "H"





Soil sample location △

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Dean Meyer, Group Leader, H-1 DATE: December 2, 1971

FROM : Harry S. Jordan, Group Leader, H-8

SUBJECT: TRITIUM AND RADIOCHEMICAL ANALYSES, PITS 8, 12, 16, 17 and 21, TA-54: REFERENCE MEMO H-1, 71-139

SYMBOL : H8-M2371

Nine test holes were drilled in August 1971 in and adjacent to the new disposal pits at TA-54 (See sketch on location). Five of the test holes (8A, 12A, 16A, and 21A)were drilled to a depth of 30 feet in the floor of the pits. Four of the test holes (8A, 16B, 17B and 21B) were drilled to depths of 60 feet, three on the perimeter and one near the center of the area. The test holes were drilled to establish background data on radioactivity in the tuff prior disposal of wastes in the pits.

Samples of tuff were collected over a five foot interval. The moisture content of each sample was determined and moisture distilled out for tritium analyses. The data is tabulated on Table 1. The tritium concentrations range from 4 to 33 pCi/ml (picocuries per milliliter of moisture). with an average of 14 pCi/ml. There was no pattern to the distribution of tritium with depth. Concentrations are low, within background data on tritium collected from a shaft at Area L (20 pCi/ml).

In undisturbed areas on the mesa moisture concentrations in the tuff will range from 3 to 8 per cent by weight in upper 10 feet of soil and tuff. The concentrations decrease with depth. Soil cover in the areas of holes 8B, 16B, 17B, and 21B was distributed by heavy equipment used in construction of the pits. The moisture content of samples in the upper 10 feet of soil and tuff from the above holes ranged from 0.6 to 5.0 per cent by weight with an average of 1.8.

The moisture contents of tuff from holes 8A, 12A, 16A, 17A, and 21A (located in bottom of pits) and below depths of 10 feet in holes 8B, 16B, 17B, and 21B ranged from <0.1 to 1.4 per cent by weight with an average of 0.4. The moisture in the soil and tuff is in the low moisture range where movement is by diffusion.

The pits are constructed in Unit 2b of the Tshirege Member of the Bandelier Tuff. Unit 2b consists of a moderately welded tuff consisting of two ashflows separated by eroded material consisting of reworked sand, tuff and pumice. Pits 8, 12, 16, and 21 are constructed through the upper ashflow reworked materials and completed into the lower ashflow. Pit 17, located topographically lower, is constructed within

TO: Dean Meyer, H-1
H8-M2371

DATE: December 2, 1971

the lower ashflow, the surface around the pit below the erosional contact between the two ashflows.

The test holes drilled in the bottom of the pits (within the lower ashflow) are completed into the top of Units 2a. The test holes drilled on the perimeter and near the center of the area are completed through Unit 2b into the top of Unit 2a.

Radiochemical analyses of samples collected from test hole 21B were composited according to stratigraphic units (i. e. upper ashflow, reworked material, and lower ashflow of unit 2b and upper ash-flow of unit 2a) and analyzed for gross alpha and beta activity as well as ^{238}Pu, ^{239}Pu, ^{137}Cs and Natural Uranium (Table 2). The results of the analyses are within limits of background data in the Los Alamos area. The positive value of 0.005 pCi/g (picocuries per gram) of ^{239}Pu in the upper ashflow (depth 0-10 feet) is within limits established for ^{239}Pu fallout in the Los Alamos, Santa Fe and Espanola areas.

HSJ:WDP:et

cc: H-8 File
WDP

Table 1. - Tritium Concentr. ions and Moisture Contents in .ttings from Test Holes.

Depth Internal (feet)	Tritium Picocuries per Milliliter of Moisture								
	Hole 8A	Hole 12A	Hole 16A	Hole 17A	Hole 21A	Hole 8B	Hole 16B	Hole 17B	Hole 21B
0-5	9	11	12	15	11	27	12	10	15
5-10	8	15	10	13	12	13	15	7	24
10-15	11	13	5	11	4	10	15	12	23
15-20	<4	13	14	10	9	14	14	13	20
20-25	9	10	16	12	10	21	16	20	33
25-30	11	12	--	6	8	12	17	18	24
30-35	--	--	--	--	--	20	18	14	25
35-40	--	--	--	--	--	22	12	12	18
40-45	--	--	--	--	--	10	10	15	26
45-50	--	--	--	--	--	13	15	12	21
50-55	--	--	--	--	--	27	16	16	15
55-60	--	--	--	--	--	20	17	13	17

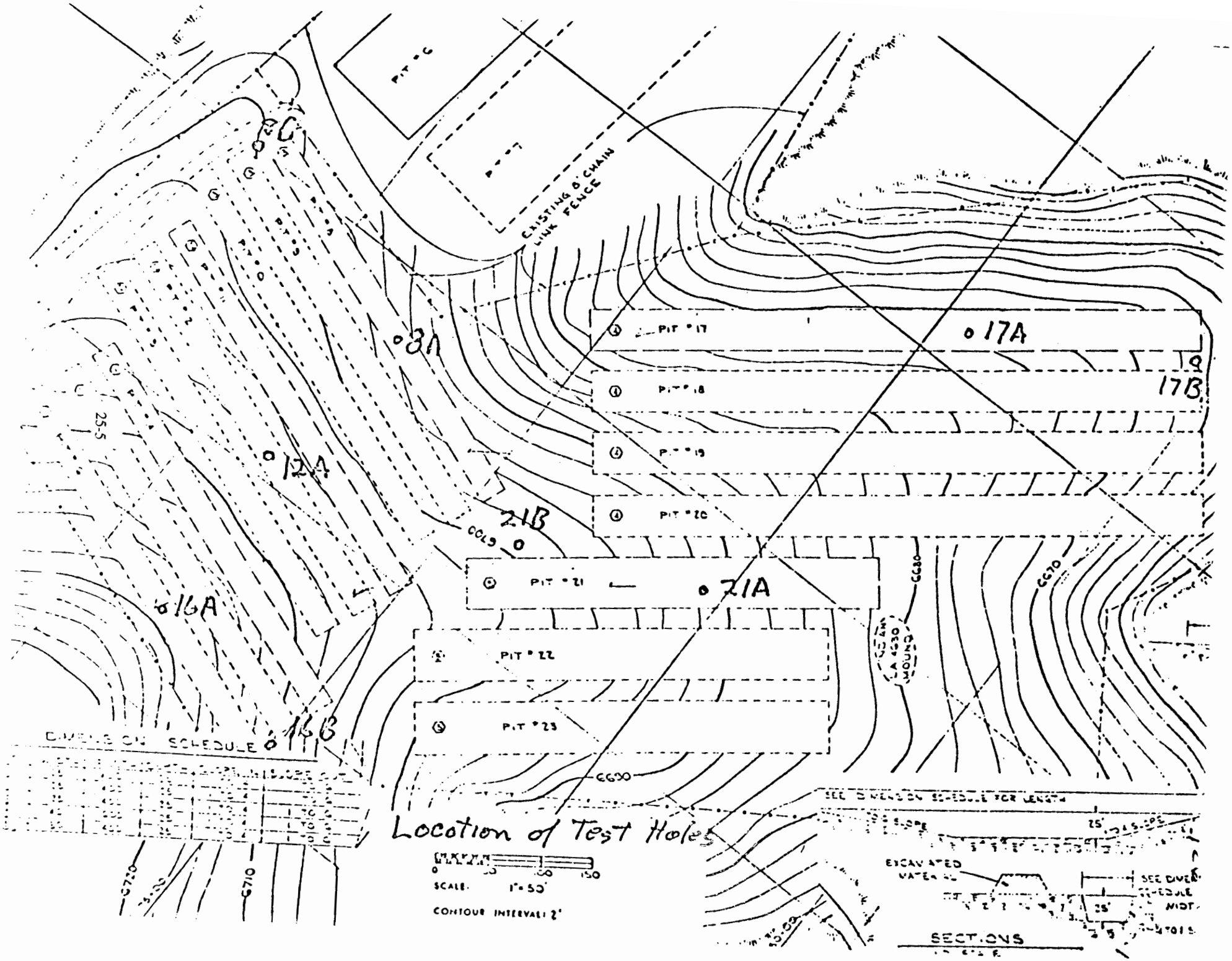
Note Limits of detections 4 picocuries per milliliter.

Depth Internal (feet)	Moisture content of tuff Percent Moisture by Weight								
	Hole 8A	Hole 12A	Hole 16A	Hole 17A	Hole 21A	Hole 8B	Hole 16B	Hole 17B	Hole 21B
0-5	0.2	<0.1	0.1	<0.1	0.8	5.0	0.6	2.0	1.9
5-10	1.1	< .1	.3	< .1	,7	2.7	.4	1.0	1.2
10~15	.9	< .1	<.1	1.0	.8	1.3	.5	.3	.5
15-20	.7	.2	<.1	<.1	<.1	.8	.4	.2	.5
20-25	.8	.1	.1	.4	<.1	.7	6	.3	.4
25-30	1.4	.1	<.1	1.2	< 1	.2	.2	.5	.1
30-35	--	--	--	--	--	1.0	.2	1.1	.4
35-40	--	--	--	--	--	.6	.1	.4	.2
40-45	--	--	--	--	--	.6	.8	.6	.3
45-50	--	--	--	--	--	.9	.4	.4	<.1
50-55	--	--	--	--	--	1.1	<.1	.3	.4
55-60	--	--	--	--	--	.8	.3	.6	.2

Table 2. - Radiochemical analyses of tuff from test hole 21B.

Description	Depth (feet)	Picocuries per gram					Micrograms per gram
		Gross Alpha	Gross Beta	^{238}Pu	^{239}Pu	^{137}Cs	Natural uranium
Unit 2b							
Upper ashflow	0-10	6	2	b/	0.005	c/	0.20
Reworked Material	10-15	8	a/	b/	b/	c/	.28
Lower Ashflow	15-40	7	a/	b/	b/	c/	.24
Unit 2a							
Upper Ashflow	40-60	7	a/	b/	b/	c/	.31

a/ Below limits of detection 1 pCi/g
b/ Below limits of detection 0.002 pCi/g
c/ Below limits of detection 2 pCi/g


PIT #6
PIT #7
EXISTING 6' CHAIN LINK FENCE
PIT #17
PIT #18
PIT #19
PIT #20
PIT #21
PIT #22
PIT #23
17A
17B
21A
21B
12A
16A
16B
25-5
CG90
CG80
CG70
CG60
CG50
DIMENSION SCHEDULE
SEE DIMENSION SCHEDULE FOR LENGTH
EXCAVATED MATERIAL
SEE DIMENSION SCHEDULE MIDT.
SECTIONS
Location of Test Holes
SCALE: 1" = 50'
CONTOUR INTERVAL: 2'

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Morton Smith, CMB-13

DATE: 12-22-71

FROM : William D. Purtymun, H-8 WDP

SUBJECT: LOGS AND CASING SCHEDULE OF HOLES DRILLED FOR HEAT FLOW MEASUREMENTS

SYMBOL : H8-M2390

The following presents logs and casing schedules of holes drilled for heat flow measurements. The holes were cased with 2 inch diameter plastic tubing. The annular space between the bore wall and casing was filled with cutting removed from the holes during drilling at Sites 1, 2, 3, and 4. Sand was used for backfill material at Site 5.

It was impossible to complete the holes to a depth necessary for the heat flow measurements due to welded tuff encountered at Sites 6 and 7. Sketch map shows general location of the holes.

SITE 1 - December 7, 1971

	Thickness (feet)	Depth (feet)
Soil, dark brown	4	4
Tuff, light gray	68	72

Hole bottomed on hard rock, probably latites of Tschicoma Formation. Cased with 70 feet of casing which extends 2.0 feet above land surface.

SITE 2 - December 10, 1971

Pumice, dark brown weathered	34	34
Tuff, brown weathered to clay	18	52

Hole bottomed on hard rock, probably latites of Tschicoma Formation. Cased with 49 feet of casing which extends 0.5 feet above land surface.

SITE 3 - December 13, 1971

Pumice, weathered, contain large amounts of moisture	67	67
Tuff, reworked, brown	36	103

TO: Morton Smith, CMB-13 -2- DATE: December 22, 1971
H8-M2390

Cased with 102 feet of casing which extends 0.5 feet above land surface.

Site 4 - December 15, 1971

	Thickness (feet)	Depth (feet)
Soil, brown	3	3
Tuff, gray	69	72
Tuff, dark gray dense	2	74

Hole bottomed into weld tuff. Cased with 73 feet of casing which extends 0.5 feet above land surface.

SITE 5 - December 17, 1971

Tuff, brown, weathered to clay	72	72
Tuff, light gray	20	92
Tuff, dark gray, dense	6	98

Hole bottomed into welded tuff. Cased with 95 feet of casing which extends 0.5 feet above land surface.

SITE 6 - December 16, 1971

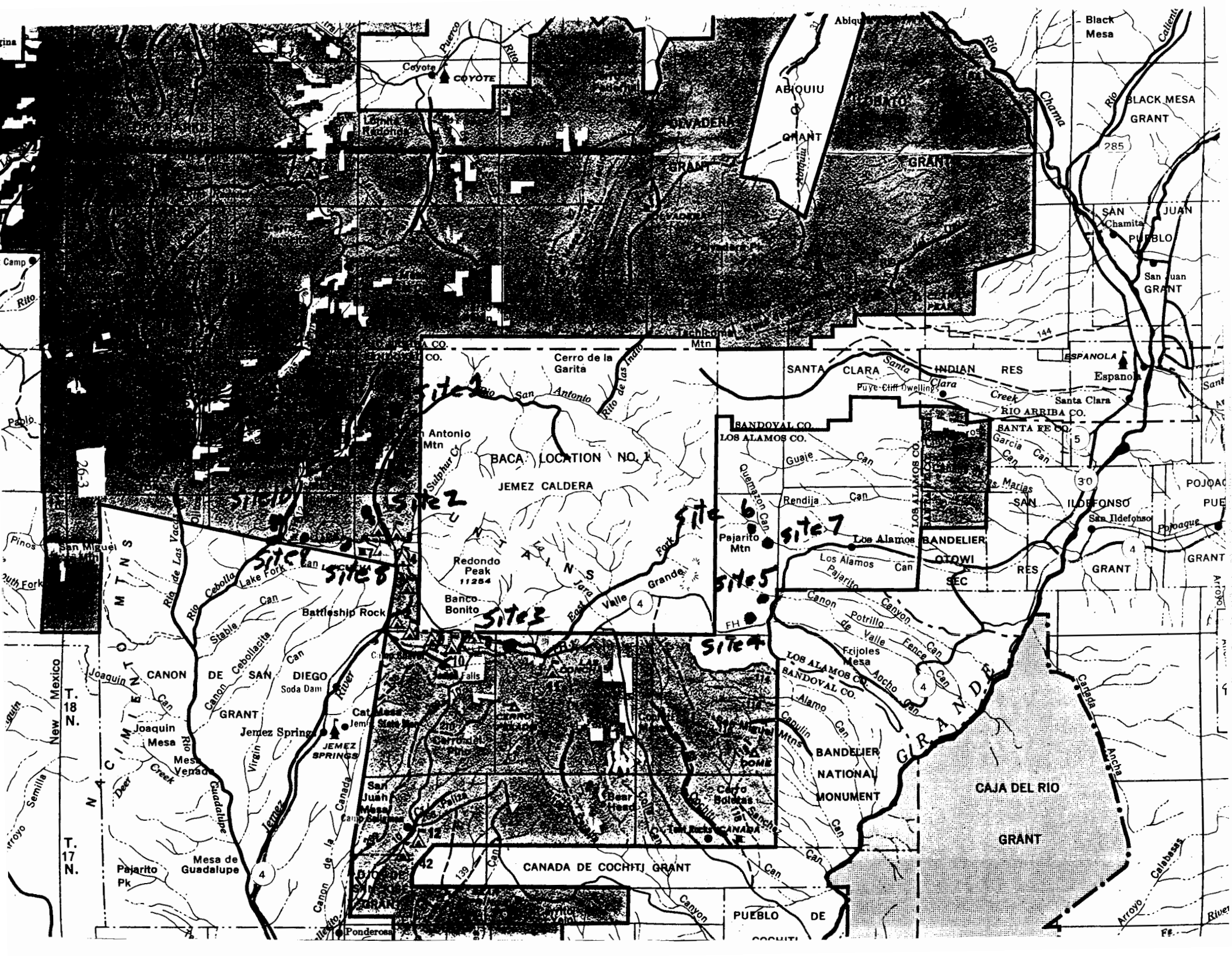
Hole abandoned and filled at a depth of 9 feet in welded tuff.

SITE 7 - December 16, 1971

Hole abandoned and filled at a depth of 24 feet in welded tuff.

WDP:et
enc. 1

cc: Dr. Marshall Reiter, NMMIT (w enc)
Don Brown, N-7 (w enc.)
ISD-5 (2) (w/o enc.)
H-8 File
WDP


Black Mesa
BLACK MESA GRANT
ABIQUIU GRANT
Coyote
COYOTE
Puerco
Rito
Chama
Rio
Caliente
Abiquiu
SAN JUAN PUEBLO
Chamita
San Juan GRANT
Cerro de la Garita
Rio San Antonio
Rito de las Indio
SANTA CLARA INDIAN RES
Puye Cliff Dwellings
Santa Clara Creek
Santa Clara
ESPANOLA
Espanola
RIO ARRIBA CO.
SANTA FE CO.
SANDOVAL CO.
LOS ALAMOS CO.
Antonio Mtn
BACA LOCATION NO. 1
JEMEZ CALDERA
Sulphur Cr
Guaje Can
Rendija Can
Garcia Can
Quemazon Can
Pajarito Mtn
Los Alamos
Los Alamos Can
Pajarito
BANDELIER OTOWI RES
SAN ILDEFONSO
San Ildefonso
Pojoaque
POJOAQUE
Redondo Peak 11254
Banco Bonito
Jara
East Fork
Valle Grande
Rio Cebolla
Lake Fork
Rio de Las Vacas
Battleship Rock
Stable Can
Cebollacita Can
CANON DE SAN DIEGO GRANT
Soda Dam
Joaquin Mesa
Mesa Venada
Jemez Springs
JEMEZ SPRINGS
Cat Mesa
Jemez
Virgin
Rio Guadalupe
Deer Creek
Jemez
Canada
San Juan Mesa
Camp Seligman
Mesa de Guadalupe
Pajarito Pk
Canon de la Canada
Ponderosa
Canon Potrillo
Canon de Valle
Fence Can
Frijoles Mesa
Ancho Can
Alamo Can
Capulin Can
Bandelier National Monument
Cerro Boletas
Bear Head
Cochiti Mtns
Sanchez Can
CANADA DE COCHITI GRANT
PUEBLO DE COCHITI
CAJA DEL RIO GRANT
Cañada Ancha
Arroyo Calabasas
Rio Grande
Arroyo Semilla
New Mexico
T. 18 N.
T. 17 N.
Site 1
Site 2
Site 3
Site 4
Site 5
Site 6
Site 7
Site 8
26-3

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : File

DATE: January 7, 1972

FROM : William D. Purtymun, H-8 WDP

SUBJECT: GEOLOGY AND HYDROLOGY OF TEST AREA NEAR TA-15

SYMBOL : H8-M2413

The test area at TA-15 is on a small narrow east-trending mesa that is part of the Pajarito Plateau (Fig. 1). The surface drainage from the mesa is to the north and south into an unnamed canyon that is a tributary to Pajarito Canyon near TA-18. The unnamed canyon and Pajarito Canyon contain only intermittent streams, runoff occurring during periods of heavy precipitation. Pajarito Canyon is tributary to the Rio Grande about 7 miles east of the test area.

Geology

The Pajarito Plateau is formed by a series of ashflow and ashfall of rhyolite tuff of the Bandelier tuff. Underlying the Bandelier is the Puye Formation composed of a conglomerate of volcanic debris and sediments with possible interbedded basalts and latites. The Puye is underlain by the siltstones and sandstones and possible interbedded basalts of the Tesuque Formation. The following table gives the estimated section of these units underlying the test area based on thickness encountered in Test Wells DT-5A at TA-49, Test Well 8 near TA-50 and Supply Well PM-2 near TA-18.

Estimated Section
Altitude of Land Surface 7,160 feet

	Thickness (feet)	Depth (feet)
Bandelier Tuff		
Tshirege Member - Nonwelded to welded	470	470
Otowi Member - Nonwelded	340	810
Guaje Member - Lump pumice	50	860
Puye Formation - Volcanic debris and sediments with possible interbedded basalt and latite	690	1,550
Tesuque Formation - Siltstones and sandstones with some interbedded basalt	1,200+	2,750+

A gravity survey indicates a north-south trending trough about 2 miles wide underlies the test area. The trough is filled with about 12,000 feet of volcanic and sediments which overlie the Precambrian Crystalline Rocks (Fig. 1).

The north-south trending Pajarito Fault Zone lies about 3 miles west of the test area. A minor north-south trending fault lies about 2 miles west of the site (Fig. 2). The minor fault down thrown to the east displaces the Tshirege Member of the Bandelier tuff about 90 feet. The Pajarito Fault Zone is dropped to the east 400 to 500 feet.

Hydrology

The depth to the main aquifer (aquifer capable of municipal and industrial water supply) varies from about 1,200 feet along the western edge of the plateau to about 800 feet along the rim of White Rock Canyon. Water in the aquifer moves eastward toward the Rio Grande where a part is discharged into the river from seeps and springs. Recharge to the aquifer on the flanks of the mountains to the west and deep canyons cut into the flanks of the mountains and western part of the plateau. This top of the main aquifer lies at a depth of about 1,150 feet below the surface of the mesa at the test area in the volcanic debris and sediments of the Puye Formation. Movement of water in the aquifer is toward Supply Well PM-2 which lies about 11,000 feet to the east (Fig. 2).

Aquifer test of Test Well DT-5A, DT-9, and DT-10 indicated the rate of movement of water in the aquifer at about 400 feet per year, thus it would take about 28 years for the water to move from beneath the test area to the supply well or about 90 years for the water to move 7 miles from test area to the Rio Grande.

Test Wells DT-5A, DT-9 and DT-10 at TA-49, test well TW-8, and Supply Well PM-2 encountered no water perched in the Bandelier tuff or in the Puye Formation above the main aquifer. It is very unlikely that perched water occurred in the rocks beneath the test area and the main aquifer.

Little if any water from precipitation infiltrates into the tuff on the mesas where the normal soil cover is undisturbed due to high evaporation rates and hydrologic characteristics of the soil as a result there is no recharge to the main aquifer from the mesas.

Samples of tuff were collected when hole 15A at the test area was drilled. The moisture content of the cuttings was not determined, but visual inspection rejected them for tritium analyses as the moisture content was too low (less than 1.0 per cent by weight) which would make

water vapor recovery difficult. This also suggests there is no movement of water into the tuff from the surface of the mesa.

Holes that are expended for experiments or abandoned and filled should be sealed at the surface either with a concrete plug or compacted soil to prevent any amount of water to move into the tuff and upset the balance that now exists.

No attempt was made to correlate the ashflows penetrated by the hole at the test area with similar units mapped at TA-49 to the south. The following is a driller log submitted to H-8 after completion of Hole 15A:

	Thickness (feet)	Depth (feet)
Bandelier Tuff		
Nonwelded to moderately welded unit	21	21
Welded tuff	9	30
Nonwelded to moderately welded unit	80	110
Welded Tuff	15	125

Construction: 6 foot diameter to 84 feet
4 foot diameter 84 to 125 feet

The following are references on file at H-8:

1. Records of wells, test holes, springs and surface-water stations in the Los Alamos Area.

2. Geology of the microseismograph station at S-Site, Los Alamos County

3. Development of ground-water supplies on the Pajarito Plateau.

4. Geology and ground-water resources of the Los Alamos area.

5. Geology and hydrology of Technical Area 49, Frijoles Mesa, Los Alamos County.

6. An evaluation of aquifer and well characteristics of municipal well field in Los Alamos and Guaje Canyons near Los Alamos.

7. Distribution of moisture in soil and near-surface tuff on the Pajarito Plateau.

WDP:et
cc: R. R. Brownlee, J-9

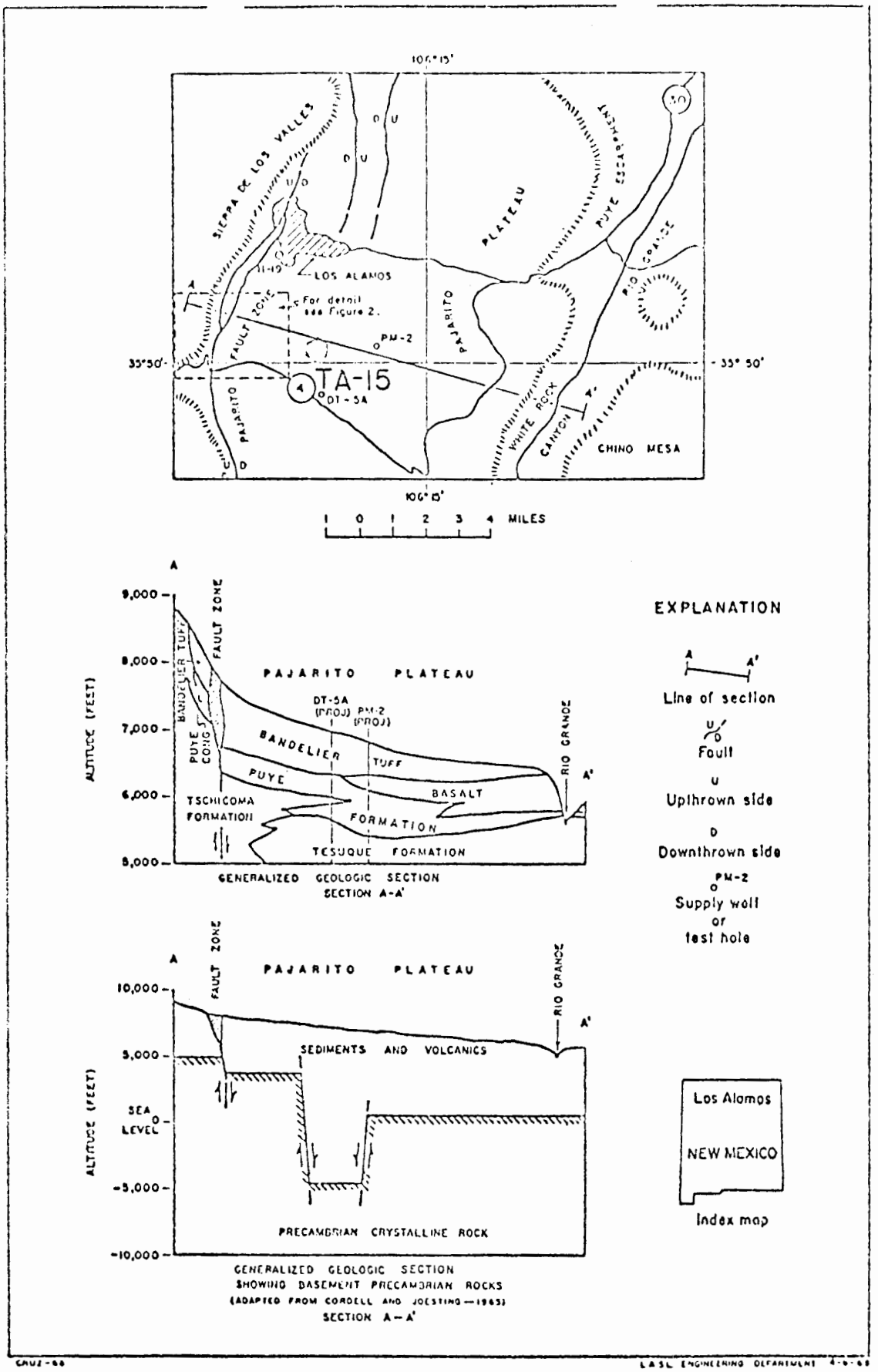


Figure 1.--Physiographic map of the Los Alamos area and generalized geologic sections.

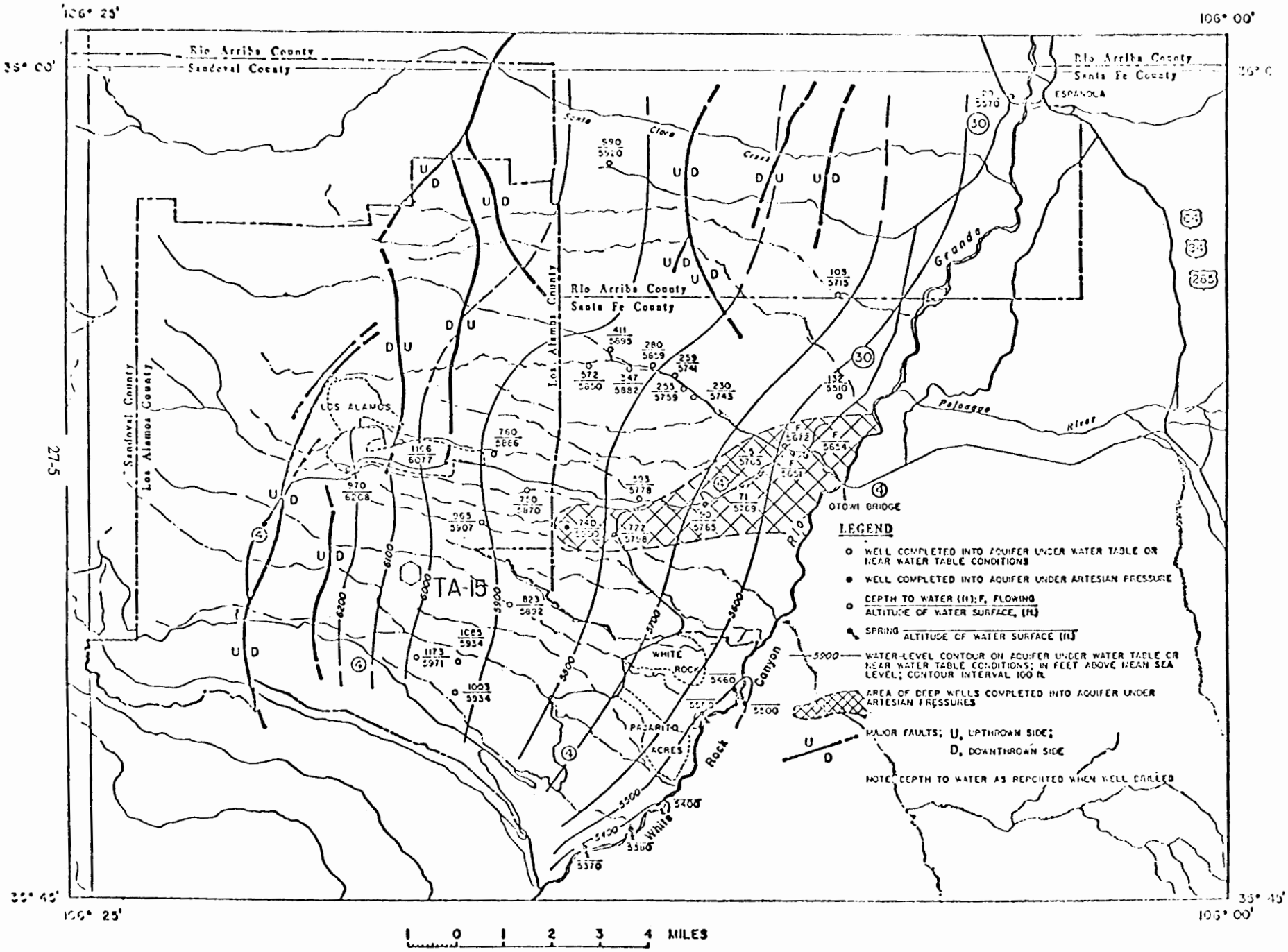


Figure 2. Major faults and water-level contours on top of main aquifer.

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P. O. Box 1663
Los Alamos, New Mexico 87544

IN REPLY
REFER TO: H8-672

November 27, 1972

Mr. Fred Swetnam
District Forest Ranger
Jemez Springs, New Mexico 87025

Dear Mr. Swetnam:

This is in reply to your inquiry of possible conversion of Hole C, Section 9, T20N, R3E, for use as a stockwell. The hole is 750 feet deep and is cased with 4-1/2 inch O.D. blank pipe.

The drilling contractor, Dan Laughlin, Shamrock Drilling Company, found the water level at about 350 feet in April 1972. At present the water is at a depth of 328 feet. This puts the saturated section within the Abiquiu Tuff (see attached log). The Abiquiu, in part, appears quite permeable.

The water from the hole did not clear up when the hole was bailed after the casing was installed. This may be due to the water in the Abiquiu Tuff creating a positive pressure and entering the casing at the bottom of the hole, thus eroding sediments from the Abo.

The hole could be completed as a stockwell by slotting the casing in place or removing from the hole and replacing with slotted pipe through the Abiquiu Tuff. The well could then yield 3 to 5 gpm (gallons per minute).

If we can furnish additional information, please contact us.

Sincerely,

William D. Purtymun
Environmental and Field
Programs, H-8

WDP:mb
cc: M. D. Smith, CMB-13

AN EQUAL OPPORTUNITY EMPLOYER

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Ed Williams, Q-23

DATE: April 13, 1973

FROM : William D. Purtymun, H-8

SUBJECT: FIELD TEST SITE FOR BASALT MELTING EXPERIMENTS

SYMBOL : H8M-73-38

Four tentative sites were located with Ed Williams, Q-23, and Randy Hanson, H-8, on April 9. They are located: (1) West of Highway 4 in Canada del Buey; (2) North rim of Water Canyon south of Pajarito Acres; (3) in Water Canyon adjacent to Highway 4; and (4) in Ancho Canyon east of Highway 4. Verbal description of the sites was presented by Ed to the staff of Q-23 and they decided to develop the site in Ancho Canyon for the experiment. The Ancho Canyon site was visited with ENG-2 on April 11 to determine ease of access.

The following presents a general description of the geology of the site. Detailed studies should be made later to correlate penetration rates in the various basalt flows.

The site is located at the western outcrop of Unit 2 of the Basaltic Rocks of Chino Mesa in Ancho Canyon (see attached map). The basalts were extruded from vents in the Cerros Del Rio Volcanic Field which lies to the east across the Rio Grande. The basalts extruded from the volcanic field flow north, northwest and west across the present course of the Rio Grande. Thus, the upper surface of Unit 2 at the site dips gently to the west. The dip is about 130 feet per mile based on the western most outcrop and the top of the basalt penetrated by TH-7 which lies about 0.2 mile to the west.

Unit 2 east of the site is discontinuous. A deep canyon was cut into the unit prior to the deposition of the Bandelier Tuff. The tuff fills the canyon and overlies Unit 2 in Ancho Canyon.

The section of Unit 2 exposed in Ancho Canyon is in excess of 200 feet. The basalt is not a single flow but a series of flows. The upper 100 feet appears massive but is composed of three or four flows. The contact between flows is marked by interflow zones of basalt breccias, which may or may not be associated with some sediments.

The uppermost flow at the site ranges from 20 to 30 feet in thickness. The contact is marked by a thin zone of breccia in the upper flow and vesicular basalt that forms the top part of the underlying flow.

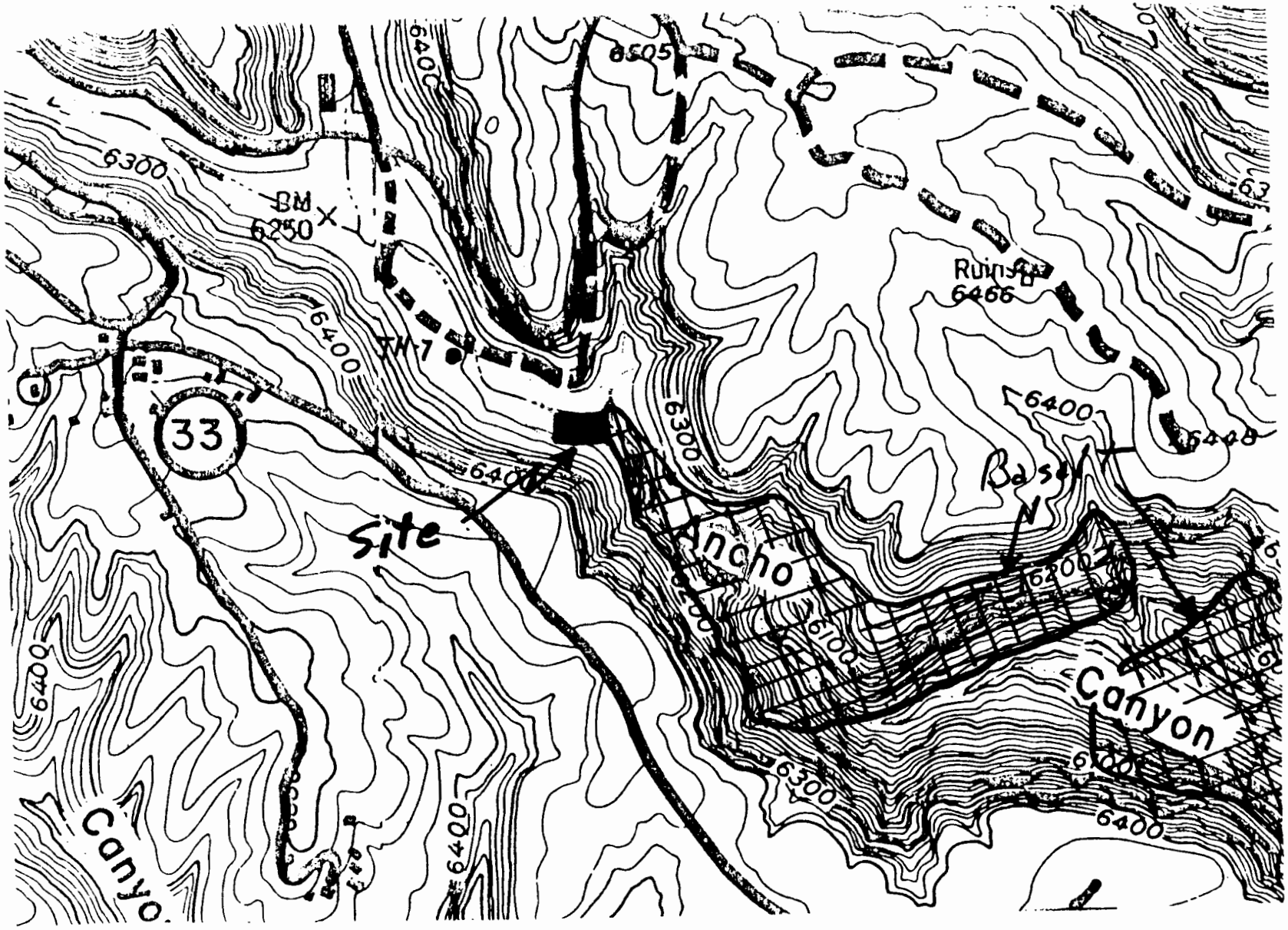
The following is a description of Unit 2 taken from R. L. Griggs, 1964, U. S. Geol. Water Supply Paper 1753.

> Unit 2 conformably overlying unit 1, forms the main cliffs along White Rock Canyon, caps much of Chino Mesa east of the canyon, and west of the canyon unit 2 caps a mesa south of White Rock. Unit 2 is more than 850 feet thick on Chino Mesa and thins gradually northward and wedges out. It consists mainly of flows of basalt and basaltic andesite and a few local beds of basaltic tuff and thin sandstone. The flows generally are more massive than those of unit 1 and in places, individual flows are more than 50 feet thick. They range from gray to dark gray and generally are lighter in color than those of the underlying unit. Some specimens contain small phenocrysts of olivine only. Some contain phenocryasts of olivine and pyroxene; others contain olivine, pyroxene, and plagioclase; and still others, small phenocrysts of pyroxene only. The groundmass is composed of plagioclase, clinopyroxene, and a small amount of magnetite. The groundmass of some specimens may contain a small amount of olivine. The plagioclase ranges in composition from sodic labradorite to calcie andesine.

If we can be of assistance please feel free to call.

WDP:et

cc: Marvin Linke, ENG-2
A. Giger, Q-23
J. Neudecker, Q-23



Location of Test Site for Basalt Rock Melting Experiment

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Ed Williams, Q-23

DATE: May 2, 1973

FROM : W. D. Purtymun, H-8

SUBJECT: TEST HOLES AT TA-56 WDP

SYMBOL : H8M-7360

Enclosed is sketch map showing location of test holes and thickness of overburden overlying the basalt at TA-56.

It appears that the best location will require removal of overburden. In the area that was investigated this would be south of the stream channel where the overburden ranges from 4.5 to 8.5 feet. Removal would be to the northeast. This area would be protected from any flash flooding that could occur during the summer.

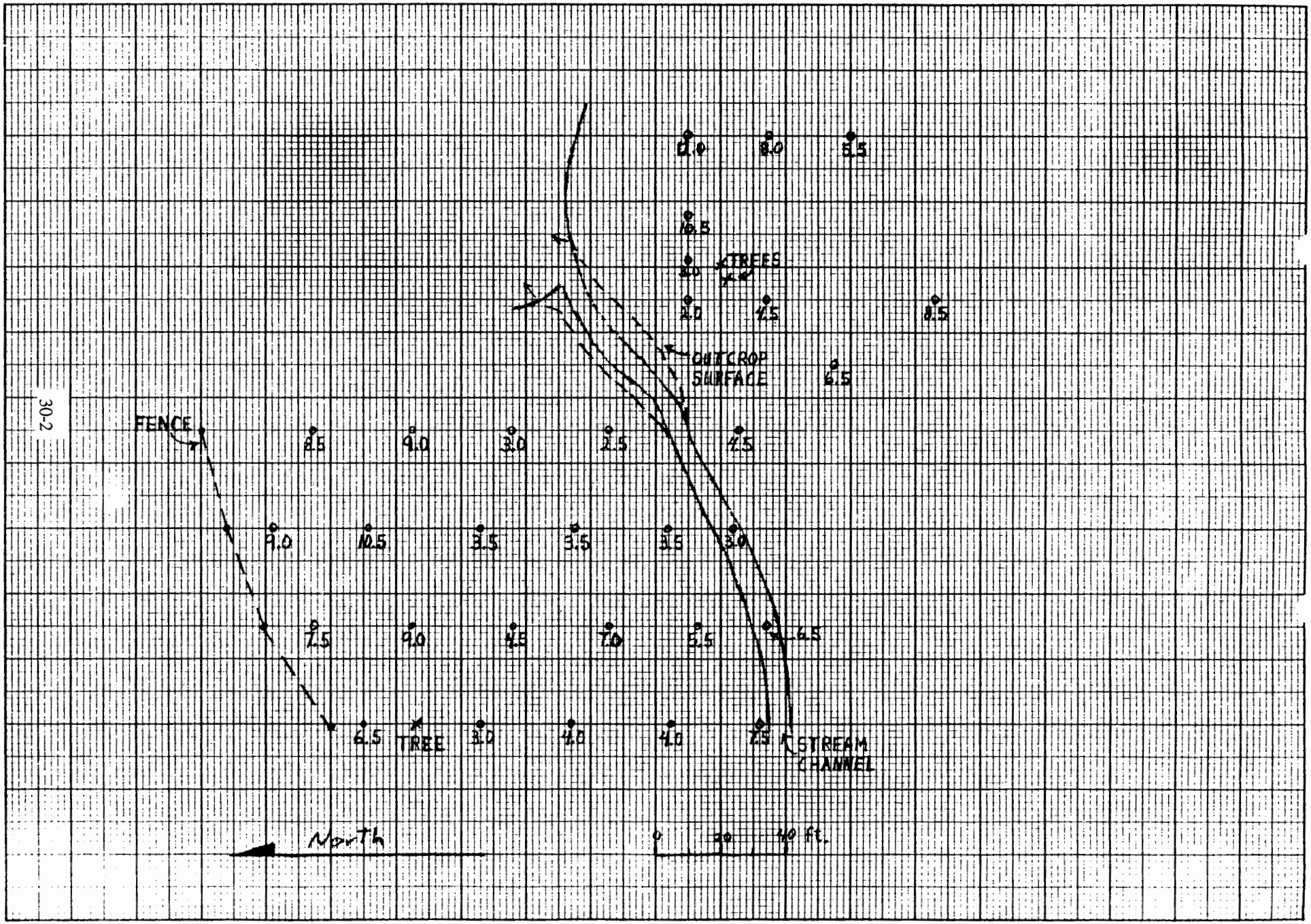
The basalt at shallow depths north of the stream would be subject to flooding. Cuttings from these holes also contained excessive moisture, which indicated some water moving through the alluvium down Ancho Canyon.

If the site south of the stream is developed, overburden removed could be used to level the land surface to the northeast for parking and a trailer area. To minimize the impact on the environment it would be advisable to leave in the two large pines that are plotted on the sketch map.

WDP:et

Attachment 1

SKETCH SHOWING LOCATION OF TEST HOLES AND THICKNESS OF OVERBURDEN (IN FT.) OVER LYING BASALT AT SITE TA-56



GEOHYDROLOGY OF PAJARITO PLATEAU

WITH REFERENCE TO QUALITY OF WATER - 1949-1972

By

William D. Purtymun

Appendix
May 1973

PHYSICAL CHARACTERISTICS OF THE BANDELIER TUFF

The Bandelier Tuff is formed by a series of ash flows and ash falls which are described as nonwelded, moderately welded, and welded tuff. The nonwelded, moderately welded, and welded tuff grade one into the other both vertically and horizontally.

The upper Tshirege Member is about 250 m thick along the western edge of the Pajarito Plateau and thins eastward to less than 15 m. Individual moderately welded and welded ash flows in the upper part of the Tshirege Member range from 6 to 40 m thick. Some of the uppermost ash flows are beveled off by erosion eastward across the plateau. Outliers of tuff overlie the Puye formation along Puye Escarpment. Most all ash flows thin eastward from the source area (Sierra de los Valles). Nonwelded ash flows of the Otowi Member may be as much as 90 m thick near the center of the plateau.(1)

I. Welding

The welding process of an ash flow tuff begins after emplacement. The major factors affecting welding are heat at the time of emplacement, amount of volatiles in the mass, rate of cooling, and thickness of the ash flow.(2) The degree of welding ranges from incipient stages marked by the cohesion of glassy fragments, to complete welding marked by the cohesion of the surfaces of glassy fragments accompanied by their deformation and the elimination of pore space.

Zonal variation of welding occurs vertically within individual flows or within a series of flows that have cooled as a single unit.(3) Single ash flows or series of ash flow that have cooled as a unit may show a greater degree of welding near the center than near the upper and lower contacts. A series of ash flows that have been emplaced in rapid succession may cool as a single unit with the greatest degree of welding near the center.

Variation of welding occurs horizontally within individual flows with greater degree welding near the mountains (the source area). The degree of welding becomes less eastward across the plateau.

The tuffs in the Los Alamos area are classified according to the degree of welding--i.e., nonwelded, moderately welded, and welded tuffs. Welding results in increased cohesion and deformation of the glassy fragments in the tuff. Nonwelded tuff has high porosity, only slight cohesion of the glassy fragments, and crumbly fracture; moderately welded tuff has lesser porosity, moderate cohesion, slight deformation of the glassy fragments, and a somewhat brittle fracture; and welded tuff has lower porosity, good cohesion, a high degree of deformation by flattening of glassy fragments, and a brittle fracture.(4)

The degree of welding influences most of the physical characteristics of the individual ash-flow tuff units.

The following shows a large range in porosity in each of the variations of tuff indicating that welding is only one of several factors determining porosity.

	Range in porosity (percent by volume)
Nonwelded tuff	40 to 60
Moderately welded tuff	30 to 55
Welded tuff	15 to 40

The surface of exposed tuff (nonwelded to welded) becomes "case hardened" as it is exposed to the weather. In this process, due to the porosity of the tuff, moisture is absorbed and some minerals are dissolved. The minerals are returned to the surface by evaporation as the tuff dries out where they are precipitated to form a rind. This rind forms a protective surface which resist the erosion of the surface by wind and water. However, exposed pumice fragments weather out rapidly leaving small cavities in tuff surface.

II. Density

The density of nonwelded tuff is lower than in welded tuff. This is due to the compaction of the matrix (glass shards and ash) and closer arrangement of the quartz and sanidine crystals, and rock fragments in a welded tuff. The specific gravity of the tuff matrix averages about 1.55. The range in bulk density of nonwelded to welded tuff depends on the porosity (i.e., the larger a porosity, the smaller the density).

The following table shows a comparison of the densities of pumice and the tuff (nonwelded towelded) with other rock types.

Rock Type	Range in density (gm/cm^3)
Pumice (nonwelded)	< 1.0
Nonwelded tuff	1.02-1.52
Moderately welded tuff	1.15-1.84
Welded tuff	1.52-2.16
Granite	2.64-2.76
Marble	2.60-2.84
Sandstone	2.14-2.36
Basalt	2.4 -3.1

III. Bearing Capacities

The bearing capacities of a tuff are dependent upon the density of tuff (i.e., the greater bearing capacities occur with the tuff of greater density). The density of the tuff is related to welding (i.e., density of the tuff increases from nonwelded tuff to welded tuff).

Data are available on the bearing capacities of the moderately welded tuff. The following table shows the relationship of density change to the resistance to crushing of a moderately welded tuff.

Density (gm/cm^3)	Resistance to Crushing (kg/m^2)
1.73	2.4×10^5
1.74	3.7×10^5
1.77	3.9×10^5
1.79 (probably with pumice inclusion)	3.4×10^5
1.81	4.8×10^5
1.83	5.6×10^5

Rock inclusions of pumice, rhyolite, and latite are found in the tuff. The frequency of occurrence of the rock fragments differs in individual ash flows and at different locations within the same ash flow.

The pumice fragments may be as much as 5 cm in length and 2 cm in diameter. The pumice is soft and friable. Pumice fragment inclusion in a small sample of the tuff would decrease the bearing capacity as failure would most likely occur within the pumice fragment. The rhyolite and latite fragments are dark gray, hard, and may be as much as five to seven cm across. These large rock fragments would add strength to the matrix of tuff.

The following table is a comparison of the bearing capacities of a moderately welded tuff (density 1.73 and ~ 1.82 g/cm^3) and miscellaneous rock type. The bearing capacity is computed as 1/5 of rupture strength of the material.

Rock Type	Bearing Capacity (kg/m^2)
Moderately welded tuff (1.73 g/cm^3)	4.7×10^4
Moderately welded tuff (1.82 g/cm^3)	1.1×10^5
Sandstone	3.4×10^5
Limestone	8.4×10^5
Marble	1.1×10^6
Granite	1.4×10^6

IV. Thermal Conductivity

The thermal conductivity of the tuff is inversely related to porosity, thus, the thermal conductivity of the nonwelded tuff would be less than a welded tuff as more pore space is available for insulation.

The only data available on the thermal conductivity was made of a moderately welded tuff in one area investigated. The following table is a comparison of the thermal properties of the tuff and miscellaneous rock types. A decrease in thermal conductivity increases the insulating value.

Rock Type	Range of Thermal Conductivity $\left(\frac{\text{cal, gm-cm}}{\text{hr x cm}^2 \text{ x oC}}\right)$
Moderately welded tuff	0.38-0.47
Limestone	4.9-11
Sandstone	9.9-20
Marble	17-25
Granite	16-35

V. Mineral Composition

The tuff is rhyolitic in composition and contains small rock fragments of rhyolite, latite and devitrified pumice and crystals and crystal fragments of sanidine and quartz, in a matrix of glass shards and welded ash. Dark minerals are scarce although traces of crystal fragments of biotite, hornblende, and pyroxene have been observed.(2)

Seven samples of a moderately welded tuff were analyzed petrographically by C. S. Ross (written communication, July 7, 1960). Ross recalculated the proportions of phenocrysts in terms of proportion by weight. The results of all seven were similar, one of which is presented here:

Pore space	about 30 percent by volume
Phenocrysts	about 20 percent by weight
Sanidine	12 percent by weight
Quartz	6 percent by weight
Magnetite	1 percent by weight
Pyroxene	± 0.5 percent by weight

The ground mass is typical devitrified welded tuff. The devitrification products are very fine grained, but show typical cristobalite feldspar structure. Cavities contain radial groups of feldspar and tridymite. The rocks contain a few fragments of altered andesite, and some brown birefracting clay like material (probably montmorillonite).

VI. Chemical Composition

The color of the tuff ranges from very light gray to medium dark gray. Some units range from pinkish gray to light pink. Large fragments of pumice that appear much darker than the matrix in some units enchance the color of the tuff. Moderately welded units are generally lighter in color than the welded units. The coloring is inherent in the tuff and probably the result of minor changes in the chemical constituents and heat of emplacement.

In general the tuff is composed namely of silica and alumina. The range in chemical constituents is shown on the following table.

Chemical Constituents	Range (in percent)
Silica (SiO_2)	72.0-78.2
Alumina (Al_2O_3)	11.2-13.8
Ferric oxide (Fe_2O_3)	1.1-2.1
Ferrous oxide (FeO)	.21-.75
Magnesium oxide (MgO)	.02-.33
Calcium oxide (CaO)	.26-1.17
Sodium oxide (Na_2O)	3.5-4.5
Potassium oxide (K_2O)	4.2-4.7
Water (H_2O)	.15-2.8
Titanium oxide (TiO_2)	.10-.32
Phosphorous oxide (P_2O_5)	.10-.07
Manganese oxide (MnO)	.00-.98
Carbon dioxide (CO_2)	<.05

VII. Joints

Joints and joint systems are prominent in the Tshirege Member. The joints divide the rocks into polygonal blocks, many of which are prismatic or columnar.

The joints can be classified into two groups, master joints and minor joints. The term "master joint" signifies those joints that are numerically predominant, are most persistent in length, and pass through several groups of beds.(5)

The master joints can be traced vertically across two or more units of the Tshirege Member. They are vertical or near vertical, dipping more than 80°. The overall vertical trends of the individual master joints are relatively straight; however, they curve slightly through individual units and upon entering a unit of different degree of welding, may be deflected slightly.

The minor joints dip at angles from about 40° to 80° and in most instances, intersect the master joints. These joints are not as persistent as master joints.

Master joint systems in Mortandad Canyon display orientation differences of about 60°.(6) Joint systems mapped at Mesita del Buey also indicate orientation differences of 60°.(7) The angular differences between these joint systems suggest that these sets are conjugate tension joints caused by shrinkage during cooling of the rocks.

HYDROLOGICAL CHARACTERISTS OF THE BANDELIER TUFF

The natural moisture content of the tuff forming the mesas between the eastward-trending canyons is generally less than five percent of volume. Thus, movement of moisture is under unsaturated conditions. The low moisture content of the tuff is caused by the protective cap of clay soil derived by weathering of the tuff near the surface and low rainfall and high evaportranspiration. The hydrologic characterists of the tuff depend largely upon the degree of welding of the individual ash flows.

I. Hydrologic Effects of Soil

The surfaces of the finger-like mesas which form the Pajarito Plateau are covered by a clayey soil derived by weathering of the underlying tuff of the Tshirege Member. The soil is thickest near the axes of the mesas and thins toward the edges where the tuff is exposed. Thick sections of soil have also developed along slow draining arroyos cut into the surfaces of mesas and in relatively flat areas where water collects and stands, allowing some infiltration into the tuff. The greatest known thickness of soil is at Frijoles Mesa where 2.7 m was logged in a shallow test hole located in a relatively flat area.

Petrographic examination of the soil derived from the Tshirege Member was made by Staritzky of the Los Alamos Scientific Laboratory.[1] He found that the size distribution of the "sand" fraction (greater than 50 microns in diameter) varied between 15 and 38 percent, the "silt" fraction (2 to 50 microns in diameter) varied between 58 and 73 percent, and the "clay fraction" (less than 2 microns in diameter) varied between 4 and 12 percent. Mineralogically, the principal constituents of the soil were quartz and feldspar, and the most important secondary constituents are the clay minerals, montmorillonite and illite. Montmorillonite is know to have the highest base-exchange capacity (85 to 100 millequivalents per 100 grams) and illite the next highest (25 to 30 millequivalents per 100 grams) among the clay minerals.

A study of the natural distribution of moisture in soil and in near surface tuff was made at Frijoles Mesa during a 2-year period. The moisture content in the soil cover, including the transition zone from the soil to weathered tuff, varied according to prevailing weather conditions. The moisture content was highest in March and April as the result of late winter snows and thawing and was generally lowest in the months of August through October owing to high evapotranspiration rates. Water from precipitation rarely infiltrated through the undisturbed soil cover into the underlying tuff and only in an extremely low moisture range (less than 5 percent moisture by volume) within the upper 1 m of the tuff.(2)

The upper two units of moderately welded tuff (thickness about 36.5 m) at Frijoles Mesa blow air through open joints in response to a declining atmospheric pressure; therefore, the soil cover, which prevents most of the precipitation from infiltrating into the underlying tuff, also impedes the exchange of air from the atmosphere to the tuff.(3)

II. Hydrologic Characteristics of Nonwelded, Moderately Welded and Welded Tuff

The hydrologic characteristics of tuff related to porosity, specific yield, specific retention, pore size distribution and hydrologic conductivity were determined of in six units of the Tshirege Member at Frijoles Mesa. These hydrologic characteristics were determined in the laboratory under saturated conditions. As saturated conditions rarely occur in the tuff, these parameters may be of only general interest.

The porosity of the tuff at Frijoles Mesa ranged from 19 to 54 percent by volume; the lowest porosities are in the welded tuffs. Specific yield and specific retention decrease with a decrease in porosity. Specific yield is greater than specific retention in a nonwelded tuff (high porosity); however, as the porosity decreases the difference becomes smaller and low porosity specific retention in a welded tuff may be greater than specific yield.

The relationship of porosity to pore size depends on the degree of welding, thickness of the flow, and position in the flow. The larger pore sizes and greater porosities are near the top of the flow and decrease vertically through the flow. This is due to the larger pores formed by escaping gases near the top and compaction and baking of the middle and lower portion of the flow as it cools.

The hydrologic conductivity is indirectly related to porosity depending upon pore size and the degree of interconnection of the pores. The permeability of the tuff matrix decreases with depth for the same reasons that the porosity decreases.

Hydrologic characteristics of the Tshirege Member of the Bandelier Tuff, as determined in the laboratory are shown in the following table.

Hydrologic Characteristics of the Tshirege Member at Frijoles Mesa

Hydrologic Characteristics						
Unit	Depth below surface of mesa (m)	Degree of welding	Porosity (percent)	Specific yield (percent)	Specific retention (percent)	Range of Hydrologic Conductivity (m/day)
6	0- 19.5	Moderate	38-54	18-34	16-27	0.004-0.25
5	19.5- 20.1	None (sand)	-	-	-	1.4-2.4
4	20.1- 41.1	Moderate	33-54	11-43	12-22	0.012-0.53
3	41.1- 53.3	Nonwelded	48	34	14	0.9
2	53.3- 83.5	Welded	19-37	.6-26	11-21	0.003-0.08
1B	83.5-152.7	Nonwelded	-	-	=	50-2.1

III. Movement of Water

The Tshirege Member is dry beneath the surfaces of the finger-like mesas. The moisture content of the tuff generally is less than 5

percent by volume, even though the specific retention ranges from 11 to 27 percent. Beneath the canyons which contain perennial or intermittent streams, the moisture content of the tuff may be as much as 60 percent by volume; however, the water movement through the tuff is as unsaturated flow. Test holes drilled through alluvium and into the tuff in Water and Mortandad Canyons penetrated thick sections (up to 55 m) of wet tuff (up to 60 percent moisture by volume); however, no free water moved into the test holes.

Instruments were used to measure moisture content of the bore wall in holes constructed in the tuff beneath the stream channel in upper Mortandad Canyon. These holes contained no free water, although the welded tuff beneath the stream contained as much as 25 percent moisture by volume. Specifically constructed moisture access holes in the tuff underlying water perched in the alluvium in lower Mortandad Canyon had moisture contents of the tuff as much as 45 percent by volume but the rock yielded no free water. The welded and nonwelded tuff in the canyon are transmitting water (high moisture content) downward by gravity into the tuff by unsaturated flow. There is some lateral movement by capillarity.

The water in the tuff moves as unsaturated flow. The majority of the pores are of capillary size. The energy relationship with moisture content of a moderately welded tuff was determined by Abrahams[4] (Fig. 1). The saturated moisture content of the tuff was about 41 percent by volume. When moisture contents are below 4 percent there is no movement of water; from 4 to 8 percent moisture is redistributed by diffusion; from 8 to 23 percent distribution is by gravity and capillarity, and above 23 percent the movement is by drainage from gravity.

A study of the movement of water through the tuff was made at Mesita del Buey by adding water to an infiltration pit. The amount of water added was equivalent to 110 years of precipitation on the Pajarito Plateau. The movement of water from an infiltration pit was monitored by a series

of moisture access tubes set in the tuff and a neutron-scattering moisture probe and scaler. The average infiltration rate from a $1m^2$ pit under a constant head of 23 cm of water averaged about 0.34 m/day for a period of about 160 days. The wetted front moving into the tuff was sharpest during the first part of the test. After about 2 months of infiltration moisture had moved downward more than 4.5 m; moisture content ranged as follows: 35 percent by volume at 0.6 m below the pit, 30 percent at 0.9 m, 25 percent at 4 m, and 20 percent at 4.6 m.

IV. Hydrologic Effects of Welding

The uppermost ash flow at Frijoles Mesa exhibits zonal variations of welding in a single cooling unit which causes vertical changes in porosity. The moderately welded flow is about 24 m thick near the center of the mesa. The greatest porosities are in the upper and basal parts of the flow. Lesser porosities (zone of denser welding) are in the lower one-third of the flow, and pore size decreases with increased depth. The following table presents the hydrologic characteristics at different intervals in a single ash flow tuff.

Hydrologic Characteristics of an Ash-Flow Tuff at Frijoles Mesa

Height above base of flow (m)	Porosity (percent)	Specific yield (percent)	Specific retention (percent)	Hydrologic Conductivity (m/day)		Pore Size distribution (percent of porosity)	
				vert.	horiz.	>.01 mm	<.01 mm
17.9	54	35	19	10.082	-	-	-
14.3	50	34	16	0.12	0.12	39	61
14.3	54	38	16	0.25	0.21	26	74
12.2	51	34	17	0.16	0.16	20	80
8.8	49	28	21	0.041	-	-	-
6.7	41	24	17	0.004	0.082	20	80
6.1	47	27	20	0.082	0.082	15	85
5.8	42	23	19	0.041	0.033	-	-
3.6	38	18	20	0.037	0.041	-	-
0.3	51	33	18	0.041	-	17	83
0.3	49	24	25	0.037	0.082	20	80

A decrease in porosity in an ash flow tuff results in a decrease in specific yield and as the specific yield decreases, the specific retention increases proportionately (Fig. 2). The hydrologic conductivity is related to pore size and pore-size distribution rather than porosity. The permeability of the tuff matrix decreases at increased depth with a general decrease in the percentage of pore sizes greater than 0.1 mm.

Variations in vertical and horizontal permeability in the lower one third of the flow may be due to movement and compaction of the ash flow as it cooled. Movement of flow as it cools could result in elongation of the pores in a horizontal plane, and the greatest permeability probably is in this direction. Three of the five horizontal hydrologic conductivities in the lower one third of the flow are greater than the vertical conductivities; however, the conductivity measurements were taken in random directions and no attempt was made at orientation to the probable direction of movement of the flow.

V. Hydrologic Effects of Joints and Contacts

Joints and the fractures in the tuff are capable of transmitting fluid. The interconnection of the joint system is an important aspect of the hydrologic regime.

Joints in moderately welded to welded tuff of the Tshirege Member range from closed to open. Locally the amount of opening is as much a 5 cm; however, the majority of joints are open less than 1 cm. All joints terminating at the base of the soil zone, which covers the surfaces of the mesas, are filled with a light-brown clay. The depth of clay filling varies from 0.9 to 1.2 m below the soil zone at Mesita del Buey and Frijoles Mesa. The joint openings are plated with clay to depths of 21 m at Frijoles Mesa. Some of the joints are filled or plated with a light-gray clay. The light-gray clay is derived from weathering of the tuff and is composed of minerals leached from the tuff by water. This clay was precipitated along the joint openings prior to the development

of the soil zone. The joints are interconnected and master joints transect one or more flows. Joints are more numerous and open in ash flows of moderately welded to welded tuffs than in nonwelded tuff.

Joints in the moderately welded to welded tuffs will transmit depending upon availability of large volumes of water and the amount of opening and the degree of interconnection between different joint systems. More than 15,000 m^3 of drilling fluid was lost while drilling 300 m of Bandelier Tuff at Frijoles Mesa. Most of the loss was in the upper 150 m in the Tshirege Member which here consist of moderately welded to welded tuff in which open joints are numerous. During grouting of a casing in a large diameter hole at Frijoles Mesa (a 76 cm dia., 15.2 m depth casing filled with water to prevent collapse), the bottom seal in the casing ruptured and the water from within the casing drained into the formation within 3 hours. The number and orientation of joints in the hole were determined before the casing was installed. A joint near the bottom was open 1 to 3 cm for about 1.2 m. The 6.9 m^3 of water moved into the joint and downward into the joint systems of the underlying flow. Observation of another large-diameter hole 15.2 deep and located 7.6 m to the north failed to disclose a trace of the water.

The experiment at Mesita del Buey indicated that water from the infiltration pit (42 m^3 of water equivalent of 110 years of precipitation on the Pajarito Plateau) moved downward through a moderately welded tuff into a pumice zone which is more porous and permeable. Movement in the pumiceous zone was lateral. Infiltration into a moderately welded tuff underlying the pumice zone was from near the center of the saturated area in the pumiceous lense. The moisture content of the upper moderately welded tuff was much lower than the underlying pumiceous zone, which indicates that specific retention of the pumice zone is greater.

Vertical infiltration through the Tshirege Member would be affected by zonal variations of welding as well as by horizontal contacts between flows.

Vertical changes in hydrologic conductivity caused by contacts between flows tend to perch infiltrating water. In the stream channel in Mortandad Canyon, water is returned to the surface from underflow in the alluvium and in a moderately welded tuff at the contact with a nonwelded tuff.

Industrial wastes discharged into surface water in Acid Canyon move into the joints and tuff of the Tshirege Member, are perched on the top of the Otowi Member, and then move laterally along the contact into a seep area at the junction of Acid and Pueblo Canyons.

Results of an infiltration experiment in the soil near TA-50 indicated that precipitation that is not removed by surface drainage infiltrates into the soil on the mesas of the Pajarito Plateau; however, the downward movement of this water is impeded or stopped by the dense transition zone between the soil and tuff and the water is returned to the atmosphere by evapotranspiration.[2] During this experiment, the amount of water added to the soil was equivalent to 50 years of precipitation on the Pajarito Plateau.

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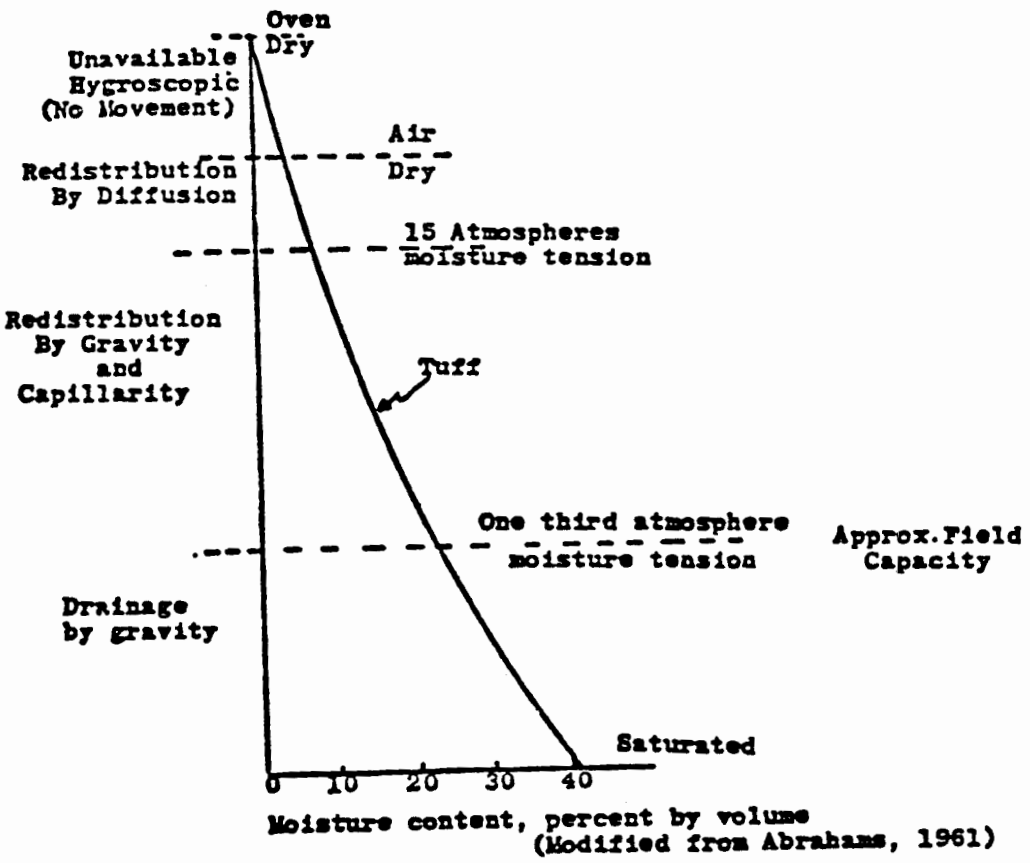


Figure 1. Energy relationships with moisture content of tuff.

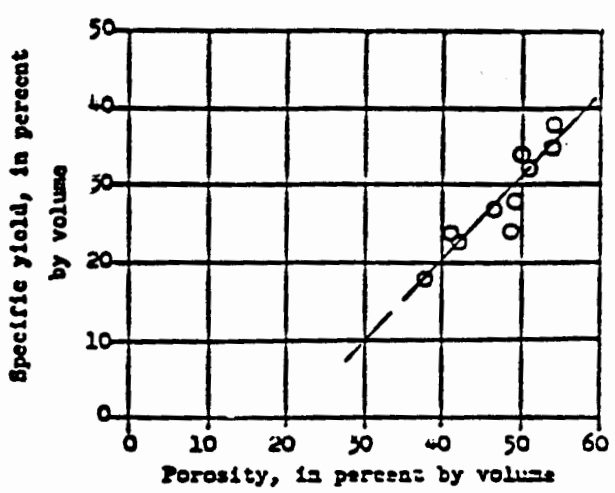


Figure 2. Relationship of specific yield to porosity of the tuff.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544
TELEPHONE:

OFFICE MEMORANDUM

TO : Margaret Ann Rogers, H-8

DATE: December 12, 1973

FROM : Bill Purtymun and Linda Trocki, H-8

SUBJECT: PERCENT MOISTURE BY WEIGHT FROM AUGER HOLES IN PIT #7, Area G

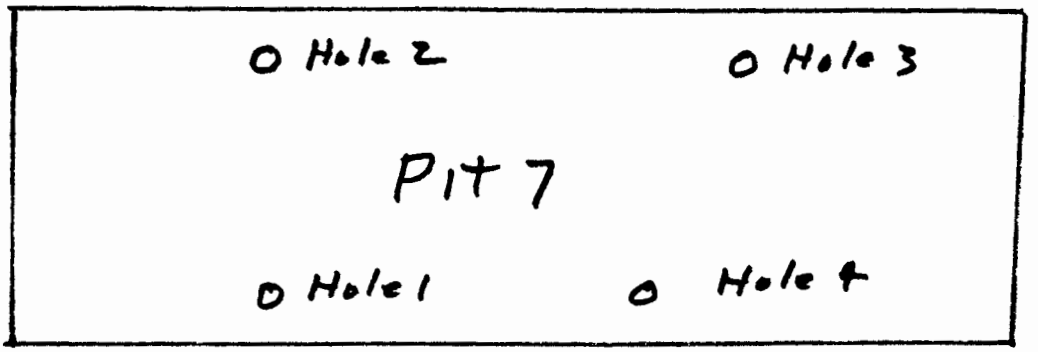
SYMBOL : H8-73-M296

Depth	9-17-73 Hole #1	9-20-73 Hole #4	9-18-73 Hole #2	9-20-73 Hole #3
0-5'	.7	5.5	1.2	1.0
5-10'	.4	.5	.6	.5
10-15'	.7	.1	.3	.6
15-20'	.9	.4	.3	2.1
20-25'	.7	.3	.2	2.4
25-30'	.7	.4	.4	.3
30-35'	.7	.3	.2	.3
35-40'	.3	.4	.5	.5
40-45'	.3	2.0	.3	.5
45-50'	.9	.5	.3	.5
50-55'	1.2			
55-60'	2.3			
60-65'	2.0			
65-70'	.9			
70-75'	1.7			
75-80'	.7			
80-85'	1.4			
85-95'	1.7			
95-107'	3.0			
107-117'	2.5			

Table 2. - Radiochemical analyses of tuff from test hole 21B.

Description	Depth (feet)	Picocuries per gram					Microgram per gram
		Gross Alpha	Gross Beta	^{238}Pu	^{239}Pu	^{137}Cs	Natural uranium
Unit 2b							
Upper ashflow	0-10	6	2	b/	0.005	c/	0.20
Reworked Material	10-15	8	a/	b/	b/	c/	.28
Lower Ashflow	15-40	7	a/	b/	b/	c/	.24
Unit 2a							
Upper Ashflow	40-60	7	a/	b/	b/	c/	.31

a/ Below limits of detection 1 pCi/g
b/ Below limits of detection 0.002 pCi/g
c/ Below limits of detection 2 pCi/g



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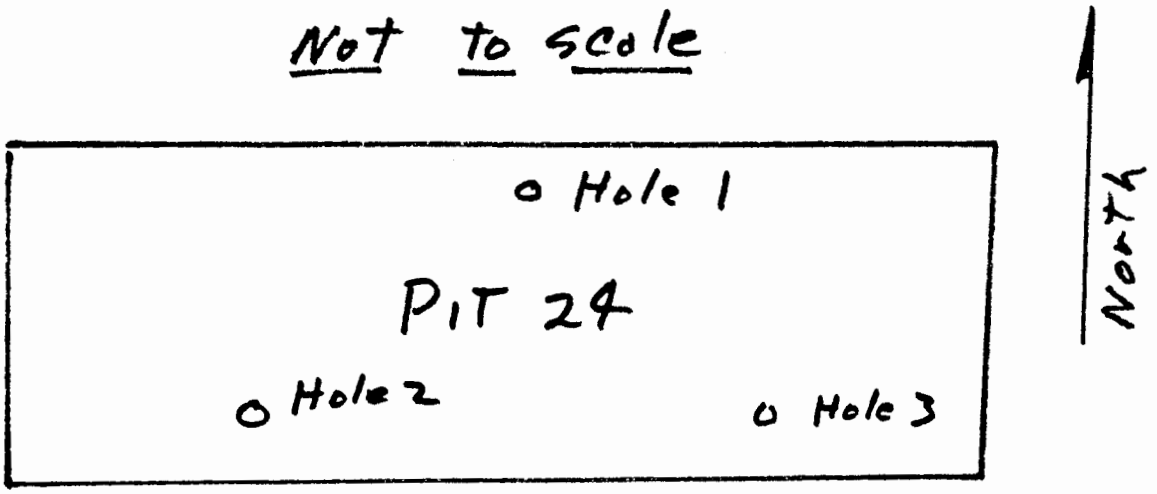


Sketch Map showing test Hole in Pits 7 and 24

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544
TELEPHONE:

OFFICE MEMORANDUM

TO : Merlin Wheeler, H-8

DATE: February 7, 1974

FROM : William D. Purtymun, H-8

SUBJECT: MOISTURE CONTENTS OF CUTTINGS FROM AUGER HOLES IN PITS 7, 8 AND 24, AREA G.

SYMBOL : H8-74-M64

Attached is memo H8-73-M296 with the results of data from four test holes in Pit 7. The following table presents data from Pit 24. Moisture contents are in percent by weight. Also attached is a sketch map of locations.

Pit 24

Depth (feet)	Hole 1	Hole 2	Hole 3
0-5	0.9	2.4	0.1
5-10	1.1	2.3	1.9
10-15	0.8	4.2	0.2
15-20	1.0	0.6	0.3
20-25	0.3	0.5	0.5
25-30	0.3	0.5	0.3
30-35	0.5	0.1	0.3
35-40	0.6	0.3	0.5
40-45	3.2	0.3	1.3
45-52	3.4	0.6	1.2

Test holes in Pits 7 and 24 were logged at 2 foot intervals with the neutron moisture sonde for background information. The moisture content of the tuff was below limits of the calibration curve which is ~ 5 percent moisture by volume. My calculations indicate that in the low range of ~ 5 to 10 percent by volume the moisture will be redistributed by diffusion. Above ~ 10 percent distribution would be by diffusion and capillary with some effect of gravity.

As yet I don't have a profile showing bottom elevations of Pits 7 and 24 for correlation purposes; however, drilling breaks were indicated at 15 to 17 feet in Pit 7 and at 19 - 24 feet in Pit 24 which are about the contacts of Unit 2b and Unit 2a. A second drilling break occurred ~ 50±5 feet in both pits. The second contact is between Unit 2a and Unit 1b and is shown by a slight increase in moisture contents in Hole 1 (Pit 7), and Holes 1 and 3 (Pit 24) indicating a change in the hydrologic characteristic of the two ashflow units.

The increase in moisture content of the tuff as the result of water ponding in a pit left open over a period of years is shown in the data from holes drilled in Pit 8 in January 1974. Pit 8 was constructed in the summer of 1971. Background data (Memo H8-M2371 attached) indicated that the moisture content of cutting from Hole 8A drilled in August 1971 ranged from 0.2 to 1.4 percent by weight. The moisture content of the tuff in cuttings from the three holes drilled in January 1974 ranged from 1.6 to 9.8 percent by weight.

The following table presents the moisture content (in percent by weight) of cuttings from three test holes drilled in January 1974 in the floor of Pit 8.

Pit 8

Depth (feet)	Hole 1	Hole 2	Hole 3
0-5	8.7	8.5	8.2
5-10	9.3	9.8	7.1
10-15	8.6	8.2	8.1
15-20	7.5	4.1	8.1
20-25	6.0	4.0	5.2
25-30	2.8	1.9	2.5
30-35	2.5	1.6	2.2
35-40	3.4	2.4	2.3
40-45	3.6	3.5	3.1
45-50	3.9	3.9	3.7

Note: Hole 1 North Side of Drums - East
Hole 2 North Side of Drums - West
Hole 3 South Side of Drums
Ref - Memo H-8-WM-90

Background data related to radioactivity in cuttings from select test holes in Pits 7 and 24 are being tabulated. Trust this is the information you wanted.

WDP:ET

Attachments 3

CY: J. A. Mohrbacker, H-8, MS-737
Keith Schiager, H-8, MS-490
Margaret Ann Rogers, H-8, MS-522

LC LAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : J. Mohrbacher, H-8 DATE: February 13, 1974

FROM : M. Wheeler, H-8 MW

SUBJECT : MOISTURE AND TRITIUM CONCENTRATIONS IN FILL MATERIAL, AREA G, TA-54

SYMBOL : H8-WM-112

Abstract

Soil samples were collected from the fill material overlying Pit No. 1 and Pit No. 2, Area G, to depths of 3.8 metres. Moisture contents varied between 3 and 13% but generally showed a similar trend with depth at all sample points. Penetration of annual precipitation appears to occur to depths of two to three metres. The moisture contents were above those observed in undisturbed tuff, and below those occurring in natural soils. Further field investigations will be required to determine actual moisture movement rates.

Tritium concentrations were significantly higher than normal background. Concentration gradients indicate that tritium is diffusing towards and perhaps out of the soil surface. No atmospheric sampling data is available concerning the quantities of tritium in the air above this site.

Sampling Procedures

In early December, 1973, samples were collected of the cover material on Pits 1 & 2, Area G, TA-54. Material was collected by two methods; holes were drilled using a four-inch power auger, and samples of the material brought to the surface were collected at regular depth intervals; a split-spoon sampler was driven into the material with an impact hammer, returned to the surface, and the samples removed from the sampler.

The samples were analyzed for moisture content using standard gravimetric techniques. Moisture samples were removed from the soil by heat distillation and analyzed for tritium content. Selected samples will be analyzed for pl tonium, cesium, and strontium. A summary of the resultant data is summarized in Table 1. The technique used in collecting the samples is indicated in the table. A sketch map of the location of the sample holes is presented as Fig. 1.

The various sample holes are of varying depths, primarily reflecting thickness of cover material in the various locations. Great care was taken to cease penetration at the first indication that waste material was being encountered. A thorough monitoring of the samples and sampling equipment performed by an H-1 monitor, indicated no detectable contamination.

After the drilling was completed, the holes were backfilled a short distance, and a 2-inch plastic pipe placed in the hole. The hole was backfilled around the pipe, and the pipe was capped. These casings will be used as access tubes for a neutron moisture meter to provide further monitoring of moisture movement in the fill material.

Three additional sets of holes have been drilled in tuff material underlying disposal pits which were not in full service.[1] Samples were collected using the power auger described above, and analyzed for moisture content. A summary of data from selected holes in Pits 7, 8, and 24 is presented in Table 2. Analysis for tritium was not performed. However, data from field investigations in 1971 indicated that background tritium concentrations in undisturbed tuff are on the order of 10-20 pico-curies/millilitre.[2]

Discussion

The fill material on Pit No. 1 and Pit No. 2 appears to have been undisturbed since covering was completed in April 1961 and July 1963, respectively. This lack of disturbance is indicated by the presence of mature specimens of Chrysothamnus parrihowardi (rabbitbrush) in the vicinity of the sample holes. This plant species requires ten to twenty years to reach adult size.

In general, a peak in the water content was located at one to two metres depth. Below this interval moisture contents decreased with depth, and then at depths of about three metres remained somewhat constant with depth. This indicates that moisture penetration by precipitation is confined primarily to the upper 2 to 3 metres of material. Penetration below that depth may occur during years of unusually high precipitation, and from slow redistribution of near-surface moisture.

Moisture contents were well below field capacity values (estimated as 15-20% for this material) indicating that moisture movement is primarily caused by capillary forces. No actual movement rates can be inferred from this data without additional field measurements. The variation in moisture contents observed between the fill on Pit No. 1 and that on Pit No. 2 may be due either to variations in soil conductivity or differences in surface slopes. Further work is planned to substantiate this.

It is interesting to compare the moisture content of the fill material with that of the tuff beneath disposal Pits 7, 8, and 24. Pits 7 and 24 were constructed in the fall of 1973, and the bottoms had been exposed to precipitation for only a few months when the moisture samples were collected. The moisture contents are similar to, or lower than those recorded in other, undisturbed portions of the tuff.[3] Pit No. 8 was constructed in August 1971, and was thus exposed to precipitation for more than two years. Water is known to have accumulated in the bottom of the pit on at least one occasion (September, 1973).[4] This increased moisture input is reflected in the higher moisture contents observed beneath Pit No. 8, compared with Pits 7 and 24.

No firm comparison can be made between the moisture transmitting capacity of the fill material (crushed tuff) and the undisturbed tuff. However, the similarity of the moisture regime beneath Pit No. 8 and that in the fill material indicates that the transmission capabilities of the

two materials are in the same range of values. Generally speaking, both material can be characterized as "poor conductors" of moisture. For comparison, moisture contents of undisturbed natural soils range up to 20% by weight at depths of one to two metres.[3]

The recorded tritium concentrations are of considerable interest. Environmental monitoring in the Los Alamos area indicates that background tritium concentrations are in the range of 10-20 pico-curies/millilitre,[2,5] for both soils and near surface tuff. The tritium concentrations observed in the fill on Pit No. 1 are more than three orders of magnitude higher than this. A search of disposal records for that pit did not reveal any single item that would appear to be a source of the tritium. Several entries recorded the disposal of 50-100 curie quantities of tritium, but none were in the near vicinity of the moisture sample holes. The significant concentration gradient towards the surface, indicates that tritium is diffusing towards, and perhaps out of the ground surface. Additional monitoring will be necessary to determine the actual quantities of tritium entering the atmosphere or vegetation at this site.

Conclusion

Moisture sampling data indicates that precipitation is penetrating to a depth of one to two metres in the fill material. The material appears to have about the same moisture transmission capacity as undisturbed tuff, both materials being lower than natural soils in the area.

Unusually high tritium concentrations were observed in the fill on Pit No. 1, but cannot be attributed to any specific source. Tritium appears to be migrating towards the ground surface.

MLW:jb

cc: L. Johnson, H-8
W. Purtymun, H-8
M. A. Rogers, H-8
K. Schiager, H-8

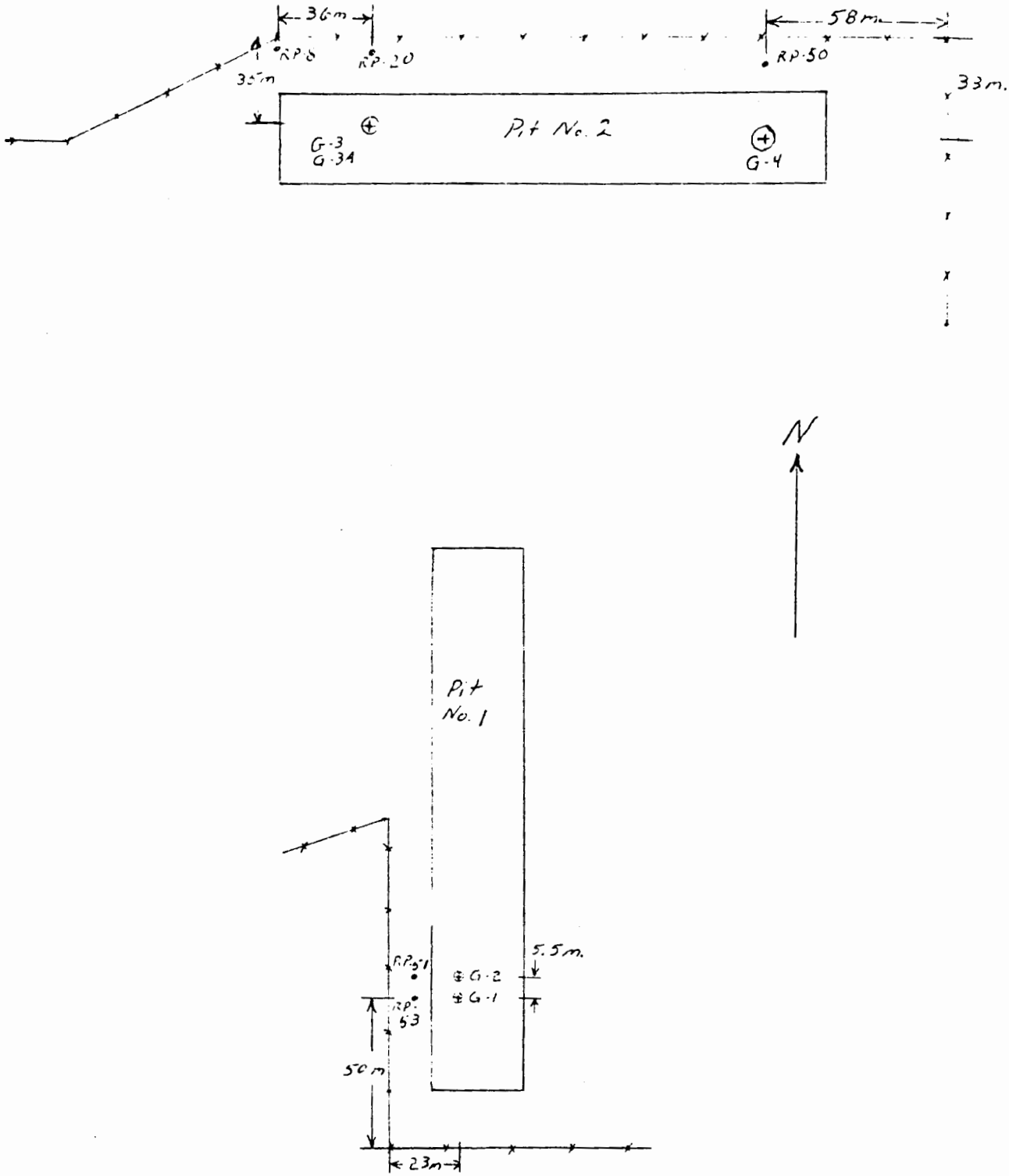


Fig. 1. Location of Sample Holes

Table 1. Data Summary, Moisture Samples, Area G. Auger Holes in Fill Material Covering Pits

Hole No.	Depth Interval m.	Moisture Content % by wt.	Tritium Content pCi/ml Water	Location
G-1 (Split spoon)	0-0.7	10.1	4 246	S.W. End Pit No. 1
	0.7-1.5	13.1	14 823	
	1.5-2.3	10.1	38 207	
	2.3-3.1	8.2	57 850	
	3.1-3.5	8.3	102 042	
G-2 (Auger)	0-0.8	9.5	7 280	S.W. End, Pit No. 1
	0.8-1.5	11.7	6 977	
	1.5-2.3	11.4	19 557	
	2.3-3.1	7.5	130 426	
	3.1-3.8	7.0	297 271	
G-3 (Split spoon)	0-0.8	3.3	685	N.W. End, Pit No. 2
	0.8-1.5	4.8	698	
	1.5-2.0	4.8	835	
G-3A (Auger)	0-0.9	3.3	645	N.W. End, Pit No. 2
	0.9-1.5	5.7	841	
	1.5-2.3	4.7	908	
	2.3-3.1	5.0	935	
G-4 (Auger)	0-0.8	5.0	157	S.W. End, Pit No. 2
	0.8-1.2	3.9	443	

Table 2. Moisture Content of Tuff, Area G

Depth (metres)	Moisture Content, Percent by Weight					
	Pit 24		Pit 7		Pit 8	
	Hole 1	Hole 2	Hole 1	Hole 2	Hole 1	Hole 2
0-1.5	0.9	2.4	0.7	1.2	8.7	8.5
1.5-3	1.1	2.3	0.4	0.6	9.3	9.8
3-4.5	0.8	4.2	0.7	0.3	8.6	8.2
4.5-6	1.0	0.6	0.9	0.3	7.5	4.1
6-7.5	0.3	0.5	0.7	0.2	6.0	4.0
7.5-9	0.3	0.5	0.7	0.4	2.8	1.9
9-10.5	0.5	0.1	0.7	0.2	2.5	1.6
10.5-12	0.6	0.3	0.3	0.5	3.4	2.4
12-13/5	3/2	0.3	0.3	0.3	3.6	3.5
13.5-15	3.4	0.6	0.9	0.3	3.9	3.9

References

1. W. Purtymun, LASL internal document. Memo to M. Wheeler providing data on moisture content of tuff beneath Pits 7, 8, and 24. (Feb. 7, 1974).

2. H. Jordan, LASL internal document. Memo to Dean Meyer detailing moisture and tritium concentrations in tuff beneath disposal areas (Dec. 2, 1971).

3. J. H. Abrahams, Jr., J. E. Weir, Jr., and W. D. Purtymun, "Distribution of Moisture in Soil and Near-Surface Tuff on the Pajarito Plateau, Los Alamos County, New Mexico". U. S. Geological Survey, Prof. Paper 424-D, 1961.

4. M. A. Rogers, Personal communication September 1973.

5. J. E. Herceg, Environmental Monitoring in the vicinity of the Los Alamos Scientific Laboratory, Calendar Year 1972. Los Alamos document, LA-5184, March 1973).

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544
TELEPHONE:

OFFICE MEMORANDUM

TO : John Finley, ENG-DO

DATE: March 19, 1974

FROM : William D. Purtymun, H-8 WDP

SUBJECT: TEST HOLES AT BLDG. TA-16

SYMBOL : H8-74-126

Three lithologic units were penetrated by test holes at Bldg. 260 at TA-16. They were clays, outwash of sand, gravel, boulders and a moderately welded ashflow tuff.

The clay ranges from dark gray to light orange in color. The darker clays contained some sand and gravel while the light orange clay contained no sand or gravel. The clay in general overlies the outwash of sand, gravel and boulders. The clays are bentonite which have the ability to adsorb and absorb water and swell accordingly.

The sand, gravel and boulders are outwash from intermittent streams that spread alluvial debris from the flanks of the mountains west of TA-16 onto the surface of the plateau. The alluvial debris is of tuff, latite, rhyolite and quartz latite. There are stringers or lenses of clay in the alluvial outwash.

The tuff underlying the outwash is moderately welded. The upper 3 to 4 feet is weathered to a light orange while the underlying unweathered unit is a light pinkish gray.

The outwash sand, gravel and boulders at the time of testing were saturated. In front of Bldg. 260 most of the holes were filled with water. The asphalt formed a confining layer. The recharge is from snowmelt in the drainage ditches cut in the outwash west of the paved areas. Most of the holes flowed after completion. The water in the gravel is seasonal with higher water tables occurring during the spring and summer. Water in the outwash probably dries up in early summer and late fall due to lack of precipitation.

The clay unit that underlies Bays 11, 12, and 13 are subject to a wetting and drying cycle that causes swelling and shrinkage of the clay. Stabilization of the foundation will probably require extension of the foundation into the gravel and drainage of the gravel overlying tuff.

A generalized cross-section and location of test holes is attached as are tables showing logs of the test holes and moisture contents.

Lee Hilton, WX-3 is preparing a map showing exact location of the test holes.

WDP:et

Attachments (3)

Cys: H. E. Ballance, WX-3
W. I. Norwood, WX-3
Tom Chandler, WX-3
Dean Keller, ENG-1

TABLE I

Log of Test Holes

		Interval (in feet)
TH-1	Sand, Gravel and boulders	0 - 2.5
TH-2	Sand, gravel, with minor amounts of clay	0 - 3
	Gravels and boulders	3 - 7.5
	Boulders	7.5
TH-3	Sand, Gravel and Boulders with minor amounts of clay	0 - 9.5
	Tuff, weathered, light orange, weathered	9.5 - 14
	Tuff, light pinkish gray, moderately welded	14 - 19
TH-4	Clay, dark gray	0 - 1
	Clay, light orange	1 - 4.5
	Boulders	4.5
TH-4A	Clay, light orange	0 - 4
	Boulders	4
TH-4B	Clay, light orange	0 - 4
	Boulders	4
TH-5	Clay, light orange	0- 3.5
	Boulders	3.5
TH-6	Clay light orange	0 - 4
	Boulders	4
TH-7	Clay, light orange	0 - 4
	Boulders	4
TH-8	Clay, light orange	0 - 4.5
	Sand, gravel, boulders with some clay lenses	4.5 - 14
	Tuff, weathered, light orange to brownish gray	14 - 19
	Tuff, welded, dark gray	19
TH-9	Clay, light orange	0 - 4.5
	Boulder	4.5
TH-10	Clay, light brown	0 - 3.5
	Sand gravel and boulders	3.5 - 5
	Boulder	5

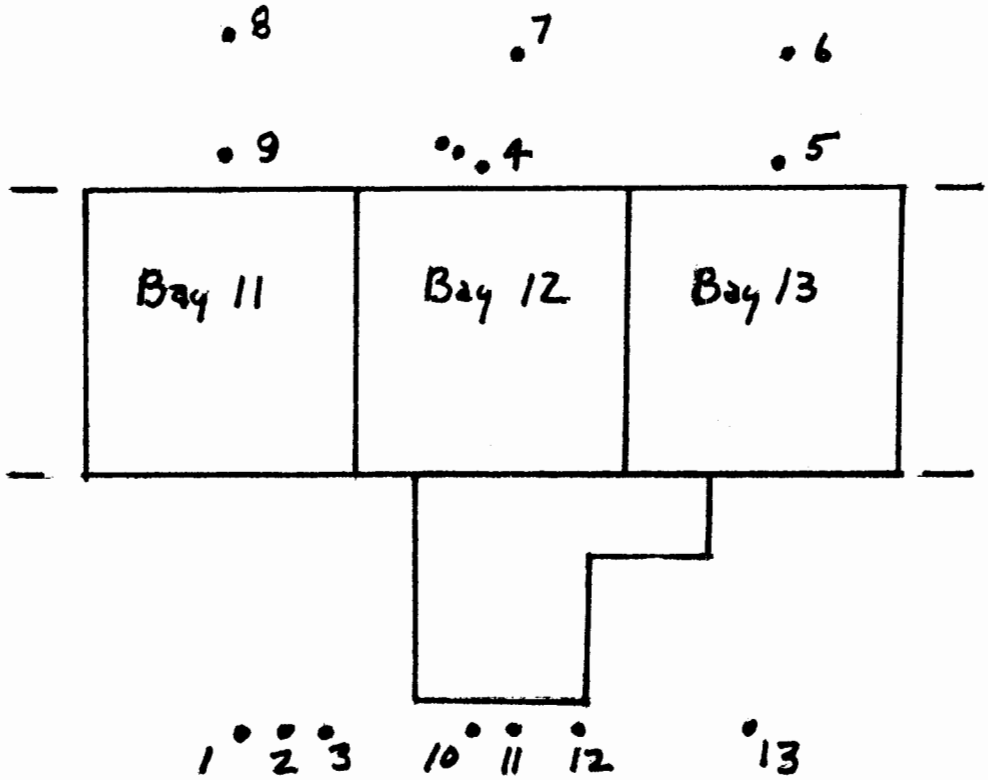
TABLE I Continued

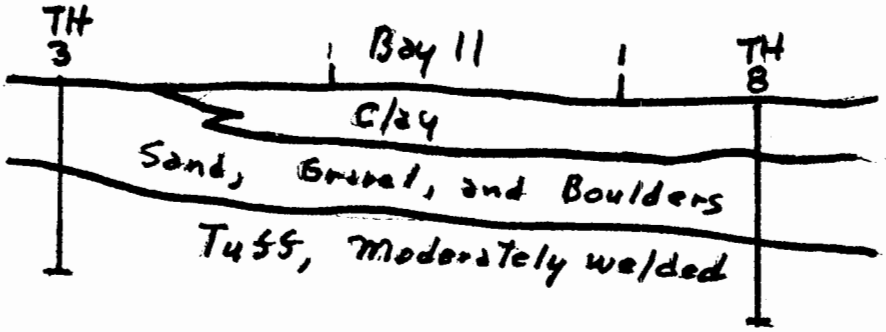
		Interval (in feet)
TH-11	Sand gravel with some clay	0 - 2.5
	Boulder	2.5
TH-12	Sand, gravel with some clay	0 - 2.5
	Sand, gravel and boulders with minor amounts of clay	2.5 - 7
	Boulders	7 - 9
	Tuff, light orange to light pinkish gray	9 - 18
TH-13	Sand and gravels	0 - 6
	Clay, dark gray	6 - 8
	Sand, gravel and boulders	8 - 10
	Tuff, weathered, light orange	10 - 14
	Tuff, light pinkish gray, moderately welded	14 - 17.5

TABLE II

Moisture Content of Cuttings

Interval (feet)	Test Holes												
	1	2	3	4	5	6	7	8	9	10	11	12	13
0 - 2.5	16	8	16	21	20		20	19	20	21	19	18	18
2.5 - 5	9	--	10	19	17		16	17	15	19	--	18	13
5 - 7.5	10		13	19	--		--	13	--	--		22	19
7.5 - 10	--		9	--				18				26	14
10 - 12.5			14					19					14
12.5 - 15			13					18				30	13
15 - 17.5			14					15				25	12
17.5 - 20			12					15				--	--





Generalized Section (not to scale)

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544
TELEPHONE:

OFFICE MEMORANDUM

TO : M. C. Smith, Group Leader, Q-22 DATE: April 2, 1974

FROM : Wm. D. Purtymun, H-8 and Francis West, Q-22

SUBJECT: EXPLORATORY TEST HOLE IN VOLCANICS WITH POSSIBLE COMPLETION AS A SMALL YIELD WATER SUPPLY.

SYMBOL : H8-74-140

The following data was compiled at the request of Don Brown in regards to data obtained during the initial phase of drilling GT-2.

The geophysical and lithologic logs of test hole GT-2, Fenton Hill Site indicated water is perched in the volcanics overlying the Abo Formation. An exploratory hole would be necessary to determine if an adequate water supply could be developed for the site.

The volcanics at the site are about 450 feet thick. The Bandelier Tuff extends from land surface to a depth of about 360 ft. The Paliza Formation from 360 to 410 ft. and the Abiquiu Tuff from 410 to 450 ft. The Bandelier Tuff is composed of a series of moderately welded to welded ash flow tuff that are ryholitic in composition. The Paliza Formation is an andesite basaltic breccia and is underlain by the Abiquiu Tuff that is a tuffaceous sand and conglomerate.

The geophysical logs of GT-2 indicated about 40 feet of saturated thickness in the volcanics (Paliza Canyon and Abiquiu Tuff). The presence of water in this section was noted by drilling condition of GT-2. Water bearing characteristics could not be determined as the hole was drilled using fluids as a cutting carrier.

The velocity log of GT-2 indicated a saturated section from a depth of 410 to 450 feet in the volcanics that is perched on the Abo Formation. The Abo is composed of shales, siltstones, and fine grained sandstones. The Paliza Canyon is a fairly stable formation while the Abiquiu Tuff is loosely consolidated and friable. The caliper log on GT-2 through the Abiquiu section indicated washout while the Paliza Canyon remained stable. The electric log indicated porosity and fresh water in the interval from 410 to 450 feet.

Generalized contours on top of the Abo Formation (using test holes GT-1, GT-2, A and D for control) indicate the surface of the Abo Formation dip to the west south west at about 80 feet per mile (Fig. 1). The water in the volcanic would move down dip perched on

the Abo Formation.

The contours on top of the Abo are generalized as the upper surface is very irregular, forming high and low areas, cut by erosion, that were later filled with volcanics. The water in the volcanics will move down dip filling these low areas while in some of the high areas the Abo may be above the water table.

The springs and seeps in Lake Fork (elevation 7890 ft) and Virgin Canyon (elevation 7750 ft) discharge from the volcanics overlying the Abo. The discharge forms perennial stream that flows in the Rio Guadalupe. The spring at elevation 8120 is perched in the volcanics.

The ground water divide in the volcanics between the Fenton Hill Site and the valley cut by San Antonio Creek occurs along the north-south trending fault that was mapped by Smith and other (1970). The spring at elevation 7950 ft. (Horse Shoe Spring) discharges from the base of the volcanics on the down thrown side of the fault. Along the Jemez River the base of the volcanics are 300 to 500 feet below the base of the volcanics to the south and south east of the Fenton Hill Site. The difference in elevation probably occurs along Virgin Canyon and due in part to erosion and in part to a probable fault that is down thrown to the east. The spring at elevations of 7300 and 7460 ft discharge from the base of the volcanics while the spring at 7560 ft discharges from a perched zone in the volcanics. The springs at elevations 7300 and 7460 ft are used for water supply at Jemez Springs. The ground water divide probably occurs along Virgin Canyon.

Test Hole A (elevation 8329 ft) was reported to have little or no water in the volcanics GT-1 (elevation 8315) was drilled using fluid as a carrier so that no hydrologic observation could be made prior to casing the hole through the volcanic. Test Hole D (elevation 7830) contains water in the volcanic that rose to a depth of ~30 ft below land surface.

The springs in Lake Fork and Virgin Canyon as well as the geophysical logs of GT-2 indicated water in the volcanics. A hole drilled by cable-tool method would be necessary to determine if a supply for this site could be constructed. There is a limited area for recharge to the aquifer in the volcanics east of the site and there is always the possibility of drilling into a high area of the Abo where the volcanics would be dry. Limited ground water storage could occur in the low areas between the highs. Thus due to the geologic and hydrologic conditions in the area a hole drilled into the volcanics at the Fenton Hill Site for a water supply should be considered an exploratory hole

until tested to determine if an adequate ground water supply could be developed.

The specifications for an exploratory hole and possible completion as a water supply well are attached.

SPECIFICATIONS FOR AN EXPLORATORY HOLE AND POSSIBLE COMPLETION AS A WATER WELL

Scope of Work

The contractor shall furnish all labor, material, equipment, and maintenance of equipment to perform all work required to drill, case, test, and develop one exploratory hole to a depth of about 450 ft using cable-tool equipment. The anticipated log of the exploratory hole to be located at TA-57, Fenton Hill Site in Sandoval County is as follows:

	Depth (feet)	
	From	To
Tuff moderately welded and weld ash flows	0	360
Basaltic breccia	360	410
Tuffaceous sand and conglomerate	410	450

Anticipated water level ~360 ft.

The thickness of the saturated thickness of the volcanic rocks penetrated above the Abo Formation (red beds) will determine if the hole will be completed as a well.

Specifications:

1. The drilling contractor must be licensed by the New Mexico State Engineer to drill in the Rio Grande Basin. The contractor shall secure the necessary permit to drill and test the exploratory hole from the State Engineer.

2. The proposed exploratory hole is to be drilled as follows:
   a. Drill a 12 or 14 inch diameter hole to a depth of about 20 ft and set 10 3/4 inch casing (the 10 3/4 inch casing will be furnished by LASL). The 10 3/4 inch casing will be cemented with a slurry grout from top to bottom by the contractor.
   b. Drill an 8 inch diameter hole to a depth of about 450 ft through the volcanics into the top of the Abo Formation (red beds).

c. The saturated thickness of volcanics encountered and hydrologic characteristics of the section will determine further completion of the exploratory hole. This decision will be made by the contractor in agreement with a LASL representative.

2. Casing construction of the exploratory hole is as follows:

a. The length of the screen or perforated (slotted casing) will be determined by the contractor in agreement with a representative of LASL. The type and size of the openings in screen or perforated casing will be determined by the contractor in agreement with a LASL representative to allow minimum entrance of sand to the cased well.

b. The screen or perforated pipe will be run with 6 inch ID standard pipe (welded or threaded) to the required depth of about 450 ft. The screen and/or perforated pipe will be furnished by the contractor. The casing and screen and/or perforated pipe will be set by the contractor.

c. The casing shall be secured at the surface in an approved manner (i.e. welded to I beams) and hung in tension in the hole.

3. Development and test of the exploratory hole is outlined as follows:

a. The contractor will provide bailing tests not to exceed 2 hours in each perched water zone above a depth of 350 feet as requested by a LASL representative chargeable to LASL as an hourly rate.

b. The contractor will provide testing by pumping for a period of at least 24 hours to determine the type and size of the pump and adequacy of the well for water supply.

4. General specifications are as follows:

a. The contractor will provide LASL with cuttings from each 5 foot interval in depth during drilling of the 8 inch diameter hole.

b. during the 24 hour test a representative of LASL will be present. Water levels will be determined prior to, during and after the test. Pumping rates will be determined at hourly intervals during the test.

WDP:et

cc: Don Brown, Q-22
Bob Hendron, Q-22
Francis West, Q-22

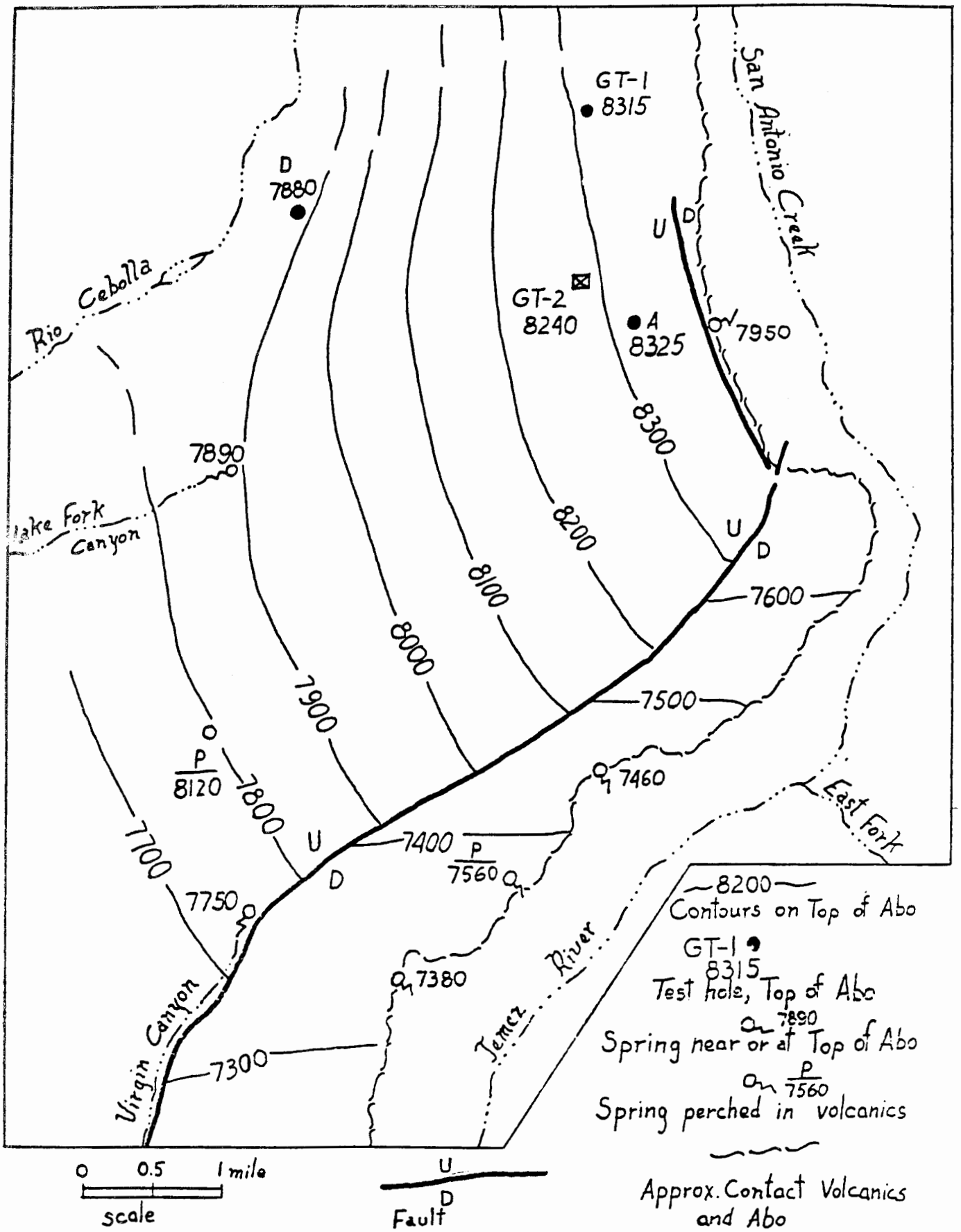


Fig. 1. Structure contours on the top of Abo Formation.

Approximate Cost of the Exploratory Hole

1.	a. Drilling 12 or 14 inch to a depth of about 20 ft and cementing in 10 3/4 inch casing	$300
	b. Drilling 8 inch hole to about 450 ft at $8 a ft.[1]	3600
2.	a. Casing 6 inch ID standard pipe about 430 ft at $5 a ft.	2150
	b. Stainless steel screen 20 ft at $60 a ft = $1200 OR perforated standard 6 inch ID pipes 20 ft at $12 a ft $240[2]	1200
3.	a. Hourly rate for testing and development 12 hrs at $25 an hr.	750
	b. Testing by pumping for 24 hours at $30 an hour	720
	Estimated total	$8720

[1] Contract terminates at 1. b if no water encountered
[2] Type of casing depends on sand size in aquifer.

May 1974

FLOOD-FREQUENCY AND MAXIMUM DISCHARGE OF SIXTEEN DRAINAGE AREAS IN THE VICINITY OF LOS ALAMOS

BY

William D. Purtymun

And

Linda Trocki

ABSTRACT

Flood-frequency and maximum discharge were compiled by a theoretical method for 2, 5, 10, 25 and 50 year recurrence intervals. The data for the drainage areas was compiled at the U.S. Atomic Energy Commission Boundary along the eastern edge of the Pajarito Plateau or at the Rio Grande. The data will provide a basis for environment studies and design criteria for facilities. The only areas in which flooding may occur are the canyon floors.

I. INTRODUCTION

Surface water drainage across the Pajarito Plateau is eastward from the Sierra de los Valles to the Rio Grande (Fig. 1). The intermittent streams have cut deep canyons, forming a series of "finger-like" mesas that comprise the surface of the Pajarito Plateau. There are no perennial streams in the Los Alamos area that flow from the mountains to the Rio Grande. Some of the large canyons on the flanks of the mountains contain perennial streams. The stream flow in these canyons is lost to evapotranspiration and into the alluvium and underlying rocks at the western edge of the plateau.

Runoff from the heavy snows on the mountains may reach the Rio Grande in two of the larger canyons, Los Alamos and Pajarito, for several weeks during the spring. Heavy intense thunderstorms cause runoff in the canyons during the summer. These flood conditions occur for only a few hours and only in the vicinity of the stream channel on the canyon floor. The "finger-like" mesas of the plateau are well drained with no possibility of flooding.

The canyons are in a youthful stage of erosion which is characterized by steep canyon walls and V-shaped cross-sectionof the valley profile. There are no flood plains along the channels and intermittent runoff continues down-cutting on the canyon floor. Any excessive runoff or flood flow caused by heavy summer storms will be concentrated in a small cross-section of the existing channel.

Surface water data necessary to evaluate the flood-frequency and maximum discharge in the canyons of the Los Alamos area does not

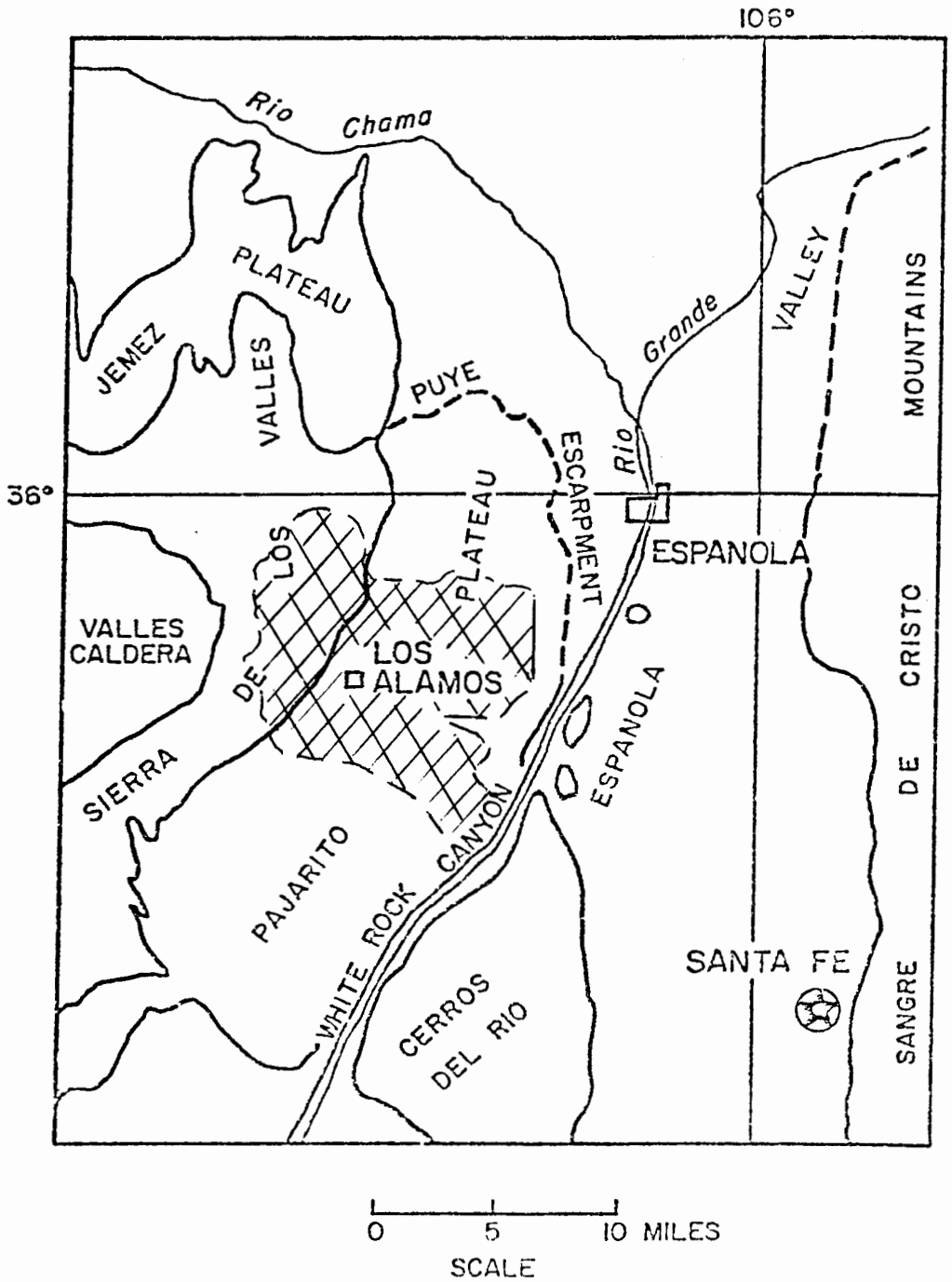
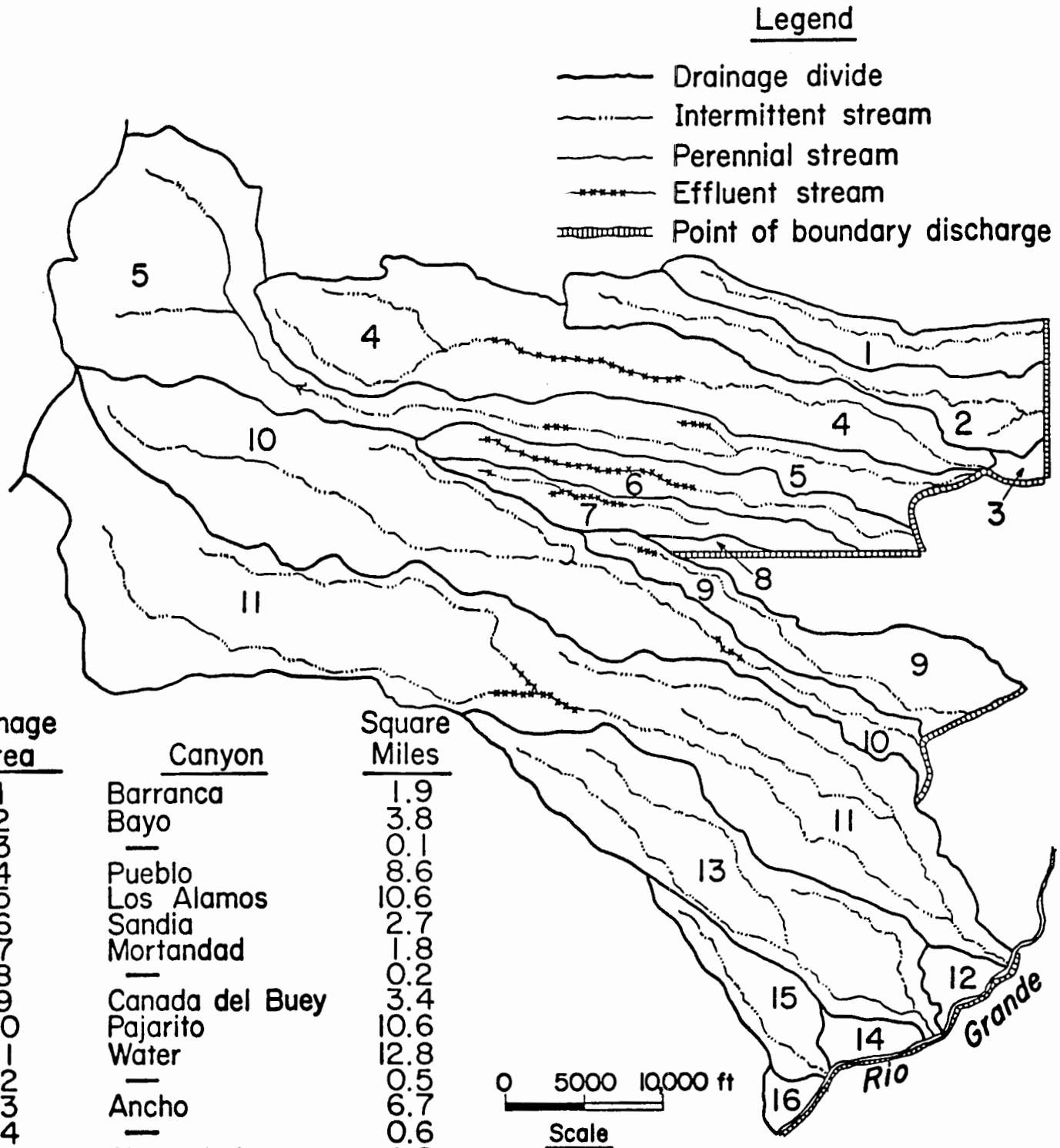


Figure 1. Physiographic features of the Los Alamos area showing drainage investigated.



Drainage Area	Canyon	Square Miles
1	Barranca	1.9
2	Bayo	3.8
3	—	0.1
4	Pueblo	8.6
5	Los Alamos	10.6
6	Sandia	2.7
7	Mortandad	1.8
8	—	0.2
9	Canada del Buey	3.4
10	Pajarito	10.6
11	Water	12.8
12	—	0.5
13	Ancho	6.7
14	—	0.6
15	Chaquehui	1.8
16	—	0.4

Figure 2. Drainage Areas and Points of Boundary Discharges

exist. Thus, theoretical data results have been obtained for 16 drainage areas (Fig. 2). The flood-frequency and maximum discharge have been computed at the U. S. Atomic Energy Commission Boundary along the eastern edge of the Pajarito Plateau or at the Rio Grande.

The data have been compiled to provide a basis for environmental studies and design criteria for facilities which in the future may be located in the canyon bottoms.

II. FLOOD-FREQUENCY AND MAXIMUM DISCHARGE

The flood-frequency and maximum discharge for 16 drainage areas were derived from nomographs devised by Scott.[1] The method uses empirical relationships between existing flood data at gaged sites and the physical and climatic conditions of the corresponding drainage basin. The nomographs are then used to estimate flood frequency from the appropriate physical and climatic conditions in areas where no direct flood data exist.

The peak discharges of 2, 5, 10, 25 and 50 year recurrence intervals were determined for each of the drainage areas containing a well defined channel from nomographs presented by Scott for Region 1 which includes the Rio Grande watershed in North-Central New Mexico.

The climatic data used with the nomographs as determined at Los Alamos were a mean minimum January temperature of 8 °F and a maximum 24-hour 2 year rainfall of 1.69 inches. Each drainage area in square miles above the AEC Boundary was determined by use

of a planimeter. The main channel slope, in feet per mile, was computed from topographic maps at points 10 and 85 percent of the distance from discharge point at the boundary and drainage divide. The difference in altitude between those two points divided by the distance between the points was used to compute the main channel slope for drainage areas.

The flood-frequency or "recurrence interval" is the average interval of time during which a flood of a given magnitude is equaled or exceeded once. A flood with a recurrence interval of 50 years is the flood that is equaled or exceeded once in 50 years, on the long term average. The concept implies no regularity in the time of recurrence of a given magnitude flood. It is possible for two or more 50 year floods to occur within a short period of time, or many more than 50 years may elapse before the occurrence for one 50 year flood.

Frequencies may be expressed in terms of probabilities, i. e. the probability of the occurrence of a 10 year flood in any given year is 1 in 10 or 0. 1 ; the probability of a 50 year flood in any given year is 1 in 50 or 0. 02.

A. Drainage Area - (Barranca Canyon)

Barranca Canyon heads on the Pajarito Plateau at an altitude of about 7, 200 ft. The stream in the canyon is intermittent. There is no release of effluent into the canyon. The flood-frequency and maximum discharge are based on the following data:

Drainage Area 1.9 square miles

Main channel slope 205 ft. per mile

Frequency	Maximum Discharge (Cfs)[1]
2-year	55
5-year	145
10-year	235
25-year	430
50-year	500

1/ Cubic feet per second

B. Drainage Area 2 (Bayo Canyon)

Bayo Canyon heads on the Pajarito Plateau at an altitude of about 6,680 ft. The stream in the canyon is intermittent. There is no release of effluent into the canyon.

Drainage Area 3.8 square mile

Main Channel Slope 150 ft. per mile

Frequency	Maximum Discharge (Cfs)
2-year	85
5-year	215
10-year	300
25-year	595
50-year	675

C. Drainage Area 3

Drainage Area 3 consists of an area of 0.1 sq. miles on the south facing wall of Los Alamos Canyon. The flood-frequency and maximum discharge were not computed as no major drainage channel exists.

E. Drainage Area 4 (Pueblo Canyon)

Pueblo Canyon heads on the flanks of the Sierra de los Valles at an altitude of about 9,000 ft. Stream flow in the canyon is intermittent; however, there are two reaches, one near the western edge and the other near the eastern edge of the plateau, that receive treated sewage effluent (fig. 2). The effluent infiltrates into the alluvium or is lost to evapotranspiration prior to reaching the AEC Boundary. There is a small amount of water in the alluvium recharged from the effluents and storm runoff. The amount varies, with seasonal larger volumes occurring in the spring and late summer from snow melt and summer thundershowers.

Drainage Area 8.6 square miles

Main channel slope 175 ft. per mile

Frequency	Maximum Discharge (Cfs)
2-year	110
5-year	250
10-year	370
25-year	590
50-year	740

F. Drainage Area 5 (Los Alamos Canyon)

Los Alamos Canyon heads on the Sierra de los Valles at an altitude of 10,400 ft. The stream in the canyon cuts into the flanks of the mountains and is perennial. Stream flow is impounded at Los

Alamos Reservoir at an altitude of about 7,600 ft. The reservoir has a storage capacity of about 4 acre-feet. Below the reservoir stream flow is intermittent. Minor amounts of effluent are released from a sewage treatment plant and cooling tower blow down near the western edge of the plateau. Sewage and industrial effluents are released into a tributary canyon near the center of the plateau. The effluents do not reach Los Alamos Canyon as they are lost to evapo-transpiration and into the alluvium above the confluence. The alluvium contains some water perched on the underlying rock. The volume is seasonal.

Drainage Area 10.6 square miles

Mean Channel Slope 210 ft. per mile

Frequency	Maximum Discharge (Cfs)
2-years	105
5-years	240
10-years	360
25-years	560
50-years	710

G. Drainage Area 6 (Sandia Canyon)

Sandia Canyon heads on the Pajarito Plateau at an altitude of 7,500 ft. Stream flow in the canyon is intermittent. Sewage

effluents and water from a cooling process at the Power Plant are released into the upper reaches of the canyon. Some water in the alluvium probably occurs in the western part of the plateau from the effluent and storm runoff.

Drainage Area 2.7 square miles

Main Channel Slope 145 feet per mile

Frequency	Maximum Discharge (Cfs)
2-years	70
5-years	190
10-years	300
25-years	560
50-years	625

H. Drainage Area 7 (Mortandad Canyon)

Mortandad Canyon heads on the Pajarito Plateau at an altitude of 7,440 ft. Stream flow in the canyon is intermittent. Cooling water from a technical area and industrial effluents are released into the canyon near the center of the plateau. These effluents and storm runoff maintain a body of perched water in the alluvium. The water in the alluvium is of limited extent, terminating about 2 miles west of the AEC Boundary. The loss to evapotranspiration and into the underlying tuff maintains a balance with the surface water recharge. The canyon is unique as the alluvium is over 100 ft. thick at the

boundary. Since hydrologic observation began in the canyon in 1959 surface runoff has not been sufficient to move from the upper canyon to the AEC Boundary, due in part to the large volume of unsaturated alluvium and the low gradient of the channel in the lower part of the canyon. The stream channel in the lower part of the canyon is discontinuous, braiding out on the canyon floor. Thus as a main channel is not well defined, the canyon does not lend itself to the theoretical flood frequencies and maximum discharge analyses.

Drainage Area 1.8 square miles

Main Channel Slope 155 feet per mile.

I. Drainage Area 8

The small segment of a south facing wall of a mesa contains no major drainage channel. The area is about 0.2 square miles.

J. Drainage Area 9 (Canada del Buey)

Canada del Buey heads on the Pajarito Plateau at an altitude of about 7,240 ft. The stream in the canyon is intermittent. A small amount of water from a cooling process is released into the canyon in its upper reach.

Drainage Area 3.4 square miles

Main Channel Slope 110 ft. per mile.

Frequency	Maximum Discharge (Cfs)
2-years	90
5-years	220
10-years	330
25-years	680
50-years	730

K. Drainage Area 10 (Pajarito Canyon)

Pajarito Canyon heads on the Sierra de los Valles at an altitude of about 10,400 ft. Several of the canyons that are confluent with Pajarito contain perennial streams on the flanks of the mountains and the western part of the plateau. Very little effluent is released into the canyon. The surface water from precipitation is sufficient to maintain water in the alluvium. The volume varies and is seasonal, dependent on recharge from snow melt and summer showers.

Drainage Area 10.6 square miles

Main Channel Slope 205 ft. per mile

Frequency	Maximum Discharge (Cfs)
2-years	105
5-years	250
10-years	355
25-years	580
50-years	700

L. Drainage Area 11 (Water Canyon)

Water Canyon heads on the Sierra de los Valles at an altitude of 10,400 ft. Some perennial flow occurs in the main stem of the canyon

on the flanks of the mountains. Treated sewage effluent is released along with waste water from technical areas along the western part of the plateau.

Drainage Area 12.8 square miles

Main Channel Slope 260 ft. per mile

Frequency	Maximum Discharge (Cfs)
2-years	100
5-years	240
10-years	340
25-years	500
50-years	650

M. Drainage Area 12

Drainage Area 12 is a steep canyon wall on the west side of the Rio Grande with an area of 0.5 sq. miles. No main channel exists so the flood frequency and maximum discharge were not computed.

N. Drainage Area 13 (Ancho Canyon)

Ancho Canyon heads on the Pajarito Plateau at an altitude of 7,280 ft. Stream flow in the canyon is intermittent except in the lower reach. In the lower reach to the Rio Grande the stream flow is perennial, fed by a spring discharging from the main aquifer.

Drainage Area 6.7 square miles

Main Channel Slope 235 ft. per mile

Frequency	Maximum Discharge (Cfs)
2-years	80
5-years	190
10-years	290
25-years	480
50-years	600

O. Drainage Area 14

Drainage Area 14 is a steep canyon wall on the west side of the Rio Grande that contains no well defined drainage channel. Drainage area is 0.6 square miles.

P. Drainage Area 15 (Chaquehui Canyon)

Chaquehui Canyon heads on the eastern part of the plateau at an altitude of 6720 ft. The stream in the canyon is intermittent. The main channel drops precipitously from the plateau to the Rio Grande.

Drainage Area 1.8 square miles

Main Channel Slope 410 ft. per mile.

Frequency	Maximum Discharge (Cfs)
2-years	40
5-years	105
10-years	160
25-years	290
50-years	350

Q. Drainage Area 16

Drainage Area 16 forms a steep wall on the west side of the Rio Grande. The basin contains no main channel. The drainage area is about 0.4 sq. mile.

III. CONCLUSION

The only areas subject to flooding are along the existing channels of the canyon floors. The surface of the mesas are well drained and present no flood problems.

Of the sixteen drainage areas investigated, only 10 contained well defined channels that were applicable for theoretical flood frequency and maximum discharge analyses. The following table illustrates the frequency in relation to the range and average of the maximum discharge of the 10 drainage areas.

	Maximum Discharge 1/	
Frequency	Range	Average
2-year	40-110	85
5-year	105-250	205
10-Year	160-370	305
25-year	290-680	525
50-year	350-740	625

REFERENCES

1. Arthur G. Scott, "Preliminary Flood-Frequency Relations and Summary of Maximum Discharges in New Mexico," U.S. Geol. Survey Open-file rept. (1971).

S ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : DISTRIBUTION

DATE: September 10, 1974

FROM : Robert W. Turner

SUBJECT : FUSION TEST REACTOR (FTR) - SITE SELECTION STUDY, LJ 5263-3

SYMBOL : ENG-9

All investigation and touring of the eight sites selected for consideration has been completed.

As the result of the tours, investigation, and discussion, I am submitting the following recommendations:

First recommendation - Site 1.
Second recommendation - Site 2.

A draft copy of the study is attached. Please review the draft and submit your comments to me either prior to or during a review meeting which will be held on September 17, 1974, in the ENGINEERING DEPARTMENT conference room, C-246, Building SM-43, to discuss the study draft, and finalize the site selection. Meeting time is 3:00 p.m.

Robert W. Turner
Acting Group Leader
Facilities Planning

Distribution:

R. W. Drake, WX-DO
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C. R. Dyer, ENG-9
L. J. 5263-3

DRAFT

FUSION TEST REACTOR (FTR)

SITE SELECTION STUDY

Prepared by
The Engineering Department
Los Alamos Scientific Laboratory
University of California
Los Alamos, New Mexico

Robert W. Turner, ENG-9
September 6, 1974
LJ 5263-3

FUSION TEST REACTOR (FTR)

SITE SELECTION STUDY

CONTENTS

SECTION 1 - SITE SELECTION STUDY

1.1 GENERAL

1.2 AREA CHARACTERISTICS

1.2.1 Meteorology

1.2.2 Hydrology

1.2.3 Geology

1.2.4 Seismicity

1.2.5 Other Physical Considerations

1.3 SELECTION OF SITES FOR INITIAL STUDY

1.3.1 Population

1.3.2 Hazards

1.3.3 Topography

1.3.4 Accessibility

1.4 DESCRIPTION OF SITES

1.5 SITE ELIMINATION

1.6 POPULATION DISTRIBUTION

1.7 COST EVALUATION

1.8 RECOMMENDATIONS

SECTION 2 - POPULATION DISTRIBUTION CONSIDERATIONS

2.1 SITE EVALUATION ON RADIATION BASIS

2.2 POPULATION DISTRIBUTION

2.3 TRANSPORT WIND FIELDS

GEOLOGICAL AND HYDROLOGICAL EVALUATION FOR THE INTENSE NEUTRON SOURCE FACILITY

A. General Geology and Hydrology

The major geological features of the Los Alamos area are the Valles Caldera and the Sierra de los Valles on the west and the Pajarito Plateau that forms an apron around the eastern flanks of the Sierra de los Valles (Fig. 1). The Valles Caldera was an active volcanic center in early Pleistocene time.[1] Eruptions spread layers of tuff and pumice on the eastern slopes of the Sierra de los Valles. The ashflows from these erruptions resulted in deposition of tuff more than 305 m thick, which form the gently sloping surface of the Pajarito Plateau.

The Pajarito Plateau is on the western margin of the Rio Grande depression which extends from southern Colorado through central New Mexico into Northern Mexico. The depression, a structural feature, range from 40 to 50 km in width at Los Alamos. The depression is filled with 2100 to 3600 m of volcanics and sediments above the basement complex of Precambrian crystalline rocks.

The major structural feature on the Pajarito Plateau is the Pajarito Fault Zone that trends north-south along the western edge of the plateau. The fault zone forms a break in slope between the mountains and the plateau. Several minor faults occur on the plateau and in areas to the north of the community of Los Alamos.

A general description is presented of the rocks that outcrop and are found in the subsurface of the plateau. They are in ascending order, from oldest to youngest, the Tesuque, Tschicoma, and Puye Formations and the Bandelier Tuff.

The Tesuque Formation consists of siltstones, sandstones, with lenses of clay and pebbly conglomerates. Interbedded with the sediments is an occassional basalt flow. Total thickness of the formation is unknown, but exceeds 700 m based on test hole penetration.

The Tschicoma Formation forms the mountain mass of the Sierra de los Valles. It consists of volcanic flow rocks of latite, quartz latites and rhyolite that were extruded as a viscous mass from volcanic centers in the area of the Valles Caldera.

The Puye Formation overlies the Tesuque Formation and interfingers with some of the younger flow rocks of the Tschicoma. The Puye is a conglomerate of volcanic debris eroded from the Tschicoma Formation. Basalts flow interfingers and in places overly the conglomerates.

The Bandelier tuff forms the upper part of the Pajarito Plateau. It consists of three members that in ascending order are: Guaje Member an ashfall pumice; the Otowi Member, a nonwelded ashflow tuff; and the Tshirege Member, a series of nonwelded to welded ashflow tuffs. The Guaje is thin generally less than 15 m while the Otowi may be as much as 65 m thick. The uppermost Tshirege Member as much as 300 m thick. The tuff and pumice are rhyolitic in composition consisting of quartz and sanidine crystals and crystal fragments, with a few small rock fragments of latite and rhyolite in an ash matrix. The porosity of the tuff may range from less than 15 percent for a welded unit to as much as 60 percent in a nonwelded unit.

The surface drainage from the Pajarito Plateau is into southeast trending canyon cut by intermittent stream. The surface of the gently

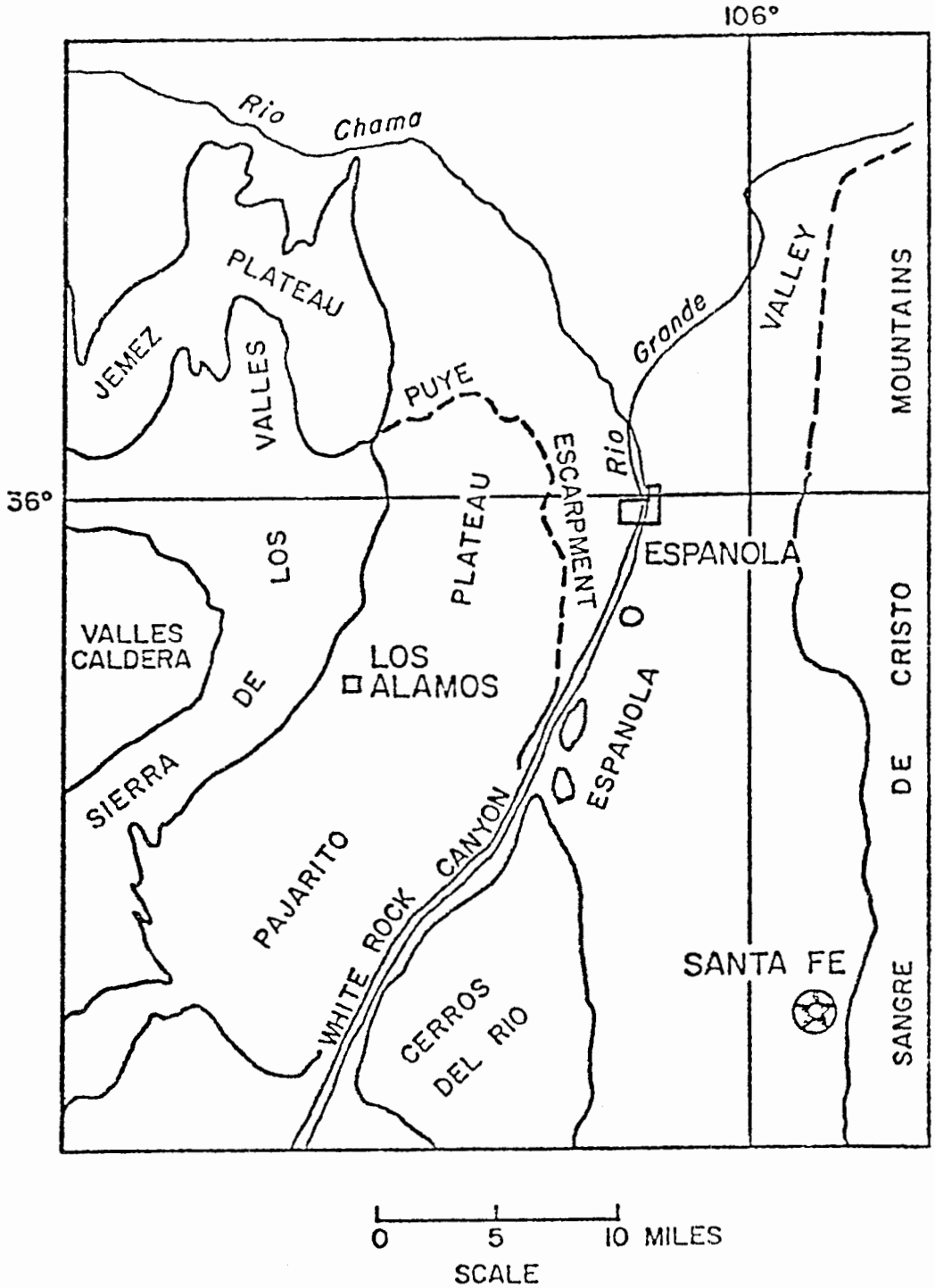


Fig. 1. Geologic features of the Los Alamos Area.

sloping mesas between the canyon are well drained with no possibility of flooding. The intermittent stream flow in the canyons occurs from spring snow melt and summer thunder showers. Drainage in the canyon is into the Rio Grande.

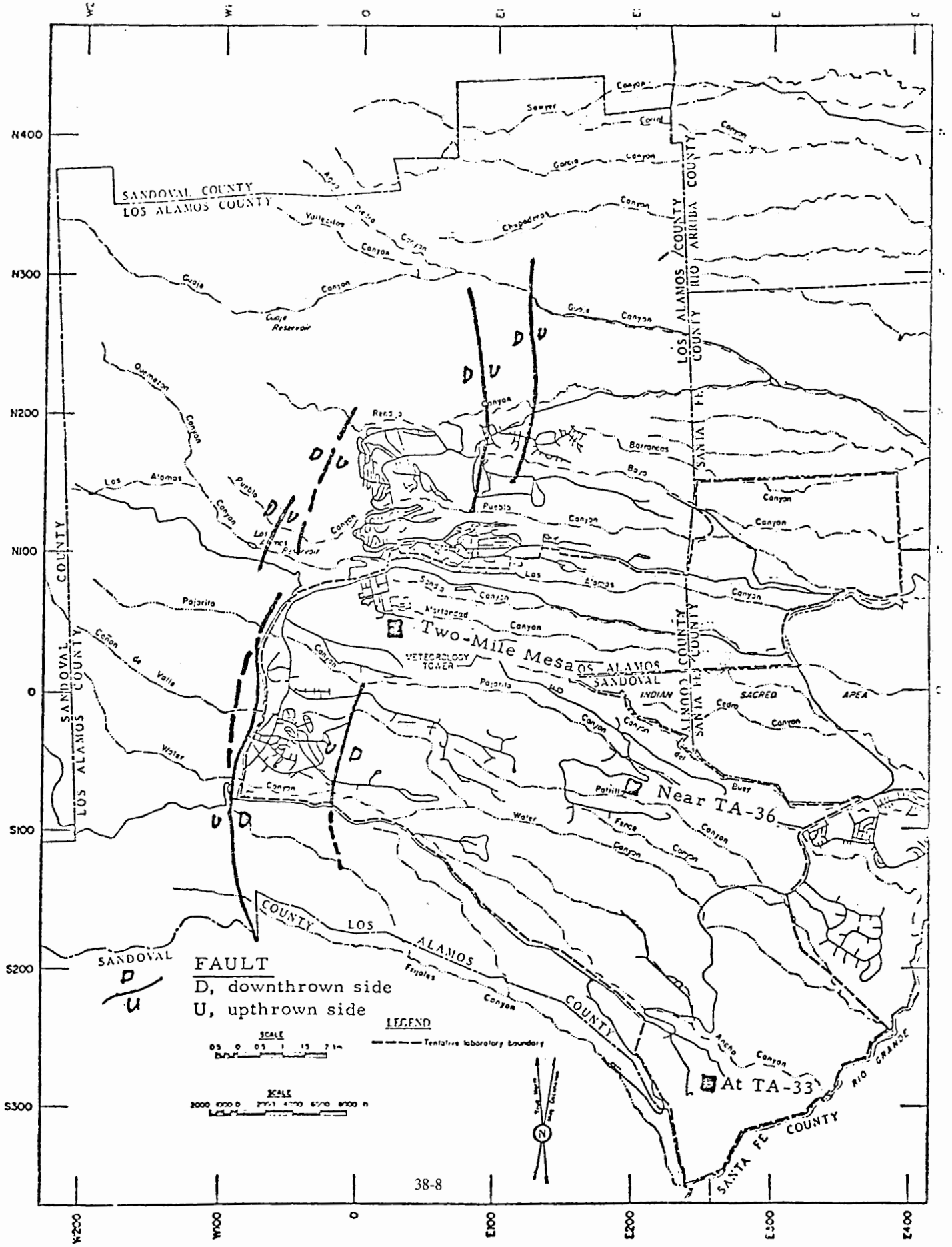
The alluvium in some of the larger canyons contains small bodies of perched water that is periodically recharged from the intermittent stream flow in the canyon.

There are no known bodies of water perch in the tuff or underlying conglomerate of the plateau except along the eastern edge in the vicinity of Los Alamos Canyon. The tuff and conglomerate are essentially dry beneath the alluvium on the canyon floor and the top of the main aquifer.

The main aquifer (source of municipal and industrial water supply) is in the Tesuque Formation and lower part of the Puye Formation beneath the Pajarito Plateau.[2] The main aquifer slopes gently from the area of recharge to the west in the Valles Caldera and Sierra de los Valles to the Rio Grande. The depth to the aquifer is about 380 m along the western edge of the plateau and decreases to about 180 m along the eastern edge. The movement of water in the aquifer is at about 120 m per year toward the Rio Grande where a part is discharged into the river through a series of seeps and springs.

B. Site Locations

The location for the 14 MeV Intense Neutron Source Facility was considered for three locations on the Pajarito Plateau (Fig. 2).


SANDOVAL COUNTY
LOS ALAMOS COUNTY
SANTA FE COUNTY
RIO ARRIBA COUNTY
Two-Mile Mesa
Near TA-36
At TA-33
WETEORLOGY TOWER
SACRED
APEA
FAULT
D, downthrown side
U, upthrown side
LEGEND
Tentative laboratory boundary
SCALE
N400
N300
N200
N100
0
S100
S200
S300
W200
W100
0
E100
E200
E300
E400

1. Two Mile Mesa

The location at Two-Mile Mesa is at an altitude of about 2274 m along the western edge of the plateau. The surface of the mesa is capped by the Bandelier Tuff which is about 230 m thick. The tuff is underlain by about 110 m of the Tschicoma Formation that is interbedded with about 120 m of the Puye Formation (Fig. 3). Surface drainage from the location is into Two-Mile Canyon. Stream flow in the canyon is intermittent. The depth to the main aquifer is at about 370 m beneath the surface of the mesa.

2. Near TA-36

The location near TA-36 is at an altitude of about 2100 m near the center of the plateau. The surface of the mesa is capped with the Bandelier Tuff which is about 180 m thick (Fig. 3). The tuff is underlain by about 80 m of basalt resting on about 220 m of the Puye Formation. The top of the Tesuque Formation is at depth of about 480 m at the location.

Surface drainage at the location is into Potrillo Canyon to the southeast. The depth to the main aquifer is about 300 m below the surface of the mesa.

3. At TA-33

The location at TA-33 is at an altitude of 1960 m near the eastern edge of the plateau. The surface of the mesa is capped with about 80 m of Bandelier Tuff which is underlain by about 220 m of basalt and interbedded basalt breccias (Fig. 3).

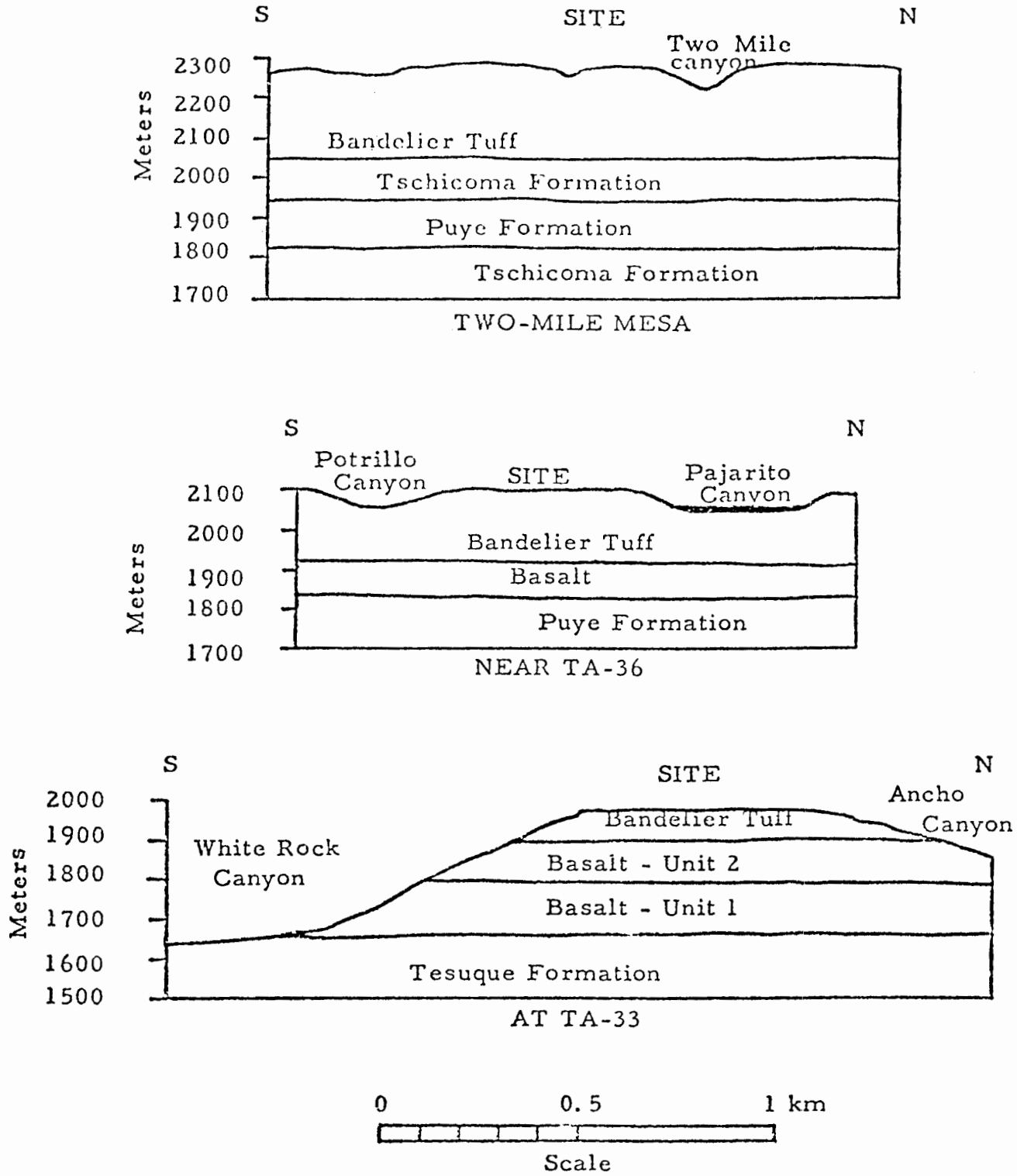


Fig. 3. Geologic sections at Two-Mile Mesa, Near TA-36 and at TA-33.

The Puye Formation is absent at this location. The top of the Tesuque Formation is about a depth of 300 m.

Surface drainage at the location is to the south into Chaquihui Canyon which drops precipitately to the Rio Grande. North of the location Ancho Canyon is cut deep into the eastern edge of the plateau.

Stream flow in Chaquihui Canyon is intermittent, however, several spring discharge from the main aquifer in the lower reach of the canyon. Stream flow in the lower reach of Ancho Canyon is perennial from the discharge from springs in the main aquifer. The main aquifer lies at a depth of about 300 m at the location probably in the lower part of the basalts or at the top of the Tesuque Formation.

C. Geologic Hazards

Geologic hazards considered at the three locations are seismic risk, surface displacement by faulting, landslide, and hydrologic considerations related to geology.

1. Seismic Risk.

The seismic risk for the Los Alamos Area is applicable for the three locations considered. The seismic risk was prepared on geological and seismological evidence. The two methods for evaluating the risks are different and results vary slightly , they are in an accpetable range.

The seismic risk based on geologic evidence relates the length of faults, displacement, and age of faulting. Evaluation

of data from the four faults it was concluded that the Los Alamos area may experience a shock of a magnitude of 5 during a period of 100 years.[3]

The seismic risk based on seismological data was restricted to shocks within 111 km of Los Alamos and included (1) non-instrumental reports of earthquake prior to 1962, and (2) instrumental studies of shocks from 1962 to 1972.

The strongest earthquake within the region of study during the 100 year period, 1872-1972, had a probable magnitude of 5.5. Estimates of the strongest shock to occur in the 100 year period based on extrapolation of earthquake frequency - magnitude relation ranged from 3.9 to 5.4 depending on data set used.

It was concluded that the seismic risk should be based on the reoccurrence of a magnitude 5.5 earthquake once every 100 years somewhere within the Rio Grande depression from Albuquerque to Questa. The seismicity of this part of the depression is (1) less than the Alququerque to Socorro segment of the same structure and (2) substantially less than equivalent areas in southern California.[4]

2. Surface Displacemtnt by Faults

Faults in the Los Alamos area trend north-south (Fig. 2). The faults displace the upper Tshirege Member of the Bandelier tuff which is 1.1 million years old.

The largest fault, the Pajarito Fault Zone lies about 2.6 km

to the west of the Two-Mile Mesa location. A smaller fault terminates in the Tshirege Member about 1.2 km to the southwest of the location. The fault apparently does not off set any ash flow units of the Tshirege Member on the north wall of Pajarito Canyon. There are no apparent lineations indicating extension of the fault through fracture or joint system into Mile-Mile Mesa. If the fault were projected northward on it's present trend it would pass 150 or 200 m west of the location as shown on Fig. 2.

There are no known faults at the locations near TA-36 or at TA-33.

3. Landslides

Landslides except for isolated rock falls from the canyon rim are an unlikely hazard at the three locations considered because of the rock characteristics and deep water table. The locations are at least 50 m from the canyon rims and this distance will allow for isolated rock falls as well as distribution of loads related to foundation design.

4. Hydrologic Consideration

The surface of the mesas at the three sites are well drained with no possibility of flooding by excessive precipitation.

Ground compaction due to the withdrawal of water from the main aquifer is not a significant geologic hazard. There has not been a significant lower of the water-table. The aquifer is of silty sandstone, sandstone and conglomerate and as such is not particularly susceptible to compaction when water is withdrawn.

D. Construction

The three locations are on the upper ashflow units of the Tshirege Member of the Bandelier Tuff. No foundation exploration has been made at the location; however, extrapolation of data from other sites near the location indicate the upper ashflows are of a moderately welded tuff. The porosity of a moderately welded tuff ranges from 30 to 55 percent by volume with a bulk density of 1150 to 1840 kg/m^3.

The moderately welded tuffs are easily excavated with heavy equipment. Foundation design should be no problem after engineering studies.

E. Contaminated - Waste Water

Contaminated waste water at the facilities will be collected through drain lines into a holding tank. The wastes in the tank will be removed as needed and treated at the liquid waste treatment plant.

The holding tank will be dug into the tuff. In case of rupture the wastes will drain into the underlying tuff.

The natural moisture content of a tuff underlying a soil on the plateau is generally less than 5 percent by volume. Pore space in the tuff is mainly capillary in size and at a low moisture below 10 percent by volume moisture will be distributed by diffusion and at a range from 10 to 24 percent the moisture will be redistributed mainly by capillarity and gravity. Above 24 percent the wastes will drain by gravity.

The loss of 1,800 m^3 of wastes over a period of a year from a rupture in the tank would allow wastes to move to a depth of about 60 m with

lobes of moisture in the tuff ranging from 20 to 28 percent immediately below the tank. Capillarity would extend the wastes outward to a radius of about 30 m. In time the wastes would reach equilibrium in the capillary size pores remaining suspended in the tuff. There would be no effect on the main aquifer that lies at depths ranging from 280 to 370 m at the locations.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : R. Jalbert, H-1

DATE: October 22, 1974

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : SECTIONS FOR THE FTR DESIGN REPORT

SYMBOL : H8-74-404

Enclosed are sections X.2, X.2.3, X.2.4, and X.4.8 for subject report. Section X.2.4 (Access and Security Aspects of the Site) is taken from site selection study and may need additional data.

WDP:dl
Enc.

X.2 Description of FTR Site

The FTR Site is on the western edge of the Pajarito Plateau adjacent to the flanks of the Sierra de los Valles. The area is at an elevation of about 7 600 feet and contains a heavy cover of pines. The slope of the area is 10 degrees or less eastward with a development of 1 to 3 feet of soil. In place the bedrock of tuff is exposed. The surface is cut by a few small channels that drain into Two-Mile Canyon.

X.2.3. Geologic and Hydrologic Description of the Site

Volcanic flow rock and sediments underly the site at the western edge of the plateau. A generalized section showing rock units and and their thickness is based on a test hole located about one mile to the northeast.

UNIT	THICKNESS (FEET)	DEPT (FEET)
Bandelier Tuff		
Tshirege Member	620	620
Otowi Member	215	835
Guaje Member	60	895
Tschicoma Formation	350	1 245
Puye Formation	390	1 635
Tschicoma Formation	270	1 905
Puye Formation	10	1 915
Tschicoma Formation	510+	2 425+

The Bandelier Tuff consists of three members: Tshirege, Otowi, and Guaje, from youngest to oldest. The Tshirege Member is composed of a series of nonwelded to welded ashflows of rhyolite tuffs. The flow underlying the site is a welded tuff. The Otowi Member is a nonwelded pumicious ashflow of rhyolite tuff while the Guaje Member is made up of an ashfall rhyolite pumice.

The Tschicoma Formation is composed of latite and quartz latite flows and pyroclastic rocks. The Puye Formation is composed of gravels and boulders of latite, quartz latite, rhyolite and pumice in a matrix of silt and sand.

The individual ashflow of the Bandelier Tuff dip gently eastward off the flank of the mountains formed by the Tschicoma Formation. As the tuff are volcanic in origin they are highly jointed due to the cooling. The Pajarito Fault is a north-south

trending fault that lies about 3 500 feet west of the site. It is a normal fault, down-thrown to the east. The displacement is estimated at 400 ft. The Water Canyon Fault also north-south trending terminates about 1 mile to the southeast of the site is also a normal fault with maximum displacement of 80 feet. The movement on both faults has been post-Bandelier.

Drainage from the site is into Two-Mile Canyon thence into Pajarito Canyon that is confluent to the Rio Grande. The stream in the Canyon is intermittent. The alluvium is thin but may contain small amounts of water seasonally. The water is perched on the underlying tuff. There is no water perched in the volcanic rocks and sediments above the main aquifer. The main aquifer of the Los Alamos Area is the only aquifer capable of municipal and industrial water supply. The top of the aquifer at the site lies at a depth of about 1 200 feet in the lower part of the Tschicoma Formation or upper part of the Puye Formation. The aquifer slopes gently eastward from the recharge area in the Jemez Mountains to the discharge area along the Rio Grande.

Los Alamos falls within seismic zone 2 of the Uniform Building Code. Seismic frequency, based on geologic evidence, historical data, and seismic records from instrumentation since 1962, indicate a recurrence interval of a magnitude 5.5 earthquake once every 100 years with the epicenters somewhere in the Rio Grande depression from Questa to Albuquerque, an area 50 miles north as well as 50 miles south of Los Alamos and 20 to 40 miles wide.

The Los Alamos area lies in the Rio Grande depression which was formed by a complex series of faults. The seismicity of this part of the depression is (1) less than the Albuquerque to Socorro segment of the same structure (of recorded earthquakes in New Mexico, 95%, occur in this segment) and (2) substantially less than equivalent areas in Southern California.

Other geological conditions, ground subsidence due to withdrawal of water, landslides and renewed volcanism, at the site have been considered. Ground subsidence is unlikely because of the already low ground water level and physical structure of the water-bearing levels. Landslides, excluding rock falls at the

canyon lip, do not occur because of the geological structure and dry condition of the mesa rock. There are indications that volcanic activity is decreasing. In the past 20 years fumaroles have ceased in activity and thermal springs have become cooler.

X.2.4 Access and Security Aspects of the Site

The site is located on the west edge of the present TA-3 area, and adjacent to the east side of State Road Loop 4. The site is located 0.76 miles from the Administration Building and 0.95 miles from the nearest Fire Station. Direct access to the site does not exist at the present time, necessitating the construction of a paved roadway across Two-Mile Canyon.

The site is located within a chain-link fenced area but is not a security area. A security fence will be required on the southside of the site to exclude technical areas which require security.

X.4.8 Land Usage and Despoilment

The site will use about 4 acres for the building and parking lot. It will require the removal of the trees and underbrush. The pine have not reached a stage for use as lumber. Consideration will be given to leave green belts where possible to enchance the aesthetics of the area and to promote recovery of vegetation.

Leveling of the site will remove excess top soil and tuff. Usable top soil will be stockpiled for rehabilitation of the area around the buildings. The tuff will be used in construction of the access road across Two-Mile Canyon.

The urbanization due to construction of the site will increase the surface runoff in to Two-Mile Canyon. Surface drainage will be maintained during and at completion of construction to minimize erosion in the area and transport of sediments into the canyon.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Wayne Hanson

DATE: October 23, 1974

FROM : W. D. Purtymun

SUBJECT : STORM RUNOFF MORTANDAD CANYON

SYMBOL : H8-74-380

Hydrologic investigations have been made in Mortandad Canyon since 1960. Two gaging stations (GS-1 and GS-2, attached map) were established in the canyon in 1962. Records from GS-1 are from 1962 to present and from GS-2 from 1962 to 1965.

There has been no runoff out of the canyon disposal area to the county line since hydrologic observation began in 1960. The canyon heads on the Pajarito Plateau and has a small drainage area. Total drainage area west of the county line is about 1.8 sq mi with 0.5 sq mi above GS-1, and an additional 0.8 sq mi from GS-1 to Obs. Hole MCO-8. Observations indicate that most, if not all, surface runoff into the canyon occurs in the 1.3 sq miles west of Obs. Hole MCO-8. The canyons contributing runoff are Mortandad (CMR Complex) Effluent, and Ten-Site canyon. East of MCO-8, the remaining 0.5 sq mi are relatively flat with no major or minor canyons entering from adjacent mesas.

The stream channel east of MCO-6 braids out on the canyon floor as the canyon begins to widen and alluvium thickens. The small drainage area with thick sections of unsaturated alluvium allows rapid infiltration of storm runoff to date.

As the channel is not well defined in the lower section of the canyon, the method for flood-frequency and maximum discharge analyses as discribed by Scott is not applicable. However, as the channel is well defined west of MCO-6, the flood-frequency and maximum discharge was computed at GS-1. The drainage area is 0.5 sq mi with a mean channel slope of 153 ft/mi.

Gaging Station 1

Frequency	Max. Discharge (cfs)
2-year	40
5-year	120
10-year	190
25-year	420
50-year	430

The maximum discharge during the period 1962 through October 11, 1974 was estimated to be about 80 cfs in which 9.2 ac-ft of water passed through the gaging station. This occurred on July 31, 1968 and caused flooding in the canyon which ended

between MCO-10 and MCO-12. The runoff did not reach the county line. The events predicted by use of Scott's method for the 12 years of record appear high.

Three of the larger events for 1974 are listed below. These events did not reach the county line.

Date	Max. Discharge (cfs)
8/5/74	10.5
8/17/74	55
10/11/74	15.4

The increased construction in the area (TA-35, TA-55) will increase the storm runoff into the canyon. At a maximum discharge of 100 to 120 cfs at GS-1, the flood flow will probably reach the county line and move on to Indian land. Channel conditions and characteristics east of the county line are unknown.

Surface flow in the canyon recharges a small body of water in the alluvium that is perched on the underlying tuff. This water body extends from the effluent outfall at TA-50 (400 ft west of GS-1) to east of Obs. Hole MCO-8. The depth to water in the alluvium ranges from near land-surface at GS-1 and MCS-3.8 to about 12 ft at MCO-4 and becomes progressively deeper to about 80 ft at MCO-8. East of MCO-8 to the county line the alluvium is dry.

The use of a dam to prevent transport of radionuclides out of the disposal area by storm runoff could couse additional problems. The radionuclides in the dry reservoir basin would be subject to resuspension by wind. The failure of the structure would release a larger crest than normal runoff. This would disperse radionuclides over a larger area beyond the county line as well as create severe erosion and possible damage to the bridge on State Road 4.

A method to prevent runoff out of the canyon and to fix radionuclides in the disposal area would be to construct infiltration shafts in the channel east of MCO-6 and MCO-8. The shafts, 3-ft in diameter and 30-ft deep, would be dug into unsaturated alluvium and would be completed above the water in the alluvium west of MCO-8. The shafts must be filled with gravel to prevent collapse.

The alluvium in the upper 30 ft is reworked material with a conductivity of about 450 ft/day. A 3-ft dia -- 30-ft deep shaft would allow infiltration at the rate of 5 cfs one minute after flow begins and would decline to about 1.5 cfs at the end of

15 min. Twelve shafts in the channel would have the total capacity to reduce the flood crest some 60 cfs; however, as the shafts will be strung out downgradient, the capacity will be slightly greater. Continued infiltration during the event will reduce the "tail off" (decline from crest) which has a tendency to move further down the canyon than the crest of the event.

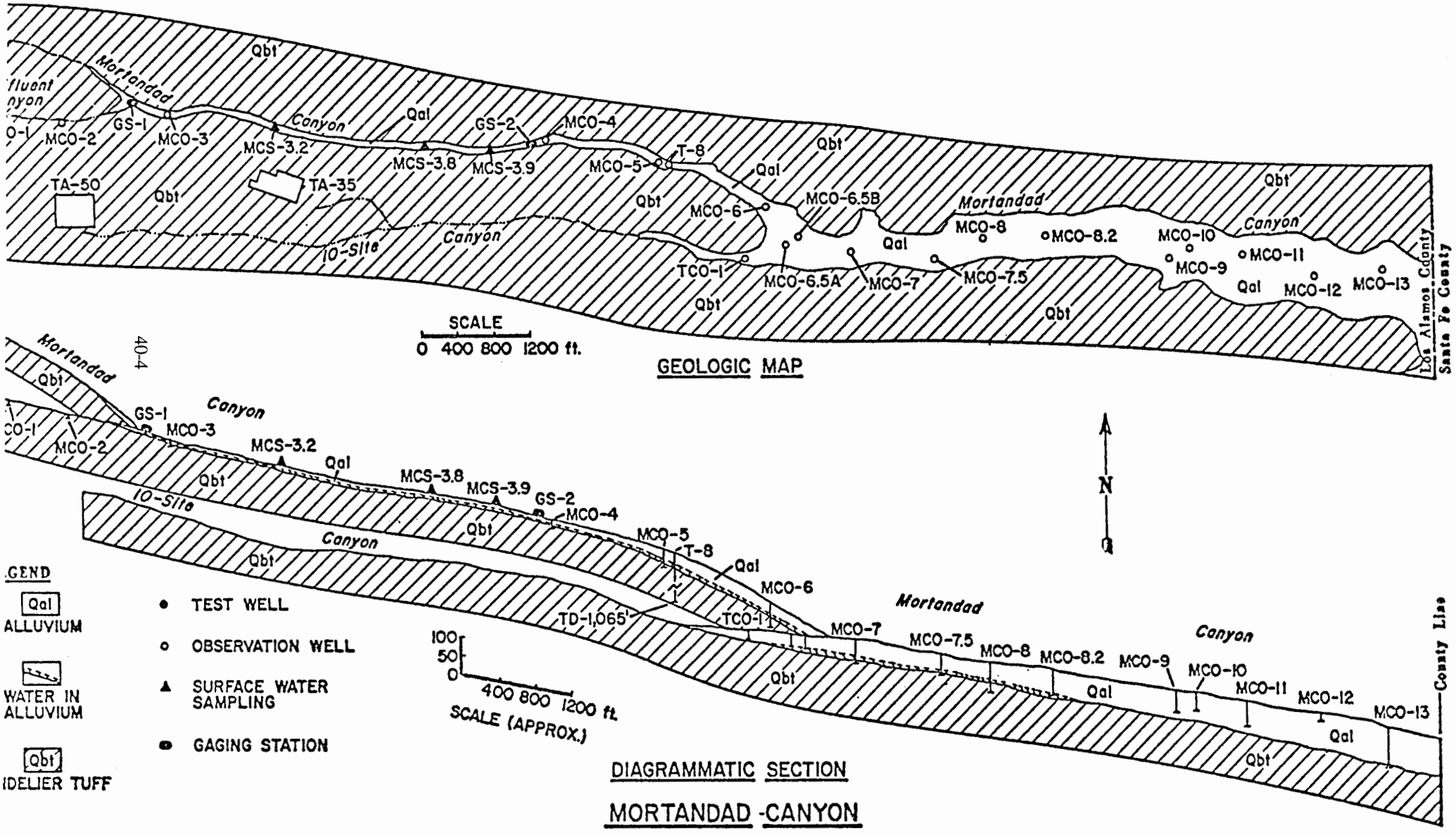
The shafts spacing will allow infiltration of water into the alluvium over a wide section of the canyon. The volume of unsaturated alluvium east of MCO-6 will absorb all infiltration of water from the shafts causing no problem with transport of radionuclides by water in the alluvium past the county line.

There will be considerable transport of suspended and bed load sediments with the storm runoff. These sediments will decrease the infiltration rates of the shafts; however, location of most of the shafts in the lower section of the canyon will result in possible use of the shafts three or four times in the next 10 years.

The estimated cost of the three ft dia, 30 ft deep shafts filled with gravel are about $665 each. The twelve shafts needed would cost ≈ $8000.

If the shaft method is used, it is planned to use three of the twelve shafts between MCO-6 and MCO-7 for a study to monitor the infiltration rate, movement of water and radionuclides in the unsaturated alluvium, the effect of sediments on infiltration rates and volume of runoff handled by the three shafts under different runoff events.

WDP:lmh


Mortandad
Canyon
Qbt
Qal
GS-1
MCO-2
MCO-3
MCS-3.2
MCS-3.8
MCS-3.9
GS-2
MCO-4
MCO-5
T-8
MCO-6
MCO-6.5B
MCO-6.5A
MCO-7
MCO-7.5
MCO-8
MCO-8.2
MCO-9
MCO-10
MCO-11
MCO-12
MCO-13
TCO-1
TA-50
TA-35
10-Site
Los Alamos County
Santa Fe County
SCALE
0 400 800 1200 ft.
GEOLOGIC MAP
N
TD-1,065'
County Line
100
50
0
400 800 1200 ft.
SCALE (APPROX.)
LEGEND
Qal
ALLUVIUM
WATER IN ALLUVIUM
Qbt
BANDELIER TUFF
TEST WELL
OBSERVATION WELL
SURFACE WATER SAMPLING
GAGING STATION
DIAGRAMMATIC SECTION
MORTANDAD CANYON

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Wayne Hanson

DATE: October 25, 1974

FROM : W. D. Purtymun WDP

SUBJECT : INFILTRATION SHAFTS AND SEDIMENT TRAPS, MORTANDAD CANYON

SYMBOL : H8-74-410

I wish to revise Memo H8-74-300 in regard to construction of flood control structures in the canyon.

Six-ft dia shafts about 20 ft deep will be more effective for infiltration of storm runoff than the 3-ft dia shafts. In view of the large volume of channel bed load carried in the runoff, sediment traps will be necessary to prevent excessive sedimentation in the shafts.

Shafts and Sediment Traps

Nine (9) shafts - 6 ft dia - 20 ft deep filled with washed gravel (Not base coarse).

Two (2) sediment traps, 10 ft wide, 100 ft long, dug to a depth of 6 ft below the stream channel. Side rounded and smoothed off to prevent walls from sluffing. Channel entrance and exit riprap at channel level. It may be advisable to construct two (2) cross-cuts (at right angles) across the traps about 50 ft in length, 20 and 60 ft from channel entrace. These would increase capacity of the traps and serve as clean-out areas when trap is partially filled.

The alluvium in the canyon is quite friable and unconsolidated. It will easily removed by the bucket-auger, and heavy equipment. The width of traps can be adjusted to type of equipment used in excavation.

WDP:lmh

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : LaMar J. Johnson, H8 Group Leader DATE: November 14, 1974

FROM : W. D. Purtymun, H8 - T.L.M.

SUBJECT : INVENTORY AND MOVEMENT OF PLUTONIUM IN ACID-PUEBLO, DP-LOS ALAMOS, AND MORTANDAD CANYON

SYMBOL : H8-74-424

The inventory is based on (1) mass of sediments in a section of the channel, and (2) the average concentration of Pu in sediments in that section. This method of inventory leaves a lot to be desired, but considering the limited data it appears to be the best method at this time.

The mass of sediments is compiled from channel width, length of section, a thickness of 0.15 m, and a specific gravity of 1.57. The physical characteristics of the sections considered in each canyon is presented on Table I.

The mass of the sediments and concentration of Pu were used to compute the amount of Pu in the section. The concentrations at the stations considered and average concentrations are presented in Table II. Location of stations and sections are shown on Figures 1, 2 and 3.

The annual amounts of Pu released from the Treatment Plants into the canyon were compiled from records furnished by H-7. The estimate from the TA-45 Plant 1943-1950 was taken from LA-5282-MS. In general there was good agreement in the amounts derived from H-7 records and the LA-5282-MS tabulation of Pu released.

The inventory in the canyon used data collected in 1968, 1970, and 1972. Pu analyses for 1973 have not been completed. The 1972 data utilizes tabulations from the Ecology Section.

Pu in the waste when released is adsorbed or retained with the finer material in the channel alluvium. The concentrations of Pu tend to buildup at the point of effluent discharge in the channel during the fall through the spring. This large concentration is reduced by transport during storm runoff, especially the heavy summer showers.

The fine particle in the alluvium in the channel have the greater affinity for the Pu; however, most of the Pu is in the coarser alluvium as it is more abundant. The finer sediments in the alluvium are carried out of the canyons (Acid-Pueblo and DP-Los Alamos) as suspended sediments with the storm runoff,

while the larger materials are being transported as bed material. The bed material lags behind, moving short distances with each succeeding runoff event.

Storm runoff reaches the Rio Grande from Acid-Pueblo and DP-Los Alamos Canyons. There has been no runoff in the drainage area of Mortandad Canyon to the Laboratory boundary (Santa Fe-Los Alamos County Line) since hydrologic investigation began in the canyon in 1960. This is due to the small drainage area and the thickness of unsaturated alluvium in the canyon.

The Pu inventories in the canyons is presented in the following sections.

I. Acid-Pueblo Canyon

	Total Plutonium (mCi)	
	Feb.	Oct.
Section (m)	1970	1972
0- 480	4.6	2.4
480- 2 600	8.7	4.3
2 600- 6 800	2.3	2.3
6 800-10 280	2.5	2.6
Total	18.1	11.6

The inventory in Acid-Pueblo Canyon indicates that from the outfall to the confluence with Los Alamos Canyon, in February, 1970 only 18.1 or 11% of the 170 mCi of Pu released into the canyon remains in the sediments. In October, 1972, only 11.6 mCi or 7% remained of the 170 mCi. The largest change occur in the upper sections of the canyon (0- 2600 m) which contain the greatest amounts of Pu. The amounts in the lower section (2600 to 10 280 m) appear to be somewhat in equilibrium, with the input transport equal to output. For the two years of data the transport is about 3.25 mCi per year.

The average Pu concentration in the sediments in each section of the canyon for 1970 and 1972 is presented in Figure 4.

II. DP-Los Alamos Canyon

	Total Plutonium (mCi)				
	May	July	Aug.	Feb.	Oct.
Section (m)	1968	1968	1968	1970	1972
0-1 800	3.9	-	.4	4.6	3.2
1 800-6 600	1.1	0.4	1.1	1.1	.5
	5.0	-	1.5	5.7	3.7

The inventory in DP-Los Alamos Canyon for 1968 reflects the transport by storm runoff. The May concentration is buildup from fall through spring. These concentrations decrease through August as the material containing Pu moves out into Los Alamos Canyon with summer runoff. The channel in this reach (0-1800) has a very thin alluvium cover and a steep gradient. Runoff is above normal due to the developed area. In the lower reach (May, 1968, February, 1970 and October, 1972), the transport appears to have equalized, with input equal to output.

The inventory in the canyon in May, 1968, indicates that from the outfall to the confluence with Pueblo only 5.0 mCi or 21% of the 24.1 mCi (1952-1967) released remains in the Canyon. In August, only 1.5 m/Ci or 6% of the 24.1 mCi remained. Transport out of this reach of the canyon by storm runoff for the year was about 3.5 mCi. In February, 1970 about 5.7 mCi or 21% of the 27.3 mCi (1952-1969) of Pu remained in this reach. The October 1972 sampling indicated about 3.7 mCi or 8% of 30.8 mCi (1952-1972) remained in the canyon.

The average Pu concentration in the sections of the canyon is presented on Figure 5.

III. Los Alamos Canyon from Junction with Pueblo to Rio Grande

	Total Plutonium (mCi)		
Section (m)	May 1968	Aug. 1968	Feb. 1970
0-4 800	1.6	1.0	2.0
4 800-7 200	1.0	< .02	1.1
Total	2.6	~1.0	3.1

The inventory in Los Alamos Canyon from the confluence of Pueblo to the Rio Grande in May 1968 was 2.6 mCi which decreased to ~1.0 in August with the transport of Pu with summer runoff.

The inventory of February 1970, combining both DP-Los Alamos (5.7 mCi) and Acid-Pueblo (18.1 mCi) and below the confluence (3.1 mCi), indicates a total of 26.9 mCi of Pu in the three separate reaches ~14% of the amounts released into DP-Los Alamos (27.3 mCi, 1952-1969) and Acid-Pueblo (170 mCi, 1943-1964). If one considers the inventory in each of the three segments of the three canyons or combinations of segments and assumes all Pu is tied up in the sediments, the loss of Pu or transport to the Rio Grande is about 80 to 90% of all Pu released from the treatment plants.

TO: LaMar J. Johnson
H8 Group Leader

DATE: November 14, 1974

IV. Mortandad Canyon

Section	Total Plutonium (mCi) Feb. 1970	Total Plutonium (mCi) Oct. 1972
0-1 460	15.8	28.2
1 460-3 040	1.5	5.1
Total	17.0	33.3

The inventory in Mortandad Canyon for February 1970 shows about 17.0 mCi of Pu in the reach from 0 to 3 040 m. The total release from 1963 through 1969 was 21.9 mCi. The remaining 4.9 mCi has been carried past MCO-8 by storm runoff, but not to MCO-12 where the sediments contained only background amounts of Pu. The inventory in October, 1972 shows about 33.3 mCi of Pu in the reach from 0-3 040 m. The release during the period 1964 to 1972 was 42.1 mCi. The remaining 8.8 mCi were carried east of MCO-8 by storm runoff but not to MCO-12.

The average Pu concentration in sediments in the canyon is presented on Figure 6.

The 30.4 mCi of Pu in the sediments of Mortandad Canyon represents the largest amounts available for transport by storm runoff. Due to the small drainage area and thickness of unsaturated alluvium runoff in the canyon has not reached the county line; however, the development and construction at TA-35 and TA-55 will increase the runoff into the Canyon. This increase may be sufficient to transport the Pu to the County line or into Indian land. Attached as an appendix are three memos dealing with storm runoff, infiltration shafts and sediment traps, and infiltration shafts for flood reduction in Mortandad Canyon.

WDP:dl
Enc.

xc: Wayne C. Hanson, H8
Tom Hakonson, H8
Jack Nyhan, H8

TABLE I

Physical Characteristics of Channels

A. Acid Pueblo Canyon

1. 0 to 480 m (Acid Canyon)
   Width 1.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 170 x 10^6g

2. 480 m to 2 600 m
   Width 2.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 1 790 x 10^6g

3. 2 600 m to 6 800 m
   Width 3 m Depth 0.15 m
   Sp. g. 1.57 Weight 2 967 x 10^6g

4. 6 800 m to 10 280 m (Confluence)
   Width 4 m Depth 0.15 m
   Sp. g. 1.57 Weight 3 278 x 10^6g

B. DP-Los Alamos Canyon

1. 0 to 1 800 m
   Width 1.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 459 x 10^6g

2. 1 800 m to 6 600 m
   Width 2.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 2 832 x 10^6g

C. Confluence Pueblo-Los Alamos to Rio Grande

1. Confluence to 4 800 m
   Width 3 m Depth 0.15 m
   Sp. g. 1.57 Weight 3 408 x 10^6g

2. 4 800 m to 7 2 00 m (Rio Grande)
   Width 4 m Depth 0.15 m
   Sp. g. 1.57 Weight 2 261 x 10^6g

D. Mortandad Canyon

1. 0 to 1 460 m
   Width 1 m Depth 0.15 m
   Sp. g. 1.57 Weight 344 x 10^6g

2. 1 460 m to 3 040 m
   Width 2 m Depth 0.15 m
   Sp. g. 1.57 Weight 744 x 10^6g

TABLE II

Computations Showing Concentrations and Amounts of Pu in Sections of the Canyon

A. Acid-Pueblo Canyon (February, 1970)

Section	Station	Concentration pCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 480	AC4	29.1			
	Acid Weir	24.8	27.0	4.6	25
480- 2 600	PC-2	4.98			
	PC-5	4.71	4.84	8.7	48
2 600- 6 800	PC-7	1.15			
	PC-9	.398	.775	2.3	13
6 800-10 280	PC-9	.398			
	SR-4	1.14	.770	2.5	14
TOTAL		-	-	18.1	100

B. Acid-Pueblo Canyon (October, 1972)[1/]

Section	Station	Concentration pCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 480	AP-1	2.5			
	AP-2	2.3			
	AP-3	6.9			
	AP-4	50			
	AP-5	13			
	AP-6	12			
	AP-7	11	14.0	2.4	21
480- 2 600	AP-8	2.1			
	PC-5	2.6	2.4	4.3	37
2 600- 6 800	AP-9	.36			
	AP-10	1.2	.78	2.3	20
6 800-10 280	AP-10	1.2			
	SR-4	.37	.78	2.6	22
TOTAL		-	-	11.6	100

1/ AP-Series Stations Ecology Section

C. DP-Los Alamos Canyon (May, 1968)

Section	Station	Concentration pCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 1 800	DPS-1	16.20			
	DPS-4	.84	8.5	3.9	78
1 800- 6 600	LAS-3	.65			
	LAS-5	.15	.40	1.1	22
TOTAL		-	-	5.0	100

D. Los Alamos Canyon (July, 1968)

Section	Station	Concentration µCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
1 800- 6 600	LAS-2	4.39			
	LAS-3	.72			
	LAS-4	.68			
	LAS-5	.22	1.5	0.4	-
TOTAL		-	-	0.4	-

E. DP-Los Alamos Canyon (August, 1968)

Section	Station	Concentration µCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 1 800	DPS-1	0.41			
	DPS-2	1.44			
	DPS-3	.91			
	DPS-4	.88	0.91	.4	27
1 800- 6 600	LAS-2	.60			
	LAS-3	.37			
	LAS-4	.30			
	LAS-5	.23	.38	1.1	73
TOTAL		-	-	1.5	100

F. DP-Los Alamos Canyon (February, 1970)

Section	Station	Concentration µCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 1 800	DPS-1	18.4			
	DPS-4	1.62	10.1	4.6	81
1 800- 6 600	LAS-2	.198			
	LAS-3	.156			
	LAS-4	.396			
	LAS-5	.848	~~4.0~~ 0.4	1.1	19
TOTAL		-	-	5.7	100

G. DP-Los Alamos Canyon (October, 1972)[1/]

Section	Station	Concentration µCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 1 800	DP-5	0.76			
	DP-6	19			
	DP-7	.93	6.9	3.2	86
1 800- 6 600	DP-9	.20			
	DP-10	.30			
	SR-4	.01	.17	.5	14
TOTAL		-	-	3.7	100

1/ DP Series Ecology Section

H. Los Alamos Canyon [Confluence LA-Pueblo To Rio Grande] (May, 1968)

Section	Station	Concentration µCi/g	Ave.	Total Pu mCi	% of Total Pu
Confluence-	LAS-6	.62			
4 800	LAS-8	.34	.48	1.6	62
4 800- 7 200	LAS-8	.34			
	LAS-9	.24	.29	1.0	38
TOTAL		-	-	2.6	100

I. Los Alamos Canyon [Confluence LA-Pueblo to Rio Grande], (August, 1968)

Section	Station	Concentration µCi/g	Ave.	Total Pu mCi	% of Total Pu
Confluence-	LAS-6	.53			
4 800	LAS-8	.02	.28	1.0	100
4 800- 7 200	LAS-8	.02			
	LAS-9	<.01	.01	<.02	-
TOTAL		-	-	≃1.0	100

J. Los Alamos Canyon [Confluence LA-Pueblo to Rio Grande] (February, 1970)

Section	Station	Concentration µCi/g	Ave.	Total Pu mCi	% of Total Pu
Confluence-	LAS-6	.860			
4 800	LAS-7	.338	.60	2.0	65
4 800- 7 200	LAS-8	.591			
	LAS-9	.364	.48	1.1	35
TOTAL		-	-	3.1	100

K. Mortandad Canyon (February, 1970)

Section	Station	Concentration µCi/g	Ave.	Total Pu mCi	% of Total Pu
0- 1 460	GS-1	87.9			
	MCS-3.8	3.8	45.8	15.8	93
1 460- 3 040	MCO-5	2.8			
	MCO-7	.40	1.6	1.2	7
TOTAL		-	-	17.0	100

L. Mortandad Canyon (October, 1972)

Section	Station	Concentration µCi/g	Concentration Ave.	Total Pu mCi	% of Total Pu
0- 1 460	M-1	223			
	M-2	117			
	M-3	91			
	M-4	48			
	M-5	124			
	M-6	24			
	M-7	21			
	M-8	9.1	82	28.2	85
1 460- 3 040	MCO-5	2.8			
	M-9	11	6.9	5.1	15
TOTAL		-	-	33.3	100

TABLE III

Annual Amounts of Plutonium Released From Waste Treatment Plants

Year	Millicuries		
	Acid-Pueblo	DP-Los Alamos	Mortandad
1943-1950	143	-	-
1951	1.3	-	-
1952	1.1	.3	-
1953	1.2	1.1	-
1954	2.2	1.0	-
1955	2.2	.9	-
1956	1.0	.8	-
1957	.9	1.0	-
1958	.9	.6	-
1959	1.2	.8	-
1960	2.6	1.7	-
1961	5.2	5.4	-
1962	3.9	2.9	-
1963	3.0	2.2	1.6
1964	.04	1.1	1.9
1965	-	1.0	3.5
1966	-	.9	1.6
1967	-	2.4	4.2
1968	-	1.6	2.6
1969	-	1.6	6.5
1970	-	1.5	5.0
1971	-	.7	6.8
1972	-	1.3	8.4
	170	30.8	42.1

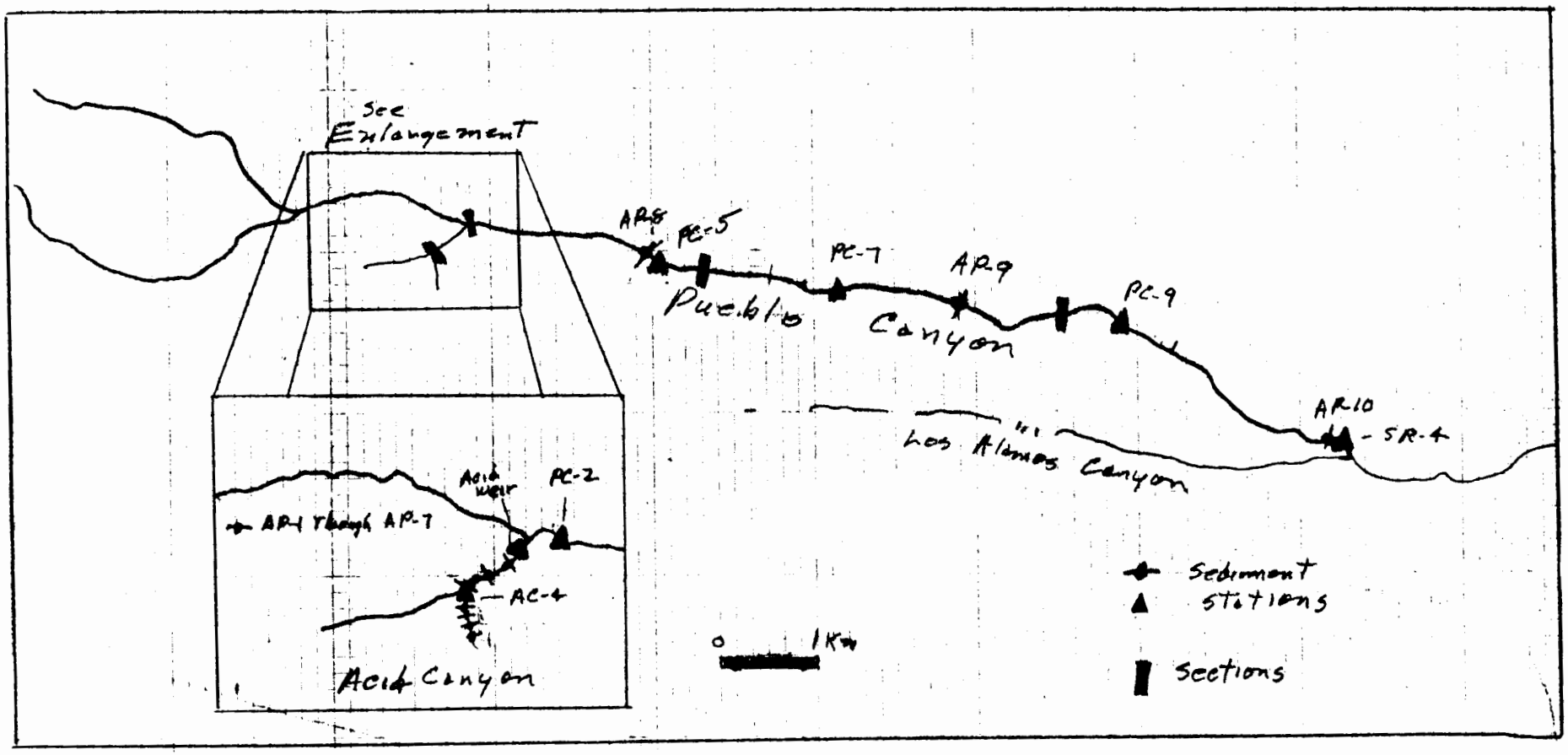
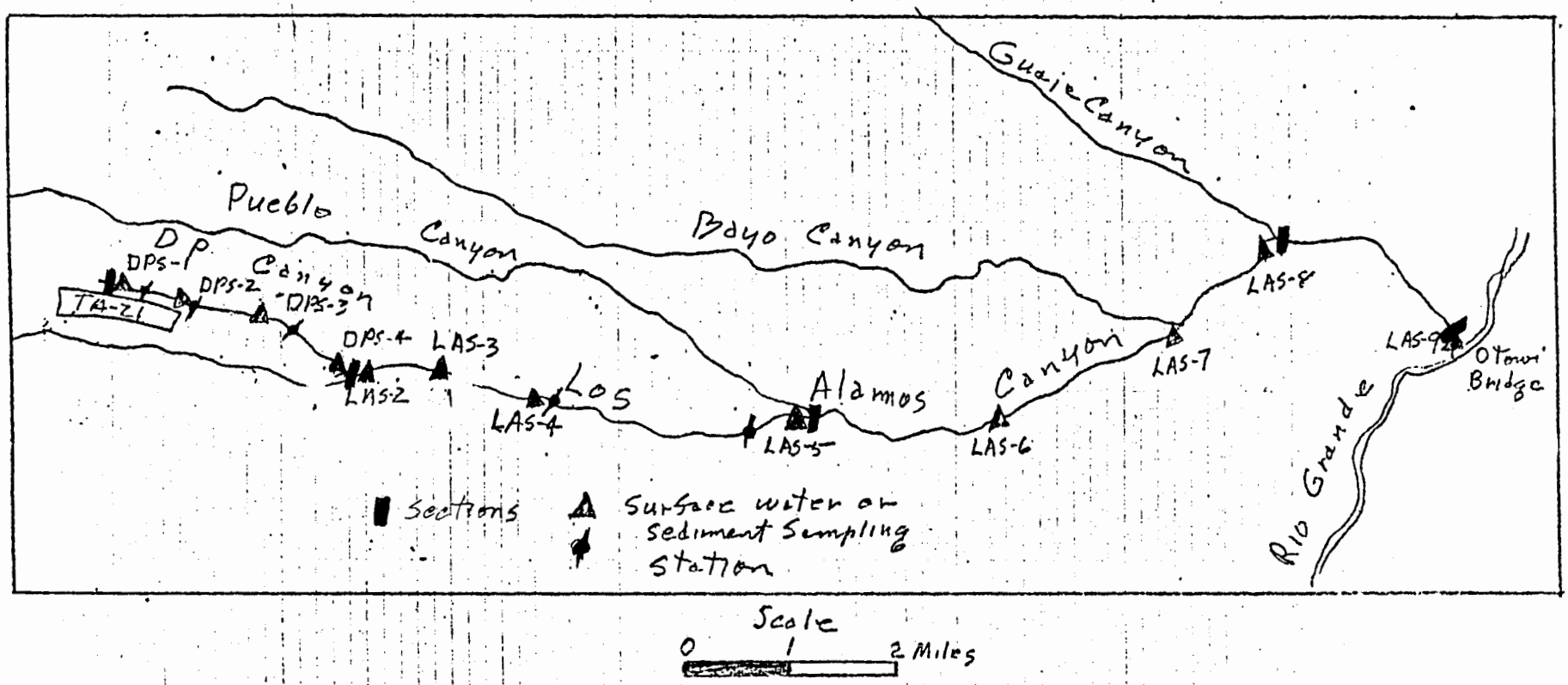


Figure 1.- Sampling stations and sections in Acid - Pueblo Canyon



Scale
0 1 2 Miles

Figure 2.-- Sampling stations and sections in Los Alamos Canyon

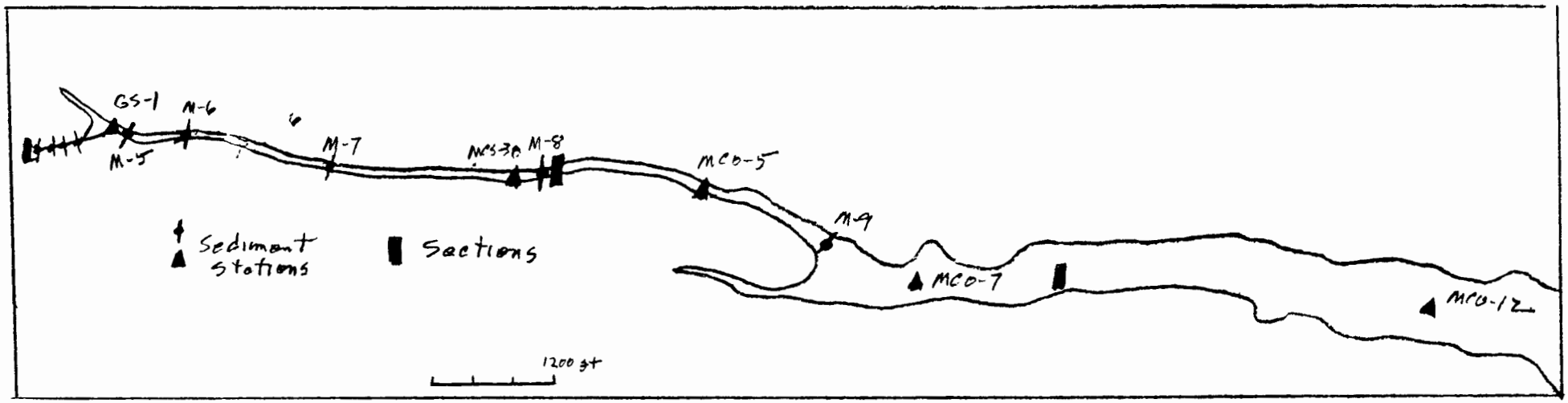


Figure 3 - Sampling stations and section in Montandon Canyon.

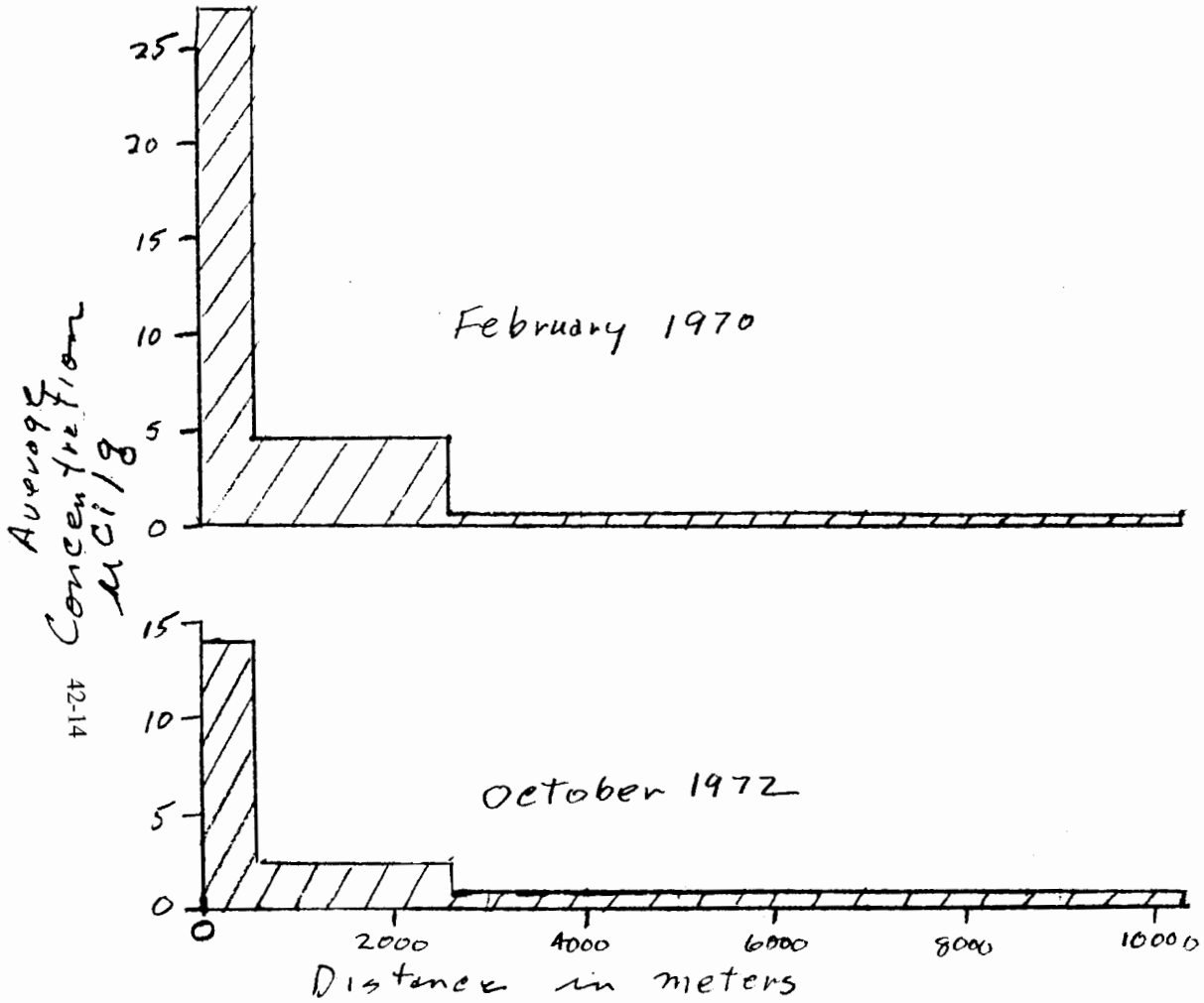


Figure 4.- Average Sediment Concentration in each section of Acid-Pueblo Canyon, 1970 and 1972.

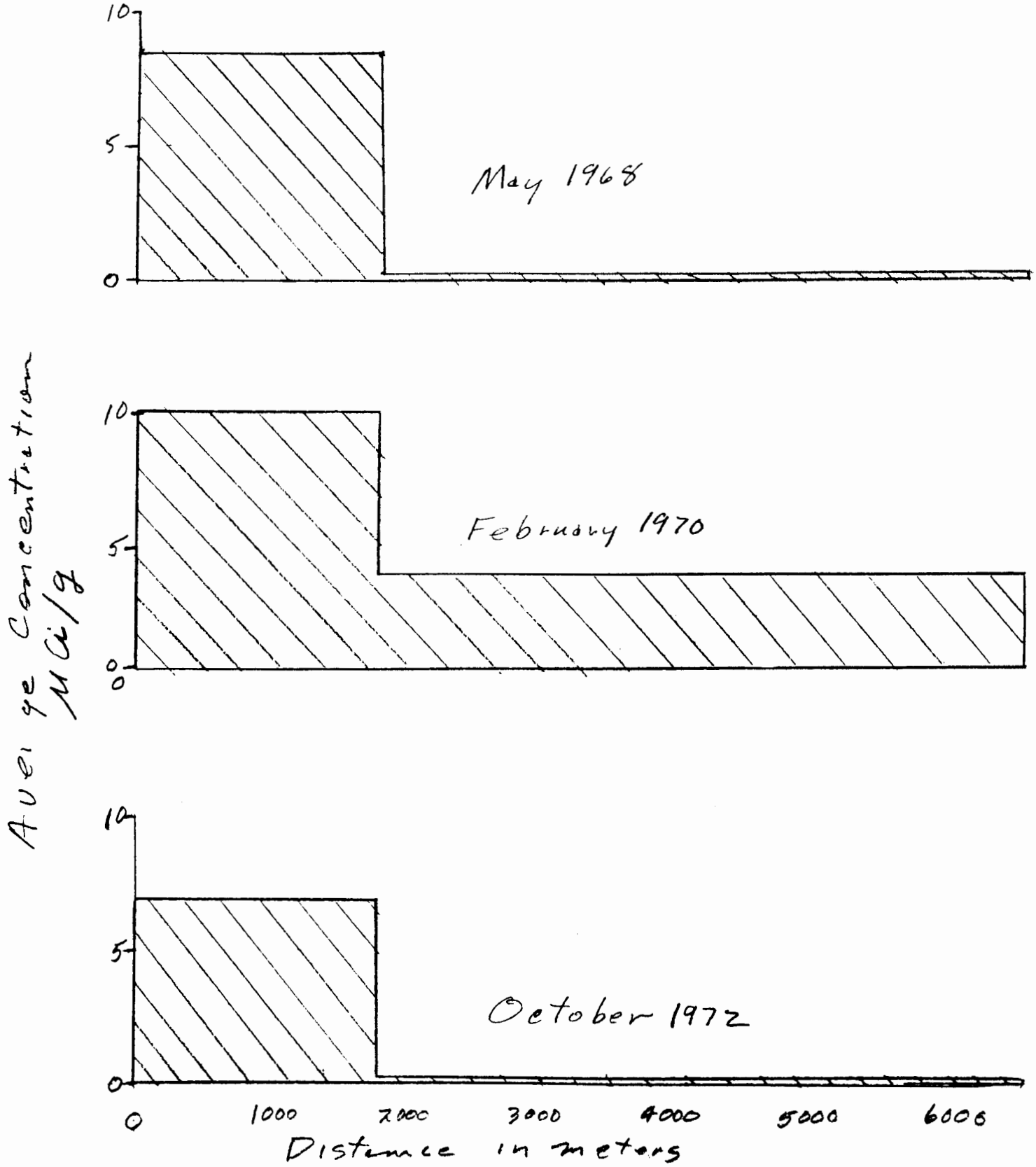


Figure 5.– Average Pu Sediment Concentrations in each section of DP-Los Alamos Canyon 1968, 1970, and 1972

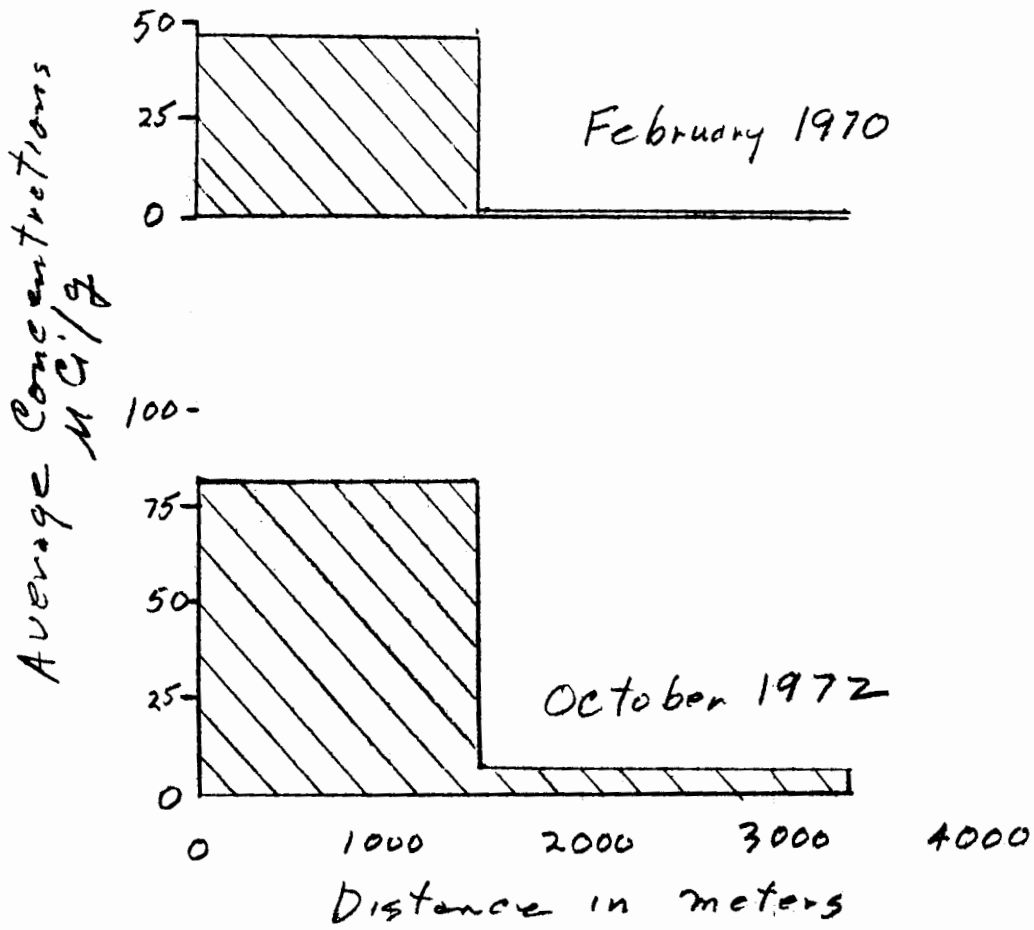


Figure 6.– Average Pu Concentration in sediments in sections of Montenedd Canyon, 1970 and 1972

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OFFICE MEMORANDUM

TO : LaMar J. Johnson, H8 Group Leader

DATE: December 3, 1974

FROM : W. D. Purtymun, H-8 T. E. Hakonson, H-8

SUBJECT : INVENTORY AND MOVEMENT OF PLUTONIUM IN ACID-PUEBLO, DP-LOS ALAMOS, AND MORTANDAD CANYON

SYMBOL : H8-74-430

Introduction

The purpose of this report is to document current knowledge on the amounts of 137Cs and Pu which the Laboratory released into Acid-Pueblo, DP-Los Alamos and Mortandad Canyons over the last 31 years and to present our estimates of residual inventories of these materials, based on sediment radionuclide concentrations. It must be recognized that the information presented herein is not definitive but may be modified as further data become available. Some of the assumptions made in estimating radionuclide release and inventory are arguable; however, they represent a best estimate based on our combined field experience in the canyons themselves.

Radionuclide Input

The three canyons used as liquid waste disposal areas have received contaminated wastes for varying lengths of time. Acid-Pueblo Canyon was used for a period of 20 years during 1944-1964 but has not been used for at least 9 years. The DP Canyon area is one which has been used for about 20 years and still receives discharges from TA-21. It is expected, however, that use of this canyon for disposal of plutonium wastes will be eliminated within the next few years when a new Plutonium Research Facility becomes operational. Mortandad Canyon has been used for about 10 years as the disposal area for wastes from the TA-50 plant.

This plant processes industrial wastes from the major portion of the Laboratory.

It is evident from data which are presented later and from discussions with the few personnel (Dean Meyer, Jim Sattizan) who were here when Laboratory operations began, that ^{3}H, ^{137}Cs, ^{238}Pu, ^{241}Am, $^{89-90}Sr$, and ^{235}U were discharged into some or all of the liquid waste disposal areas. Unfortunately, the lack of comprehensive records on the radionuclide content of treated effluent (with the exception of plutonium) was not maintained until just recently. Therefore, it was impossible to estimate the quantities of these radionuclides which were released to the canyon areas. Sufficient data were available to crudely estimate plutonium input to the canyons by utilizing gross alpha activity measurements on the treated effluent. All the alpha activity in the effluent was assumed to be ^{239}Pu; consequently the estimated input to the canyons was in terms of ^{239}Pu "equivalents". In reality the "Pu" in liquid effluents released to DP and Mortandad Canyons after 1959 consisted of a mixture of ^{238}Pu and ^{239}Pu. Recent analyses for ^{238}Pu and ^{239}Pu in liquid effluents indicate that about 50% of the Pu in DP Canyon effluents is ^{239}Pu while over 90% of the Pu in Mortandad Canyon effluents is ^{238}Pu.

Records on the amounts of ^{239}Pu in the untreated effluent from TA-1 were not maintained during the 1944-1950 period. Consequently, estimates of additions of this radionuclide into AP Canyon are without a quantitative basis. A crude estimate was made by assuming that the amount of ^{239}Pu in the effluent increased linearly through the 1944-1950 time period. The first year that complete records were available (1952), pretreatment liquid effluents designated for disposal in AP Canyon contained 45 mCi Pu.

A linear extrapolation from 45 mCi Pu released in 1952 to 0 released in 1943 (a year prior to plutonium processing) followed by numerical integration resulted in an estimated plutonium input of about 143 mCi into AP Canyon (Table 1). Robeck (TID-460), utilizing some data on the Pu content of TA-1 effluent, estimated that as much as 63 mCi Pu was released to Acid-Pueblo Canyon during 1949 whereas our estimate (i.e. based on the linear extrapolation) was about 20 mCi during that year. The descrepancy between the two values demonstrates the need for caution in applying the value of 143 mCi. The actual value may be higher as evidenced by Robecks paper, or it may be lower, as Group H-7 contends.

During the 13.5 year period when the TA-45 plant was operational (1951-1964), an additional 27 mCi was released into AP Canyon which brings the total estimated additions to 170 mCi Pu.

The TA-21 facility which became operational in 1952 has released an estimated 32 mCi Pu to DP Canyon through 1973 (Table 1). The possibility exists that prior to 1952, additional Pu (and other radionuclides) seeped into DP-Los Alamos Canyon from disposal pits and drains located on the adjacent mesa. Elevated Pu concentrations were measured in Los Alamos Canyon water and soils as early as 1946 (Kingsley, LA-516). There is no way of assessing the quantities of radioactivity involved.

The TA-50 waste treatment facility became operational in 1964 and as of 1973 had released an estimated 51 mCi Pu to Mortandad Canyon (Table 1). The input of Pu to this canyon is expected to increase after the new Plutonium Research Facility becomes operational.

As mentioned previously, ^{137}Cs release to the canyons could not be estimated due to a lack of records.

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Inventory Model

The radionuclide inventory estimates presented in this memo were calculated from the following equations:

$$I = (C)\ (L)\ (W)\ (D)\ (S) \qquad (1)$$

where,

I = calculated inventory (mCi) for segment L
C = average radionuclide concentrations (mCi/g) in sediments.
L = length of stream channel segment (meter) over which C applied.
W = average width (meters) of stream
D = depth (meters) of sediment to which C applied.
S = specific gravity (g/m^3) of sediment.

D was taken as 0.15 m and S as 1.57×10^6 g/m^3. The total inventory (TI) was;

$$TI = \sum_{1}^{n} I$$

Where n equals the number of individual stream channel segments considered in each canyon.

The errors associated with the model ~~is~~ are obviously of the same order as those associated with the input data. The radionuclide concentration data ~~is~~ are likely the largest source of error in the inventory estimates for both Pu and ^{137}Cs. The coefficient of variation ($\frac{S.\ D.}{mean} \times 100$) for triplicate samples averaged about 80 percent for Pu and 40 percent for ^{137}Cs.

Model Input

The Pu and ^{137}Cs data used in equation I are presented in Tables II, III and IV. The location of sampling stations and stream channel sections for which calculations were made, are

shown in Figs. 1-3. Plutonium inventories in each canyon were estimated from data collected in 1968, 1970 and 1972. The 1972 data utilizes tabulations from the Ecology Section (LA-5586), and Environmental Monitoring Report for 1972 (LA-5184). The ^{137}Cs data were gathered in 1972 and were partially reported in LA-5282-ms.

TABLE I

SUMMARY OF PLUTONIUM ADDITIONS TO THE LIQUID WASTE DISPOSAL AREAS FROM 1943 THROUGH 1973

YEAR	TA-45[a] mCi Pu in Effluent	TA-21 mCi Pu in Effluent	TA-50 mCi Pu in Effluent
1943-50	143.		
1951	0.4		
1952	0.3	0.1	
1953	0.9	1.6	
1954	2.0	0.5	
1955	2.2	1.1	
1956	1.1	0.8	
1957	0.9	1.0	
1958	0.9	0.5	
1959	1.2	0.9	
1960	2.2	1.7	
1961	5.7	5.0	
1962	3.9	3.2	
1963	5.1	2.5	1.5
1964	0.04	1.1	2.0
1965		1.0	3.5
1966		0.8	1.7
1967		3.4	4.2
1968		1.6	2.6
1969		1.6	6.8
1970		1.5	5.1
1971		0.7	6.0
1972		1.1	8.1
1973		0.4	8.8
TOTALS	170.	32.1	51.3

[a] TA-45, TA-21, and TA-50 released liquid effluent into Acid-Pueblo, DP-Los Alamos and Mortandad Canyons, respectively.

TABLE II

Physical Characteristics of Channels

A. Acid Pueblo Canyon

1. 0 to 480 m (Acid Canyon)
   Width 1.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 170 x 10^6 g

2. 480 m to 2 600 m
   Width 2.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 1 790 x 10^6 g

3. 2 600 m to 6 800 m
   Width 3 m Depth 0.15 m
   Sp. g. 1.57 Weight 2 967 x 10^6 g

4. 6 800 m to 10 280 m (Confluence)
   Width 4 m Depth 0.15 m
   Sp. g. 1.57 Weight 3 278 x 10^6 g

B. DP-Los Alamos Canyon

1. 0 to 1 800 m
   Width 1.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 459 x 10^6 g

2. 1 800 m to 6 600 m
   Width 2.5 m Depth 0.15 m
   Sp. g. 1.57 Weight 2 832 x 10^6 g

C. Confluence Pueblo-Los Alamos to Rio Grande

1. Confluence to 4 800 m
   Width 3 m Depth 0.15 m
   Sp. g. 1.57 Weight 3 408 x 10^6 g

2. 4 800 m to 7 2 00 m (Rio Grande)
   Width 4 m Depth 0.15 m
   Sp. g. 1.57 Weight 2 261 x 10^6 g

D. Mortandad Canyon

1. 0 to 1 460 m
   Width 1 m Depth 0.15 m
   Sp. g. 1.57 Weight 344 x 10^6 g

2. 1 460 m to 5100 m
   Width 2 m Depth 0.15 m
   Sp. g. 1.57 Weight 1714 x 10^6 g

TABLE III

Computations Showing Concentrations and Amounts of Pu in Sections of the Canyon

A. Acid-Pueblo Canyon (February, 1970)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 480	AC4	29.1		
	Acid Weir	24.8	27.0	4.6
480- 2 600	PC-2	4.98		
	PC-5	4.71	4.84	8.7
2 600- 6 800	PC-7	1.15		
	PC-9	.398	.775	2.3
6 800-10 280	PC-9	.398		
	SR-4	1.14	.770	2.5
TOTAL		-	-	18.1

B. Acid-Pueblo Canyon (October, 1972)[1/]

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 480	AP-1	2.5		
	AP-2	2.3		
	AP-3	6.9		
	AP-4	50		
	AP-5	13		
	AP-6	12	8.4	
	AP-7	11	~~14.0~~	2.4
480- 2 600	AP-8	2.1	4.8	
	PC-5	2.6	2.4	4.3
2 600- 6 800	AP-9	.36		
	AP-10	1.2	.95 ~~.78~~	2.3
6 800-10 280	AP-10	1.2		
	SR-4	.37	.61 .78	2.6
TOTAL		-	-	11.6

1/ AP-Series Stations Ecology Section

C. DP-Los Alamos Canyon (May, 1968)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 1 800	DPS-1	16.20		
	DPS-4	.84	8.5	3.9
1 800- 6 600	LAS-3	.65		
	LAS-5	.15	40	1.1
TOTAL		-	-	5.0

Table III (con't.)

G. Lower Los Alamos Canyon [Confluence LA-Pueblo To Rio Grande] (May, 1968)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
Confluence-	LAS-6	.62	0.53	
4 800	LAS-8	.34	.48	1.6
4 800- 7 200	LAS-8	.34		
	LAS-9	.24	.18 .29	0.7
TOTAL		-	-	2.3

H. Lower Los Alamos Canyon [Confluence LA-Pueblo to Rio Grande], (August, 1968)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
Confluence-	LAS-6	.53		
4 800	LAS-8	.02	.28	1.0
4 800- 7 200	LAS-8	.02		
	LAS-9	<.01	.01	<.02
TOTAL		-	-	≃1.0

I. Lower Los Alamos Canyon [Confluence LA-Pueblo to Rio Grande] (February, 1970)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
Confluence-	LAS-6	.860		
4 800	LAS-7	.338	.60	2.0
4 800- 7 200	LAS-8	.591		
	LAS-9	.364	.48	1.1
TOTAL		-	-	3.1

J. Mortandad Canyon (February, 1970)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 1 460	GS-1	87.9		
	MCS-3.8	3.8	45.8	15.8
1 460- 5 100	MCO-5	2.8		
	MCO-7	.40	1.6	2.7
TOTAL		-	-	18.5

Table III (con't.)

D. DP-Los Alamos Canyon (August, 1968)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 1 800	DPS-1	0.41		
	DPS-2	1.44		
	DPS-3	.91		
	DPS-4	.88	0.91	.4
1 800- 6 600	LAS-2	.60		
	LAS-3	.37		
	LAS-4	.30		
	LAS-5	.23	38	1.1
TOTAL		-	-	1.5

E. DP-Los Alamos Canyon (February, 1970)

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 1 800	DPS-1	18.4		
	DPS-4	1.62	10.1	4.6
1 800- 6 600	LAS-2	.198		
	LAS-3	.156		
	LAS-4	.396		
	LAS-5	.848	0.4	1.1
TOTAL		-	-	5.7

F. DP-Los Alamos Canyon (October, 1972)[1/]

Section	Station	Concentration x 10^{-9} mCi/g	Ave.	Total Pu mCi
0- 1 800	DP-5	0.76		
	DP-6	19		
	DP-7	.93	6.9	3.2
1 800- 6 600	DP-9	.20		
	DP-10	.30		
	SR-4	.01	.17	.5
TOTAL		-	-	3.7

1/ DP Series Ecology Section

Table III (con't.)

K. *Mortandad Canyon (October, 1972)*

Section	Station	Concentration $\times 10^{-9}$ mCi/g	Ave.	Total Pu mCi
0- 1 460	M-1	223		
	M-2	117		
	M-3	91		
	M-4	48		
	M-5	124		
	M-6	24		
	M-7	21		
	M-8	9.1	82	28.2
1 460- 5 100	MCO-5	2.8		
	M-9	11	6.9	11.8
TOTAL				40.0

TABLE IV

Concentrations and Amounts of ^{137}Cs in Sections of the Canyons

A. Acid-Pueblo Canyon (October, 1972)

Section (m)	Station	Concentration x 10^{-9} mCi/g	Avg.	Total ^{137}Cs (mCi)
0-480	Ap-1	0.53		
	Ap-2	0.05		
	Ap-3	1.5		
	Ap-4	0.74		
	Ap-5	14		
	Ap-6	1.1		
	Ap-7	1.5	2.8	0.48
480-2600	Ap-8	1.1	1.1	2.0
2600-6800	Ap-9	0.31	0.31	0.92
6800-10280	Ap-10	0.20	0.20	0.66
Total				4.1

B. DP-Los Alamos Canyon (October, 1972)

Section (m)	Station	Concentration x 10^{-9} mCi/g	Avg.	Total ^{137}Cs (mCi)
0-1800	m-1	1654		
	m-2	187		
	m-3	5.9		
	m-4	49		
	m-5	24	33	
	m-6	15		
	m-7	51	284	130
1800-6600	m-9	13		
	m-10	3.6	8.3	24
Total				154

C. Lower Los Alamos Canyon (October, 1972)

Section (m)	Station	Concentration x 10^{-9} mCi/g	Avg.	Total ^{137}Cs (mCi)
Confluence-4800	m-10	0.20		1.1
4800-7200	m-11	1.6	0.9	9.1
Total				10.2

Table IV (con't)

D. Mortandad Canyon (October, 1972)

Section (m)	Station	Concentration x 10^{-9} mCi/g	Avg.	Total ^{137}Cs (mCi)
0-1460	m-1	2022		
	m-2	506		
	m-3	527		
	m-4	629		
	m-5	285		
	m-6	1191		
	m-7	315		
	m-8	90	696	240
1460-5100	m-9	91		
	m-10	0.6	46	79
Total				319

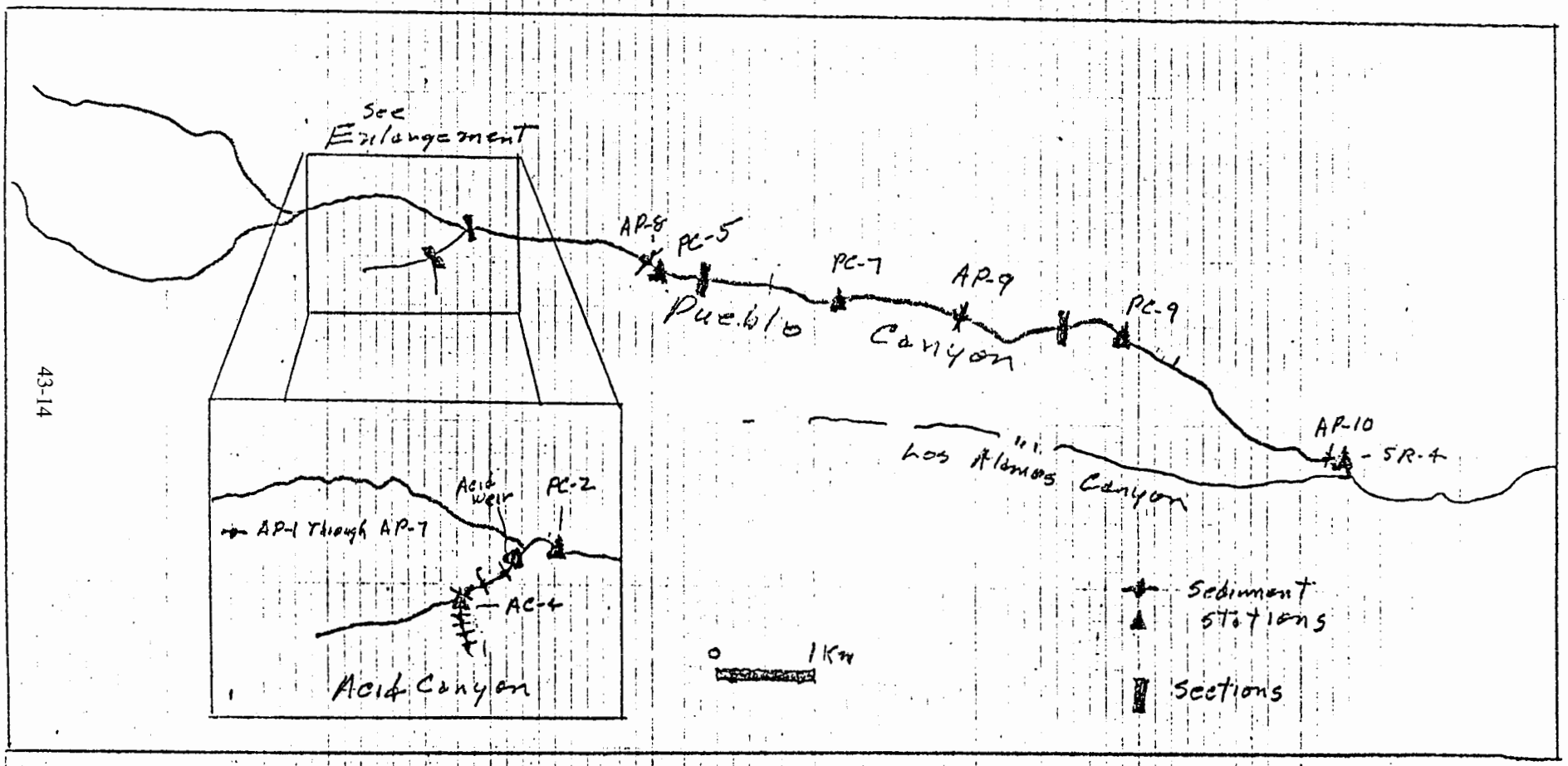

Figure 1. Sampling Stations and sections in Acid - Pueblo Canyon

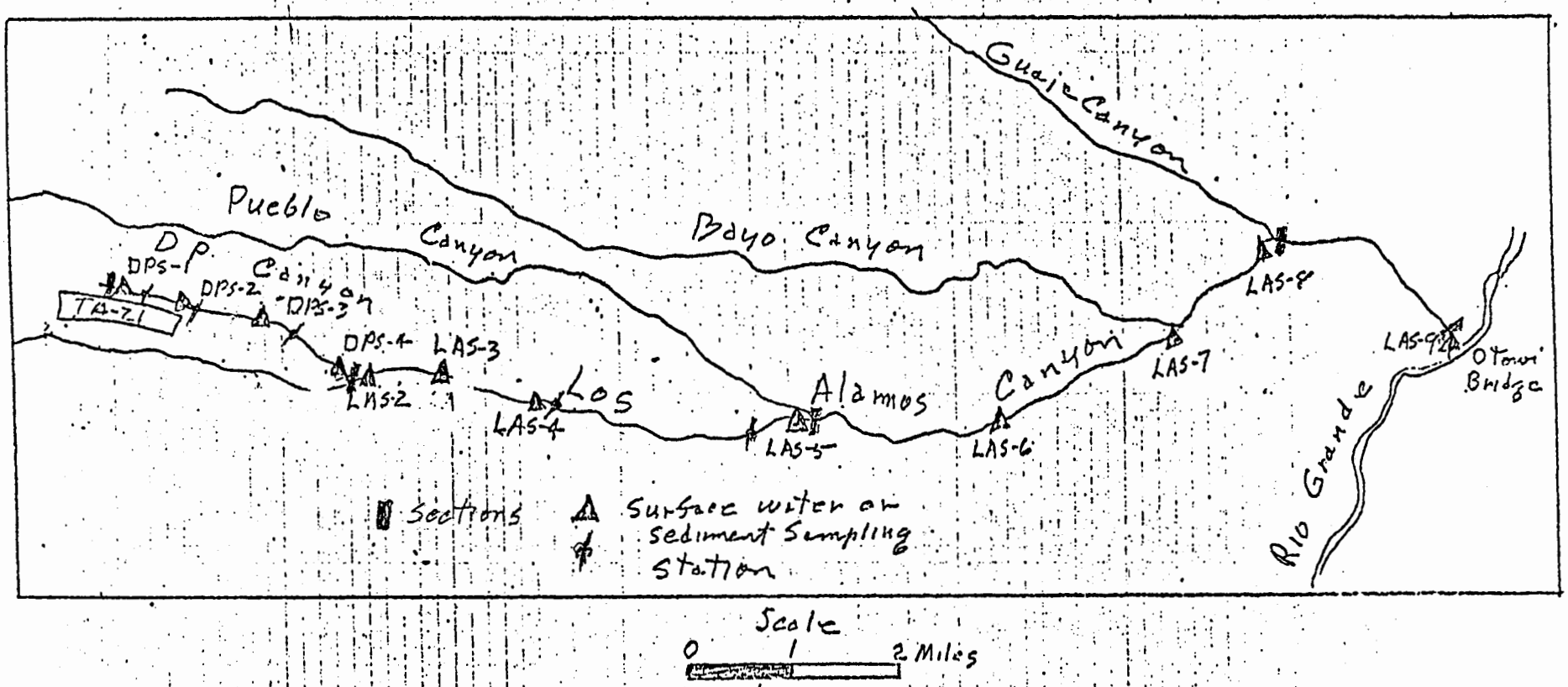

Figure 2.- Sampling stations and sections in Los Alamos Canyon

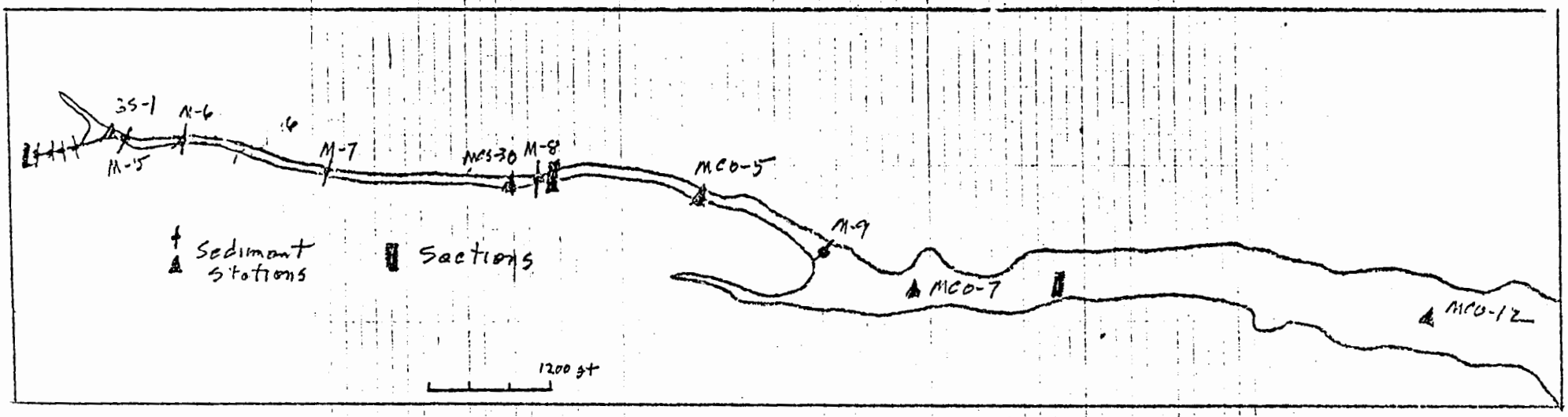

Figure 3.- Sampling stations and section in Montandon Canyon.

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LOS ALAMOS, NEW MEXICO 87544

TO: LaMar Johnson

DATE: December 3, 1974

Pu Inventory

Acid-Pueblo Canyon

The inventory and relative distribution of Pu in four segments of Acid-Pueblo Canyon are presented below:

	Total Pu (mCi)			
Section (m)	Feb. 1970	% Total	Oct. 1972	% Total
0-480	4.6	25	2.4	21
480-2600	8.7	48	4.3	37
2600-6800	2.3	13	2.3	20
6800-10280	2.5	14	2.6	22
Total	18.1	100	11.6	100

Calculations based on Feb. 1970 samples indicate that about 18.1 mCi remain in the 10280 m section of stream channel downstream from the waste-outfall. This value represents about 11% of the estimated input of 170 mCi. In October, 1972, 11.6 mCi was the calculated inventory for the same sections of stream channel. If the difference between 1970 and 1972 estimates are real, then the annual loss from this stream section was about 2.2 mCi/year or roughly 13% of the current inventory per year. The latter figures were based on a 6.5 mCi loss over three summer rainfall seasons. The loss appears to have been from the upper reaches of the canyon where the stream channel is narrow, precipitous and easily scoured. The flux of Pu in the lower sections (2600-10280 m) apparently is in equilibrium, with gains equaling losses.

Data on the vertical distribution of the Pu in Acid-Pueblo sediments indicate that the radionuclide is relatively well mixed to sampling depths of 30 cm throughout the entire 10280 meter section. Snow and rain runoff and sewage effluent are all at least partially responsible for the redistribution of sediment Pu with distance and depth.

The ratio of $^{239-241}Pu/^{238}Pu$ in Acid-Pueblo Canyon sediments averaged 17, reflecting the laboratories early work with ^{239}Pu.

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LOS ALAMOS, NEW MEXICO 87544

TO: LaMar Johnson DATE: December 3, 1974

The discrepancy between our inventory estimates and the amount of Pu released to the canyon measured about 150-160 mCi. There are several possible explanations for the discrepancy and these include:

1. The removal of significant amounts of Pu from the upper 160 meters of the canyon during the dismantling and clean-up of TA-45 and,
2. The flushing of Pu downstream during snow melt and/or rain runoff events.

It is impossibe to assess the amount of Pu removed during the TA-45 clean-up operation. Records compiled by J. Enders show that 504 truck loads of material were removed from the TA-45 area and were buried in Area G and C. Personal communications with C. Blackwell, J. Enders and C. Christenson lead us to believe that a very small amount of the rubble actually came from the canyon, per se. This contention is further substantiated by the physical appearance of the canyon today. There is little evidence of soil and/or rock removal from the stream channel other than one or two isolated spots where chisel marks are visible in the Tuffe. Most of the material which was removed from the canyon consisted of the cliff face immediately below the TA-45 waste outfall. According to Blackwell and Enders, a road was built to the bottom of the cliff where front end loaders scooped up about 94 truck loads of rubble for burial in Area C. The waste outfall area from TA-1, which is immediately adjacent to the TA-45 outfall, also bears no evidence of clean-up. The soils are well developed and heavily vegetated.

Unfortunatley, recollections from the past and opinions based on field observations, provide little bases for deriving a quantitative estimate of the amount of Pu removed from the canyon. It is our belief, however, that relatively small amount of the radioactivity was removed from the canyon during the clean-up operation.

TO: LaMar Johnson DATE: December 3, 1974

In our opinion, the most likely explanation for the relatively small residual Pu inventory is that the material was transported downstream during runoff events. Such a process was noted in Pueblo and Los Alamos Canyons as early as 1946, when Kingsley (LA-516, LA-516A) measured elevated Pu levels in soils and water about 10000 m below the respective waste outfalls and that levels in stagnant pools in the stream were much lower following spring rains than in late fall. Robeck (TID-460) in 1950, also suggested runoff transport phenomena as a mechanism of Pu redistribution in Pueblo Canyon.

Sediment radionuclide concentrations from the confluence of Pueblo and Los Alamos Canyon to the Rio Grande, demonstrate that Pu has been transported downstream from the waste outfalls (Schnap and Tribley, LAMS-709; Dodd, LAMS-2038; Hakonson, LA-5586; Purtymun, LA-4561). Three studies in DP Canyon (Purtymun, LA-5744) and in Mortandad Canyon (Hakonson, in preparation; Purtymun, Johnson, and John, U.S. Geol. Survey Prof. Paper 550-D) demonstrated that runoff is an operative mechanism in the transport of radioactivity down the canyons.

Determining the rate of Pu movement downstream in Acid-Pueblo Canyon is difficult with the data presently available. We have attempted to do so, however, utilizing 1970 and 1972 data. As mentioned previously, the loss of Pu from 1970 to 1972 was about 2.2 mCi/year or about 13% of the current inventory each year. The curves in Fig. 4 show the accumulative input of Pu to the canyon from 1943-1964 (upper curve) and the residual remaining each year through 1972 assuming a 13% annual loss (lower curve). The calculating formula along with an example calculation also appear in the Figure.

The Pu inventory in 1972 as estimated by equation 1 was 11.6 mCi which compares very well with a predicted inventory, based on a 13% annual loss, of 8 mCi. The use of the 13% annual decrement model assumes that Pu transport out of the 10280 m section began the first year wastes entered the canyon (1943) and that the flushing process proceeded at a

TO: LaMar Johnson DATE: December 3, 1974

continuous rate through each succeeding year. The validity of these assumptions is questionable. However, the data presented by Kingsley (LA-516, LA-516A) demonstrate that by 1946, Pu had moved several thousand meters downstream. In addition, hydrologic observations over the past 16 years indicate that 3-4 runoff events in the Acid-Pueblo watershed reach the Rio Grande each year. Regardless of the validity of the assumptions, the exercise demonstrates the need for continuing long-term observations and special studies to provide a sound bases for predicting annual losses and transport mechanisms of the radioactivity.

At a 13% annual loss the Pu inventory in Acid-Pueblo Canyon would approach background levels (0.82 mCi over the 10280 m segment) by 1988. Pu concentrations in Acid-Pueblo sediments above the waste outfall in 1972, averaged 0.1 pCi/g in 5 samples.

DP-Los Alamos Canyon

The results of the inventory estimates for two sections of DP-Los Alamos Canyon are presented below:

Section (m)	May 1968	% Total	Aug. 1968	% Total	Feb. 1970	% Total	Oct. 1972	% Total
0-1800	3.9	78	0.4	27	4.6	81	3.2	86
1800-6600	1.1	22	1.1	73	1.1	19	0.5	14
Total	5.0	100	1.5	100	5.7	100	3.7	100

The Pu inventories in May and August 1968, reflect the storm transport phenomena that we believe is operative in Pu redistribution. The inventory in May 1968 represents build up of Pu during the Fall-Winter-Spring months, while the August inventory represents the residual after the summer rainfall season. The loss in the 0-1800 segment during the 3 month period was about 90% of the residual inventory while the overall loss from both segments was about 70% of the inventory. The stream

TO: LaMar Johnson DATE: December 3, 1974

channel in the 0-1800 m segment has a thin (< 30 cm) alluvial cover and has a steep gradient (182 m fall/1800 m stream). Run-off is above normal due to the large areas of paved landscape (townsite) which drain into DP canyon. Losses from the lower section (1800-6600 m) apparently equaled gains since the inventory remained relatively constant.

The 5 mCi inventory in May 1968 represent about 20% of the 25.2 mCi (1952-1967) released to the canyon while the August 1968 inventory of 1.5 mCi represent 6% of the input.

The 1968 data suggest that Pu losses from the canyon are cyclic, with buildup occurring during the Fall-Winter-Spring months and losses occurring during the summer months when storm runoff periodically fills the streams.

The inventory estimate in February 1970 was 5.7 mCi which represents 20% of the 28.4 mCi released to the canyon. About 12% (3.7 mCi) of the 31.7 mCi input remained in October 1972.

The inventory estimates for all three years indicate that year to year losses approximately equal gains, even though within year losses may occur within a short time period. The overall loss of Pu from May 1968 to February 1970, was about 2.5 mCi. This value was derived as follows:

Net Pu loss = 5 mCi (May 1968 inventory)
+ 3.2 mCi (additions during 1968-1969) — 5.7 mCi (February 1970 inventory)
= 2.5 mCi, or 1.25 mCi/year

The loss of 1.25 mCi/year, represents about 19% of the 6.6 mCi present in the canyon in 1968 (i.e. 1.6 mCi input + 5 mCi inventory). The net loss from February, 1970 to October, 1972 was 5.3 mCi (i.e. 5.7 mCi inventory in Feb. 1970 + 3.3 mCi input-3.7 mCi inventory in Oct. 1972), which represents an annual loss over the three summer seasons of 1.8 mCi/year.

TO: LaMar Johnson DATE: December 3, 1974

The relative loss, based on an input of 1.8 mCi/year and 1970 inventory and annual input total of 6.8 mCi (i.e. 5.7 mCi + 1.1 mCi) was 26% per year. The average of the two relative loss rates was 23% per year. Applying this value to the estimated input (Fig. 5, upper curve), analogous to the presentation in Fig. 4, yields the predicted inventory (lower curve, Fig. 5) based on a 23 % annual loss.

Purtymun's estimate of the inventory in October, 1972 was 3.7 mCi, which compares with a predicted value of 4.7 mCi, assuming a 23% annual loss. The model predicted that background levels (0.17 mCi for the 6600 m segment) would be achieved by 1987, assuming that wastes continue to be released into DP Canyon until 1976 at a rate of 0.4 mCi/year. Pu concentrations in sediments from above the outfall in DP canyon averaged 0.05 pCi/g for 6 samples.

The average ratio of $^{239}Pu/^{238}Pu$ in DP-Los Alamos sediments was 5.2. The ratio in effluent from TA-21 during 1972 averaged 0.5 reflecting increased Laboratory use of ^{238}Pu since 1958. Data on the vertical distribution of the Pu to maximum sampling depths of 30 cm indicate that the radionuclide has mixed with depth throughout the 6600 m segment.

Lower Los Alamos Canyon to Rio Grande

This section of stream channel which lies below the confluence of Acid-Pueblo and DP-Los Alamos Canyon has received all of the radioactivity transported out of the two upper canyons. Based on the estimates presented earlier, about 160 mCi Pu from Acid-Pueblo and 30 mCi Pu from DP-Los Alamos may have washed into this stream segment over the past 30 years. The inventory estimates and relative distribution of Pu in Lower Los Alamos Canyon in 1968 and 1970 appear below

TO: LaMar Johnson DATE: December 10, 1974

Segment (m)	Total Pu (mCi) May 1968	% Total	Aug. 1968	% Total	Feb. 1970	% Total
0-4800	1.6	62	1.0	∿98	2.0	65
4800-7200	0.7	38	< .02	∿ 2	1.1	35
Total	2.3	100	∿1.0		3.1	100

It is apparent that little of the 190 mCi Pu from the upper portions of Acid-Pueblo and DP-Los Alamos remains in the lower segment. The May and August 1968 data reflect summer storm transport, analagous to the data for the upper 6600 m in DP-Los Alamos Canyon. The estimated inventory was 2.3 mCi in May and about 1 mCi in August. The inventory in February 1970 was 3.1 mCi.

The data in Figs. 4 and 5 were used to estimate the annual Pu addition to lower Los Alamos Canyon over the past 30 years. Recall that a 13% annual loss was calculated for Acid-Pueblo Canyon, while the average annual loss from DP-Los Alamos Canyon was 23%. The upper curve in Fig. 6 shows the accumulative Pu additions from 1943 to 1973. The average annual Pu loss, as calculated by the method described earlier, was 53%/year. The lower curve in Fig. 6 show the resulting inventories based on the 53% annual loss. Calculated inventories (equation I) in May 1968 and in February 1970 were 2.3 mCi and 3.1 mCi, while corresponding predicted values based on a 53% annual loss were 3.9 mCi and 3.4 mCi. The 53% annual decrement model predicted background levels (0.48 mCi for the 7200 m segment) would be achieved in the late 1980's.

Sediment loads passing Otowi bridge on the Rio Grande River average 2.2×10^9 kg/year over the last 21 years (U.S. Geological Survey, Water Quality Records). Obviously the capacity for dilution of radioactivity with suspended sediments as it enters the Rio Grande is large.

Sediment samples from the Rio Grande in 1973 did not

contain elevated amounts of plutonium. Studies of the river will be expanded, especially in the newly constructed Cochiti Reservior.

The $^{239}Pu/^{238}Pu$ ratio in sediments from lower Los Alamos Canyon averaged 29, which more nearly corresponds to the high $^{239}Pu/^{238}Pu$ ratio observed in Acid-Pueblo Canyon.

Based on the data presented above, lower Los Alamos Canyon receives about 2 mCi/year from Acid-Pueblo and about 0.5 mCi/year from the DP-Los Alamos branch.

Mortandad Canyon

The A.E.C. owns the land in Mortandad Canyon to about 5100 m below the TA-50 waste outfall. The San Ildefonso Indians own the remaining portion of the canyon down to the Rio Grande. Sediment samples have not been taken on indian land, however, some were taken in 1972 at the Laboratories east boundary in the canyon and at the point where Mortandad Canyon crosses State Road 4.

The inventory estimates for 1970 and 1972 are presented below:

	Total Pu (mCi)			
Section (m)	Feb. 1970	% Total	Oct. 1972	% Total
0-1460	15.8	85	28.2	71
1460-5100	2.7	15	11.8	29
Total	18.5	100	40	100

The Feb. 1970 inventory estimate was 18.5 mCi, which compares with an input of 22.3 mCi through 1969. The October estimate was 40 mCi, which compares with an input of 41.5 mCi through 1972. The 21.8 mCi increase in Pu from 1970 to 1972 reflects additions of the radionuclide from TA-50. During this period, records show that 19.2 mCi were released into the canyon.

Changes in the relative distribution of the Pu within the

TO: LaMar Johnson DATE: December 10, 1974

two sections may be indicative of relocation by storm runoff. None of the radioactivity has reached Indian land as evidenced by background concentrations in the sediments immediately upstream and at the State Road 4 crossing (Hakonson, LA-5586).

The physical characteristics of Mortandad Canyon are the primary reason for the relatively small downstream movement of the Pu. The drainage area is small, at about 6 km^2 and the lower reaches of the canyon (i.e. >1200 m post-outfall) broaden and are covered with alluvial deposits to a depth of as much as 25 m. The alluvium is unsaturated, and thus far, has had the capacity to absorb all the water (i.e. effluent, storm runoff and etc.) which reaches the area. Observations over the last 16 years indicate that runoff from the upper canyon has never reached post-outfall distances in excess of about 3500 m. However, The development and construction at TA-35 and TA-55 has increased runoff into the canyon. This increase may be sufficient to transport the Pu to off-site areas in the event that corrective measures are not implemented.

The $^{239}Pu/^{238}Pu$ ratio favors ^{238}Pu at 0.28. Concentrations are relatively uniform with depth in the upper 1200 m of the canyon and become increasingly concentrated in the surface 2.5 cm below this point. Surface water is always in the channel to about 1200 m post-outfall, but soaks into the alluvium at distances beyond 1200 m. The lower portion, from about 1200-3500 m, flows water periodically during summer storm runoff events.

Cesium-137 Inventory

Acid-Pueblo Canyon

The cesium-137 inventory for the four segments of Acid-Pueblo Canyon appears below.

TO: LaMar Johnson DATE:

^{137}Cs In Acid-Pueblo Canyon (October 1972)

Segment (m)	Total ^{137}Cs (mCi)	% Total
0-480	0.48	12
480-2600	2.0	49
2600-6800	0.92	22
6800-10280	0.66	16
Total	4.1	100

The estimated inventory of 4.1 mCi compares with a background value of 3.1 mCi based on average pre-outfall concentrations of 0.38 pCi/g.

Few sediment samples from this canyon contained above-background levels of ^{137}Cs. Thus, the amount of ^{137}Cs released to the canyon was either small or it has since been transported downstream by storm runoff.

The ^{137}Cs inventory of 4.1 mCi in October 1972, compares with an estimated Pu inventory of 11.6 mCi. The highest percentage of both ^{137}Cs and Pu occurred in the 480-2600 m segment.

DP-Los Alamos Canyon

The DP-Los Alamos Canyon inventory to 6600 m post-outfall was as follows:

^{137}Cs In DP-Los Alamos Canyon (October 1972)

Segment (m)	Total ^{137}Cs (mCi)	% Total
0-1800	130	84
1800-6600	24	16
Total	154	100

About 84% of the estimated 154 mCi ^{137}Cs was located in the upper 1800 m of the canyon while the remaining 16% was distributed in the lower segment (1800-6600 m). In 1973, the only year specific analyses for ^{137}Cs were made on effluent, 1.1 mCi

TO: LaMar Johnson DATE:

was released into DP-Los Alamos Canyon from TA-21 (LA-5586). It seems likely that release levels in previous years were larger, since the TA-21 plant has received steadily less radioactivity in the past few years.

There appeared to be a distributional relationship between the Pu and ^{137}Cs in October 1972 samples. A least squares regression of ln ^{137}Cs vs ln Pu for 25 post-outfall sediment samples was highly significant ($r = 0.74$, $\alpha < 0.01$).

The ^{137}Cs inventory of 154 mCi in October 1972 compares with an estimated Pu inventory of 3.7 mCi. On an activity basis, there is about 42 times as much ^{137}Cs as Pu. The highest percentages of both ^{137}Cs and Pu occurred in the upper 1800 m of the canyon.

Lower Los Alamos Canyon

The inventory estimate from the confluence of Pueblo and Los Alamos Canyons to the Rio Grande appears below:

^{137}Cs in Lower Los Alamos Canyon (October 1972)

Segment (m)	Total ^{137}Cs (mCi)	% Total
Confluence-4800	1.1	11
4800-7200	9.1	89
Total	10.2	100

The total inventory for the Acid-Pueblo-DP-Los Alamos Canyon system, including lower Los Alamos Canyon, was about 168 mCi. About 92% was in the upper reaches of DP-Los Alamos Canyon (0-6600 m), less than 3% in upper Acid-Pueblo Canyon (0-10280 m) and about 6% in Lower Los Alamos Canyon.

Mortandad Canyon

The ^{137}Cs inventory in Mortandad Canyon to 5100 m post-outfall is presented on the following page:

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

TO: LaMar Johnson DATE:

^{137}Cs In Mortandad Canyon (Oct. 1972)

Segment (m)	Total ^{137}Cs (mCi)	% Total
0-1460	240	75
1460-5100	79	25
Total	319	100

The ^{137}Cs inventory of 319 mCi for Mortandad Canyon was the largest of any of the three canyons; the value being twice the total for DP-Los Alamos and Acid-Pueblo.

Release of ^{137}Cs to Mortandad Canyon totaled 293 mCi in 1973 (LA-5586). Assuming that a similar quantity was released from 1963-1972 (no records are available), then the estimated inventory of 319 mCi accounts for about 1/10 of the total which was released in the canyon.

The ^{137}Cs concentrations were at background levels in sediments just above (∿ 5200 m) Indian land and at State Road 4. Consequently, the material must lie somewhere within the first 5100 m post-outfall.

There are at least two possible areas where the unaccounted ^{137}Cs might be found. The first is in the deeper alluvium (> 30 cm) of the lower portion of the 1460-5100 m segment. The coring device used to collect sediment in 1972, reached into the profile a maximum of 30 cm. The runoff water which soaks into the alluvium in this segment may carry the ^{137}Cs to depths exceeding the 30 cm limit of the sampler. The other possible location for the ^{137}Cs is that at some time during the past, the stream channel over flowed and carried much of the ^{137}Cs along with it. We know that such an event has occurred several times in the past, but as yet have not studied the matter sufficiently to comment.

A runoff event in Mortandad Canyon on September 15, 1974 carried an estimated 7 mCi ^{137}Cs past the 1200 m post-outfall

TO: LaMar Johnson DATE:

location. About 97% of the ^{137}Cs was associated with suspended particulates greater than 0.45 μ; whereas, only 3% was associated with the water. The 7 mCi ^{137}Cs transported during this event represents about 2% of the estimated inventory.

There was a highly significant correlation ($r = 0.91$, $\alpha < 0.01$) between ln ^{137}Cs and ln Pu in sediments, based on 33 samples from the canyon. The presence of this relationship strengthens the argument that a physical transport mechanism (i.e. storm runoff) is operative in redistributing both Pu and ^{137}Cs, since the two are chemically disimilar.

Discussion and Summary

The following tabulation lists our estimate of Pu and ^{137}Cs in all the canyons as of 1972.

Canyon	Total Pu (mCi)	Total ^{137}Cs (mCi)
Acid-Pueblo	11.6	4.1
DP-Los Alamos	3.7	154
Lower Los Alamos	3.1*	10.2
Mortandad	40	319
Total	58.4	487.3

* Based on February 1970 samples

The amount of Pu and ^{137}Cs associated with biological organisms is very small (< a few percent) based on the observed concentrations in plants and animals (LA-5586), and on the relatively small area which has been contaminated. Sediments are definitely the major reservior of the Pu and ^{137}Cs.

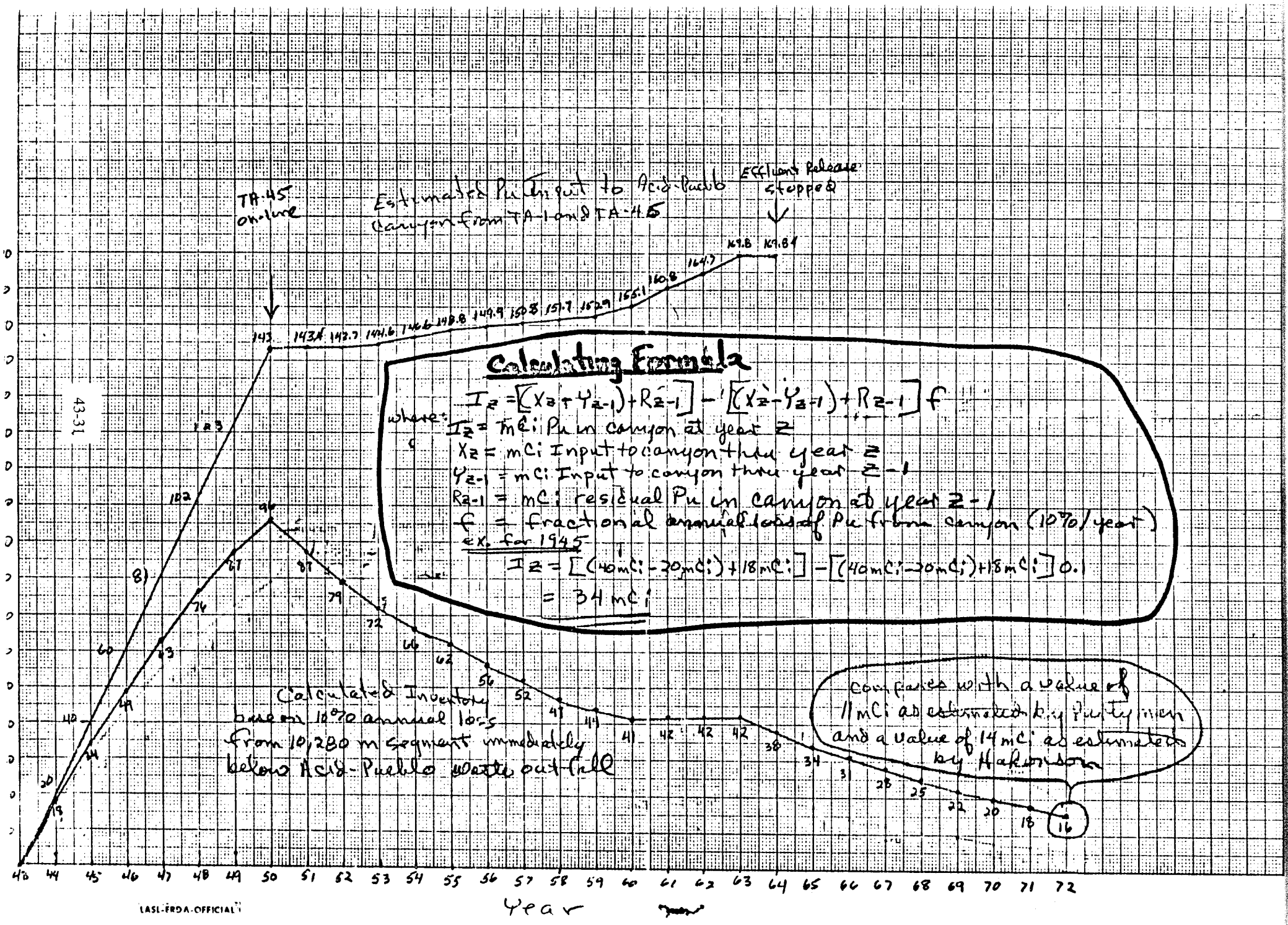
As a consequence, sediment transport processes are primal in redistributing the radionuclides. Storm runoff seems to be the major vector in all three canyons. Fine particulates, which contain higher concentration, are transported the furtherest during any particular event. However, coarser materials which comprise 90 plus percent of the alluvium, carries the bulk of

TO: LaMar Johnson DATE:

the radioactivity downstream. One study in Mortandad Canyon determined that a relatively small runoff event moved about 7 mCi ^{137}Cs downstream during a 4 hour period.

Pu, and probably ^{137}Cs, has been carried completely out of the Acid-Pueblo and DP-Los Alamos canyon system. Estimates show that as much as 180 mCi Pu may have entered the Rio Grande River. Average annual losses of 13% (Acid-Pueblo) and 23% (DP-Los Alamos) were estimated for the two upper sections of the canyon system, whereas, a 53% annual loss appeared to adequately predict on hand inventories in Lower Los Alamos Canyon. Pu from liquid effluent in Mortandad Canyon is confined exclusively to the 5100 m section immediately below the waste outfall. Prospects for the material remaining there are dim, in light of construction activities on the upper Mortandad Canyon watershed.

The amounts of ^{137}Cs present in the canyons in 1972 were about 10 times greater than the Pu. A considerable amount of ^{137}Cs is believed unaccounted for by the inventory estimate in Mortandad Canyon.



Calculating Formula

$$I_z = [(X_z + Y_{z-1}) + R_{z-1}] - [(X_z - Y_{z-1}) + R_{z-1}]\,f$$

where:

I_z = mCi Pu in canyon at year z

X_z = mCi Input to canyon thru year z

Y_{z-1} = mCi Input to canyon thru year $z-1$

R_{z-1} = mCi residual Pu in canyon at year $z-1$

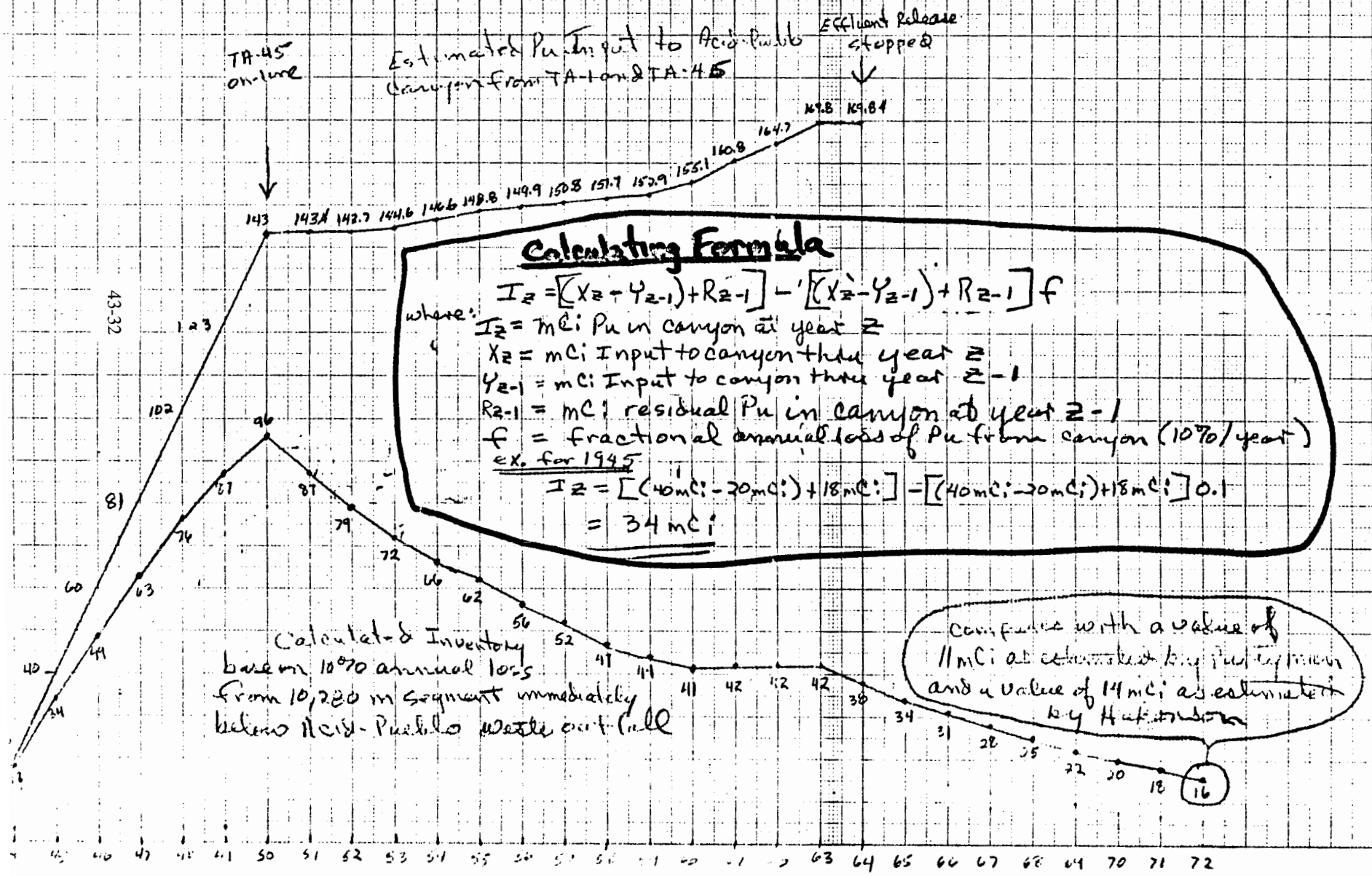
f = fractional annual loss of Pu from canyon (10%/year)

ex. for 1945

$$I_z = [(40\,mCi - 20\,mCi) + 18\,mCi] - [(40\,mCi - 20\,mCi) + 18\,mCi]\,0.1$$

$$= 34\,mCi$$

compares with a value of 11 mCi as estimated by Purtymun and a value of 14 mCi as estimated by Hakonson



Calculating Formula

$$I_z = [(X_z + Y_{z-1}) + R_{z-1}] - [(X_z - Y_{z-1}) + R_{z-1}]f$$

where:

I_z = mCi Pu in canyon at year z

X_z = mCi Input to canyon this year z

Y_{z-1} = mCi Input to canyon thru year z-1

R_{z-1} = mCi residual Pu in canyon at year z-1

f = fractional annual loss of Pu from canyon (10%/year)

ex. for 1945

$$I_z = [(40\,mCi - 20\,mCi) + 18\,mCi] - [(40\,mCi - 20\,mCi) + 18\,mCi]\,0.1$$

$$= 34\,mCi$$

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Calculating Formula

$$I_z = [(X_z - Y_{z-1}) + R_{z-1}] - [(X_z - Y_{z-1}) + R_{z-1}]\,f$$

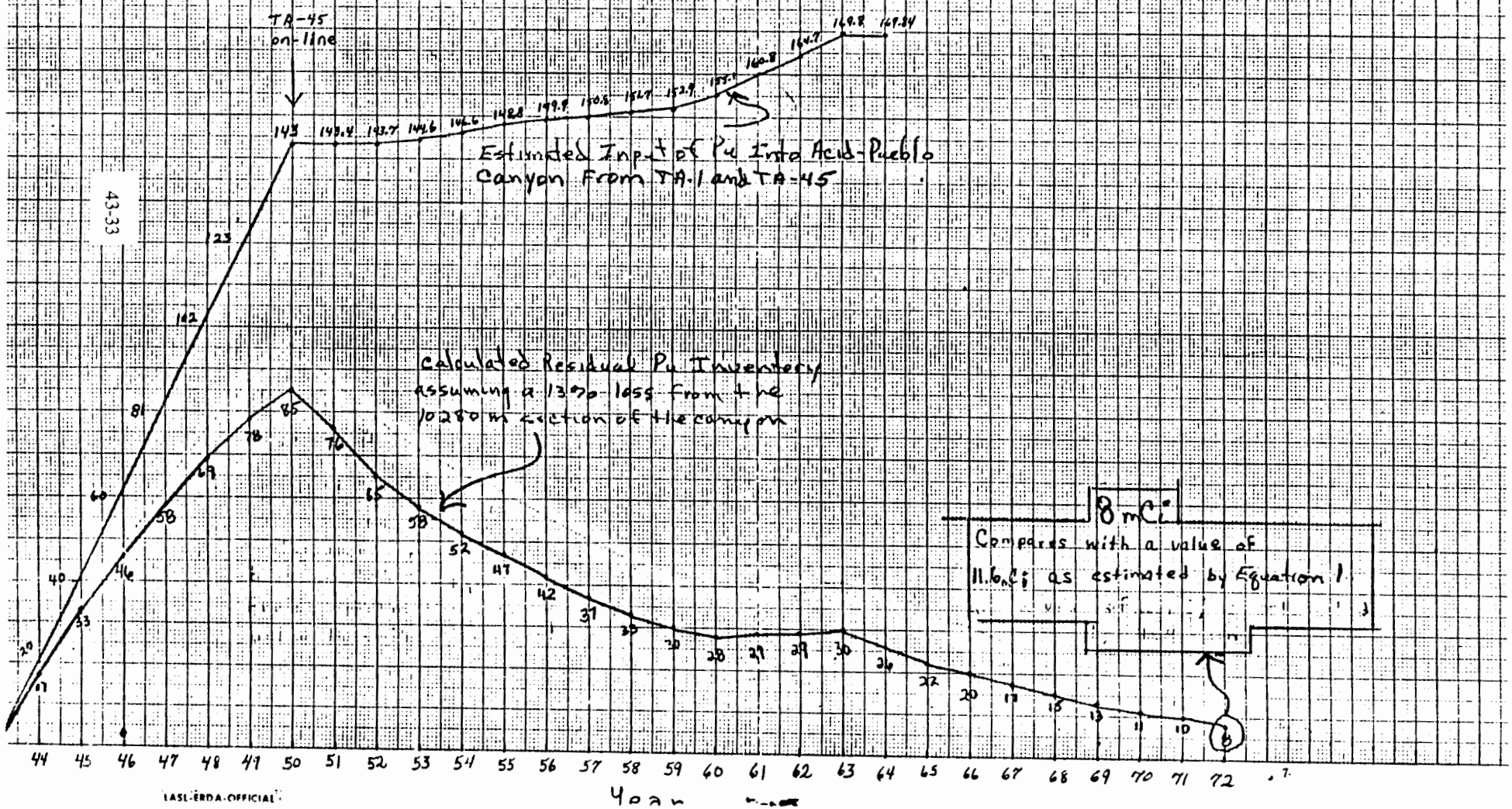
where:

I_z = mCi Pu in canyon at year Z
X_z = mCi Input to canyon thru year Z
Y_{z-1} = mCi Input to canyon thru year Z-1
R_{z-1} = mCi residual Pu in canyon at year Z-1
F = Fractional annual loss of Pu from canyon (0.13/year)

ex. for year 1995

$$I_{(1995)} = [(40\,mCi - 20\,mCi) + 17\,mCi] - [(40\,mCi - 20\,mCi) + 17\,mCi]\,0.13$$
$$= 33\,mCi$$

Fig. 4 Estimated total Pu input to Acid-Pueblo canyon from 1943 to 1964 (Top Curve). The calculated Pu inventory in alluvial sediments (0-10 280 m pe based on an average annual Pu loss of 13 pe per year.



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Calculating Formula

$$I_z = [(X_z - Y_{z-1}) + R_{z-1}] - [(X_z - Y_{z-1}) + R_{z-1}]\,f$$

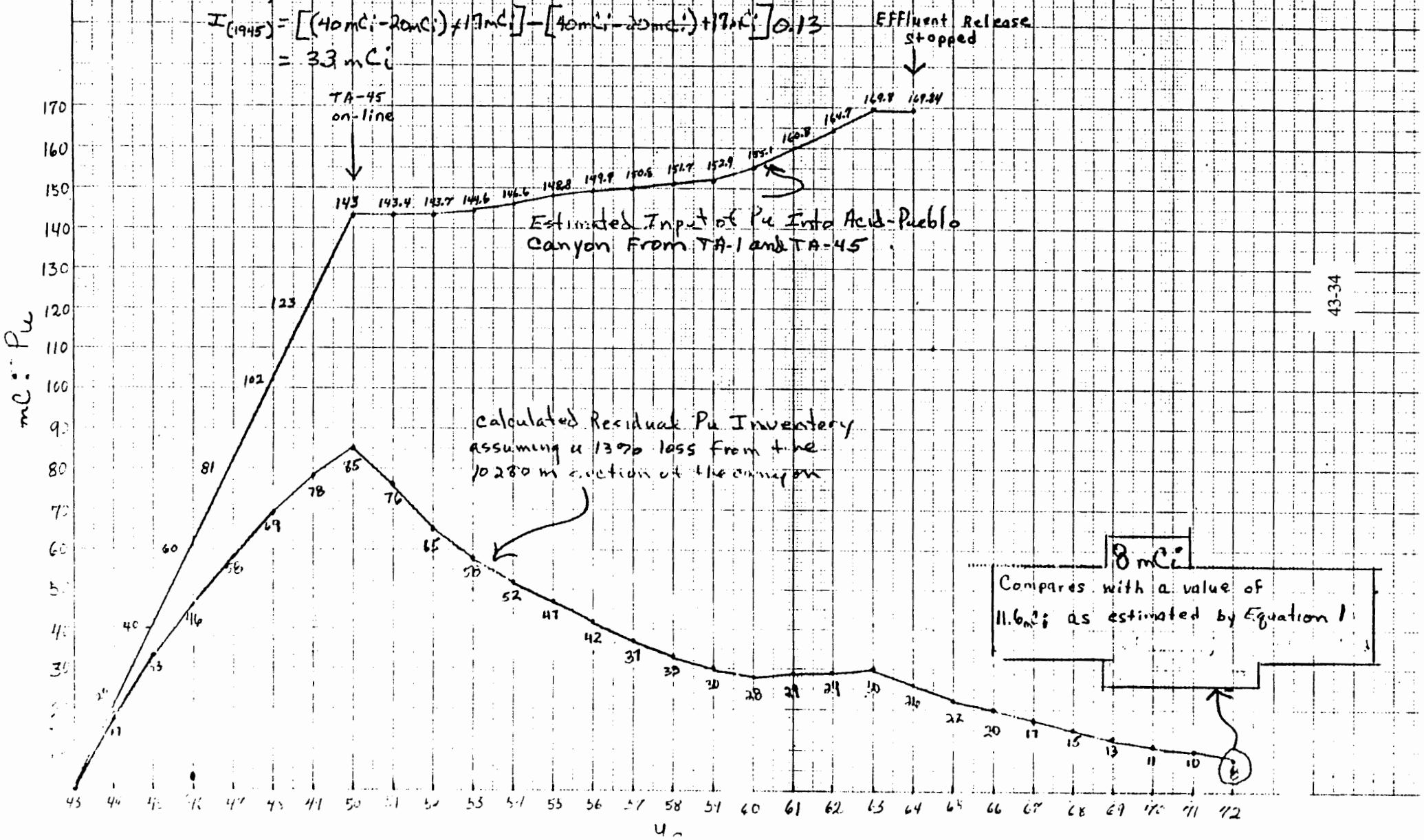
where:

I_z = mC: Pu in canyon at year Z
X_z = mC: Input to canyon thru year Z
Y_{z-1} = mC: Input to canyon thru year Z-1
R_{z-1} = mC: residual Pu in canyon at year Z-1
f = fractional annual loss of Pu from canyon (0.13/year)

ex. for year 1945

$$I_{(1945)} = [(40\,mCi - 20\,mCi) + 17\,mCi] - [40\,mCi - 20\,mCi) + 17\,mCi]\,0.13$$
$$= 33\,mCi$$

Fig. 4 Estimated total Pu input to Acid-Pueblo C from 1943 to 1964 (Top Curve). The calcula inventory in alluvial sediments (0-10 2 based on an average annual Pu loss o per year.



Calculating Formula

$$I_z = [(X_z - Y_{z-1}) + R_{z-1}] - [(X_z - Y_{z-1}) + R_{z-1}]F$$

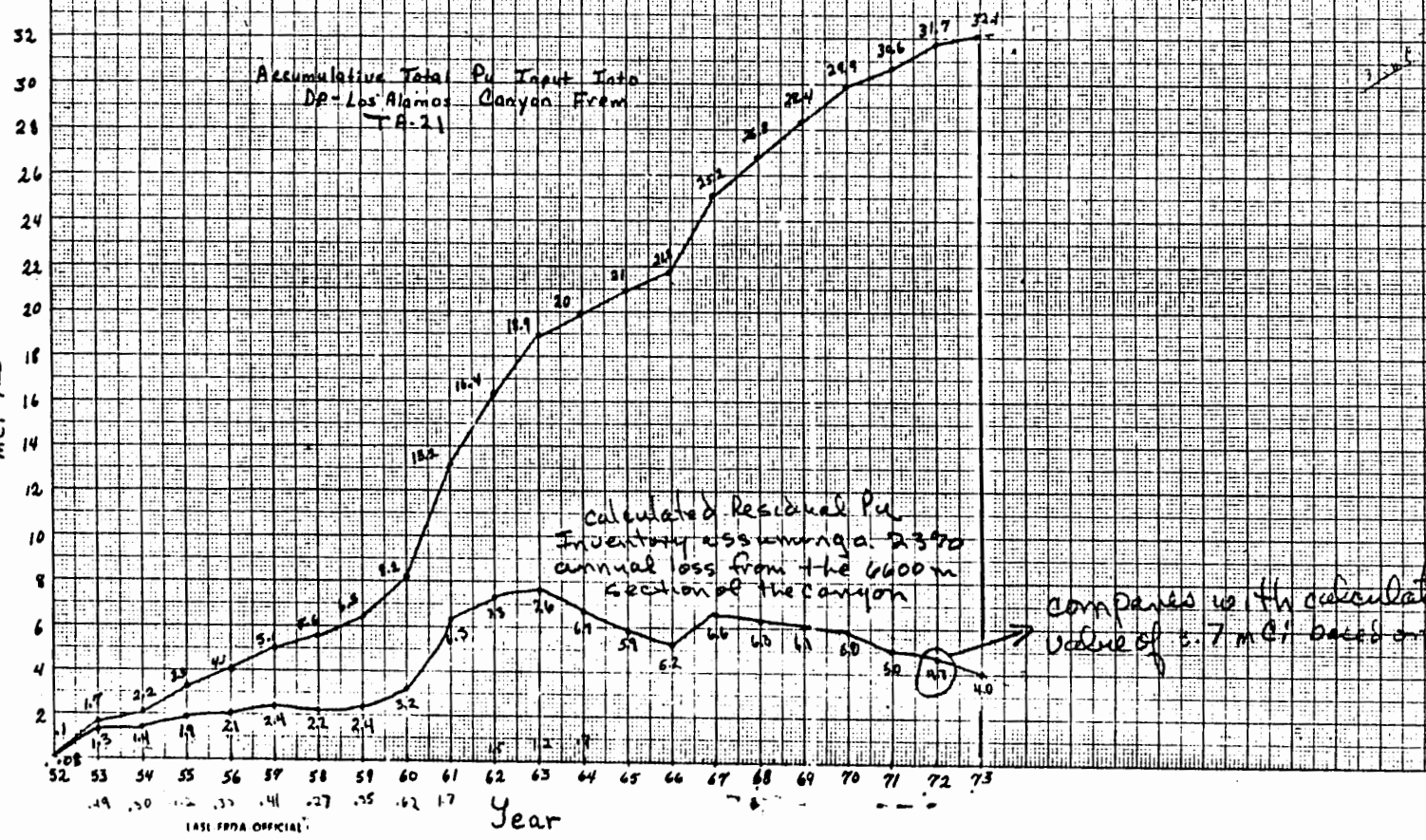
where:

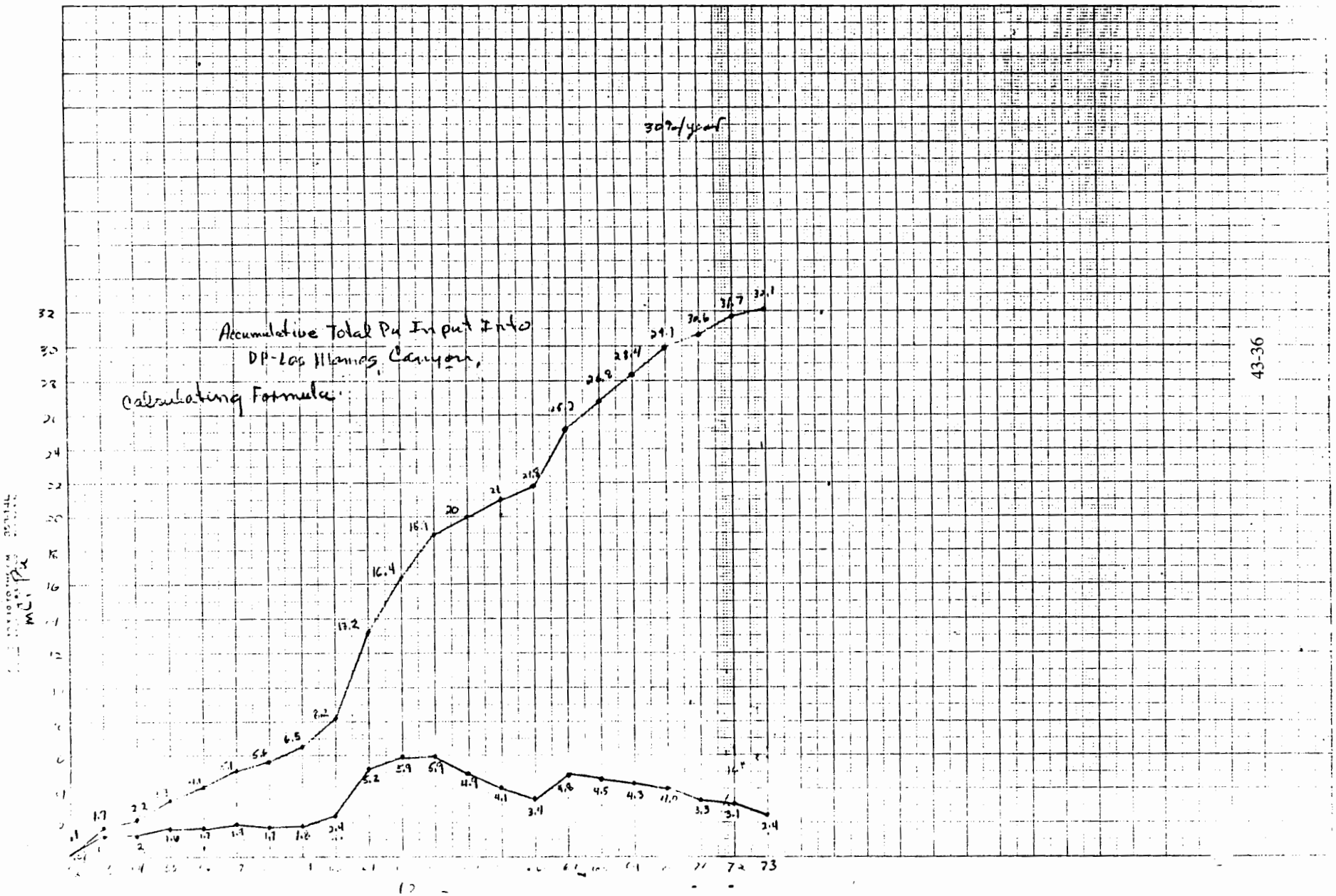
I_z = mCi Pu in canyon at year Z
X_z = mCi Input to canyon thru year Z
Y_{z-1} = mCi Input to canyon thru year Z-1
R_{z-1} = mCi residual Pu in canyon at year Z-1
F = Fractional annual loss of Pu from canyon (29%/year)

ex. for Z = 1953

$$I_z = [(1.7 - 0.1) + 0.07] - [(1.7 - 0.1) + 0.07]\,0.29$$
$$= 1.2 \text{ mCi}$$

Fig. 5 Estimated total Pu input into DP-Los Los Alamos Canyon from 1952 - 1973 (Top curve). The calculated Pu inventory in alluvial sediments (0-6600 m post-outfall) based on an average annual Pu loss of 23 percent per year.




30%/year
Accumulative Total Pu Input Into
DP-Los Alamos Canyon,
Calculating Formula
MCi Pu
32
30
28
26
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22
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18
16
14
12
10
8
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4
2
1.7
2.2
5.6
6.5
8.2
13.2
16.4
16.1
20
21
21.8
25.2
26.8
28.4
29.1
30.6
31.7
32.1
5.2
5.9
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4.5
4.3
3.3
3.1
2.4
72
73

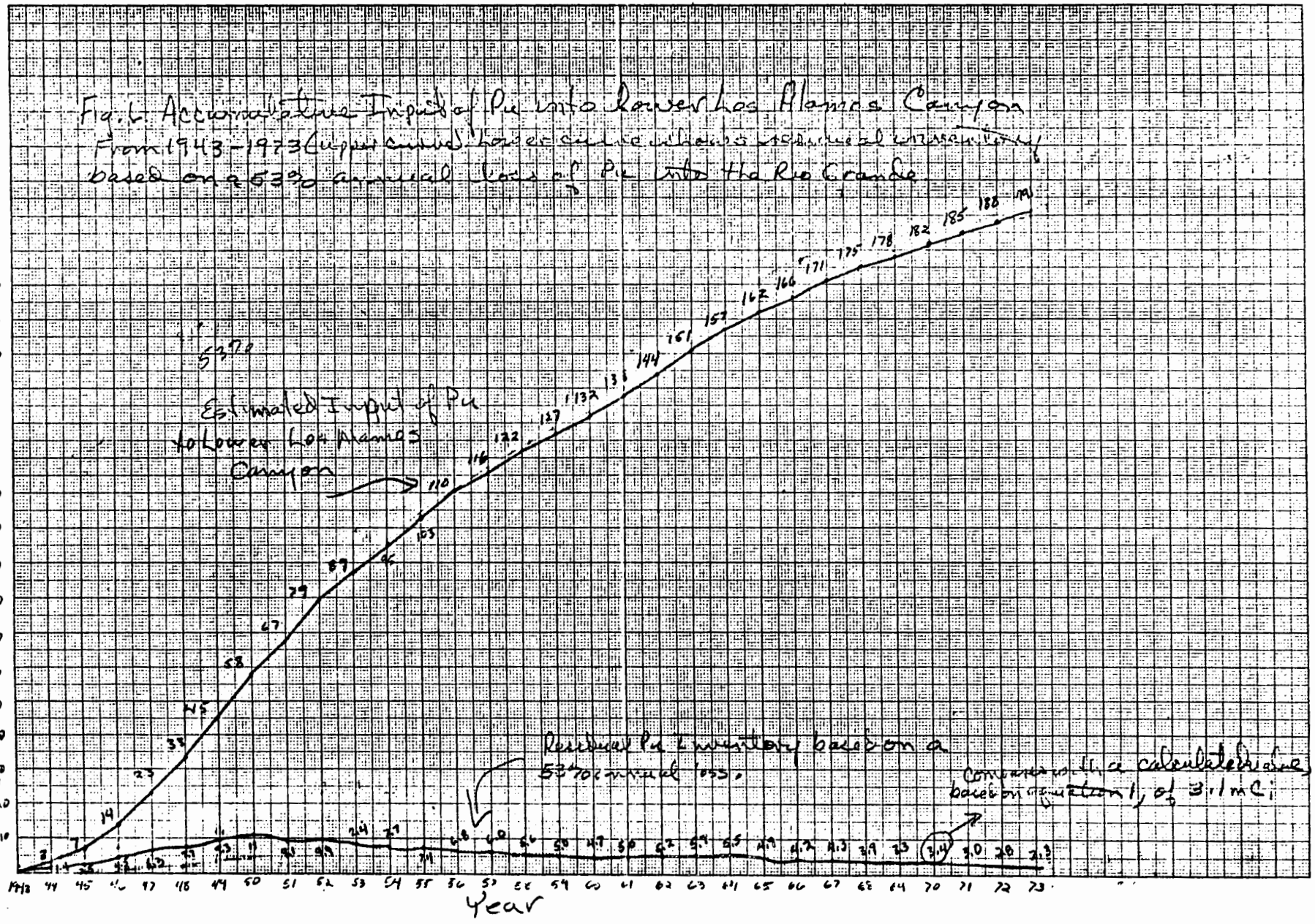
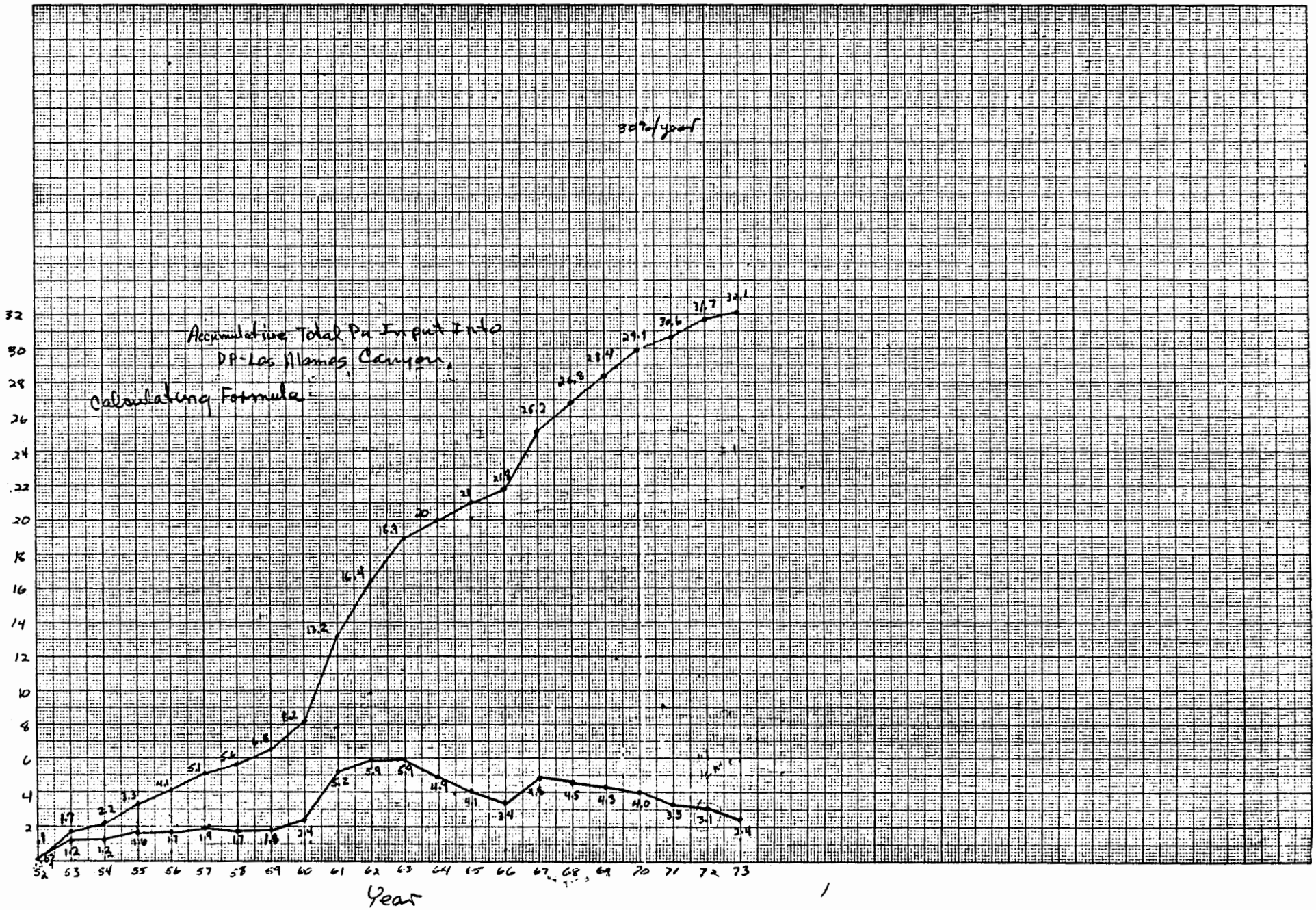


Fig. 6. Accumulative Input of Pu into lower Los Alamos Canyon
From 1943-1973 (upper curve) based on a 53% annual loss of Pu into the Rio Grande
53%
Estimated Input of Pu to Lower Los Alamos Canyon
Residual Pu Inventory based on a 53% annual loss.
Comparable to a calculated inventory based on Equation 1, of 3.1 mCi
mCi
Year


Accumulative Total Pu Input Into
DP-Los Alamos Canyon.
Calculating Formula:
Year

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P. O. Box 1663
Los Alamos, New Mexico 87544

IN REPLY REFER TO: H8-74-265

December 10, 1974

Frank Trainer
U.S.G.S.-WRD
P.O. Box 4369
Albuquerque, New Mexico 87106

Dear Frank:

Listed below are the results of radiochemical analyses of water from USGS test holes in the Jemez Mountains.

	Gross Alpha	Gross Beta	Total Uranium
	pCi/l		µg/l
Near Jemez Sprs.	6.6 ± .5	23.2 ± 1.5	.9
Near Battleship Rock	1.4 ± .3	40.2 ± 1.6	1.7
Near Porter	0.3 ± .2	8.9 ± 1.5	.1
Guadalupe Box	1.5 ± .3	10.9 ± 1.5	.06

Also enclosed is a copy of LA-5780-MS, as you requested.

Sincerely,

Bill Purtymun
Group H-8
Environmental Studies

WDP:pb
Enclosure

AN EQUAL OPPORTUNITY EMPLOYER

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Jim Owens, H-8 DATE: November 12, 1974

THRU : Stewart M. Lombard, H-8 SML

FROM : W. D. Purtymun, H-8 T.L.M.

SUBJECT : FLUOROMETER ANALYSIS OF JEMEZ MOUNTAINS SAMPLES

SYMBOL : H8-74-423

There are 40 samples from 4 locations in the Jemez Mountains taken at various dates between 11-29-73 and 7-30-74 to be analyzed in a fluorometer to determine the presence or absence of fluoroscene dye (a marker). These samples are to be returned, as they belong to the U.S.G.S. The 40 samples are numbered one to 40 as follows:

1.	11-29-74	Soda Dam	21.	5-10-74	Soda Dam
2.	11-29-74	Jemez Springs	22.	5-10-74	Jemez Springs
3.	1-18-74	Test Hole #1	23.	5-10-74	L. S. Spring
4.	1-25-74	Jemez Springs	24.	5-16-74	Soda Dam
5.	1-25-74	Soda Dam	25.	5-16-74	Jemez Springs
6.	1-25-74	L. S. Spring	26.	5-16-74	Test Hole #1
7.	2- 7-74	Test Well #1	27.	5-16-74	L. S. Spring
8.	3-18-74	Soda Dam	28.	5-28-74	Soda Dam
9.	3-18-74	Test Well #1	29.	5-28-74	Jemez Springs
10.	3-18-74	L. S. Spring	30.	5-28-74	L. S. Springs
11.	3-21-74	Jemez Springs	31.	6-11-74	Soda Dam
12.	4- 2-74	Test Well #1	32.	6-11-74	Jemez Springs
13.	4- 2-74	L. S. Spring	33.	6-11-74	Test Hole #1
14.	4- 8-74	Test Well #1	34.	6-11-74	L. S. Spring
15.	4- 8-74	L. S. Spring	35.	7-12-74	Soda Dam
16.	4-23-74	Test Well #1	36.	7-12-74	Jemez Springs
17.	4-23-74	L. S. Spring	37.	7-12-74	Test Well #1
18.	5- 3-74	Soda Dam	38.	7-12-74	L. S. Spring
19.	5- 3-74	Jemez Springs	39.	7-30-74	Soda Dam
20.	5- 3-74	L. S. Spring	40.	7-30-74	Jemez Springs

SML:WDP:dl

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Ed Williams, Q-23 DATE: March 3, 1975

FROM : Wm. D. Purtymun WDP

SUBJECT : MOISTURE AND DENSITY LOGGING OF BASALT HOLE

SYMBOL : H8-75-76

Attached is the moisture log (Table I) and density log (Table II) of the 97.5 ft (29.7 m) hole in basalt at TA-56.

The moisture content were run using a sonde with slightly different calibration than logs run on 10-25-74. The logs are compatible. There appears to be some increase in moisture content at the 11 ft depth due to snow melt into a fracture. The lower part of the hole (depth 90 to 97.5 ft) appears to contain some moisture (apparently free water in an interflow) that is cased out of the hole by the rock melt around the bore hole.

I went over the calibration for the density log and found that the decay factor for the source in the sonde had been corrected. I also found that the density calibration I used for the October 1974 logs were based on a specific gravity of basalt of 3.0. The standard calibration (set dia.of hole cased with steel tubing) could not be used in the basalt with the larger diameter coupled with rock melt on the hole wall. A new calibration based on a 2.6 specific gravity was prepared. For comparison the log of 10-25-74 was correct from this calibration and is shown on Table II. The density shown is wet density, for correction to dry density use Table I to determine lbs of moisture per cu ft and adjust. The density log, until we can make a precise calibration, should be used too as an indication of relative changes of the basalt penetrated by the hole.

The density data indicates that the hole penetrated two interflow zones between basalts of slightly different ages, one from 42 to 50 ft and the other from 88 to 97.5 ft (TD).

WDP:bh
Enclosures

Table I Moisture Content (Neutron Log) 1/

Depth (ft)	10-25-74	2-19-75	Depth (cont'd) (ft)	2-19-75
1	3.5	-	33	4
2	3	-	35	4
3	3.5	-	37	3.5
4	3	-	39	4
5	3.5	-	41	5.5
6	3.5	-	44	4.5
7	3.5	-	48	6
8	3	-	52	4
9	3.5	-	56	4
10	2	-	60	4
11	2	8.5	64	4
12	2	-	67	4.5
13	3	-	70	4.5
14	3	-	73	4.5
15	3	-	76	4.5
16	3	-	79	4.5
17	3.5	-	82	4.5
18	3.5	-	85	4.5
19	3	-	88	4.5
20	3	3.5	90	16
21	3	-	92	23.5
22	3	-	94	15
23	2	-	95	9
24	2	-	96	9
25	3	-	97	9
26	3	4	97.5	10
27	3	-		
29	-	4		

1/ Moisture Content (Percent by Volume)

Table II Density (Gamma Log) 1/

Depth (ft)	10-25-74	2-19-75	Depth (cont'd) (ft)	2-19-75
1	153	-	39	160
2	157	-	40	155
3	158	-	41	160
4	155	-	42	150
5	158	-	44	149
6	155	-	46	151
7	156	-	48	151
8	157	-	50	152
9	159	-	52	154
10	155	-	53	157
11	157	-	56	159
12	158	-	58	157
13	158	-	60	157
14	158	158	62	156
15	157	-	64	158
16	158	-	67	158
17	158	-	70	157
18	159	-	73	160
19	158	-	76	160
20	159	-	79	158
21	159	-	82	159
22	159	-	85	160
23	156	-	88	154
24	158	-	90	152
25	158	-	92	141
26	157	158	93	144
27	157	-	94	148
28	158	-	95	151
29	156	155	96	148
32	-	160	97	148
33	-	154	97.5	149
34	-	158		
35	-	157		
36	-	162		
37	-	163		
38	-	160		

1/ Density (lbs per cubic ft)
Note: Calibration based ona specific gravity of 2.6; 10-25-74 Log Adjusted for 2.6 sp. g.

LOS ALAMOS SCIENTIFIC LABORATORY
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LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Ed Williams, Q-23, ms-572

DATE: September 19, 1975

FROM : W. D. Purtymun, H-8 WP

SUBJECT : ANTICIPATED GEOLOGIC SECTION AT TA-56

SYMBOL : H8-75-308

Mail Stop : 522

Approximate Elevation of Site; 1890 m

Geologic Section	Thickness (m)	Depth (m)
Basaltic rocks of Chino Mesa		
Unit 2	105	105
Unit 1	70	175
Santa Fe Group		
Totavi Lentil	15	190
Tesuque Formation	>600	>790

Lithologic Description

Unit 2

Consists mainly of flows of basalt and basaltic andesite with a few local beds of basaltic breccia and sediments. The colors range from gray to dark gray. The basalt contains phenocrysts of olivine, pyroxene, and plagioclase. The gound mass is composed of plagioclase, clinopyroxene and some magnetite. The individual flows may be as much as 15.5 m thick and separated by a thin section of breccia and sediment.

Unit 1

Consists of basalt flows, breccia and interbedded sediments. The individual flows are generally thin (i.e. not more than 8 m thick). The major phenocrysts are olivine which may be altered to saponite and celadonite. The groundmass is labradorite, chinopyroxene, and some magnetite. The color ranges from dark gray to black. The interbedded sediments are arkosic sandstones and conglomerates containing some volcanic debris. The interbedded sediments and basaltic breccias may attain thickness of 6 to 8 m between the basalt flows.

Totavi Lentil

The Totavi Lentil is a gray, poorly consolidated channel fill conglomerate composed of quartz, quartzite, schists, gneiss and granite that range in size from sand to boulders. Well-sorted lenses of silt and sand are present sporadically.

Tesuque Formation

The Tesuque is a sequence of light-colored arkosic siltstones and sandstones that contain lenses of clay and pebbly conglomerate. The beds are friable to moderately well-cemented. Bedding is poorly developed except in the fine-grained materials.

Hydrology

Units 1 and 2 of the basaltic rocks of Chino Mesa may contain small quantities of perched water locally. This occurrence is generally in the lower part of the flow with the interbedded sediments acting as a perching layer.

The main zone of saturation will occur a depth of about 180 to 190 m below the site. A part of the Totavi and underlying Tesuque Formation are saturated.

WDP:pb

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OFFICE MEMORANDUM

TO : File

DATE: September 19, 1975

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : STOCKPILE AND STAGING AREA FOR PROPOSED LASER BUILDING, TA-35

SYMBOL : H8-75-307

Mail Stop: 522

The site for the building was visited with Dave Kirby, Eng-9, on 9/15/75. The site lies east of TA-50 and adjoins the other laser facilities to the east. The areas north, west, and south of the site are small and slope off rapidly into adjacent canyonsor drainage to the canyons.

The soil and tuff excavated will be used at the site. The soil and tuff, until used, will be stockpiled with similar materials at TA-55. The staging area for equipment and construction material is to be located in an open area north of TA-50.

Using the existing area at TA-55 for stockpiling the soil and tuff and the staging area north of TA-50, will have minimum effect on the native vegetation in the area, and will not introduce a new area for erosion and sedimentation.

WDP:pb
cy : Dave Kirby, Eng-9, ms 702

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : File - Mail Stop 490 DATE: October 3, 1975

FROM : William D. Purtymun, H-8 WDP

SUBJECT : DESIGNATION OF SAMPLING STATIONS, JEMEZ AREA (GTE)

SYMBOL : H8-75-349

Designation	Description
U	Redondo Creek at SR 4
V	Sulphur Creek at SR 4
F (U + V)	Sulphur Creek below Redondo
N	Rio San Antonio above Sulphur
J	Jemez River near Battleship
S	Jemez River above Rio Guadalupe
Q	Rio Guadalupe above Jemez River
R	Jemez River below Rio Guadalupe
T	Rio Cebolla
JF-1	Limestone Spr. near Battleship
JF-5	Soda Dam, Hot Springs
31	Cold Spring Lake Fork Canyon
4	LaCueva WS-Spring and/or Well
27	Hofheins Flowing Well
JS-2 and JS-3	Jemez WS, FS Trailer
JS-4 and JS-5	Jemez WS, FS Office

WDP:pb

CY: Howard Adams, H-7 ms 518
Alan Stoker, H-8 ms 490
Max Maes, H-8 ms 522

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : John Alquist, H-8 MS 490

DATE: November 7, 1975

FROM : W. D. Purtymun, H-8

SUBJECT : LOGS OF TEST HOLES AT TA-1

SYMBOL : H8-75-404

Mail Stop : 522

During drilling of holes at TA-1 it was not possible to distinguish soil weathered in place or fill, thus these two zones on the following table are logged as fill. The tuff penetrated by the test-hole appears to have a greater moisture content and weathered to a greater depth than other areas of the plateau.

Samples were collected at 2 ft intervals to a depth of 20 ft and at 5 ft intervals from depths of 20 to 30 ft in holes drilled with the auger.

Split-spoon samples were collected at 0.5 ft intervals except in the upper 4 ft of the first hole (DRD-5) where thay were at 1 ft intervals. The split-spoon was driven through the fill in the top of the tuff.

WDP:pb

Attachment: Log of Test Holes at TA-1 (Table)

CY: LaMar Johnson, H-8 Group Leader, MS 490
Alan Stoker, H-8, MS 490

LOG OF TEST HOLES AT TA-1

November 6, 1975

Hole[a/]	Log	Depth (ft) From	To
DRD-1	Fill	0	5
	Tuff, grey	5	19
	Tuff, reddish brown	19	21
	Tuff, grey	21	30
DRD-2	Fill	0	6
	Tuff, grey	6	15
	Hole caved, abandoned		
DRD-3	Fill	0	4
	Tuff, grey	4	16
	Tuff, reddish brown	16	17
	Tuff, grey	17	30
DRD-4	Fill	0	6
	Clay-reddish brown	6	18
	Tuff, grey, weathered	18	30
DRD-5[b/]	Fill	0	6
	Tuff, weathered	6	13
DRD-6	Fill	0	13
	Tuff, weathered	13	30
DRD-7	Fill	0	9
	Tuff	9	30
DRD-8[b/]	Fill	0	9.5
DRD-9[b/]	Fill	0	10
	Concrete ≈ 9.5'		

LOG OF TEST HOLES AT TA-1

November 6, 1975.

(Continued)

Hole	Log	Depth (ft) From	To
DRD-10[b/]	Fill	0	10
DRD-11	Fill	0	10
	Tuff	10	30
DRD-12	Fill	0	4
	Tuff	4	30
	Tuff wet to 22'		
DRD-13	Fill	0	3
	Tuff	3	30
	Fracture at ≈16' filled with clay		
DRD-14	Fill	0	8
	Hit concrete at 6', hole abandon, out of line		
DRD-14A	Fill	0	10
	Tuff	10	30
DRD-15	Fill	0	7
	Tuff	7	30
DRD-16	Fill	0	7
	Tuff	7	18
	Hole drilled to 28'. No cutting return, clay on bit.		
DRD-17	Fill	0	3
	Tuff	3	30
DRD-18	Fill	0	7
	Tuff	7	30

LOG OF TEST HOLES AT TA-1

November 6, 1975

(Continued)

Hole	Log	Depth (ft) From	To
DRD-19	Fill	0	3
	Tuff, grey	3	10
	Tuff, reddish brown	10	13
	Tuff, grey	13	30
DRD-20	Fill	0	4
	Tuff	4	30
DRD-21	Fill	0	9
	Tuff, weathered	9	26
	Clay, brown	26	30
DRD-22	Fill	0	9
	Concrete	9	10
	Tuff	10	30
DRD-23	Fill	0	9
	Tuff	9	30
DRD-24	Tuff	0	9
	Fill	9	30
	Hole offset ≈4' south of DRD-22		
DRD-25	Fill	0	5
	Tuff	5	30
	Tuff wet at 16'		

a/ Auger hole except as noted

b/ Split-spoon, Drive hammer

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OFFICE MEMORANDUM

TO : John Ahlquist, H-8 MS 490

DATE: November 12, 1975

FROM : W. D. Purtymun, H-8 WDP/pr

SUBJECT : LOGS OF TEST HOLES AT TA-1, November 12, 1975

SYMBOL : H8-75-447

Mail Stop : 522

Hole	Log	Depth (ft) From	To
DRD-26	Fill	0	9
	Tuff, light brown	9	14
	Tuff, weathered, clay	14	22
	Tuff, brown, weathered	22	30
DRD-27	Fill	0	9
	Tuff, light grey	9	12
	Tuff, weathered	12	28
	Poor cutting return from 12 to 23', No returns below 23'		
DRD-28	Fill	0	9
	Tuff, grey, weathered	9	30
DRD-29	Fill	0	9
	Tuff, weathered	9	30
DRD-30	Fill	0	10
	Tuff, grey, some weathering	10	30
DRD-31	Fill	0	10
	Concrete at 6 to 7', hole abandon		
DRD-32	Fill	0	11
	Tuff, grey	11	30
	8-inch pipe at 6'		

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Hole	Log	Depth (ft) From	To
DRD-33	Fill	0	4
	Tuff, light grey	4	28
	Wet at 16'		
DRD-34	Fill	0	3
	Tuff, light grey	3	13
	Tuff, reddish brown	13	16
	Tuff, dark grey	16	28
DRD-35	Fill	0	3
	Tuff, light grey	3	28
DRD-36	Fill	0	9
	Tuff, dark grey, wet, weathered	9	21
	Tuff, grey, wet	21	28
DRD-37	Fill	0	5
	Tuff, light grey	5	28
DRD-38	Fill	0	6
	Tuff, light grey	6	28
DRD-39	Fill	0	7
	Tuff, light grey	7	28
DRD-40	Fill	0	8
	Tuff, light grey	8	12.5
DRD-41	Fill	0	9
	Tuff, light grey, wet	9	16
	Tuff, dark grey, wet	16	17
	Tuff, grey, wet	17	28

TO: John Ahlquist DATE: November 12, 1975

Hole	Log	Depth (ft) From	To
DRD-42	Fill	0	8
	Tuff, dark grey, wet	8	12.5
DRD-43	Fill	0	8
	Tuff, light grey	8	12.5

WDP:pb

CY: LaMar Johnson, H-8 Group Leader, MS 490
Alan Stoker, H-8 MS 490

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : John Ahlquist, H-8 MS 490 DATE: November 24, 1975

FROM : William D. Purtymun, H-8 WDP/pt

SUBJECT : LOGS OF TEST HOLES AT TA-1, November 20, 1975

SYMBOL : H8-75-448

Hole	Log	Depth (ft) From	To
DRD-44	Fill	0	10
	Tuff, grey, weathered	10	28
DRD-45	Fill	0	10
	Tuff, grey, some weathering	10	28
	Concrete ≈ 6 ft		
DRD-46	Fill	0	10
	Tuff, grey	10	28
DRD-47	Fill	0	9
	Tuff,grey	9	18
	Tuff, dark grey, wet	18	28
DRD-48	Fill	0	9
	Tuff, light grey	9	17
	Tuff, dark grey, wet	17	28
DRD-49	Fill	0	11
	Tuff, grey	11	28
	Sample recovery poor below 20 ft		
DRD-50	Fill	0	10
	Tuff, grey, weathered	10	18

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Hole	Log	Depth (ft) From	To
DRD-51	Fill	0	6
	Tuff, dark grey, weathered	6	12
	Tuff, light grey	12	18
DRD-52	Fill	0	4
	Tuff, dark brown, weathered, wet	4	15
	Tuff, light grey	15	18
DRD-53	Fill	0	6
	Tuff, dark brown, weathered	6	15
	Tuff, grey	15	18
DRD-54	Fill	0	3
	Tuff, dark grey, wet	3	12
	Tuff, grey	12	18
DRD-55	Fill	0	3
	Tuff, dark grey, wet	3	11
	Tuff, grey	11	18
DRD-56	Fill	0	6
	Tuff, light grey	6	10
	Tuff, dark grey	10	18
DRD-57	Fill	0	9
	Tuff, light grey	9	16
	Tuff, dark grey	16	18
DRD-58	Fill	0	9
	Tuff, light grey	9	15
	Tuff, dark grey	15	18

November 24, 1975

Hole	Log	Depth (ft) From	To
DRD-59	Fill	0	9
	Tuff, grey	9	28
	Gravel or concrete 8 ft		
DRD-60	Fill	0	9
	Tuff, grey	9	28
DRD-61	Fill	0	10
	Tuff, grey	10	28
	Concrete ≈9 ft		
DRD-62	Fill	0	10
	Tuff, grey	10	18
	Tuff, brown, some weathering	18	28
	Concrete ≈9 ft		

Note: Log of holes DRD-1 through DRD-25 reported H8-75-404; Holes DRD-26 through DRD-43 reported H8-75-447.

WDP:pb
CY: LaMar Johnson, H-8 Group Leader, MS 490
Alan Stoker, H-8 MS 490

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : John Ahlquist, H-8 ms 490 DATE: November 26, 1975

FROM : William D. Purtymun, H-8

SUBJECT : LOGS OF HOLES AT TA-1, November 25, 1975

SYMBOL : H8-75-451

Mail Stop: 522

Hole	Log	Depth (ft) From	To
DRD-63	Fill	0	10
	Tuff, grey	10	18
	Gravel or Concrete 8 to 10 ft		
DRD-64	Fill	0	9
	Tuff, brown, weathered	9	15
	Tuff, grey	15	18
DRD-65	Fill	0	11
	Tuff, grey	11	18
	Concrete 10-11 ft		
DRD-66	Fill	0	9
	Tuff, grey, weathered	9	16
	Tuff, brown, weathered	16	18
DRD-67	Fill	0	10
	Tuff, grey some weathering	10	18

Preceeding logs reported in Memos H8-75-404, H8-75-447, and H8-75-448.

WDP:pb
CY: LaMar Johnson, H-8 ms 490
Alan Stoker, H-8 ms 490

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : John Ahlquist, H-8

DATE: December 16, 1975

FROM : W. D. Purtymun, H-8 WDP/pk

SUBJECT : LOGS OF HOLES AT TA-1, December 12, 1975

SYMBOL : H8-75-457

Mail Stop: 490

H-8 FILE
SD.
File

Hole	Log	Depth (ft) From	To
DRD-68	Fill	0	2
	Tuff, gray	2	4.5
DRD-69	Fill	0	2
	Tuff, brown, weathered (wet)	2	4.5
DRD-70	Fill	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-71	Fill	0	2
	Tuff, brown, weathered (wet)	2	4.5
DRD-72	Fill (gravel)	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-73	Fill	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-74	Fill	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-75	Fill	0	3
	Tuff, brown	3	4.5
DRD-76	Fill	0	4.5
DRD-77	Fill	0	3
	Tuff, brown weathered	3	4.5
DRD-78	Fill	0	3
	Tuff, gray (wet)	3	4.5

Hole	Log	Depth (ft) From	To
DRD-79	Fill	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-80	Fill	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-81	Fill	0	3
	Tuff, brown, weathered (wet)	3	4.5
DRD-82	Fill	0	4.5
DRD-83	Fill	0	3
	Tuff, gray	3	4.5
DRD-84	Fill	0	2
	Tuff, brown, weathered	2	4.5
DRD-85	Fill	0	2
	Tuff, brown	2	4.5
DRD-86	Fill	0	2
	Tuff, gray	2	4.5

Preceeding logs reported in Memos H8-75-404, H8-75-447, H8-75-448, and H8-75-451.

WDP:pb

CY: LaMar Johnson, H-8 MS 490
Alan Stoker, H-8 MS 490

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P. O. Box 1663
Los Alamos, New Mexico 87544

IN REPLY REFER TO: H8-7-76

January 5, 1976

Charles Shields
U. S. Forest Service
Jemez Springs, New Mexico 87025

Dear Charlie:

I am enclosing the following data on the test holes drilled by LASL in 1972 as you requested.

Test Hole A
Location - NE 1/4, NW 1/4, SW 1/4, Sec 18, T19N, R3E
Elevation - 8450 ft

Log	Thickness (ft)	Depth (ft)
Bandelier Tuff	30	30
Abiquiu Tuff	125	155
Abo Formation	335	590

Length of 4.5 in - OD Casing: 578 ft
Water levels - 1972, 490 ft; 1975, 485 ft
Water in Hole A occurs within the fine sediments of the Abo Formation. The drilling contractor who set the casing does not believe the well capable of yielding enough water for a stock well.

Test Hole B
Location - NE 1/4, NW 1/4, NE 1/4, Sec 31, T20N, R3E
Elevation - 8625 ft

Log	Thickness (ft)	Depth (ft)
Bandelier Tuff	380	380
Tschicoma Formation	60	440
Abo Formation	210	650

Length of 4.5 in - OD casing: 566 ft
Water levels - 1972, 451 ft; 1975, 453 ft.
Hole B is completed in the Abo Formation and water levels indicate the aquifer is in the fine sediments of the Abo; however, the aquifer extends up into the lower part of the Tschicoma Formation. The

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lower end of the blank casing is sealed with clay or fine sediments reflecting a water level below the base of the Tschicoma Formation. The drilling contractor who set the casing believes that the well would yield 2 to 5 gpm.

Test Hole C
Location - SE 1/4, SW 1/4, SE 1/4, Sec 9, T20N, R3E
Elevation - 8800 ft

Log	Thickness (ft)	Depth (ft)
Bandelier Tuff	240	240
Abiquiu Tuff	340	580
Abo Formation	170	750

Length of 4.5 in - OD casing: 750 ft
Water Levels - 1972, 328 ft; 1975, 316 ft.
The water levels indicate the aquifer is in the Abiquiu Tuff, in part, which is quite permeable. The water from the hole did not clear when the hole was bailed after the casing was installed. This may be due to water in the Abiquiu Tuff causing a positive pressure and entering the casing at the bottom of the hole, thus eroding fine sediments from the Abo. The hole could possibly yield 3 to 5 gpm from the Abiquiu.

Test Hole D
Location - SW 1/4, NW 1/4, SE 1/4, Sec 10, T19N, R2E
Elevation - 7900 ft

Log	Thickness (ft)	Depth (ft)
Bandelier Tuff	120	120
Abo Formation	380	500

Length of 4.5 in - OD casing: 500 ft
Water Levels - 1972, 70 ft; 1975, 61 ft.
The water levels indicate the aquifer is in the lower part of the Bandelier Tuff and Abo Formation. The hole would yield 2 to 5 gpm.

Note: The test holes were drilled for heat flow measurements. The 4.5 in. OD casing is blank (contains no slots). The holes indicated could be completed as stock wells by slotting the casing in place or by removing it from the hole and replacing it with slotted pipe. The casings are connected by thread coupling.

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The Abo Formation is made up of sediments which are mostly fine-grained (siltstones, shales and clays), thus the development of water for stock use from the Abo is slight. The best development for stock wells is in the base of volcanics (Bandelier Tuff, Abiquiu Tuff, or Tschicoma Formation) overlying the Abo. The top of the Abo forms a semi-impermeable barrier which perches water in the lower part of the overlying volcanics. However, the upper surface of the Abo is very irregular. Completing a well on a topographic high in the Abo would result in a dry hole while several hundred feet away a low in the Abo could contain water.

Based on experience in the area and discussion with the drilling contractor who set the blank casing (Don Laughlin, Shamrock Drilling Co., Espanola) low yield stock wells could probably be completed in Holes B, C, and D with a greater part of the yield coming from the volcanics.

The Forest Service stock well (Windmill) in Lake Fork Canyon was measured in August. The water level in the 210 ft. deep well was at 161 ft.

Attached is a map showing location of the test holes.

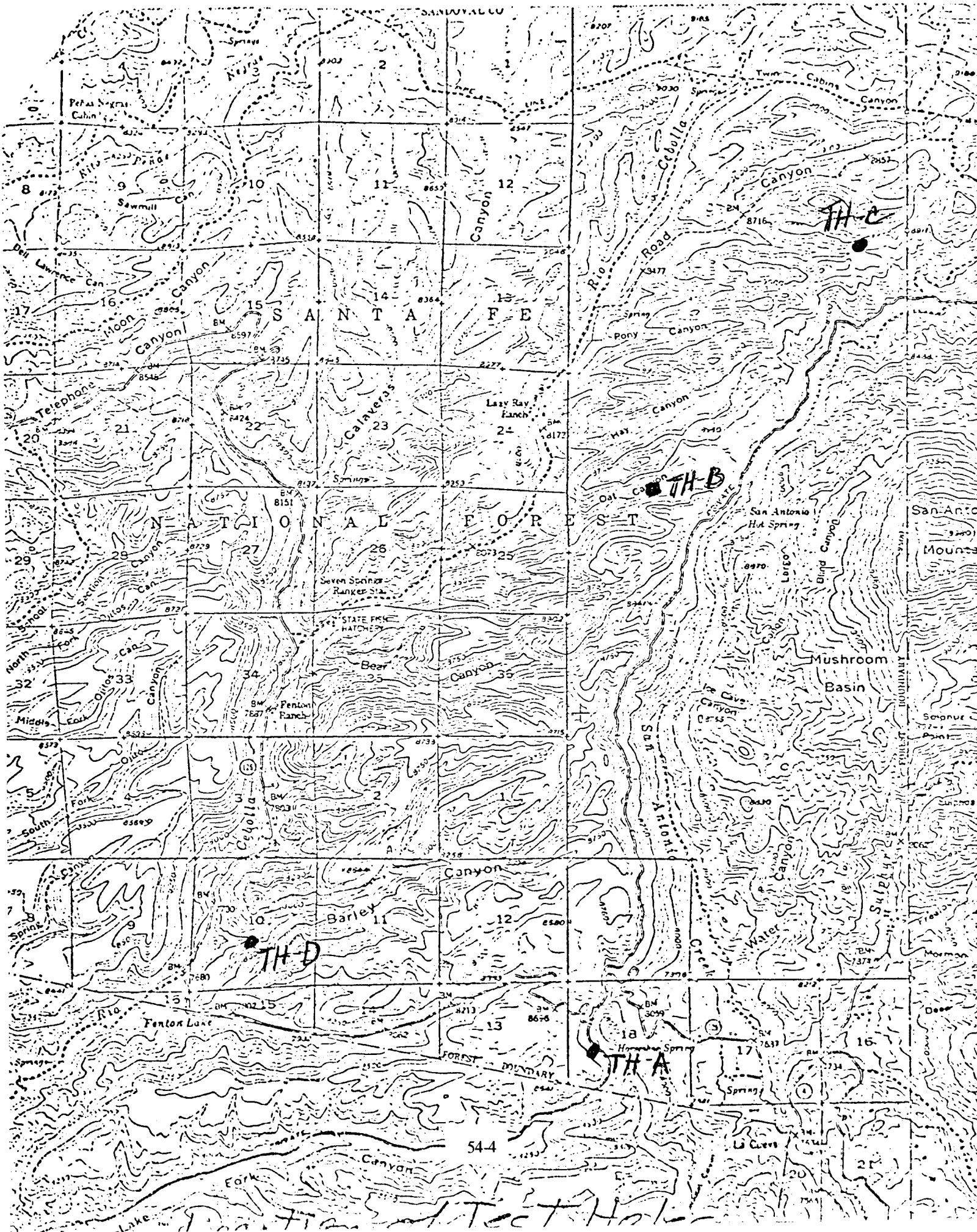
For additional information, please contact us.

Sincerely,

Bill

W. D. Purtymun
Group H-8
Environmental Studies

WDP:pb
CY: Mort Smith, Q-22
Robert Hendron, Q-22
Ken Rea, H-8


SANDOVAL CO
S A N T A F E
N A T I O N A L F O R E S T
Twin Cabins Canyon
Cebolla
Canyon
Rio Road
Pony Canyon
Hay Canyon
Oat Canyon
Lazy Ray Ranch
Calaveras
Moon Canyon
Telephone
Sawmill Can
Seven Springs Ranger Sta
STATE FISH HATCHERY
Bear Canyon
Fenton Ranch
San Antonio Hot Spring
Mushroom Basin
Ice Cave Canyon
San Antonio Creek
Sulphur Canyon
Water Canyon
Barley Canyon
Fenton Lake
FOREST BOUNDARY
TH-A
TH-B
TH-C
TH-D
Test Hole

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OFFICE MEMORANDUM

TO : John Ahlquist, H-8

DATE: January 5, 1976

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : LOGS OF HOLES AT TA-1, DECEMBER 17-23, 1975

SYMBOL : H8-3-76

Mail Stop : 490

Hole	Log	Depth (ft) From	To
DRD-87	Fill (wet)	0	4.5
DRD-88	Fill	0	3
	Tuff, gray (dry)	3	4.5
DRD-89	Fill	0	1
	Tuff, gray (dry)	1	4.5
DRD-90	Fill	0	3.5
	Tuff, gray (dry)	3.5	4.5
DRD-91	Fill	0	4.5
	(Concrete 3-4.5 ft)		
DRD-92	Fill	0	1
	(Concrete at 1 ft)		
DRD-92A	Fill	0	1
	(Concrete at 1 ft)		
DRD-92B	Fill	0	4
	Concrete	4	4.5
DRD-93	Fill	0	3
	Tuff, brown, weathered	3	4.5
DRD-94	Fill	0	3.5
	Tuff, gray	3.5	4.5

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Hole	Log	Depth (ft) From	To
DRD-95	Fill	0	4.5
DRD-96	Fill	0	4
	Tuff, dark gray	4	4.5
DRD-97	Fill	0	2
	Tuff, gray	2	4.5
DRD-98	Fill	0	3
	Tuff, dark gray	3	4.5
DRD-99	Fill (gravel & asphalt)	0	8
	Tuff, gray	8	10
DRD-99A	Fill (gravel & asphalt)	0	8
	Tuff, gray	8	13
DRD-100	Fill (wet)	0	4
	Tuff, dark gray, weathered	4	13
DRD-101	Fill	0	2
	Tuff, dark gray	2	8
DRD-102	Fill	0	6
	(Concrete at 6 ft)		
DRD-103	Fill	0	3
	Tuff, gray	3	8
DRD-104	Fill (wet)	0	6
	Tuff, gray	6	13
DRD-105	Fill	0	4
	Tuff, gray	4	10

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Hole	Log	Depth (ft) From	To
DRD-106	Fill	0	6
	Tuff, gray	6	13
DRD-107	Fill	0	5
	Tuff, brown, weathered	5	14
	Tuff, dark gray	14	18
DRD-108	Fill	0	5
	Tuff, gray	5	11
	Tuff, brown	11	15
	Tuff, dark gray	15	20
DRD-109	Fill	0	4
	Tuff, brown (wet)	4	8
	Tuff, dark gray (wet)	8	10
DRD-110	Fill	0	3
	(Concrete at 3 ft)		
DRD-110A	Fill	0	4
	Tuff, gray	4	10
DRD-111	Fill	0	6
	Tuff, reddish brown (wet)	6	13
DRD-112	Fill	0	4
	Tuff, dark gray (wet)	4	11
	Tuff, reddish brown (wet)	11	13

Preceeding logs reported in Memo H8-404-75, 447, 448, 451, and 457.

WDP:pb
CY: LaMar Johnson, H-8, MS 490
Alan Stoker, H-8, MS 490

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OFFICE MEMORANDUM

TO : LaMar Johnson, H-8 Group Leader, MS 490 DATE: January 7, 1976

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : SEEPAGE PITS DP-East (TA-21-DPE-164)

SYMBOL : H8-6-76

A reconnaissance was made of the seepage pits at DP-East in reference to contamination reported by Group H-7. The pits received about 2.5 curies of ^{227}Ac and an unknown amount of ^{210}Po in 1951 and 1952. On December 18, 1975 water from a cooling process was being released into the west pit from a near-by building. There appears to be permanent water in the west pit, but there is no overflow into the adjacent drainage at this time. The pits are within a fenced area that is posted. Outside the fence are two drains that carry small amounts of water from the near-by building. Flow is through culverts into DP Canyon.

Group H-7 collected seven soil and water samples in the area. The analytical results and locations are shown on Fig. 1. The high concentrations of gross alpha reported are in the pits inside the fenced area.

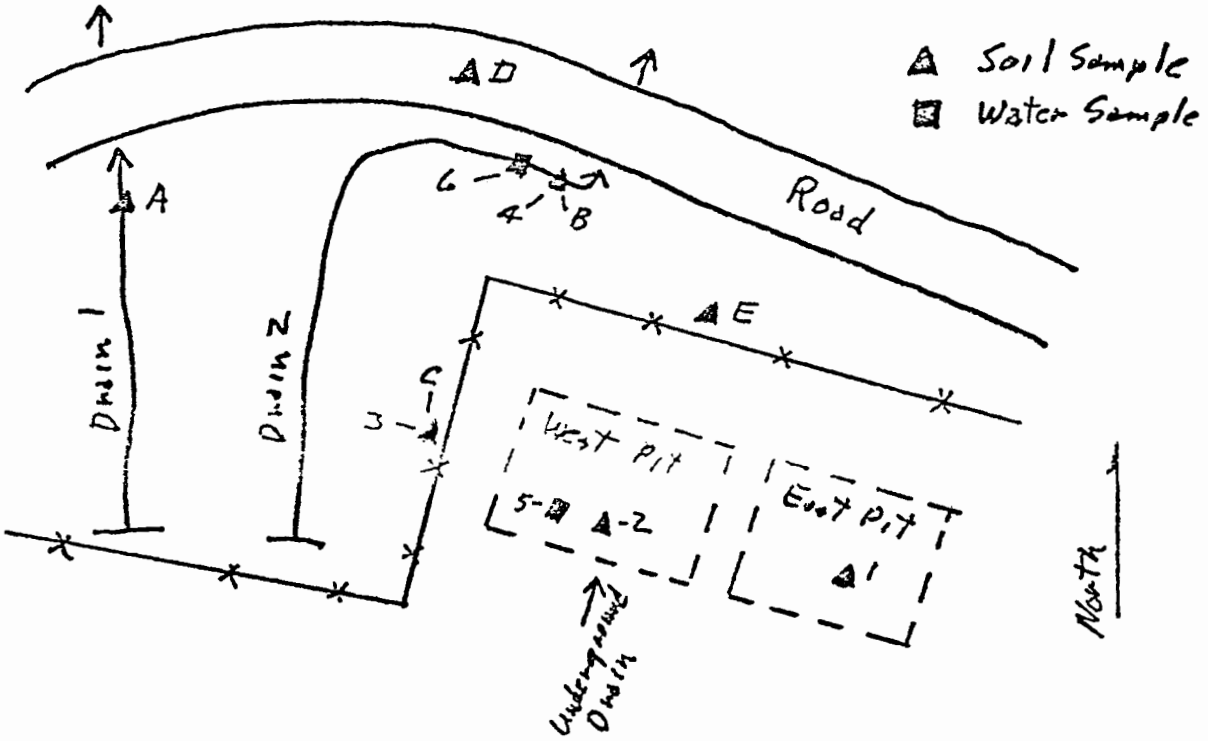
Five soil samples were collected and screened by the ZnS Alpha Detection System at TA-1. The results and locations of stations are also shown on Fig. 1. The samples were collected outside the fence. Only one sample (drain 2) was above 44 d/m/g which is the detection limits of the instrument.

A survey (Group H-1) was made of the area outside the fence (road, drains, ditches, and slope) and the berm area inside the fence adjacent to the pits using a Phoswick Survey Instrument. The results were below the limits of detection of the instrument which is about 2200 d/m/g.

Water in Drain 2 (Location 6, 148 d/m/ℓ) and soil from Drain 2 (Locations 4, 7.4 d/m/g; and B, 120 d/m/g) are above natural background for soil and water. Overflow from the pits has probably occurred from the West Pit during periods of heavy precipitation or release of water into the pits carrying contaminates into Drain 2. It is also possible that there is some release of contaminates from the near-by building into Drain 2.

The survey indicates that there is low-level alpha contamination in the area outside the fence, which is not as great as occurs in the release area in DP Canyon from Building 257 at DP-West. Studies with greater detail may be considered in the future. Also consideration should be given to end release of water into the pits from the near-by buildings.

WDP:pb
CY: Wayne Hanson, H-8 MS 490
Kenneth Apt, H-8 MS 490
Tom Gunderson, H-8 MS 490
Jerry Buchholz, H-7 MS 518



Group H-7 Analyses (12-12-75)

Location	Description	Gross Alpha[a/]
1	Soil 0 - 2" (East Pit)	7860 d/m/g
1	Soil 2 - 4" (East Pit)	730 d/m/g
2	Muck Surface (West Pit)	1990 d/m/g
3	Soil Surface (Outside Fence)	12.5 d/m/g
4	Soil Surface (Drain 2)	7.4 d/m/g
5	Water (West Pit)	40 d/m/ℓ
6	Water (Drain 2)	148 d/m/ℓ

[a]Acid Leach

Group H-8 Soil Analyses (12-22-75)

Location	Description	Gross Alpha[b/]
A	Surface (Drain 1)	<44 d/m/g
B	Surface (Same H-7 Loc. 4)	120 d/m/g
C	Surface (Same H-7 Loc. 3)	<44 d/m/g
D	Surface (Composite Road)	<44 d/m/g
E	Surface (Slope)	<44 d/m/g

[b]Direct counting ZnS alpha detection system

Figure 1 Location of sampling stations and table of results.

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OFFICE MEMORANDUM

TO : John Ahlquist, H-8 MS 490 DATE: February 3, 1976

FROM : W. D. Purtymun, H-8

SUBJECT : LOGS OF HOLES AT TA-1

SYMBOL : H8-76-45

Hole	Log	Depth (ft) From	Depth (ft) To
TU-RD-1	Fill	0	18
	Tuff, brown, weathered	18	28
TU-RD-2	Fill	0	6
	Hole caved abandoned		
TU-RD-2A	Fill	0	8
	Fill (?), no cuttings recovered	8	16
TU-RD-2B	Fill	0	16
	Tuff, dark gray, wet	16	27
TU-RD-3	Fill	0	9
	Tuff, gray, wet	9	27
TU-RD-4	Fill	0	15
	Tuff, gray, wet	15	27
TU-RD-5	Fill	0	12
	Tuff, gray, wet	12	17
	Tuff, dark gray, dry	17	24
TU-RD-6	Fill	0	4
	Tuff, gray	4	12

COPY

Hole	Log	Depth (ft) From	To
TU-RD-7	Fill	0	5
	Tuff, brown, weathered	5	13
TU-RD-8	Fill	0	4
	Tuff, dark gray, some brown weathering	4	13
TU-RD-9	Fill	0	5
	Tuff, gray	5	13

Note:

Holes TR-UD-1 to TR-UD-5 are located on fill overlying a channel cut in the tuff. Hole TR-UD-3 contained free water in the fill above the tuff the day after it was completed.

Hole	Log	Depth (ft) From	To
RD-1	Fill, wet	0	10
	Tuff, brown, weathered, wet	10	12
	Tuff, gray, dry	12	18
RD-2	Fill, wet	0	8
	Tuff, brown, weathered, wet	8	12
	Tuff, gray, dry	12	18
RD-3	Fill	0	4
	Tuff, gray	4	13
RD-4	Fill	0	3
	Tuff, gray	3	10
RD-5	Fill	0	2
	Tuff, gray	2	10

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Hole	Log	Depth (ft) From	To
RD-6	Fill	0	7
	Tuff, reddish brown weathered	7	18
RD-7	Fill	0	8
	Tuff, brown, weathered	8	13
	Tuff, gray	13	18
RD-8	Fill	0	2
	Tuff, dark gray	2	13
RD-9	Fill	0	1
	Tuff, gray	1	8
RD-10	Asphalt and Fill	0	1
	Tuff, gray	1	8
RD-11	Fill	0	1
	Tuff, gray	1	8
RD-12	Tuff, gray	0	8
RD-13	Fill	0	7
	Tuff, gray	7	13
RD-14	Fill	0	5
	Tuff, brown weathered, joint red clay ≈9 ft	5	13
RD-15	Fill	0	2
	Tuff, light gray	2	10
RD-16	Fill	0	8
	Tuff, reddish brown	8	18

WDP:pb
CY: LaMar Johnson, H-8 MS 490
Alan Stoker, H-8 MS 490

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OFFICE MEMORANDUM

TO : File

DATE: April 15, 1976

FROM : W. D. Purtymun, H-8 WDP/pk

SUBJECT : FIELD NOTES HOLE M-1, TA-54

SYMBOL : H-8

Hole M-1 was drilled at an angle of about one (1) degree above horizontal at an elevation of 6626.1 ft about 175 ft east of Pit 3. The hole became horizontal at a distance of 40 to 50 ft and then assumed a negative angle the remaining length of the hole (287 ft).

The hole was collared in Unit 2A and penetrated about 114 ft of the Unit before entering the interflow pumice above the top of Unit 1B (see sketch on page 2 of notes). The hole penetrated the top of Unit 1B at 143 ft and continued a downward pitch in this unit to 287 ft.

Unit 2A is a moderately welded tuff, light pinkish gray with a few small inclusions of rhyolite and dark gray devitrified pumice fragments. The number of joints observed in the core in the 114 ft section was twenty (20). Of these, five (5) contained white filling or precipitate plating and fifteen (15) were filled or plated with brown clay. The joint frequency was about one joint for every 6 ft of the unit penetrated. Amount of core recovered was about 103 ft for a core recovery of about 90%.

The interflow zone at the base of Unit 2A, from 114 to 143 ft, was a light gray nonwelded tuff with large dark gray pumice fragments. The vertical thickness of the interflow zone was about 1.7 ft. At the base was a well sorted friable sand made up of sanidine and quartz crystals and crystal fragments in a light gray ash. No joints were observed in the core recovered. Core recovery was about 8 ft for the interflow section for a core recovery of about 29%.

The upper section of Unit 1B is a moderately welded grading downward into a nonwelded tuff. The tuff is light gray, pumiceous, containing large devitrified pumice fragments and small rock fragments of rhyolite in an ash matrix. The hole penetrated the moderately welded section from 143 ft to about 185 ft (vertical section about 4 ft). Three (3) joints filled or plated with brown clay were observed in the core. Joint frequency in this section was about one joint for 14 ft of penetration. Core recovery from 143 to 185 ft was about 29 ft or about 69%.

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The tuff of Unit 1B became more friable (nonwelded) with increasing size of pumice fragments from 185 to 287 ft (vertical thickness about 11.5 ft). Core recovery in the 102 ft of penetration was 21 ft or about 20%. No joints were observed in the core recovered.

Attached are field notes showing joints observed in core, core run number, distance cored, amount of core recovered, general lithology of core and sketch of geologic units and trace of Hole M-1.

Core recovery in Unit 2A which underlies the pit is good in the order of 90%. It is necessary to over core (barrel 10 ft) to about 11 or 11.5 ft to retain core in the barrel. Unit 2A extends to a depth of 10 ft below the pit in the area of principal interest.

Core recovery in the interflow zone at the base of Unit 2A and non-to-moderately welded section of Unit 1A ranged from 20 to 69%. Various techniques were tried to improve core recovery such as short core runs, over core as much as 5 ft, pushing barrel through tuff, varying speed of rotation as well as rate of penetration. The major problem is the physical characteristics of the tuff nonwelded (friable) with large pumice fragments causes the core to break up into small pieces which are blown out or fall out of inter-barrel as it is pulled from the hole. The core retainer is to small to hold the broken core in the barrel. If additional coring in the nonwelded units is contemplated, a "basket type" retainer should be obtained.

A sampling system to collect cutting during a core run is being plumbed into the air-exhaust system to back up monitoring as well as study if core recovery is poor.

WDP:pb
cc: LaMar Johnson, MS 490
Merlin Wheeler, MS 737
M. A. Rogers, MS 737

Field Notes M-1 4-13-76

Note J 25W = Joint ≈ 25° white precipitate
J 30B = Joint ≈ 30° Brown clay

Distance from Collar in feet

0 10 20 30 40 50 60 70 80 90 100

J25W J60W CF CF J30B J70B J80B CF CF CF J5B J5B

J70W J30W J10B CF J70B J5B J70B CF J5B J5B CF

Core Run

#1 - 5.4 | #2 - 5.0 | #3 - 5.2 | #4 - 5.0 | #5 - 10.1 | #6 - 10.7 | #7 - 11.8 | #8 - 10.5 | #9 - 11.5 | #10 11.6 | #11 10.8

5.2 5.2 4.6 4.2 10.0 9.0 9.0 5.9 10.0 10.0 10.0

Core Recovery

Tuff, Moderately welded, light pinkish gray

Distance from Collar in feet

100 110 120 130 140 150 160 170 180 190 200

58-3

J70W J10B J10B J30B J15B J60B

J60B J45B J60B CF CF CF

Core Run

#12 11.8 | #13 10.5 | #14 12.3 | #15 12.0 | #16 14.0 | #17 14.0 | #18 - 14.0 | #19 - 10.5

10.0 10.0 8.0 0.0 11.0 10.0 10.0 5.5

Core Recovery

Tuff, light pinkish gray | Interflow pumaceous nonwelded | Tuff, nonwelded to moderately weld, light gray pumaceous

Elevation 6622.6

Elevation 6620.9

Edge of pit Elev 6617.8

Elevation 6615.9

Field Note M-1 Cont.

Distance from Collar in Feet

200 210 220 230 240 250 260 270 280 290 300

← No or poor core recovery – no obs. joints in core recovered →

Core Run

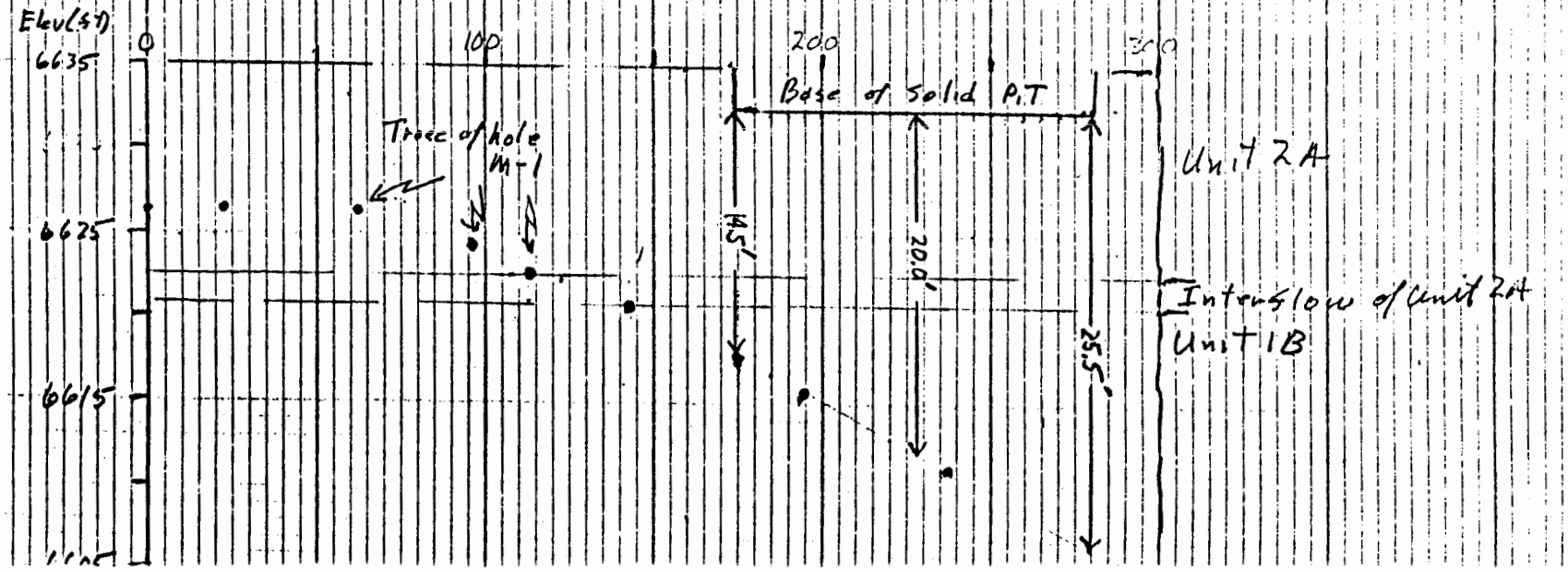
#20 – 13.5	#21 – 11.5	#22-3	#23 – 14.5	#24 – 11.0	#25 – 14.5	#26 – 16.5	#27 – 7.5
0.4	0.0	0.0	1.5	0.0	6.0	1.0	7.0

West edge of Pit

Tuff, nonwelded, light gray, large pumice fragments

Elevation 6611.4

Sketch showing Geologic Units and Hole M-1



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OFFICE MEMORANDUM

TO : Al Blair, Q-DO MS 570 DATE: April 30, 1976
THRU : Alan Stoker and LaMar Johnson, H-8

FROM : W. D. Purtymun, H-8

SUBJECT : U. S. GEOL. SURVEY SURFACE WATER GAGING STATIONS ON THE JEMEZ RIVER NEAR BATTLESHIP ROCK AND ON THE RIO GUADALUPE.
SYMBOL : H8-76-180

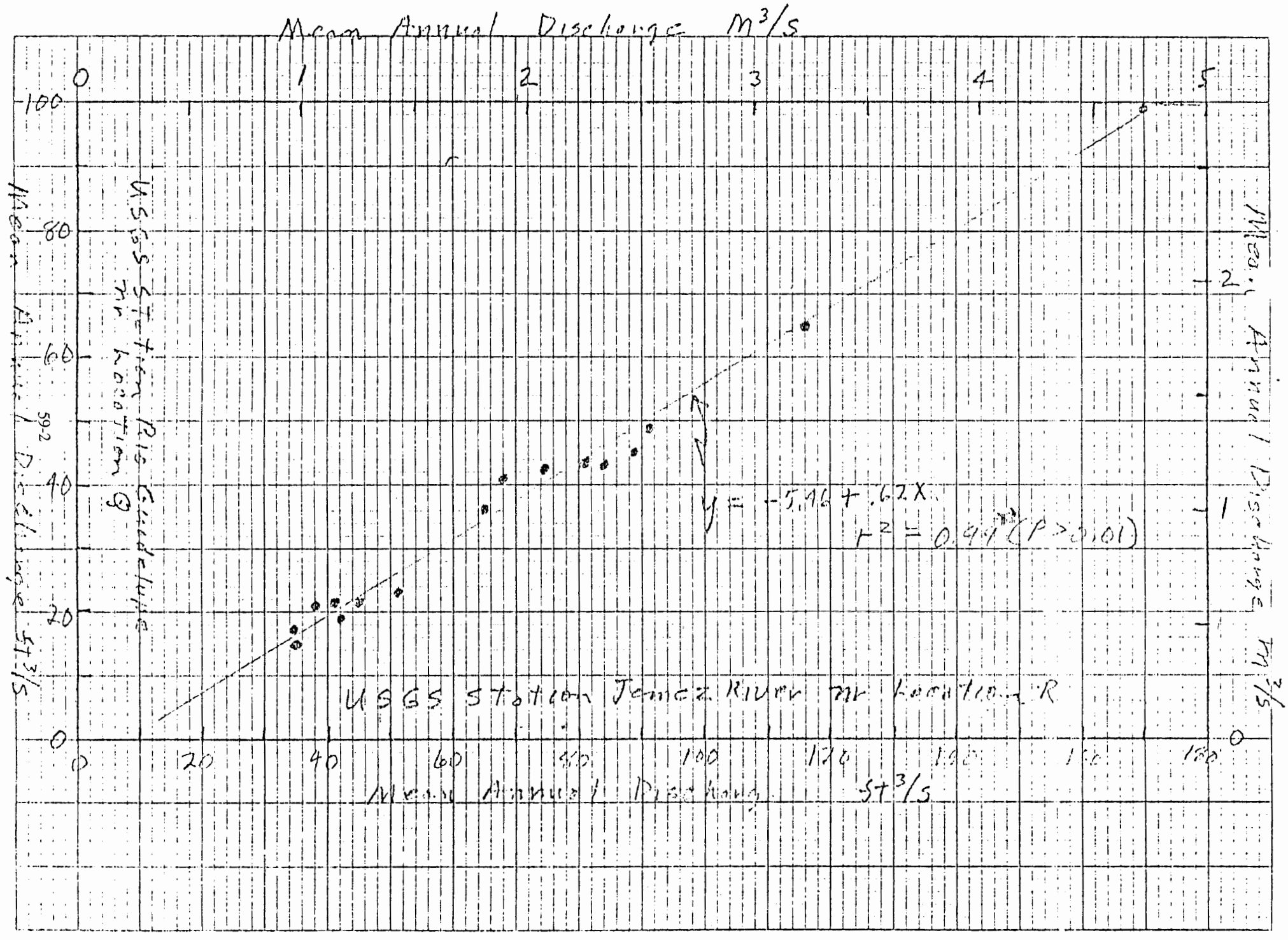
Stream characteristics at both gaging stations are well defined with over 18 years of continuous records. The discharge for the Jemez River near Battleship has ranged from 3 to 1030 CFS and that for the Rio Guadalupe from 3 to 1350 CFS. The station ratings are only good for ±10 percent, thus any small increase or decrease in flow would be impossible to determine.

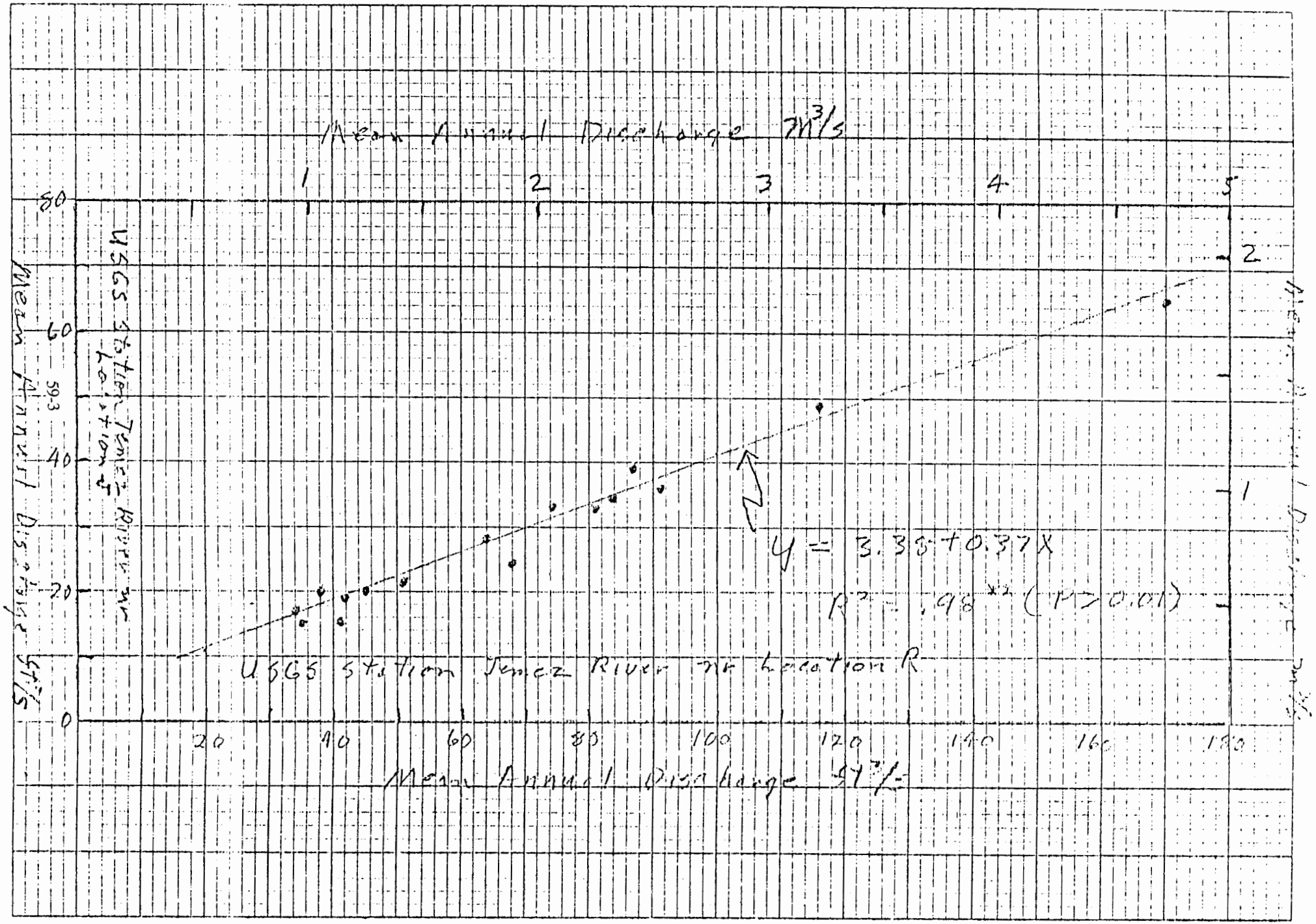
A linear regression of the mean annual discharge of both stations (y variable) versus station near Jemez Pueblo (x variable), a permanent USGS gaging station indicates a very good correlation (attached). Annual volume of water at Jemez near Battleship Rock and the Rio Guadalupe can be estimated from the station near Jemez Pueblo. Records from the station are available for public inspection and use.

The station near Jemez Pueblo is equipped with a digital as well as a standard water-stage recorder, thus peak flows day and hour can be determined.

The basic hydrologic characteristics at the two stations, maintained with Laboratory funds by the U. S. Geol. Survey, are well established. No additional data can be obtained by continued operation of the stations (near Battleship Rock and the Rio Guadalupe) at this time.

WDP:pb
Attachment


Mean Annual Discharge m³/s
0
1
2
3
4
5
100
80
60
40
20
0
Mean Annual Discharge ft³/s
USGS Station Rio Grande near Location Q
y = -5.46 + .62X
r² = 0.91 (P > 0.01)
USGS Station Jemez River near Location R
0
20
40
60
80
100
120
140
160
180
Mean Annual Discharge ft³/s
Mean Annual Discharge m³/s


Mean Annual Discharge m³/s
1
2
3
4
5
80
60
40
20
0
Mean Annual Discharge m³/s
USGS Station Jemez River nr Location R
y = 3.33 + 0.37x
R² = .98** (P > 0.01)
20
40
60
80
100
120
140
160
180
Mean Annual Discharge m³/s
2
1
Mean Annual Discharge m³/s

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OFFICE MEMORANDUM

TO : Alan K. Stoker, H-8

DATE: May 19, 1976

FROM : W. D. Purtymun, H-8

SUBJECT : USE OF IODINE 131 AT TA-57

SYMBOL : H8-76-253

MAIL STOP: 490

Iodine 131 is used as a tracer in standard oil field work. The tracer is placed in the logging tool, lowered to the depth in the hole for study, and then released. The tracer in the hole is then followed by the standard gamma logging tool.

Iodine was used in hole EE-1 in June 1975 to locate a hole in the casing. It was released at a depth of about 4600 ft. and traced upward to the hole at about 300 ft.

It was also used in March 1976 in both holes, GT-2 and EE-1, in an effort to determine the shape and orientation of the fracture between the two holes (memos H-1T-76-116, H-1T-76-4445). The tracer was released at a depth of about 9600 ft. Hole EE-1 was pressurized and fluids and tracer moved through the fracture into GT-2. Subsequent pressurization and pumpage moved the tracer upward in GT-2 where it was collected into two ponds adjacent to the hole.

Most of the tracer reaching the ponds was retained as no overflow from the ponds has occurred. Some of the tracer may have been lost by infiltrating into the underlying tuff but the volume was probably small due to fine sediment accumulation in the base of the pond. The top of the aquifer perched in the lower part of the volcanics on top of sediments of the Abo Formation is at 380 to 400 ft. Water in the aquifer moves to the southwest where it is discharged through seeps and springs into Lake Fork Canyon and Rio Cebolla.

The losses when pumpage into EE-1 with return through GT-2 are about 20% (i.e., 10 gpm at EE-1, return 8 gpm at GT-2) apart of which is later recovered when pumpage ends. If leakage occurs in GT-2 above the granite in the sediment section of the hole it would be into a limestone aquifer that discharges along the Jemez River from Battleship Rock to Jemez Springs. The estimated transit time for water in the aquifer from GT-2 to the discharge area along the Jemez River is about 6 years (LA-5780-MS). There would be little if any movement if leakage of fluids should occur in the natural occurring fractures in the granitic section of the hole. Based on five aquifer tests to a depth of 6500 ft. the coefficient of transmissibility of the fractures were extremely low, ranging from 2.2 to 4.4 gpd/ft.

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It appears that the March 1976 use of iodine will have very little if any effect on the environment. The short half-life of iodine coupled with dilution with natural water would decrease the concentrations. Transport in aquifers is slow allowing for decay before reaching discharge areas. Further dilution will occur in the Rio Cebolla and Jemez River.

WDP:mar

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OFFICE MEMORANDUM

TO : LaMar Johnson, H-8 Group Leader MS 490 DATE: May 27, 1976

FROM : T. C. Gunderson, W. D. Purtymun, and T. E. Hakonson TH

SUBJECT : RESPONSE TO MEMO #H7-76-LAE-229

SYMBOL : H8-76-229

Your memo (H8-76-215) and the one from Emelity (H7-76-LAE-229) are viewed by this committee as two separate requests that are related only indirectly. This memo is in response to H7-76-LAE-229.

Of concern to this committee is that by supplying H-7 with a number representing a "safe" level of alpha activity in the evaporation pond, we will condoning what we feel from an environmental view point is an undesireable solution, to the liquid waste disposal problem.

The question, "what is a safe level of alpha activity in pond water?" is not particularly relevant to the radioactive waste treatment and associated environmental problems that could result from the proposed system. A number of studies demonstrate that the loss of radioactivity from water to sediments, algae, pond sides, etc. is both rapid and virtually complete (copies of various papers are in our files). The problem, then, becomes one of what constitutes a safe level of radioactivity in pond substrate, not one of what is safe for water.

What is of further concern to this committee is the presence of a variety of other radioactive and stable elements in the liquid effluents, some of which may have considerably greater environmental impact than alpha emittors. Setting a standard (e.g. a "safe" concentration for water) for many of these materials is extremely risky due to the lack of appropriate environmental data for many of them.

Consequently, we feel that the question posed the committee is not appropriate and should certainly not serve as a basis for pursuing this program.

We offer the following comments as support of our position, recognizing that such comments may exceed our charter as outlined by H7-76-LAE-229.

We question the use of solar evaporation ponds under

any conditions without supportive data justifying their feasibility and advantages over other, potentially more desirable systems. The implication from Emelity's memo is that evaporation ponds would require less energy in meeting "zero" discharge goals than say a gas or coal-fired total evaporation system. Until a complete comparative cost analysis has been conducted such an assumption is unfounded. The energy (dollars) required for environmental protection measures and for periodic and final cleanup of a pond area may be equivalent or exceed the energy demands of a closed evaporative system over the life of the respective systems.

Based upon 1975 data from H-7, about 20 mCi Pu, 7 mCi ^{90}Sr and 200 mCi ^{137}Cs would accumulate on pond sides, sediments, algae, etc. each year so that periodic cleanup would be necessary. Consideration must be given to the cost (i.e., energy) of such a cleanup, and more importantly to final cleanup upon facility decommissioning.

There is a lack of very crucial information which would indicate whether the pond system would work at all. For example, no one has measured the evaporation rate at Los Alamos. Figures on evaporation rates are quoted from data obtained in Santa Fe over 22 years ago. Consequently, we strongly urge that a pilot study using a small scale plant be conducted before rushing into an ill-conceived waste treatment program. A pilot study would determine actual evaporation rates as well as the effect of different chemical combinations on algal growth. Different pond designs could be tested to reduce wave action, resulting spray and suspended particulate transport.

Several major nuclear laboratories have, in the past, used small impoundments for short term disposition of radioactive liquids. Virtually everyone had problems with the control of radioactivity in such structures. These previous experiences must be carefully reviewed, before committing the LASL resources to such a facility.

Some of the problems that require consideration include leakage of water and radioactivity into surrounding strata, and physical and biological transport of radioactivity away from the pond (e.g., by wind, birds and other large and small animals). Such problems were encountered in the operation of solar evaporative ponds at Rocky Flats (conversation with M. A. Thompson at Rocky Flats by T. Gunderson). Although such problems represent a very minor health problem, they do represent a potentially

significant political problem.

Another factor which merits consideration is the odor resulting from the effluent. Current wastes have an acrid disagreeable odor which would likely emanate from a pond. Such an odor may limit certain uses of landscape surrounding a pond. The visual aesthetics of the estimated 10 acres of evaporation pond also must be considered in evaluating the impact of the program.

The land area currently contaminated in Mortandad Canyon amounts to about 1.7 acres while the proposed evaporation pond would contaminate 10 acres. It is difficult to see the advantages of contaminating an area nearly 6 times larger eventhough control of radioactivity may be better.

Our opinion is that total evaporation of effluent in a closed system provides the most desireable method of meeting zero release to the environment. Until comparative cost data are available, we recommend this approach be taken. Prior to doing a cost analysis, a study should be conducted to determine how much influent waste is absolutely necessary. Reduction of liquid and radioactive waste quantities at their sources may greatly reduce the cost (i.e., energy) required to solve our liquid waste problem, and may provide more options for meeting the zero release criterion.

One lesson of TA-1 is that long term planning is absolutely essential to avoid problems in the future.

TEH:pm

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : J. R. Buchholz, H-7

DATE: June 24, 1976

THRU : L. J. Johnson

FROM : W. D. Purtymun, A. K. Stoker

SUBJECT : DISPOSAL OF WASTE SULFURIC ACID FROM CMC-4 AT TA-46

SYMBOL : H8-76-301

REF : Memo H7-76-331 dated June 11, 1976
To: B.B. McInteer CNC-4

In reference to the proposal to dispose of 100-150 gal./day of H_2SO_4 by reacting with crushed limestone in an 8' diam. by 60' deep shaft we have certain reservations. We are not able to predict the effects of the disposal of that much acid by an untested method.

The method as outlined has not been used at Los Alamos for the disposal of large quanities of acid. As a consequence, we are not prone to approve of such a method of disposal with out a small pilot study. The break down of limestone will decrease the permeability of the tuff. The effect of acid or dilute acid on the tuff and movement of fluids and associated chemicals from the shaft are unknown. Another unknown is what other chemicals or radio-chemicals are associated with the acids.

Therefore we strongly recommend that a pilot study be conducted which will provide an opportunity to evaluate any potential environmental problems. It would also seem to be a good opportunity to work out some engineering problems which may arise. The pilot study will also permit the interim disposal of the waste acid solution.

Our suggestion is to construct a small shaft about 12-in. in diameter and 15 ft. deep. Adjacent to the shaft would be constructed 4 or 5, 3-in. diameter monitoring holes to a depth of 50 ft. These holes could be constructed with H-8 equipment.

The engineering design of the shaft drop line for acid, size of limestone, characteristics of limestone fill (interbeded with sand or gravel, etc.) and actual testing of the shaft by release of acid we would leave to H-7 and CNC-4.

After starting disposal of acid, H-8 would monitor for the movement of fluids in the tuff from the shaft. H-7 and CNC-4 would conduct tests necessary to determine engineering design of the proposed large shaft, i.e. volume of acid, pressure build-up if contained or fluid level if uncontained. At termination of the experiment, cores or cutting will be taken of tuff ajacent to the shaft to determine chemical properties associated with fluid movement.

These results together with other data taken during the pilot study could be evaluated to determine the overall feasibility and safety of the disposal method, as well as any long-range measures that might be found necessary.

xc:B.B. McInteer, CNC-4
J.L. Warren, H-7, MS 517
R.A. Penneman, CNC-4, MS 346
H.S. Jordan, H-DO, MS 690

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Bill Dunne, H-7

DATE: October 28, 1976

THRU : Alan Stoker, H-8

FROM : W. D. Purtymun, H-8

SUBJECT : ESTIMATE SIZE OF DISPOSAL PONDS OR SHAFTS

SYMBOL : H8-76-490

MAIL STOP: 490

The ponds or shaft to facilitate the infiltration of waste water at each Technical Area will probably be completed into a tuff. The coefficient of permeability of the tuff varies according to degrees of welding as shown by the table.

Tuff	Porosity Range (%)	Coefficient of Permeability (g pd/st^2)[a]
Welded	15-35	<0.01 - 0.10
Moderately Welded	30-55	.05 - 5.0
Non-Welded	40-60	2.0 - 20

a) Estimated from Laboratory Analyses (Vertical Permeability) of tuff (Abrahams, 1963 and Weir and Purtymun, 1964).

The vertical and horizontal permeabilities will vary slightly. The coefficient of permeability is defined as the number of gpd that will flow through a cross-section of one sq. ft under a hydrologic gradient of 1 ft at prevailing water temperatures. Laboratory analyses are corrected to 60°F.

The sites for disposal waste water were not visited. Identification of the possible tuff units present were made from a general knowledge of the geology of the area. Prior to construction of ponds or shafts a preliminary investigation should be made to define the type of tuff and its hydrologic characteristics. Suspended particles in waste water, growth of algae, and wind blown dust into ponds or shafts will decrease the permeability.

It has also been noted that after long periods of injection or release of water into the tuff the permeability decreases due to the pore-size of the ash matrix. Water is held in tension as the pod of injected fluids becomes larger. The intermittent release of fluids to the tuff can cause an "air-lock" which also decreases the permeability. These are some of the factors that will affect release of waste water in a tuff unit.

The following table presents a generalized description, estimates of permeability, and estimated surface area exposed to waste water necessary for the approximate volumes of flow. It is to be used for planning purposes only. Detailed field studies should be made prior to construction of infiltration ponds or shafts.

Attachment
(1) Table

WDP:kr

Structure No.	Probably Tuff Unit Present	Approximate (gpd) Flow	Estimated Permeability gpd/ft^2	Estimated surface area (ft^2)	Contaminant
TA-8-21[a]					Photo proc.
TA-8-22[a]	Welded	1500	0.05	30,000	Cooling, photo proc.
TA-15-183	Mod. Welded	3000	1.0	3,000	Photo rinse
TA-16-222	" "	700	1.0	700	Mixed HE; Cooling water
TA-16-260	" "	4500	1.0	4,500	H.E. Machining, Cooling, Wash
TA-16-280	" "	9000	1.0	9,000	H.E. Wash
TA-16-430	" "	5000	1.0	5,000	H.E. Machining, Cooling
TA-22-52	Welded (?)	4800[b]	.05	96,000	Photo, $FeCl_2$ -Organic Solvents
TA-9-21[a]	Welded	?	.05	-	H.E. Wash, (?)
TA-9-40[a]	Welded	?	.05	-	H.E. Wash, (?)
TA-36-1	Mod. Welded	?	1.0	-	Photo proc.
TA-33-86	Mod. Welded	1500[c]	1.0	1,500	Cooling

[a] Welded Tuff precluded use of septic tanks in area - const. evaporation pond.

[b] Intermittent Release 8-hr day at 10 gpm.

[c] Est ≈1 gpm

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : R. L. Henning, ENG-2, MS 984 DATE: December 8,1976

THRU : A. K. Stoker, H-8

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : TEST BORING PROPOSED BUILDING RD-33, TA-52 (Lab. Job 5654-52).

SYMBOL : H8-76-473

Five (5) test holes 22 feet deep were drilled near each corner and at the center of the proposed site for building RD-33 at TA-52. The thickness of soil or fill at the site ranges from 1 to 2 ft (Table 1). It is underlain by a light gray moderately welded tuff that has been mapped as Unit 3b of the Tshirege Member of the Bandelier Tuff.[1,2] The tuff is described as a ledge-forming crystal-fragment tuff containing numerous pebble size fragments of hard igneous rock. The tuff penetrated by the test holes was uniform over the area. Weathering of tuff beneath the fill or soil was generally less than one (1) ft. No water was encountered and moisture content of the tuff appeared to be less than 6% by volume.

The tuff can be described as a competent rock although no penetration tests were made at the site. About one mile west of the site, at TA-55, design recommendations for bearing pressures were 5×10^3 lb/sq ft for compacted soil or fill and 12×10^3 lb/sq ft for the tuff or Unit 3b.[1]

The average altitude at the site is 7184 ft. Test boring with penetration tests at the main UHTREX building, 200 ft to the east, were made in 1960 at a hole altitude of about 7172 ft or 12 ft lower than the proposed site. The penetration tests of 8 holes (≈7172 ft) at UHTREX for depths of 5 and 10 ft with N = 50 had a D that ranged 1 to 6 inches (note: "N" is equal to the number of blows of a drive hammer required to drive a 2 inch O.D., 1.375-inch ID, standard split spoon sampler through a vertical distance of "D" inches using a 140-lb hammer with a free fall of 30 inches). Interpretation of data based on experience indicates with N = 50 and D = 12 inches or less, the bearing capacity of the tuff is in the range of 50×10^3 lb/sq ft. The bearing capacity should be reduced by a factor of 5 for dead loads and a factor of 10 for live loads.

No bearing capacities of the tuff were made at the site. The preceding descriptions of bearing capacities are presented for ENG-1 and 2 evaluation.

TABLE 1

LOG OF TEST HOLES

	Thickness (ft)	Depth (ft)
Northeast Hole (8.5 ft west of corner)		
Soil or Fill	2	2
Tuff, light gray, moderately welded	20	22
Southeast Hole (5.5 ft west of corner)		
Soil or Fill	1	1
Tuff, light gray moderately welded	21	22
Northwest Hole (2 ft SE of corner)		
Soil or Fill	1	1
Tuff, light gray, moderately welded	21	22
Southwest Hole (7 ft east of corner)		
Soil or Fill	1	1
Tuff, light gray, moderately welded	21	22
Center Hole (67 ft west of SE corner and 20 ft north)		
Soil or Fill	1	1
Tuff, light gray, moderately welded	21	22

Note: No pumice zone or lenses were detected during drilling. The southeast hole encountered some hard igneous rocks (probably less than 2-in diam.) at various depths in the tuff.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544
Telephone Ext:

OFFICE MEMORANDUM

TO : FILE

DATE: April 6, 1977

FROM : W. D. Prutymun, H-8

SUBJECT : Log of Test Hole TA-45

SYMBOL : H8-77-217

MAIL STOP: 522

		Depth (ft) From	Depth (ft) To
Hole C-7	Fill	0	9
	Tuff, wet	9	28
Hole D-7	Fill	0	6
	Tuff, wet	6	13
Hole C-6	Fill	0	3
	Tuff, moist	3	8
Hole B-6	Asphalt	0	1
	Tuff, dry	1	6
Hole B-5	Fill	0	1
	Tuff	1	6
Hole B-4	Fill	0	1
	Tuff	1	6
Hole B-3	Fill	0	1
	Tuff	1	6
Hole C-5	Fill	0	4
	Tuff	4	6
	Weathered to Clay	6	8
	Tuff	8	10
Hole SP-2A	Fill	0	14
	Tuff	14	22

Hole SP-2B	Fill	0	12
	Concrete at 12'		
Hole Cor. F	Fill	0	8
	Tuff	8	17
Hole Cor. EA	Fill	0	3
	concrete at 3'		
Hole Cor. EB	Fill	0	3
	Tuff	3	8
Hole Cor. D	Fill	0	4
	Tuff	4	9.5
Hole HB-1	Fill	0	3
	Tuff	3	8
Hole Cor C	Fill	0	4
	Tuff	4	12
Hole SB-1	Fill	0	4
	Tuff	4	12
Hole SP-1	Fill	0	7
	Tuff	7	12
Hole Cor. B	Fill	0	4
	Tuff	4	13
Hole Cor A	Fill	0	3
	Tuff	3	12

cc: Jack Purson
Don Mayfield
Corey Cate

WDP:fd

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : M. Dean Keller, Eng. 1 MS 624 DATE: November 3, 1977

FROM : W. D. Purtymun and Ed Sagon

SUBJECT : Test Borings East of TA-48

SYMBOL : H8-77-816

Five test holes were completed in Unit 3 of the Tahinege Member of the Bandelier Tuff at a depth of 52 ft. (See attached sketch for location). The holes penetrated two subunits of Unit 3, the lower 3a and upper 3b. The tuff penetrated contained three drilling breaks representing different ashflows within the unit. The drilling breaks occured about 10 to 12 ft.; 22 to 24 ft.; and 37 to 42 ft. The flow from about 22 to 37 ft. was much harder than the flows above or below that interval. The contact between subunits 3b and 3a occured at the 37 to 42 ft. drilling break.

Unit 3 is a moderately welded ashflow unit. The tuff can be described as a compentent rock although no penetration tests were made at the site. About 0.25 mi. to the southeast at TA-55, design recommendations for bearing pressures for the tuff was 12 X 10^3 lbs/sq. ft. The tuff is moderately welded, excavation can be made using heavy equipment. No explosives will be needed.

Moisture content in TH-1 appeared to be excessive to a depth of about 7 ft. and probably reflects infiltration of run off into the soil and fill from the paned area around the main building. Moisture contents of the tuff determined from TH-3 and TH-5 were not excessive though slightly higher than found in undisturbed areas. This is due to runoff from paved areas and discharge to near by ponds that hold cooling water. Moisture contents of tuff from two test holes are shown below:

Depth (ft.)	Moisture Content (p/o by weight) TH-3	TH-5
0-7	7.6	7.7
7-12	8.1	9.2
12-17	8.9	9.3
17-22	8.4	9.6
22-27	7.6	7.9
27-32	7.5	7.7
32-37	6.7	8.0
37-42	7.1	7.3
42-47	7.3	8.6
47-52	6.8	7.3

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LOS ALAMOS, NEW MEXICO 87544

TO: M. Dean Keller, Eng. 1 MS 624 DATE: November 3, 1977

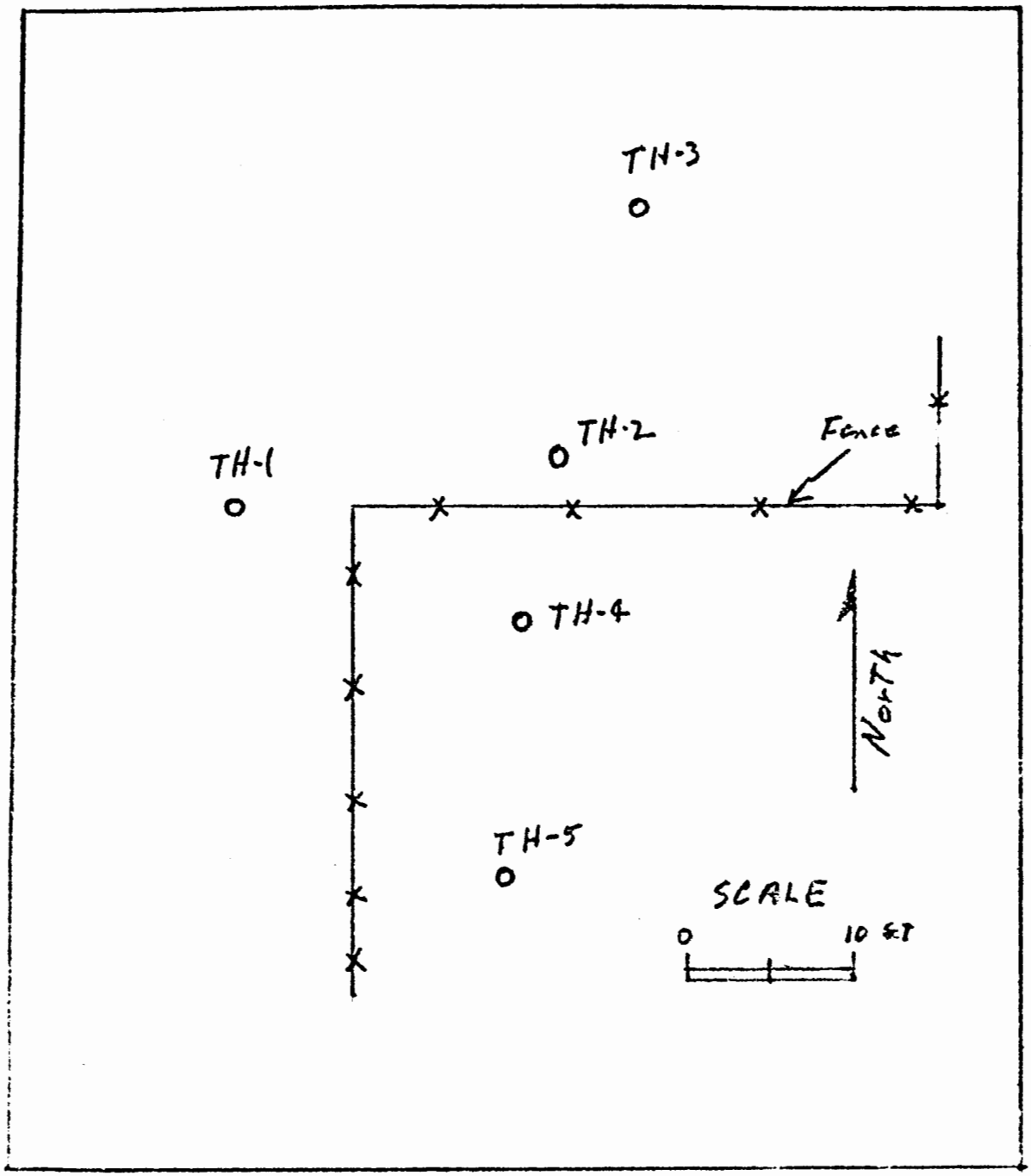
The following table presents a log of the upper sections of the test holes. The holes were completed in the tuff at a depth of 52 ft.

Test Hole	Description	From (St)	To (St)	Thickness (St)
TH-1	Fill and weathered soil and tuff wet	0	7	7
TH-2	Fill and weathered soil and tuff	0	4	4
TH-3	Fill and weathered soil and tuff, some gravel near surface	0	3	3
TH-4	Weathered soil and tuff	0	1	1
TH-5	Weathered soil and tuff	0	3	3

WDP&ES:pdb

cc: John Balagna CNC-11
Dave Kirby Eng-9

Enc.



Location of Test Holes- East side of TA-48

LOS ALAMOS SCIENTIFIC LABORATORY
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LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Joe Repa, Eng-2, MS-M984 DATE: November 16, 1977

FROM : W. D. Purtymun WDP and Ed Sagon ES

SUBJECT : TEST BORINGS AT PROPOSED STRUCTURE OCCUPATIONAL HEALTH LABORATORY OFFICE BUILDING

SYMBOL : H8-77-857

Twelve test borings were made in the area of the proposed building and adjacent parking area. The holes were augered 4-inches in diameter with the exception of hole 11 which was 12-inches in diameter. The depth ranged from 17 to 32 ft.

The holes were drilled into unit 3 of the Tshirege Member of the Bandelier Tuff. Unit 3 is composed of several ashflows of rhyolite tuff. The tuff is moderately welded made up of quartz and sanidine crystals and crystal fragements, small inclusions of rhyolite and latite rack fragments in a ash matrix. The tuff encountered in most of the borings was light gray. Holes 2, 7, and 9 encountered light pinkish gray and light red tuff which is the result alteration by gasses escaping along joints as the ashflows colled. Joints and fracture in the tuff are common. They are generally vertical or near vertical and have a frequency that varies from one joint from every 6 to 10 ft. of horizonal exposure.

Unit 3 is a moderately welded tuff that has a density that ranges from 70 to 115 lbs/cu. ft. with a porosity that ranges from 30 to 55 percent by volume. No penetration tests were made in the borings; however, based on past experience the design recommendations for bearing pressures are in the range of 10×10^3 to 12×10^3 lbs/sq. ft. Compacted soil and fill derived from the tuff generally have design recommendation for bearing pressures of about 5×10^3 lbs/sq. ft.

The tuff is a compentent rock that stands well in vertical cuts; however, due to jointing, the cuts should be made on a 1 to 5 slope to prevent stabbing. This refers to excavation of depth in which workmen will enter. The joints and altered tuff encountered in holes 2, 7, and 9 will not effect the compentency of the rock. Excavation can be made with heavy equipment. No explosive will be necessary.

The tuff is well above the main water table, at a depth of 1200 ft. below the mesa surface. The tuff is about 800 ft. thick at the site and is dry. On the plateau, the Bandelier tuff does not contain any known perched water.

The moisture content of soil and fill from the bore holes ranged from 5.7 to 9.9% by weight while that of the tuff ranged from 0.9 to 5.3% by weight (Table 2). This is within the normal range found on the plateau.

Table 1

LOG OF HOLES

	St From	St To
Hole 1		
Tuff, light gray	0	22
Hole 2		
Tuff, light red	0	3
Tuff, light reddish gray	3	22
Hole 3 (≈ 34' East of SW Cor of bldg.)		
Tuff, light gray	0	22
Hole 4 (≈ 30' East of NW Cor of bldg.)		
Tuff, light gray	0	22
Hole 5		
Tuff, light gray	0	17
Hole 6		
Fill or Soil	0	2
Tuff, light gray	2	17
Hole 7 (17' N of stake 7)		
Tuff, light reddish gray	0	3
Tuff, light gray	3	22
Hole 8 (South edge of parking lot)		
Fill	0	14
Tuff, light brown	14	17
Tuff, light gray	17	32
Hole 9		
Fill	0	1
Tuff, light pink, weathered	1	10
Tuff, light brown	10	12
Tuff, light brown, drilling break, soft	12	17
Tuff, light gray	17	32
Hole 10		
Fill	0	6
Tuff, weathered	6	7
Tuff, light gray	7	22
Hole 11 (12' dia≈ 25' west of hole 6)		
Tuff, light gray	0	22
Hole 12 (≈ 65' SW of stake 7)		
Tuff, light gray, drilling break 28 to 32 ft, softer	0	32

Table 2

MOISTURE CONTENTS OF BORE HOLE CUTTINGS

(percent by weight)

	Depth (ft)					
	0-7	7-12	12-17	17-22	22-27	27-32
Hole 1	1.8	1.5	1.6	2.4	-	-
2	4.3	4.0	4.1	4.0	-	-
3	2.0	2.9	2.4	2.2	-	-
4	2.6	2.5	2.7	3.1	-	-
5	3.6	3.5	3.0	-	-	-
6	2.8	2.9	3.2	-	-	-
7	2.8	3.3	4.0	3.8	-	-
8	9.7[a]	9.9[a]	3.9	2.9	1.9	0.9
9	6.6[a]	5.7[a]	5.0	3.3	3.5	3.3
10	8.5[a]	5.3	4.9	3.4	-	-

[a] Soil, fill, or weathered tuff

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Alan Stoker

DATE: December 28, 1977

FROM : W. D. Purtymun

SUBJECT : ROCKFALLS AT PROPOSED LOCATION FOR NEW TRITIUM HANDING FACILITY AT TA-41

SYMBOL : H8-77-871

Los Alamos Canyon at TA-41 trends nearly east west and is cut into the Bandelier Tuff. The proposed addition to Building 4 is located on the north side of the stream adjacent to the lower slope of the canyon. The lower slope of the canyon is formed by the non-welded ashflows of the Otowi Member which is overlain by the cliff forming units of moderately welded tuff of the Tshirege Member. There is a small break in the north canyon wall forming a northwest trending spur in the area of the proposed building (See attached sketch). The slope is steep, about 40°, containing a sparse growth of pines and oaks. It is broken by two narrow benches (one man made, the other natural) immediately above the fence. The slope is strewn with boulders which range in size from a few feet to more than 15 ft. in diameter. The upper cliff forming unit contain numerous near vertical joints which will result in additional rockfalls onto the talus of the lower slopes.

There have been numerous rock falls on the lower slopes as shown by scars on the trunks of trees. The scars for the most part are near slope level; however, one tree contained a scar about 6 ft. from the base from a boulder that bounced as it came down the slope. The presence of the highly jointed near vertical cliff and the talus on the lower slope constitute a rockfall potential that could be a hazard to the proposed facility. It is not possible to quantify the magnitude or frequency of any particular rock fall in the area of the slope or cliff. The extensive fracturing of the cliff unit makes it impractical to eliminate the problem at the source by stabilization. Construction of barriers at the base of the slope should be considered as a means of mitigating or eliminating damage to the facility when rockfalls occur. Barriers to contain rockfalls should be included with the construction of the building. This is necessary to answer recurring questions of possible rockfall damage which will be asked during the life of the facility.

The topography makes it very unlikely that any large rocks could reach the proposed location other than by rolling down the slope. Thus, energy absorbing barriers could effectively be employed to stop such rocks from striking the new building.

The barriers should be located at the base of the slope and be constructed of 5-in dia steel pipe 18 ft in length, spaced 6 ft apart and

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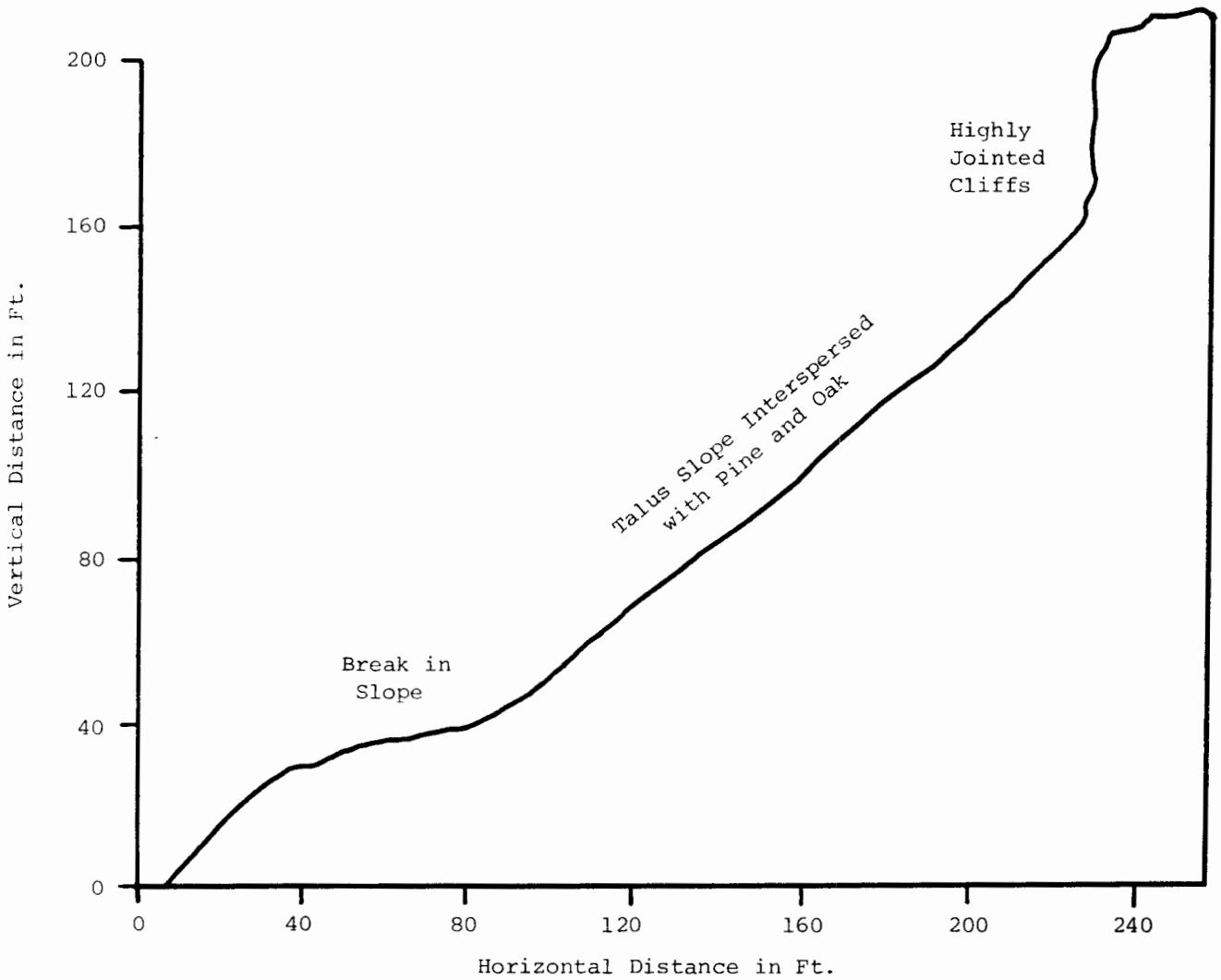
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

TO: Alan Stoker DATE: December 28, 1977

cemented upright in 6 ft deep holes. The steel pipes should be filled with cement and coupled together with 1-in steel cable on 2-ft centers. The outer face of the barrier should be covered with chain link fence. The pipes of the second barrier, located 8 to 10 ft away and parallel to the first barrier, should be off-set to the pipes of the first barrier. The barrier nearest the base of the slope must be located to provide access for a front-end loader to periodically remove talus, which will continue to creep down the slope and reduce the height of the barrier.

The part of the building exposed to possible rock damage will be the north and west walls. Consideration should be given to construct these walls of reinforced concrete.

WDP:pdb



Profile of Northwest Trending Spur above Proposed Building

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P.O. BOX 1663
LOS ALAMOS, NEW MEXICO 87545

IN REPLY REFER TO: H8-78-87
MAIL STOP: 490

January 31, 1978

Mr. C. E. Bingham
Asst. Area Manager for Engineering
US Department of Energy
Los Alamos Area Office
Los Alamos, NM 87544

Dear Mr. Bingham:

Attached is a table showing the results of two aquifer tests run on the Fenton Hill Water Supply Well for transmittal to Don Akins of the State Engineers Office. Test one was run with airline in operation and test two with airline closed. This resulted in slightly different static water levels in the two tests. Mr. Akins will review data and set up a meeting for about the second week of February to discuss the results of the tests.

Sincerely,

W. D. Purtymun

WDP:pdb

Enc: (1) Table

xc: Robert Hendron, G-4, MS-980
Dan Miles, G-4, MS-980

An Affirmative Action/Equal Opportunity Employer

Date (1978)	Hour	Lapse Time (Min)	Cumulative Time (Min.)	Production (Gal.)	Rate (gpm)	Water Level[a] (Meas. ft)	Remarks	
Test 1								
1-18	11:15	0	0	0			Pump On	
	12:15	60	60	2,618	43.6	-	"	
	13:15	60	120	2,620	43.7	-	"	
	15:15	120	240	5,239	43.7	-	"	
							"	
1-19	09:15	1,080	1,320	47,558	44.0	-	"	
	13:00	225	1,545	9,350	41.6	-	"	
	13:50	275	1,595	-	-	365.48	"	
1-20	10:00	1,260	2,805	55,300	43.9	-	"	
							"	
1-21	09:25	1,225	4,210	61,200	43.6	-	"	
							"	
1-23	10:00	2,915	7,125	127,100	43.6	-	"	Maximum Drawdown 0.32 ft.
	10:25	25	7,150	-	-	365.36	"	Specific Capacity
	12:40	135	7,285	-	-	365.33	"	137 gpm/ft of drawdown
	13:00	180	7,305	7,860	43.7	-	Pump Off	
	13:15	15	7,320	-	-	365.18	Recovery	
	13:30	15	7,335	-	-	365.41	"	
	14:00	30	7,365	-	-	365.26	"	
	14:25	25	7,390	-	-	365.23	"	
	14:40	15	7,405	-	-	365.16	"	
	14:55	15	7,420	-	-	365.38	"	
	15:00	5	7,425	111[b]	-	365.22	"	
	15:15	15	7,440	-	-	365.22	"	
1-25	12:00	2,595	10,015			365.32	"	Static WL Airline on
				TOTAL 318,837	Av. 43.7			
Test 2								
1-25	13:50					366.66		Static WL Airline Close
	13:55			1,430[b]		366.67		"
	14:00	0	0	0	0	-	Pump On	
	14:08	8	8	-	-	367.76	"	
	14:15	7	15	-	-	367.35	"	
	14:25	10	25	-	-	366.87	"	
	14.32	7	32	-	-	366.76	"	
	14:37	5	37	-	-	366.80	"	
	14:50	13	50	1,900	38.0	-	"	Drawdown after 25 min of
	15:05	15	65	-	-	366.76	"	pumping 0.20 ft. Specific Capacity
	15:07	2	67	650	38.2	-	Pump Off	191 gpm/ft of drawdown.
	15:20	13	80	-	-	366.67	Recovery	
				TOTAL 2,550	Av. 38.1			

a/ No change in airpressure during test 1 on contineous recorder
b/ Volume of water pumped during recovery and between the two tests.

Note: Water level reported on completion July 1976, 365 ft. Airline pressure at recorder 21 psi, apparent length of airline at recorder 413 ft, at MP in casing 408 ft. Test 1 run with airline on. Test 2 airline shut off resulting in slightly different water levels.

*U.S. GOVERNMENT PRINTING OFFICE 1994-0-573-024/87079

MARCH 1994

3/1/1994 General

LA-12733-MS
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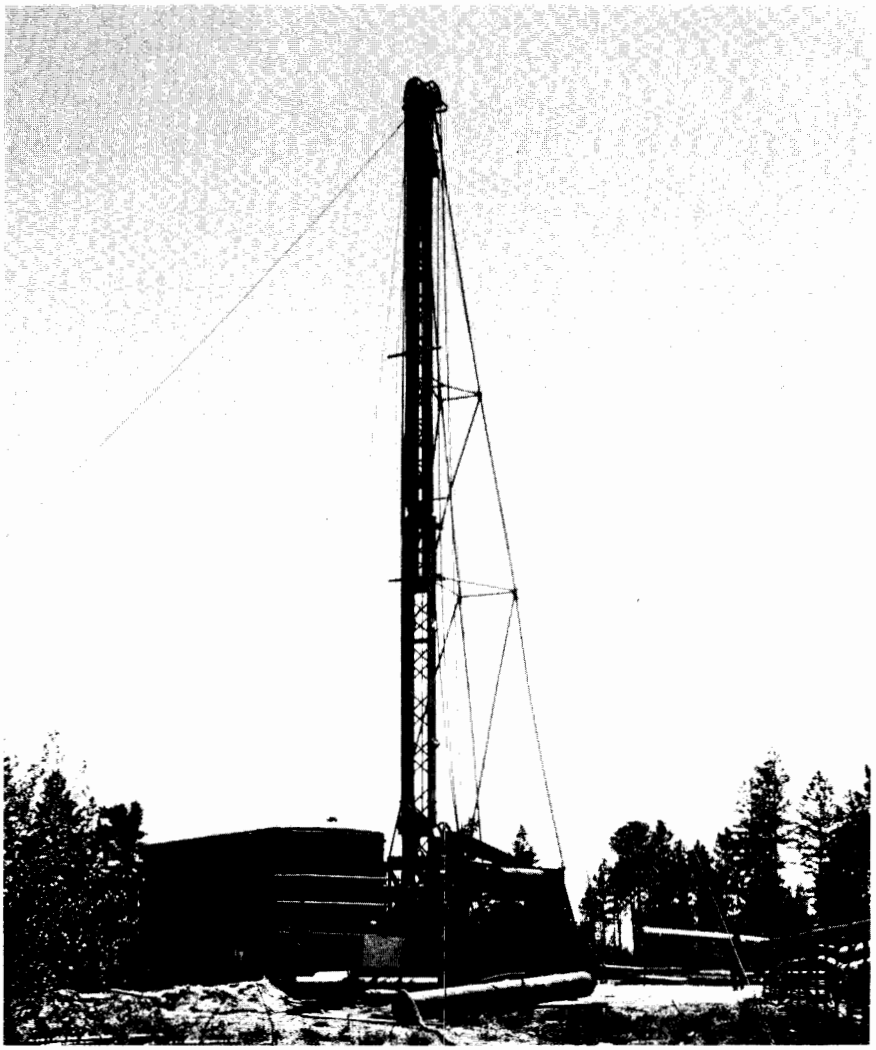
1961–1990



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Cover Photo: *Drilling Supply Well FH-1, Fenton Hill, August 1977 (see Chapter 36). Photo taken by W. Purtymun.*

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LA-12733-MS
Vol. II

UC-903
Issued: March 1994

Source Document Compilation: Los Alamos Investigations Related to the Environment, Engineering, Geology, and Hydrology

1961–1990

Compiled by
William D. Purtymun

Los Alamos
NATIONAL LABORATORY
Los Alamos, New Mexico 87545

SOURCE DOCUMENT COMPILATION: LOS ALAMOS INVESTIGATIONS RELATED TO THE ENVIRONMENT, ENGINEERING, GEOLOGY, AND HYDROLOGY 1961–1990

Compiled by

William D. Purtymun

ABSTRACT

This document is a compilation of informal reports, letters, and memorandums regarding geologic and hydrologic studies and investigations such as foundation investigations for structures, drilling or coring for environmental studies, development of water supply, or construction of test or observation wells for monitoring. Also included are replies requested for specific environmental, engineering, geologic, and hydrologic problems.

The purpose of this document is to preserve and make the original data available to the environmental studies that are now in progress at Los Alamos and provide a reference for and supplement the LAMS report "Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface water stations at Los Alamos: with Reference to the Geology and Hydrology," which is in preparation. The informal reports and memorandums are listed chronologically from December 1961 to January 1990.

Item 208 is a descriptive history of the U.S. Geological Survey's activities at Los Alamos from 1946 through 1972. The history includes a list of published and unpublished reports that cover geology, hydrology, water supply, waste disposal, and environmental monitoring in the Los Alamos area.

Contents

Chapter	Descriptive Title	Date	Page
1.	Bayo Canyon test holes	12/15/61	1-1
2.	Ultra-High Temperature Reactor	8/18/61	2-1
3.	Rocks and mineral of concrete aggregate	10/2/61	3-1
4.	Particle Accelerator Mesita de Los Alamos	11/6/63	4-1
5.	Exploratory holes Mesita de Los Alamos	2/5/64	5-1
6.	Geology at proposed Meson Facility	10/16/64	6-1
7.	Inspection of Pit 3, Area G	2/18/63	7-1
8.	Inspection of Pit 5, Area G	12/9/66	8-1
9.	Geology, loading tests Mesita de Los Alamos	12/16/66	9-1
10.	Seepage pits near Bldg. 35, TA-21	2/20/67	10-1
11.	Quality of water for use at power plant	4/7/67	11-1
12.	Geology of proposed waste pit near Bldg. 40, TA-21	3/7/69	12-1
13.	Sand with pumpage from Pajarito Field	2/18/69	13-1
14.	Hydrologic data for densely welded tuff	4/2/69	14-1
15.	Materials waste pit, Area "A", TA-21	6/30/69	15-1
16.	Geology near Bldg. 257, TA-21	7/19/69	16-1
17.	Induced radiation in tuff, Meson Facility	10/16//69	17-1
18.	Geohydrology of tuff at Mesita de Los Alamos	10/16/69	18-1
19.	Permeability of the tuff to water vapors	11/21/69	19-1
20.	Migration of tritium in tuff Area G, TA-54	7/7/70	20-1
21.	Geologic section at TA-46	2/2/71	21-1
22.	Engineering tests Area C	4/28/71	22-1
23.	Survey of storage pits Area G, TA-21	7/26/71	23-1
24.	Waste Storage Areas H,J, and L, TA-51	0/22/71	24-1
25.	Radiochemical analyses Area G, TA-54	12/2/71	25-1
26.	Logs and casing schedules heat flow holes Fenton Hill	12/22/71	26-1
27.	Geology and hydrology near TA-15	1/7/72	27-1
28.	Conversion of heat flow holes to wells	11/27/72	28-1
29.	Tentative test sites for heat penetrator experiments	4/13/73	29-1
30.	Test holes TA-56 (heat penetrator site)	5/2/73	30-1
31.	Physical and hydrologic of the Bandelier Tuff (from Geohydrology of the Pajarito Plateau with reference to the quality of water - 1949 to 1972)	May 1973	31-1
32.	Moisture content of tuff, Pit 7, Area G	12/12/73	32-1
33.	Moisture content 3 test holes Area G	2/7/74	33-1
34.	Moisture and tritium content in fill material Area G TA-54	2/13/74	34-1
35.	Test holes at Bldg. 260, TA-16	3/19/74	35-1
36.	Geohydrology for supply well at TA-57	2/2/74	36-1
37.	Flood flow and maximum discharge of sixteen drainage areas in the vicinity of Los Alamos	5/74	37-1
38.	Site selection Fusion Test Reactor	9/10/74	38-1
39.	Geologic section at Fusion Test Reactor	10/22/74	39-1

40.	Storm runoff Mortandad Canyon	10/23/74	40-1
41.	Infiltration shafts and sediment traps, Mortandad Canyon	10/25/74	41-1
42.	Inventory and movement of plutonium in Acid-Pueblo, DP- Los Alamos, and Mortandad Canyons	11/14/74	42-1
43.	Up date above memo	12/3/74	43-1
44.	Radiochemical analyses Jemez Area	10/10/74	44-1
45.	Moisture and density logging of basalt hole TA-56	3/3/75	45-1
46.	Geologic section at TA-56	9/19/75	46-1
47.	Stockpile and storage area for proposed laser Bldg. near TA-35	9/19/75	47-1
48.	Designation of sampling stations Jemez area	10/3/75	48-1
49.	Logs of test holes at TA-1	11/7/75	49-1
50.	Logs of test holes at TA-1	11/12/75	50-1
51.	Logs of test holes at TA-1	11/24/75	51-1
52.	Logs of test holes at TA-1	11/26/75	52-1
53.	Logs of test holes at TA-1	12/16/75	53-1
54.	Test holes (heat flow) Jemez Area	1/5/76	54-1
55.	Logs of test holes at TA-1	1/5/76	55-1
56.	Seepage pits DP-East (TA-21-DPE-164)	1/7/76	56-1
57.	Logs of test holes at TA-1	2/3/76	57-1
58.	Field notes hole M-1 (Horizontal holes) Area G TA-54	4/15/76	58-1
59.	Gaging Stations Rio Guadalupe and Jemez River	4/30/76	59-1
60.	Use of Iodine 131 at TA-57	5/19/76	60-1
61.	Safe level of alpha activity in evaporation ponds	5/27/76	61-1
62.	Disposal of sulfuric acid	6/24/76	62-1
63.	Estimated size of disposal ponds or shafts	10/28/76	63-1
64.	Test boring at proposed Bldg. RD-33, TA-52	12/8/76	64-1
65.	Log of test holes TA-45	4/6/77	65-1
66.	Test borings East of TA-48	11/3/77	66-1
67.	Test borings H-Division office Bldg.	11/16/77	67-1
68.	Rockfalls at proposed Tritium Bldg.	12/28/77	68-1
69.	Aquifer tests at supply well Fenton Hill	1/31/78	69-1
70.	Log of test hole near TA-22	2/1/78	70-1
71.	Logs of test holes on 2-Mile Mesa	5/15/78	71-1
72.	Logs of test holes at TA-53	6/2/78	72-1
73.	Location of heat flow hole near El Cajete	6/23/78	73-1
74.	Chemical and radiochemical analyses Bandelier National Monument	6/6/78	74-1
75.	Water temperatures in distribution system	7/20/78	75-1
76.	Log of test hole at TA-46	10/18/78	76-1
77.	Data from deep test hole on Sigma Mesa	5/4/79	77-1
78.	Aquifer, supply well Fenton Hill	5/4/79	78-1
79.	Location of exploratory holes Fenton Hill, water rights	5/14/79	79-1
80.	Foundation holes Fenton Hill	7/17/79	80-1
81.	Test holes at proposed storage pond Fenton Hill	9/7/79	81-1
82.	Test holes Fenton Hill proposed tower	10/29/79	82-1
83.	Logs at proposed site for storage pond Fenton Hill	10/29/79	83-1
84.	Water quality Santa Clara Creek	12/14/79	84-1

85.	Rockfall inspection TA-2	12/14/79	85-1
86.	Water supply Fenton Hill	3/12/80	86-1
87.	Water well #3 Fenton Hill	2/13/80	87-1
88.	Logs of test holes SM-66, TA-3	3/18/80	88-1
89.	Hydrologic characteristics of supply well #2 Fenton Hill	4/4/80	89-1
90.	Test holes at proposed pump station at TA-57 Fenton Hill	5/12/80	90-1
91.	Well location Pueblo Canyon	5/27/80	91-1
92.	Update on activities at TA-49	7/17/80	92-1
93.	Test borings Bldg. SM-200, TA-3	9/3/80	93-1
94.	Test borings Bldg. SM-102, TA-3	9/3/80	94-1
95.	Test borings MPF-16, TA-53	10/6/80	95-1
96.	Test hole near Bldg. M, TA-53	11//14/80	96-1
97.	Test holes Bayo and Pueblo Canyons	11/17/80	97-1
98.	Inspection Pit 27, Area G, TA-54	1/19/81	98-1
99.	Test hole waste demonstration site LS-6	1/19/81	99-1
100.	Rockfall inspection TA-2	2/23/81	100-1
101.	Tests hole near Bldg. M TA-53	4/7/81	101-1
102.	Characteristics of tuff HRL	4/7/81	102-1
103.	Log test holes at Waste Area C	4/8/81	103-1
104.	Inspection, addition to Pit 27, Area G, TA-54	4/29/81	104-1
105.	Test holes proposed solar pond near TA-46	5/15/81	105-1
106.	Generalized geohydrology of TA-22	5/21/81	106-1
107.	Logs of test holes solar evaporation waste ponds on Sigma Mesa	7/27/81	107-1
108.	Test borings Bldg. SM-29, TA-3	8/27/81	108-1
109.	Shaft inspection Area G, TA-54	8/31/81	109-1
110.	Geohydrology of Area L, TA-54	1/19/82	110-1
111.	Test hole west of Omega Reactor Bldg.	1/27/82	111-1
112.	Soil used for dikes around oil storage	3/16/82	112-1
113.	Test borings security and safeguards upgrading TA-41	5/24/82	113-1
114.	Test borings TA-16	7/14/82	114-1
115.	Radium 226 analyses Fenton Hill	8/6/82	115-1
116.	Oil disposal shaft Area L, TA-54	9/23/82	116-1
117.	Rockfall inspection TA-2	9/23/82	117-1
118.	Inspection of Pit 33, Area G, TA-54	10/10/82	118-1
119.	Location of shafts Area G, TA-54	12/1/82	119-1
120.	Test hole LS-6 experimental site	10/26/82	120-1
121.	Inspection of shafts in Area L, TA-54	2/15/83	121-1
122.	Inspection of shafts in Area G, TA-54	2/15/83	122-1
123.	Inspection of shafts in Area G, TA-54	4/1/83	123-1
124.	Test holes at TA-55	4/11/83	124-1
125.	Test holes near Bldg. MD-22, TA-54	5/3/83	125-1
126.	Test borings TA-51	5/25/83	126-1
127.	Test borings at TA-35	7/3/83	127-1
128.	Test holes in upper Canada del Buey	8/19/83	128-1
129.	Test holes for percolation tests at TA-51	8/22/83	129-1
130.	Test borings SM-29, TA-3	8/24/83	130-1
131.	Rockfall inspection TA-2	7/25/83	131-1

132.	Proposed barrow pit Mortandad Canyon	9/24/83	132-1
133.	Test borings in Museum Parking Lot	10//28/83	133-1
134.	Test borings Sigma Mesa	10/31/83	134-1
135.	Test borings visitor entry station Ad Bldg. TA-3	1/5/84	135-1
136.	Shaft inspection Area G. TA-54	10/31/83	136-1
137.	Pit inspection Area G. TA-54	11/16/83	137-1
138.	Location of soil sampling stations related to siting sanitary landfill	2/3/84	138-1
139.	Shaft 29 inspection Area G. TA-54	3/1/84	139-1
140.	Pit 29 excavation Area G. TA-54	3/16/84	140-1
141.	Test borings SM-410, TA-3	4/27/84	141-1
142.	Inspection shaft 31, Area L. TA-54	5/21/84	142-1
143.	Location of decontamination pit	5/21/84	143-1
144.	Test holes Bldg. 210. TA-3	5/30/84	144-1
145.	Rockfall inspection TA-2	6/15/84	145-1
146.	Test holes meteorological tower TA-16	6/28/84	146-1
147.	Inspection shaft 30. Area L. TA-54	6/28/84	147-1
148.	Subsurface investigation TA-16, weapons subsystem	7/9/84	148-1
149.	Log of test holes-Acid Sewer Line Removal	7/13/84	149-1
150.	Inspection of Pit 29-Area G-TA-54	7/13/84	150-1
151.	Test borings TA-46 and TA-55	7/18/84	151-1
152.	Test borings TA-55, Guard Tower Installation	7/18/84	152-1
153.	Test Borings At Ponds GT-2 and EE-1 TA-57	8/2/84	153-1
154.	Test Borings, road realignment near TA-55	9/10/84	154-1
155.	Proposed geohydrologic investigation at Area L	9/19/84	155-1
156.	Inspection Shaft 32, Area L	9/19/84	156-1
157.	Test borings, Kryton Fluoride Project	9/20/84	157-1
158.	Test borings advance laser addition	10/10/84	158-1
159.	Cement storage and handling system TA-55	10/10/84	159-1
160.	Shaft inspection shafts 126, 127, and 128	10/11/84	160-1
161.	Soil borings and subsurface investigation TA-16	10/18/84	161-1
162.	Subsurface investigation, tower installation TA-18	10/29/84	162-1
163.	Inspection shaft 33. Area L	11/19/84	163-1
164.	Test borings Bldg. RC-33 TA-48	11/19/84	164-1
165.	Evaporation and estimated infiltration from ponds at Fenton Hill	1/15/85	165-1
166.	Test borings Bldg. WA-200, TA-46	1/12/85	166-1
167.	Test borings SM-29, TA-3	3/6/85	167-1
168.	Inspection shaft 34 Area L	3/6/85	168-1
169.	Test borings SM-494, TA-3	3/9/85	169-1
170.	Test holes near TD-91, TA-22	7/9/85	170-1
171.	Inspection of shafts 128 through 133 Area G	8/16/85	171-1
172.	Test borings Bldg. SM-141, TA-3	8/16/85	172-1
173.	Test boring cooling tower TA-3	9/3/85	173-1
174.	Inspection shaft C-11, Area G	10/7/85	174-1
175.	Test holes Bldg. SM-200, TA-3	10/16/85	175-1
176.	Rockfall inspection TA-2	10/16/85	176-1
177.	Test borings Bldg. 200, TA-3	2/18/86	177-1
178.	Soil borings at TA-35 and TA-46	4/7/86	178-1

179.	Test hole TA-48	6/13/86	179-1
180.	Test borings Accelerator No.2, TA-53	7/22/86	180-1
181.	Construction of Retention Ponds (sediment traps) in Mortandad Canyon	8/1/86	181-1
182.	Test holes in Potrillo Canyon Rocket Sled Track	7/15/86	182-1
183.	Soil borings storage Bldg. TA-16	5/19/86	183-1
184.	Test holes Meteorological Tower TA-O	5/27/86	184-1
185.	Inspection shafts 136 and 137 Area G	7/14/86	185-1
186.	Mayfield test holes Area G (1979 ?) WDP	1987	186-1
187.	Geologic data, TA-21	5/7/87	187-1
188.	Test holes TA-59	4/23/87	188-1
189.	Test holes strain gage at TA-33	6/9/86	189-1
190.	Root Tomography holes at TA-33	6/11/87	190-1
191.	Rockfall inspection TA-2	6/17/87	191-1
192.	Test hole TA-16 package treatment plant	7/16/87	192-1
193.	Test borings MPF-3, TA-53	3/24/87	193-1
194.	Log of holes at junction SR-4 and main hill road	8/31/87	194-1
195.	Soil borings Pajarito and Puye roads	9/28/87	195-1
196.	Inspection of shafts 140 through 143	10/30/87	196-1
197.	New pump well 1, TA-57	12/2/87	197-1
198.	Test holes East Jemez Road-Telephone duck bank-	3/16//88	198-1
299.	Rockfall inspection TA-2	11/1/88	199-1
200.	Rockfall inspection TA-41	11/10/88	200-1
201.	Test holes meteorological tower north of TA-40	7/7/88	201-1
202.	Inspection of shafts 142 through 149 Area G	5/4/89	202-1
203.	Test holes TA-35 LAPRE reactor	7/7/89	203-1
204.	Rockfall TA-41	12/7/89	204-1
205.	Rockfall TA-2	1/29/90	205-1
206.	Review Installation work plan (with hydrologic properties of Bandelier Tuff and Puye Conglomerate)	6/19/90	206-1
207.	U.S. Geological Survey Ground Water Branch history of operations at Los Alamos	1946-1972	207-1

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UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545

OFFICE MEMORANDUM

TO : David Kirby, Eng-9, MS-702 DATE: February 1, 1978

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : LOG OF TEST HOLE NEAR TA-22

SYMBOL : H8-78-59

MAIL STOP: 702

The log of the test hole drilled January 30, 1978 is as follows:

	Depth (ft) From	To
Soil, light to dark brown, clay, with a few rock <1 in. dia. of latite and rhyolite	0	8
Tuff, light pinkish gray, moderately welded, quartz and sanidine fragment, with a few small rock fragments of latite and rhyolite; Unit 3a	8	38
Tuff, dark gray, welded, quartz and sanidine crystals, and crystal fragments, in a densely welded ash matrix; Unit 2b	38	40

The soil appears dense and consists mainly of plastic clay which has a very low permeability. This section of the hole should not be considered in design criteria for the seepage shaft. The tuff, Unit 3a from 8 to 38 ft, is moderately welded and can be augered for construction of the shaft by ZIA Co. The 30 ft. section of unit 3a has a permeability high enough to be considered for a seepage shaft to receive about 500 gal/day.. The design of the shaft, diameter need, is being determined by Issac Suazo, ZIA U/E. The lower unit 2b, is a densely welded tuff and can not be angered.

If we can be of further assistance please call.

WDP:pdb

xc: Issac Suazo, ZIA U/E

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext: 5862

OFFICE MEMORANDUM

TO : Dave Kirby, ENG-9, MS 702

DATE: May 15, 1978

FROM : W. D. Purtymun, H-8

SUBJECT : LOGS OF TEST HOLES

SYMBOL : H8-78-249

MAIL STOP 490

Attached are the logs of test holes drilled on Two-Mile Mesa. Issac Suazo, ZIA U/E, and I will run perculation tests on holes 3 and 4 as soon as connections to the water line are completed. Moisture content of cuttings from holes 2 and 3 were as expected. Hole 2 is collared in unweathered tuff. The upper section of hole 3 has about 7 ft of soil and weathered tuff so the moisture content in that interval is slightly higher.

WDP:mar
Attach: a/s
xc: Issac Suazo, ZIA U/E

GENERALIZED LOG

Hole 1

Tuff, light red, moderately welded	0 - 19
Tuff, light gray, mdoerately welded	19 - 42
Tuff, dark gray, welded	42 - 43

Hole 2

Tuff, light red, moderately welded	0 - 24
Tuff, light gray, moderately welded	24 - 52
Tuff, dark gray, welded	52 - 57

Hole 3

Soil, brown, sandy	0 - 3
Soil and tuff, brown, weathered with silts and clays	3 - 6
Tuff, light gray, moderately welded	6 - 20
Tuff, light red, moderately welded	20 - 44
Tuff, gray, moderately welded	44 - 52

Hole 4

Soil, brown, sandy	0 - 3
Soil and tuff, brown, weathered with silt and clay	3 - 6
Tuff, light, gray, moderately welded	6 - 21
Tuff, light red, moderately welded	21 - 22

MOISTURE CONTENTS

Depth (ft)	(Percent by weight) Hole 2	Hole 3
0 - 2	2.8	6.8
2 - 7	2.7	7.2
7 - 12	2.5	3.9
12 - 17	2.2	2.7
17 - 22	2.6	1.7
22 - 27	2.4	1.4
27 - 32	2.5	1.9
32 - 37	2.9	1.5
37 - 42	3.2	1.2
42 - 47	1.9	1.0
47 - 52	2.9	0.8
52 - 57	4.9	--

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545

OFFICE MEMORANDUM

TO : Phil Hunt, ENG-2, MS-984

DATE: June 2, 1978

FROM : W. D. Purtymun, H-8

SUBJECT : GEOLOGIC LOGS OF TEST HOLES AT TA-53

SYMBOL : H8-78-276

MAIL STOP: 490

Attached are the logs from the test holes drilled May 31 at TA-53. The soil is light brown, ranging in thickness from 1 to 2 ft. The soil is underlain by a moderately welded tuff. The tan tuff is slightly weathered, underlain by a unweathered gray tuff. Both belong to the same unit. Field estimates indicated the moisture content of the tuff to be less than 5% by volume. As the tuff is a moderately welded unit, your design for bearing capacity of 4000 lbs/sq ft is good. If we can be of further assistance pleast advise.

WDP:tj
Attachments: a/s

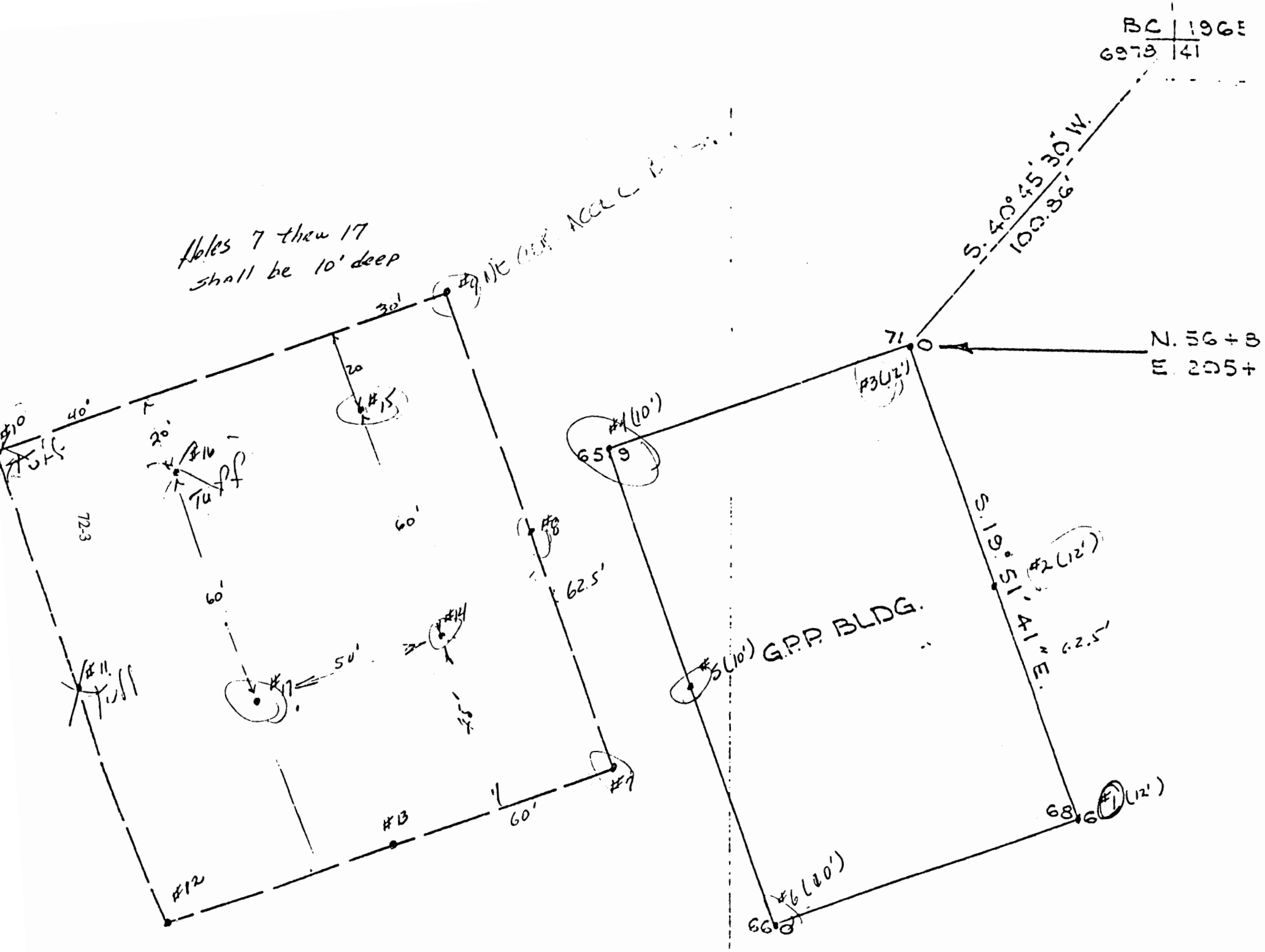
Log of Test Holes

(Depth in feet)

Hole #	Soil	Tuff (tan)[a]	Tuff (gray)
Hole 1	0 - 1.5	1.5 - 2.5	2.5 - 12
Hole 2	0 - 1	1 - 4	4 - 12
Hole 3	0 - 1.5	1.5 - 5	5 - 12
Hole 4	0 - 2	2 - 5	5 - 12
Hole 5	0 - 1.5	1.5 - 4	4 - 12
Hole 6	0 - 1	1 - 4	4 - 12
Hole 7	0 - 2	2 - 4	4 - 12
Hole 8	0 - 2	2 - 4	4 - 12
Hole 9	0 - 1.5	1.5 - 5	5 - 12
Hole 10	Not drilled		
Hole 11	Not drilled		
Hole 12	0 - 1.5	1.5 - 4	4 - 12
Hole 13	0 - 1	1 - 3	3 - 12
Hole 14	0 - 1.5	1.5 - 4	4 - 12
Hole 15	0 - 1	1 - 3.5	3.5 - 12
Hole 16	Not drilled		
Hole 17	0 - 2	2 - 4	4 - 12

[a]Tuff, slightly weathered, some pumice fragments weathered to clay.

For Location see attached ENG-2 sketch.


BC | 1965
6978 | 41
S. 40° 45' 30" W.
100.36'
N. 56+8
E. 205+
71
0
#3 (12')
#4 (10')
65
9
S. 19° 51' 41" E.
62.5'
#2 (12')
G.P.P. BLDG.
#5 (10')
#6 (10')
66
8
68
6
#1 (12')
Holes 7 thru 17
shall be 10' deep
30'
20
#9
#15
#10
40'
20'
#16
Tuff
72-3
60'
#8
62.5'
60'
#14
#11
Tuff
50'
#17
#7
#13
60'
#12

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(CONTRACT W-7405-ENG-36)
P.O. BOX 1663
LOS ALAMOS, NEW MEXICO 87545

IN REPLY REFER TO: H8-78-388
MAIL STOP: 490

June 23, 1978

Mr. Charley Shields
US Forest Service
Jemez Springs, NM 87025

Dear Charley:

Attached is a map showing the location of a temperature gradient hole located near El Cajete. It was drilled in December 1971. If additional information is needed, please contact me.

Sincerely,

Bill

William D. Purtymun
Group H-8
Environmental Surveillance

WDP:tj

Enc: a/s

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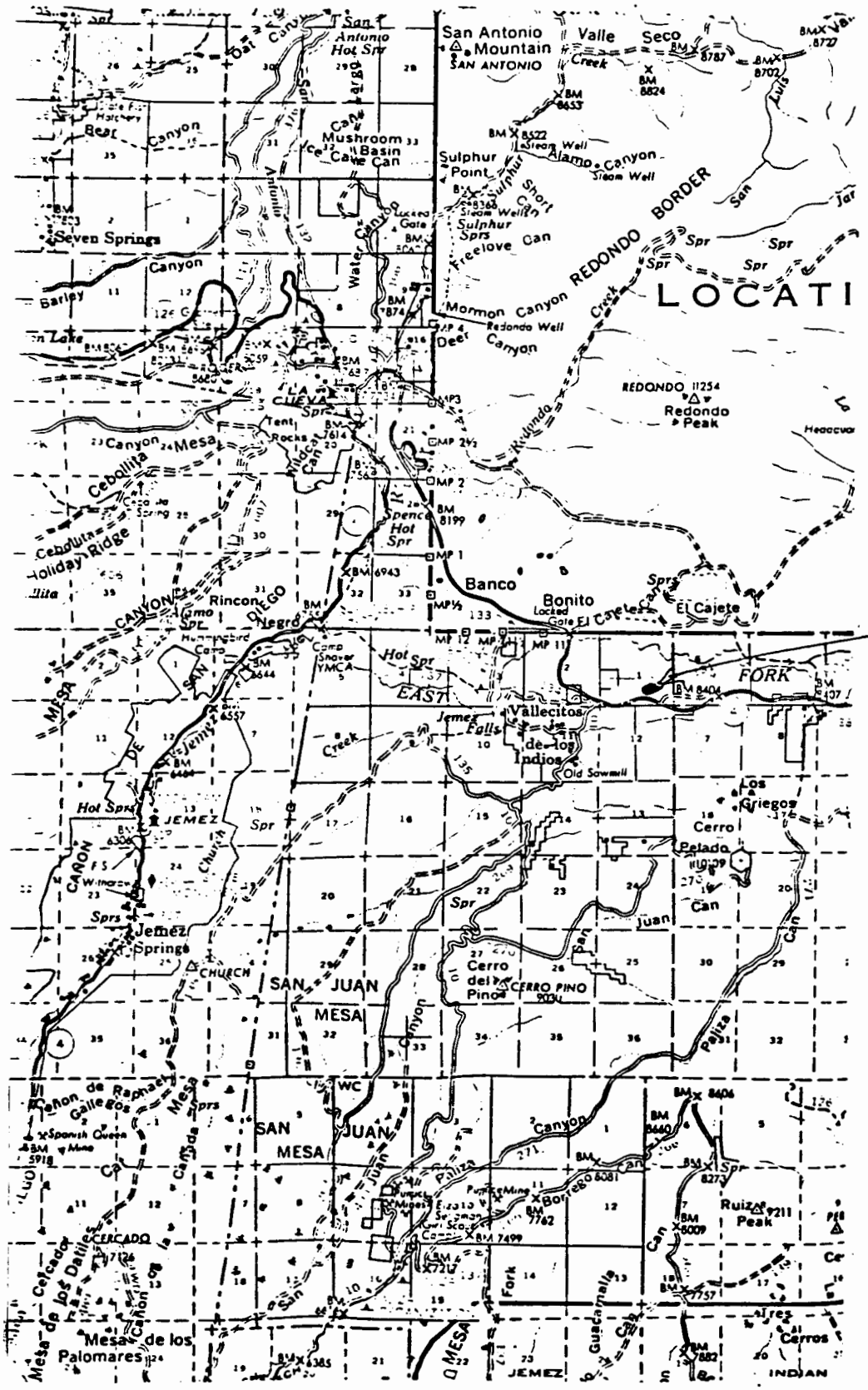

Charley Shields
USFS
Jemez Springs

Location of Temp Gradient hole drilled in 1971.

Approx Location on This scale
Purtymun

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P.O. BOX 1663
LOS ALAMOS, NEW MEXICO 87545

IN REPLY
REFER TO: H8-78-369
MAIL STOP: 490

June 6, 1978

Mr. John D. Hunter
Bandelier National Monument
Los Alamos, New Mexico 87544

Dear John:

Attached are the results from the chemical and radiochemical analyses of water collected in the Monument in 1977. Sample locations are shown on the attached sketch.

A comparision of the chemical quality of prefire and post-fire analyses from the station near Park Headquarters indicates major changes occurred with increases of Ca, HCO_3, Cl, F, and TDS. Mg, Na, and CO_3 did not change

	mg/ℓ	
	Prefire[a]	Post-fire
Ca	9	32
HCO_3	48	120
Cl	4	7
F	0.3	1.2
TDS	137	222

significantly. The pH also remained about the same at 7.5. The pH (alkalinity) should have increased due to the presents of ash; however, the sediments in the runoff had a buffering effect on the ash reducing the alkalinity to near normal. The chemical quality of the water will return to normal as the ash is flushed from the burn area and vegetation of these areas increases.

There was no significant changes in radionuclides or radioactivity of post-fire analyses in surface water at the Park Headquarters. Other radiochemical analyses were normal with no significant concentrations of nuclides. This completes the data we collected in 1977.

Sincerely,

Bill

William D. Purtymun
Group H-8
Environmental Surveillance

WDP:tj (W571)
Enc: Results
Sketch

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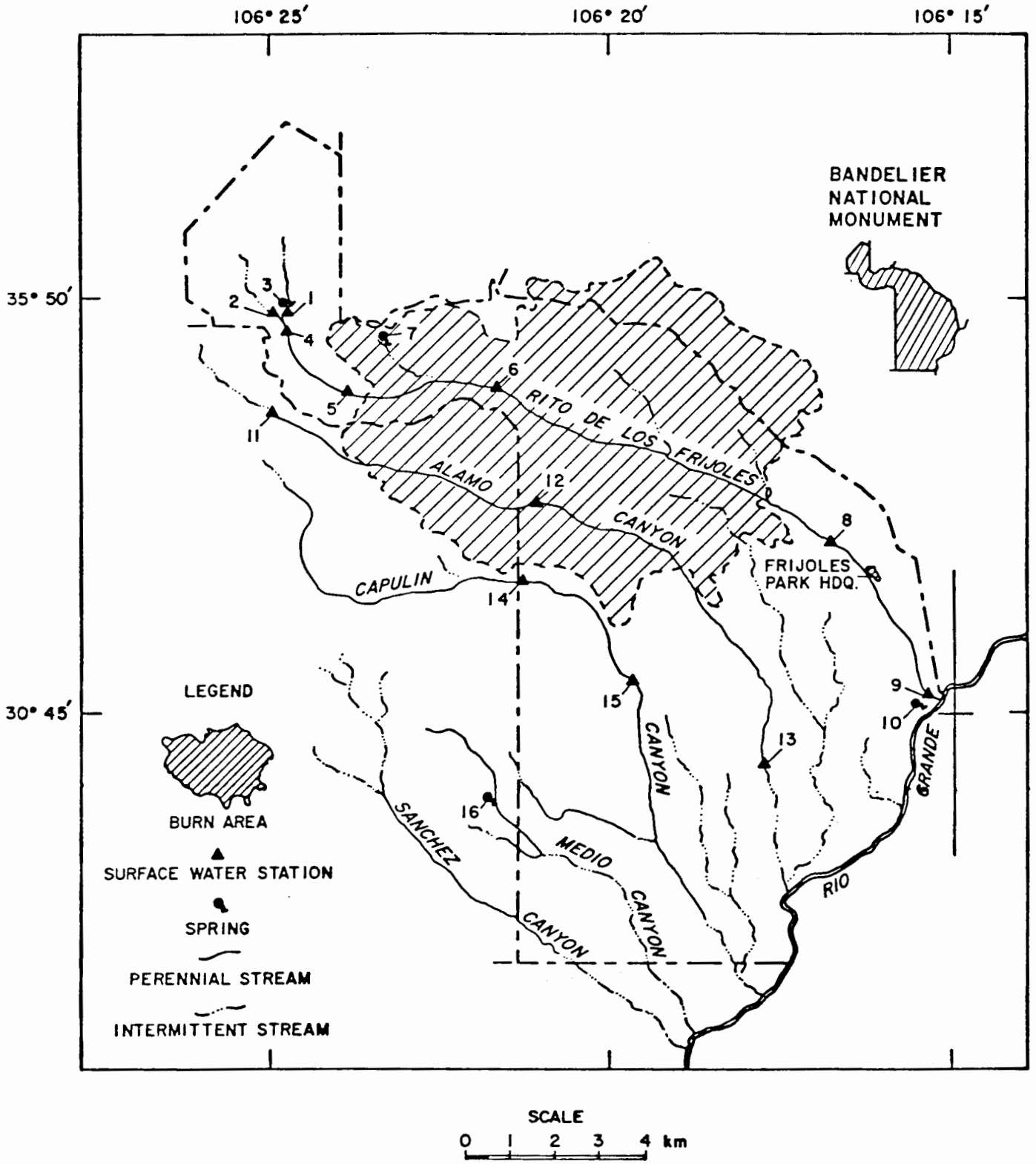
106° 25′
106° 20′
106° 15′
35° 50′
30° 45′
BANDELIER NATIONAL MONUMENT
RITO DE LOS FRIJOLES
ALAMO CANYON
CAPULIN
FRIJOLES PARK HDQ.
SANCHEZ CANYON
MEDIO CANYON
CANYON
RIO GRANDE
LEGEND
BURN AREA
SURFACE WATER STATION
SPRING
PERENNIAL STREAM
INTERMITTENT STREAM
SCALE
0 1 2 3 4 km

TABLE I

CHEMICAL AND RADIOCHEMICAL ANALYSES OF SURFACE AND GROUND WATER IN AND ADJACENT TO BANDELIER NATIONAL MONUMENT

(Samples collected after Burn in June 1977)

CHEMICAL

Station	Location	Date	SiO_2	Ca	Mg	K	Na	CO_3	HCO_3	Cl	F	NO_3	TDS	Total Hard	Cond. (μmho/cm)	pH	Total U (μg/ℓ)	T(°C)
			Concentrations in mg/ℓ															
1	Frijoles, N. Fork	7-8-77		13	3	3.2	5	0	48	12	0.1	0.4	154	44	130	7.3	1.9(±0.6)	10
2	Frijoles, W. Fork	7-8-77		10	2	0.7	9	0	48	5	0.2	0.4	164	34	130	7.8	2.5(±0.6)	16
3	Spring, N. Fork	7-8-77		12	3	2.3	8	0	66	2	0.1	0.4	150	44	130	7.8	2.5(±0.6	10
5	Frijoles	7-8-77		10	<1	0.2	9	0	62	5	0.1	0.3	140	26	100	7.7	2.8(±0.6)	15
10	Spring 10	9-14-77		13	2	-	11	0	62	4	0.5	0.9	138	41	140	7.8		18
11	Alamo Canyon	7-10-77		13	3	4.1	3	0	50	2	0.2	0.8	148	44	140	7.2	2.5(±0.6)	11
16	Turkey Spring	7-10-77		24	5	2.5	11	0	104	3	0.2	<0.4	166	80	250	7.8	2.0(±0.6)	19
6	Frijoles, UC	7-8-77		17	3	1.1	9	0	84	6	0.1	0.8	166	56	170	7.6	3.4(±0.8)	17
7	Apache Spring	7-8-77		13	5	3.5	14	0	60	22	0.1	<0.4	222	54	200	7.5	2.0(±0.6)	7
8	Frijoles Park Hdq.	3-8-77		8	2	-	10	0	48	2	0.2	<0.4	110	30	120	7.9		1
	" " "	7-10-77		32	4	1.9	10	0	120	7	1.2	1.3	214	96	220	7.6	5.5(±0.8)	13
	" " "	11- 1-77		13	<1	-	22	0	78	7	0.3	1.6	190	32	180	7.9		
9	Frijoles at Rio Grande	7-10-77		34	4	4.5	13	0	124	2	<0.1	2.2	246	102	260	7.5	6.8(±1.0)	17
	Frijoles at Rio Grande	9-14-77		22	4	-	17	0	102	6	0.2	0.4	182	72	210	8.5		17
12	Alamo Canyon	7-10-77		29	4	6.3	8	0	98	1	0.1	0.4	176	90	260	7.6	2.4(±0.6)	15
13	Alamo Canyon	7-10-77		33	5	4.0	11	0	122	3	0.1	1.3	232	104	240	7.7	3.7(±0.8)	22
14	Capulin Canyon	7-10-77		15	3	2.3	10	0	72	3	0.1	0.4	148	51	170	7.7	1.9(±0.6)	17
15	Capulin Canyon	7-9-77		21	4	4.5	8	0	92	2	0.2	<0.4	178	70	220	7.8	2.4(±0.6)	18

RADIOCHEMICAL

			^{137}Cs 10^{-9} μCi/mℓ	^{238}Pu 10^{-9} μCi/mℓ	^{239}Pu 10^{-9} μCi/mℓ	Gross-α 10^{-9} μCi/mℓ	Gross-β 10^{-9} μCi/mℓ	Total U μg/ℓ
4	Frijoles	8-11-77	30(±140)	0.004(±0.036)	-0.019(±0.018)	0.7(±1.2)	4.1(±1.8)	0.7 ± 0.2
10	Spr. 10	9-14-77	-10(±140)	-0.033(±0.030)	-0.010(±0.024)	-1.1(±1.2)	0.5(±1.6)	0.4 ± 0.2
16	Turkey Spr.	8-21-77	150(±140)	0.000(±0.40)	0.003(±0.036)	-	-	2.6 ± 0.6
6	Frijoles UC	8-10-77	-20(±140)	0.010(±0.040)	0.004(±0.032)	0.6(±1.0)	16.0(±3.6)	0.8(±0.2)
7	Apache Spr.	8-19-77	70(±140)	-0.020(±0.100)	0.030(±0.100)	0.5(±1.2)	6.0(±1.8)	0.7(±0.2)
8	Frijoles, Park Hdq.	3-9-77	-50(±80)	-0.002(±0.024)	0.009(±0.018)	-0.5(±1.2)	1.7(±1.4)	0.0(±0.2)
	" " "	8-2-77	30(±140)	0.000(±0.040)	-0.029(±0.032)	0.6(±1.8)	18.0(±4.0)	0.6(±0.4)
	" " "	10-25-77	-20(±40)	0.000(±0.036)	0.020(±0.160)	0.2(±1.2)	7.6(±2.2)	2.9(±0.6)
9	Frijoles at Rio Grande	8-7-77	-	-0.014(±0.028)	0.002(±0.024)	1.7(±1.8)	3.0(±1.6)	0.9(±0.2)
	"	9-14-77	30(±18)	-0.022(±0.020)	-0.007(±0.022)	-0.5(±1.6)	10.6(±2.8)	0.5(±0.2)
12	Alamo Canyon	8-19-77	140(±140)	-0.011(±0.032)	0.003(±0.030)	1.1(±1.2)	7.1(±1.8)	2.3(±0.4)
13	Alamo Canyon	8-7-77	-	0.007(±0.038)	-0.006(±0.078)	0.1(±1.2)	13.5(±3.2)	1.6(±0.6)
14	Capulin Canyon	8-17-77	-40(±140)	-0.033(±0.030)	-0.009(±0.032)	0.0(±0.8)	-0.1(±1.0)	0.6(±0.7)
15	Capulin Canyon	8-17-77	-60(±140)	-0.035(±0.026)	-0.015(±0.024)	0.2(±1.0)	3.2(±1.4)	1.0(±0.2)

Note: Parenthetical values represent twice the analytical error term for that analyses.

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LOS ALAMOS, NEW MEXICO 87545
Telephone Ext. 5862

OFFICE MEMORANDUM

TO : Mike Terry, ENG-9, MS 702

DATE: July 20, 1978

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : WATER TEMPERATURES IN DISTRIBUTION SYSTEM

SYMBOL : H8-78-325

MAIL STOP: 490

If further data is needed, please call. We also have records of water temperatures at individual well head.

	Temperature at Tap °C				
Date	FS-1	FS-2	FS-3	FS-4	FS-5
3-76	17	17	--	21	17
7-76	26	25	26	26	25
10-76	23	24	24	24	23
3-77	12	8	10	10	9
8-77	23	29	26	23	27
10-77	20	20	20	20	21
3-78	18	16	15	16	15

Temperatures are at Fire Stations; FS-1 = TA-3, FS-2 = TA-21 (DP), FS-3 = White Rock, FS-4 = M. Golf Course, and FS-5 = S-Site.

WDP:mar

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LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO Nick Matwiyoff, CNC-4, MS-346 DATE: October 18, 1978

FROM W. D. Purtymun, H-8

SUBJECT TEST HOLES AT TA-46

SYMBOL H8-78-453

MAIL STOP 490

The cutting from the first test hole at TA-46 were logged as follows: Other holes encounted the same formations.

	Feet From	Feet To
Bandelier Tuff		
Tshirege Member	0	360
Otowi Member	360	695
Guaje Member	695	727
Puye Formation	727	747

The Tshirege Member is a series of welded to nonwelded ashflows; Otowi Member, a massive nonwelded ashflow; and Guaje, a pumice fall. All tuff were rhyolitic in composition. The Puye Formation is a conglomerate composed of volcanic debris.

The hole was reamed to a 16-inch diameter and cased with 13 3/8-inch steel casing. The casing was cemented in with from the bottom, i.e., cement pumped in through a plug at bottom of the casing filling the annular spare between casing and hole wall. (From notes).

The hole was completed at a depth of about 747 feet, or about 400 feet above the main aquifier which lies at a depth of about 1160 feet at the site. Test drilling on the mesas adjacent the area have not encountered perched water above the main aquifier.

The series of holes drilled at TA-46 (casing cemented in from the bottom) should pose no problems if failures occur in the distillation system in holes. Fluids would be contained in casing.

Attached is memo of anticipated sections prior to drilling at TA-46. Detailed data can be found in LASL Engineer Drawing related

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to construction of the holes and casing. Unfortunately, I did not retain my copies. R. L. Henning, ENG-2, was the project engineer. If I can be of further assistance, please call.

WDP:vh

Attachment: (a/s)

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Dick Olwin, J-6, MS 680

DATE: May 4, 1979

FROM : W. D. Purtymun, H-8

SUBJECT : INFORMATION FOR MAY 14, 1979 CONFERENCE AT DEEP TEST HOLE ON THE PAJARITO PLATEAU

SYMBOL : H8-79-152

The test hole will penetrate the top of the main aquifer (water-bearing unit capable of municipal and industrial water supply) at about 1200 ft. At a depth of about 5500 to 5600 ft, the water will become slightly saline (1 to 3 gram per liter). The drilling of the test hole and drilling fluids used are the same as would be used in completion of a water supply well, thus, no contamination of the fresh water aquifer with undesirable chemicals. Some artesian pressures will not cause the well to flow, but will probably cause water level in the hole to rise 50 to 80 ft if the drilling mud were removed from the hole.

Water bearing zones will be cased off to assure no mixing of fresh and saline waters. Geothermal waters use in production of space heat or electric energy will be through the cased hole assuring no mixing of fresh and thermal water.

Production of space heat or electric energy could result in waste waters containing highly undesirable chemical constituents. These undesirable chemicals will have to be removed before the waters can be released to the environment.

WDP:vh

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UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : G. J. Nunz, GDO, MS 570

DATE: May 4, 1979

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : INFORMATION FOR MAY 14, 1979 CONFERENCE AT FENTON HILL SITE

SYMBOL : H8-79-153

"The deep experimental holes penetrate a fresh water aquifer at a depth of 365 to about 450 ft, and a saline (1 to 3 grams/liter) aquifer at a depth of 1750 ft to 2395 ft (top of the granite). The holes are cased and cemented through these water-bearing zones to prevent mixing of fresh and saline aquifers.

The experimental holes are cased to near zone of fracture in the granite with circulation of water during experiments through the casing or tubing in the casing. Circulating water is not released or lost into the fresh or saline aquifers.

The circulating waters are held in ponds at the site and reused. When excess water in the pond necessitates release, the water is analyzed prior to release. If it contains undesirable chemicals, they are removed by treatment (such as fluorides). After treatment, the water is released into an adjacent dry canyon. Studies made during periods of release indicate water from the ponds infiltrate into the alluvium of the canyon with 1000 ft of the ponds. The water does not enter the live streams in the area.

The laboratory has maintained since 1974, a monitoring net to determine the chemical quality of surface and ground water in the area. The results have indicated no effects of the operations at the geothermal site.

WDP:vh

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LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Ed Kaufman, G-DO, MS 575

DATE: May 14, 1979

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : LOCATION FOR EXPLORATORY HOLES AT FENTON HILL

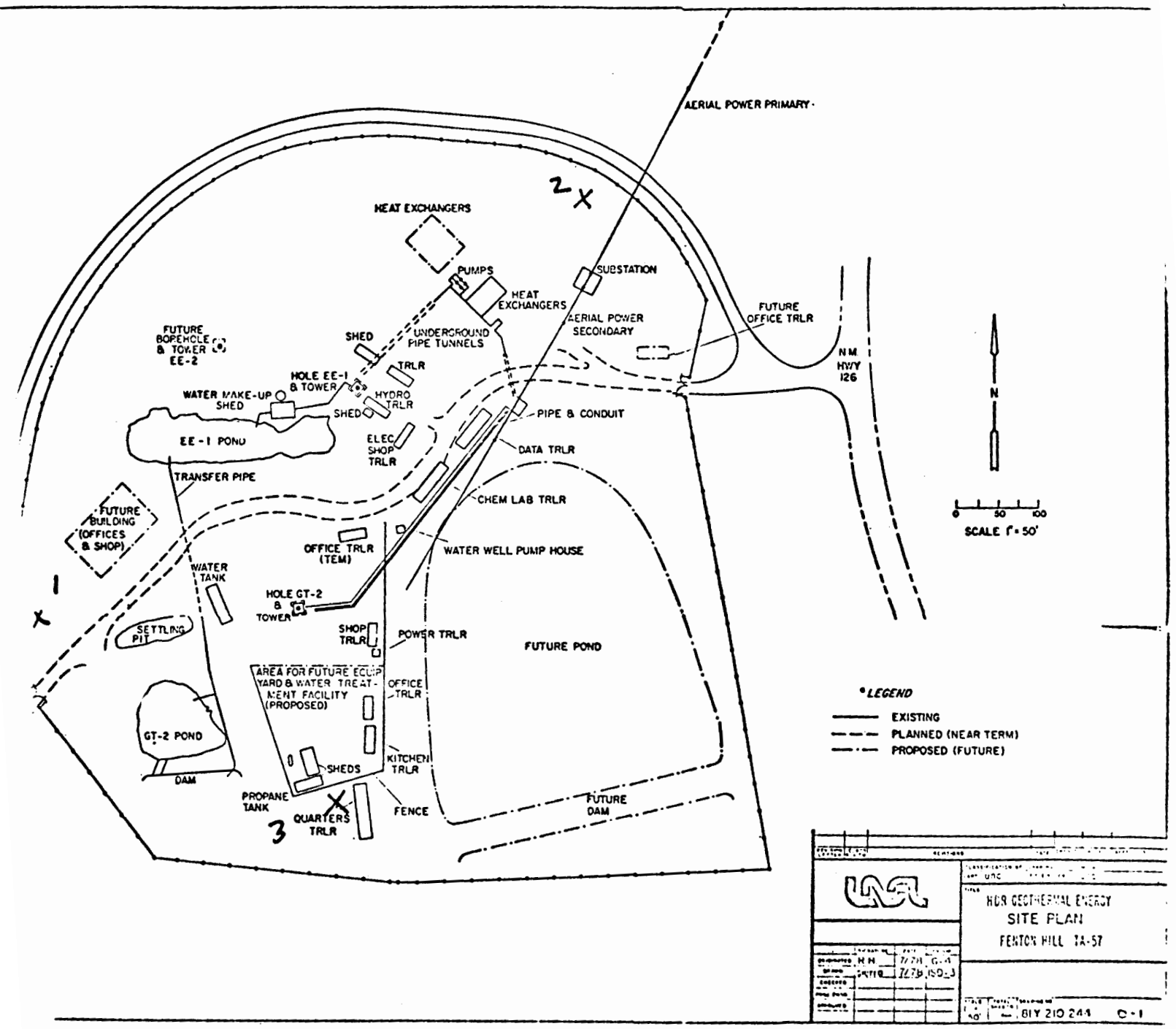
SYMBOL : H8-79-166

Enclosed are two maps showing proposed locations for test holes to evaluate the hydrologic characteristics of the volcanics as possible source of water supply for the site. Locations can be changed slightly to accomodate siting of the rig. After data from the first test hole, other locations are subject to change. Proposed drilling sequence at this time 1, 2, 3---ie.

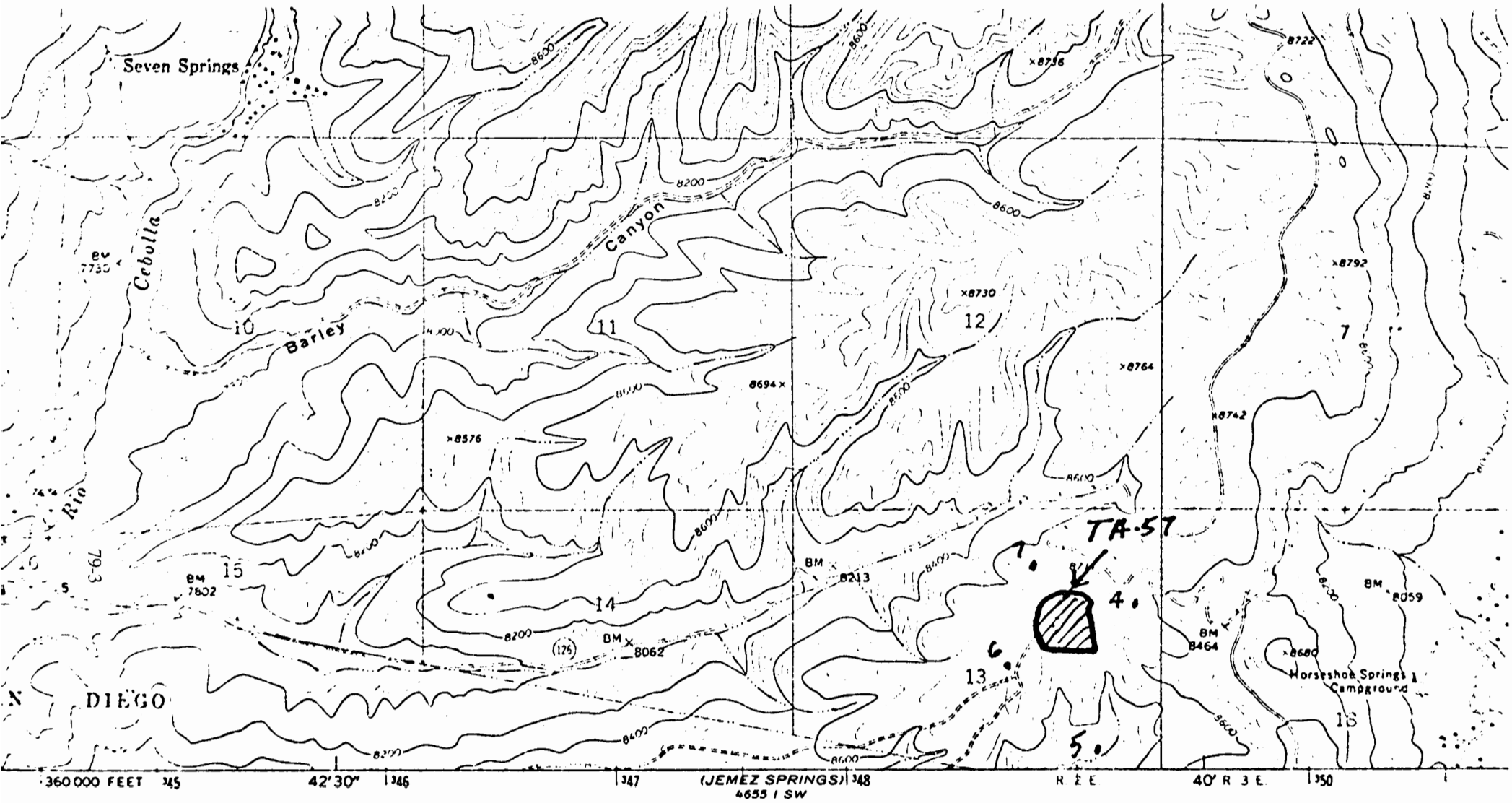
The holes should be drilled about 20 ft into the top of the Abo Formation, penetrating the entire saturated thickness of the volcanics. Casing should be slotted through the entire saturated section. The estimated depth of holes range from 340 (Hole 5) to 500 feet (Holes 4 and 7).

WDP:vh

xc: Francis West, G-9, MS 983



First Three holes Tobe drilled within The Site



THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR WASHINGTON, D. C. 20242
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

Proposed location of 4 Test Hole outside The Site

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Price Fernon, Eng. - 2, MS 984 DATE: July 17, 1979

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : FOUNDATION HOLES AT FENTON HILL

SYMBOL : H8-79-251

Two Hole Near GT-2

1. 3.5 ft from Northeast Corner of Pad GT-2

Fill, dry	0 to 4 ft
fill, wet, muck	4 to 8 ft
Tuff(?), water, muck	8 to 12 ft

2. 3 ft from Northwest corner of Pad GT-2

Fill, dry	0 to 4 ft
fill, wet, muck	4 to 7 ft
Tuff(?), water, muck	7 to 12 ft

The water level in both holes was at about 5 ft. The cuttings were at so impregnated with muck (oil drilling mud, and residual chemical from circulating loop), that we couldn't determine exactly where the tuff contact occurred, but it appeared at about 8 and 7 ft according to the down pressure increase on the rotary table. The accumulation of water and muck is due to leakage from the well head and the fact that the holes were drilled in the excavation or cellar, which is now filled with gravel that was used for setting the "blow out" preventor when the GT-2 was drilled. I suggest excavating the area with a backhoe to find out where the formulation can be set.

Two Hole Near EE-1

3. 3 ft from Southwest corner of Pad EE-1

Fill, dry	0 to 3.5 ft
Tuff, dry	3.5 to 12 ft

4. 2 ft out from center of pad, eastside EE-1

Fill, dry	0 to 4 ft
Tuff, dry	4 to 12 ft

TO: Price Fernon, Eng. 2 -2- DATE: July 17, 1979

One Hole near EE-2

5. 10 ft Southeast of Rig Platform

Fill	0 to 3 ft
Tuff, dry	3 to 7 ft

Buried pipes and electrical conducts are adjacent to the existing pad at GT-2 and EE-1 so that caution should be used in excavation in these areas. A cellar, now filled with gravel, may extend beyond the pad at EE-1, but was not encountered by the by the two test holes.

WDP:vh

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LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO: Jim Gose, ENG-2, MS 984
Jim Hill, G-4, MS 980

DATE: September 7, 1979

FROM: ~~W. D. Purtymun and Charlene Wardlow, H-8~~ WDP CW

SUBJECT: TEST HOLES AT THE FENTON HILL PROPOSED STORAGE POND SITE

SYMBOL: H8-79-333

MAIL STOP: 490

Seven holes ranging in depth from 17 to 42 feet were drilled in the vicinity of the proposed site of the storage pond (Fig. 1). The driller's logs of the holes are shown in Figure 2. The holes were logged with a neutron probe to determine moisture content by volume and the data is shown in Figure 3.

The bottom elevation of the proposed pond is 8685 feet. Holes 1, 2, 5, 6, and 7, encountered a wet silty clay zone at approximately 8700 elevation ranging in thickness from 6 to 20 feet. The silty clay zone is a badly weathered tuff that receives water from precipitation. The zone would underlie the pond in the vicinity of holes 1, 2, and 6. The moisture content by volume in the silty clay zone ranged from 25 to 45%. Oven dried cuttings of the zone had a moisture content of 40%.

The wet silty clay zone is plastic as most of the holes had bridged so that the entire depth could not be logged.

The plastic silty clay zone may cause problems during excavation for the proposed pond and stability of the pond itself.

WDP:CW:vh

Enclosures: Figure 1, 2, and 3

Plan View of Proposed Storage Area at TA-57

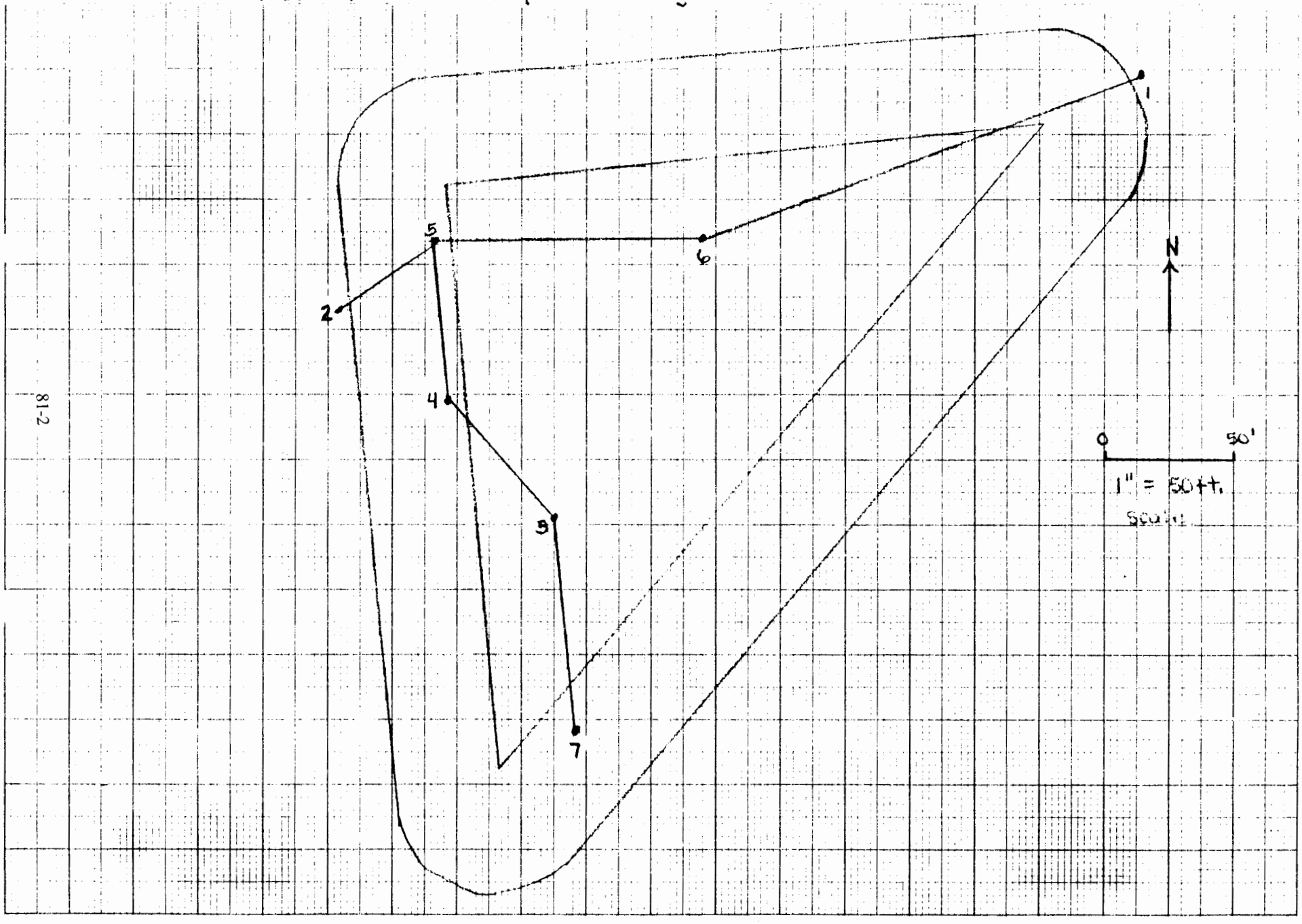


Figure 1

GRAPH PAPER GRAPHIC CONTROLS CORPORATION Buffalo New York Printed in U.S.A. SQUARE 10 X 10 TO THE HALF INCH AS 0813-E1

Driller's Logs and Correlations

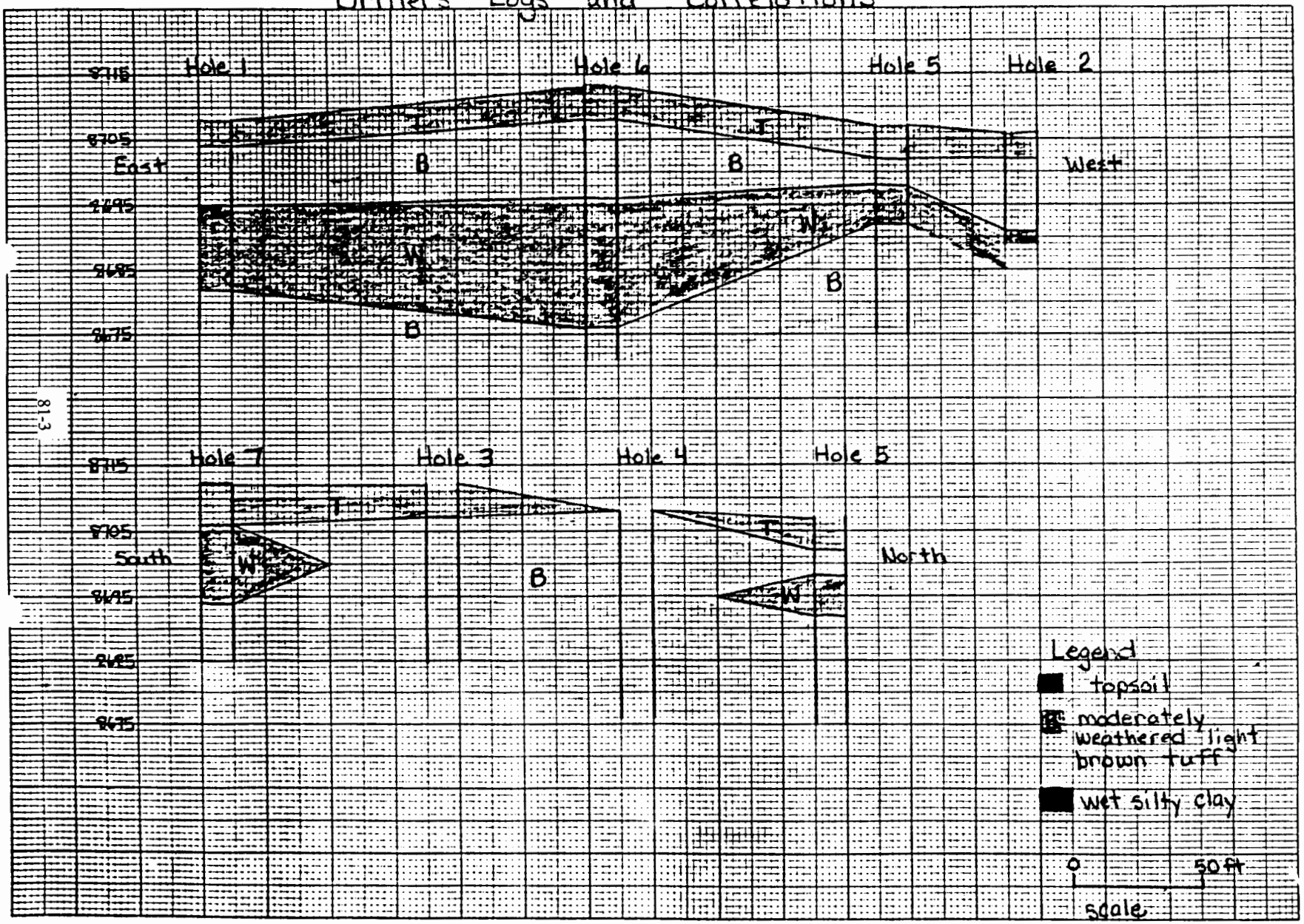


Figure. 2

vertical axis – elevation, in feet

horizontal axis – water content by volume in percentage, [illegible]

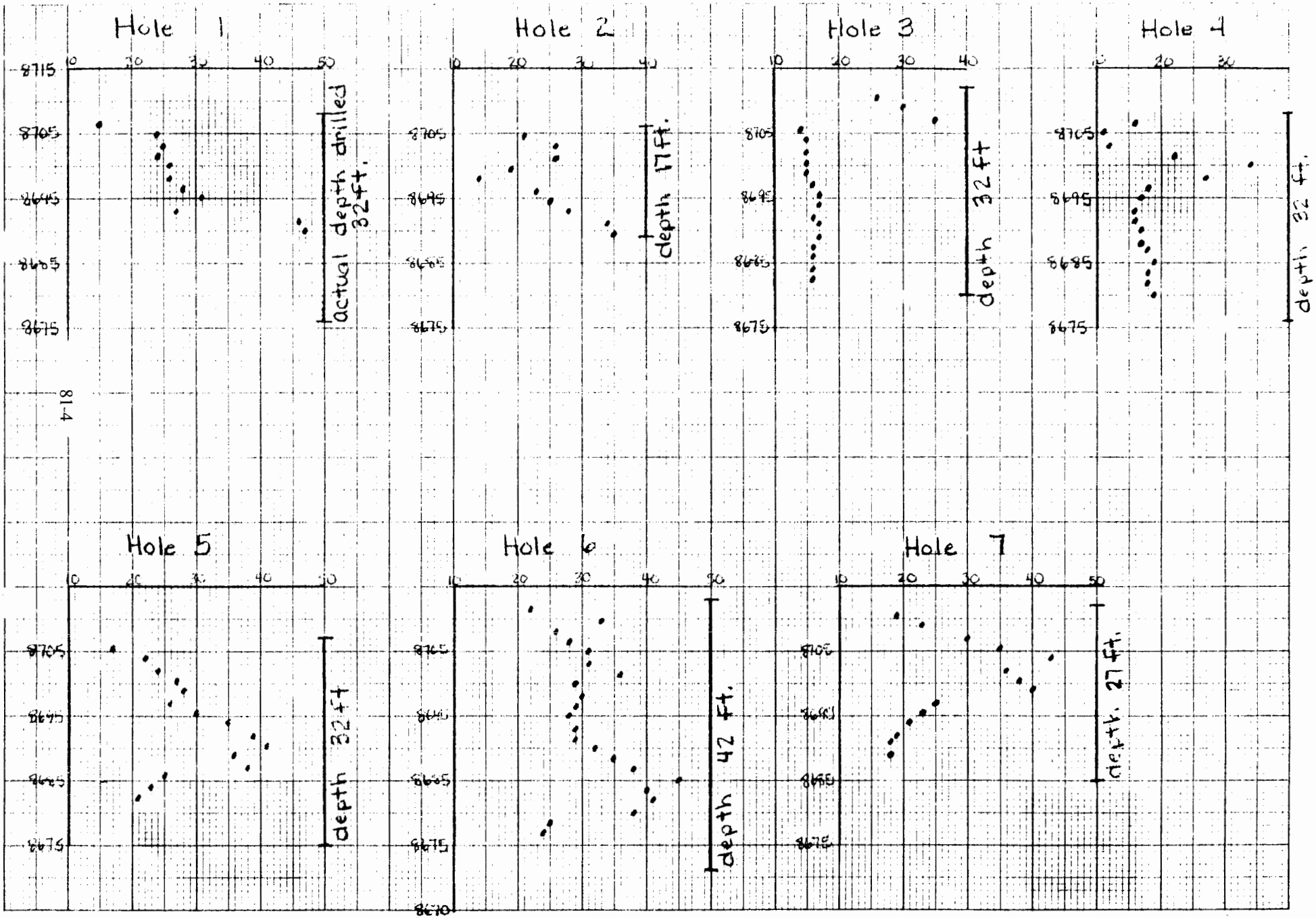


Figure 3

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO : Price Ferron, ENG-2, MS 984

DATE: October 29, 1979

FROM : William D. Purtymun, H-8 WDP
Charlene Wardlow, H-8 CW

SUBJECT : PROPOSED TOWER SITE AT TA-57 TEST HOLE

SYMBOL : H8-79-416

MAIL STOP: 490

Attached are the logs of the two holes drilled 100 feet west of EE-2. The two holes were approximately 15 feet apart. Lithology of of both holes was the same.

0-12 feet - light pinkish grey moderately welded tuff

The moisture content of cuttings from the western most hole at a depth of 5 ft was 12% by weight. The moisture content of the tuff from this hole reflects infiltration of water from the drainage ditch along the west side of the access road. The foundation should be at least 2 ft into the undisturbed tuff.

WDP:CW:vh

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext.

OFFICE MEMORANDUM

TO : Jim Gose, ENG-2, MS 984
Jim Hill, G-4, MS 980

DATE October 29, 1979

FROM : W. D. Purtymun, H-8 WP
Charlene Wardlow, H-8 CW

SUBJECT : PROPOSED STORAGE POND SITE AT TA-57 TEST HOLES

SYMBOL : H8-79-415

MAIL STOP: 490

Attached are the logs from five holes drilled at the proposed storage pond site at TA-57.

NE corner 0-22 ft - light brownish grey moderately welded tuff

NW corner 0-22 ft - light brownish grey moderately welded tuff

SE corner 0-22 ft - light brownish grey moderately welded tuff

SE corner 0-5 ft - light brown weathered tuff
5-27 ft - light brownish grey moderately welded tuff

Center 0-5 ft - badly weathered brown tuff
5-24 ft - light pink moderately welded tuff
24-27 ft - brown weathered tuff
27-42 ft - badly weathered tuff, wet

The moisture content of cuttings from the center hole from a depth of 28-32 ft was 21% by weight. The location appears to be alright with respect to the underlying tuff. The base on floor of the reservoir should have about 10 ft of moderately welded tuff above the weathered zone at 24 to 42 ft.

WDP:CW:vh

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P.O. BOX 1663
LOS ALAMOS, NEW MEXICO 87545

IN REPLY
REFER TO: H8-79-525
MAIL STOP: 490

December 14, 1979

Mr. Jose H. Lucero
P.O. Box 580
Espanola, NM 87532

Dear Jose:

After looking through the files, I could come up with only one chemical analysis in the area. The sample was taken of surface water from Santa Clara Creek midway between Ponds 2 and 3. It was collected on April 16, 1969. The results were:

Chemical (mg/ℓ)

Ca	6	Cl	1
Mg	0.5	F	<0.1
Na	10	NO_3	0.1
CO_3	0	TDS	82
HCO_3	22	T. Hard	16

Conductance 54 μmho
pH 7.3

Low concentrations of chemical constituents are typical of water in high mountain streams. Quality is exceptionally good.

If I can be of further service, please contact me.

Yours truly,

Bill

W. D. Purtymun
Group H-8 MS 490
Environmental Surveillance

An Affirmative Action/Equal Opportunity Employer

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO Merle Bunker, Group Leader P-2, MS 776 DATE December 14, 1979

THRU : Wayne R. Hansen, H-8 Group Leader

FROM W. D. Purtymun, H-8

SUBJECT STABILITY OF ROCKS ON WALL AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

SYMBOL H8-79-526

MAIL STOP: 490

A reconnaissance was made of the canyon on December 12, 1979, at the request of A. Lyle, P-2 (memo P-2-140). There appears to have been little movement of rocks on the slopes of the canyon walls above the site since the study by the U.S. Geologic Survey in September, 1970. Only one large boulder (600 to 800 lbs) was lodged against the east end of the "rock catcher" on the north side of the canyon. Another boulder (400 to 600 lbs) was lodged against the chain link fence on the south side of the canyon. The fence was bulged slightly.

Scars on trees caused by rock falls indicate that movement of the rocks is close to the slope, within 3 to 4 feet. Thus, it appears that on the north canyon slope above the buildings, the "rock catcher" and chain link fence below the catcher will arrest any loose boulders moving down from above.

Inspection of the slope failed to detect any rocks that were unstable or any other evidence of recent movement besides that noted above.

It may be advisable to break up the boulder in the rock catcher and repair the wire spacing the cables. We will plan to take a more complete look at the slope in the spring after freezing and thawing occur. It may be advisable to consider contracting for a Geologic Consultant to look at the area in reference to rock falls as an independent review of past work.

WDP/mlk

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO : Distribution

DATE March 12, 1980

FROM : W. D. Purtymun, H-8 WDP
Naomi Becker, G-5, Dan Miles, G-4 DM

SUBJECT : WATER SUPPLY AT FENTON HILL

SYMBOL : H8-80-184

MAIL STOP: 490

The purpose of this memo is to document activities since 1978 related to the development of a water supply for domestic and geothermal usage at Fenton Hill Site (TA-57). The memo also proposes hydrologic studies to be made of the new well FH-3.

I. WATER RIGHTS

Effective May 15, 1978, the water rights for Fenton Hill under State Engineer's Office (SEO) Permit-34834 was increased to 18 ac-ft for the year 1978 and to 15 ac-ft per year for the years 1979 through 1986. Eighty (80) percent of diversion is to be returned to the ground water reservoir or surface water in the area. (See attached correspondence and Application for Permit, Attachment I).

A requirement which LASL has not complied with is under "Action of the State Engineer," items 1 and 3, in reporting water returned to the ground water reservoir and/or surface water system in the vicinity of the well RG-24834 (FH-1). It should be noted that during 1979, discharge from the ponds at TA-57 into the small canyon tributary to Lake Fork Canyon was not reported to DOE, thus, it was not reported with amount of water produced to the SEO in Albuquerque. However, discharges were reported to the EPA under the NPDES permit requirements, and these reports are automatically available to the New Mexico Environmental Improvement Division, and thus accessible to the SEO.

Three meetings were held with the LASL, DOE, and SEO to discuss additional use of water above the 18 ac-ft 1978, and 15 ac-ft from 1979 through 1986. The meetings resulted in the drilling of five slim holes and a second supply well during December 1979 and February 1980 (see Section III of this memo).

The first meeting, January 16, 1979, was held in Santa Fe to probe the possibility of LASL obtaining water rights for 60 ac-ft in FY 1981 and 15 ac-ft in each FY-1982 through 1985, in addition to the 18 ac-ft (1978) and 15 ac-ft (1979-1986). There were two possible areas to obtain the water, aquifers in the volcanics, and the Madera Limestone. LASL would make a literature search and come up with some hydrologic characteristics.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

The second meeting, March 23, 1979, was held in Santa Fe (see Attachment II for attendees). The hydrologic characteristics of the volcanic aquifer and Madera Limestone as well as the effects of pumpage at the Fenton Hill Site on streams and springs were discussed. The SEO would use estimated aquifer characteristics (Transmissivity "T" and coefficient of storage "S") of the volcanics ($T = 100{,}000$ gpd/ft^2, $S = 0.0005$, discharge area Lake Fork Canyon 15,000 ft) and of the Madera Limestones ($T = 115{,}000$ gpd/ft^2, $S = 0.0005$, discharge area Jemez River 24,000 ft) to calculate the estimated amount of water rights at the Fenton Hill Site to offset the effect of increased pumpage on the local surface water.

The third meeting, April 23, 1979, was held at Los Alamos. The SEO had computed the following effects of pumpage on local surface water.

LASL Hot Dry Rock Experiment

Calculations based on cumulative use of 60 af in FY 1981 and 15 af/an in each of FY's 1982 through 1985 inclusive.

Fiscal Year	Assumed entire appropriation from Volcanics Calculated effects on Rio Cebolla & Lake Fork Springs Tributary at end of Fiscal year (af/an)	Assumed entire appropriation from Madera Calculated effects on Jemez River at end of FY indicated (af/an)
1981	16.0	56.7
1982	17.5	17.1
1983	16.3	15.1
1984	15.5	14.6
1985	15.1	14.6
1986	10.7	.40
1987		
1988		
1989		
1990		
1991		
1992	1.6	

It was decided by LASL to explore the possibilities of taking the additional water (60 ac-ft FY 1981 and 15 ac-ft in FY 1982 through FY 1985) out of the volcanic aquifer. LASL was to do additional studies to determine the aquifer characteristics and feasibility of the aquifer to produce the additional pumpage. This study will be explained in Section III of this memo.

II. GENERAL STATEMENT OF GEOHYDROLOGY OF THE VOLCANIC

The volcanic aquifer is perched on clay, shales, and siltstones of the underlying Abo Formation. The upper surface of the Abo has been fluted and dissected by erosion prior to deposition of the volcanics. These erosional channels in the Abo, which were subsequently filled with volcanic debris, comprise the aquifer that supplies the water from well FH-1 of the Fenton Hill Site (Attachment III). The amount of storage in this aquifer is determined by width, length, and spatial extent of the channel. Topographic highs of the Abo surface limit the aquifers thickness and lateral extent, and will "disconnect" portions of the aquifer where the Abo surface is above the water table.

Generalized contours on top of the Abo in the area of Fenton Hill indicate the formation dips to the southwest at about 80 ft/mi. Thus, the general movement of water in the aquifer was believed to be to the southwest where a series of springs and seeps discharge from the volcanics into the middle and lower reaches of Lake Fork Canyon.

The supply well FH-1 (1976) was completed at a depth of 450 ft with the water level at about 365 ft below land surface after completion of the drilling. The aquifer may have been artesian since the water rose in the well about 10 ft after the aquifer was penetrated. The well did not penetrate the Abo Formation. Aquifer tests in January 1978 indicated the well had a specific capacity of 137 gpm per ft of drawdown at a pumping rate of 44 gpm after pumping 122 hrs. A second test indicated a specific capacity of 191 gpm per ft of drawdown at a pumping rate of 38 gpm after 25 min of pumping. Based on the specific capacity the transmissivity (T) of the aquifer was estimated at 100,000 gpd/ft^2, which was used by SEO calculations reported in April 1979.

The total production from the well November 1976 through July 1979, has been about 9,8 x 10^6 gal. The water level has declined from 366.7 ft below land surface in January 1978 to 368.5 ft in July 1979. The decline in water level indicates that pumpage is exceeding recharge to the aquifer.

III. HYDROLOGIC STUDIES DECEMBER 1979 - FEBRUARY 1980

As suggested at the meeting of LASL, SEO and DOE on April 23, 1979, the following proposed study was to be made by LASL to evaluate the volcanic aquifer's characteristics.

A. Proposed Study

1. Drill 4 to 6 slim holes (6-in dia) through the volcanics into the top of the Abo Formation to determine the top and lateral configuration of the base of the aquifer in the volcanic aquifer.

2. Based on geologic and hydrologic data derived from the slim holes, locate and drill a test hole (supply well FH-2), and perform an aquifer test. The purpose of the test would be to determine aquifer characteristics needed to evaluate the aquifer for potential to produce the additional required production (60 ac-ft FY 1981, and 15 ac-ft FY 1982 through FY 1986).

3. Using these aquifer characteristics, in cooperation with the SEO, determine the effects of pumpage on surface water flow in the area, thus determining the amount of water rights needed for the additional production.

B. Actual Study

The proposed program was not carried out in the prescribed sequence. Moreover, the data that were to be collected were not gathered, improperly gathered, or lost. This is due in part to no one person being in charge, a lack of understanding with the drilling contractor, or improper specifications in the contract, and a lack of recognition of the program goals.

Sequence of Events

1. The test hole (Supply Well FH-2) was located in December 1979, and drilling began prior to completion of the slim holes. Hence, this test hole was sited without the information the slim holes could supply. The test hole was evidently located near the edge of the aquifer as the Abo Formation was encountered at a depth of 433 ft or more than 20 ft higher than occurred in Supply Well FH-1. The hole (FH-2) was completed at a depth of 450 ft with the water level at 371 ft below land surface. A test on February 4, 1980, indicated a specific capacity of 0.8 gpm per ft of drawdown at a pumping rate of 20 gpm after 2.25 h of pumping. At that time the pumping rate was increased to 40 gpm and the water level dropped to the top of the pump setting (49 ft) after 40 min with a specific capacity of about 1 gpm per ft of drawdown. Using the aquifer test results, a value of "T", calculated from the drawdown at a pumping rate of 20 gpm, was about 600 gpd/ft^2, while from the water level recovery data, T was about 300 gpd/ft^2. Erratic water levels in the slim hole 75 ft north precluded any independent determination of T or S.

2. Five slim holes were drilled to a depth of 450 ft in December 1979 and January 1980. Some of the holes may have not been deep enough to penetrate the Abo Formation. The holes are cased with 1 1/2 in. galvanized pump. During drilling of these holes, no geologic or hydrologic logs were kept. The driller did not keep any notes. Drill cuttings have been found from one hole; thus, the data necessary to determine the configuration of the base of the aquifer has been lost.

3. A lack of supervision of the driller during slim hole development led us to believe that these holes were not completed properly with respect to aquifer connection. The annulus between the bore hole wall and slotted pipe may be filled with drilling mud and cuttings. If this is the case, water level measurements in the slim holes could misrepresent the aquifers response to tests of FH-3 when completed.

4. Elevations of the five slim holes and well FH-2 were surveyed and water levels measured during the week of February 4, 1980. ENG-4 prepared a location map of slim holes, supply wells, and Granite Test Holes. (Attachments IV and V).

In short, the results of field activities during December 1979 through February 1980 were discouraging. The slim holes did not yield the information necessary to determine the configuration of the base of the aquifer. Well FH-2 was poorly located. The tests indicated a very reduced yield when compared with well FH-1. This might have all been avoided had the proposed study been properly followed.

IV. THIRD TEST HOLE (WATER SUPPLY FH-3)

In early February, we were requested by G-Division (Nunz, Hill, and Hendron) to recommend a location for a third test hole or supply well due to the poor performance of FH-2. The data needed (i.e., configuration of the base of the aquifer) to make an intelligent recommendation was not available, nor is it now available. The ideal location for this new well would be in the thickest saturated section of the volcanics in a channel cut into the Abo (Attachment VI).

Under pressure to secure a continuation of the contract of the drill rig present, the location was chosen near FH-1, about 75 ft to the south. The location was chosen based on (1) FH-1 penetrated 85 ft of saturated volcanics and did not reach the top of the Abo, (2) yield from the well indicated by the present production is large, and (3) the proximity of FH-1 to the new well will be ideal to determine the aquifer characteristics during testing. The disadvantage is the proximity of two wells. If both are used, it will accelerate the water-level decline when compared to wells properly spaced. Construction of the well began on February 20, 1980.

V. HYDROLOGIC STUDIES OF FH-3

We were informed in the Fall of 1979 that a consultant was to be hired to determine hydrologic characteristics and secure the needed additional water rights. It is not clear that a consultant will actually begin work by the time the new well FH-3 is completed.

In an attempt to insure that future field activities will not repeat past performance, it is proposed that the following program be carried out by Dan Miles, G-4, Naomi Becker, G-5, and W. D. Purtymun, H-8, to insure data collection necessary to evaluate the hydrologic characteristics of the aquifer. This will answer both the question of whether the volcanic aquifer can supply the quantity of water necessary to TA-57 operations and satisfy LASL's obligation to furnish aquifer characteristics to SEO.

1. A bore-hole TV log will be run in FH-2 to determine if slots in casing are sufficient and, if possible, the amount of bridging of sand particles in slots, thus checking this well's connection with aquifer. This is scheduled udring the week of March 17-21, 1980.

2. The well FH-2 will be equipped with a water-stage recorder after the well is logged with the TV. The records will be used to determine if water-level trends can be related to pumping well FH-1 and to determine the barometric pressure effect on the aquifer.

3. Dan Miles will coordinate with the drilling contractor for FH-3 in collection of samples and drilling information assisted by Becker and Purtymun.

4. Upon completion of FH-3, we will conduct an aquifer test as specified in the driller's contract. In order to use FH-1 as an observation well during the test, the pump will be pulled and the well equipped with a water stage recorder. Water-level data will be collected from the slim holes and FH-2 for use in determining the transmissivity and storage coefficient. Reduction of data will be completed by Miles, Becker, and Purtymun. Some additional staffing from G-Division will be required during this test.

5. Geophysical logging of slim holes should be done by the U.S. Geological Survey, or other capable company, using a gamma-ray density probe to determine, if possible, the contact between the volcanics and Abo Formation. This data is necessary to delineate the extent of the aquifer (i.e., saturate volume of volcanics).

We have the water storage recorders. Needed are the geophysical logs and having the pump pulled from FH-1 two or three days prior to the test.

Approaching the testing of FH-3 in this manner should result in maximum return of data required by the SEO. Prior to the aquifer test, the SEO should be contacted to see if they wish to send an observer to the test. In addition, the data will be useful in the future if additional water rights are to be obtained.

WDP:NB:vh
Attach. (I thru VI)

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

Distribution:

G. J. Nunz	G-DOF,	MS 575
M. C. Smith	G-DOF,	MS 575
Paul Frank	G-1,	MS 575
E. L. Koufman	G-1,	MS 575
C. L. Edwards	G-2,	MS 978
Hendron/Hill	G-2,	MS 978
B. R. Dennis	G-3,	MS 586
W. A. Morris	G-4,	MS 980
J. W. Tester	G-5,	MS 981
Aamodt/Brown	G-5,	MS 981
H. F. Althaus	DOE-ENG	MS 316
Felix Miera	LS-6,	MS 495
W. R. Hansen	H-8,	MS 490

ATTACHMENT I

STATE OF NEW MEXICO

STATE ENGINEER OFFICE

DISTRICT 1

S.E. REYNOLDS
STATE ENGINEER

May 23, 1978

ADDRESS CORRESPONDENCE TO
2340 MENAUL N.E.
SUITE 205
ALBUQUERQUE, NEW MEXICO 87107
PHONE 842-3126

FILE: RG-24834

Mr. Kenneth R. Braziel, Area Manager
U. S. Department of Energy
Los Alamos Area Office
Los Alamos, New Mexico 87544

Dear Mr. Braziel:

Enclosed is your copy of the above-numbered application for permit for water to be used in geothermal research which has been approved subject to the conditions set forth on the reverse side of the permit.

Please note Condition #3 which sets out the requirement for metering the amount of water used under this permit and the reporting of said usage to this office.

This permit will automatically expire on January 1, 1987.

Very truly yours,

J. L. Williams
Supervisor, District 1

mlh
Encl: Permit (1)

cc: Santa Fe

Department of Energy
Los Alamos, New Mexico 87544

MAY 3 1 1978

R. H. Hendron, G-4, LASL (MS-980)

WATER RIGHTS - FENTON HILL

In response to your previous correspondence G-4-78-102, dated December 7, 1977 please be advised effective May 15, 1978 the water rights for Fenton Hill under Permit RG-34834 have been increased to 18 acre feet for the year 1978 and to 15 acre feet for the years following through 1986. The permit is to be automatically cancelled effective January 1, 1987.

Your attention is directed to Items 1, 2 and 3 on the reverse side of the permit. Please advise this office of the methods planned by your office for assuring that these items are complied with and that a report acceptable to the State Engineer is made available to that office on or before the 10th day of each month following the period of useage. A copy of the report should also be made available to this office.

Original signed by
Harry F. Althaus

Harry F. Althaus, Chief
Facilities Engineering Branch

LFE:HFA

Enclosure:
Permit RG-34834 dtd 5/15/78 (3 copies)

cc: Dean Miller, The Zia Company, w/encl
W. Purtyman, LASL (MS-490), w/encl
B. Crismon, LAAO, w/encl
H. Althaus, Fac.Engrg. Br., w/encl

Revised August 1967

ATTACHMENT I

IMPORTANT—READ INSTRUCTIONS ON BACK BEFORE FILLING OUT THIS FORM

APPLICATION FOR PERMIT

To Appropriate the Underground Waters of the State of New Mexico

'78 JAN 5 PM 1 15

Date Received _____ File No. _____

1. Name of applicant U. S. Department of Energy
   Mailing address Los Alamos Area Office
   City and State Los Alamos, New Mexico 87544
2. Source of water supply shallow water aquifer, located in Rio Grande
   (artesian or shallow water aquifer) (name of underground basin)
3. The well is to be located in the NE ¼ SW ¼ NE ¼, Section 13 Township T 19 N
   Range R 2 E N.M.P.M., or Tract No. ____ of Map No. ____ of the _____ District,
   on land owned by U. S. Department of Agriculture, Forest Service
4. Description of well: name of driller Existing well drilled under RG-24834 and RG-24834-2
   Outside Diameter of casing 7 inches; Approximate depth to be drilled 450 feet.
5. Quantity of water to be appropriated and beneficially used 18 acre feet in 1978 and 15 acre feet,
   thereafter through 1986. (consumptive use and diversion) *
   for scientific research for geothermal hot dry rock energy purposes.
6. Acreage to be irrigated or place of use same as well location, para. 3 above acres.

Subdivision	Section	Township	Range	Acres	Owner

Additional statements or explanations The production of steam at Fenton Hill has been demonstrated by circulating water between two deep hot dry rock geothermal holes connected by hydraulic fracturing. Additional experimentation is now necessary to conduct heat flow studies and other research to test the concept of hot dry rock geothermal energy extraction.

Although the geothermal holes are located in hot dry rock and not in an aquifer, make-up water, to offset down hole and other losses, is necessary to conduct further experimentation. It is the opinion of the Department of Energy that appropriation of the quantity of water designated under paragraph 5 above, from the existing water well drilled under permits numbers RG-24834 and RG-24834-2, will not affect the Guadalupe River flow. However, a study will be performed to determine if there is an affect. If there is an affect, DOE will acquire the appropriate rights to offset the affect or will provide make-up water by means which will not affect the Guadalupe River.

*Consumptive use is estimated to be 20 percent of the diversion.

'78 JAN 9 AM 10 28

I, Kenneth R. Braziel, affirm that the foregoing statements are true to the best of my knowledge and belief and that development shall not commence until approval of the permit has been obtained.

U. S. Department of Energy, Permittee,

By: Kenneth R. Braziel
Kenneth R. Braziel, Area Manager

Subscribed and sworn to before me this 5th day of January, A.D., 1978.

My commission expires 3-10-78 Emma E. Hahn
Notary Public

'78 MAY 10 AM 10 10

Number of this permit RG-24334

ACTION OF STATE ENGINEER

After notice pursuant to statute and by authority vested in me, this application is approved provided it is not exercised to the detriment of any others having existing rights; further provided that all rules and regulations of the State Engineer pertaining to the drilling of _____ wells be complied with; and further subject to the following conditions:

1. Diversion of water under this permit shall not exceed 18 acre feet per annum for the year 1978 and 15 acre feet per annum for each subsequent year through 1986. Eighty percent of the amount diverted shall be returned to the ground water reservoir and/or surface water system in the vicinity of well RG-24834.

2. All diversion of water from RG-24334 shall be measured by a totalizing meter, or meters, of a type and at a location (s) approved by and installed in a manner acceptable to the State Engineer.

3. Consumptive use and/or return flow shall be measured and/or computed by the permittee by a method acceptable to the State Engineer. Records of diversion and consumptive use and/or return flow shall be submitted to the State Engineer on or before the 10th day of the following month for each calendar month.

4. This permit shall automatically expire on January 1, 1997.

Proof of completion of well shall be filed on or before _____, 19____

Proof of application of water to beneficial use shall be filed on or before _____, 19____

Witness my hand and seal this 15th day of May, A.D., 19 78

S. E. Reynolds, State Engineer

By: M. B. Compton, Engineer, Water Rights Bureau

INSTRUCTIONS

This form shall be executed, preferably typewritten, in triplicate and shall be accompanied by a filing fee of $5.00. Each of triplicate copies must be properly signed and attested.

A separate application for permit must be filed for each well used.

Secs. 1—4—Fill out all blanks fully and accurately.

Sec. 5—Irrigation use shall be stated in acre feet of water per acre per annum to be applied on the land. If for municipal or other purposes, state total quantity in acre feet to be used annually.

Sec. 6—Describe only the lands to be irrigated or where water will be used. If on unsurveyed lands describe by legal subdivision "as projected" from the nearest government survey corners, or describe by metes and bounds and tie survey to some permanent, easily located natural object.

Sec. 7—If lands are irrigated from any other source, explain in this section. Give any other data necessary to fully describe water right sought.

ATTENDANCE MEETINGS LASL, SEO AND DOE

January 16, 1979

M. B. Compton	SEO
D. R. Cooper	SEO
P. D. Akin	SEO
M. P. Spinks	SEO
D. N. Stone	SEO
C. E. Bingham	DOE
H. F. Althaus	DOE
E. M. Nunez	LASL
R. H. Hendron	LASL
W. D. Purtymun	LASL
E. L. Kaufman	LASL

March 23, 1979

M. B. Compton	SEO
H. F. Althaus	DOE
R. H. Hendron	LASL
E. L. Kaufman	LASL
W. D. Purtymun	LASL
C. E. Bingham	DOE
D. R. Cooper	SEO
P. D. Akins	SEO
M. P. Spinks	SEO
D. N. Stone	SEO

ATTACHMENT III

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544
TELEPHONE:

OFFICE MEMORANDUM

TO : M. C. Smith, Group Leader, Q-22 DATE: April 2, 1974

FROM : Wm. D. Purtymun, H-8 and Francis West, Q-22

SUBJECT: EXPLORATORY TEST HOLE IN VOLCANICS WITH POSSIBLE COMPLETION AS A SMALL YIELD WATER SUPPLY.

SYMBOL : H8-74-140

The following data was compiled at the request of Don Brown in regards to data obtained during the initial phase of drilling GT-2.

The geophysical and lithologic logs of test hole GT-2, Fenton Hill Site indicated water is perched in the volcanics overlying the Abo Formation. An exploratory hole would be necessary to determine if an adequate water supply could be developed for the site.

The volcanics at the site are about 450 feet thick. The Bandelier Tuff extends from land surface to a depth of about 360 ft. The Paliza Formation from 360 to 410 ft. and the Abiquiu Tuff from 410 to 450 ft. The Bandelier Tuff is composed of a series of moderately welded to welded ash flow tuff that are ryholitic in composition. The Paliza Formation is an andesite basaltic breccia and is underlain by the Abiquiu Tuff that is a tuffaceous sand and conglomerate.

The geophysical logs of GT-2 indicated about 40 feet of saturated thickness in the volcanics (Paliza Canyon and Abiquiu Tuff). The presence of water in this section was noted by drilling condition of GT-2. Water bearing characteristics could not be determined as the hole was drilled using fluids as a cutting carrier.

The velocity log of GT-2 indicated a saturated section from a depth of 410 to 450 feet in the volcanics that is perched on the Abo Formation. The Abo is composed of shales, siltstones, and fine grained sandstones. The Paliza Canyon is a fairly stable formation while the Abiquiu Tuff is loosely consolidated and friable. The caliper log on GT-2 through the Abiquiu section indicated washout while the Paliza Canyon remained stable. The electric log indicated porosity and fresh water in the interval from 410 to 450 feet.

Generalized contours on top of the Abo Formation (using test holes GT-1, GT-2, A and D for control) indicate the surface of the Abo Formation dip to the west south west at about 80 feet per mile (Fig. 1). The water in the volcanic would move down dip perched on

the Abo Formation.

The contours on top of the Abo are generalized as the upper surface is very irregular, forming high and low areas, cut by erosion, that were later filled with volcanics. The water in the volcanics will move down dip filling these low areas while in some of the high areas the Abo may be above the water table.

The springs and seeps in Lake Fork (elevation 7890 ft) and Virgin Canyon (elevation 7750 ft) discharge from the volcanics overlying the Abo. The discharge forms perennial stream that flows in the Rio Guadalupe. The spring at elevation 8120 is perched in the volcanics.

The ground water divide in the volcanics between the Fenton Hill Site and the valley cut by San Antonio Creek occurs along the north-south trending fault that was mapped by Smith and other (1970). The spring at elevation 7950 ft. (Horse Shoe Spring) discharges from the base of the volcanics on the down thrown side of the fault. Along the Jemez River the base of the volcanics are 300 to 500 feet below the base of the volcanics to the south and south east of the Fenton Hill Site. The difference in elevation probably occurs along Virgin Canyon and due in part to erosion and in part to a probable fault that is down thrown to the east. The spring at elevations of 7300 and 7460 ft discharge from the base of the volcanics while the spring at 7560 ft discharges from a perched zone in the volcanics. The springs at elevations 7300 and 7460 ft are used for water supply at Jemez Springs. The ground water divide probably occurs along Virgin Canyon.

Test Hole A (elevation 8329 ft) was reported to have little or no water in the volcanics GT-1 (elevation 8315) was drilled using fluid as a carrier so that no hydrologic observation could be made prior to casing the hole through the volcanic. Test Hole D (elevation 7830) contains water in the volcanic that rose to a depth of ~30 ft below land surface.

The springs in Lake Fork and Virgin Canyon as well as the geophysical logs of GT-2 indicated water in the volcanics. A hole drilled by cable-tool method would be necessary to determine if a supply for this site could be constructed. There is a limited area for recharge to the aquifer in the volcanics east of the site and there is always the possibility of drilling into a high area of the Abo where the volcanics would be dry. Limited ground water storage could occur in the low areas between the highs. Thus due to the geologic and hydrologic conditions in the area a hole drilled into the volcanics at the Fenton Hill Site for a water supply should be considered an exploratory hole

until tested to determine if an adequate ground water supply could be developed.

The specifications for an exploratory hole and possible completion as a water supply well are attached.

SPECIFICATIONS FOR AN EXPLORATORY HOLE AND POSSIBLE COMPLETION AS A WATER WELL

Scope of Work

The contractor shall furnish all labor, material, equipment, and maintenance of equipment to perform all work required to drill, case, test, and develop one exploratory hole to a depth of about 450 ft using cable-tool equipment. The anticipated log of the exploratory hole to be located at TA-57, Fenton Hill Site in Sandoval County is as follows:

	Depth (feet)	
	From	To
Tuff moderately welded and weld ash flows	0	360
Basaltic breccia	360	410
Tuffaceous sand and conglomerate	410	450

Anticipated water level ~360 ft.

The thickness of the saturated thickness of the volcanic rocks penetrated above the Abo Formation (red beds) will determine if the hole will be completed as a well.

Specifications:

1. The drilling contractor must be licensed by the New Mexico State Engineer to drill in the Rio Grande Basin. The contractor shall secure the necessary permit to drill and test the exploratory hole from the State Engineer.

2. The proposed exploratory hole is to be drilled as follows:
   a. Drill a 12 or 14 inch diameter hole to a depth of about 20 ft and set 10 3/4 inch casing (the 10 3/4 inch casing will be furnished by LASL). The 10 3/4 inch casing will be cemented with a slurry grout from top to bottom by the contractor.
   b. Drill an 8 inch diameter hole to a depth of about 450 ft through the volcanics into the top of the Abo Formation (red beds).

c. The saturated thickness of volcanics encountered and hydrologic characteristics of the section will determine further completion of the exploratory hole. This decision will be made by the contractor in agreement with a LASL representative.

2. Casing construction of the exploratory hole is as follows:

a. The length of the screen or perforated (slotted casing) will be determined by the contractor in agreement with a representative of LASL. The type and size of the openings in screen or perforated casing will be determined by the contractor in agreement with a LASL representative to allow minimum entrance of sand to the cased well.

b. The screen or perforated pipe will be run with 6 inch ID standard pipe (welded or threaded) to the required depth of about 450 ft. The screen and/or perforated pipe will be furnished by the contractor. The casing and screen and/or perforated pipe will be set by the contractor.

c. The casing shall be secured at the surface in an approved manner (i. e. welded to I beams) and hung in tension in the hole.

3. Development and test of the exploratory hole is outlined as follows:

a. The contractor will provide bailing tests not to exceed 2 hours in each perched water zone above a depth of 350 feet as requested by a LASL representative chargeable to LASL as an hourly rate.

b. The contractor will provide testing by pumping for a period of at least 24 hours to determine the type and size of the pump and adequacy of the well for water supply.

4. General specifications are as follows:

a. The contractor will provide LASL with cuttings from each 5 foot interval in depth during drilling of the 8 inch diameter hole.

b. during the 24 hour test a representative of LASL will be present. Water levels will be determined prior to, during and after the test. Pumping rates will be determined at hourly intervals during the test.

WDP:et

cc: Don Brown, Q-22
Bob Hendron, Q-22
Francis West, Q-22

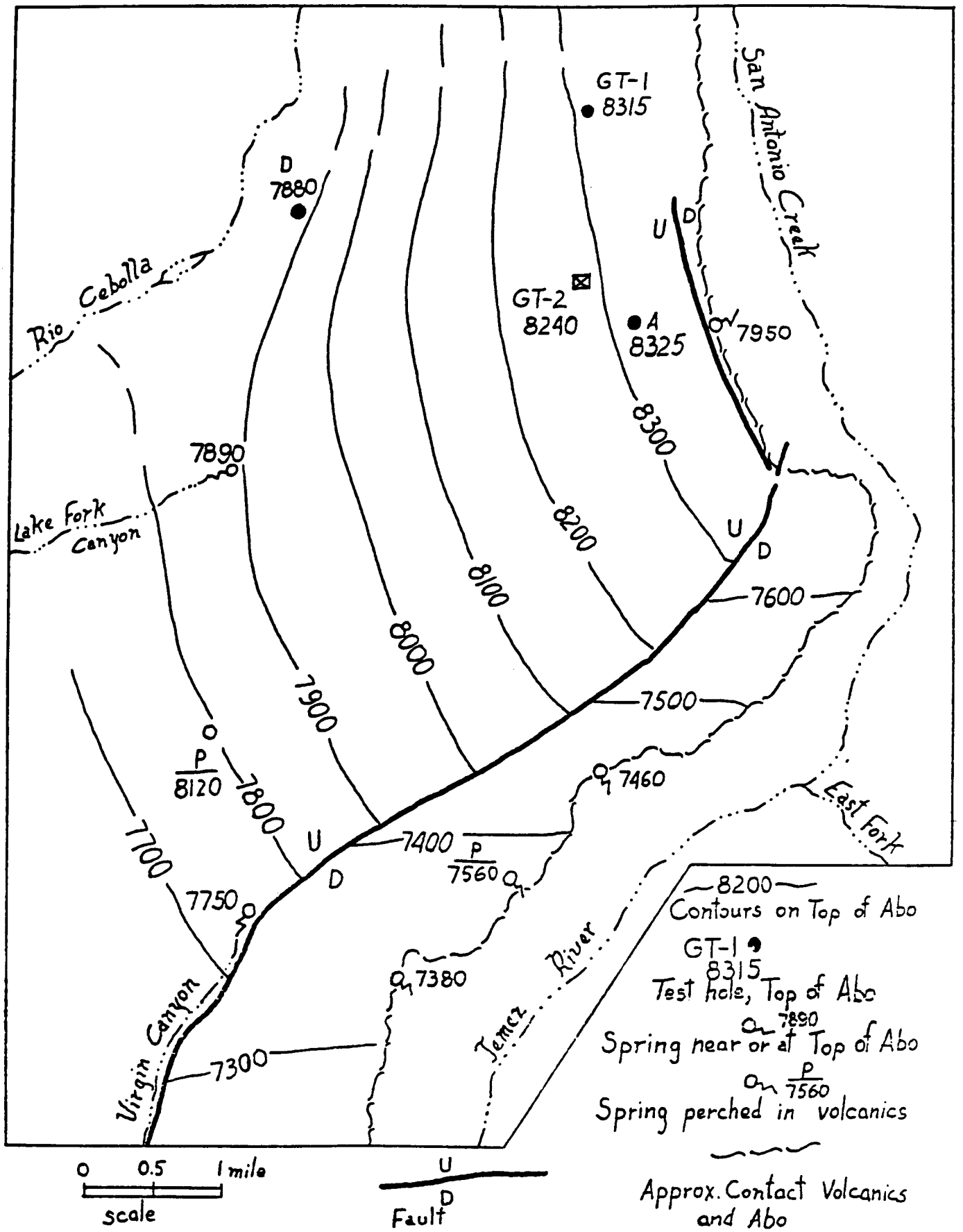


Fig. 1. Structure contours on the top of Abo Formation.

Approximate Cost of the Exploratory Hole

1.	a. Drilling 12 or 14 inch to a depth of about 20 ft and cementing in 10 3/4 inch casing	$300
	b. Drilling 8 inch hole to about 450 ft at $8 a ft.[1]	3600
2.	a. Casing 6 inch ID standard pipe about 430 ft at $5 a ft.	2150
	b. Stainless steel screen 20 ft at $60 a ft = $1200 OR perforated standard 6 inch ID pipes 20 ft at $12 a ft $240[2]	1200
3.	a. Hourly rate for testing and development 12 hrs at $25 an hr.	750
	b. Testing by pumping for 24 hours at $30 an hour	720
	Estimated total	$8720

[1] Contract terminates at 1. b if no water encountered
[2] Type of casing depends on sand size in aquifer.

Elevations (in feet)

	Land Surface	Top of Casing
Slim Hole 1	8684.6	8686.7
Slim Hole 2	8699.2	8701.3
Slim Hole 3	8706.4	8606.6
Slim Hole 4	8695.6	8696.9
Slim Hole 5	8689.0	8692.2
FH-2	8688.6	a/

a/ Top of 20" Surface Casing 8689.1 ft.
Top of 16" Casing 8691.2 ft.

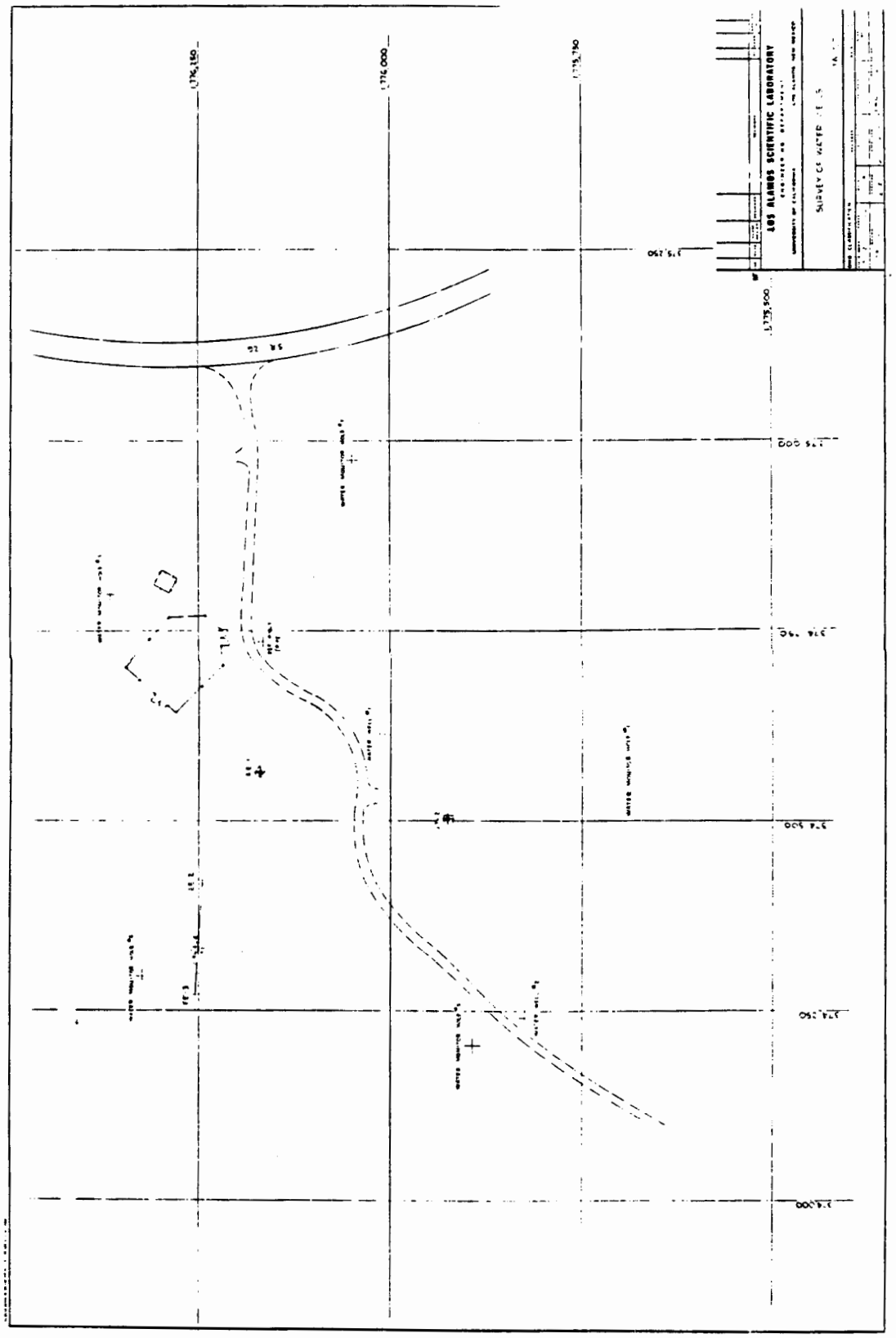
Water Levels (in feet)

	2/4/80	2/6/80
Slim Hole 1	366	365.68
Slim Hole 2	379.8 b/	-
Slim Hole 3	412.7	411.05
Slim Hole 4	377.3	377.37
Slim Hole 5	371	370.03
FH-2 6	371 c/	370.26
FH-1	-	370.66

b/ MP Land surface

c/ MP Top of 16" casing (Elevation 8691.2')

ATTACHMENT V



ATTACHMENT VI

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS NEW MEXICO 87545
Telephone Ext

OFFICE MEMORANDUM

TO : Distribution

DATE: February 13, 1980

FROM : ~~Jim Hill, G-2~~

SUBJECT : Water Well #3

SYMBOL : G-2

MAIL STOP: 980

Water well #2 was completed near the west side of the site in January. The well proved to be inadequate in production for its intended purpose. A committee consisting of Bill Purtyman, Dan Miles and Naomi Becker with Bob Hendron and Jim Hill assisting, was formed to pick a location for water well #3. With the information available, it was decided to place the well as near as feasible to water well #1. The final location agreed to is ∿ 75' south of water well #1. Some sentiment was expressed for drilling the well near the test hole #1 at the south end of the site. This was dismissed as the available information was too sketchy to attach any credence to such a location.

Distribution
G. Nunz, G-DOF MS 575
C.L. Edwards, G-2 MS 978
Bill Purtyman, H-8 MS 490
Dan Miles G-4 MS 980
Naomi Becker G-5 MS 980
G-2 File
Ed. Kaufman, G-DOF MS 575

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO Price Feron, ENG-2, MS 984

DATE March 18, 1980

FROM W. D. Purtymun, H-8 WDP

SUBJECT LOGS OF TEST BORING, MARCH 17, 1980

SYMBOL H8-80-195

MAIL STOP 490

The following data was collected as you requested in memos ENG-2-80-195 and ENG-2-80-209.

Micro-Machining Facility, SM-66, TA-3

Test Hole BH-20	Depth(ft) From	To
Soil & Fill	0	6
Tuff, light brown (Tuff moderately welded)	6	18
Test Hole BH-21		
Soil & Fill	0	10
Tuff, light brown	10	15
Tuff, dark brown (Tuff moderately welded)	15	18

Road Improvement, TA-54

Station 9 + 00	Soil	0-2 ft (Adjacent to Road)
Station 18 + 09	Fill	0-2 ft (On Road)
Station 24 + 50	Soil (clayey)	0-6 ft (Ditch)
Station 24 + 50	Soil (clayey)	0-7 ft (Adjacent to Ditch)
Station 35 + 00	Fill	0-2 ft (Edge of Road)
Station 47 + 00	Fill	0-3 ft (Edge of Road)
Station 60 + 00	Soil	0-0.5 ft (Adjacent to Road)
Station 70 + 00	Fill	0-2 ft (On Road)
Station 80 + 00	Fill	0-2 ft (On Road)

Note: Soil or Fill underlain by Tuff

WDP:vh

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Naomi Becker, G-5, MS 981
Dan Miles, G-4, MS 980

DATE: April 4, 1980

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : HYDROLOGIC CHARACTERISTICS OF SUPPLY WELL FH-2

SYMBOL : H8-80-247

The transmissivity of the aquifer at FH-2 was determined from drawdown and recovery water level measurements during an aquifer test on February 4, 1980 (Fig. 1). Method used is described by Wenzel (1942) and Todd (1959). The storage coefficient could not be determined because of erratic water level fluctuations in the observation hole.

A water stage recorder was installed on well FH-1 on March 20, 1980, along with a microbaragraph. The water level in the well responded inversely to the atmospheric pressure changes, i.e., when pressure increased, water levels declined. The barometric efficiency of the well was computed from the average water level and barometric change from March 20 through 28 (Fig. 2).

The storage coefficient (S) of the aquifer was estimated by a method described by Todd (1959) using the barometric efficiency of the well as described in the following equation:

$$S = \frac{\alpha b}{Ew\ B}$$

Where α = Porosity (estimated at 0.44 from 3-D elastic properties log of GT-2)
b = Thickness of aquifer (63 ft)
Ew = bulk modules of compression of water (Todd 3×10^5 psi $\approx 6.9 \times 10^5$ ft of water)
B = Barometric efficiency (0.49)

or $$S = \frac{(0.44)(63)}{(6.9 \times 10^5)(0.49)} = 8.2 \times 10^{-5}$$

Water level declines in the vicinity of the well can be estimated (assuming no water available for recharge and a homogeneous and unbounded aquifer) by using the transmissivity and storage coefficient. The following equations are found in Wenzel and Todd:

$$u = \frac{1.87r^2S}{T_t}$$

and $$s = \frac{114.6\ Q}{T}\ W(u)$$

where r = distance from FH2(ft)
S = 8.2×10^{-5}
T = 1×10^3gpd/ft.
t = time after pumping began (days).
Q = ~9.3 gpm continuous pumping, which is equal to about 15 ac.ft/year.
W(u) = derived from u in tables for values of W(u) (Wenzel 1942).
s = decline in water level (ft) at distance from FH-2.

Water level declines at distances of 10, 250 and 500 ft from FH-2 were estimated using the two equations and parameters described above.

At the end of	Cumulative Pumpage 10^6 gal	Cumulative Pumpage ac-ft	Distance from FH-2: 10 ft	250 ft	500 ft
			Water level declines (ft)		
1st year	4.9	15	18	10	9
2nd year	9.8	30	18	11	10
5th year	24.4	75	19	12	11
10th year	48.9	150	23	16	14

The data shown is subject to the assumptions made of the aquifer. The actual aquifer is, however, neither homogeneous or of indefinite areal extent. As a result, water level declines would be much greater than tabulated. The data is presented to indicate the minimum magnitude of water level decline under ideal aquifer condition if production from FH-2 was at 15 ac-ft/year.

References

L. K. Wenzel, "Methods for Determining Permeability of Water Bearing Materials," U.S. Geol. Survey Water Supply Paper 887 (1942).
K. D. Todd, "Ground Water Hydrology," John Wiley and Sons, Inc., Publishers, New York, New York (1959).

WDP/mlk
Enc. (Figs. 1 & 2)
xc: W. R. Hansen/A. K. Stoker, H-8
F. R. Miera, LS-6

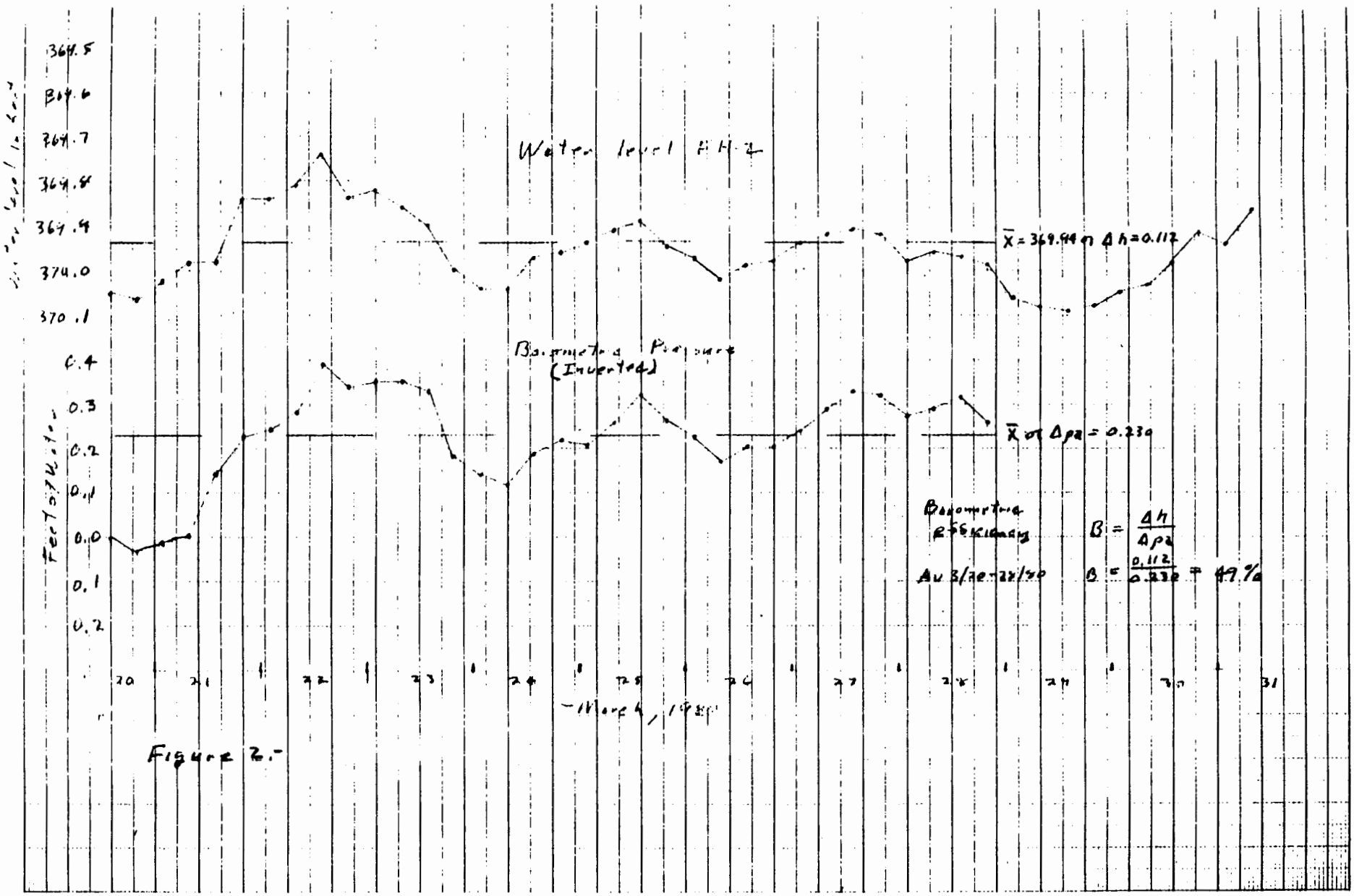
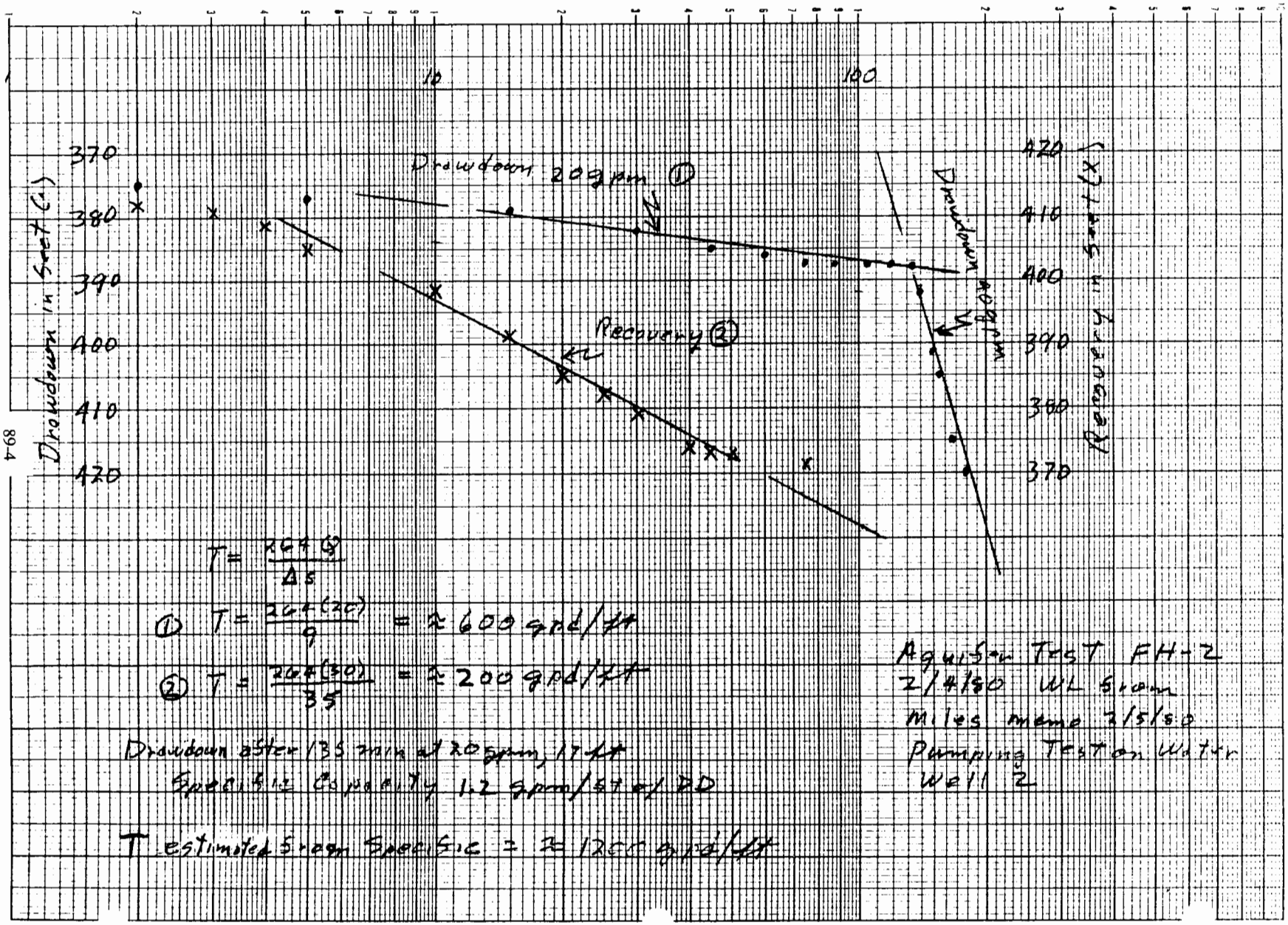

Water level H-4
Barometric Pressure (Inverted)
X̄ = 369.44 m Δh = 0.112
X̄ of Δpa = 0.230
Barometric efficiency
B = Δh / Δpa
Au 3/ae-22/70
B = 0.112 / 0.230 = 49%
Feet of Water
364.5
364.6
364.7
364.8
364.9
370.0
370.1
0.4
0.3
0.2
0.1
0.0
0.1
0.2
20
21
22
23
24
25
26
27
28
29
30
31
March, 1980

Figure 2.-

GRAPH-CHART GRAPHIC CONTROLS CORPORATION Buffalo, New York Made in U.S.A.

SEMI LOGARITHMIC 3 CYCLES X 140 DIVISIONS AD 0840 GD



$T = \frac{264\,Q}{\Delta s}$

① $T = \frac{264(20)}{9} = \approx 600$ gpd/ft

② $T = \frac{264(30)}{35} = \approx 200$ gpd/ft

Drawdown after 135 min at 20 gpm, 17 ft

Specific Capacity 1.2 gpm/ft of DD

T estimated from Specific = ≈ 1200 gpd/ft

Aquifer Test FH-2
2/4/80 WL from
Miles memo 2/5/80
Pumping Test on Water
Well 2

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext.

OFFICE MEMORANDUM

TO Jim Gose, ZIA Tech Division DATE May 12, 1980

FROM W. D. Purtymun, H-8 WDP

SUBJECT TEST HOLES AT PROPOSED PUMP STATION AT TA-57

SYMBOL H8-80-349

MAIL STOP 490

Four test holes, 12 to 23 ft in depth, were drilled at the proposed structure on May 9, 1980. The holes penetrated a moderately welded to welded tuff to a depth of 10 to 12 ft. Below 10 to 12 ft the tuff was a nonwelded to moderately welded tuff. Free water was encountered in the welded tuff in the eastern-most hole. Water was present in an open joint or fracture and was the result of snowmelt ponded on the recently exposed surface of the tuff.

Both the units of the tuff should have a good bearing capacity (~5000 lbs/ft^2); however, the presence of free water in the upper tuff unit may indicate some problem. Final decision on bearing capacity of the tuff can be made after the sump for the pumps is excavated, which will expose both units. At that time bearing capacities can be adjusted if necessary.

WDP/mlk

UNIVERSITY OF CALIFORNIA
LOS ALAMOS SCIENTIFIC LABORATORY
(CONTRACT W-7405-ENG-36)
P.O. BOX 1663
LOS ALAMOS, NEW MEXICO 87545

IN REPLY REFER TO: H8-80-376
MAIL STOP: 490

May 27, 1980

Mr. Glenn Hammock
G. Herkenhoff & Associates
302 8th Street NW
Albuquerque, NM 87102

Dear Glenn:

Enclosed is the data you requested in reguards to well locations in Pueblo Canyon. Table I presents the anticipated log and probable hydrologic characteristics of the aquifer. Figure 1 shows access roads and proposed well locations, while Figure 2 shows the topography in the vicinity of the proposed locations.

Water for drilling operations would be available from Los Alamos well field booster #3 (Fig. 1). Well spacing is about one mile, as well location two is slightly north and upgradient to the ground water movement at location one.

The presence of water from the Bayo St Plant and possible perched water in basalts at a depth of about 235 ft will require a string of surface casing to the top of the main aquifer. This would be similar to the construction of supply well PM-1.

Access to both locations is on an unpaved road off State Road 4 that services the Bayo STP.

Both areas will require some site work to level the area for the rig. This will be about as much as required when we drilled PM-1. Also, enclosed is a copy of report on a well site in Pueblo Canyon written in 1965.

If I can be of further assistance, please call me at 667-7952.

Sincerely,

Bill

W. D. Purtymun
Group H-8, MS 490
Environmental Surveillance

WDP:vh

Enc.: Report

An Affirmative Action/Equal Opportunity Employer

xc: Harry Althaus, DOE ENG, LAAO, MS 316

TABLE 1

ANTICIPATED LOG OF ADDITIONAL SUPPLY WELLS IN PUEBLO CANYON AREA

Elevation: 6450 to 6500 ft.

Total Depth of Pilot Hole: 2800 ft.

Hydrologic Data:

Probable depth to water: 625 to 650 ft.

Probable yield: 600 to 1400 gpm

Probably drawdown: 50 to 120 ft.

Aquifers: Puye Conglomerate & Tesuque Fm.

Probable Geologic Station:

Stratigraphic Unit	Thickness (feet)	Depth (feet)
Alluvium:		
Gravel and boulders	10	10
Puye Conglomerate:		
Conglomerate, gravels and boulders	70	80
Basaltic rock of Chino Mesa:		
Basalts and interflow breccias, may contain perched water at a depth of 235 feet	200	280
Puye Conglomerate:		
Conglomeratie, gravels & boulders	170	450
Basaltic Rocks of Chino Mesa:		
Basalt and interflow breccias	100	550
Puye Conglomerate:		
Conglomerate, gravels and boulders	150	700
Tesuque Formation:		
Siltstone, sandstone & conglomerate interbedded with occasional basalt flow in the upper 1,000 ft of formation	2100	2800

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LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO : File

DATE : July 17, 1980

THRU : Wayne R. Hansen, H-8 Group Leader

FROM : W. D. Purtymun and A. John Ahlquist, H-8

SUBJECT : UPDATE ON ACTIVITIES AT TA-49

SYMBOL : H-8

MAIL STOP : 490

Classification changed to UNCLASSIFIED
by authority of the U.S.D.O.E.,
Per E. M. Sandoval, TSM, OS-6 JAN 25 1994
(Sig. of person authorizing change, title, org., date)
Nella Lang TSM, OS-6 JAN 25 1994
(Sig. of second reviewer, title, organization, date)
File

Note: Every portion of this document is Confidential NSI.

I. INTRODUCTION

This memo presents data collected from January through July 3, 1980, at TA-49 in reference to accumulation of water in Core Hole 2 (CH-2) near the center of Area 2. [CH-2 is a 4-1/2" hole drilled November 30, 1959, to a depth of 500.5 ft from a surface elevation of 7137 ft. It was cased with a 2" diam. pipe. The bottom 20 ft of casing is slotted. In January 1961, a 6-ft-clay pad (capped with asphalt) was placed over Area 2 with a 2-1/2" diam extension to the casing bringing the casing above the pad surface.] Five test holes were drilled adjacent to Areas 2, 2A, and 2B and three holes were drilled into sand-filled shafts in Areas 2A and 2B. Cuttings from the holes were monitored on the site by H-1 and no contamination was detected. Data related to moisture neutron logging in the eight holes is discussed with reference to water in CH-2. Results of bailing water from CH-2 are included.

Continued activities are outlined and additional support requested.

II. TEST HOLES

Five test holes were drilled to a depth of 123 ft adjacent to Areas 2, 2A, and 2B (Fig. 1). The holes are located to provide hydrologic monitoring of the tuff below the bottom of the shafts in Areas 2, 2A, and 2B, and to determine if water found in CH-2 is being recharged beyond the area or if water is being discharged from the area. Cuttings from the holes were logged and moisture content determined over 5 ft drilling intervals. The holes were logged with a neutron sonde at ~1.6 ft intervals to provide a baseline for additional moisture monitoring and aid in determination of geologic units (Figs. 2 through 4). The neutron logs were run to a depth of about 103 ft, the length of the logging cable. Data from the neutron log is used to describe moisture content of materials penetrated by the holes. The average and standard deviation of a number of observed moisture values are used to describe the moisture distribution in the various units.

DERIVATIVE CLASSIFIER
Sharon J. Anderson
Classification Analyst
Classified by LA-4000
Declassify on 92-1 July 17, 2009 (Date or event)
Review
NATIONAL SECURITY INFORMATION
Unauthorized Disclosure Subject to Criminal Sanctions.
CONFIDENTIAL

Starting at the surface, the holes penetrated a soil and pumice zone and Units 4, 5, and 6 of the Tshirege member of the Bandelier tuff. The lower part of Test Hole 2 (TH-2) is completed into Unit 3 of the Tshirege as the ground surface at TH-2 is at a lower elevation than the other four holes.

The soil and pumice zone ranged from 5.3 to 9.7 ft thick with the thickest sections occurring near the axis of the mesa. The average moisture content, as determined from the neutron logs, in the soil and pumice ranged from about 15 to near 20% by volume (Fig. 5). The large standard deviation (SD) associated with the average reflects variation in moisture distribution through the soil and pumice zone. Moisture in this zone is from infiltration from precipitation. It should be noted that no free water was encountered in the soil and pumice, thus, the specific retention of the soil and pumice is greater than 20% by volume.

Unit 6 ranged from 54 to about 70 ft thick. Unit 6 is a moderately welded tuff with an average porosity of about 48% by volume and a specific retention of about 20% by volume. The maximum moisture content from the neutron logs were about 13% by volume while the average moisture content ranged from 5.5 to 8.5% by volume. No free water was encountered in Unit 6. The maximum moisture content was well below the specific retention of the tuff.

Unit 5 (sand unit) ranges from a knife edge to about 3 to 4 ft thick. As it is thin in the area, the thickness penetrated by the test holes could not be determined. The slight increase in moisture content in Unit 6 above the contact is normal due to the downward moisture flux in the unit perching above a boundary as formed by the ash flows at the contact of Unit 6 and Unit 5. The low moisture content of the tuff above and below Unit 5 indicates no free water is being transmitted through the relatively flat lying thin sand layer comprising Unit 5.

The section logged in Unit 4 with the neutron sonde was about 30 ft in TH-1, TH-3, TH-4, and TH-5, and about 46 ft in TH-2. The total thickness of Unit 4 in TH-2 is about 55 ft (Fig. 2). Unit 4 is a moderately welded tuff with a porosity of about 46% by volume and a specific retention of about 16% by volume. The maximum moisture content logged with the neutron sonde in the unit was about 12% by volume, which is below the value for specific retention. Average moisture content in the five holes ranged from 7.2 to 7.8% by volume. No free water was encountered during drilling in Unit 4.

Unit 3 in TH-2 is a nonwelded to a moderately welded tuff. The moisture content of the cuttings is low (estimated from % weight measurements to be less than 5% by volume). There was no free water encountered in Unit 3.

University of California
LOS ALAMOS SCIENTIFIC LABORATORY
Los Alamos, New Mexico 87545

III. TEST HOLES IN SHAFTS 2A-O, 2A-Y, AND 2 B-Y

Test holes were drilled in three sand-filled shafts (unused) and into the underlying tuff. The holes were drilled to determine if the shafts were a possible recharge area for the water that has accumulated in CH-2. The holes were logged and moisture content determined of sand and tuff. The holes were cased as deep as possible to facilitate neutron moisture logging. Casing depths vary as the holes collapsed when the drilling auger was pulled. Several neutron logs were run in each hole to determine the distribution of moisture in the sand with time.

Test Hole 2A-O penetrated 59 ft of sand and 15 ft of underlying tuff. The moisture content of the cuttings from the sand decreased with depth with an apparent slight increase in moisture in the underlying tuff (Fig. 6). As the data on cuttings are reported in moisture % by weight, the increase of moisture in the tuff is a density difference and does not necessarily indicate excessive moisture at the bottom of the shaft.

Test Hole 2A-O was cased in the sand to about 56 ft or just above the bottom of the shaft. Neutron logs of the hole indicate moisture from precipitation has infiltrated to about a depth of 8 ft in the sand. The average moisture content in the upper 8 ft of sand from April 18 through June 19 ranged from 10.6 to 11.1% by volume with a maximum moisture of 12.1% by volume (Fig. 7). In the lower 50 ft of sand the average moisture content ranged from 7.4 to 7.8% with a maximum of 8.7% by volume. The specific retention of the sand as determined from laboratory experiments ranged from 23.8 to 25.2% with an average of 24% by volume. Thus, maximum moisture content of the sand was well below the specific retention. However, there is an apparent downward flux of moisture in the sand in a low moisture range. The estimated moisture content of the tuff (converted from % weight to % volume) beneath the sand is less than 6% by volume. No free water was encountered in drilling the hole.

Test Hole 2A-Y penetrated 58 ft of sand and 22 ft of underlying tuff. Moisture content of the cuttings in the sand decreased with depth with an apparent increase in the underlying tuff as in Test Hole 2A-O (Fig. 8). Test Hole 2A-Y was cased to ~29 ft. Neutron logs of the hole indicated moisture from precipitation has infiltrated to a depth of 6.2 ft in the sand. The average moisture content in the upper 6.2 ft of sand on May 16, and June 19 was 10.3 and 11.3% by volume with a maximum of 12.7% by volume (Fig. 7). The average moisture content of the underlying 22 ft of sand was 6.6 and 6.7% by volume with a maximum of 7.4% by volume. The estimated moisture content of the tuff (converted from % weight to % volume) underlying the sand is less than 6% by volume. No free water was encountered in drilling the hole.

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Test Hole 2B-Y penetrated 58 ft of sand and 22 ft of underlying tuff. As in Test Holes 2A-O and 2A-Y, the moisture contents decrease with depth with an apparent increase in moisture in the tuff (Fig. 9). The hole was cased to ~30 ft. Neutron logs of the hole indicated moisture from precipitation has infiltrated to 6.2 ft into the sand. The average moisture content in the upper 6.2 ft of sand from May 21 through June 19 has ranged from 9.3 to 10.7% by volume with a maximum moisture of 11.3% by volume. The average moisture content of the underlying 19 ft of sand ranged from 6.6 to 6.8% by volume with a maximum content of 8.2% by volume. The estimated moisture content of the tuff (converted % weight to % volume) underlying the sand was less than 6% by volume. No free water was encountered in drilling the hole.

In comparing the moisture data in the sand of the three shafts, shaft 2A-O contains the largest concentrations (Fig. 7). From the limited data, it appears that in this shaft there is a downward flux of moisture in the sand at a low moisture range. The low moisture range is less than the specific retention of the sand.

IV. CORE HOLE FLUID LEVEL MEASUREMENTS AND ACTIONS

With the discovery of water infiltration into CH-2 and measured contamination in that water, a history of water level measurements was compiled and is reproduced below along with pertinent activities.

Date & Time	Fluid Level (ft)	Comments
June 1960	Hole dry	USGS Geophysical Log
Summer of '73 or '74	Hole dry	Recalled from bottom sampling
Prior to 9/25/74	--	Subsidence hole appears in pad above shaft 2M (noted from aerial photograph taken 9/25/74)
2/27/75	450 ft(?)[a] (~15 m)	
12/4/75	450 ft(?)[a] (~15 m)	
9/76	--	Hole filled over shaft 2M and pad repaved with ashphalt

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TO: File -5- DATE: July 17, 1980

Date & Time	Fluid Level (ft)	Comments
10/77	460 ft(?)[a](~14 m)	Recalled depth from sample taking
8/14/78	--	Water sample collected
Winter '78-'79		

			Barometric Pressure (in. of Hg)
4/16/79	14:00	348.59[a]	22.90
4/19/79	10:00	348.61	22.83
4/27/79	09:00	348.66	22.88
5/4/79	16:00	348.68	22.99
5/15/79	11:15	348.72	23.04
5/31/79	15:00	348.80	--
4/8/80	11:30	349.92	--
5/12/80	15:15	350.07	22.75
6/10/80	09:20	350.21	22.99

[a]Measured from the top of casing

To better detect water movement into or out of the casing, it was decided to bail as much fluid as possible from the hole. This was done in June 1980. Bailing results and data are shown below.

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TO: File -6- DATE: July 17, 1980

Date	Time	Water Level (ft)[a]	Barometric Pressure
6/10/80	09:20	350.21	22.99
	Bail ~5.0 gal		
6/10/80	14:00	380.75	22.96
6/11/80	08:55	380.68	
	Bail ~6.4 gal		
6/11/80	11:45	418.72	
6/17/80	09:00	418.41	23.02
	Bail ~6.4 gal		
6/17/80	11:20	456.15	23.02
6/18/80	09:20	455.60	23.04
	Bail ~5.1 gal		
6/18/80	11:20	486.38	23.02
6/19/80	09:30	486.37	23.05
	Bail ~1.3 gal (all we could get)[b]		
6/19/80	10:40	494.00	23.05
7/3/80	09:30	~493.80	

[a]Measured from the top of the core hole; drilled depth was 500.5 ft; extension of pad added ~6-6.5 ft for a total present depth of ~506.5 ft-507 ft.

[b]An estimated 1.65 ft of fluid remains in the hole above the mud bottom; ∴ depth to mud is 495.65 ft.

The volume of fluid removed equals the volume that would occupy a 2.0 in. diam. cylinder, i.e., no fluid in the annulus between the casing and formation flowed into the annulus during these operations. We suspect the bottom of the annulus is also filled with drilling mud which acts as a barrier to flow of fluids between the casing and annulus. There is some hydrological connection as the fluid level dropped 1.62 ft from 4/16/79 to 6/10/80.

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V. SUMMARY AND CONCLUSION

Five 123-ft-deep test holes (TH-1 through TH-5) drilled around Areas 2, 2A, and 2B do not penetrate the entire section of Bandelier Tuff underlying TA-49. However, in the upper 123 ft, it appears from data collected that there is no recharge from outside Area 2 into Core Hole 2 (CH-2) or discharge from the area. The presence of water in CH-2 indicates recharge is within the areas--infiltrating through sand-filled shafts in Areas 2A or 2B or through the asphalt pad (solar collection, partially sealed cracks in the asphalt, or the subsidence hole above hole 2M that appeared in 1974 and was sealed in September 1976).

The presence of contaminants in the fluid from CH-2 in 1978 indicates recharge to CH-2 must move through the upper unit (Unit 6) of the Bandelier Tuff as all shafts are completed in this unit. Unit 5, the sand layer is thin [2 ft thick (78'-80')] in CH-2, and 20 ft below the bottom of shafts in the area.

Moisture data collected from holes drilled in unused sand-filled shafts indicates water from precipitation infiltrates into the upper 6 to 8 ft of the sand. The moisture content in that zone depends on weather. Moisture content in the lower section of sand is lower and varies only slightly. The moisture content of the sand is well below the specific retention values though there appears to be a downward flux of moisture in the low moisture range. The tuff beneath the sand does not contain excessive moisture as if water was ponding in the bottom of the shaft. In all respects, the moisture content of the sand and tuff in the holes drilled in the three shafts cannot account for the accumulation of water in CH-2. Other sand-filled shafts (unused and used) in Areas 2A and 2B could be a source of recharge to CH-2 if they are located in a low area such as south of the asphalt pad. The long-term effect of the exposed sand in the top of the shafts will alter the moisture content of the tuff in Unit 6, increasing the possibility of movement through the tuff mainly by capillary movement with some possibility of movement of free water.

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TO: File -8- DATE: July 17, 1980

VI. CONTINUED STUDIES

Additional moisture neutron logging is planned for the test hole and the holes in the shafts to evaluate seasonal moisture changes.

Cuttings from two test holes are being analyzed for radionuclides to provide background data. Cuttings (sand and tuff) from the shafts are also being analyzed to determine if there has been any movement of contaminants from the adjacent used shafts.

VII. ADDITIONAL SUPPORT

We need to have Engineering locate the five test holes by LASL coordinate system and establish elevation at top of casing (surface string) and land surface. Data will be used to determine gradient of contact between Units 5 and 6 of the tuff, the most probable pathway for any horizontal movement of water from the area. Additionally, an elevation measurement at the top of CH-2 is desirable.

WDP/AJA:mar
Attachments

Xc: D. M. Kerr, DIR, MS 100
R. H. Campbell, NSP-T+V, MS 670
H. S. Jordan, H-DO, MS 400

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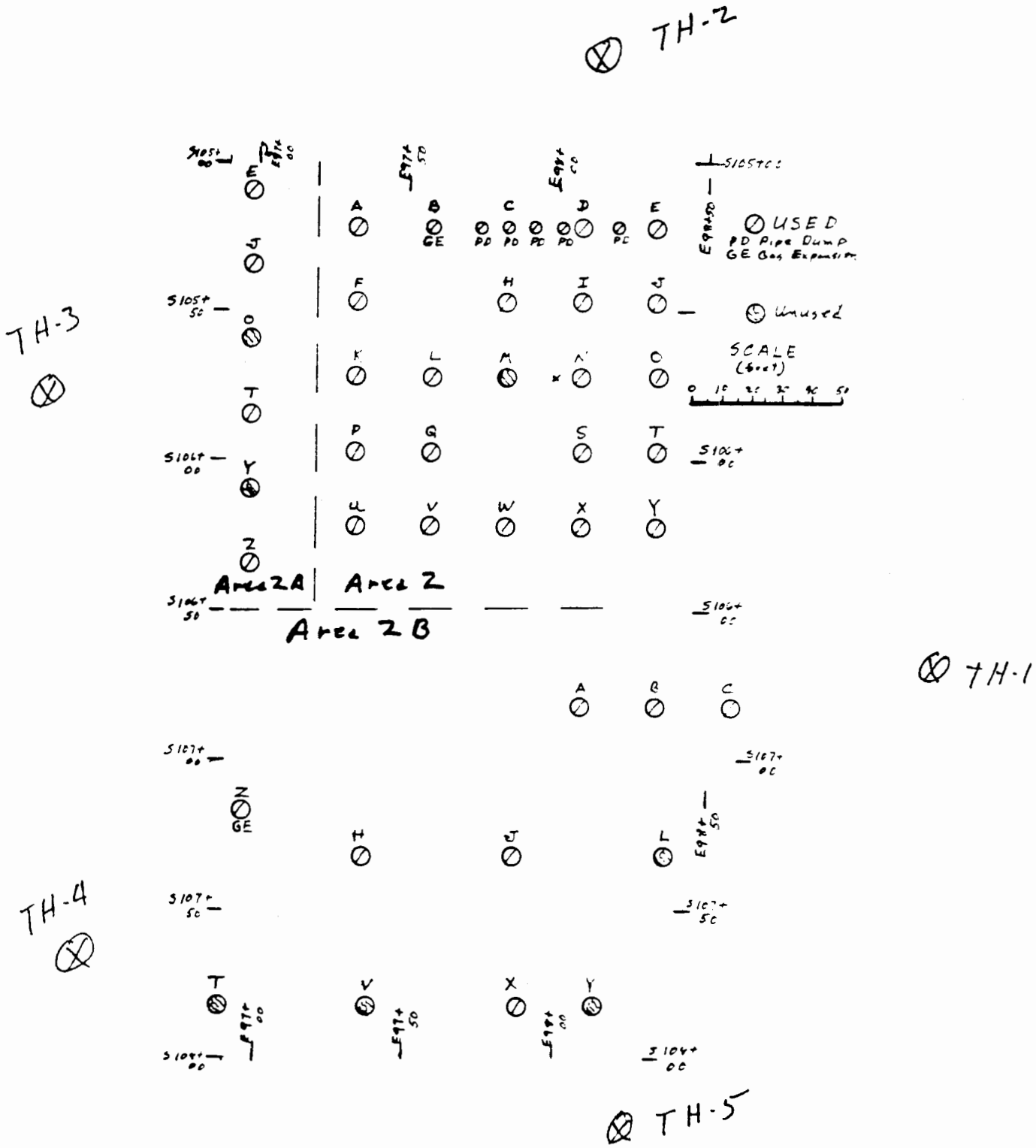

Fig. 1. Approximate location of Test Holes adjacent to Areas 2, 2A, and 2B.

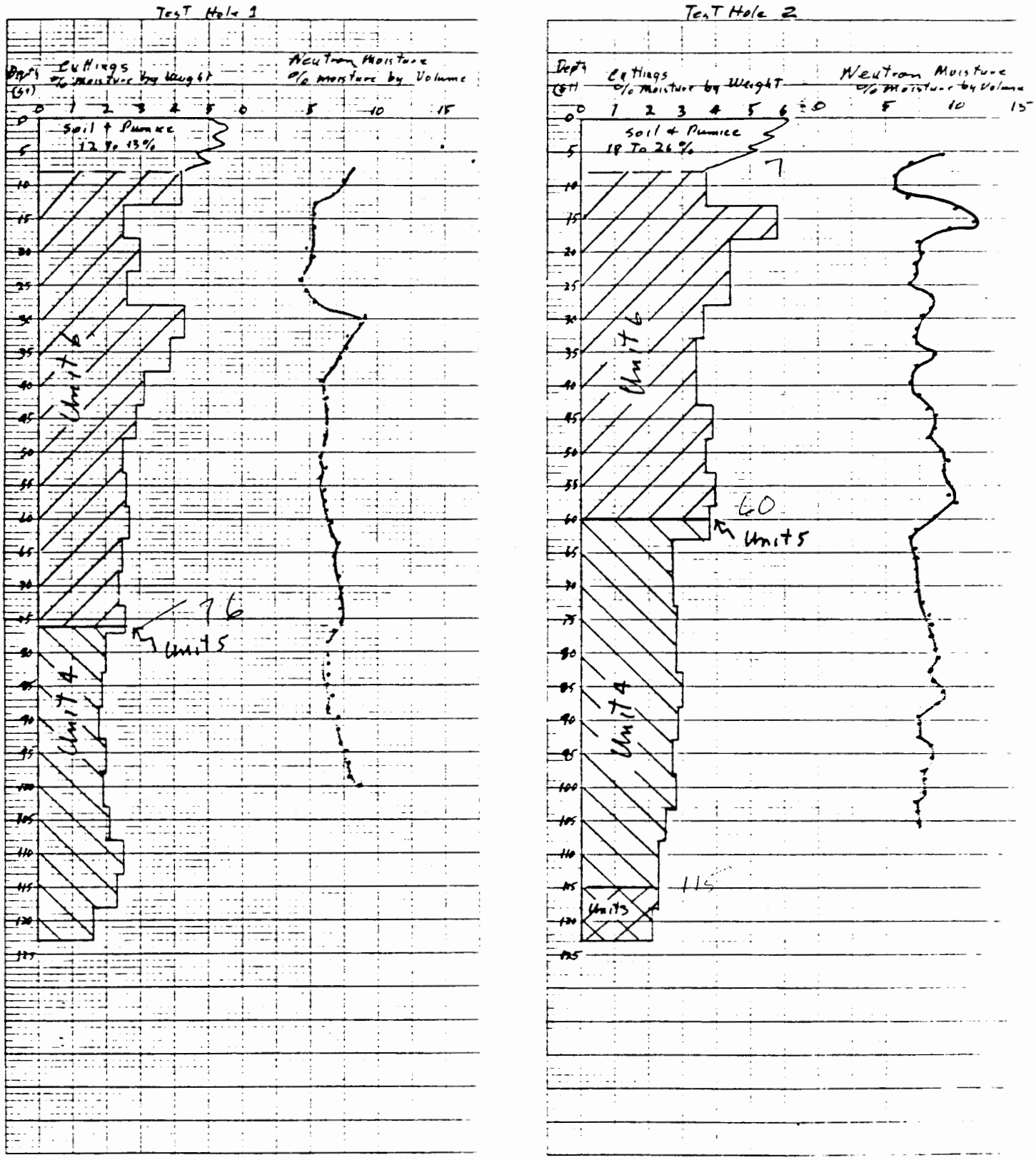

Fig. 2. Geologic and neutron logs of Test Holes TH-1 and TH-2.

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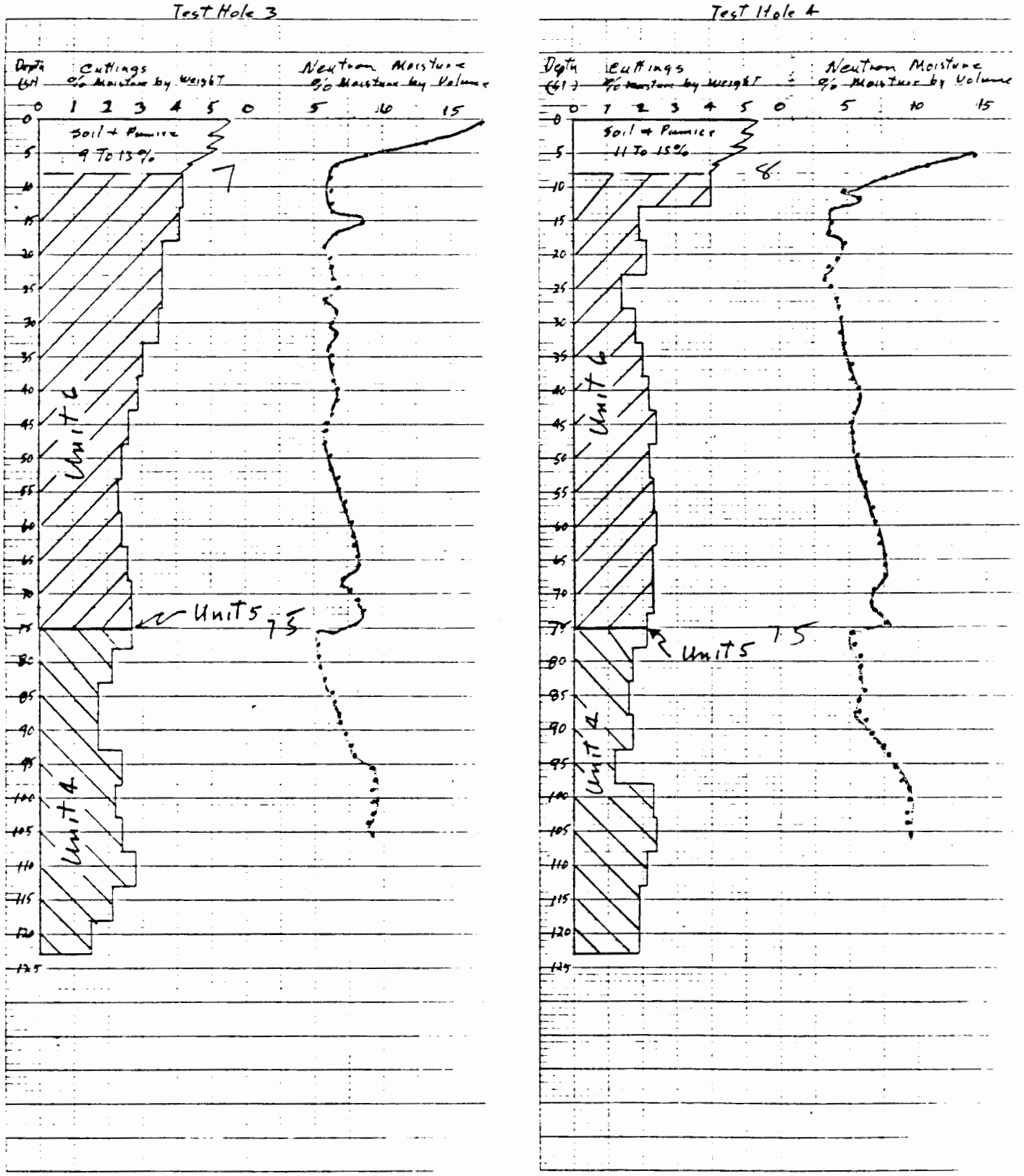

Fig. 3. Geologic and neutron logs of Test Holes TH-3 and TH-4.

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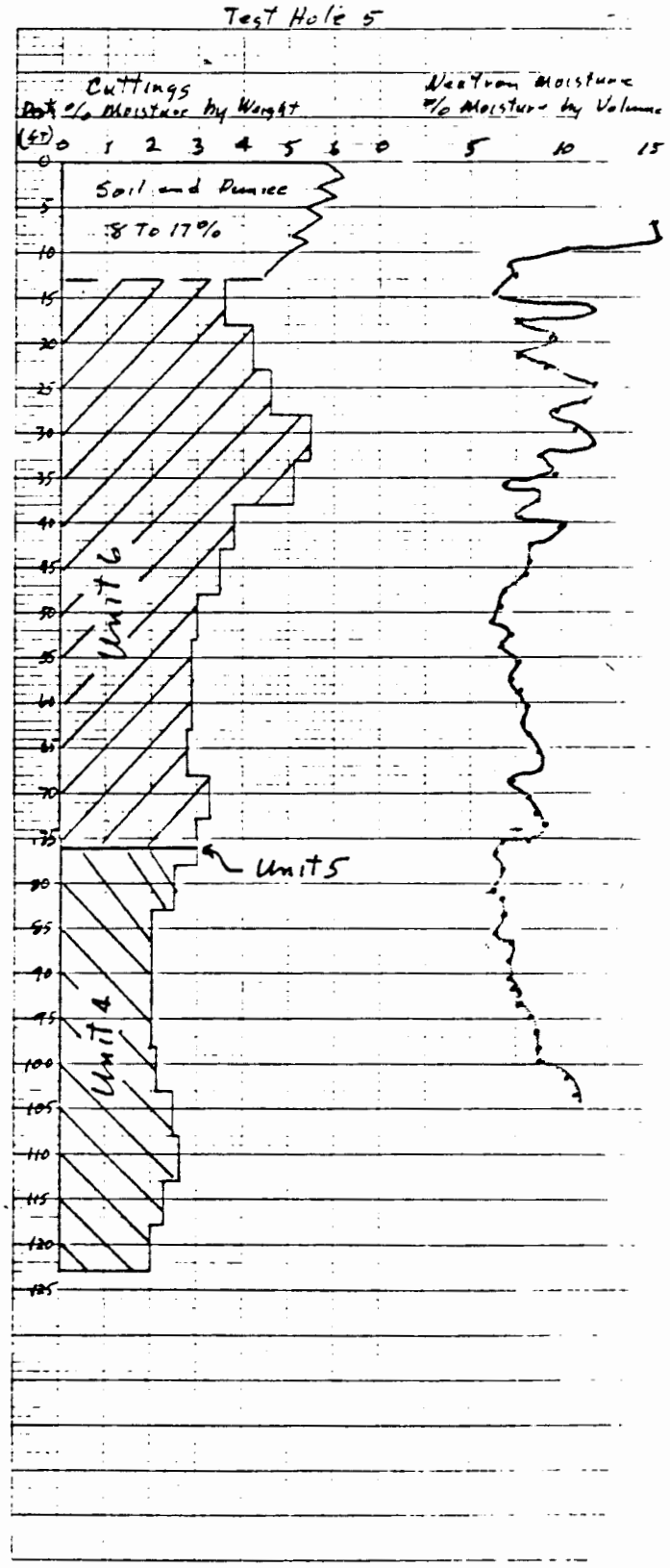

Fig. 4. Geologic and neutron logs of Test Hole TH-5.

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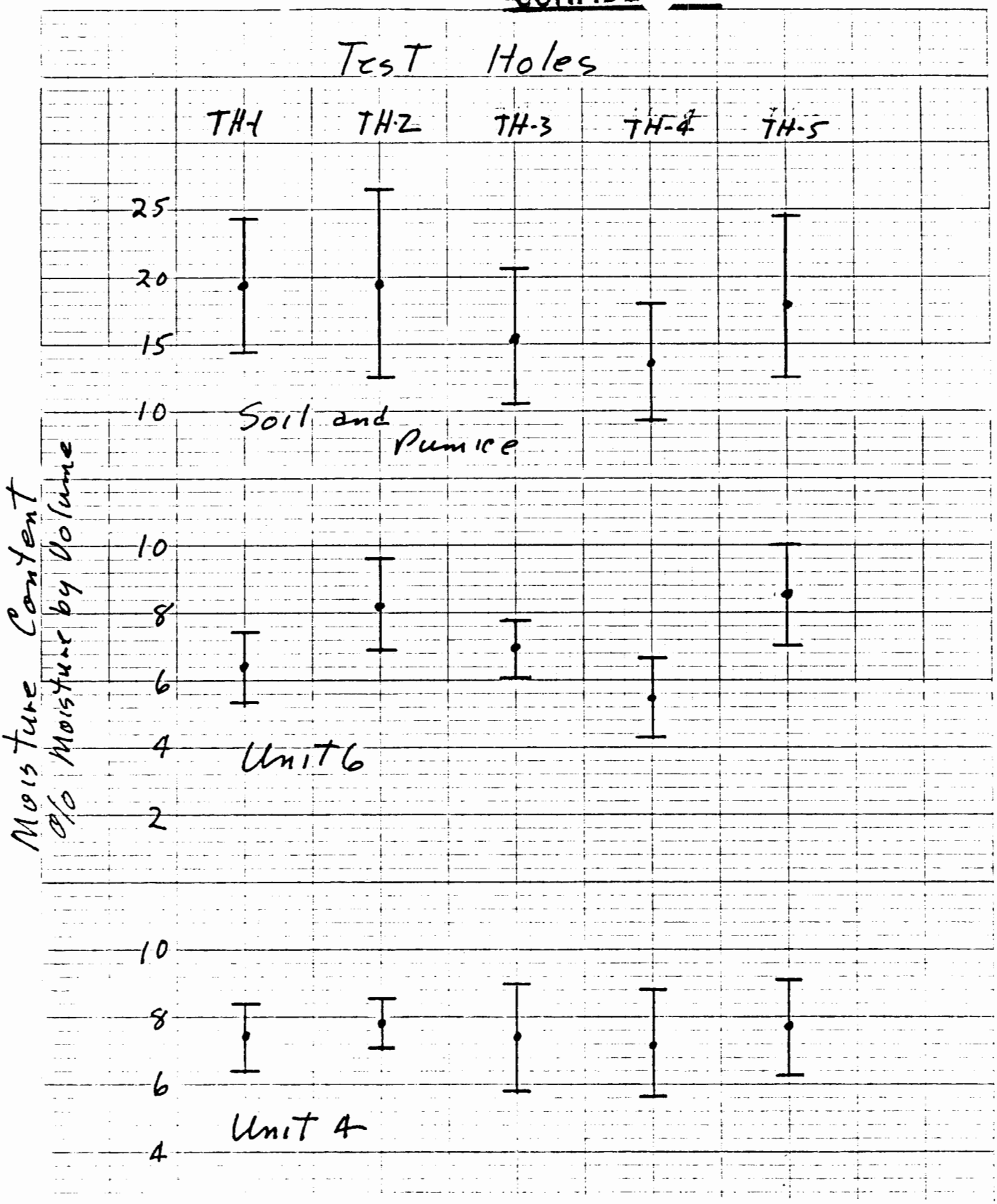

Fig. 5. Average moisture content of pumice and soil and tuff of Unit 4 and 6 in test holes.

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Shaft 2A0 ~~CONFIDENTIAL~~

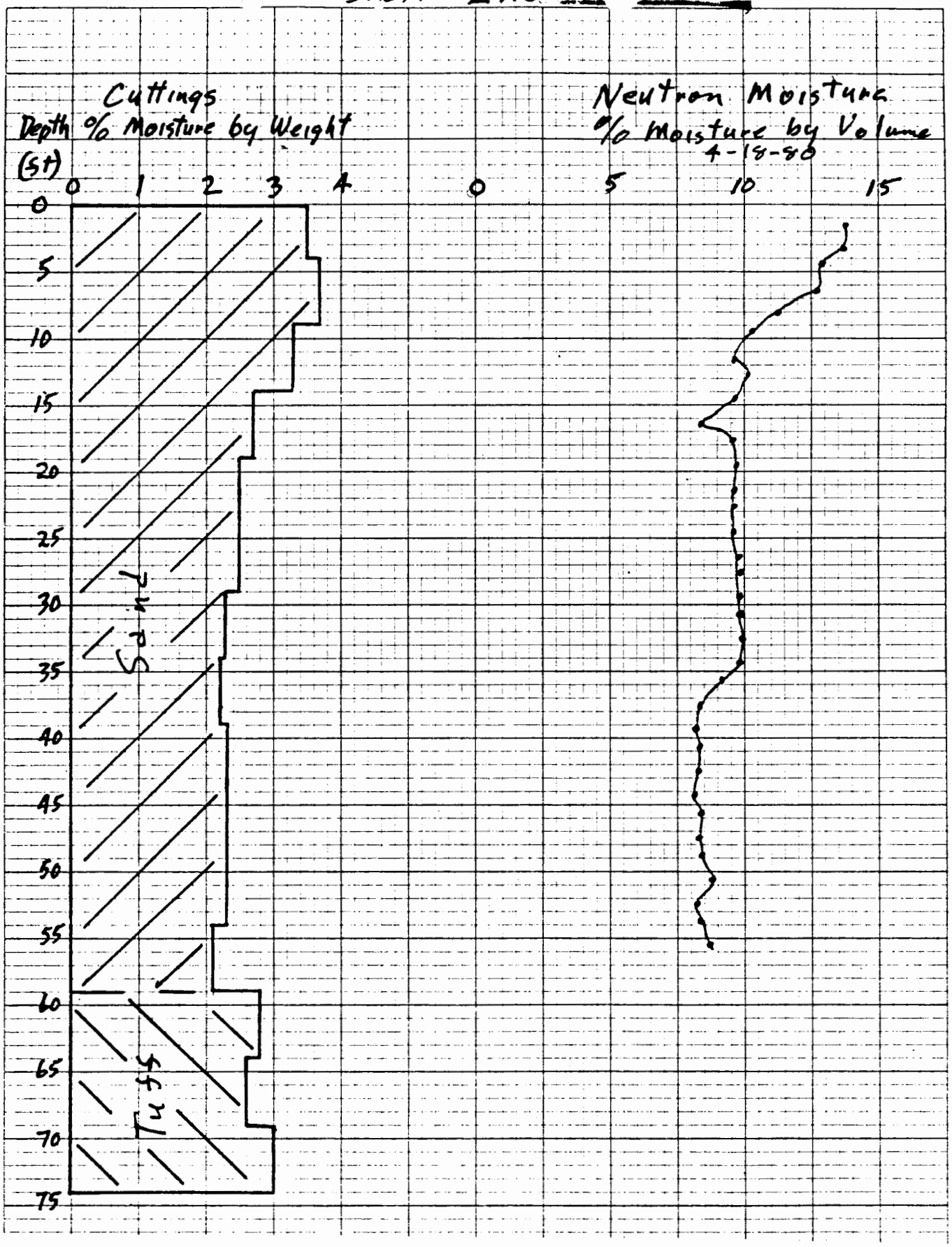

Fig. 6. Geologic and neutron logs of Shaft 2A-0.

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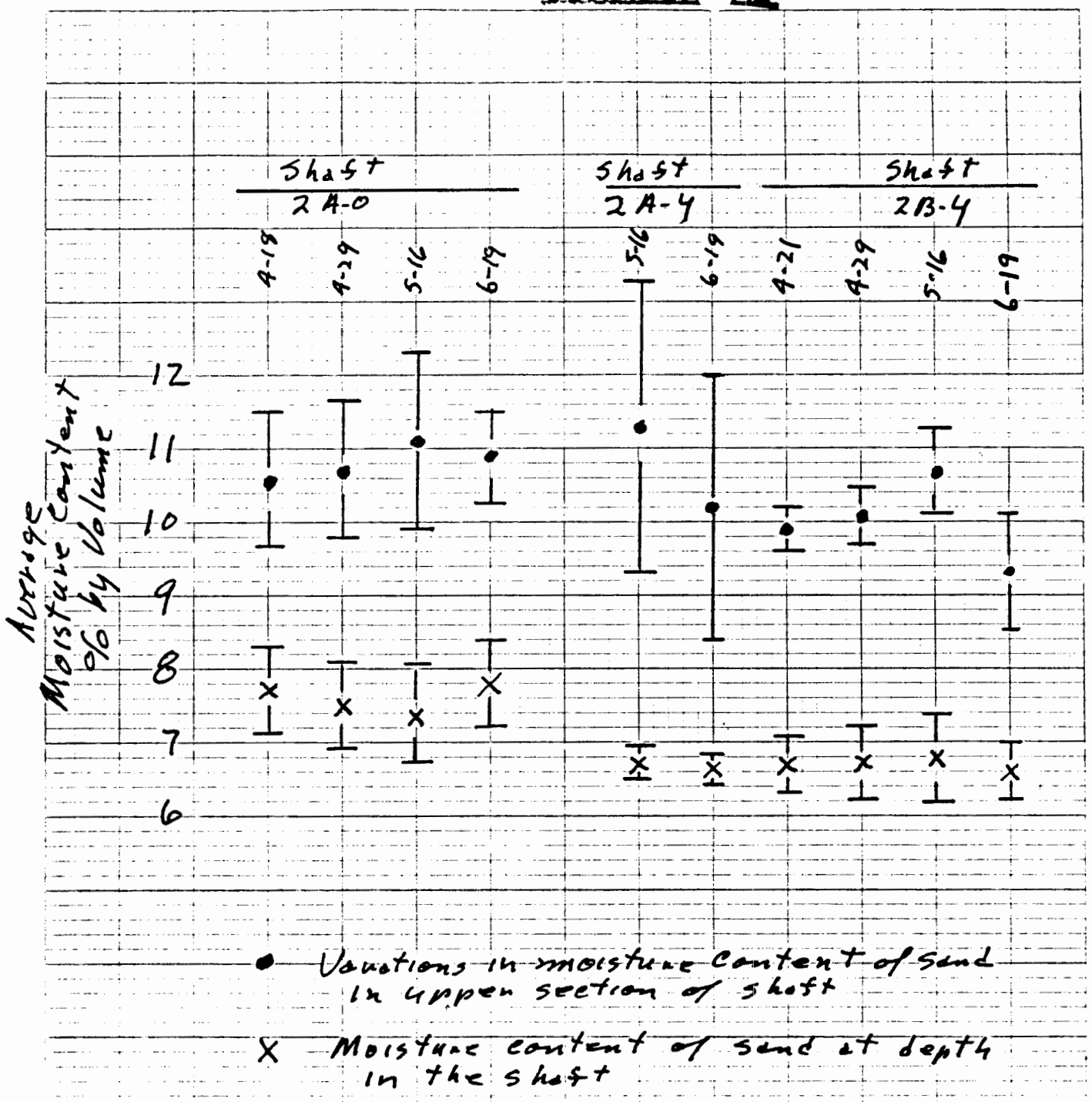

Fig. 7. Average moisture content of sand in Shafts 2A-0, 2A-Y, and 2B-Y.

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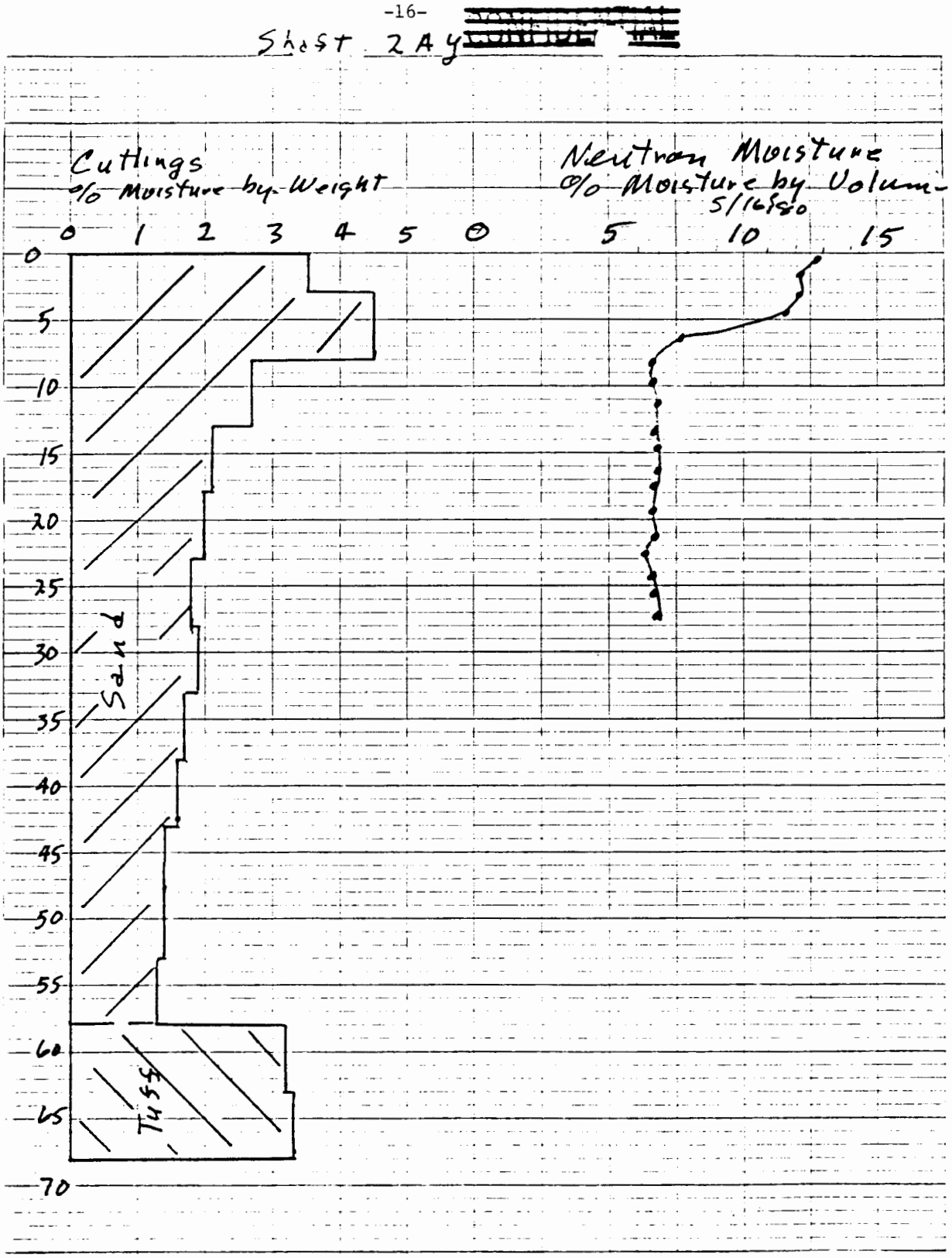

Fig. 8. Geologic and neutron logs of Shaft 2A-Y.

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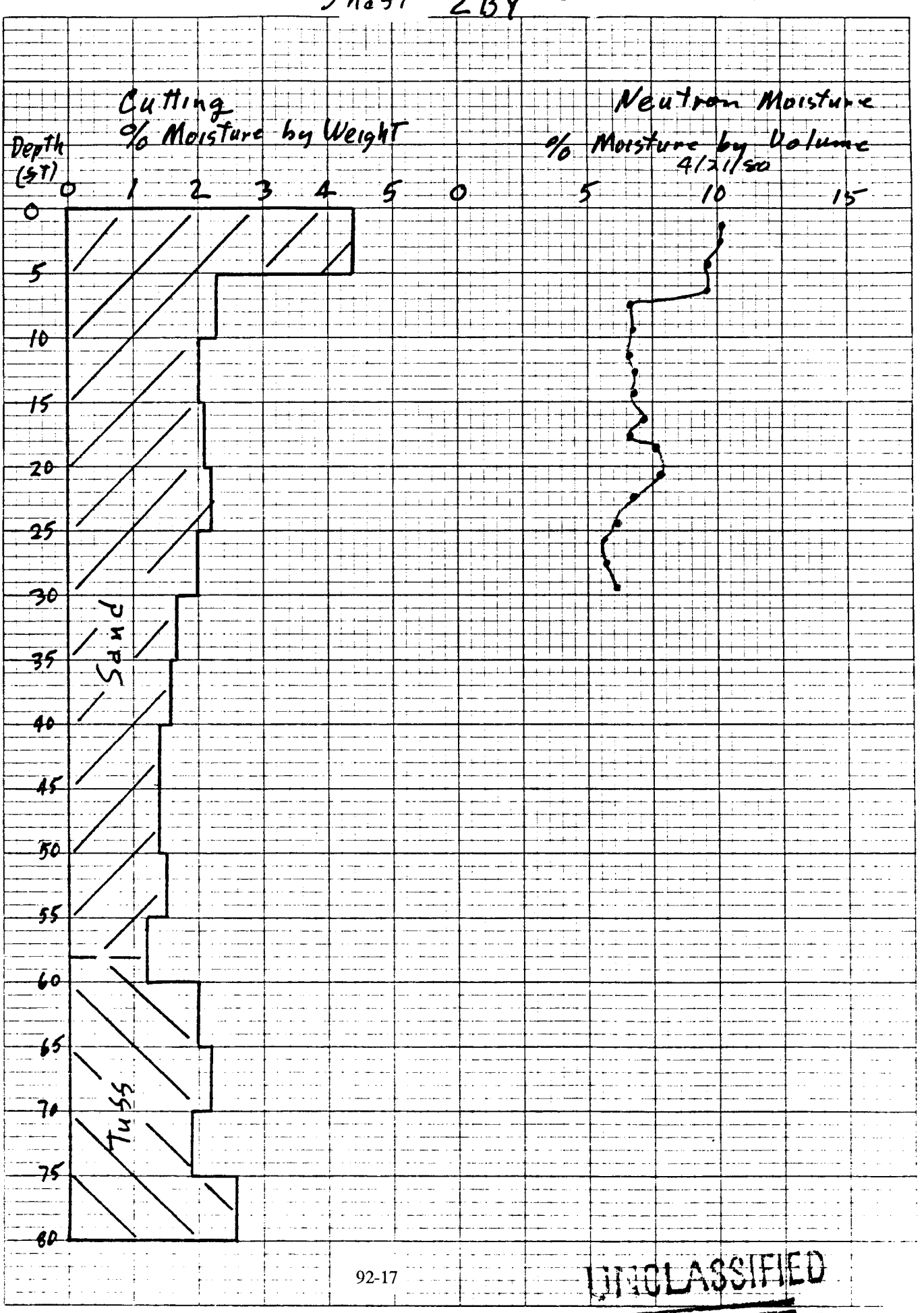

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Fig. 9. Geologic and neutron logs of Shaft 2B-Y.

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SQUARE 5 X 5 TO THE HALF INCH AS 0074-60

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OFFICE MEMORANDUM

TO : Price Fernon, ENG 2, MS 984

DATE: September 3, 1980

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : TEST BORINGS, TELECOMMUNICATIONS CENTER MODIFICATION, BLDG. SM-200, TA-3, L.J. 6309-3.

SYMBOL : H8-80-612

MAIL STOP: 490

Log of two test borings on September 2 are as follows:

Test Hole 1 (Southeast-80 ft out, 2 ft east)
Fill, dark brown - 0-6 ft.
Tuff, light reddish-gray - moderately welded - 6-13.

Test Hole 2 (Southwest - 80 ft out, 17 ft. west)
Fill, dark brown - 0-6 ft.
Tuff, gray, moderately welded 6-13 ft.

Tuff as penetrated by the test holes generally has a safe bearing capacity of 5000 lbs./sq. ft.

WDP:vh

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OFFICE MEMORANDUM

TO : R. Riedel, ENG 2, MS 984 DATE: September 3, 1980

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : TEST BORINGS, LITHIUM HYDRIDE MACHINING, BLDG. SM-102, TA-3
L.J. 6495-3

SYMBOL : H8-80-611

MAIL STOP: 490

Logs of two test borings on September 2 are as follows:

Test Hole 1 (West)
Tuff, gray, moderately welded 0-13 ft.

Test Hole 2 (East)
Tuff, light reddish-gray, moderately welded 0-13 ft.

Moderately welded tuff as penetrated by test holes generally has a safe bearing capacity of 5000 lbs/sq. ft.

WDP:vh

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OFFICE MEMORANDUM

TO : Mike Ragsdale, ENG-2, MS 984 DATE: October 6, 1980

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : TEST BORINGS, WAREHOUSE AND STORAGE BLDG., MPF-16, TA-53; L.J. 6317-53

SYMBOL : H8-80-665

MAIL STOP: 490

Two test borings were drilled at the east and west end of the proposed building. The holes were located on, and penetrated about, 8 ft. of a moderately welded tuff. The tuff has a good bearing capacity and no problem should be encountered.

WDP:vh

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OFFICE MEMORANDUM

TO : Charles King, P-DO, MS 460

DATE: November 14, 1980

FROM : W. D. [redacted], H-8

SUBJECT : TEST HOLE NEAR BLDG. M, TA-53

SYMBOL : H8-80-763

MAIL STOP: 490

A test hole was drilled to a depth of 52 ft northeast of Bldg. M on November 13, 1980.

Geologic Log	Feet From	Feet To
Soil and Fill	0	2
Unit 3, tuff moderately welded, gray; section from 14 to about 20 ft. weathered to a brownish gray, excessive moisture.	2	20
Unit 2A, tuff, moderately welded, brownish gray; upper section 20 to about 26 ft weathered.	20	52

The moderately welded tuff of both units will allow excavation with a "bucket auger." No pumic pockets were encountered during drilling. The zone (excessive moisture) at a depth of about 14 to 20 ft may effect the stability of the wall of a shaft; in other sections the wall will be stable.

Cuttings from the hole are being analyzed for moisture content, tritium, and gamma activity. As soon as results are available, I will forward them to you.

WDP:vh

xc: Don Doehling, ENG-4, MS 822

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OFFICE MEMORANDUM

TO : File

DATE: November 17, 1980

FROM : W. D. Purtymun, H-8

SUBJECT : TEST HOLES BAYO AND PUEBLO CANYONS

SYMBOL : H8-80-764

MAIL STOP: 490

The following test holes were drilled for Ford, Bacon, and Davis (F, B, and D) on November 12 and 13, 1980. The hole numbers are as used by FB and D. Samples were collected at 3 ft intervals to a depth of 15 ft and then in 5 or 7 ft intervals. The samples were given to Don Mayfield for storage.

Bayo Canyon	Feet From	Feet To
Hole 317-8		
Soil	0	6
Tuff	6	12
Hole 317-1		
Soil	0	18
Tuff	18	25
Hole 317-2		
Soil	0	27
Tuff	27	37
Hole 317-7		
Soil	0	2
Tuff	2	18
Hole 317-3		
Soil	0	14
Tuff	14	20
Hole 317-4		
Soil and Sand	0	14
Tuff	14	37
Hole 317-6		
Soil	0	12
Tuff	12	37

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TO: File **DATE:** November 17, 1980

Most of the tuff encountered in the holes in Bayo Canyon was badly weathered with some of the holes encountering pumice near the bottom.

Pueblo Canyon	Feet	
Hole 321-14	From	To
Alluvium	0	1
Clay	1	12
Hole 321-15		
Alluvium	0	7
Sand and Clay	7	12
Basalt	12	13

WDP:vh

xc: Don Mayfield, H-8

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OFFICE MEMORANDUM

TO : R. S. Powell, H-8, MS 518 DATE: January 19, 1981

FROM : W. D. Purtymun, H-8

SUBJECT : PIT #27, INSPECTION JANUARY 19, 1981

SYMBOL : H8-81-44

MAIL STOP: 490

A geologic inspection was made of Pit #27 with reference to guidelines issued for construction and use of solid waste pit. Joint frequence appeared to be about one major joint for every seven feet of pit wall. This is normal for the area. Joint openings were few and not of a size to require remedial action. The pit itself is dug into Unit 2b of the Tshirege Member of the Bandelier Tuff. The contact of two ash flows that make up Unit 2b is about 12 to 15 feet below the land surface.

One large slab of tuff is about to fall out of the southwest wall of the pit. It should be removed prior to use of the pit. Surface runoff should be diverted from the pit. Otherwise, the pit is suitable for use.

We are arranging to have the walls of the pit photographed by ISD with you (Sid) as contact. When "as built" drawings are complete, we would like a set. Depending on schedule, we may wish to map joints and fractures for additional record.

WDP:vh

xc: J. L. Warren, H-7, MS 518

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OFFICE MEMORANDUM

TO : Mike Ragsdale, ENG-2, MS 984 DATE: January 19, 1981

FROM : W[redacted], H-8

SUBJECT : TEST HOLE WASTE DEMONSTRATION SITE, LS-6

SYMBOL : H8-81-43

MAIL STOP: 490

The tuff underlying the proposed Waste Demonstration Site is Unit 3 of the Tshirege Member of the Bandelier Tuff. It is a moderately-welded tuff with density ranging from 70 to 115 lbs/ft^3, and has a safe bearing capacity of 5000 to 10 000 lbs/ft^2. Major joints systems in the tuff are near vertical, ranging from 70° to 90° from the horizontal. As the joints were formed and the ashflow cooled, the orientation in the horizontal plain is random. The joint frequency is about one major joint for each 6 to 8 ft along the wall of an open pit. The tuff should be easily excavated with a back hoe.

The tuff encountered in the four test holes was essentially the same.

NE HOLE	(ft)
Soil	0-2
Tuff, light pink, weathered	2-4
Tuff, light gray	4-28

SE HOLE	
Soil	0-2
Tuff, light gray	2-28

NW HOLE	
Soil	0-2
Tuff, light pink weathered	2-3
Tuff, light gray	3-28

SW HOLE	
Soil	0-2
Tuff, light pink weathered	2-3
Tuff, light gray	3-28

WDP:vh

xc: G. DePoorter, LS-6, MS 495

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Telephone Ext:

OFFICE MEMORANDUM

TO : Merle Bunker, P-2 Group Leader, MS 776 DATE: February 23, 1981

THRU : Wayne R. Hansen, H-8 Group Leader

FROM : W. D. Purtyman and Naomi Becker, H-8

SUBJECT : STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

SYMBOL : H8-81-133

MAIL STOP: 490

A reconnaissance was made of the north canyon wall on February 19, 1981, at the request of A. Lyle, P-2. The last inspection of the slope was made on December 12, 1979 (H8-79-526). Since the last inspection, only one rock, about 300 to 400 lbs., has lodged in the rock catcher on the north wall on the canyon. It is located between posts 4 and 5. It should be removed or broken up and wire spacers repaired.

Two dead trees, one located on the north wall inside the security fence (chain link), the second just outside the security fence on the north wall at the west end, should be removed. If they come down they may take out the security fence. The one north of the building could slide into the structure when it falls. For safety, they should be removed.

With reference to the north wall, the western end of the rock catcher appears to be in the area of greatest rock fall potential. The cables and posts of the rock catcher make a slight bend to the south. Consideration should be given to stringing a second net of spaced cables through the angle of the bend, using existing posts. The existing rock catcher net of cables are low in this area. This was discussed with A. Lyle on February 19, 1981.

Inspection of the slope failed to detect any rocks that were unstable or any other evidence of recent movement besides that noted above. It may be advisable to consider contracting for a Geologic Consultant to look at the area in reference to rock falls as an independent review of past work.

WDP:NB/mlk

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OFFICE MEMORANDUM

TO : Charles King, P-DO, MS 460

DATE: April 7, 1981

FROM : W. D. Purtymun, H-8

SUBJECT : TEST HOLE NEAR BLDG. M, TA-53
(see Memo H8-80-763, 11/14/80)

SYMBOL : H8-81-212

MAIL STOP : 490

A test hole was drilled to a depth of 52 ft, northeast of Bldg. M on November 13, 1980. The follow presents the moisture content, gross gamma activity, and tritium content of the tuff.

Depth (ft)	Moisture Content (% Weight)	Gross Gamma (NCPM/G)	^3H (pCi/mL)
0 - 2	7	5 ± 0.1	6.4 ± 0.4
2 - 7	9	7 ± 0.1	2.0 ± 0.3
7-12	11	5 ± 0.1	0.7 ± 0.3
12-17	17	7 ± 0.1	0.0 ± 0.3
17-22	14	7 ± 0.1	0.7 ± 0.3
22-27	8	7 ± 0.1	0.8 ± 0.3
27-32	6	7 ± 0.1	0.0 ± 0.3
32-37	5	8 ± 0.1	0.4 ± 0.3
37-42	7	9 ± 0.2	0.3 ± 0.3
42-47	6	9 ± 0.2	0.5 ± 0.3
47-52	6	9 ± 0.2	0.7 ± 0.3

Excessive moisture occurs to a depth of about 22 ft. The tuff in the interval of 12-17 ft is just about saturated and may give a bit of trouble in construction of the shaft.

Gross gamma activity of the cutting is normal, shows no contamination. Tritium from land surface to about 7 ft is low but present. Probably occurs from operations at the site in the form of fallout with precipitation.

If I can be of further help, feel free to call.

WDP/mlk

xc: Don Doehling, ENG-4, MS 822 101-1
Jerry Miller, H-1, MS 810

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Telephone Ext:

OFFICE MEMORANDUM

TO : Kirk Ellard, ENG-2, MS 984 DATE: April 7, 1981

FROM : W. D. Purtymun, H-8

SUBJECT : CHARACTERISTICS OF THE TUFF NEAR HRL - WASTE WATER PUMPING, L.J. 6625-0

SYMBOL : H8-81-215

MAIL STOP: 490

The waste water below HRL is along the top of a bench on the north wall of Los Alamos Canyon. The bench is formed by Unit 2 of the Tshirege Member of the Bandelier Tuff. In this area Unit 2 is a light pinkish gray, moderate to welded tuff consisting of quartz and numerous sanidine crystals and crystal fragments, with minor amounts of rock fragments of latite, rhyolite, and devitrified pumice, some mafic minerals in a matrix of ash. The porosity of a moderate to welded tuff can range from 25 to 40% by volume with densities that range from 95 to 120 lbs/cu ft.

The surface of the exposed tuff of Unit 2 is "case hardened" by weathering. Due to the porosity of the tuff, moisture (precipitation) is absorbed dissolving mineral from the tuff. The minerals are returned to the surface by evaporation as the tuff dries out where they are precipitated to form a rind (case hardened).

WDP/mlk

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext:

OFFICE MEMORANDUM

TO : File

DATE: April 8, 1981

FROM : ~~W-8~~ Purtymun, ~~H-8~~

SUBJECT : LOG OF SHALLOW TEST HOLES AT WASTE "Area C."

SYMBOL : H8-81-216

MAIL STOP: 490

Eighteen shallow test holes were drilled in Area C on March 18, 1981, to obtain samples for radiochemical analyses. The holes were drilled using a 4-inch diameter auger to a depth of about 8 ft. Samples were collected from land-surface to 3 ft and 3 to 8 ft for analyses.

The following presents a log of the holes. The location of holes are found in Area C Surveillance Log Book No. 22691 held by Don Mayfield, H-8 (Page 81).

	Range in Feet		
Hole No.	Soil	Tuff (Weathered)	Tuff (Unweathered)
C102	0-2	2-5	5-8
C103	0-2	2-4	4-8
C104	0-3	3-4	4-8
C105	0-3	3-8	-
C106	0-3	3-8	-
C107	0-4	4-8	-
C108	0-2	2-4	4-8
C109	0-3	3-8	-
C110	0-6[a]	6-8	-
C111	0-3	3-8	-
C112	0-3	3-5	5-8
C113	0-4	4-5	5-8
C114	0-4	4-6	6-8
C117	0-2	2-5	5-8
C118	0-3	3-5	5-8
C119	0-3	3-8	-
C120	0-3	3-7	7-8
C121	0-2	2-4	4-8

[a]May be fill

The soil zone ranges from about 2 to 4 ft. At hole C110 there appeared to be about 6 ft of fill material overlying weathered tuff.

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The weathered tuff beneath the soil zone contains some clays as well as stratas of unweathered tuff. The weathering of tuff to clay probably takes place along joints in the upper part of the tuff. In the cutting, the weathered tuff ranges in color from light to dark brown. Foundations can probably be placed into the weathered tuff if consideration is given to their design.

The unweathered tuff is light gray, moderately welded tuff. It is part of Unit 3 of the Tshirege Member of the Bandelier Tuff.

Attached is a memo H-8-M-2124, April 28, 1971 which presents results of test drilling and penetration tests at Area "C" in regard to formation design for the weather tower.

WDP/mlk

Enc.

xc: Harry Jordan, H-DO, MS 400
Don Mayfield, H-8, MS 490
Steve Diamond, WX-4, MS 985

LOS ALAMOS NATIONAL LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87545
Telephone Ext :

OFFICE MEMORANDUM

TO : Sid Powell, H-7, MS 518

DATE: April 29, 1981

FROM W. D. Purtymun, H-8 WDP

SUBJECT :INSPECTION, ADDITION TO PIT #27

SYMBOL :H8-81-264

MAIL STOP :490

About 2,900 cubic yards of storage was added to Pit #27 in March 1981, by excavation of tuff from the pit floor (ENG R-5031). This extended the depth of the original pit about 9 ft with the base of the pit now at an elevation of 6673 ft. The floor or base of the pit is now about 15 ft above the floor of the adjacent canyon, which is tributary to Pajarito Canyon and about 70 ft above the floor of Pajarito Canyon.

Inspection of wall and floor of the new excavation indicated that the Pit is in compliance with the guidelines issued for construction and use of solid waste pits. For original geologic inspection of Pit 27, see Memo H8-81-44 (1/19/81).

WDP:vh

xc: J. L. Warren, H-7, MS 518

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Telephone Ext :

OFFICE MEMORANDUM

TO : Mike Burkett, WX-8 , MS 777

DATE: May 15, 1981

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : TEST HOLES AT PROPOSED SOLAR POND

SYMBOL : H8-81-314

MAIL STOP : 490

Seven (7) test holes were augered in the area of the proposed solar pond east of TA-46. The holes penetrated Unit 3 of the Tshirege member of the Bandelier tuff. Unit 3 in this area is a moderately welded tuff consisting of quartz and sanidine crystals and crystal fragments, few rock fragments of dark gray rhyolite and gray pumice in a light gray ash matrix. Unit 3 is overlain in the area by a thin soil zone of dark brown clay soil. Similar moderately welded tuff of Unit 3 at TA-55 was determined to have allowable bearing pressure about 12 x 10^3 lbs/sq ft, while the compacted fill of natural soil had an allowable bearing pressure of 5 x 10^3 lbs/sq. ft. (Dames and Moore, 1972, Report of Geologic, Foundation, Hydrologic, and Seismic Investigation, Plutonium Processing Facility, Los Alamos Scientific Laboratory, Los Alamos, New Mexico).

The holes encountered 1 to 2 ft of soil overlying the tuff. Some of the hole encountered joints or fractures as the cutting changed color from a light gray to a dark gray, light brown and some clay were present. The change in color at the cutting reflect weathering along the joints prior to development of the soil zone. Joints in the tuff of Unit 3 will be encountered every 5 to 7 ft of the wall (proposed solar pond). The joints are near vertical; however, some low angle joints may occur. The orientation of the joints is random. There may be some block fallout of the pond wall where two joints intersect in tuff back of the pond face.

The moderately welded tuff will excavate easily with heavy equipment.

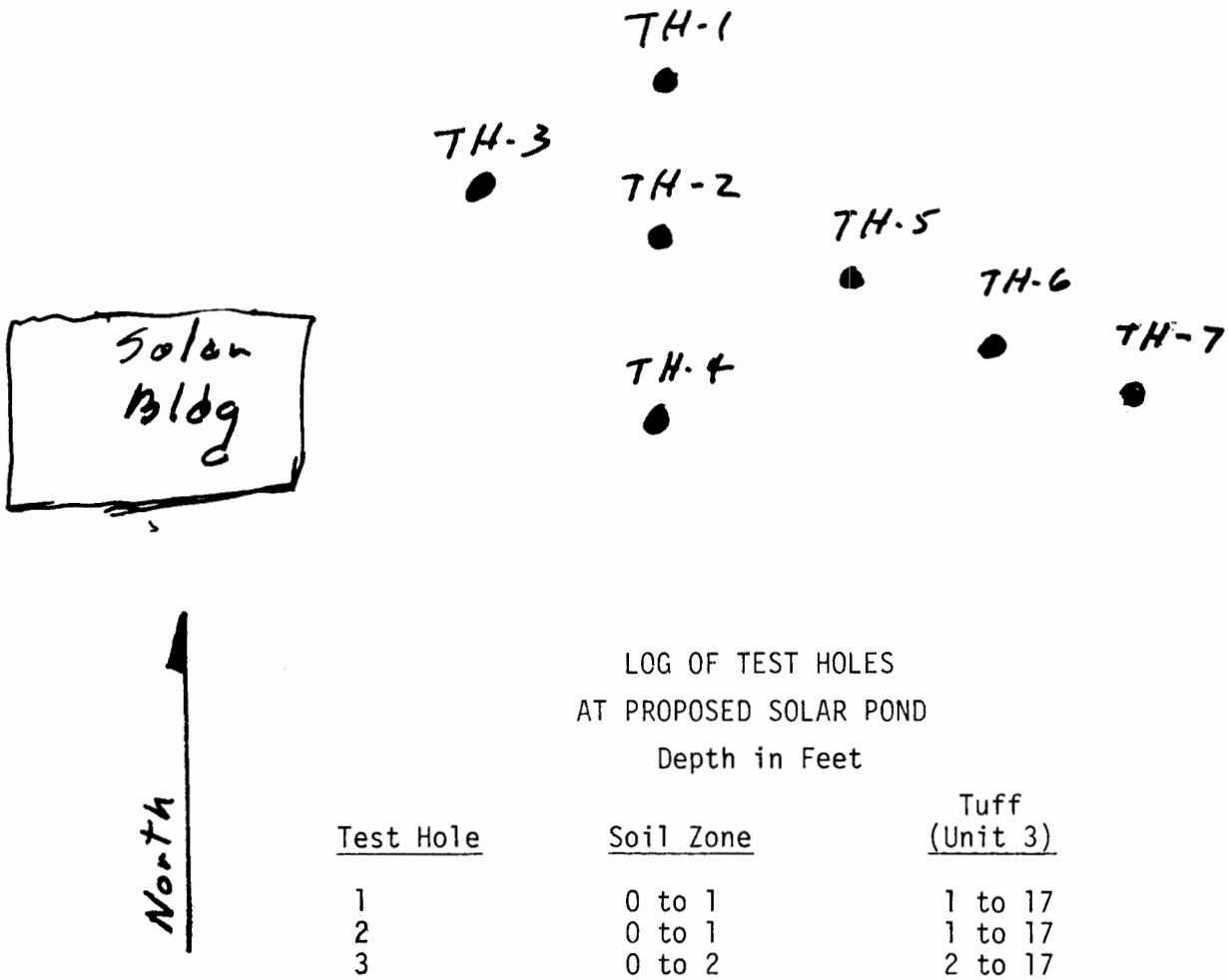
The logs of the holes are attached; locations are shown on attached sketch.

WDP/mlk

Attach. (a/s)

SKETCH MAP SHOWING LOCATION OF TEST HOLES (TH)

AT PROPOSED SOLAR POND (Not to Scale)



LOG OF TEST HOLES

AT PROPOSED SOLAR POND

Depth in Feet

Test Hole	Soil Zone	Tuff (Unit 3)
1	0 to 1	1 to 17
2	0 to 1	1 to 17
3	0 to 2	2 to 17
4	0 to 2	2 to 12
5	0 to 2	2 to 12
6	0 to 2	2 to 12
7	0 to 1	1 to 12

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LOS ALAMOS, NEW MEXICO 87545
Telephone Ext :

OFFICE MEMORANDUM

TO : Billy Bowles, WX-7, MS 950

DATE: May 21, 1981

FROM : W. D. Purtymun, H-8

SUBJECT : GENERALIZED GEOHYDROLOGY OF TA-22

SYMBOL : H8-81-325

MAIL STOP : 490

The follow is a generalized description of the geohydrology of TA-22 as you requested on May 15, 1981.

WDP:vh

Enc.: (a/s)

TA-22 is located along the western edge of the Pajarito Plateau adjacent to the flanks of the Sierra de los Valles. The area is at an elevation of about 7 500 feet with the mesa north of the site open and fairly flat. The surface of the mesa is cut by a few small channels that drain into Pajarito Canyon.

The surface of the mesa is formed by a brown clay soil. The thickness ranges from a few feet to as much as 12 feet. The soil is derived from weathering of the underlying tuff or volcanic rocks.

Volcanic rocks and sediments underly the site at the western edge of the plateau. A generalized section showing rock units and their thickness is based on a test hole located about one mile to the northeast.

UNIT	THICKNESS (FEET)	DEPTH (FEET)
Bandelier Tuff		
Tshirege Member	620	620
Otowi Member	215	835
Guaje Member	60	895
Tschicoma Formation	350	1 245
Puye Formation	390	1 635
Tschicoma Formation	270	1 905
Puye Formation	10	1 915
Tschicoma Formation	510+	2 425

The Bandelier Tuff consists of three members: Tshirege, Otowi, and Guaje, from youngest to oldest. The Tshirege Member is composed of a series of nonwelded to welded ashflows of rhyolite tuffs. The flow underlying the site is a welded tuff. The Otowi Member is a nonwelded pumicious ashflow of rhyolite tuff while the Guaje Member is made up of an ashfall rhyolite pumice.

The Tschicoma Formation is composed of latite and quartz latite flows and pyroclastic rocks. The Puye Formation is composed of gravels and boulders of latite, quartz latite, rhyolite and pumice in a matrix of silt and sand.

The individual ashflow of the Bandelier Tuff dip gently eastward off the flank of the mountains formed by the Tschicoma Formation. As the tuff are volcanic in origin, they are highly jointed due to the cooling. The Pajarito Fault is a north-south trending fault that lies about 1.5 miles west of the site. It is a normal fault, down-thrown to the east. The

The displacement is estimated at 400 ft. The Water Canyon Fault is north-south trending terminates about 0.5 miles to the south of the site, and is a normal fault with maximum displacement of 80 feet. The movement on both faults has been post-Bandelier.

Drainage from the site is into Pajarito Canyon that is confluent to the Rio Grande. The stream in the Canyon is intermittent. The alluvium is thin, but may contain small amounts of water seasonally. The water is perched on the underlying tuff. There is no water perched in the volcanic rocks and sediments above the main aquifer. The main aquifer of the Los Alamos Area is the only aquifer capable of municipal and industrial water supply. The top of the aquifer at the site lies at a depth of about 1 200 feet in the lower part of the Tschicoma Formation or upper part of the Puye Formation. The aquifer slopes gently eastward from the recharge area in the Jemez Mountains to the discharge area along the Rio Grande.

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : Mike Ragsdale, ENG-2, MS 984 DATE: August 27, 1981

FROM : W. D. Purtymun, H-8 WDP

SUBJECT : SOLAR EVAPORATION OF LOW LEVEL RADIOACTIVE WASTE WATER, L. J. 6526-50 TEST BORINGS

SYMBOL : H8-81-514

MAIL STOP: 490

Log of test borings drilled 8/24/81 near TA-50 are as follows:

	(Feet) From	To
Test Hole 1 (NE Corner)		
Soil, brown clay with some sand and gravels, almost saturated above contact with underlying tuff 3 to 7 ft.	0	7
Tuff, brown, weathered, moderately welded, wet from 7 to 9 ft.	7	23
Test Hole 2 (SE Corner)		
Soil, brown, clay, with some sand and gravel	0	7
Tuff, brown weathered, moderately welded, extremely wet 15-17 ft. (probably fracture) and 17-24 ft; Dry 24 to 27 ft.	7	27
Test Hole 3 (SW Corner)		
Soil, brown, clay with sand and gravel	0	8
Tuff, brown, weathered, moderately welded	8	23
Test Hole 4 (NW Corner)		
Soil, brown, clay with some sand and gravel, extremely wet 3 to 7 ft.	0	8
Tuff, brown, weathered moderately welded, wet 7 to 8 ft.	7	13

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The wet soil at base of soil zone encountered in Test Holes 1 and 4 and wet tuff, probably a fracture in tuff 15 to 17 ft in Test Hole 2 is drainage of sanitary waste from the tile field south of TA-50. The presence of water in the soil and tuff will reduce the bearing capacity of the moderately welded tuff as it is in the process of weathering.

A set of borings were drilled on 8/26/81 west of the previous location. The logs are as follows:

NE Corner	(Feet) From	To
Soil, clay, brown with some sand and gravel	0	5
Tuff, brown, weathered moderately welded	5	22

NW Corner

Log same as NE Corner,
Tuff appears to be dryer;
completed in tuff at 17 ft.

SE Corner		
Soil, clay, brown with sand and gravel	0	6
Tuff, brown , weathered, moderately welded; wet zone clay (probably fracture) 8 to 10 ft.	6	17

SW Corner

Same as NW corner;
completed in tuff at 17 ft.

The foundation should be set into top of tuff. The base of the soil zone at both locations contains more moisture, especially at the first location, than is usually encountered.

WDP:vh

xc: Price Fernon, ENG-2, MS 984

LOS ALAMOS SCIENTIFIC LABORATORY
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LOS ALAMOS, NEW MEXICO 87544

OFFICE MEMORANDUM

TO : K. O. Ellard, ENG-2, MS 984 DATE: August 27, 1981

FROM : W. D. Purtymun, H-8

SUBJECT : TEST BORING: ELEVATOR INSTALLATION, BLDG. SM-29; L. J. 6691-3.

SYMBOL : H8-81-513

MAIL STOP: 490

The following is a log of test boring near CMR Bldg.

	(Feet) From	To
Soil or fill, brown, clay with sand and gravel; wet 3 to 6 ft.	0	6
Tuff, brown, weathered, moderately welded; wet 15 to 17 ft probably fracture	6	23

Wet soil or fill overlying the tuff at 3 to 6 ft probably is the result of lawn irrigation. I would set the foundation down into the top of the tuff.

WDP:vh

xc: Price Fernon, ENG. 2, MS 984

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Sid Powell, H-7, MS 592

DATE: August 31, 1981

THRU:

MAIL STOP/TELEPHONE:

FROM: W. D. Purtymun, H-8

SYMBOL: H8-81-520

SUBJECT: INSPECTION OF SHAFT FOR DISPOSAL OF MATERIAL FROM THE MESON FACILITY

The walls of the two intersecting shafts are badly broken along the intersection of east and west walls due to a large southeast-west trending joint. Three or four blocks on the west wall and two on the east wall are now keystoned (held in), but may fall out during disposal operations. Extreme care should be taken.

The exposed walls of the shaft are badly broken; however, the walls are in no worse condition than have been encountered in the open pits. The shafts meet existing criteria for receiving solid wastes.

WDP/mlk

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Jim White, H-7, MS 518

DATE: January 19, 1982

THRU:

MAIL STOP/TELEPHONE: 490;667-5021

FROM: Wayne R. Hansen, H-8 Group Leader

SYMBOL: H8-82-22

SUBJECT: REFERENCE MATERIAL ON AREA L, TA-54, CHEMICAL STORAGE AND DISPOSAL AREA

Area L is used for storage and disposal of chemical or toxic waste materials. The storage area consists of a pit 12 ft. wide, 200 ft. long and about 12 ft. deep, with ramps on long dimension. The wastes are buried in layers interbedded with tuff. The pit was filled and a cover of crushed tuff has been compacted over the waste. Trenches in the area were also used for disposal; however, these have now been filled and covered. One small pit is now being used for disposal of bulk liquids. Wastes are now being disposed of in shafts 2 to 6 ft in diameter and about 60 ft. deep. Containers of liquids, chemicals or oils are placed in the shafts, which are then back-filled with crushed tuff.[1]

Area L, TA-54, is located on Mesita del Buey, a narrow southeast trending mesa that is part of the Pajarito Plateau (Fig. 1). The surface of the mesa at Area L is covered with a thin clay-like soil and is underlain by a series of ashflow and ash falls of dry rhyolite tuff. The tuff is underlain by volcanic flow rocks of basalt and sediments. The pit and trenches are completed into Unit 2b of the Tshirege Member of the Bandelier Tuff, while the shafts extend through Unit 2b into the top of Unit 2a.

Surface drainage from the mesa at Area L is to the north into an unnamed canyon that is a tributary to Canada del Buey (Fig. 1). Stream flow in the unnamed Canyon and Canada de Buey is intermittent, occurring only from heavy thunder shower activity during the summer. Canada del Buey is a tributary to the Rio Grande.

The main aquifer of the Los Alamos area lies at a depth of about 950 ft at Area L. Overlying the main aquifer is about 340 ft of dry rhyolite tuff and 610 ft of volcanic flow rocks and sediments. Hydrologic data collected during construction of two supply wells into the aquifer (one located one mile west, the other, two miles northwest), encountered no water perched in sediments or volcanics above the main aquifer. Two test holes drilled in Pajarito Canyon south of Area L encountered no perched water below the stream channel alluvium.[2] Movement of water in the main aquifer beneath Area L is the southeast toward the Rio Grande where a part is discharged into the river through seeps and springs.[3] Movement in the aquifer is estimated from aquifer test at about 1 ft/day.[4]

REFERENCES:

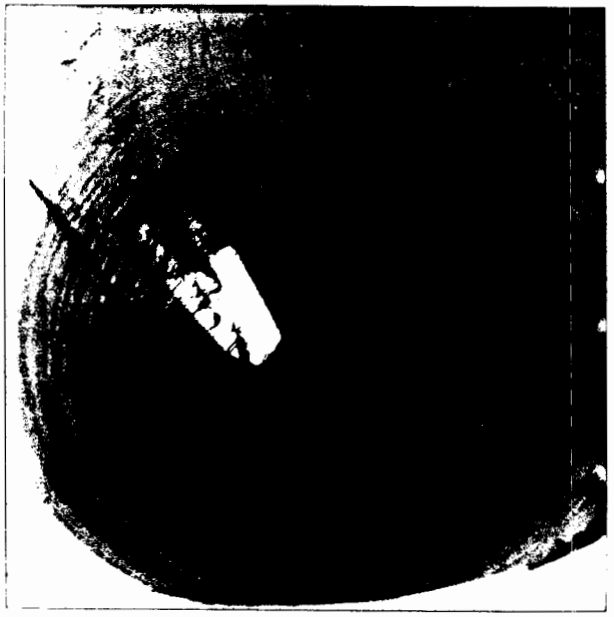
1. Materials Disposal Area L, Los Alamos Scientific Laboratory, ENG-R-3650.

2. R. L. Cushman, "An Evaluation of the Aquifer and Well Characteristics of the Municipal Well Fields in Los Alamos and Guaje Canyons near Los Alamos, New Mexico," U.S. Geol. Survey Water Supply Paper 1809-D (1965).

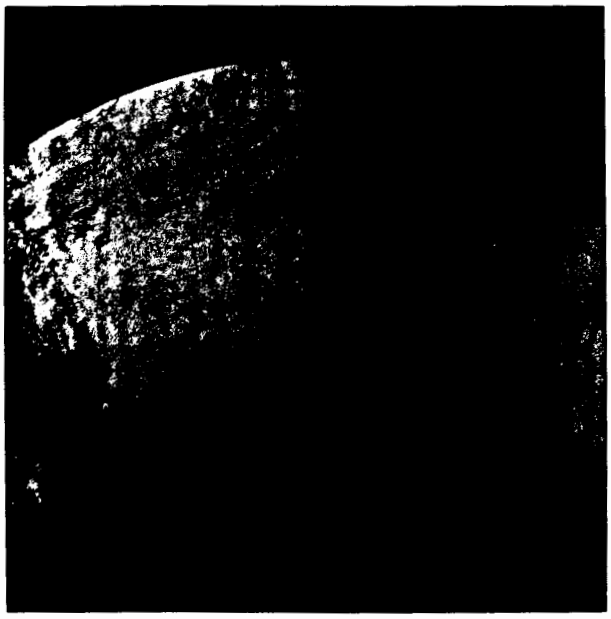
3. R. L. Griggs, "Geology and Ground Water Resources of the Los Alamos Area, New Mexico," U.S. Geol. Survey Wastes Supply Paper 1753 (1964).

4. C. V. Theis and C. S. Conover, "Pumping Test in the Los Alamos Canyon Well Field near Los Alamos, New Mexico," U.S. Geol. Survey Water Supply Paper 1619-I (1962).

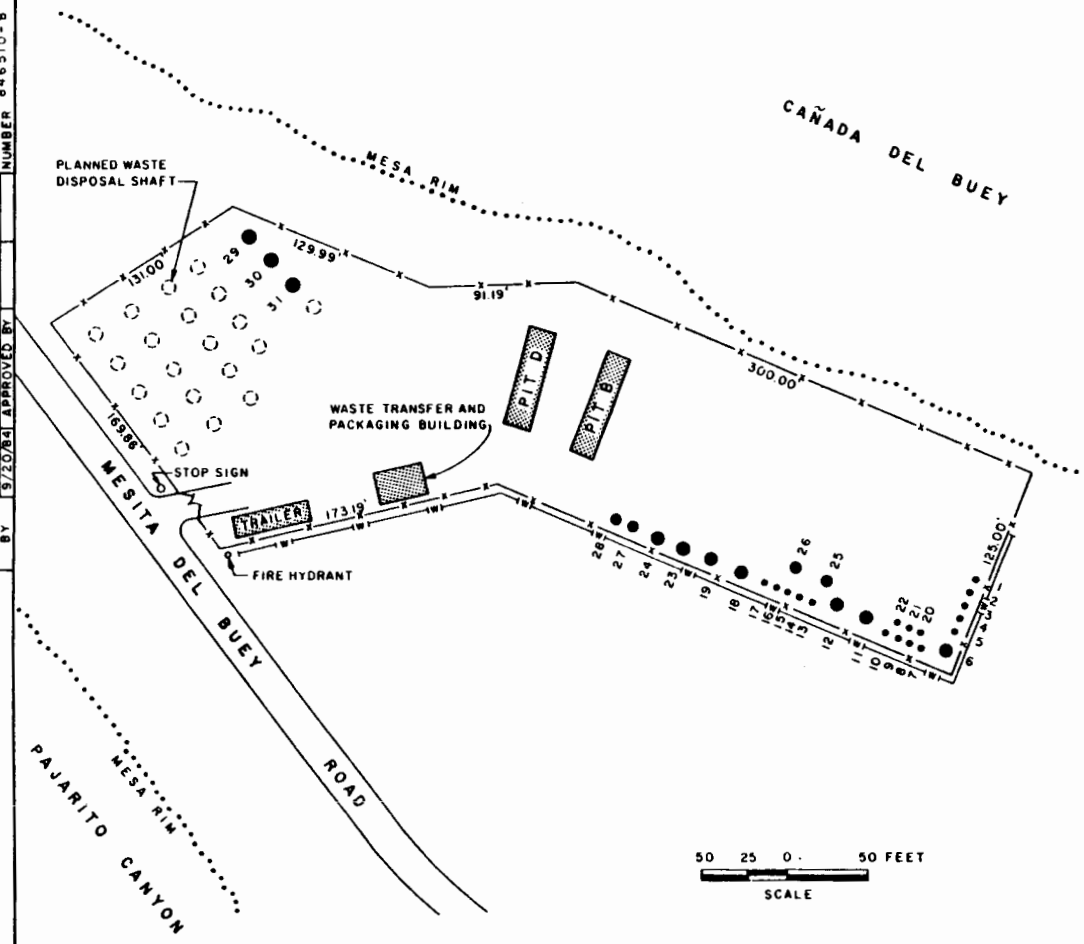
5. W. D. Purtymun and W. R. Kennedy, "Geology and Hydrology of Mesita del Buey," Los Alamos Scientific Laboratory report LA-4660 (1971).



Area L Shaft 29
February 29, 1984



Area L Shot 29
February 29, 1984



AREA L SHAFTS[1]				
SHAFT NO.	SHAFT DIAMETER (FEET)	DATE DRILLED	DATE CAPPED	CONTENTS
1	3	1980	9/83	ORGANICS[2]
2	3	2/75	7/79	ACIDS & BASES
3	3	2/75	11/78	INORGANIC
4	3	2/75	5/80	ORGANIC
5	3	2/75	6/77	WASTE OIL
6	8	6/75	6/79	REACTIVE
7	3	6/75	6/79	REACTIVE
8	3	6/75	6/79	REACTIVE
9	3	6/75	6/79	GAS CYLINDERS
10	3	6/77	6/79	WASTE OIL
11	8	6/78	7/79	WASTE OIL/SOLVENT
12	8	1/78	7/79	WASTE OIL/SOLVENT
13	3	6/79	5/82	INORGANIC
14	3	6/79	5/82	REACTIVE
15	3	6/79	5/82	REACTIVE
16	3	6/79	5/82	GAS CYLINDERS
17	3	6/79	5/82	ORGANIC
18	8	6/79	6/80	WASTE OIL
19	8	4/80	5/82	WASTE OIL
20	3	4/80	9/83	INORGANIC
21	3	4/80	OPEN	GAS CYLINDERS
22	3	4/80	9/80	ORGANIC
23[3]	8	4/82	3/84	WASTE OIL
24[4]	8	4/82	4/84	ORGANIC & WASTE OIL
25	6	9/82	OPEN	INORGANIC
26	6	9/82	3/84	ORGANIC
27	4	1/82	OPEN	SPECIAL[5]
28	4	1/82	OPEN	SPECIAL
29	6	12/83	6/84	ORGANIC
30	6	12/83	OPEN	ORGANIC
31	6	12/83	OPEN	EMPTY

NOTES:
(1) ALL SHAFTS ARE APPROXIMATELY 60 FEET DEEP.
(2) SHAFT ONE CONTAINS WASTES NOT IN DRUMS.
(3) PRIOR TO SHAFT 23, LIQUIDS WERE DISPOSED OF IN DRUMS WITHOUT ADDING ABSORBENTS.
(4) MIDDLE SECTION OF THIS SHAFT NOT USED.
(5) USED FOR MISCELLANEOUS WASTE REQUIRING GREATER ISOLATION.

DRAFT

FIGURE 2-8

TA-54 AREA L
WASTE MANAGEMENT FACILITIES

PREPARED FOR

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

IT CORPORATION

DRAWING NUMBER 846510-B
CHECKED BY
APPROVED BY
DRAWN BY L.L.F. 9/20/84

10 1200 HERCULENE ABB SMITH CO. PBM, PA

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Dean Keller, ENG DO, MS 700

DATE: January 27, 1982

THRU:

MAIL STOP/TELEPHONE: 490/667-7952

FROM: W. D. Purtymun, H-8

SYMBOL: H8-82-39

SUBJECT: TEST HOLE WEST OF OMEGA REACTOR BLDG.

A test hole was augered to a depth of 28 feet west of Structure No. TA-2-1 on January 21, 1982. The log of the hole is as follows:

	Depth (ft) From	Depth (ft) To
Soil or backfill, light brown, silty sand with some gravels and pebbles; loosely consolidated with moderate amount of moisture.	0	6
Gravels, pebbles, and cobbles in a brown silty sand, unconsolidated; deposit by stream in Los Alamos Canyon; water perched in gravel above tuff; water encountered at a depth of about 13 ft below land surface; water level in the gravel fluctuates with volume found in stream channel to south; water tables are generally highest in spring from snowmelt runoff and in late summer and early fall from summer thunder storm runoff.	6	17
Tuff, light reddish brown, weathered, non-welded to moderately welded, some clay; a large amount of moisture in the tuff below the contact with the overlying saturated gravels; however, at depth 25 to 28 ft tuff adhering on the auger seemed quite dry.	17	34

The area west of the building is disturbed to depth of 6 to 10 ft with utility lines (i.e., fire mains, piping for cooling water from the reactor to the cooling tower, and miscellaneous electrical or control cables; Photography and layout on file with A. R. Lyle CNC-5). The fill in the trenches is probably loosely consolidated as is the underlying gravels. Design for foundations for shielding should be based on about 3000 lbs/sq. ft, as we discussed at the site on 1/21/82. Presence of water in the gravel may result in settling of the foundation 2 to 4 inches when load is applied.

WDP:vh

xc: A. R. Lyle, CNC-5, MS 776

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Steve Diamond, Q-11, MS-K573

DATE: March 16, 1982

THRU:

MAIL STOP/TELEPHONE: K490/667-7952

FROM: W. D. Purtymun, H-8 WDP

SYMBOL: H8-82-131

SUBJECT: SOIL USED FOR DIKES AROUND OIL STORAGE

Soils on the "finger-like" mesas of the Pajarito Plateau was formed by weathering of the underlying rhyolite tuff. The soil has the greater thickness near the axis of the mesa and thins toward the canyon rims where the tuff is exposed. The natural soil formed on the mesa has an average density of about 160 lbs/cu. ft. Studies indicate little, if any, infiltration of water from precipitation through the soil zone into the underlying tuff indicating that the soil has a low permeability.[1] The permeability of natural soil ranges from <0.5 to 2 inch/hr.[2] Soil compacted 90% will have a much lower permeability.

The soil zone near TA-50, including weathered zone at the top of the tuff, ranges from five to seven feet. The soil is described as light brown clay with some sand and gravel. The primary soil constituents are quartz and feldspar, some rock fragments of latite, rhylote, and occasional pumice in a fine sand to clay matrix. Clay minerals are mainly montmorillonite and lilte[3].

Conclusions: Soil derived from weathering of the tuff, compacted 90%, will form an effective barrier to contain an oil spill from storage until "clean-up measures" are undertaken.

WDP:vh

See attached References

REFERENCES

1. J. H. Abrahams and others, "Distribution of Moisture in Soil and Near-Surface Tuff on the Pajarito Plateau, Los Alamos County, New Mexico," U.S. Geol. Survey Prof. Paper 424-D (1961).

2. J. W. Nyham, "Soil Survey of Los Alamos County, New Mexico," Los Alamos Scientific Laboratory report LA-6779-MS.

3. E. Staritzky, "Petrographic Examination of Local Soils," Los Alamos Scientific Laboratory report, LA-741 (1949).

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. L. Reidel, ENG-2, MS 984

DATE: May 24, 1982

THRU:

MAIL STOP/TELEPHONE:

FROM: W. D. Purtymun, H-8

SYMBOL: H8-82-283

SUBJECT: TEST BORINGS, SECURITY AND SAFEGUARDS UPGRADING, TA-41; L.J. 6709-41

Subsurface investigation was made for the new parking area at TA-41. Two test holes were drilled as located on ENG-C 43921, Sheet C2. Logs of both holes were similar.

Test Hole 1 and 2

Sandy Soil, brown, some gravels	0 to 3 ft
Cobbles and boulders in a matrix of sand and gravels	3 to 14 ft
Tuff, brown, weathered to sand with a few rock fragments of rhyolite	14 to 18 ft

Water was encountered at a depth of about 10.5 ft in the gravels and boulders; water recharged from stream flow perched on the weathered tuff. Water table will fluctuate with amount of water in the nearby stream channel.

No subsurface problem should be encountered in extending the parking area if routine compaction is completed prior to applying asphalt.

WDP:vh

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Chris Sanchez, ENG-2, MS-984

DATE: July 14, 1982

THRU:

MAIL STOP/TELEPHONE: K490/667-5021

FROM: W. D. Purtymun, H-8

SYMBOL: H8-82-379

SUBJECT: TEST BORINGS, TRITIUM PROCESSING FACILITY ROAD AND FENCE, TA-16; L.J. 6981-16

Eight test borings ranging in depth from 8 and 13 ft. were drilled along the centerline of the road layout from Anchor Ranch Rd. to the New Tritium Processing Facility. The logs of the holes are as follows: locations are distances in feet from Anchor Ranch Road (Fig. 1).

WDP:vh

	Depth (feet) From	To
Test Hole 0 + 25		
Soil, silty clay, brown (wet 3 to 4 ft and 7 to 8 ft)	0	8
Tuff, light tan, weathered (wet)	8	10
Tuff, light gray, moderately welded	10	13
Test Holes 2 + 25; 4 + 25; 6 + 10; and 8 + 20		
Soil, silty clay, light brown (dry)	0	3
Tuff, light gray, moderately welded	3	8
Test Hole 10 + 20		
Soil, silty clay, light brown (dry)	0	3
Soil, light tan, silty clay, hard pan (dry)	3	6
Tuff, light pinkish gray, moderately welded	6	8
Test Hole 12 + 00		
Soil, silty clay, light brown (dry)	0	2
Tuff, light pinkish gray, moderately welded	2	8
Test Hole 13 + 10		
Soil, brown (mostly organic material, decomposed leaves and pine needles)	0	0.5
Tuff, light gray, moderately welded	0.5	8

Test hole 0 + 25 is located east of a drainage ditch that contains processing water, thus the excess moisture and weathered tuff encountered in the hole. Test hole 10 + 20 contained "hard pan" at a depth of 3 to 6 ft beneath the soil zone. The "hard pan" is poorly developed soil that has completely dried out. It is very hard, much like adobe and is difficult to drill.

With the exception of the excessive moisture encountered in test hole 0 + 25, I can see no problem with normal road construction. The drainage ditch of processing water may have to be realigned. Some soil (wet) may have to be removed to stabilize the area.

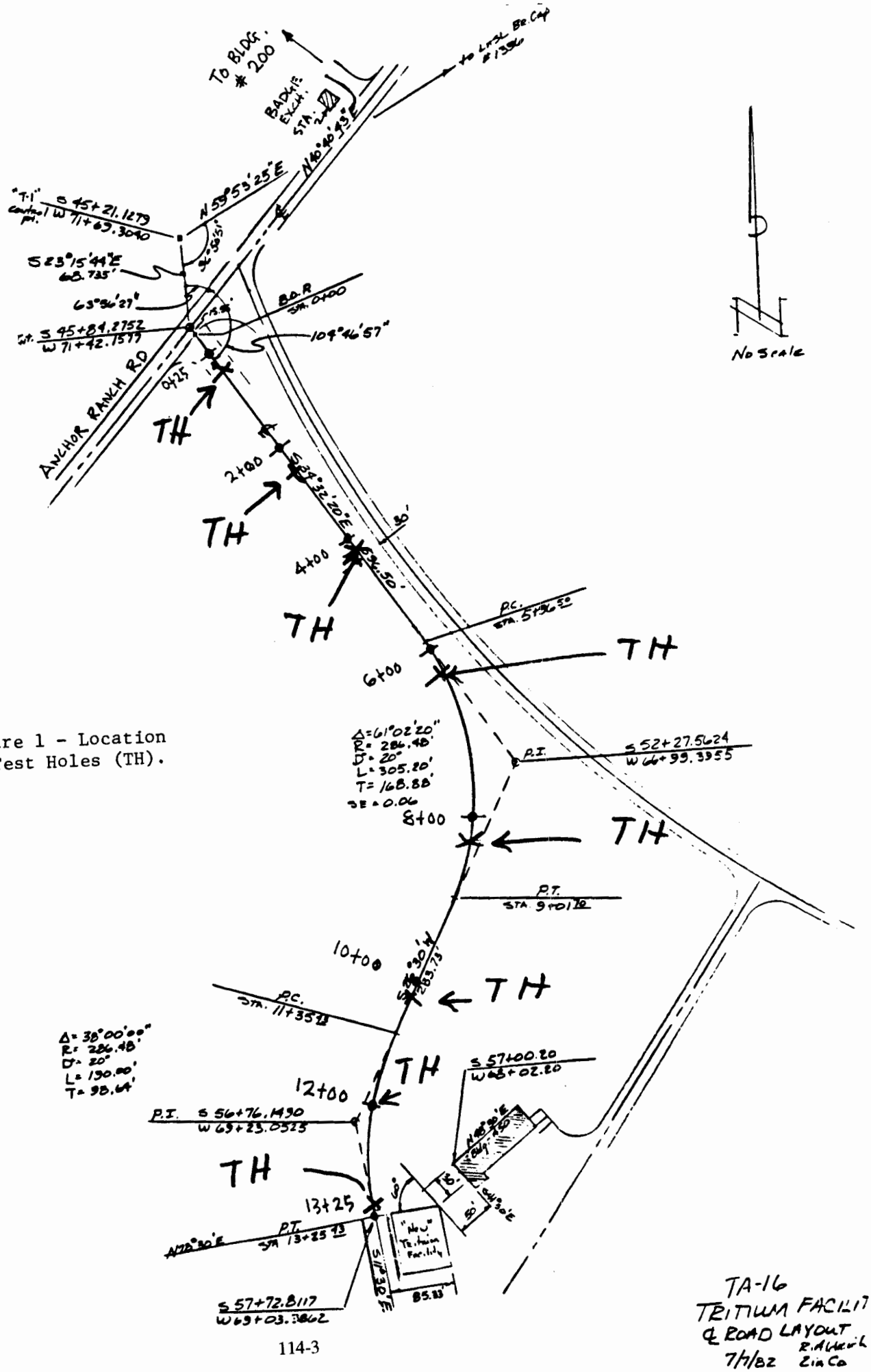


Figure 1 - Location of Test Holes (TH).

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Wally McCorkle

DATE: August 6, 1982

THRU:

MAIL STOP/TELEPHONE: H-8-K490/667-3134

FROM: W. D. Purtymun WDP

SYMBOL: H-8-82-418

SUBJECT: Analyses for Ra^{226} (Fenton Hill)

Results, average of two analyses (X±SD).

Frenton Hill	Discharge	4-14	0.11±0.08	pCi/ℓ
"	"	"	4-15	0.75±1.00	pCi/ℓ
"	"	"	4-16	0.06±0.01	pCi/ℓ
"	"	"	4-19	0.07±0.06	pCi/ℓ
"	"	"	4-20	0.14±0.01	pCi/ℓ
"	"	"	4-21	0.05±0.01	pCi/ℓ

WDP:fs

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Karen Balo, H-7, MS E516 DATE: September 23, 1982

THRU: W. R. Hansen, H-8 Group Leader MAIL STOP/TELEPHONE: K490/5021

FROM: W. D. Purtymun, H-8 SYMBOL: H8-82-470

SUBJECT: OIL DISPOSAL SHAFT, SHAFT AREA L.

It was reported when shaft 25 was dug that a nest containing baby rats was recovered with the cutting some where between 40 and 60 ft as the hole was being reamed. The presence of the nest indicates some communication of the shaft with the land surface.

The contact between the ashflows unit 2B (upper unit) and Unit 2A (underlying unit) occurs at a depth of about 35 ft. The contact along the wall of Pajarito Canyon south of Area L is indicated by weathering of the soft material at the contact with horizontal cavities extending back from the cliff face under the mesa. Several middens or pack rat nests are found on the contact. Along the wall of Canada de Buey north of Area L the contact is covered with rockfall material, weathered tuff, and tree and plant litter that form the surface of the north facing slope of the canyon.

A major north-south trending near vertical joint intersects the south wall of the shaft 25 and extends into the north wall. Along the joint on the south wall at a depth of about 28 to 36 ft there is a large hole that extends back into the wall of the shaft. A smaller similar type hole occurs in the north wall at a slightly deeper depth. These two holes are at/or near the contact between the two ashflow units. It is suspected that there is communication (a hole) from the shaft along the contact to the outcrop on Canyon wall of Pajarito Canyon.

On August 17 an attempt was made to obtain pictures of the wall of the shaft by modifying a bore wall (well) TV camera. The shaft monitored by the TV camera failed to obtain clear pictures.

An attempt was made on August 18 to determine if connection exists along the contact from the outcrops on the Canyon wall (north and south) to shaft 25.

Smoke grenades were dropped in the shaft, the shaft sealed and the shaft pressurized by an air blower. Tests were run in morning and afternoon. No smoke was observed at the contact of the two ashflows on the canyon walls to the north and south of the shaft. Smoke did fill the adjacent shaft from an open joint.

It appears, though it hasn't been proven, that an opening exists from shaft 25 to the outcrop in the canyon wall to the south. It is suggested that a portion of the shaft from below the contact at a depth of about 36 ft to about a depth of 28 be filled with crushed tuff. This should eleiminate any wide spread oil movement along the contact between the two ashflows from oil stored above the 28 ft. level. The tuff will provide material to absorp the oil.

WDP:pt

cc: John Warren, H-7, MS E516.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker, CNC-5, Group Leader, MS G766 DATE: September 23, 1982

THRU: Wayne R. Hansen, H-8 Group Leader MAIL STOP/TELEPHONE: K490/7952

FROM: W. D. Purtymun, H-8 SYMBOL: H8-82-485

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

A reconnissance was made of the north canyon wall on September 21, 1982, at the request of A. Lyle, CNC-5. The last inspection of the slope was made on February 23, 1981 (H8-81-133). Since the last inspection was made, no rocks have lodged in the rock catches or in the security fence.

As previously stated in the last memo (H8-81-133). The rock catcher between post 4 and 5 on the east end should be repaired and the rock in the catcher should be broken up or removed. Dead trees between the security fence and building should be removed.

Inspection of the slope failed to detect any rocks that were unstable; however, there appears to be a number of blocks along the canyon rim that are potential for rock fall. Thus, the rock catcher should be kept in repair.

WDP:pt

cc: A. Lyle, CNC-5, MS G776

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Miguel Salazar, H-7, MS-J592
THRU: Wayne R. Hansen, H-8 Group Leader
FROM W. D. Purtymun, H-8

DATE: October 20, 1982

MAIL STOP/TELEPHONE: K490/7952

SYMBOL H-8-82-535

SUBJECT INSPECTION OF PIT 33, AREA G, TA-54, OCTOBER 8, 1982

A geologic inspection was made of Pit 33 with reference to guidelines issued for construction and use of solid pits.

The pit is dug into unit 2b of the Tshirege Member of the Bandelier Tuff. At Pit 33, Unit 2b consists of two ashflows. The contact is indicated by a zone of large dark gray devitrified pumice fragment on the top of the lower ashflow. The pumice zone is near horizontal and is as much as 6 ft in thickness though in some places becomes indistinct. The zone occurs at a depth of about 10 to 15 ft in the east wall and at a depth of about 15 to 20 ft in the west wall of the pit.

The tuff in both ashflows is a moderately welded tuff consisting of quartz and sanidine crystals and crystal fragments, some latite, and pumice in a gray ash matrix. The upper ashflow is slightly denser (harder) than the lower flow as seen by slower and more difficult excavation.

The tuff in the walls of the pit is broken by joints which formed as the ashflow cooled. Most of the joints, major or master joints, are vertical or near vertical. They range from closed to open. Some joint openings are clay filled or clay platted. The joint frequency is about the same as in other pits in the area, about one master joint for 6 to 8 ft of pit wall. The joint openings are not of a size to require remedial action.

We have documented the wall of the pit by photographs taken by ISD. When the "as built" drawings of the pit are complete we would like a set.

Surface runoff should be diverted from entering the pit, otherwise Pit 33 is suitable for use.

WDP:amc

cc: John Warren, H-7, MS-E516

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, H-7, MS J592

DATE: December 1, 1982

FROM: W. D. Purtymun, H-8

MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL: H-8-82-629

SUBJECT: LOCATION OF SHAFTS, AREA G, TA-54

The three new shafts located near the west end of Pit 2 are in compliance with guide lines issued for construction of pits for solid wastes. The new shafts are to be located between shafts (filled and capped) No. 50, 60, 59, and 34 (ENG R-4464).

118 120 119

The shafts, 6 ft. in diameter, will be about 60 ft. deep. They should penetrate Unit 2b and will be completed into the lower Unit 2a of the Tshirege Member of the Bandelier Tuff. Both units are moderately welded ashflow. The shafts will encounter some near vertical to vertical points that will cause some blocks to dislodge from the shaft walls. This should cause no problem in completion or use of the shaft to dispose of wastes.

As the shafts are in a present shaft disposal area, we would like to obtain samples of the tuff every 10 ft. during drilling of the pilot hole. The samples should be collected in plastic bags to contain the moisture, marked as to date, shaft number, and depth of collection. Please notify us when construction begins and we will assist in setting up a sampling scheme.

WDP/hy

File

sent 10/28/82

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Ed Hoth, Eng-2, MS-M984

DATE: October 26, 1982

THRU:

MAIL STOP/TELEPHONE: K490/7952

FROM: W. D. Purtymun, H-8 WDP

SYMBOL: H-8-82-553

SUBJECT: TEST HOLE AT LS-6 EXPERIMENTAL SITE

A 4-inch diameter test hole was drilled to a depth of 32 ft at the site. The hole penetrated about 4.5 ft of soil and weather tuff and about 27.5 ft of a moderately welded tuff of Unit 3 of the Tshirege Member of the Bandelier Tuff. The tuff was light gray consisting of quartz and sanidine crystals and crystal fragments, a few small rock fragments of gray rhyolite and white pumice in a gray ash matrix. The moisture content of the tuff was low, about 5% by volume or less.

The moderately welded tuff will be easily worked with a backhoe, bulldozer, or a bucket auger.

The tuff is broken by a number of vertical to near vertical joints. Intersection of these joints behind the walls of a pit or shaft may allow the blocks to fall into the excavation. During and after excavation the walls should be inspected to determine if there are any loose blocks that should be removed.

WDP:amc

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Karen Balo, H-7, MS E516

DATE: February 15, 1983

THRU: W. R. Hansen, H-8 Group Leader by

MAIL STOP/TELEPHONE: K490/7-5021

FROM: W. D. Purtymun, H-8

SYMBOL: H8-83-139

SUBJECT: INSPECTION OF SHAFTS 23, 24, 25, AND 26 AREA L, TA-54

The shafts at Area L are dug through Unit 2B (upper unit) and into Unit 2A (underlying unit) of the Tshirege Member of the Bandelier Tuff. These units are moderately welded ashflows of rhyolite tuff. The contact between the two units occurs at about 35 ft. The small diameter of the shafts, 4 to 6 ft, preclude a good examination of the shaft walls for joints or contact between ashflows.

Shafts 23 and 24 are 4-ft diameter shafts drilled to a depth of about 60 ft. They are located on the west end of the shaft disposal area next to the fence. The shafts exhibit few joints and no blocks pulled loose during the construction.

Shafts 25 and 26 are 6-ft diameter shafts drilled to a depth of about 60 ft. They are located north of a group of shafts drilled along the fence in the eastern part of Area L. The walls of the shaft were smooth, showing few joints and only a few blocks pulled loose from the joints during construction. In shaft 25, there were a series of small blocks pulled loose from a southwest trending joint on the west wall from a depth of about 12 to 29 ft. In shaft 26, there was a small block pulled out of the east wall at a depth of about 12 ft.

When the covers were removed from shafts 25 and 26, there was a strong odor of benzene and toluene in the shafts. Organic compounds, oils and solvents were disposed of in shafts (filled and capped) to the south of

shafts 25 and 26. At the time these organics were disposed, there was no material to fix the fluids in the barrels. It appears that these barrels have ruptured or corroded through, releasing fluids from the barrels. Liquid organic materials are now mixed with vermiculite or to tuff prior to disposal. The benzene and toluene are highly volatile and thus are moving in a vapor phase through open joints or fractures in the tuff or along the contact between the two ashflows. In disposing of wastes into these shafts, I would use an excess of tuff dug from the shafts to fill the void space between the walls of the shaft and waste containers.

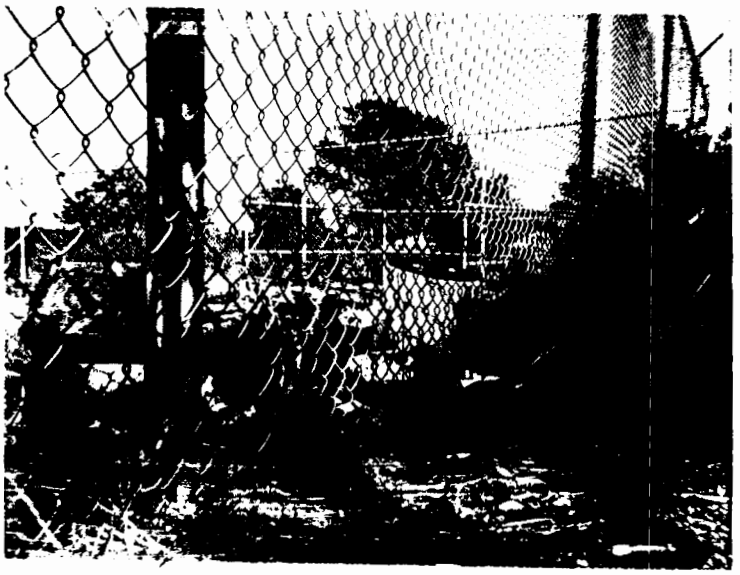
Construction of two other shafts in the vicinity of shafts 25 and 26 was terminated and the shafts filled with cutting when strong oil or solvent odors were encountered. When possible these shafts, though they do not contain wastes, should be capped to prevent any deep infiltration of water from precipitation or runoff into tuff.

Your suggestion to move any additional shafts to the west end of the area should be implemented. Location should be at least 50 ft from the canyon rim.

WDP/pb

Cy: John Warren, H-7, MS E516
Don Mayfield, H-8, MS K490

Area L TA-54
Chemical Pit
Disposal ≈ 1971



Area L TA-54
Storage ≈ 1971

Note; See Draft Report Purtymun 1971 - "Waste Storage at Area H, T, and L

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, H-7, MS J592

DATE: February 15, 1983

THRU: W. R. Hansen, H-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-5021

FROM: W. D. Purtymun, H-7

SYMBOL: H8-83-140

SUBJECT: INSPECTION OF SHAFTS 118, 119, AND 120 IN AREA G, TA-54

The three shafts in Area G are located west of Pit No. 2 in the shaft disposal area. They are constructed through Unit 2B and underlying Unit 2A into the top of Unit 1B.

Shaft 118 - Drilled to a depth of 65 ft/8ft diameter. Contact between two ashflows at about 12 ft (Unit 2B and 2A) and encountered white nonwelded pumiceous at Unit 1B at about 48 ft. A southeast trending joint was broken out on the south wall of the shaft from about 20 to 28 ft.

Shaft 119 - Drilled to a depth of about 62 ft/8 ft diameter. I did not notice contact between Unit 2B and 2A; however, the top of white nonwelded pumiceous occurred at 43 ft. A block was pulled out of an east-west joint between 24 and about 31 ft depth on the east wall of the shaft.

Shaft 120 - Drilled to a depth of about 63 ft/8 ft diameter. Contact between Unit 2B and 2A at about 10 ft; top of white pumiceous at Unit 1B at about 53 ft. A west wall block was out at about 25 to 35 ft from the east-west trending joint.

Samples of tuff were collected at about 10 ft intervals during the drilling of the 4-ft diameter pilot hole of Shaft 119. The moisture content of the tuff was low, probably less than 10% by volume. The moisture was distilled out and the samples analyzed for tritium. The results are as follows:

Depth (ft)	Tritium (nCi/ℓ)
10	50
20	1200
30	5000
40	7000
50	1500
60	700

The tritium concentrations are very high; however the moisture content of tuff is very low. The tritium is migrating from an adjacent shaft that contains tritium wastes in the vapor phase. Migration takes place through the open joints and fractures and along contacts between the ashflow units.

The changes in atmosphere pressure exert a pumping action on the vapors containing tritium in the joints, fractures, and contacts between ashflows, allowing tritium to escape from the open shaft in vapor phase during periods of barometeric lows.

Cuttings from the shafts piled on the land surface will also contain tritium associated with moisture. Evaporation from the cutting pile will distribute the tritium to the atmosphere. Dilution of tritium in the atmosphere will reduce concentrations to acceptable levels. An air sampler located a couple of hundred feet northwest of the three shafts failed to detect any increase in tritium concentrations during the month of December. The shafts were drilled during the period December 15 through 21, 1982.

There is no apparent reason why the shafts can not be used for the disposal of wastes. They meet the guidelines of December 10, 1980. I would recommend that as wastes are placed in the shaft, tuff from the cutting pile be dumped into the shaft to fill the void space between the waste--whether in boxes or barrels. This should be done as the wastes are added to the shaft.

WDP/pb

Cy: John Warren, H-7, MS E516
Don Mayfield, H-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, H-7, MS J592

DATE: April 1, 1983

THRU: Wayne R. Hansen, H-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-7952

FROM: W. D. Purtymun, H-8

SYMBOL: H8-83-225

SUBJECT: INSPECTION OF SHAFTS 154 AND 155, AREA G, TA-54

The two shafts are 3 ft in diameter and about 65 ft deep. They penetrate about 40 ft of Unit 2B and terminate about 25 ft into Unit 2A of the Tshirege member of the Bandelier Tuff. Both ashflows are of a moderately welded tuff.

Shaft 154 - The east wall of the shaft has a block and some minor horizontal layering at a depth of 26 ft. This may represent a contact between two ashflows within Unit 2B. An east-west joint at the surface dips north and intersects the north wall at 18 ft. The shaft is not straight but drifts off to the southeast as much as 1.5 to 2 ft in 65 ft.

Shaft 155 - There is a tuff blockout (wedge about 1 ft on a side) where two joints intersect within the east wall from the surface of the 3-ft shaft to a depth of about 22 ft. There are no other notable features in the shaft walls, which are smooth with few joints. The shaft is straight.

The shaft, to be used for disposal of packaged tritium wastes, will be cased with 30-inch CMP to help restrict the movement of tritium in the vapor phase as occurs at other shaft locations at Area G. The integrity of the casing will be tested by monitoring tubes between the casing and shaft wall while the integrity of the packaged tritium wastes (55-gal. drums with wastes encased in asphalt) will be monitored by tubes placed in the casing filled with the waste containers.

The shafts meet the guidelines for disposal of solid waste at Area G as outlined by memorandum H7-80-660, December 10, 1980.

WDP:les

Cy: John Warren, H-7, MS E516
Don Mayfield, H-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: David Trujillo, ENG-2, MS M984 DATE: April 11, 1983

THRU: Wayne R. Hansen, H-8 Group Leader MAIL STOP/TELEPHONE: K490/7-7952

FROM: W. D. Purtymun, H-8 SYMBOL: H8-83-254

SUBJECT: TEST HOLES REQUESTED BY ENG-2 AT TA-55

Four test holes were drilled on March 16, 1983, to determine geologic conditions for the foundation design for the office addition PF-3, TA-55 (Lab. Job No. 664-55). The test holes were located north of BLDG PF-3 (see ENG Drawing SK-7176 for locations). Logs of the holes are as follows:

Test Hole No.	Elevation (ft)	Log (ft) Fill	Tuff
1	7981.2	0-7	7-12
2	82.0	0-7	7-12
3	82.0	0-6	6-12
4	82.0	0-5	5-7

The fill material consisted of soil and crushed tuff. It was quite wet (moisture content probably in excess of 20% by volume). The underlying rhyolite tuff is composed of quartz, sanidine crystal, and crystal fragments, a few rock fragments of latite and rhyolite in an ash matrix. The tuff penetrated by the test holes is also quite wet. The matrix of the tuff is dark gray and appears partly weathered from the excess moisture.

The test holes are in an area covered by asphalt. Excessive moisture in the fill and tuff penetrated by the test holes is the result of water that has infiltrated into the exposed fill north of Bldg. PF-2 and the retaining wall south fo Bldg. PF-6 (ENG Drawing SK-7176). The water has moved north in the fill under the asphalt. The asphalt cover prevents evaporation (drying out) from the fill and tuff penetrated by the test holes.

If we can be of further service, please call.

WDP/pb

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. L. Riedel, ENG-2, MS M984 DATE: May 3, 1983

FROM: W. D. Purtymun, H-8 MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL: H8-83-307

SUBJECT: TEST HOLES, TRAILER REPLACEMENT FACILITY, BLDG MD-22, TA-54, L.J. 6867-54

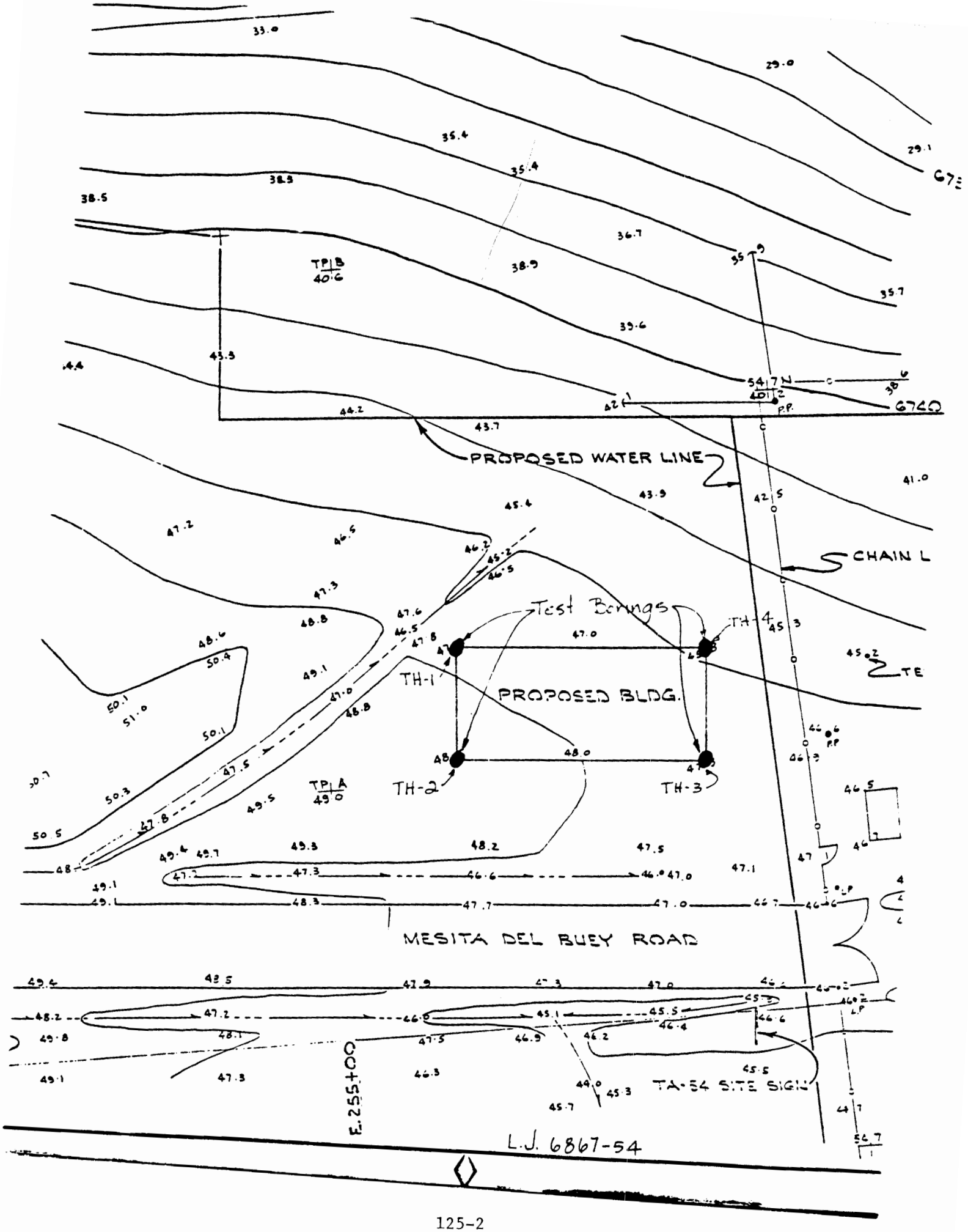
Four test borings were augered in the area of the proposed Bldg. MD-22 on May 2, 1983. The log of the holes were about the same except for the thickness of the soil zone. The soil zone was thin ranging from about 2 ft in test hole 1 to one ft or less in the other three test holes (see sketch for test hole location). The test holes penetrated 16 to 18 ft of Unit 2b of the Tshirege Member of the Bandelier Tuff. It is a moderately welded tuff composed of quartz and sanidine crystals and crystal fragments, a few small rock fragments of latite and rhyolite in a light gray ash matrix. The moderately welded tuff has a safe bearing capacity of 3000 to 5000 lbs/sq ft. The tuff has numerous joints and fractures most of which are vertical or near vertical. The joints or fractures will not be a problem.

In reference to a shaft as a drain field for a septic tank, a nearby test hole indicated the contact between Unit 2b and underlying Unit 2a at a depth of about 50 ft. I would locate the shaft as far as practical from the canyon rim. This will restrict any liquid in the shaft from moving to the canyon walls through either joints or the contact between ash flows. There should be no problem if you locate the shaft north of the proposed building as you indicated.

Enclosed is a copy of the design criteria for septic tank drain field (shafts).

WDP/pb

Enc. a/s


PROPOSED WATER LINE
CHAIN L
Test Borings
TH-1
TH-2
TH-3
TH-4
PROPOSED BLDG.
TP B
40.6
TP A
49.0
MESITA DEL BUEY ROAD
TA-54 SITE SIGN
E. 255+00
L.J. 6867-54

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO E. J. Hoth, ENG-2, MS M984

DATE: May 25, 1983

FROM: W. D. Purtymun, HSE-8 WDP/pb

MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL HSE8-83-358

SUBJECT TEST BORINGS, TA-51, MAY 23, 1983

Four test borings were augered in the area of the proposed Environmental Research Laboratory (Ref. 11, L.J. 6629-51) and Environmental Science Center (Ref. 12, TA-51, L.J. 6651-51). The soil zone at the locations ranged from 2 to 3 ft in thickness. The soil is a light brown clay soil with a few rock fragments of latite and rhyolite. The soil zone is underlain by Unit 3 of the Tshirege Member of the Bandelier Tuff. Unit 3 is a moderately welded, light gray tuff. It is composed of quartz and sanadine crystals and crystal fragments, a few rock fragments of dark gray latite and rhyolite, and minor amounts of pumice in a light gray ash matrix. The moderately welded tuff has a safe bearing capacity of about 5000 lbs/sq. ft.

The soil zone in test hole 1 was about 3 ft thick; test hole 2, about 2.5 ft thick; test hole 3, about 3 ft thick; and test hole 4, about 2 ft thick. The test borings penetrated 20 to 21 ft of Unit 3, a moderately welded light gray tuff. The moisture content of the soil may be as much as 15% moisture by volume; however, the underlying tuff is quite dry, estimated at less than 5% moisture by volume.

The test borings encountered no anomalies either in the soil or the tuff that would effect the foundation design. Location of the test holes is shown on the attached figure 1.

WDP/pb

Att. a/s

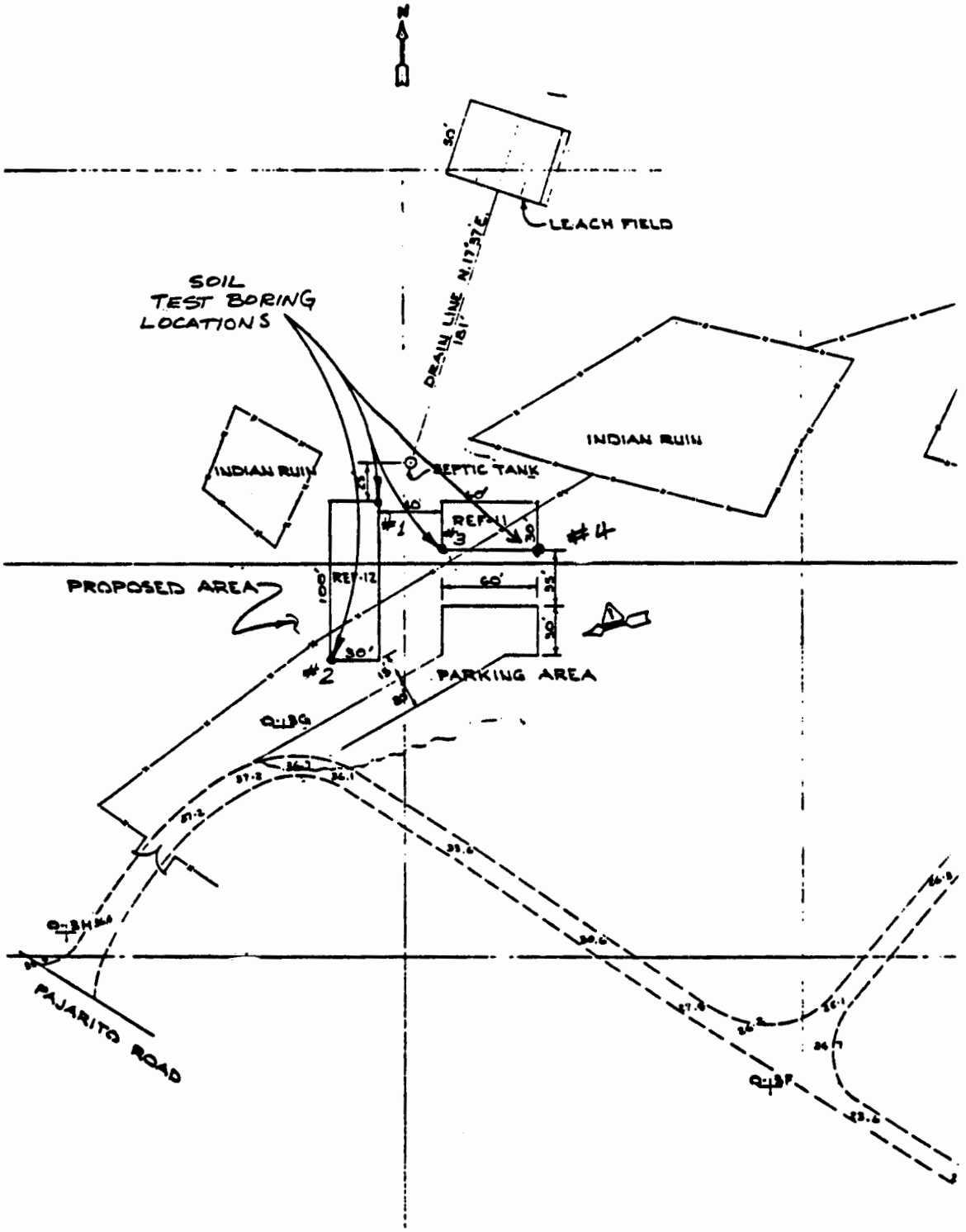


Fig. 1 Location of Test Borings at TA-51, May 23, 1983

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO David Trujillo, ENG-2, M984

DATE August 3, 1983

FROM W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE K490, 7952

SYMBOL

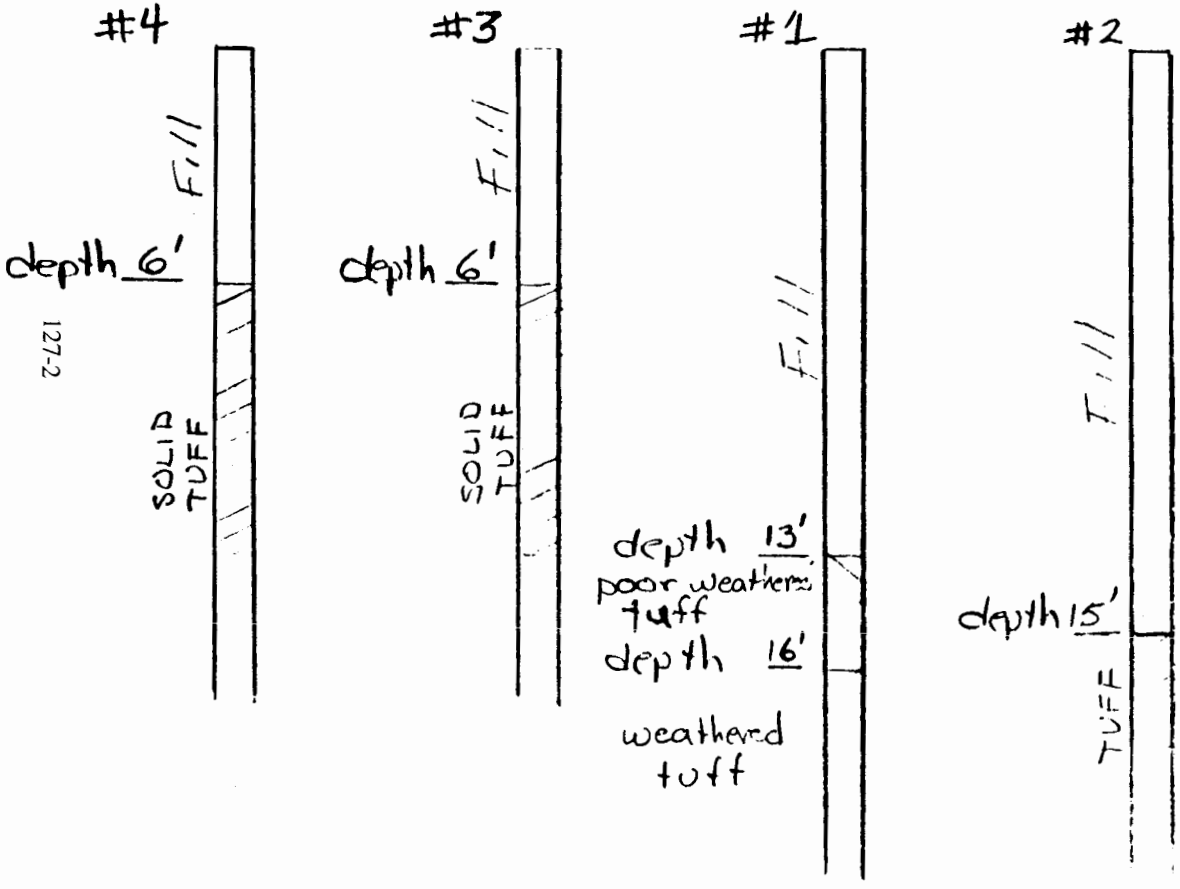
SUBJECT HSE8-83-530

TEST BORINGS AT TA-35

Attached is location and logs of test borings at proposed addition to Bldg. TSL-85, TA-35.

7/19/83 dwt

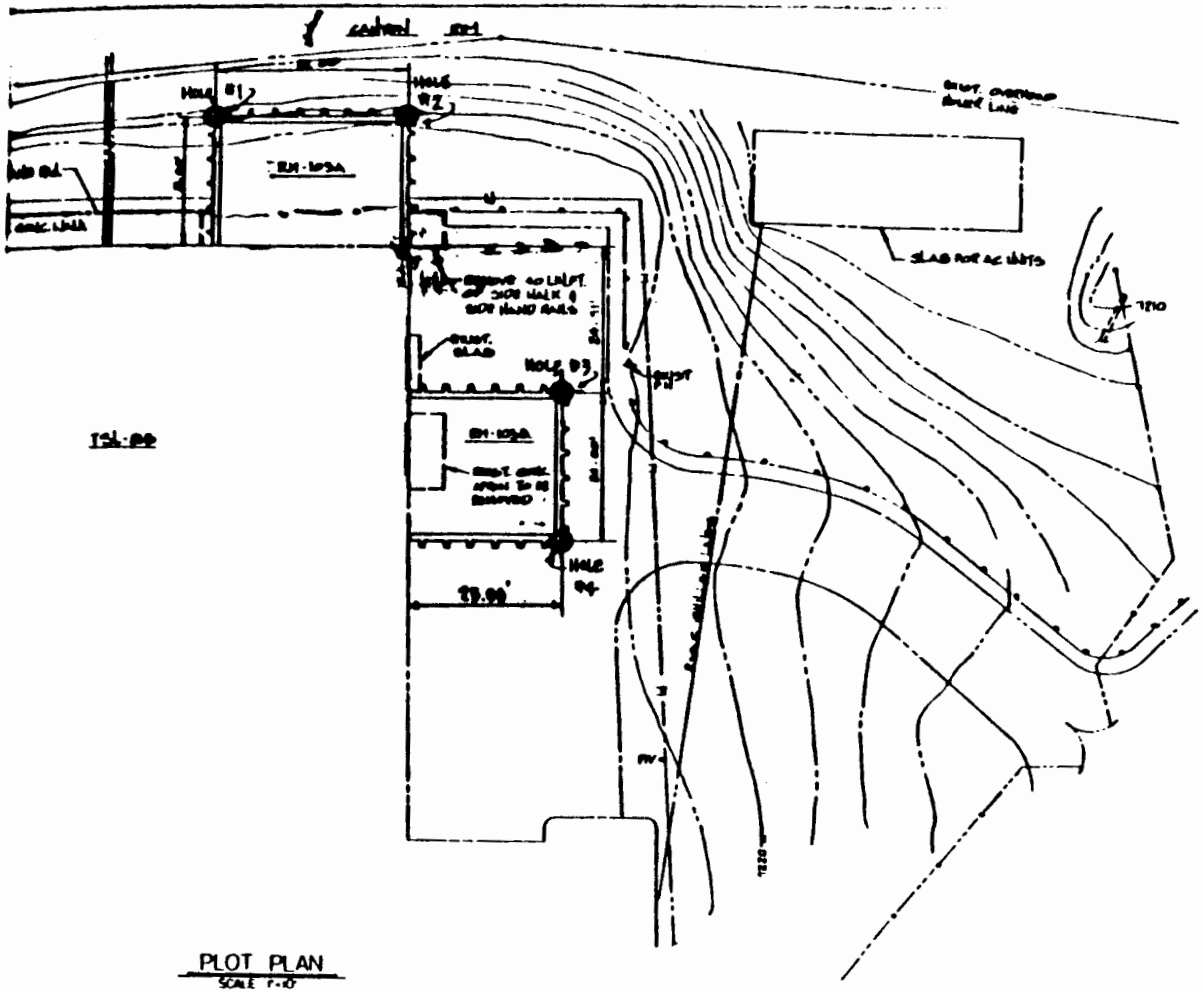
All depths vertically down from hub next to hole



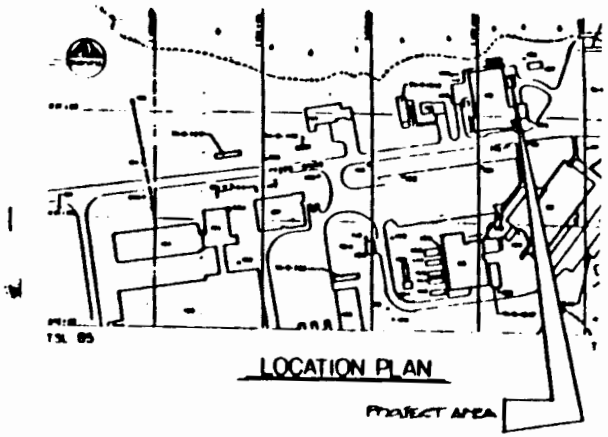
SEE ATTACHED CIVIL PLOT PLAN FOR LOCATION OF TEST HOLES

BORINGS BY PURTYMUN HSE

127-2



PLOT PLAN
SCALE 1"=10'



LOCATION PLAN

LEGEND

EXIST CONST
NEW CONST
CONST. TO BE REMOVED

TEST HOLE LOCATION

THIS JOB MUST BE INSPECTED AND ANY CHANGES APPROVED BY _____
_____ PHONE _____

Los Alamos

KRYPTON FLUORIDE PROJECT

CIVIL PLOT PLAN & LEGEND

TA-35

DEPARTMENT OF ENERGY

C-2

LAB JOB NO. 7272-35 PHASE "A"

DRAWING NO. ENG-C44221

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Dick Crombie, ENG-11 Group Leader, MS M701 DATE August 19, 1983

FROM W. D. Purtymun, HSE-8 MAIL STOP/TELEPHONE K490/7-7952

SYMBOL HSE8-83-550

SUBJECT LOG OF TEST HOLES IN CANADA DEL BUEY

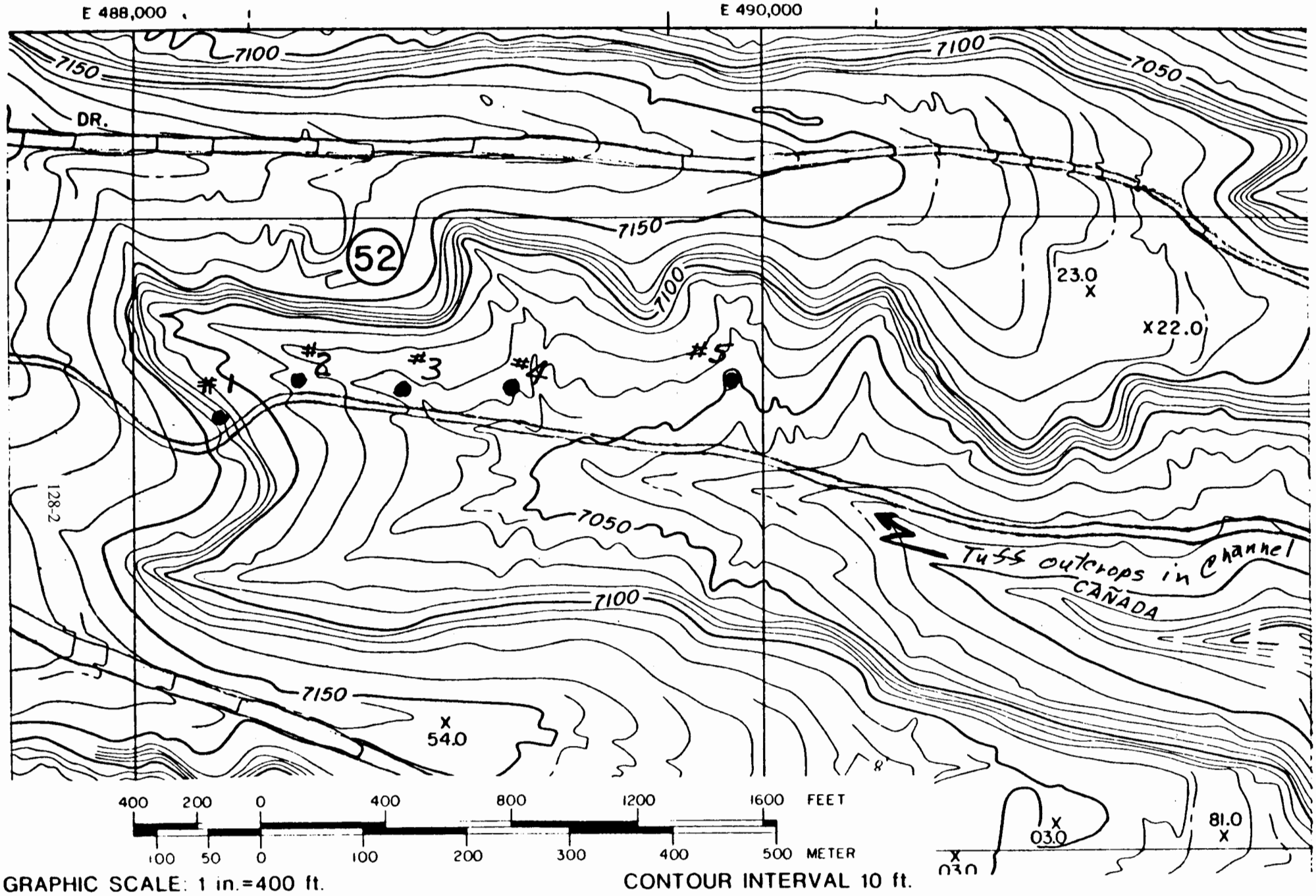
	(feet) From	To
Test Hole 1		
Soil and weathered tuff	0	12
Tuff, light gray, non-to-moderately welded	12	17
Test Hole 2		
Soil and weathered tuff	0	22
Tuff, light brown, non-to-moderately welded, weathered	22	27
Test Hole 3		
Soil and weathered tuff	0	22
Tuff, light brown, non-to-moderately welded, weathered	22	27
Test Hole 4		
Soil and weathered tuff	0	9
Tuff, light gray, non-to-moderately welded	9	12
Test Hole 5		
Soil and weathered tuff	0	7
Tuff, light gray, non-to-moderately welded	7	12

Attached is a map showing the location of the test holes. East of Test Hole 5 the tuff is exposed in the channel. The material logged as soil and weathered tuff may be used for fill material. The underlying tuff non-to-moderately welded may also be considered for fill material. It is only slightly consolidated and does contain some weathered clay, especially in the head of the canyon. Samples were collected for compacted permeabilities as requested by Jim Hewitt. I understand he will have the test made by a commercial laboratory.

WDP:pb

Att: a/s

Cy: Jim Hewitt, Holmes and Narver, ENG-11, MS M701



Location of Test Holes in Upper Cañada del Buey

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Welton Smith, ENG-1, MS-M713

DATE: August 22, 1983

FROM: W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE: K490/667-7952

SYMBOL: HSE8-83-564

SUBJECT: TEST HOLES FOR PERCOLATION TESTS

Three holes were augered northwest of the Environmental Science Center (TA-51) in the area of the drain field for the center. The holes encountered the same lithologic section.

	(ft) From	(ft) To
Soil, dark brown, clayey	0	1
Tuff, light gray, moderately welded, quartz and sanidine crystals and crystal fragments, small rock fragments of latite and rhyolite in a light gray ash (A single ashflow, Unit 3)	1	52

A single hole was augered at the site for the Administration Building at Area G (TA-54). The hole encountered two ashflows, Upper Unit 2B and Lower Unit 2A of the Tshirege Member of the Bandelier Tuff.

	(ft) From	(ft) To
Soil, brown clayey	0	1
Tuff, light gray, moderately welded, few rock fragments of latite, quartz and sanidine crystals in a light gray ash matrix (Unit 2B)	1	37
Tuff, light pinkish gray, moderately welded, few rock fragments of latite and rhyolite, gray pumice, quartz and sanidine crystals in an ash matrix Unit 2A)	37	52

The hole is located about 40 ft west of the northwest corner of the fence.

WDP:mlk

xc: Price Fernon, ENG-2, MS M984

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. L. Riedel, ENG-2, MS M984

DATE: August 24, 1983

FROM: W. D. Purtymun, HSE-8 WDP

MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL: HSE8-83-570

SUBJECT: TEST BORINGS, CHEMICAL SURETY MATERIALS FACILITY, SM-29, TA-3, L.J. 6862-3

Seven test holes were drilled on the west side of Bldg. SM-29 south of Wing 1 (Fig. 1). The bedrock (tuff) is exposed in the area. Only a thin section (generally less than 1 ft) of gravel and soil was encountered overlying the tuff. The tuff penetrated by the holes was a single ashflow. The tuff is moderately welded, light pinkish gray, with quartz and sanidine crystals and crystal fragments, a few small rock fragments of gray latite and pumice in an ash matrix. The depth of the test holes is as follows:

	Depth (ft)
TH-1	22
TH-2	17
TH-3	12
TH-4	22
TH-5	22
TH-6	22
TH-7	22

The holes did not encounter any anomalies in the tuff.

Three test holes were drilled on the west side of Bldg. 29 south of Wing 4 (Fig. 2). The location of the holes is in the area between the building and the parking lot. There is some roof drainage into this area resulting in a greater zone of weathering and greater than normal moisture content of the soil and tuff. The log of the three test holes is as follows:

	(Ft) From	To
TH-8		
Soil or fill, brown, clayey, wet	0	4
Tuff, brown, weathered, wet	4	7
Tuff, light pinkish gray, moderately welded	7	22

TH-9		
Soil or fill, brown, clayey, wet	0	5
Tuff, brown, weathered, wet	5	8
Tuff, light pinkish gray, moderately welded	8	22
TH-10		
Soil or fill, brown, wet	0	5
Tuff, light brown, weathered, wet	5	7
Tuff, light pinkish gray, moderately welded	7	22

WDP:les

Attachment: Figs. 1 and 2

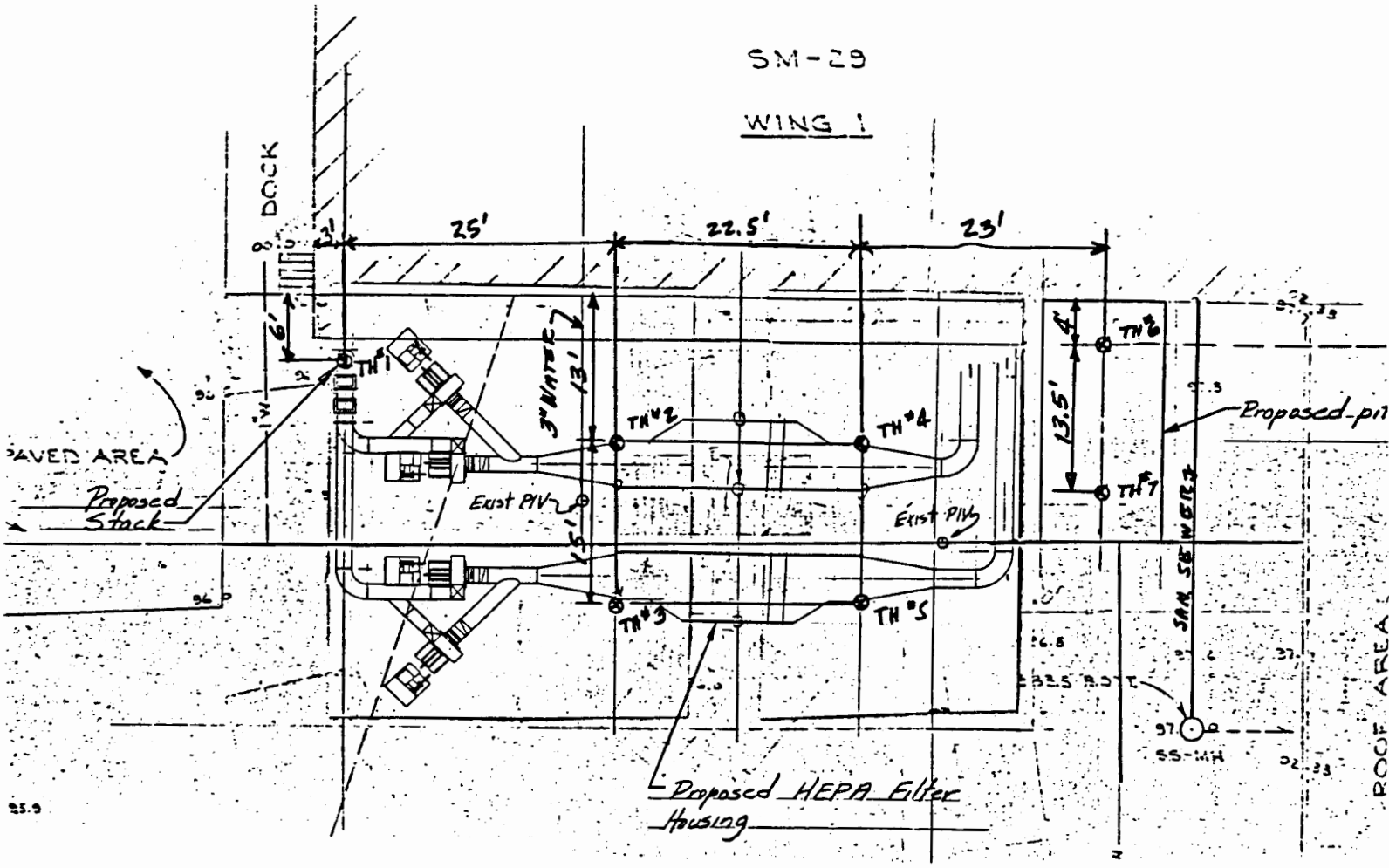

Fig. 1 Location of Test Holes 1 through 7, south of Wing 1, SM-29

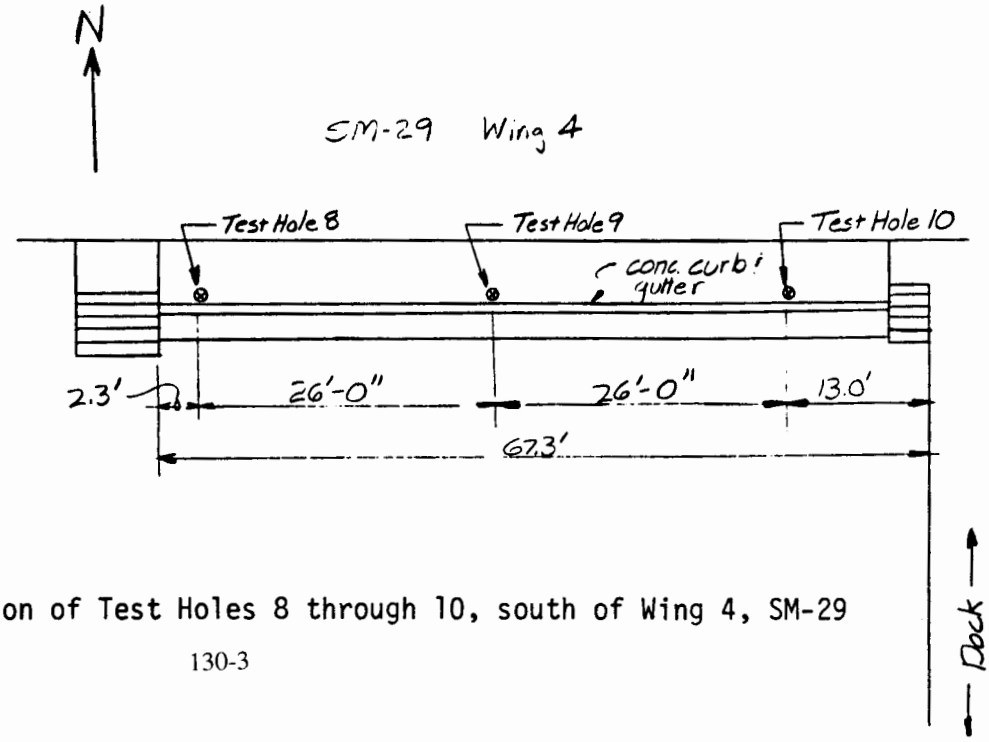

Fig. 2 Location of Test Holes 8 through 10, south of Wing 4, SM-29

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker, CNC-5 Group Leader, MS G766 — DATE: July 25, 1983

THRU: Wayne R. Hansen, HSE-8 Group Leader — MAIL STOP/TELEPHONE: K490/75021

FROM: W. D. Purtymun, HSE-8 — SYMBOL: HSE8-83-513

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

A reconnaisance was made of the north wall of Los Alamos Canyon above the site on May 26, 1983. The reconnaissance was made at the request of A. Lyle, CNC-5. The last inspection of the slope was made on September 21, 1982 (H8-82-485). Since the last inspection was made, no rocks have lodged in the rock catchers or in the security fence. There has been no movement of rocks or rock falls on the slope.

The inspection of the slope failed to detect any rocks that are unstable; however, there appears to be a number of blocks along the canyon rim that are potential for rock fall. If rocks should dislodge, the slope below the cliff face (most unstable area), rock catchers, and security fences above the buildings should prevent the rocks from causing any damage.

The north wall of the canyon was photographed in early June by IS-7 (Neg. No. CN 8303121 through CN 8303130). The photos are in color and are on file with A. Lyle CNC-5. They were taken from the access road south of the stream and are overlapping views from west to east. The pictures document the upper rim of the canyon, the area for potential rock fall. The pictures are to be used for comparison with future inspections.

WDP/pb

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Richard Crombie, ENG-11 Group Leader, MS M701 DATE: September 14, 1983

THRU: W. R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/667-7952

FROM: W. D. Purtymun, Don Van Etten & Naomi Becker SYMBOL: HSE8-83-608

SUBJECT: PROPOSED BARROW PIT IN MORTANDAD CANYON

To facilitate long-range plans for the Laboratory, Robert Turner, ENG-11, informally requested in September 1981 that HSE-8 consider locating a barrow area for a large volume of fill material to be used in construction at the Laboratory. The past source of fill material located south of Pajarito Acres in Potrillo Canyon had been depleted.

One possible location that could furnish a large volume of fill material proposed to ENG-11 was in lower Mortandad Canyon. The area was visited with ENG-11 and a preliminary study was made in October 1981. ENG-11 placed no time constraints upon completion of the study. The purpose of this report is to document the study that was made in the canyon.

If the proposed barrow area discussed in the attached report is to be considered for use at any time in the future, it is necessary to protect this resource by rehabilitating the existing infiltration tank and constructing a second tank immediately.

WDP:mlk

Attach: Report on proposed barrow pit in Mortandad Canyon

Cy: Robert Turner, ENG-11, MS M701

GEOLOGIC DESCRIPTION OF THE PROPOSED BARROW AREA IN MORTANDAD CANYON

Summary:

The fill material in Mortandad Canyon is a sand with mixed with silt and clay. In the study area there is a volume of about 170 x 10^3 yds^3 of fill material available in the upper 9 yds of the canyon bottom. An additional 3 x 10^6 yds^3 of fill material are probably available in the canyon east of the study area. About 2.5 miles of existing road will have to be repaired or improved or a new road about 0.5 miles in length be constructed to connect with paved road in Sandia Canyon. The latter is recommended. Of immediate concern is if this reach of Mortandad Canyon is to be used as a barrow area the tank to retain runoff west of barrow area should be rehabilitated (remove sediments) and enlarged and a second tank constructed. The retention of storm runoff west of the proposed barrow area is necessary to prevent contamination of the fill material by transport and dispersion of contaminated sediments from the midreach of Mortandad Canyon, which receives treated radioactive liquid wastes from the industrial treatment plant at TA-50.

I. INTRODUCTION

Mortandad Canyon is one of the many long, narrow, southeast trending canyons that is cut into the Bandelier Tuff.[1] The Bandelier Tuff forms the upper surface of the Pajarito Plateau. Mortandad Canyon heads on the western edge of the Pajarito Plateau and is tributary to the Rio Grande to the east (Fig. 1).

Liquid industrial effluents from the Waste Treatment Plant at TA-50 are released into the midreach of Mortandad Canyon. The treated effluents contain trace amounts of radionuclides.[2] The effluents, some waste water, and occasional storm runoff maintain surface flow in a

short reach of the canyon. The surface flow recharges a small body of shallow ground water in the alluvium below the effluent outfall from TA-50. The concentrations of radionuclides in the effluent, waste water, storm runoff, and shallow aquifer are reduced by ion exchange and adsorption with fine materials in the alluvium. A high "build-up" of radioactivity in the alluvium near the effluent outfall does not occur as the radionuclides in the alluvium are transported and dispersed down the canyon by storm runoff. The distance of the transport and dispersion of radionuclides is limited to within the Laboratory area. This is because the small drainage area of the canyon does not produce a large volume of runoff and there is a large volume of unsaturated alluvium to adsorb the runoff when it does occur.[3]

A. Location of Barrow Area

The barrow pits are located east of the area contaminated by the transport of radionuclides by storm runoff. Test holes drilled in the alluvium of the canyon indicate that the alluvium underlying the barrow area does not contain perched water.[3] The eastern limits of the shallow ground perched in the alluvium occurs about 2500 ft west of the proposed site. The western extent of the barrow area is at or near the area of contamination transported by storm runoff, while the eastern edge extends down the canyon to the Laboratory boundary, which is with the Sacred Land of San Ildefonso Pueblo. The area investigated is at the eastern edge of the contaminated area.

II. OCCURRENCE OF ALLUVIUM

The use of alluvium in the canyon is proposed for the fill material. The alluvium in the canyon is derived from weathering of the Bandelier Tuff. It is composed of two units: an upper sand unit about 20 ft thick that was formed by mechanical erosion of the tuff, and a lower sandy clay unit that is a section of tuff that has weathered in place.[1]

The upper sand unit is composed of gravels, sand, silt and clays, while the underlying sandy clay unit contains a slightly larger percentage of silts and clay. In general, the silt and clay portion of the alluvium is small, less than 10% by weight in the upper sandy clay unit. A typical particle size distribution for the upper sand unit is as follows:

Grade	Size Range (mm)	Distribution (Per cent by Weight
Granules	2.36 - 3.96	5.5
Very Coarse Sand	1.17 - 2.36	22.5
Coarse Sand	0.589 - 1.17	42.5
Medium Sand	0.245 - 0.589	16.5
Fine Sand	0.147 - 0.293	5.5
Very Fine Sand	0.074 - 0.147	1.5
Silt and Clay	- 0.074	6.0

The alluvium consists of very few boulders, cobbles, and pebbles of rhyolite tuff intermixed with sand, silts and clay. The sand consists mainly of medium to very coarse grained crystals, crystal fragments of quartz and sanidine, and fragments of rhyolite tuff. There are very few small rock fragments of rhyolite, latite, and dacite that were incorporated within the ashflow that has weathered to form the alluvium.

The alluvium increases in thickness downgradient in the canyon. At observation Well MCO-9 the upper sand unit is 20 to 25 ft thick underlain by a lower sand clay unit that is over 40 ft thick. At MCO-10 the upper sand unit is about 20 ft thick underlain by over 60 ft of the sand clay unit. In the lower part of the canyon at the Laboratory boundary, seismic data confirmed by a test hole indicates the alluvium (upper sand and lower sand clay unit) is about 120 ft thick.[2] Physical and hydrologic characteristics of the fill material are being determined by an outside

contractor. The results will be tabulated and transmitted as soon as results are received.

A. Monitoring Dispersion of Radionuclides by Storm Runoff

Hydrologic studies began in Mortandad Canyon in November of 1960. Since that time there has been no runoff to transport radionuclides out of the canyon (disposal area) onto the Sacred Area (Fig. 1). The major transport of radionuclides has occurred and terminated west of the Sacred Area. It is within this area that contains no transported radionuclides that the location of the barrow pit is proposed.

1. Radionuclides in Sediments 1978 and 1981. The major radionuclides released with the effluents into Mortandad Canyon from the treatment plant at TA-50 are ^{238}Pu, ^{239}Pu, and ^{137}Cs. These radionuclides are bound to the sediments in the stream channel. These sediments in the reach of effluent flow in the canyon are further transported and dispersed by storm runoff.[4] One of the largest runoff events that has occurred in the canyon was late November 1978 and was about 102 ft^3/sec at the gaging station near the effluent outfall. The event was preceeded by several days of snow and rain that saturated the channel, causing the largest of the number of events to flow and transport contaminated sediment to near MCO-9 (Fig. 2).

A survey was made of the sediments in the canyon on December 4, 1978 to determine the extent of the transport and dispersion of the radionuclides in the suspended and bed sediments. The survey was made by collecting sediment samples every 300 ft down the channel to the Laboratory boundary with the Sacred Land. The samples were analyzed for ^{238}Pu, ^{239}Pu, and ^{137}Cs (Table I). The results of the analyses indicated that transport of Pu and Cs ended between Stations 14 and 15. Based on regional soil sample fallout concentrations, background ^{238}Pu is 0.008 pCi/g; background ^{239}Pu is 0.028 pCi/g; and background ^{137}Cs is 0.92 pCi/g.[4] The ^{238}Pu at Stations 14 and 5 is at fallout levels (0.008 pCi/g). The ^{239}Pu at Station

14 (0.099 pCi/g) and at Station 15 (0.049 pCi/g) is slightly elevated when compared to fallout levels (0.028 pCi/g). The ^{137}Cs concentrations decrease from 0.43 pCi/g at Station 14 to 0.26 pCi/g at Station 15. These concentrations are below fallout levels of 0.92 pCi/g.

A second survey was made in October 1981 where sediment samples were collected and analyzed for ^{137}Cs and gross gamma (Table I). The results of the analyses indicate only minor amounts of ^{137}Cs east of Station 14, most at or slightly above the background level of 0.92 pCi/g.

Based on the two surveys (1978 and 1981) the transport of contaminated sediments by storm runoff ended between Station 14 and Station 15.

2. In-Situ Radionuclide Survey. An in-situ survey was made of sediments in the area (grid area shown Fig. 1) by laying out a detailed grid (Fig. 3). The in-situ measurements are calculated by assuming a uniform distribution of radionuclides with depth. The stations in the grid are laid out on 83 ft centers (25 m). The in-situ gamma spectra were taken at the 17 grid stations with an intrinsic germanium detector operated from the HSE-8 Environmental Surveillance van. Samples of sediment to a depth of 5 cm were taken at 9 of the 17 grid stations and analyzed in the laboratory for ^{137}Cs. The in-situ gamma specra was used to determine the ^{137}Cs surface concentrations, which was compared to the results of analyses in the laboratory (Table II). The in-situ and analytical measurements for ^{137}Cs are indicative of the transport of contaminants by storm runoff.

Four of the in-situ ^{137}Cs measurements (A-6, C-6, D-6, and F5.5) were slightly above background levels of 0.92 pCi/g. The location of these samples are near the toe of the talus slope along the north side of the canyon. They are above the braided channel that would carry the storm runoff. Samples analyzed in the laboratory from grid locations A-3, A-6, C-2, and C-6 contained concentrations of ^{137}Cs slightly above background

levels (Table II). There is slight correlation between the in-situ measurement and laboratory analyses.

There appear to be some slightly elevated concentrations of ^{137}Cs in the in-situ and laboratory analyses; however, the concentrations are not exceedingly high and are of such low concentrations that they do not appear to be associated with transported contamination in the channel. In-situ measurement in the channel at Station 8 and near Station 12 were 11.4 and 4.9 pCi/g, respectively. The sediments at these stations reflect transport of contaminated sediments in the disposal area.

3. Test Holes in Grid Area. Thirteen test holes were drilled in a grid area of 420 ft square (Fig. 4). The depth of the holes ranged from 28 to 48 ft (Table III). All but two of the holes were completed in alluvium or weathered tuff (sediment). Two holes located near the northern edge of the canyon below the cliff (Hole A-7 and F-6) penetrated 10 and 8 ft of unweathered tuff, respectively (Table III).

The cutting from the upper section of the test holes (0-3 ft and from 3 to 8 ft) were analyzed for ^{137}Cs and gross gamma activity (Table IV). The ^{137}Cs and gross gamma activity in the cutting were at or near limits of detection and were well below background levels (0.92 pCi/g) for surface soil.

III. VOLUME OF ALLUVIUM

The volume of alluvium in the canyon that can be removed for fill material is computed for the grid area and estimated for a portion of the canyon.

The grid area contains about 168×10^3 yd^3 (cubic yards) of fill material based on the area (18.7×10^3 yd^2) and depth of the test holes (9 yds). An additional 168×10^3 yd^3 would be available if excavation can be made to a depth of 18 yds.

The barrow pit can be extended east of the grid area for 700 yds (2100 ft). Based on a width of 140 yds (~420 ft) and an average depth of 18 yds (54 ft) about 1.8×10^6 yds^3 of fill material would be available. There is probably an additional 1×10^6 yds^3 of fill material east of this area to the Laboratory and Sacred Area boundary.

IV. DEVELOPMENT OF THE BARROW AREA

An archaeology survey was made of the area in July 19~~75~~62. The only cultural resource recorded as LA-30638 is located southwest of the grid area (See Appendix A). Recommendations are made to preserve this site within A.

Development of the barrow area should be made systematically. In view of possible transport of contaminates into the area by exceeding the large runoff event, the existing infiltration tank in the canyon west of the grid area should be rehabilitated and a second tank added. <u>If the proposed barrow area is to be considered, to protect this resource this work should be done immediately</u>. Rehabilitation of the existing tank entails removal of sediments that have collected in the tank and enlarge it slightly. A second tank should be constructed east of the present tank (downgradient) in the canyon. The purpose of the infiltaration tanks is to impound runoff in order to allow infiltration of the runoff into the thick section of unsaturated alluvium (over 40 ft) and retain suspended sediments containing radionuclides as previously discussed.

At the grid area, about 0.5 to 1 ft of sediments should be removed from the braided channel area and used to build a dike in the low channel west of the grid area. This would prevent any local or runoff in the canyon west of the proposed grid area from entering the barrow pit.

Transport of material from the barrow area could be on the existing road that is located on the mesa south of Mortandad Canyon. It joins

Pajarito Road east of TA-52. The road is quite primitive and will have to be improved. The length of this unimproved road is 2.5 miles. It is recommended that a road from the barrow area be constructed over the low mesa to the north of the proposed barrow area, connecting to the paved road in Sandia Canyon (the Laboratory Truck Route). This results in a shorter road construction (0.5 miles) and would result in equal or shorter haul for the fill material if used in the TA-3 area.

References

1. E. H. Baltz, J. H. Abrahams, and W. D. Purtymun, "Preliminary Report on the Geology and Hydrology of Mortandad Canyon near Los Alamos, New Mexico with Reference to Disposal of Liquid, Low-Level Radioactive Wastes," U.S. Geol. Survey Open-File Report (1962).

2. W. D. Purtymun, "Dispersion and Movement of Triutium in a Shallow Aquifer in Mortandad Canyon at the Los Alamos Scientific Laboratory," Los Alamos Scientific Laboratory report LA-5716-MS (1974).

3. W. D. Purtymun, W. R. Hansen, and R. J. Peters, "Radiochemical Quality of Water in the Shallow Aquifer in Mortandad Canyon 1967-1978," Los Alamos National Laboratory report LA-9675-MS (1983).

4. Environmental Surveillance Group, "Environmental Surveillance at Los Alamos during 1982," Los Alamos National Laboratory report LA-9762-ENV (1983).

TABLE I

RADIOCHEMICAL ANALYSES OF SEDIMENTS
(Results in pCi/g except as noted)

Station	December 4, 1978			October 28, 1981	
	^{238}Pu	^{239}Pu	^{137}Cs	^{137}Cs	Gross Gamma*
6	0.352±0.036	0.365±0.036	9.40±1.40	---	---
7	0.269±0.030	0.376±0.038	8.00±1.20	---	---
8	0.194±0.024	0.289±0.032	5.40±0.80	---	---
9	0.259±0.026	0.230±0.024	8.80±1.20	---	---
10	0.149±0.020	0.231±0.042	6.90±1.00	---	---
11	0.153±0.020	0.322±0.034	4.30±0.60	7.50±0.60	6.6±0.26
12	0.125±0.018	1.280±0.100	0.67±0.10	6.80±0.60	8.1±0.24
13	0.026±0.006	0.104±0.018	0.89±0.28	6.50±0.60	12.0±0.34
13A	---	---	---	2.70±0.32	15.0±0.38
14	0.002±0.004	0.099±0.018	0.43±0.16	0.45±0.16	13.0±0.34
14A	---	---	---	1.70±0.24	15.0±0.36
15	0.001±0.004	0.049±0.014	0.26±0.08	0.82±0.18	13.0±0.34
15A	---	---	---	1.30±0.26	13.0±0.34
16	---	---	0.60±0.12	0.64±0.16	5.7±0.26
16A	---	---	---	0.29±0.14	4.5±0.24
17	---	---	0.59±0.32	0.95±0.12	4.8±0.24
18	---	---	0.72±0.20	0.72±0.14	4.6±0.24
19	---	---	0.75±0.16	---	---
20	0.000±0.002	0.021±0.008	0.43±0.26	---	---
21	---	---	0.34±0.08	---	---
22	---	---	0.23±0.16	---	---
23	---	---	0.50±0.16	---	---

*No. of counts per minute/g (NCPM/G)

Note: ± value represents twice the uncertainty term for that analysis.

TABLE II

CESIUM-137 SURVEY OF AREA
(pCi/g)

	In-Situ	Laboratory Analysis*
A-1	0.47±0.08	---
A-2	0.36±0.08	0.41±0.06
A-3	0.46±0.08	1.09±0.12
A-4	0.43±0.08	---
A-5	0.45±0.08	1.36±0.12
A-6	1.25±0.14	2.83±0.36
A-7	0.37±0.08	---
B-3	0.42±0.08	0.50±0.10
B-5	0.49±0.08	0.18±0.04
C-2	0.45±0.08	1.32±0.18
C-4	0.45±0.08	0.91±0.16
C-6	1.29±0.14	2.33±0.14
D-5	0.50±0.08	---
D-6	1.23±0.14	---
E-7	0.78±0.14	---
F-5.5	1.06±0.14	---
F-6	0.65±0.12	---

*Depth 0-5 cm analysis in Lboratory

Note: ± value represents twice the uncertainty term for that analysis.

TABLE III

LOG OF TEST BORINGS

Hole Number	Depth (ft) Alluvium or Weathered Tuff (Brown)	Unweathered Tuff (Gray)
A-1	0 - 28	---
A-4	0 - 48	---
A-7	0 - 18	18 - 28
B-2	0 - 28	---
B-6	0 - 28	---
C-3	0 - 28	---
C-5	0 - 28	---
D-4	0 - 28	---
E-3	0 - 28	---
E-5	0 - 28	---
F-2	0 - 28	---
F-4	0 - 28	---
F-6	0 - 20	20 - 28

TABLE IV

CESIUM-137 IN CUTTINGS FROM TEST HOLE
(pCi/g)

Test Hole	Depth (ft) 0 - 3	3 - 8
A-1	0.09±0.18	0.15±0.10
A-4	0.15±0.14	0.02±0.20
A-7	0.18±0.12	0.10±0.16
B-2	0.04±0.06	0.05±0.04
B-6	0.05±0.06	0.06±0.06
C-3	0.05±0.06	0.08±0.04
C-5	0.01±0.04	0.03±0.10
D-4	0.15±0.06	0.01±0.08
E-3	0.14±0.20	0.03±0.12
E-5	0.07±0.08	0.13±0.16
F-2	0.07±0.10	0.01±0.08
F-4	0.06±0.06	0.06±0.08
F-6	0.09±0.08	0.02±0.14

Note: ± value represents twice the uncertainty term for that analyses.

TABLE V

GROSS GAMMA IN CUTTINGS FROM TEST HOLES
(NCPM/G)

Test Hole	Depth (ft) 0 - 3	3 - 8
A-1	8.0±0.28	6.8±0.26
A-4	4.8±0.24	5.2±0.24
A-7	7.4±0.28	7.4±0.28
B-2	3.9±0.24	7.5±0.28
B-6	3.8±0.24	4.6±0.24
C-3	7.0±0.26	7.4±0.28
C-5	4.3±0.24	5.8±0.26
D-4	7.2±0.28	5.5±0.26
E-3	6.8±0.13	7.7±0.28
E-5	4.3±0.12	5.1±0.24
F-2	9.2±0.15	8.1±0.28
F-4	4.3±0.12	4.2±0.24
F-6	8.5±0.14	5.7±0.26

Note: ± value represents twice the uncertainty term for that analysis.

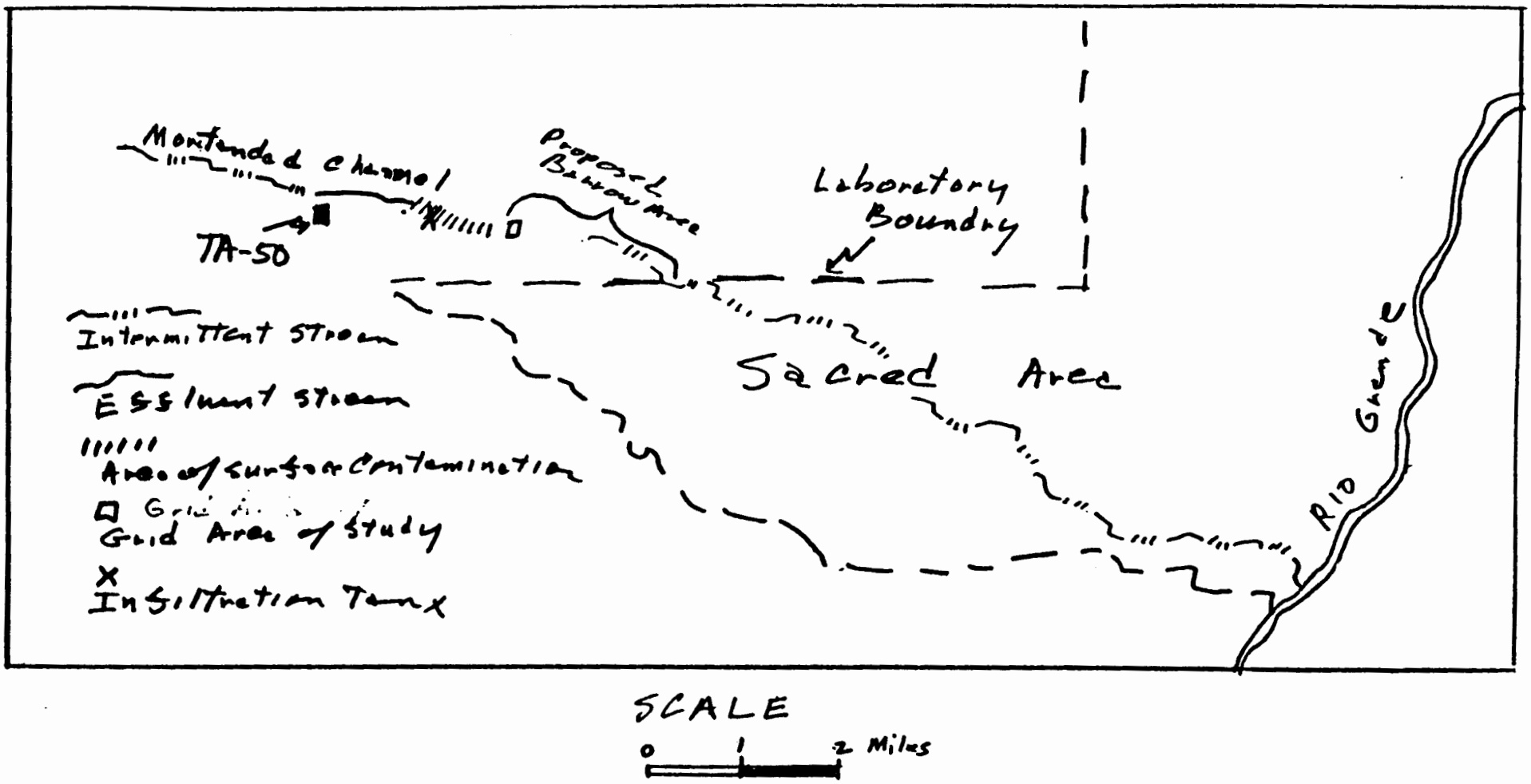


Figure 1.– Sketch Map Showing Location of Proposed Borrow Area

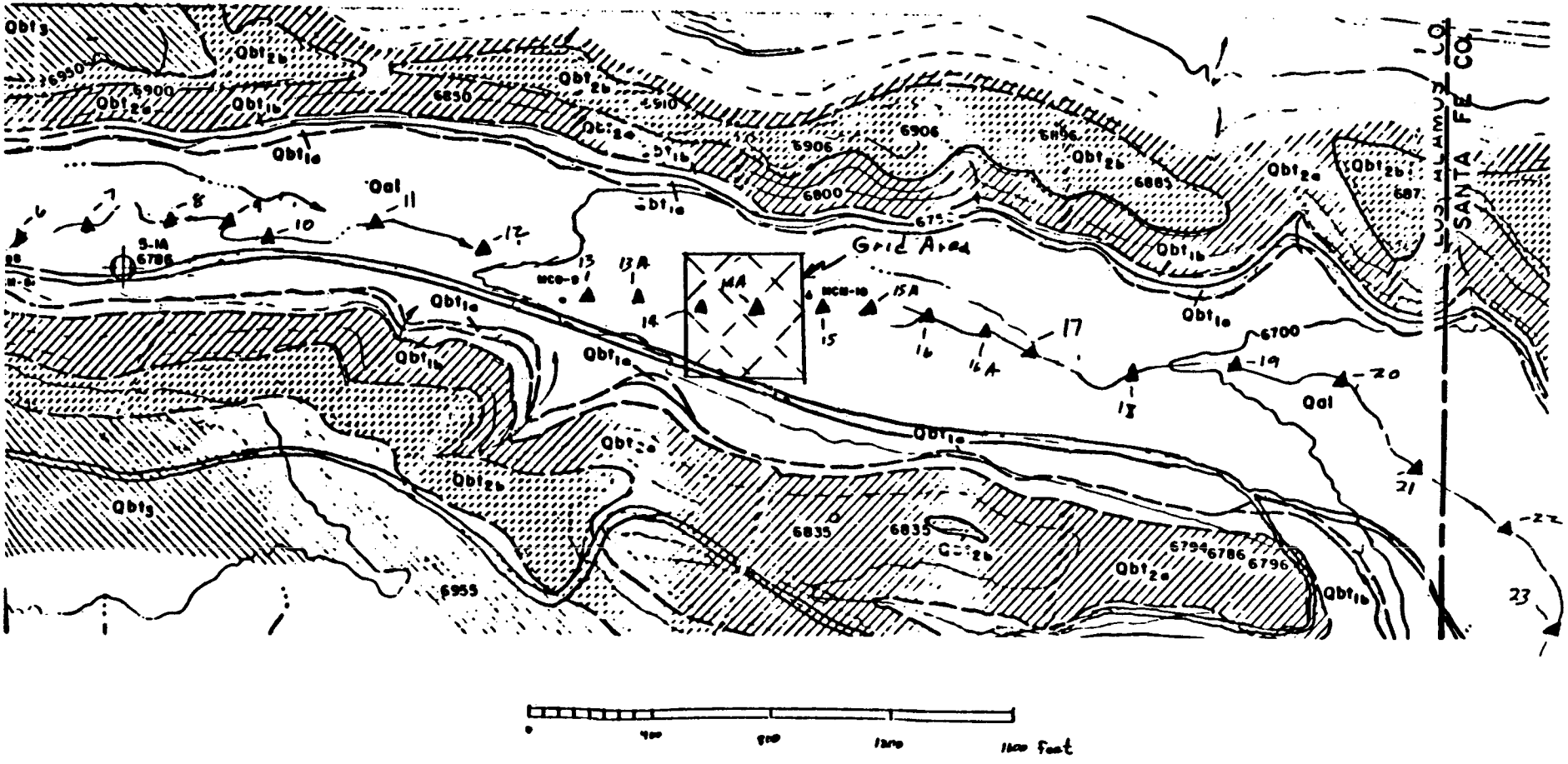


Figure 2- Location of Sediment Stations, 1978 and 1981

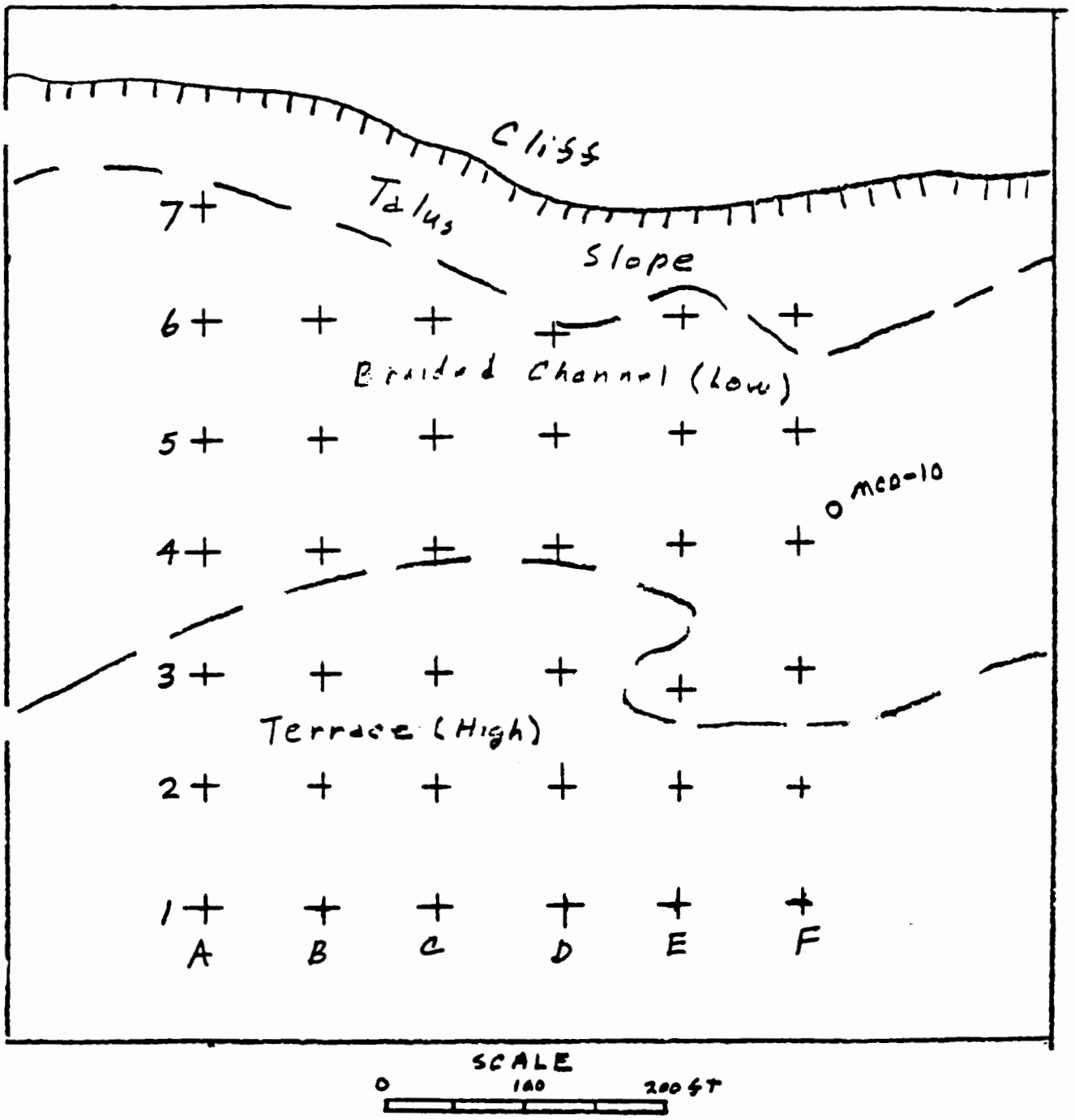


Figure 3.- Grid Area used in location of Test borings and radiation survey

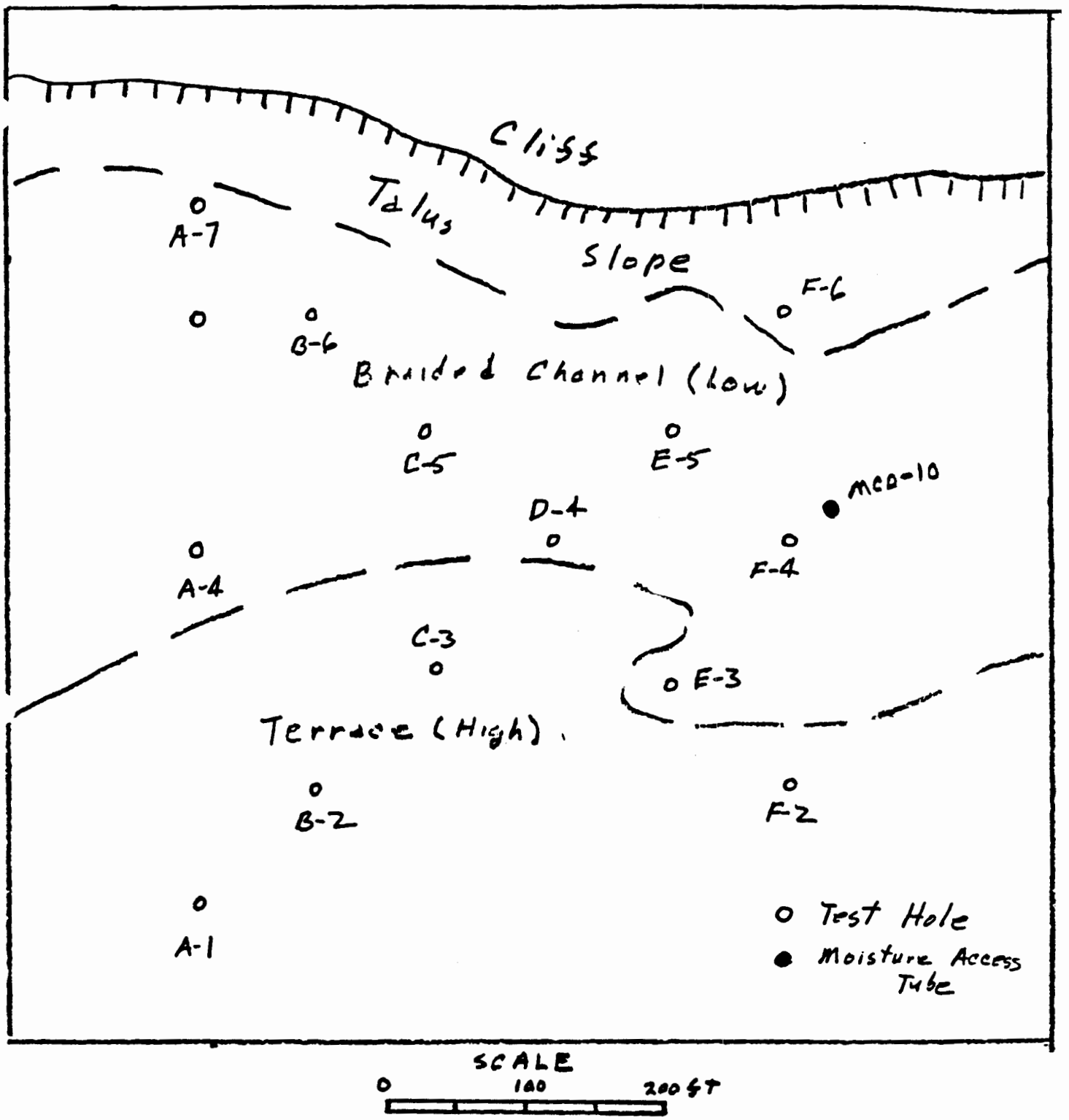


Figure 4.- Location of Test borings in Grid Area

APPENDIX A

ARCHEOLOGICAL AND CULTURAL SURVEY

APPENDIX A

Museum of New Mexico: Memorandum

Date: 7/15/82

To: Ken Rea, H-8, thru Wayne R. Hansen, H-8 Group Leader

From: David H. Snow

Subject: ARCHEOLOGICAL SURVEY, Mortandad Canyon

I have inspected cultural resources recorded as LA 30638 (see attached Museum of New Mexico Site Survey form), on 6/16/82, as a result of being informed of proposed borrow pit activities in the area. The site lies on a low terrace above the floor of Mortandad Canyon, 2600 feet (792m) west of the Santa Fe County line, and 1200 feet (366m) north of the Sandoval County line, in Sec. 24, Township 19N, Range 6E, Los Alamos County, on lands owned and managed by Los Alamos National Laboratory. The brief description of this historic site, a 20th century line camp or similar seasonal use site that is provided in the survey form, is augmented here by the information recorded by me in June.

LA 30638 appears to have consisted of a temporary structure, presumably constructed of logs (represented by several badly burned timbers) and roofed by sheets of corrugated metal present on the site; a cement lined rock walled cistern which may have had a plank top and a bucket hoist; a flimsy pole and barbed wire corral, and as yet undetermined but suspected surface features suggested by a possible stone foundation alignment near the cliff base, and a slight rectangular depression near the corral (see attached sketch map). The site lies at the base of the south wall of Mortandad canyon and additional temporary structures may have existed at the base of the canyon wall immediately to the south of the center of the site.

Artifacts observed can be divided into several categories based on their presumed role and function in site activities: (1) those that suggest repeated functional requirements, such as stove parts, metal buckets, pails and paint cans altered for continued use after the original contents were used, dish fragments, mason jar and similar glass containers and, of course, the construction materials, including nails; (2) those that represent use-discard such as food tins, cartridges, and bottle glass. The latter, in particular, seem to represent transient and probably repeated use of the site since they consist of sardine (or similarly packaged fish) tins, condensed milk cans, coffee cans and a minimum of bulky, breakable bottles. The former category consists of items which might be expected to remain at a site that saw repeated short-term use (over-night to up to a week or more in duration) to aid in preparing meals, collecting water, storage of perishable, and protection from rodents, insects or other animals for periods of time.

The artifact assemblage represents, pending additional analysis and identification, a limited use configuration during the period ca. AD 1920-40. Federal control of the area in January 1941 precludes use of the site for traditional purposes after that date. A single piece of purple glass may represent an 'heirloom' possession (manganese was no longer added to glass flux after 1921) or it may indicate use of the site prior to 1921.

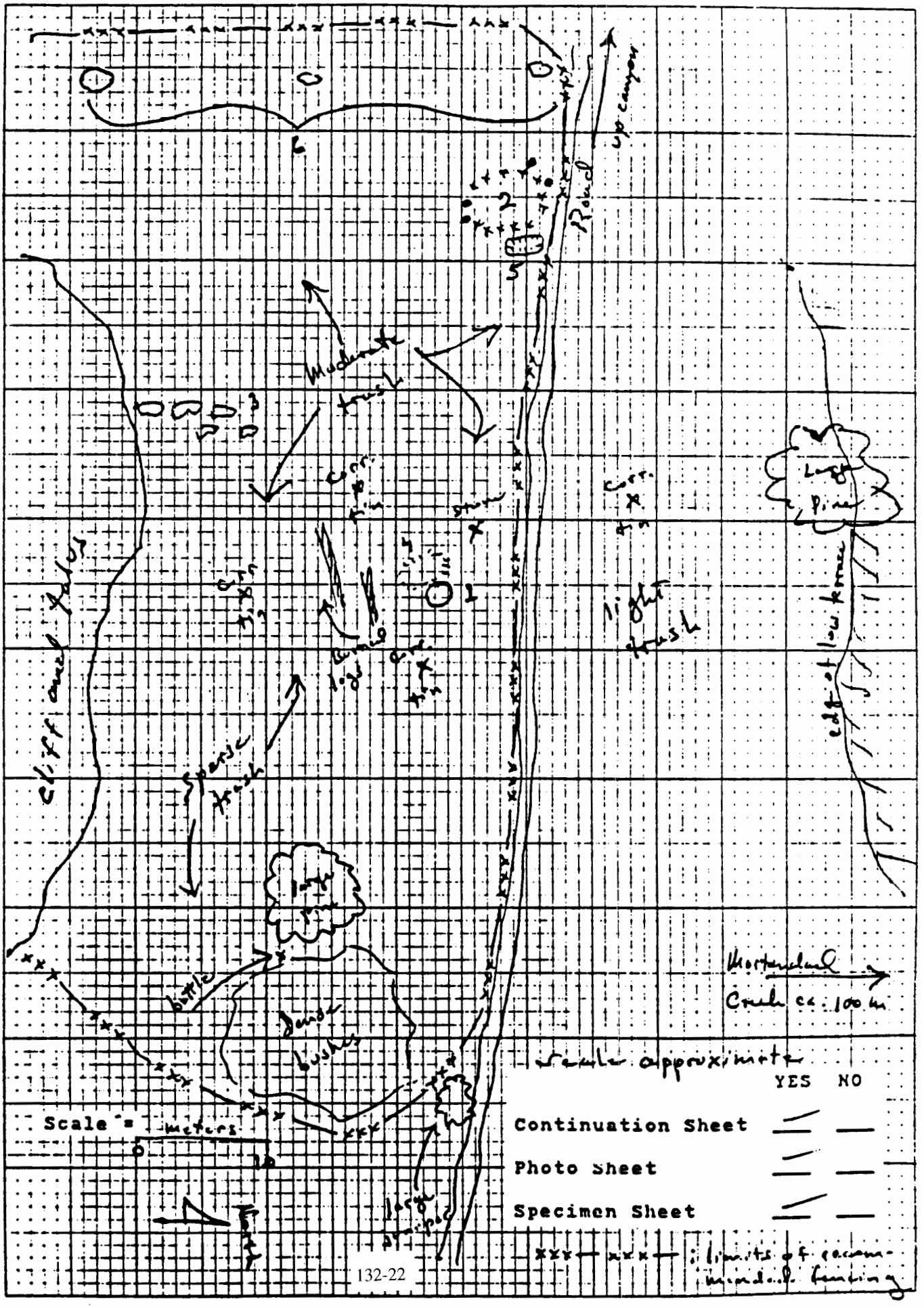
While archeologists have pieced together a reasonable picture of prehistoric live on the Pajarito Plateau based, in part, on information generated

MEMO: Ken Rea, page 2

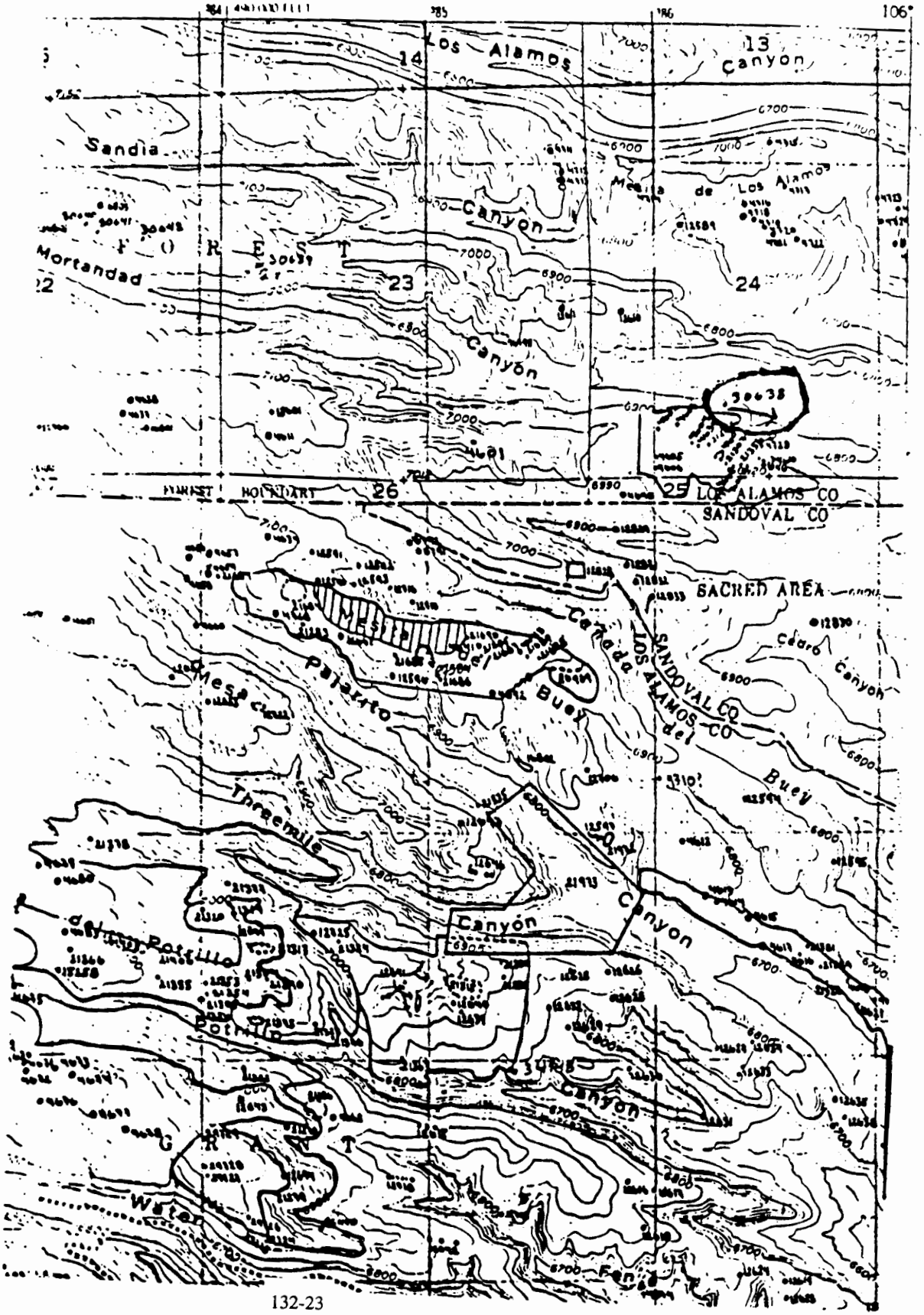
through the auspices of LANL, virtually nothing is known of the use of the region prior to US Government occupation of much of the region in the 20th century. LA 30638 represents a segment of the local and regional data base known and suspected to exist, which can inform on a variation of traditional western US life-styles, that of the 'cowboy'. As practiced by traditional hispano cultural participants during the years following US occupation in 1848, the seasonal transhumance pattern of herding (both sheep and cattle) contrasts with a similar pattern involving seasonal crop specialization in areas typified by the Pajarito Plateau.

There are apparently similar sites on LANL land but, lacking 100% survey, the target population of seasonal Anglo/Hispano sites of which LA 30638 is an as yet unknown sample, its significance for future scientific and cultural research is high. Such research is aimed at elucidating and explaining local transhumant patterns of the late 19th and 20 centuries with particular focus on agricultural patterns in the Tewa Basin. For this reason we recommend preservation in place until such time as the potential data base is adequately identified and quantified for assessment of its contribution to local and regional culture history and processes.

Recommendations. Using the cistern as an approximate center of the architectural and artifact distribution, that is, the site limits, an area was paced off which represents the zone of potential adverse impact on the site. This area is indicated on the attached sketch map and measures approximately 35-40 m N-S and 80 m E-W, and includes a buffer zone around the limits to the east and west. No architecture was noted north of the road, although scattered artifacts are present; in the event borrow activities occur in this direction, the surface should be 100% collected to preserve existing artifacts connected with the use of LA 30638. Fencing should be erected as indicated on the map prior to borrow activities to protect the site. In the event this site cannot be avoided it is recommended that a program of mitigative action be formulated and submitted to the appropriate Federal and State officials for review and concurrence.


Pond
up canyon
Moderate brush
cliff and talus
sparse brush
large pine
bushes
Scale = meters
0
10
large pine
edge of low meadow
light brush
Mortenson Creek ca. 100 m
trails approximate
YES NO
Continuation Sheet
Photo Sheet
Specimen Sheet
limits of recommended fencing

FRIJOLES QUADRANGLE
NEW MEXICO
7.5 MINUTE SERIES (TOPOGRAPHIC)
SE/4 FRIJOLES 15 QUADRANGLE



MUSEUM OF NEW MEXICO ARCHAEOLOGICAL SURVEY LANL SURVEY Project SITE NO.: L.A. 30638

Site name MORTANDAD RANCH SITE (NOT THE HISTORIC NAME) Quad no. _____ : ____ Field No. T 300

source ~~USGS WHITE ROCK QUAD.~~ Fri 0/P S Accessibility: 4-wh. dr. ____ foot ____ sedan ____ backhoe ____

____ ¼ of the SW ¼ of the SE ¼, Sec. 24, T. 19 N., R. 6 E., County LOS ALAMOS State N M

Location UTM: EASTING 13 386 290 NORTHING 39 68 900

0.4 MILE W OF FOOT OF HILL (PUYE DRIVE) • 10M SO. OF ROAD. Elevation 6780'

Stake location (MNM, Other) _____

Site is in what nearest named drainage? IN MORTANDAD CANYON Nearest town LOS ALAMOS Nearest highway SH 4

Ownership DOE Informant _____

FEATURES *(indicate number)*: Pit houses ____ Kivas ____ Surface rooms: Slab/Jacal ____ Masonry ____ Adobe ____ Other ____

Refuse area *(direction)* ____ Hearths ____ Burials ____ Sherd/Chipping area ____ Grids/Dams/Terraces/Borders ____ Petroglyphs/Pictographs ____

Trails/Steps/Toeholds ____ Other ____

PLAN *(check ✓)*: 1-room ____ Arc ____ Linear ____ L-shaped ____ C-shaped ____ F-shaped ____ E-shaped ____ ( )-shaped ____

Enclosed plaza: by a wall ____ by rooms ____ Scattered dwelling units ____ Indeterminate ____ Other ____

Single-tier ____ Double-tier ____ ( )-tiers ____ Part double-tier ____ Part ( )-tiers ____ Orientation ____ Exposure ____

Modern structures on site ____

Nature and depth of fill ____ Area of site ____ x ____ meters/feet

Condition: Undisturbed ____ Eroded ____ Pot-hunted ____ Pottery/Artifact abundance: 0, 10's, 100's, 1000's Multiple component site? ____

SITUATION *(check ✓)*: Valley bottom ____ Bench/Terrace ____ Slope ____ Ridge ____ Mesa top ____ Cliff edge ____ Overhang ____ Cave ____

Dune ____ Other ____

Terrain: Level ____ Broken ____ Slopes to *(direction)* ____ Surface deposits: Alluvium ____ Colluvium ____ Aeolian ____ Talus ____ Residual ____

Soil: Rocky ____ Gravelly ____ Sandy ____ Clayey ____ Other ____ Local outcrops: Sandstone ____ Shale ____ Limestone ____

Basalt ____ Tuff ____ Caliche ____ Other ____ Arable land *(type, distance & direction)* ____

Water *(distance & direction)*: River ____ Arroyo ____ Stream confluence ____

Spring/Seep ____ Bedrock pool ____ Local vegetation patterns ____

Field remarks HISTORIC SITE. RANCH SITE. PROBABLY EARLY 20TH C.
A WELL, OR CISTERN. MASONRY W/CEMENT LINING. CIRCULAR CROSS SECTION BUT FUNNEL-LIKE IN CROSS SECTION. 2M. DIAMETER AT SURFACE, 2+M. DEEP. BOTTOM IS FILLED W/TRASH - EXACT DEPTH NOT KNOWN. NO INDICATION OF HOUSE EXCEPT FOR CHARRED PLANKS AND ABOUT 10 PIECES OF CORRUGATED IRON ROOFING. TIN CANS ON GROUND.
LOCAL STORY - SMALL FRAME HOUSE USED BY TROOPS DURING WW II AS GUARD POST. MEN SET HOUSE AFIRE ONE MORNING WHILE PREPARING BREAKFAST AND HOUSE WAS DESTROYED. MAYBE - MEN ON GUARD DUTY DO NOT USUALLY PREPARE THEIR ~~OWN~~ OWN MEALS. PERHAPS A HEATING STOVE SET THE FIRE.

Excavation requirements: Labor ____ Time ____ Registered site? National ____ State ____

CULTURE ____ (component 1) / ____ (component 2) Phase or Date ____ (component 1) / ____ (component 2)

Zone ____ Locality ____ Photo: B/W ____ Color ____

Lab remarks ____

Field recorder STEEN Date 20 APRIL 81 Survey collections storage: Survey cabinet ____ Drawer ____

Lab recorder ____ Date ____ Bulk cabinet ____ Drawer ____

4-1-73

CODED BY TL DATE 5/18/81

1

3

2

4

Photos for LA 30638
Color originals on file with H-8

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. L. Marsh, ENG-9, MS M702

DATE: October 28, 1983

FROM: W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL: HSE8-83-723

SUBJECT: TEST BORINGS FOR PROPOSED BUILDING IN MUSEUM PARKING LOT

The following presents the log of the test holes, while locations are shown on Figure 1.

	(Feet)	
Test Hole 1	From	To
Asphalt and gravel	0	1
Tuff, light brown to reddish gray	1	6
Tuff, brownish gray	6	28
Test Hole 2		
Asphalt and gravel	0	1
Tuff, light brown to reddish gray	1	7
Tuff, brownish gray	7	28
Test Hole 3		
Asphalt and gravel	0	1
Fill, light brown, silty sand	1	3
Tuff, brownish gray	3	28
Test Hole 4		
Asphalt and gravel	0	1
Fill, light brown silty sand	1	2
Tuff, light reddish brown	2	9
Tuff, brownish gray	9	28
Test Hole 5		
Fill, gravel and sand	0	4
Tuff, brownish gray	4	28
Test Hole 6		
Soil, light brown	0	2
Tuff, brownish gray	2	28

The tuff exhibited a variety of color, due perhaps to deposition near the source area (Valles Caldera); however, the test holes penetrate only one ashflow unit. The unit is a moderately welded tuff. The tuff is composed of quartz and sanidine crystals and crystal fragments, a few small rock fragments of pumice, rhyolite and latite in an ash matrix. The moderately welded tuff has a safe bearing capacity of about 5000 lbs/sq. ft. The moisture content of the tuff appeared quite dry, estimated at about 5% by volume.

The test borings encountered no anomalies in the tuff that would effect foundation design.

WDP:pb

Att. Fig. 1 - Location of Test Holes in Museum Parking Lot.

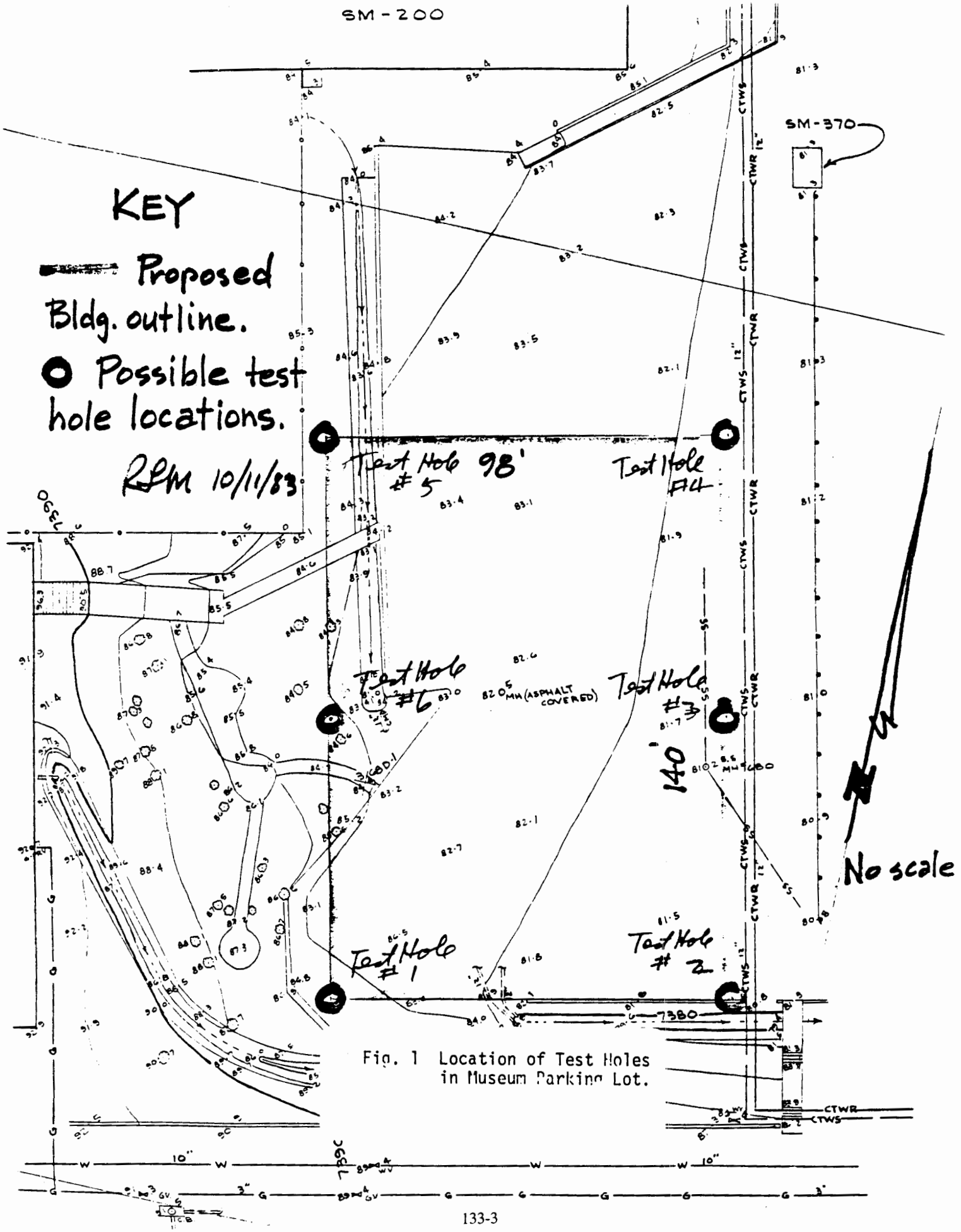


Fig. 1 Location of Test Holes in Museum Parking Lot.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Dean Miller, ZIA Co, MS-A199 DATE October 31, 1983

FROM W. D. Purtymun, HSE-8 MAIL STOP/TELEPHONE K490/667-7952

SYMBOL HSE8-83-726

SUBJECT TEST BORINGS SIGMA MESA

The following logs are of three test holes drilled on Sigma Mesa.

	(Set) From	To
Hole #1		
Soil, light brown, silty loam	0	4
Tuff, light pinkish gray	4	58
Tuff, light brownish gray	58	108
Hole #3		
Soil, light brown, silty loam	0	3
Tuff, light pinkish gray	3	38
Hole #7		
Soil, light brown, silty loam	0	4
Tuff, light pinkish gray	4	38

The tuff penetrated by the deep test hole represents two ashflow units; however, the units are very similar as they are moderately welded tuffs. The tuff units are composed of quartz and sanidine crystal and crystal fragments, a few small rock fragments of dense dark gray rhyolite and latite in an ash matrix. The moisture content of the tuff is low, probably around 5% by volume.

The moderately welded tuff has a safe bearing capacity of about 5000 lbs/sq ft. The tuff contains joints and fractures, most of which are vertical or near vertical.

The test borings encountered no anomalies that would effect foundation design or the construction of a 100 ft shaft using the bucket auger rig.

The bucket auger tends to pull blocks of tuff from the shaft walls when the pilot hole is being reamed to a larger diameter. This occurs due to the presence of the vertical or near vertical joints in the tuff.

To construct a shaft with smooth walls, drilling or reaming the pilot hole to a larger diameter should be made in several increases in diameters, instead of one step. However, if reaming the pilot hole to a larger diameter, for example 4 ft to 11 ft, can be made in only one step, the drilling should be smooth, not in a sudden broken manner, cutting only a small amount of tuff at each turn of the auger. Either method should produce a shaft with smooth walls.

WDP:mlk
cc: Vern Penny, ZIA Co. MS-A199

(25)
A/VI

MISCELLANEOUS INVESTIGATIONS

Group HSE-8 furnishes geologic, hyudrologic, and test drilling support to other groups in the Laboratory and Zia Company. The investigations in 1983 included test borings for preliminary foundation investigations, rock fall reconnaissance, support to the U.S. Geological Survey in construction of a test facility, and investigation of a barrow pit. The data collected during these investigations supplements the environmental monitoring program. The data plays an important part in disposal and storage of wastes as well as locations of the monitoring net for disposal areas.

A. Test Borings, Foundation Design or Geologic Information

Ad. Bldg
LS-6 test A
Personnel
South of Ad. Bldg

Ten investiations were made for the Laboratory and Zia Company in 1983. Forty-seven test holes were drilled with a total of 358 m of soil, fill or tuff penetrated.

April 11: Ta-55, Office Addition, ENG-2:

Four test holes ranging in depth from 2 to 4 m penetrated fill material overlying the moderately welded tuff of Unit 3.

May 3: TA-54, Proposed Building, ENG-2:

Four test holes 5.5 m in depth penetrated a thin soil zone and were completed in a moderately welded tuff of Unit 2B.

May 25: TA-51, Proposed Environmental Research Laboratory, ENG-2:

Four test holes 6.7 m in depth penetrated a thin soil zone and were completed in a moderately welded tuff of Unit 3.

August 3: TA-35, Proposed addition to Building, ENG-2:

Four test holes 8.5 m in depth penetrated a thick section of fill material and are completed in a mdoerately welded tuff of Unit 3. The test holes were located on fill material next to the run of Mortandad Canyon.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. L. Marsh, ENG-9, MS K702 DATE: January 5, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-7952

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-13

SUBJECT: SOIL TEST BORINGS FOR PROPOSED VISITOR ENTRY STATION, SM-43 (REF: ENG-9-754-83)

Six test borings were drilled at locations shown on Figure 1. The locations are differ from the proposed hole location plan. Access with the rig in the area was limited due to vehicles parked in the area. Log of the borings are as follows:

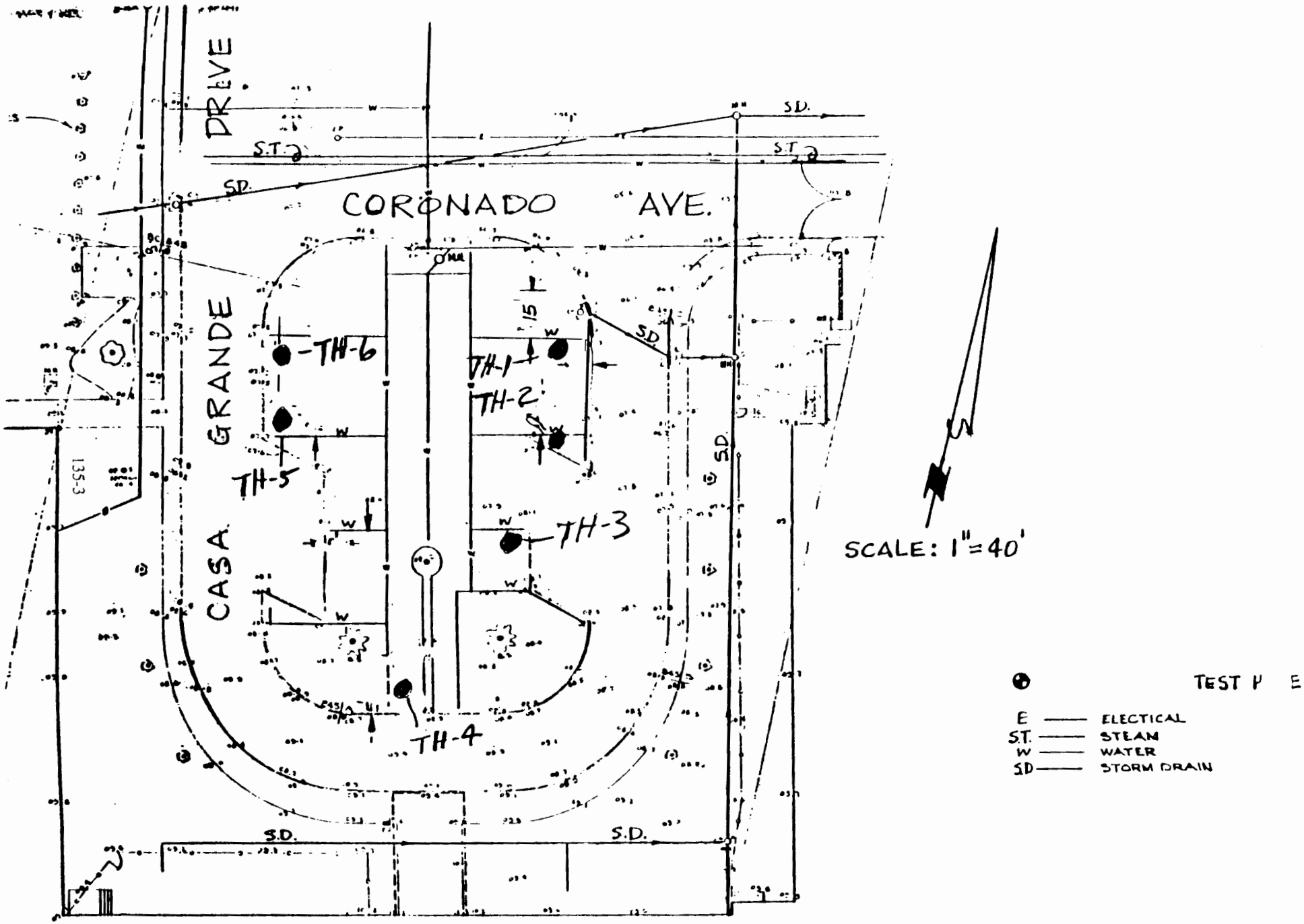
	(ft) From	(ft) To
Test Hole 1		
Soil, brown, clay, wet	0	4
Soil, black, clay, wet	4	5
Soil, brown containing weathered pumice, wet	5	8
Tuff, light reddish brown, upper 2 ft, weathered and wet	8	23
Test Hole 2		
Soil, brown, clay, wet	0	5
Soil, brown, containing some minor amounts of pumice, wet	5	7
Soil, brown, clayey wet, maybe intensely weathered tuff	7	10
Tuff, light reddish brown, upper 2 ft weathered, wet	10	23
Test Hole 3		
Soil, brown, clay, wet	0	6
Soil, brown, containing weathered pumice, wet	6	8
Tuff, light reddish brown, upper 2 ft weathered, wet	8	23
Test Hole 4		
Soil, brown, some clay, wet	0	6
Tuff, light reddish brown, upper 3 ft weathered, wet; two zone of brick red tuff at about 11 and 15 ft (probably joints)	6	23

	(ft) From	To
Test Hole 5		
Soil, brown, clay, wet	0	6
Tuff, light reddish brown, upper 2 ft weathered and wet	6	23
Test Hole 6		
Soil, brown, clay, wet	0	7
Tuff, light reddish brown, upper 4 ft weathered, wet, joint filled with wet clay at about 9 ft	7	23

The foundations should be extended into the unweathered tuff which is at a depth of 8 to 12 ft. The soil or fill material penetrated in the upper part of the holes is quite wet probably in the order of 30 to 45% moisture by volume and contains a large amount of clay. The clay is quite plastic. The tuff, unweathered, has a safe bearing capacity of about 3000 lbs/sq ft. The foundation should extend into the unweathered tuff. The unweathered tuff is a light reddish brown moderately welded tuff consisting of quartz and sanidine crystals and crystal fragments, a few small rock fragments of pumice, latite and rhyolite in an ash matrix. The test holes encountered no anomalies in the unweathered tuff which would effect the foundation design.

WDP:pb

Att: a/s



SM-43

Figure 1. Approximate Location of Test Holes

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592

DATE: October 31, 1983

FROM: W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE: K490/667-7952

SYMBOL: HSE8-83-728

SUBJECT: SHAFT INSPECTION

Shafts No. 191 and 192 for disposal of wastes from the Meson Facility and Shafts No. 121, 122, 123, and 124 in the shaft deposit area were inspected and meet criteria for disposal of solid wastes as set forth in guidelines of December 10, 1980, Memo. H-7-80-660

Shafts No. 191 and 192 are composite or connected three (3) 8-ft diameter shafts. These shafts contain numerous blocks of tuff pulled from shaft wall during construction. Extreme caution should be exercised in working around these shafts as surface is undercut on the north side where blocks of tuff have fallen or pulled out of the shaft wall.

WDP:mlk

cc: John Warren, HSE-7, MS-E516
Don Mayfield, HSE-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592

DATE: November 16, 1983

FROM: W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL: HSE8-83-787

SUBJECT: PIT 26 INSPECTION - NOVEMBER 10, 1983

Pit 26, Area G, TA-54, was inspected to determine if the pit complies with the guidelines issued for the construction and use of pits for the disposal of solid radioactive wastes (H7-80-660, December 10, 1980).

The pit is dug into Unit 2b of the Tshirege member of the Bandelier Tuff. The unit in the pit consists of two ash flows. The contact between the two flows occurs at an elevation of about 6992 ft. The contact is shown by an increase in the amount and size of dark gray devitrified pumice fragments in the top of the lower ash flow. The contact is nearly horizontal, though in places becomes indistinct. The tuff in both flows is a gray moderately welded tuff, consisting of quartz and sanidine crystals and crystal fragments with a few rock fragments of rhyolite, latite, and pumice in a gray ash matrix.

The tuff in the walls of the pit is broken by joints that formed as the ash flows cooled. Most of the major joints are vertical or nearly vertical. They range from closed to open. Beneath the thin soil zone (less than 1 ft thick) exposed in the walls of the pit, the joints are filled with clay. At depth the joints may be filled with clay or open slightly with the joint face weathered with a thin layer of clay. The fresh joint faces exposed in the walls are the result of excavation of the pit; the tuff pulled apart. The frequency of the joints is about one master joint for every 6 to 8 ft of wall of the pit. This frequency is normal at Area G. The floor of the pit is covered with a layer of crushed tuff. The joint openings in the walls or joint systems in the floor (filled with tuff) are not of a size to require remedial action.

The pit is about 310 ft long, 50 ft wide, with a maximum depth of 35 ft (Engineer Drawing No. R-5030). The floor of the pit is ramped at the long dimension to allow construction and vehicle access during disposal operations. Total excavation of tuff was 22,200 cubic yards.

The long dimension of the pit is northeast-southwest. The "spill point" or lowest area is the southwest corner of the pit.

In summary, the inspection of Pit 27 indicates that the pit is in compliance with the guidelines and is suitable for disposal of wastes. The finished pit has been documented by photographs that are on file in HSE-8.

WDP:mlk

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Richard Crombie, ENG-11 Group Leader, MS M701 DATE February 3, 1984

FROM W. D. Purtymun MAIL STOP/TELEPHONE K490/7-7952

SYMBOL HSE8-84-79

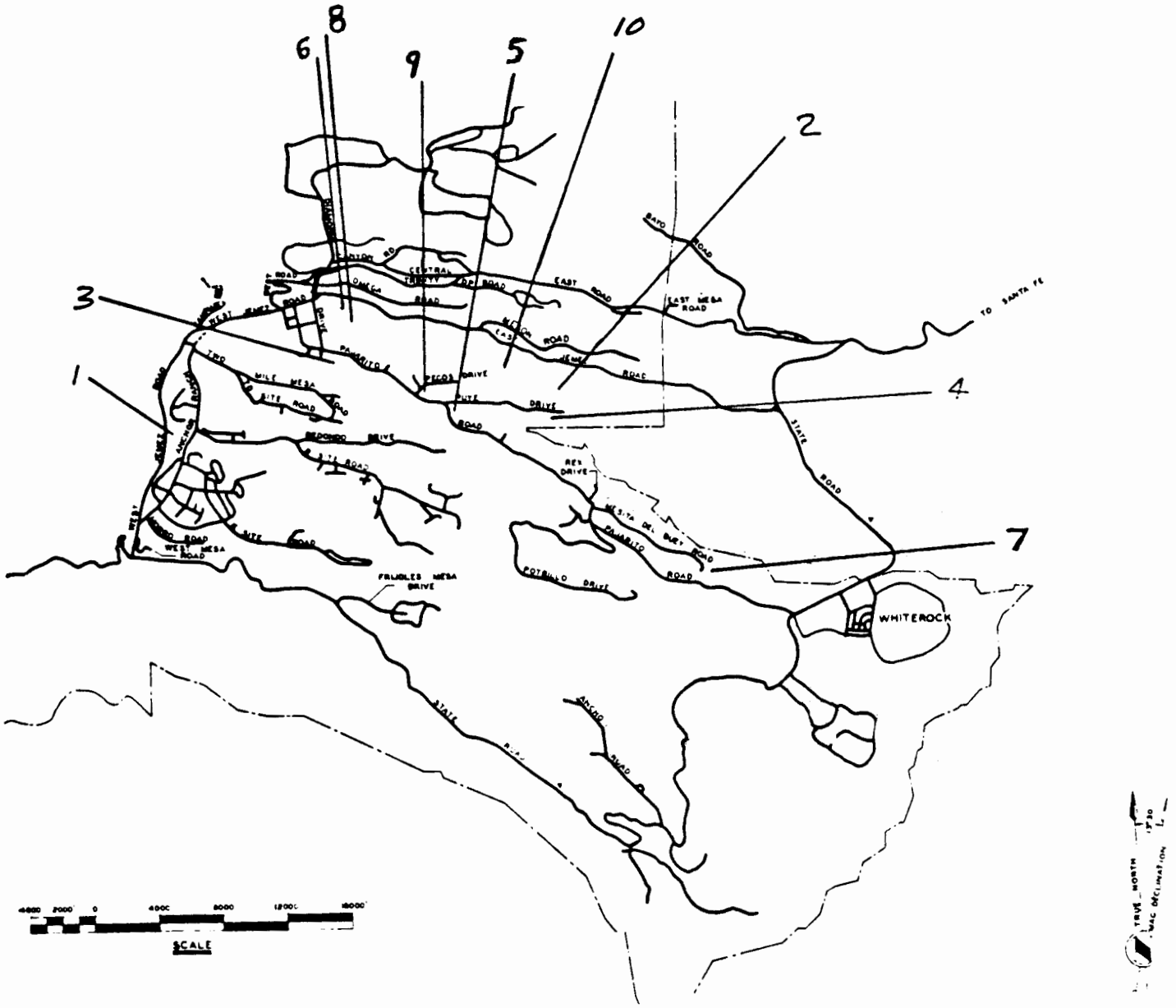
SUBJECT LOCATION AND DESCRIPTION OF SOIL SAMPLING STATIONS

Attached are locations and descriptions of soils that were analyzed for physical properties by Fox and Associates and by New Mexico State at Las Cruces.

WDP:les

Attach: a/s

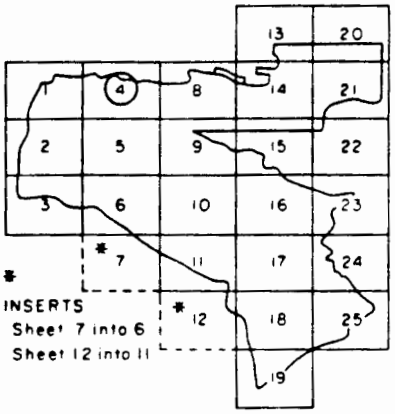
Cy: Dean Keller, ENG-4, MS M700



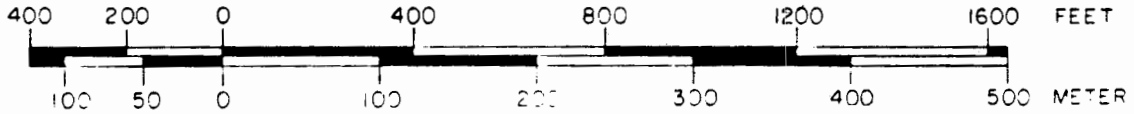
Generalized Locations of Sample Stations

1. Gravel pit near S-Site (South Site)
2. Mortandad (Canyon)
3. S of building (east of TA-59 and tank)
4. Soil near Mortandad ruins
5. Canada del Buey
6. Sandia near Sant. Landfill
7. Area of fill (Area G, TA-54)
8. Sandia behind dump (Sandia Canyon)
9. Fill near TA-50
10. Gravel pit near Meson

SHEET LAYOUT

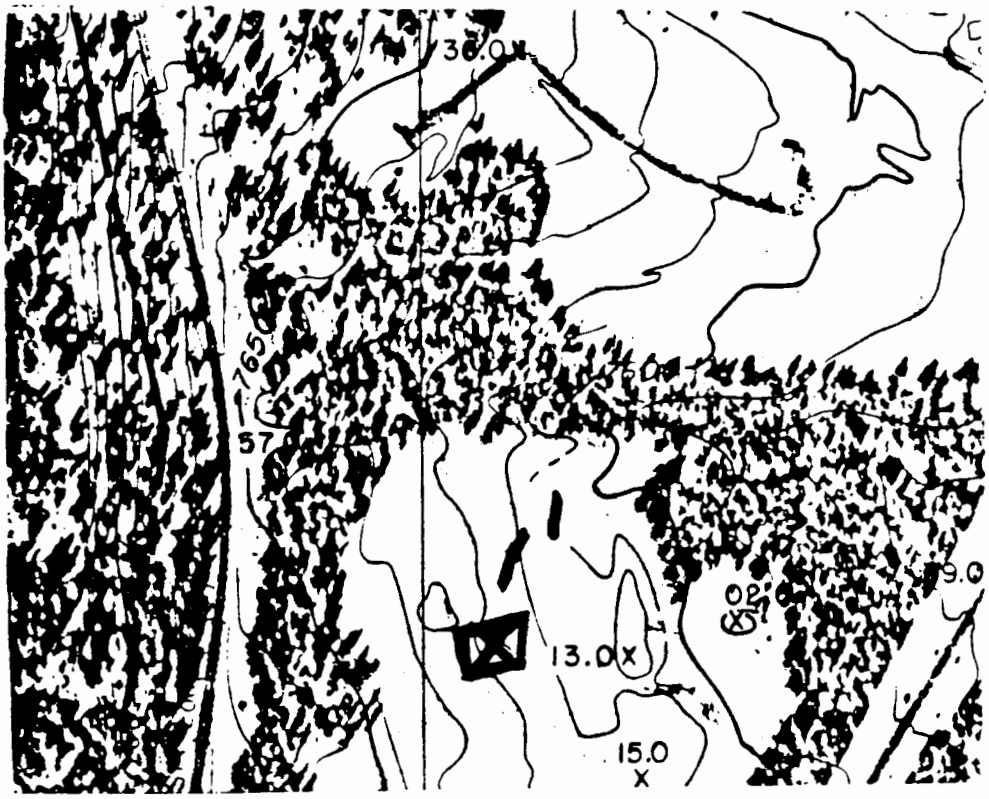


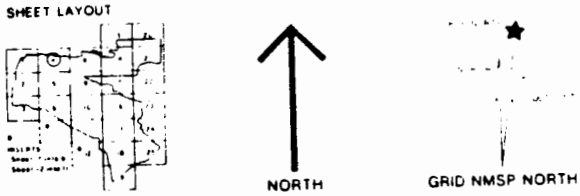
MAPPING COMPLETED BY PHOTOGRAMMETRIC METHODS UTILIZING 1:30,000 & 1:28,000 PHOTOGRAPHY OBTAINED DURING NOVEMBER 1976 WITH A ZEISS RMK A 15/23 CAMERA OF 153.42mm CALIBRATED FOCAL LENGTH. MAPPING BASED ON CONTROL SURVEYS TIED TO THE NEW MEXICO STATE PLANE COORDINATE SYSTEM (CENTRAL ZONE). MAPPING COMPLETED IN ACCORDANCE WITH NATIONAL MAP ACCURACY SPECIFICATIONS.



GRAPHIC SCALE: 1 in.=400 ft. CONTOUR INTERVAL 10 ft.

The ten locations of the sampling stations are shown on sections of the Ortho/Topo series of maps. The maps in this series are on file with Engineering Group 2 (ENG-2). The layout sheet is shown above. The map scale is 1 inch = 400 feet and contour interval 10 feet. Samples collected were representative of the media, either soil, alluvium, or tuff. A brief description of the material tested is included on the location and description sheets that follow this page. Tuff units referred to are from the Tshirege member of the Bandelier Tuff. The tuff sampled is crushed in a size range from sand to gravel.

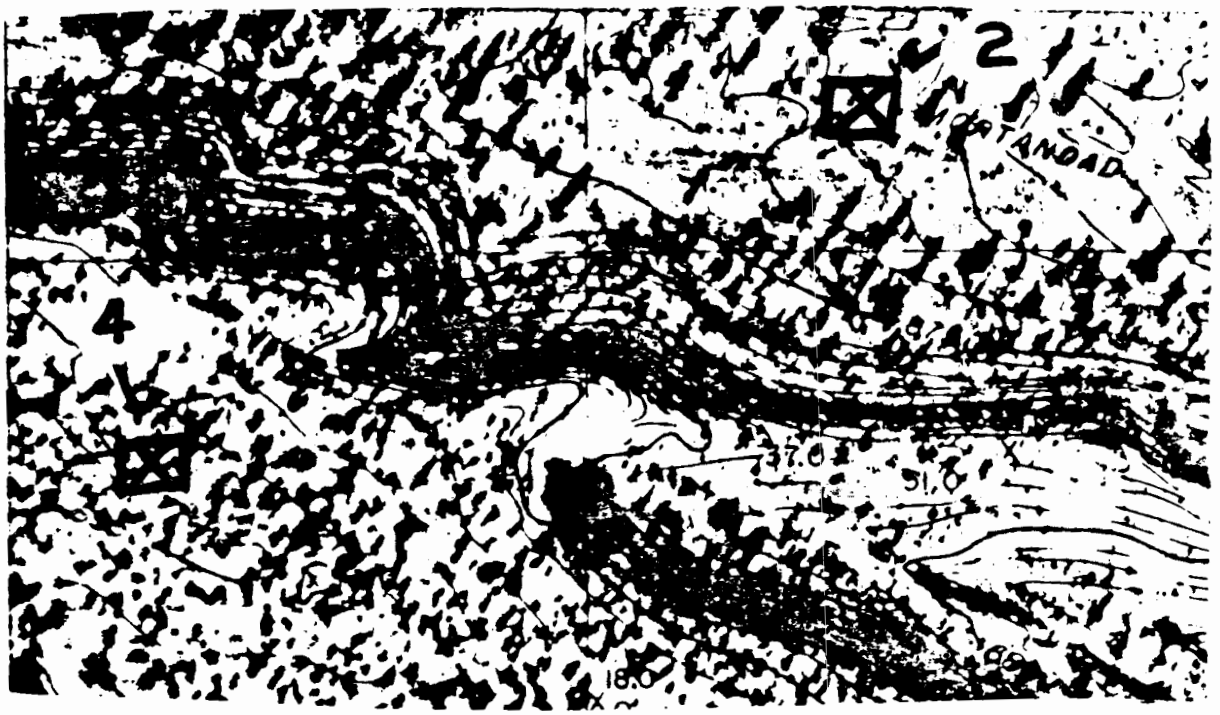




Location is on sheet 2 of 25.

Location 1 - Gravel Pit near S-Site (South Side)

Sample is of alluvium deposited on the western edge of the Pajarito Plateau from Valle Canyon. The gravels represent transport from the flanks of the mountain west of the plateau and consist of volcanic debris, boulders of latite, rhyolite, and densely welded tuff in a matrix of sand and gravel. The alluvium or gravels from this area were used in the past for fill and roadbed material. The volume of gravels remaining is unknown.



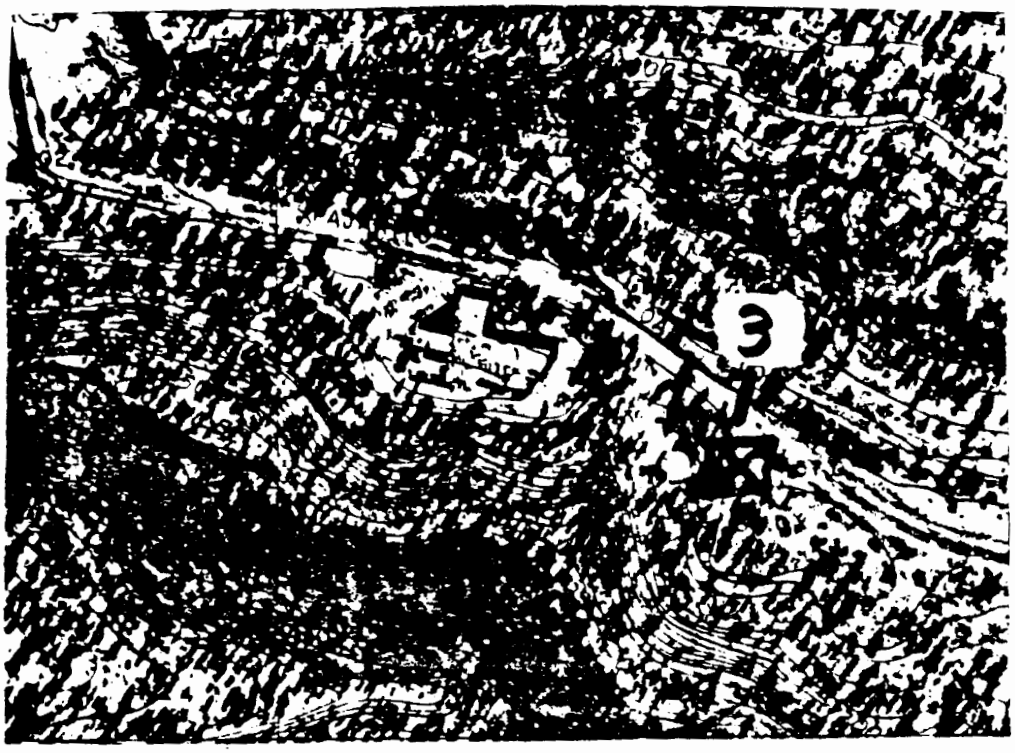
Locations on sheet 10 of 25.

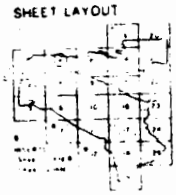
Location 2 - Mortandad (Canyon)

Sample of alluvium derived from weathering and erosion of the tuff, deposited on the floor of Mortandad Canyon. The alluvium consists mainly of quartz and sanidine crystals and crystal fragments, a few small rock fragments of tuff, latite, and rhyolite is a silty sand matrix. Area proposed as a barrow pit for fill material (memo HSE8-83-608.

Location 4 - Soil near Mortandad Ruins

Sample of soil derived from weathering of underlying tuff of Unit 3, maximum thickness at 2 feet. (For comparison of a soil at a higher elevation in pines see Location 3.)

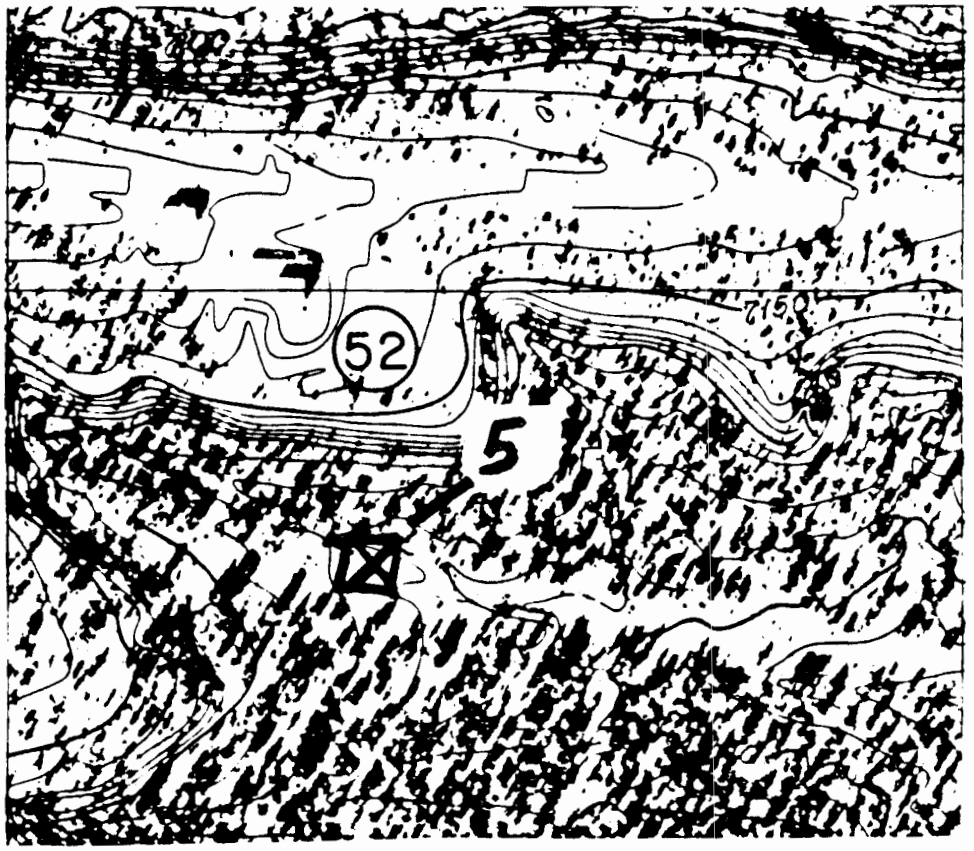


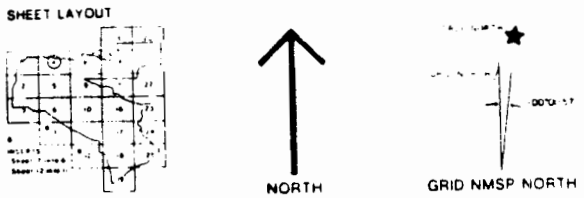


Location on sheet 4 of 25.

Location 3 - S of Building (East of TA-59 and Tank)

Sample of soil derived from weathering of Unit 3. Thickness less than 3 feet. (For comparison of a soil at a lower elevation in pinon and junipers see Location 4.)

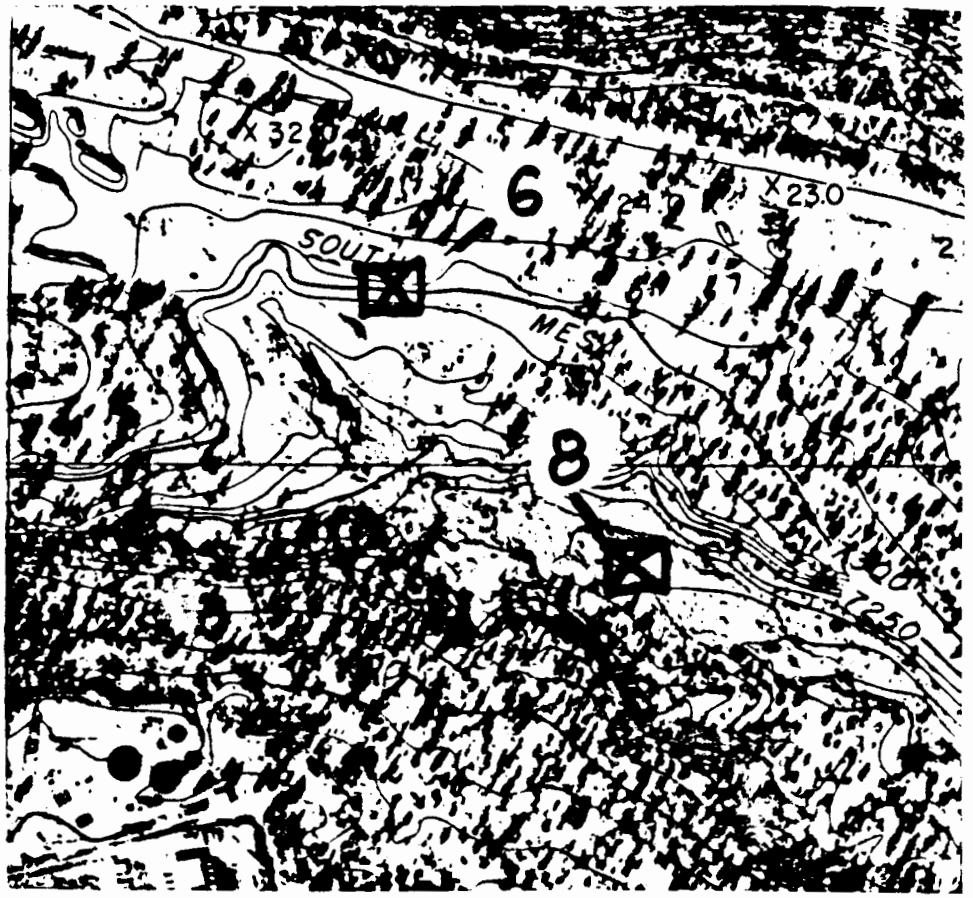




Location on sheet 9 of 25.

Location 5 - Canada del Buey

Samples of weathered tuff from an area considered for a sanitary landfill (memo HSE8-83-550). Tuff weathered from Unit 3 and underlying Unit 2B. Consists of quartz and sanidine crystals and crystal fragments, small rock fragments of dense latite and rhyolite in a weathered silty sand matrix.



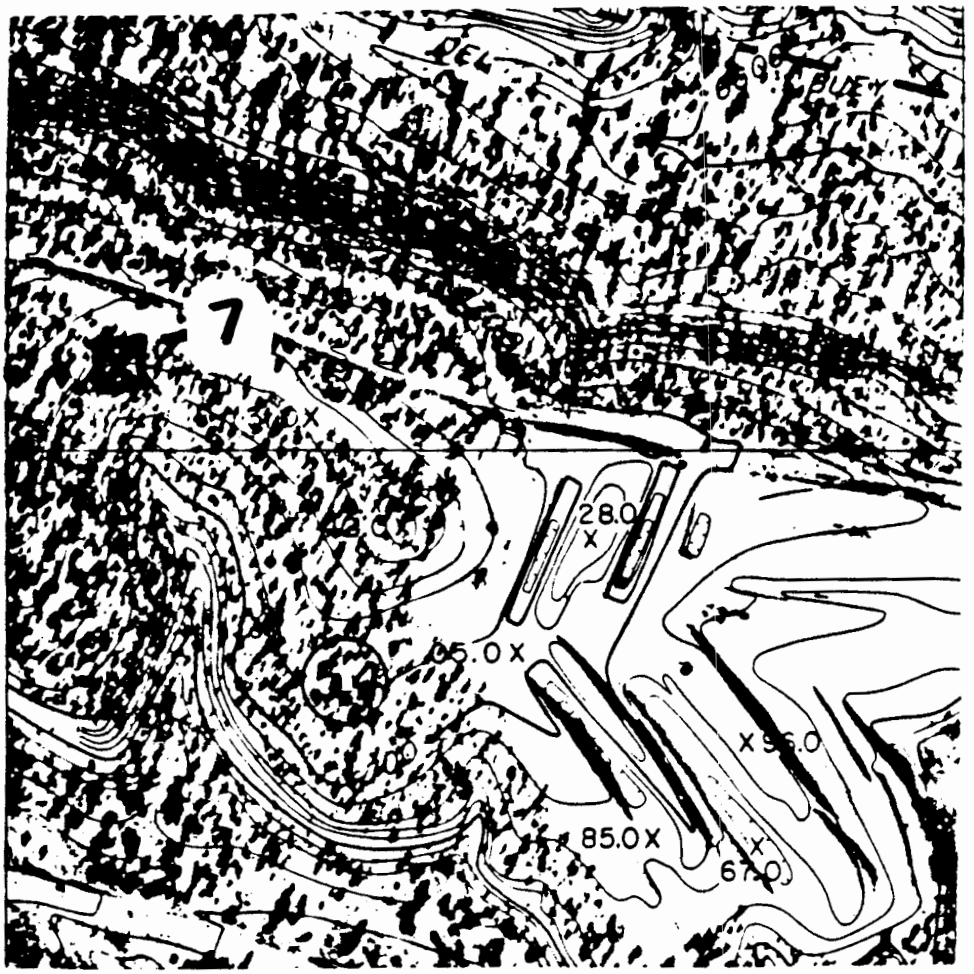
Locations on sheet 4 of 25.

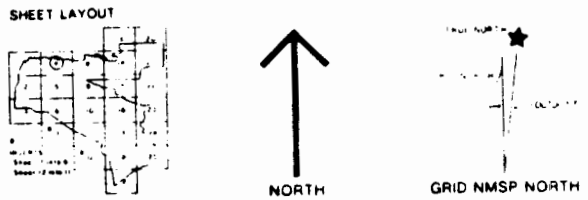
Location 6 - Sandia near Sanitary Landfill

Sample of soil and some tuff excavated from pit that will be to cover sanitary wastes. Soil derived from weathering of Unit 3, the underlying tuff.

Location 8 - Sandia behind Dump (Sandia Canyon)

Samples of alluvium from stream channel derived from weathering of Units 2 and 3. Quartz and sanidine crystals and fragments, small rock fragments of tuff, rhyolite, and latite in a silty sand matrix. Proposed for use as fill and cover material for a sanitary landfill in canyon. Alluvium is probably less than 4 to 5 feet thick.

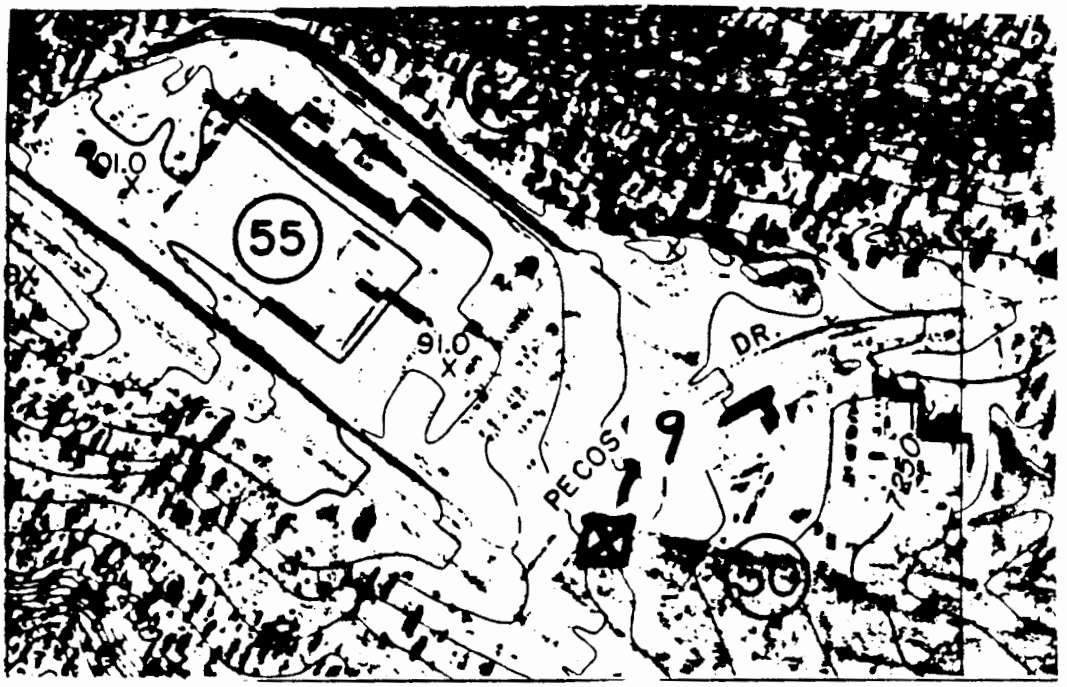




Location on sheet 16 of 25.

Location 7 - Area of Fill (Area G, TA-54)

Samples of moderately welded tuff of Unit 2B excavated from a radwaste pit for solid wastes. Used for cover material between layer of wastes and final cover. Unit 2B consists of quartz and sanidine crystals and crystal fragments, small rock fragments of pumice, dense rhyolite and latite in a gray ash matrix.



Location on sheet 4 of 25.

Location 9 - Fill near TA-50

Sample of final cover used to cap the northwest corner of Area C, which consists of pits filled with radwastes. The material consists of a mixture of soil, weathered, and fresh tuff.

Location on sheet 8 of 25.

Location 10 - Gravel Pit near Meson

Sample of moderately welded tuff of Unit 2B consisting of quartz and sanidine crystals and crystal fragments, a few small rock fragments of pumice, dense rhyolite and latite is a gray ash matrix. Material from pit is used for fill and cover material.

OCT 17 1983

COLLEGE OF AGRICULTURE AND HOME ECONOMICS

DEPARTMENT OF CROP AND SOIL SCIENCES
Box 3Q/Las Cruces, New Mexico 88003
Telephone (505) 646-3405

NEW MEXICO STATE UNIVERSITY

October 12, 1983

2-LF3-K95371

Los Alamos National Lab
Accounting Department
P.O. Box 1663
Los Alamos, NM 87545

Soil analysis (Lab #4461-4470)

Sample	pH	mmhos/cm EC	ESP	% OM	------ppm------ N	P	K
1 Gravel Pit Near S-Site	6.75	0.33	0.2	0.26	1.8	3.2	7.1
2 Mortandad	7.02	0.22	0	0.13	0.9	1.5	9.4
3 S of Building	6.58	0.35	2.9	1.08	0.4	0.9	13.4
4 Soil Near Mort. Ruins	6.73	0.47	2.4	0.33	0.6	1.2	5.7
5 Canada del Buey	6.52	0.38	1.4	0.56	0.4	1.5	9.5
6 Sandia Near Sant. Landfill	6.67	0.38	0.4	1.27	1.5	2.1	19.5
7 Area of Fill	7.89	1.58	5.5	0.23	4.3	1.2	18.2
8 Sandia Behind Dump	6.38	1.72	2.3	0.75	0.3	0.6	4.3
9 Fill Near TA 50	7.39	1.43	2.7	0.69	2.5	3.2	27.1
10 Gravel Pit Near Meson	8.27	0.17	5.1	0	0.3	0.9	2.9

Sample	Texture	1/3 bar	15 bar	cm/hr Hydraulic Cond.
Gravel Pit Near S-Site	Sandy Loam	8.7	5.1	16.1
Mortandad	Sand	4.3	2.5	30.0
S of Building	Silt Loam	15.8	7.3	0.7
Soil Near Mort. Ruins	Silt Loam	9.2	4.7	4.2
Canada del Buey	Silt Loam	14.2	6.3	3.0
Sandia Near Sant. Landfill	Silt Loam	13.5	5.8	1.3
Area of Fill	Silt Loam	11.7	3.1	4.2
Sandia Behind Dump	Silt Loam	15.1	6.1	1.3
Fill Near TA 50	Silt Loam	14.3	6.2	4.8
Gravel Pit Near Meson	Sand	5.2	1.3	51.8

cc Mr. Crombie/Purtymun
Mr. Archie Velarde

Job No. 430670

Project: LF3-K9537-1

Sieve Analysis on Soil from Canada Del Buey, sampled by Client on September 6, 1983.

SIEVE ANALYSIS

Sieve Size	% Passing
No. 4	100
No. 10	98
No. 40	77
No. 80	72
No. 200	61.6

MOISTURE CONTENT

5.6% (as received)

FALLING HEAD PERMEABILITY TEST

8.85×10^{-7} feet per minute

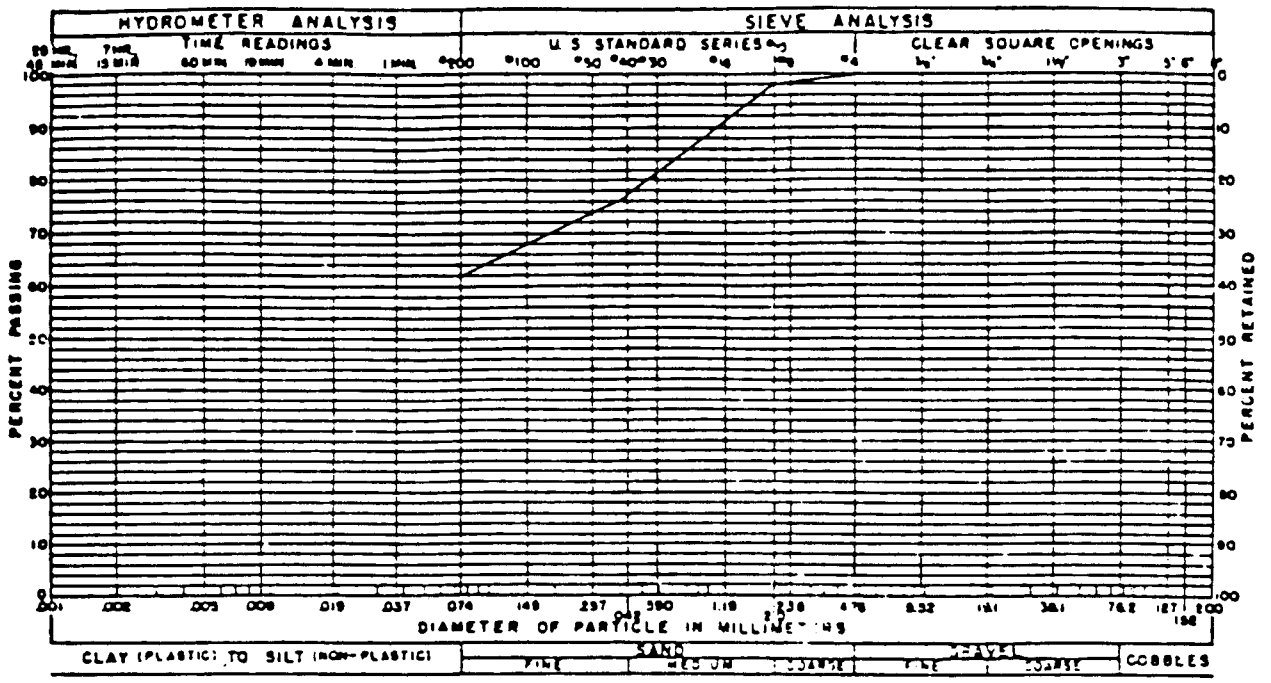
ATTERBERG LIMITS

Liquid Limit - No Value

Plasticity Index - Non Plastic

F. M. FOX & ASSOCIATES, INC.
Consulting Engineers and Geologists

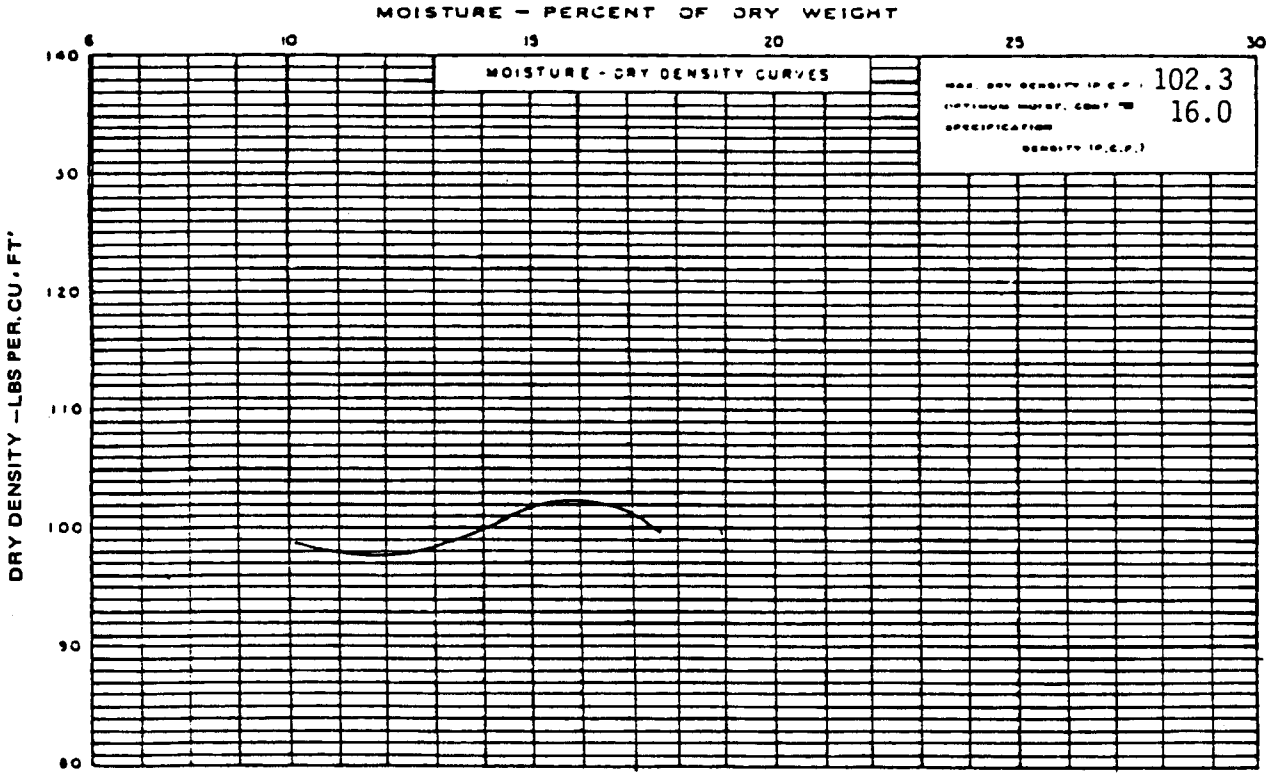
F. M. FOX & ASSOCIATES, INC.
3412 BRYN MAWR DRIVE, N.E.
ALBUQUERQUE, NEW MEXICO 87107
(505) 884-0900



GRADATION TEST RESULTS

GRAVEL 0 % SAND 38 % SILT AND CLAY 62 %

LIQUID LIMIT NV % PLASTICITY INDEX NP %



COMPACTION TEST RESULTS

COMPACTION TEST PROCEDURE AASHTO T-99, Method A

SAMPLE OF SILT, very sandy, brown (ML)

FROM Canada Del Buey Date Sampled: 9/6/83 FIG.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Dave Trujillo, ENG-2, MS M984

DATE: February 21, 1984

FROM: W. D. Purtymun, HSE-8 WDP

MAIL STOP/TELEPHONE: K490/7-7952

SYMBOL: HSE8-84-112

SUBJECT: TEST HOLE, GAS FACILITY

The log of the hole is as follows:

Asphalt	0 - 1 ft
Fill material and gravel	1 - 3 ft
Tuff, weathered, light gray	3 - 4 ft
Tuff, moderately welded, dark gray	4 - 7 ft

The moderately welded tuff contained some excess moisture, but should have a safe bearing capacity of 3000 to 4000 lb/sq ft. A joint penetrated near the bottom of the hole (brick red cuttings) should cause no problem with the design.

WDP:les

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Harry Patterson, HSE-7, MS E516 DATE: March 1, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-7952

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-129

SUBJECT: INSPECTION OF SHAFT 29, AREA L, TA-54

Shaft 29, dug in December 1983, was inspected on February 29, 1984, and determined suitable for disposal of organic wastes. The shaft is 6 ft. in diameter and about 65 ft. deep. The shaft is not straight but drifts to the north about 4 to 5 ft. at total depth of 65 ft. The shaft penetrated two ash flows of rhyolite tuff. The upper flow is Unit 2 B and the underlying flow is Unit 2 A of the Tshirege Member of Bandelier Tuff. The contact between the two Units occurs at a depth of about 22 ft. Joints and fractures were few in the walls of the shaft. One near vertical joint occurred in the upper flow terminating at the contact at about 22 ft. The joint was trending east-west and intersected the shaft in the northeast and northwest quadrant. A few roots were present in the upper 15 ft. of the joint. Several small blocks of tuff were pulled from the joint when the shaft was being reamed to the 6-ft. diameter. Brown clay plates the joint face in the upper part of the shaft.

The shaft is suitable to disposal of packaged organic wastes.

WDP:pb

Cy: Karen Balo, HSE-7, MS E516

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: [redacted]l Purtyman, HSE-8, MS-K490 — DATE: March 16, 1984

FROM: Miguel D. Salazar, HSE-7, Disposal Sites Engineer — MAIL STOP/TELEPHONE: K592/7-6095

SYMBOL: HSE-7B-84-12

SUBJECT: PIT 29 EXCAVATION

We propose to excavate Pit 29 by changing the end slopes from 1 on 3 to 1 on 2.5 and 1 on 5 to 1 on 2.5. The side walls slopes will be excavated per our usual practices. An entrance and exit ramp will be excavated constructed as shown on figure 1, 2, and 3.

The modified end slopes will give us additional burial volume on this pit.

We foreseen no operational problems nor any design criteria breachment.

Please advise and approve or disapprove this proposal.

MDS/rfg

xc: K. A. Balo, HSE-7, MS-K592

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. L. Riedel, ENG-2, MS M984 DATE: April 27, 1984

THRU: W. R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun and N. M. Becker, HSE-8 SYMBOL: HSE8-84-291

SUBJECT: TEST BORING AT BUILDING SM-410-TA-3, BUILDING ADDITION; L.J. 7671-3

A test hole was augered north of building SM-410, TA-3, near Test Hole 1 as indicated on your drawing. Only one hole was drilled as access with the drill rig was limited. The hole penetrated about 5 ft of soil or fill material that was quite wet. It was underlain by about one foot of dark gray tuff that contained a large amount of moisture. This in turn was underlain by a fairly dry light to dark gray moderately welded tuff. The hole was completed at a depth of about 12 ft. The tuff has a safe bearing capacity of about 5000 lbs/sq. ft.

The wet soil or fill overlying the tuff is the result of snow melt on the north side of the building and lawn irrigation. The foundation should be set down into the tuff.

WDP:NMB:pb

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Harry Patterson, HSE-7, MS E516 DATE: 21 May 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: W.D. Purtymun, HSE-8 WDP/pl SYMBOL: HSE8-84-357

SUBJECT: INSPECTION OF SHAFT 31, AREA L, TA-54

Shaft 31, dug April 1984, was inspected on May 7, 1984, and determined suitable for disposal of organic wastes. The shaft is 6 feet in diameter and 61 feet deep. As with Shaft 29, it is not straight, but drifts to the North 3 to 4 feet at a total depth of 61 feet. The shaft penetrated two ash flows of rhyolite tuff. The upper flow is Unit 2B and the underlying flow in Unit 2A of the Tshirege Member of the Bandelier Tuff. The contact between the two ash flow occurs at a depth of about 20 to 22 feet. A major joint in Unit 2B strikes east-west and dips slightly to the northwest and terminates at the contact between the two ash flows. A second joint, below the contact in Unit 2A, strikes northeast-southwest is near vertical. At a depth of about 45 feet, a block of tuff about 1.5 feet wide, 3 feet long, and 1.5 to 2.5 feet within the wall of the shaft was pulled out during construction.

The shaft is suitable for disposal of packaged organic wastes.

WDP/ls

Cy: Karen Balo, HSE-7, MS E517

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592 DATE: 21 May 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: W.D Purtymun, HSE-8 SYMBOL: HSE8-84-356

SUBJECT: LOCATION OF DECONTAMINATION PIT

The new pit is to be located in the southwest corner of the proposed Pit 31. This pit replaces the old decontamination pit that was destroyed during the contruction of Pit 29. The new pit will be about 50 feet long, 20 feet wide, and about 5 feet deep with an entrance ramp on the long dimension. About 0.5 feet of gravel will be placed in the floor of the pit.

The location of the pit and limited use (deconamination of suspect contamination of vehicles or equipment at the site) will not compromise the use of the area for storage and disposal of solid wastes.

WDP/ls

Cy: B. Mayers, HSE-7, MS J592

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: David Trujillo, ENG-9, MS M984

DATE: May 30, 1984

FROM: W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE: K490/0810

SYMBOL: HSE8-84-414

SUBJECT: TEST HOLES TA-3, SOUTH OF BLDG. 210

The log of four test holes are numbered in sequence as drilled.

	Feet From	Feet To
Test Hole 1		
Asphalt, soil and fill	0	2
Tuff, wet, weathered	2	5
Tuff, light reddish brown, moderately welded	5	12
Test Hole 2		
Asphalt, soil and fill	0	2
Tuff, wet, weathered	2	4
Tuff, light reddish brown, moderately welded	4	17
Test Hole 3		
Asphalt, soil and fill	0	2
Tuff, light reddish brown, moderately welded	2	17
Test Hole 4		
Soil and fill	0	2
Tuff, light reddish brown moderately welded	0	6

Tuff in the upper few feet of the hole contained excessive moisture probably due to the asphalt road and to the fill in the adjacent water line. The moderately welded tuff has a safe bearing capacity of about 5000 lbs/sq ft. Tuff near the southeast corner of the building is at the surface.

WDP:mlk

Mailed 5/31/84

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker, INC-5 Group Leader, MS G776 DATE: June 15, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-84-466

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

A reconnaissance was made of the north wall of Los Alamos Canyon above the site on June 15, 1984. The reconnaissance was made at the request of A. Lyle, INC-5. The last inspection of the canyon walls was made on May 26, 1983 (Memo HSE8-83-513). Since the last inspection was made, no rocks have lodged in the rock catcher or in the security fence. There has been no apparent movement of rocks or rock falls on the slope. The security fence and rock catcher appear to be in good shape.

The standing dead pines located between the buildings and security fence on the north wall of the canyon have been removed as recommended in a previous memo.

The inspection failed to detect any rocks that are unstable; however, there appears to be a number of blocks that are potential for rock fall. If the rocks should dislodge, the slope below, rock catcher and the security fence above the buildings should prevent the rock falls from causing any damage.

WDP:mm

Cy: A. Lyle, INC-5, MS G776

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: P. C. Hunt, ENG-2, MS M984 DATE: June 28, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-84-498

SUBJECT: METEOROLOGICAL TOWER INSTALLATION, TA-16, L. J. 7580-16, TEST BORINGS

Two test holes were drilled at the site. One at the center of the foundation of the tower and a second about 10 feet west. The second test hole was to verify the log of the first. The units penetrated were of the same thickness.

	DEPTH (FEET)	
	From	To
Clayey soil, brown, containing a few small rock fragments, moist in zone so that clay balls up on auger.	0	8
Clayey soil, light brown containing light gray pumice fragments.	8	11
Clayey soil, brown, moist, dense, hard.	11	13
Tuff, light pinkish gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few rock fragments of gray ryhyolite in an ash matrix.	13	22

The moderately welded tuff has a safe bearing capacity of about 5000 pounds per square feet. The test borings encountered no anomalies either in soil or tuff that would effect the foundation design.

WDP:mm

Cy: HSE-DO, MS P228

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Harry Patterson, HSE-7, MS E516 DATE: June 28, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-84-497

SUBJECT: INSPECTION OF SHAFT 30, AREA L, TA-54

Shaft 30 is 6 feet in diameter and about 65 feet deep. When inspected on June 26, 1984, the shaft had several stacks of barrels emplaced and covered with tuff. About the upper 40 feet of the shaft was open.

The upper part of the shaft penetrated 23 feet to 25 feet of Unit 2B with the lower part of the shaft completed in Unit 2A of the Tshirege Member of the Bandelier Tuff. There were no major blocks of tuff or open joints in the wall of the shaft. The shaft had fewer joints in the upper 40 feet than were observed in adjacent shaft 29 (HSE8-84-129) and shaft 31 (HSE8-84-357).

Based on observation in the lower part of shafts 29 and 31 and inspection of the upper part of shaft 30, there is no geologic or hydrologic factor that would prevent the use of the shaft for disposal of packaged organic wastes.

Shaft 30 is suitable to disposal of packaged organic wastes.

WDP:mm

Cy: K. Balo, HSE-7, MS E516
HSE-DO, MS P228

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: L. Bailey, ENG-9, MS M702

DATE: July 9, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490

MAILSTOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, [redacted], HSE-8

SYMBOL: HSE8-84-537

SUBJECT: SUBSURFACE INVESTIGATION TA-16, IN REGARDS TO WEAPONS SUBSYSTEM LABORATORY (ENG-9-491-84).

Four test holes were augered west of the new Tritium Building to determine the properties of the tuff. The holes are to be located on an Engineering Drawing at a later date. They are laid out in a general north-south line and are numbered from north to south.

There was little or no soil overlying the tuff in the area. The tuff penetrated by the test holes is Unit 6 of the Tshirege Member of the Bandelier Tuff. It consists of guartz and sandidine crystals and crystal fragments, a few small fragments of dark gray rhyolite and dacite in a light pinkish gray ash matrix. The ash flow is dense and hard. It is moderately welded grading into a welded tuff.

The test holes ranged from 15 to 22 ft. in depth. There was little if any change in lithology of the tuff penetrated by the test holes; however, it did show an increase in welding at depth. The tuff became denser or the degree of welding became greater with depth. The following logs show the break in welding:

HOLE	DEPTH (FT.) From	To
Test Hole 1		
Moderately Welded Tuff	0	12
Welded Tuff	12	16
Test Hole 2		
Moderately Welded tuff	0	12
Welded Tuff	12	22

HOLE	DEPTH (FT.) From	To
Test Hole 3		
Moderately Welded Tuff	0	10
Welded Tuff	10	22
Test Hole 4		
Moderately Welded Tuff	0	7
Welded Tuff	7	15

The break between the moderately welded and welded tuff shown on the above logs is approximate. Test holes 1 and 4 were terminated at depths of 16 and 15 feet as the tuff was to hard and dense (welded) to auger. The moderately welded tuff 12 feet (Test Hole 1) to 7 feet (Test Hole 4) can probably be ripped with earth moving equipment. However, it is doubtful if the equipment can remove the welded tuff below depths of 12 feet (Test Hole 1) and 7 feet (Test Hole 4).

WDP:mm

Cy: D. Miller, ENG-9, MS M702

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Richard Romero, HSE-8, MS K490 DATE: July 13, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-553

SUBJECT: LOG OF TEST HOLES-ACID SEWER LINE REMOVAL

The following logs were compiled as test holes were augered for samples. The locations are referenced to survey location (HSE8-84-522) east and west of initial point hole 00+00.

HOLE	DEPTH (FT.) From	To
Hole 00+60W		
Soil or fill, brown, clayey soil with a few rock fragments of tuff.	0	5
Tuff, moderately welded, reddish brown, weathered.	5	12.5
Hole 00+40W		
Soil or fill, tan, clay soil, some sand with a few rock fragments of tuff.	0	6
Tuff, moderately welded, brown, weathered.	6	12.5
Hole 00+20W		
Soil or fill, tan as above.	0	4
Tuff, moderately welded, tan to reddish brown, some weathering.	4	12.5
Hole 00+20E		
Soil or fill, tan to brown, clayey soil.	0	3
Tuff, moderately welded, tan, little or no weathering.	3	12.5

HOLE	DEPTH (FT.) From	To
Hole 00+40E		
Soil or fill, brown, clay soil, some rock fragments of tuff.	0	3
Tuff, moderately welded, gray to dark gray, little if any weathering.	3	12.5
Hole 00+60E		
Soil or fill, tan to brown, clayey soil, few rock fragments of tuff.	0	3
Tuff, moderately welded, gray to dark gray, little ir any weathering.	3	12.5

WDP:mm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592 DATE: July 13, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS/K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-554

SUBJECT: INSPECTION OF PIT 29 - AREA TA-54, JULY 6, 1984

An inspection was made of Pit-29 with reference to Guidelines (H7-80-660) issued for construction and use of solid waste pits in TA-54 on Mesita del Buey.

The pit is dug into Unit-2B of the Tshirege Member of the Bandelier Tuff. The Unit consists of two ashflows. The contact occurs at about the elevation of 6700 feet. The contact is shown by an increase in the amount and size of dark devetrified pumice fragments in the top of the lower ash flow. The contact is near horizontal, though in places the contact becomes indistinct. The tuff in both ashflows is a moderately welded tuff, consisting of quartz and sanidine crystals and crystal fragments with a few small rock fragments of gray rhyolite, latite, and pumice in a gray ash matrix. It also contains a few dark gray devitrified pumice fragments.

The pit is unique as it was constructed with a vehicle access ramp in the northwest corner. By constructing in this manner the ramps were excavated at a steeper grade thus allowing more waste to be accommodated in the pit. The deepest portion of the pit is about 46 feet at the center line of marker 2+50. To reduce the chance of rock falls or slabs of tuff dislodging from the sides of the pit, two benches were constructed in the walls of the long dimension. Also, the walls are also slightly sloped to the center of the pit. In general, the maximum dimensions of the pit are about 200 feet long, 80 feet wide at surface and 40 feet wide at base.

The walls of the pit contain numerous joints, on the average of one master joint for about 6 to 8 feet of wall length. The joints range from open as much as 2 inches to closed. On close inspection of the open joints, especially the large openings, it was determined that these openings were caused construction. The nature of the joints, were no different than noted in inspection of other pits in the area. Joints opening in the floor of the pit have been filled with crushed tuff during construction. Runoff into the pit have aided in distributing the tuff in open joints, insuring a good seal. Surface drainage should be diverted from the pit.

We have documented the walls of the pits in photographs taken by IS-7. When a set of the "as built" drawing of the pit is complete, we would like a set.

As the inspection indicated, the pit meet the "guidelines", and can be used for disposal of solid wastes.

WDP:mm

Cy: J. Warren, HSE-7, MS E516
K. Balo, HSE-7, MS E516

Los Alamos

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Los Alamos, New Mexico 87545

memorandum

TO: R. L. Riedel, ENG-2, MS M984 DATE: July 18, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-569

SUBJECT: TEST BORING FOR TA-46, ADDITION TO BUILDING W-158 AND TA-55, ADDITION TO BUILDING PF-7

ADDITION TO BUILDING W-158

Two test borings were made at locations 1 and 4 (adjacent to existing building), as were unable to position the rig over the other two locations on the sides of the bunkers.

TEST HOLE 1	DEPTH (FT.) From	To
Fill, brown, silty clayey, sand, with a few small rock fragments, moisture est. at 10% to 15%.	0	6
Tuff, light pinkish gray, moderately welded, quartz and sanidine crystals, and crystal fragments and a few rock fragments of gray rhyolite, some moisture (est. less than 10%).	6	18
Tuff, gray, moderately welded (as described above.	18	22

TEST HOLE 4		
Fill, brown, silty clayey sand (as described in TH-1).	0	5
Tuff, light pinkish gray, moderately welded (as described in TH-1).	5	12

The foundation for the new building should be set onto the tuff.

ADDITION TO BUILDING PF-7

Two test borings, west and east, were augered north of Building PF-7.

LOG OF TEST HOLES WEST AND EAST	DEPTH (FT.) From	To
Asphalt	0	≈1
Tuff, light brown, moderately welded, badly weathered, moisture ≈ 10% by vol. contained excessive moisture 15% to 20% at depth 5 to 7 feet, tuff appears sandy in cutting consisting mostly of quartz crystals and crystal fragments, a few small rock fragments of dark gray rhyolite and latite in a brown weathered ash matrix.	1	7
Tuff, light pinkish gray, moderately welded, some weathering, consists of quartz and sanidine crystals and crystal fragments, a few small rock fragments of dark gray rhyolite and latite, moisture content est. at less than 10%.	7	18

Lithologic log of both test holes were the same.

It appears from nearby excavation that the upper section of tuff 1 to 5 feet maybe a competent rock in which the footing may be set. The excessive moisture at depths of 5 to 7 feet may reduce the bearing capacity of the overlying tuff somewhat.

WDP:mm

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memorandum

TO: E. J. Roth, ENG-2, MS M984 DATE: July 18, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-570

SUBJECT: TEST BORINGS TA-55, GUARD TOWER INSTALLATION

Two test borings were augered near the northwest and southwest corners of the security fence of TA-55.

NORTHWEST CORNER	DEPTH (FT.) From	To
Fill or tuff, badly weathered, excessive moisture, quartz and sanidine crystals and crystal fragments, rock fragments of dark gray rhyolite; 0-5 ft. light gray; 5-11 ft. brown, excessive moisture est. 15-20%, 9 to 11 ft.; 11-19 dark gray, est, moisture 10 to 15%.	0	19
Tuff, light gray, moderately welded, quartz and sanidine crystals and crystal fragments, few small rock fragments of dark gray rhyolite in a light gray matrix of ash (moisture est. varies with depth but less than 10%).	19	37
SOUTHWEST CORNER		
Soil or fill brown, clayey soil.	0	4
Tuff, light gray moderately welded (as described above). Moisture 4 to 9 ft. est. at less than 10%; 9 to 10 ft. about 15%; 10-18 ft. less than 10%.	4	18

Foundation should probably be into the tuff (19 ft. NW corner, 4 ft. SW corner). Moderately welded tuff has a safe bearing capacity of about 5000 lb./sq. ft.

WDP:mm

Cy: M. Smith, Zia EFED, MS A199
HSE-DO, MS P228
CRM-4 (2), MS A150

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Los Alamos, New Mexico 87545

memorandum

TO: Joe C. Skalski, Jr., ESS-4, MS J979 DATE: August 2, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-638

SUBJECT: TEST BORINGS AT POND GT-2 and EE-1

The subsurface investigation at Ponds GT-2 and EE-1 were requested by Joe Skalski, ESS-4.

A. Pond GT-2

The dam at Pond GT-2 is scheduled for demolition and the pond area for cleanup and restoration if no further drilling is scheduled for GT-2. Should further drilling be scheduled the pond will be repaired and used for drilling fluids. Four test holes were drilled adjacent to and in the remaining eastern section of the dam (dam has been breached in order to help dry out pond sediments) to determine physical characteristics of fill and depth to compentent rock. Logs of the test holes were prepared as the holes were drilled. Moisture contents were estimated from cuttings, i.e., <20% moisture indicates depth section logged could have a maximum moisture content of as much as 20%. Approximate locations of test holes are shown on sketch of Figure 1.

TH-1 (Below Dam)	Depth (Ft.) From	To
Fill, silty, sand, some gravel brown (<10% moisture).	0	4
Fill, silty sand, some gravel contains organic natural, dark brown to black (<20% moisture).	4	5
Fill, silty sand, some gravel brown (<20% moisture).	5	9
Tuff, light grayish brown, moderately welded (<10% moisture).	9	17

NOTE: Hole uncased, open 14 ft., also dry 3 hours after drilled.

	Depth (Ft.)	
TH-2 (Adjacent and Below Dam		
Fill, silty sand, some gravel, brown (<10% moisture).	0	3
Fill, silty sand, some gravel, contains organic material, dark brown to black (<20% moisture).	3	7
Fill, silty sand, some gravel, brown (10-15% moisture).	7	9
Tuff, light grayish brown, moderately welded (<10% moisture).	9	17

NOTE: Hole uncased, open 15 ft. also dry 3 hrs. after drilled.

TH-3 (Top of Dam West)		
Fill, silty sand, some gravel, brown (<10% moisture).	0	3
Fill, silty sand, some gravel contains organic material, dark gray to black (<20%-10% moisture).	3	11
Tuff, dark gray, moderately welded (≈ 10% moisture).	11	17

NOTE: Hole uncased, open 15 ft. also dry 3 hrs. after drilled.

TH-4 (Top of Dam East)		
Fill, silty sand some gravel, brown (≈ 10% moisture).	0	3
Fill, silty sand, some gravel, organic material (≈ 15% moisture).	3	4
Tuff, dark gray, moderately welded (<10% moisture).	4	17

NOTE: Hole uncased, open 14 ft. also dry 3 hrs. after drilled.

The fill material overlying the tuff, dark gray to black contains some organic material from seepage of water from the pond. The moisture content at the fill tuff contact is about 20% by volume; but, apparently does not contain any free water. The tuff at depth logged in from the holes is a competent rock, capable of supporting heavy equipment.

B. Pond EE-1

Three test holes were drilled and cased with 2-inch plastic pipe in the southwest corner of the berm Pond EE-1. The holes were drilled to evaluate the competency of the berm and provide a method to monitor seepage through the berm. The berm in this area is about 10 ft. wide at the top and stands 10 to 15 ft. above the land surface outside the berm. The lower 8 ft. of the plastic casing is perforated with 1/4 inch holes. The annulus around the casing and hole were filled with gravel to about 2 ft. of land surface. The upper two ft. were sealed with compacted silty sand. Logs of the holes were prepared as they were drilled. Approximate locations of the holes are shown on sketch of Figure 2.

HOLE 1	Depth (Ft.) From	To
Fill, silty sand, light brown, (<10% moisture).	0	7
Fill, silty sand, brown, (<15% moisture).	7	10
Fill, silty sand, dark brown (<20% moisture).	10	15
Tuff, light brown to tan, moderately welded (<15% moisture).	15	20

NOTE: Hole cased with 20 ft. of pipe which extends 2 ft. above LSD water level in hole 17.5 ft. top casing 1 hr. after completion.

HOLE 2	Depth (Ft.) From	To
Fill, silty sand, light brown (≈ 10% moisture).	0	9
Fill, silty sand, brown (<20% moisture).	9	16
Tuff, light brown, moderately welded.	16	22

NOTE: Hole cased with 20 ft. pipe which extends 1.5 ft. above LSD. Hole dry 1 hr. after completion.

HOLE 3	Depth (Ft.) From	To
Fill, silty sand, light brown (≈ 10% moisture).	0	11
Fill, silty sand, dark brown (<20% moisture).	11	14
Tuff, light brown to tan, moderately welded (≈ 10% moisture).	14	17

NOTE: Hole cased with 18.6 ft. of pipe which extends 2 ft. above LSD. Hole dry 1 hr. after completion.

The fill in the berm of Pond EE-1 is a silty sand with some gravel. The three holes were drilled through the fill material into the top of the tuff. Hole 1 encountered some free water, apparently seepage at the contact at the base of the fill and on top of the tuff. The other two holes were dry one hour after they were completed. The fill in the berm is stable and should cause no trouble when the pond is filled. However, when the pond is filled water levels in the holes should be monitored and the base of the berm outside the pond inspected frequently to determine if excess free water is building up in the fill that could cause failure.

WDP:mm

Cy; Bob Hendron, ESS-4, MS J979

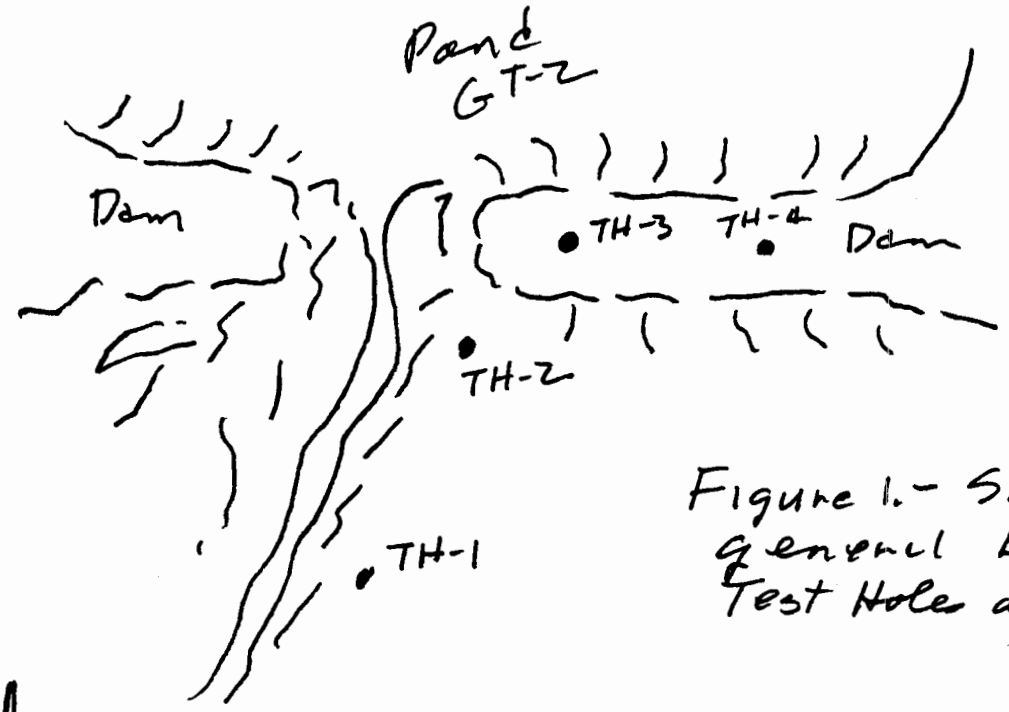

Figure 1.- Sketch showing general Location of Test Holes at Pond GT-2

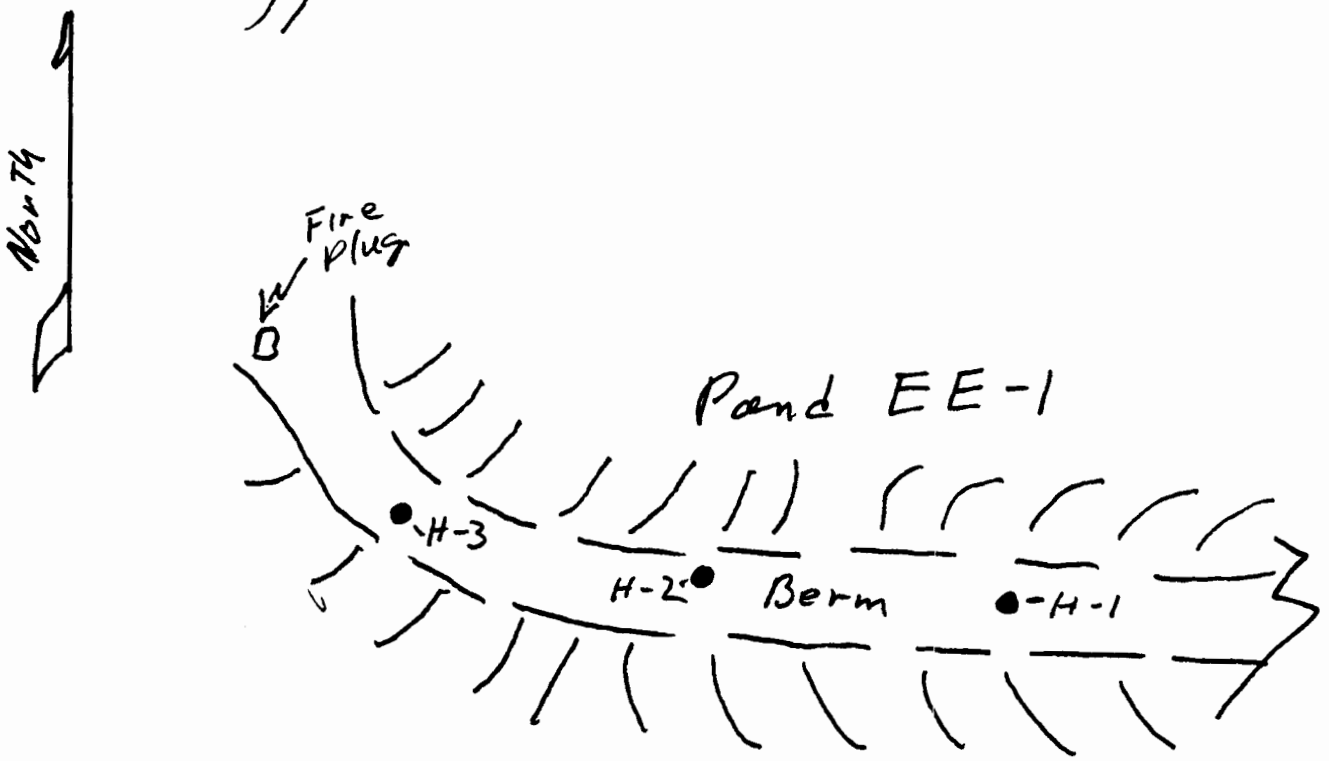

Figure 2.- Sketch showing general Locations of Holes at Pond EE-1

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Los Alamos, New Mexico 87545

memorandum

TO: Dean Keller, ENG-9, MS M702 DATE: September 10, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 TOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-767

SUBJECT: TEST BORINGS, ROAD REALIGNMENT NEAR TA-55

Three test holes were drilled west of the three proposed retaining structures to determine the physical characteristics of the tuff.

TEST HOLE 1	DEPTH (ft.) From	To
Near Station 24+00		
Tuff, light gray, densely to moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of latite or rhyolite in an ash matrix.	0	17
Tuff, light tan, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of latite and gray rhyolite in an ash matrix; slight increase in quartz crystals at about 37 ft.	17	52

TEST HOLE 2		
Near Station 33+50		
Tuff, light pinkish, moderately welded tuff, quartz and sanidine crystals and sanidine crystals and crystal fragments, a few small rock fragments in an ash matrix.	0	16
Tuff, tan, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments in an ash matrix, increase in quartz crystals at 42 ft.	16	52

TEST HOLE 3	DEPTH (ft.) From	To
Near Station 39+50		
Tuff, gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of latite and rhyolite in an ash matrix.	0	19
Tuff, tan, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments in an ash matrix.	19	52

Tuff penetrated by the test holes is very similar in lithology and degree of welding but probably represents two and probably three ash flow 0 to ≈ 17 ft., ≈ 17 to ≈ 40 ft., and ≈ 40 ft. to 52 ft. It is a moderately welded tuff with a safe bearing capacity of about 5000 lbs./sq. ft. If you have further questions please feel free to contact me.

WDP:mm

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO Wayne R. Hansen, HSE-8 Group Leader, MS K490 DATE September 19, 1984

FROM W. Purtymun, N. Becker, M. Maes; HSE-8 MAIL STOP/TELEPHONE K490/7-0810

SYMBOL HSE8-84-812

SUBJECT PROPOSED GEOHYDROLOGIC ENVIRONMENTAL INVESTIGATION AND ESTABLISHMENT OF A GEOHYDROLOGIC MONITORING SYSTEM AT AREA L, TA-54

A preliminary investigation is to be undertaken at Area L (Chemical Waste Disposal Area) to: 1) determine the hydrologic characteristics of the tuff, 2) to determine if migration of chemicals or oils out from existing pits or shafts has occurred, 3) establish a system to monitor for possible infiltration of moisture which could cause potential transport of oil or chemicals, and 4) establishing observation wells in the adjacent canyons.

The method of study includes the drilling and sampling of three core holes. Drilling and construction of five moisture access holes for use with the neutron-moisture logger will also be accomplished.

Core Holes

Three core holes are to be drilled in Area L. Locations are: 1) adjacent to seepage pit B (liquid lithium hydroxide release), 2) adjacent to shaft 12 (oil in drums), and 3) adjacent to shaft 24 (vermiculite-oil mixture in drums). Holes are to be drilled using a hollow stem auger to a depth of about 100 ft. Drive split spoon or auger cores will be collected at about a 10 ft. interval. Upon completion of drilling and sampling, the holes will be used to determine if vapor migration (vapor from organic compounds) of organics from the shafts or pits exists in the tuff. Samples will be collected by pumping air from the holes or through the use of packers to pump air from selected depths within the holes. The methods employed will depend on results of analyses of cores.

Analyses of Cores

Cores are to be analyzed to determine if migration of chemicals or oils has occurred. Initial core analyses will be determined as described

below; however, unused portions of the cores will be retained if further analyses are necessary.

1. Moisture content shall be determined of all cores.

2. Cores taken from near the seepage pit will be analyzed for Li, Cr, Cu, NH_4F_2, F, and TDS (Total Dissolved Solids).

3. Cores taken near shafts will be analyzed for total organic carbon.

4. A special set of cores will be collected outside of Area L and analyzed for the above constituents or compounds to provide background for comparison of analyses from within Area L.

Moisture Monitoring

Five moisture acess holes will be constructed (four within Area L and one on the mesa outside the area) to measure the distribution and possible movement of moisture in the tuff. The depth of holes will be determined from the moisture analyses of cuttings and the core hole samples. Holes will be constructed using a 3-inch auger and cased with aluminum tubing to provide a monitoring capability with the neutron-moisture equipment. Cuttings from these holes will be collected over a 5 ft. interval and the moisture content will be determined.

Observation Wells in the Adjacent Canyons

Six observation wells will be constructed, three in Pajarito Canyon and three in Canada del Buey. In each canyon, there will be one well upgradient from Area L, one opposite L, and one below Area G. These will be completed down to the alluvium-bedrock contact, and will be cased with 4 in. PVC casing which is perforated in the bottom 8-ft. section. These wells will become part of the monitoring system for the disposal areas on Mesita del Buey.

The proposed program will take about six weeks to complete the drilling and construction phase. It will require about three people full time. Cost for chemical analyses will be kept to minimun as described. Data analyses and report preparation can be sandwiched within the program. Routine monitoring of moisture distribution should not take more than one day a month for the first year.

WP:NB:MM:mm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Harry Patterson, HSE-7, MS E516

DATE: September 19, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-84-813

SUBJECT: SHAFT 32, AREA L, TA-54

Completion of shaft 32 (pilot hole 4 ft. diameter ≈ 15 ft. deep) was terminated due to construction problems. A large fracture in the northwest wall caused the hole to drift 1.5 to 2 ft. to the northwest at a depth of about 15 ft. Due to the fracture and drift, it was concluded that standard shaft reamed to a 6 ft. diameter, 65 ft. deep could not be completed.

The existing shaft 32 (≈ 15 ft. deep) should be used for disposal and sealed to prevent infiltration of precipitation into the tuff.

WDP:mm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Price Feron, ENG-2, MS M984 DATE: September 20, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 MAILSTOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-814

SUBJECT: TEST BORINGS, KRYPTON FLUORIDE PROJECT, PHASE C, L.J. 7272-35

The area designated for locations of the test holes was almost inaccessible for the rig due to temporary buildings and trailers. We were able to complete three holes in the general area. The designations are from west to east, locations are known to Paul Kleinen (RKE) who was at the site when the holes were drilled. The holes are located on the northern edge of the mesa, with Hole 1 located northeast of Building 183.

	DEPTH (FT.) From	To
HOLE 1		
Fill, brown, silty clay with rock fragments of tuff, some small rock fragments of rhyolite.	0	3
Tuff, light gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of rhyolite in ash matrix.	3	10
HOLE 2		
Fill, brown (as above).	0	3
Tuff, light gray to light brown (as above).	3	17
HOLE 3		
Fill, brown (as above).	0	7
Tuff, light gray to light brown (as above).	7	17

The fill material is not compacted, contains some moisture (about 10% to 12% by volume). The tuff is a moderately welded tuff and should have a safe bearing capacity of 5000 lb/sq. ft. Paul indicated that additional holes would be requested when temporary buildings and trailers are moved out of the way.

WDP:mm

Cy: Paul Kleinen, (RKE), MS M703

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: P. C. Hunt, ENG-2, MS M984 DATE: October 10, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 MAILSTOP/TELEPHONE: K490/7-0810
JC Henderson, Acting GL, 10/10/84

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-891

SUBJECT: ADVANCE LASER ADDITION, BLDG. TSL-128, TA-35, LJ 7205-35; TEST BORINGS

Five test holes were drilled west of Bldg. TSL-128 as requested.

	DEPTH (FT.) From	To
HOLE 1		
Asphalt and fill.	0	1
Tuff, light tan to gray, moderately welded, quartz and sanidine crystals and crystal fragments, small rock fragments of dark gray latite in gray ash matrix.	1	12
HOLE 2		
Fill, brown, sandy.	0	1
Tuff, light gray to tan moderately welded (as above).	1	12
HOLE 3		
Asphalt, fill and soil, brown to dark brown, silty, clayey, few rock fragments.	0	8
Tuff, light gray to tan moderately welded (as above).	8	13

HOLE 4	DEPTH (FT.) From	To
Asphalt, fill, and soil (as above).	0	2
Tuff, light gray to tan moderately welded (as above).	2	13

HOLE 5		
Asphalt, fill, and soil (as above).	0	7
Tuff, light gray to tan, moderately welded (as above).	7	13

Foundation should be set into tuff. The tuff is a moderately welded, moisture content estimate 8-10% by volume, safe bearing capacity of about 5000 lb/ft^2.

WDP:mm

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Los Alamos, New Mexico 87545

memorandum

TO: D. Romero, ENG-2, MS M984 DATE: October 10, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 STOP/TELEPHONE: K490/7-0810
J.C. Tunderson, Acting GL, 10/10/84

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-889

SUBJECT: CEMENT STORAGE AND HANDLING SYSTEM, TA-55, LJ 7703-55, TEST BORINGS

The test boring was made as you requested.

	DEPTH (FT.) From	To
Fill, dark brown to brown, mainly silt and clay, some sand not compacted, moisture content (water and organic) ≈10 to 15%.	0	18
Tuff, light gray, moderately welded, quartz and sanidine crystals and fragments, some rock fragments of dark gray latite in gray ash matrix.	18	22

The fill material contains organic fluids which gave off explosive vapors in the cutting and open hole. Test indicated a variety of organics present. Prior to any excavation in the area, HSE-5 should be contacted (Leroy Garcia, reference Reg. #3897, Data Sheet 84-224).

The foundation should be set into the tuff unless the fill is reworked and compacted. The tuff is a moderately welded tuff with a bearing capacity of about 5000 lb/ft^2.

WDP:mm

Cy: Tom Keenan, MST-12, MS E501
Leroy Garcia, HSE-5, MS K486

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592 DATE: October 11, 1984

THRU: Wayne R. Hansen, HSE-8 Group Leader, MS K490 MAILSTOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-901

SUBJECT: SHAFT INSPECTION

Shafts 126, 127, and 128 were inspected on October 11, 1984 and meet criteria for disposal of solid wastes as set forth in guidelines of December 10, 1980 (Memo H-7-80-660).

The shafts are straight, 6 ft. in diameter and about 65 ft. deep. The shafts penetrated three ashflow units. The upper contact between Units 2B and 2A occur at a depth of about 12 ft. Both ashflows are a moderately welded tuff. The lower contact between Units 2A and 1B occurs at a depth of about 53 ft. Unit 1B is a nonwelded tuff. The few fractures or joints in the wall of the shaft are of no consequence. The shafts are suitable for disposal of solid wastes.

WDP:mm

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Dean Miller, ENG-9, MS M702 DATE: October 18, 1984

THRU: Alan K. Stoker, HSE-8 Acting Group Leader MS K490 TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-932

SUBJECT: SOIL BORINGS AND SUBSURFACE INVESTIGATIONS, TA-16

Four (4) test borings were made northwest of TA-16 on October 16, 1984 as you requested (ENG-9-763-84). The holes penetrate soil and badly weathered tuff. They are numbered clockwise from the southwest corner of the proposed building to northeast corner.

HOLE 1	DEPTH (FT.) From	To
Soil, silty loam, brown to dark brown, some small rock fragments.	0	9
Tuff, tan to light brown, weathered into silt, clay with a few small rock fragments, moisture content exceedingly high in places, up to an estimated 20-25% by volume.	9	22
HOLE 2		
Soil (as above).	0	5
Pumice, light gray, appears saturated.	5	8
Tuff, tan to light brown weathered to silt and clay exceedingly wet, estimate 20 to 25% by volume.	8	22

HOLE 3	DEPTH (FT.) From	To
Soil (as above).	0	9
Tuff, tan to light brown weathered to silt and clay.	9	16

HOLE 4		
Soil (as above).	0	10
Tuff, tan to light brown, weathered to silt and clay.	10	22

Soil and tuff has weathered in place with the contact between the soil and tuff not clearly defined. The tuff has weathered to silt and clay with a few small rock fragments. The weathered tuff in the two holes next to the fence contained a high moisture content (estimated 20-25% by volume). The weathered tuff in the two holes farthest from the fence was a little dry with the moisture content of silt and clay ranging from 15 to 20% by volume.

Pumice layer was encountered in Hole 2 between soil and tuff. Pumice appears saturated, many contain free water. The pumice is El Cajete Member of Valles Rhyolite which is found along the western edge of the Pajarito Plateau adjacent to the lower flank of the mountain.

The soil is a silty loam. The soil moisture varies from an estimated 10 to 20% by volume.

I have no recommendation for the bearing capacities or foundation due to the thick section of unconsolidated material, silt and clay, and excessive moisture content. I would look at foundation design of the new building that was constructed south of the proposed building site. I am sure they encountered similar geologic units and conditions.

WP:mm

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: E. J. Hoth, ENG-2, MS M984 DATE: October 29, 1984

THRU: Alan K. Stoker, HSE-8 Acting Group Leader MS K490 TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-960

SUBJECT: SUBSURFACE INVESTIGATION - SECURITY ENHANCEMENTS, TOWER INSTALLATIONS TA-18, L. J. 7847-18

Three test holes were drilled at TA-18 as you requested on October 22, 1984 (ENG-2-84-995). The test holes are numbered in sequence of drilling. Test Hole 1 near Kiva No. 2, Test Hole 2 near junction of road to Kiva No. 2 and Kiva No. 3 and Test Hole 3 near Kiva No. 1.

TEST HOLE 1	DEPTH (FT.) From	To
Soil, dark brown, sandy	0	3
Alluvium, brown, mainly sand, with a minor amount of gravels, unconsolidated, contains water perched on underlying tuff from 9 to 14 ft.	3	14
Tuff, light tan, containing quartz and sanidine fragments, a few small rock fragments in a matrix weathered to sand, silt, and clay (extremely wet from overlying perched water).	14	28

TEST HOLE 2		
Soil, dark brown, sandy	0	2
Alluvium, brown, (as in Test Hole 1) contains water perched on underlying tuff from 8 to 12 ft.	2	12
Tuff, light tan, weathered (as in Test Hole 1).	12	23

TEST HOLE 3	DEPTH (FT.) From	To
Soil, dark brown sand and gravel	0	2
Alluvium, brown gravel, pebbles, cobbles and probably some boulders in a matrix of silt, clay, and sand, contains water perched on underlying tuff from 13 to 18 ft.	2	18
Tuff, tan, weathered (as in Test Hole 1).	18	32

Water was encountered in all the test holes perched in alluvium and on the underlying tuff. As typical of water in alluvium in canyons on the Pajarito Plateau, the water table is highest during the spring from snowmelt and in later summer from showers.

The alluvium in test holes 1 and 2 is derived from weathering and erosion of the tuff, thus is mainly sand. The alluvium in test hole 3 is derived from weathering and erosion of the tuff and volcanic rocks (latite and rhyolites) that form the flanks of the mountains to the west. It is made up of rock fragments, gravels to cobbles in a matrix of sand, silt and clay.

WDP:mm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Harry Patterson, HSE-7, MS E516 DATE: November 19, 1984

THRU: Thomas C. Gunderson, HSE-8 Acting Group Leader MAIL STOP/TELEPHONE: K490/7-0810
TC Gunderson

FROM: W. D. Purtymun, HSE-8 WDP SYMBOL: HSE8-84-1047

SUBJECT: SUBJECT INSPECTION OF SHAFT 33, AREA L, TA-54

Please disregard Memorandum HSE8-84-902, dated October 11, 1984. The shaft inspected was shaft 33 instead of shaft 32.

Shaft 33 was inspected on October 11, 1984. The shaft is 6 ft. in diameter and about 65 ft. deep. The shaft is not straight but drifts to the north about 2 ft. at a depth of 65 ft.

The shaft penetrated two ashflow units of rhyolite tuff. The upper Unit 2A and lower Unit 2B are moderately welded tuff. The contact between the two units occur at a depth of about 25 to 27 ft. There several blocks of tuff pull from the southeast wall of the shaft along a near vertical joint at a depth from 18 to 35 ft. Remainder of the shaft walls are fairly smooth, with only a few joints encountered.

The shaft is suitable for disposal of packaged organic wastes.

WDP:mm

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: D. Gutierrez, ENG-2, MS M984 DATE: November 19, 1984

THRU: Tom Gunderson, Acting Group Leader MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-84-1041

SUBJECT: TEST BORINGS, PREFABRICATED OFFICE BUILDING, BUILDING RC-33, TA-48; L.J. 7318-48, PHASE B

Two test borings at TA-48 were completed as you requested in ENG-2-84-1049.

TEST HOLE 1	DEPTH (FT.) From	To
(Near Building) Fill, brown, a few small rock fragments of latite and rhyolite in a matrix of clay, silt and sand (reworked and weathered tuff), unconsolidated.	0	5
Tuff, dark gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of rhyolite and latite in a dark gray ash matrix, some excess moisture estimated to range from 8 to 10% by volume.	5	12
TEST HOLE 2		
Fill, brown (as above).	0	6
Tuff, dark gray, moderately welded (as above).	6	13

Fill overlying tuff is unconsolidated and not suitable to complete a foundation in to unless compacted. The moderately welded tuff has a safe bearing capacity of about 5000 lbs/sq ft. The test borings encountered no anomalies in the tuff that would effect foundation design.

WDP:mm

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memorandum

TO: Dan Miles, ESS-1, MS J979 DATE: January 15, 1985

THRU: Tom Gunderson, HSE-8 Acting Group Leader, MS K490 TELEPHONE: K490/0810

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-85-48

SUBJECT: EVAPORATION AND ESTIMATED INFILTRATION FROM PONDS AT FENTON HILL, 1984

In 1984 pond GT-1 (upper pond) was full having an approximate surface area of 11,100 ft^2, annual evaporation 48 inches, resulting in evaporation loss about 340,000 gal.

Pond GT-3 contained water seven months (Jan-July 63%, Technical Report 31 NMSE). The surface area of the pond is 6,500 ft^2, seven months evaporation, 30 inches resulting about 123,000 gal evaporation.

EVAPORATION

Pont GT-1	12 months	340,000 gal
Pont GT-3	7 months	123,000 gal
1984 TOTAL EVAPORATION ≈		463,000 gal

Annual infiltration loss (1,400,000 gal) is based on pond areas and precentage of pond area to annual infiltration loss reported in LA-8217-PR.

Pond GT-1	11,200 ft^2	55%
Pond GT-2	2,800 Ft^2	14%[a]
Pond GT-3	6,500 ft^2	31%
	20,500 ft^2	

[a] Destroyed and filled about 1980.

Pond GT-1 0.55 x 1,400,000 gal = annual infiltration of 777,000 gal

Pond GT-3 0.31 x 1,400,000 gal = annual infiltration of 434,000 or for 7 months = 253,000 gal

INFILTRATION

GT-1	12 months	777,000 gal
GT-3	7 months	253,000 gal
1984 Total Infiltration ≈		1,030,000 gal

WDP:mm

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Los Alamos, New Mexico 87545

memorandum

TO: P. C. Hunt, ENG-2, MS M984 DATE: February 12, 1985

THRU: A. K. Stoker, HSE-8 Deputy Group Leader, MAIL STOP/TELEPHONE: K490/7-0813

FROM: W. D. Purtymun, HSE-8 SYMBOL: HSE8-85-140

SUBJECT: **TEST BORINGS, FOURIER TRANSFORM SPECTROMETER FACILITY, BUILDING WA-200, TA-46; L.J. 7552-46**

Seven test borings at TA-46 were completed as you requested in ENG2-85-87. Test hole TH-7 was not drilled as access with the drill rig was not possible.

	DEPTH (FT.) From	To
Test Hole TH-1		
Soil, brown, clayey with some gravel	0	4
Soil, brown, clayey, wet	4	6
Tuff, light gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of dark gray rhyolite in gray ash matrix	6	13
Test Hole TH-2		
Soil, brown, clayey with some gravel, wet (15 to 25% by volume) at base	0	4
Tuff, light gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of dark gray rhyolite in gray ash matrix	4	13
Test Hole TH-3		
Soil, brown (as above)	0	4
Tuff, light gray, moderately welded (as above)	4	12

	DEPTH (FT.) From	To
Test Hole TH-4		
Soil, brown (as above)	0	4
Tuff, light gray, moderately welded (as above)	4	13
Test Hole TH-5		
Soil, brown (as above)	0	6
Tuff, light gray, moderately welded (as above)	6	13
Test Hole TH-6		
Soil, brown (as above)	0	3
Tuff, light gray, moderately welded (as above)	3	13
Test Hole TH-7		
(Not drilled)		
Test Hole TH-8		
Soil, brown (as above)	0	3
Tuff, light gray, moderately welded (as above)	3	13

There was an excess of moisture (est. 15 to 25% by volume) in the base of the soil overlying the tuff. This is a seasonal effect with the soil drying out in the late spring and summer and becoming wet again in late fall, winter, and early spring. Unless the soil is compacted and drained, the foundations should be completed into the tuff. The moderately welded tuff has a safe bearing capacity of about 5000 lbs/sq ft. The test borings encountered no anomalies in the tuff that would effect foundation design.

WDP:mm

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memorandum

TO: E. J. Hoth, ENG-2, MS M984 DATE: March 6, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-85-216

SUBJECT: **TEST BORINGS - SAFEGUARDS AND SECURITY UPGRADES: GUARDPOST INSTALLATION, SM-29, TA-3; POWER AND LIGHTING TA-41 and TA-18**

TEST HOLES TA-3	DEPTH (FT.) From	To
Test Hole 1		
Soil, brown, clayey, silty, sandy, moisture content est. 15 to 20% by volume (wet), very plastic.	0	3.5
Tuff, light brown, moderately welded.	3.5	7
Test Hole 2		
Soil, brown, clayey silty with some sand, moisture content est. 15-20% by volume (wet) very plastic.	0	3
Tuff, light pinkish, gray, moderately welded.	3	5

Soil is plastic when wet, should make allowances for even small loads. Tuff was dry with a safe baring capacity of 5000 lbs/ft^2.

TEST HOLES TA-41		
Test Hole 3		
Sand and gravels mixed with silt and clay, moisture 10-15% by volume.	0	15

Sand and gravels are apparently fill material places adjacent to buildings to north. Compaction should allow foundations for light loads.

TEST HOLES TA-18	DEPTH (FT). From	To
Test Hole 4 (Near Bldg. PL-1		
Soil, brown, clayey silty, with some sand, moisture content range 10 to 20% by volume, plastic in places.	0	15
Test Hole 5 (Near Bldg. PL-31		
Asphalt	0	0.5
Sand and gravels, mixed with some silts and clay.	0.5	13
Test Hole 6 (Near West of Guard Station		
Sand and gravels, mixed with some silt and clay	0	14

No water was encountered in the test holes. Sand and gravels compacted should bear light loads. Soil in Test Hole 4 plastic in places should receive special consideration even for light loads.

WDP:mm

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Los Alamos, New Mexico 87545

memorandum

TO: Harry Patterson, HSE-7, MS E516 DATE: March 6, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-85-215

SUBJECT: **INSPECTION OF SHAFT 34, AREA L, TA-54**

Shaft 34 was inspected on March 4, 1985. The shaft is 6 ft in diameter and about 63 ft deep. The shaft drifts to the north about 2 ft at a depth of 63 ft.

The shaft penetrated two ashflow units of rhyolite tuff. Both units 2A and 2B are moderately welded tuffs. The contact between the ashflow occurs at a depth of about 25 to 27 ft. There are several blocks of tuff out of the north and northeast wall of the shaft from a depth of about 10 to 34 ft. These blocks were pulled loose from a series of near vertical east-west and southwest-northeast trending joints in the north and northeast walls of the shaft. One east-west joint with a dip of about 45 degrees to the south cuts the south wall of the shaft at about 22 ft. The rising west limb of the joint contains a large open joint (22 to 18 ft). The joint open 2 to 6 inches for 3 to 4 ft is formed by construction where the auger has pulled a block of tuff loose along the joint. The wall in the lower part of the shaft 34 to 63 ft contains few if any joints.

The shaft is suitable for disposal of packaged organic wastes; however, crushed tuff should be used to fill the voids between each lift of barrels as they are placed in the shaft. This will result in a better envelope of tuff between the barrels and shaft walls.

WDP:mm

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Los Alamos, New Mexico 87545

memorandum

TO: David Trujillo, Eng-9, MS-M984 DATE: April 9, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS-K490 MAILSTOP/TELEPHONE: K490/7-0810

FROM: W.D. Purtymun, HSE-8 SYMBOL: HSE8-85-375

SUBJECT: **TEST BORINGS, GEOCHEMISTRY ANALYTICAL BLDG. SM-494, TA-3, L.J. 7804-35.**

Four test borings were completed at TA-3 as you requested in Memo ENG-285-310.

	DEPTH (FT.) From	To
TEST HOLE NE CORNER		
Soil and fill, dark brown, clayey, exceeding wet down to about 6 ft., a few fragments of tuff and rhyolite rock fragments.	0	9
Reworked tuff and pumice, (water-laid) reworked tuff dark brown with small rock fragments of tuff and rhyolite, silts, sands, and gravels of the reworked tuff, some lenses of white pumice.	9	13
Tuff, dark reddish brown, moderately welded, quartz and sanidine crystals and crystal fragments, a few rock fragments in a dark brown ash matrix, tuff slightly weathered below contact with reworked tuff.	13	19
Tuff, light brown moderately welded, quartz and sanidine crystals and crystal fragments with a few rock fragments in a light brown ash matrix.	19	34

TEST HOLE SE CORNER	DEPTH (FT.) From	To
Soil or fill, dark brown, clayey, wet to about 6 ft.	0	8
Tuff, light reddish brown, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments in a fine ash matrix.	8	18
TEST HOLE NW CORNER		
Asphalt and fill, fill, brown, clayey.	0	4
Reworked tuff, reddish brown, a few small rock fragments, clayey.	4	6
Tuff, light gray, moderately welded.	6	13
TEST HOLE SW CORNER		
Soil or fill, dark brown, clayey, a few small rock fragments.	0	5
Tuff,light gray, moderately, welded.	5	13

The foundation should be set into the tuff. The moderately welded tuff underlying the soil, fill, or reworked tuff has a safe bearing capacity of about 5000 pounds per square foot. The test borings encountered no anomalies in the tuff that would effect the foundation design.

WDP:mm

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Los Alamos, New Mexico 87545

memorandum

TO: T. C. Gunderson, HSE-8, MS K490

DATE: July 9, 1985

THRU: D. D. Simes

MAIL STOP/TELEPHONE: M984/7-7302

FROM: R. E. Lucero

SYMBOL: ENG-2-85-770

SUBJECT: REQUEST FOR TEST HOLE DRILLING

Request that a test hole be drilled on the east side of building TD-91, TA-22 to determine the permeability of this area for a A.W. Pit.

R. E. Lucero
ENG-2 Engineering Studies

Taken Care of

REL/bac

Cy: W. D. Purtymun, HSE-8, MS K490
N. Mezins, MS H822
M. Davis, MS P952
W. Mangum, MS H822
ES/LJ 8063-22
ENG-2 File

Hole 1 near AWP
0 - 12 Soil
12 - 38 Tuff Wet
100' East of AWP

Hole 2
0 - 8 Soil
8 - 32 Tuff, light gray
no fracture - moderately
Welded

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Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592

DATE: August 16, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader
MS K490

MAIL STOP/TELEPHONE: K490/0810

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-85-981

SUBJECT: **INSPECTION OF SHAFTS AT TA-54, AREA G**

Shafts 128, 129, 130, 131, 132, and 133 were inspected on August 14, 1985, and met the criteria for disposal of solid wastes as set forth in guidelines of December 10, 1980 (Memo H7-80-660).

The shafts penetrated three ashflows. A contact between two ashflows of Unit 2B occurs at a depth of about 14 ft. The lower contact between Units 2B and underlying Unit 2A occurs at about 52 ft. The shafts are straight with very few fractures or joints in the shaft walls. The joints and fractures are of no consequence. The shafts are suitable for disposal of solid wastes.

WDP:mlk

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Price Feron, ENG-2 Assoc. Group Leader
MS M984

DATE: August 16, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader
MS K490

MAIL STOP/TELEPHONE: K490/0810

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-85-982

SUBJECT: **LABORATORY CONSTRUCTION, BLDG. SM-141, TA-3, L.J. 7918-3 TEST BORING**

One test hole was drilled at the location as directed by Shaski Kavde. The log of the hole is as follows:

	Depth (ft) From	To
Fill, dark gray to black, sand and gravels with a few thin lense of wet light-brown clay	0	7
Soil, light brown, clay to fine sand, wet, plastic	7	9
Tuff, light gray, quartz and sanidine crystals and crystal fragments; a few small, gray rock fragments of rhyolite or latite, moderately welded	9	15
Tuff, brick red, same as above, moderately welded	15	18

The foundations should be set into the tuff. The moderately welded tuff at a depth of 9 ft has a safe bearing capacity of about 5000 lb/sq ft. The test boring encountered no anomalies in the tuff that would effect proper foundation design.

Price, could you see that Shaski of Raymond Kaiser Engineers gets a copy of this memo? Thanks.

WDP:mlk

xc: Shashi Kavde (c/o Price Feron) MS M984

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Price Feron, ENG-2 Assoc. Group Leader, MS M984

DATE: September 3, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/0810

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-85-983

SUBJECT: **LABORATORY CONSTRUCTION, COOLING TOWER ADDITION AND UPGRADE, SM-285, TA-3**

One shallow test hole was drilled at the location as directed by Scott C. Richardson.

The log of the hole is as follows:

	Depth (ft) From	Depth (ft) To
Fill, gray, sand and gravel beneath asphalt	0	1.5
Tuff, light gray to light brown, quartz and sanidine crystals and crystal fragments, a few small rock fragments of gray rhyolite, moderately welded	1.5	8.0

The tuff has a safe bearing capacity of about 5000 lbs/sq ft. No anomolies were encountered in the tuff that would cause concern in the foundation design.

Price, could you see that Scott of Holmes and Narver, Inc. gets a copy of this memo? Thanks.

WDP:cel

xc: Scott C. Richardson (c/o Price Feron, MS M984)

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592

DATE: October 7, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8

SYMBOL: HSE8-85-1218

SUBJECT: INSPECTION OF SHAFT C-11, AREA G, TA-54

Shaft C-11 was inspected on October 3, 1985, and meets the criteria for disposal of solid wastes as set forth in guidelines of December 10, 1980 (Memo H7-80-660).

The shaft is 6 ft in diameter and 64 ft deep. The shaft is straight with a few fractures or joints in the shaft wall. One small block (about 2 ft by 3 ft) is pulled out of the west wall at about 40 ft. The contact between Unit 2B and underlying Unit 2A occur at about 40 ft.

The shaft is suitable for disposal of solid wastes.

WDP:brm

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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Chris Sanchez, ENG-2, MS M984

DATE: October 16, 1985

THRU: Thomas C. Gunderson, HSE-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8

SYMBOL: HSE8-85-1213

SUBJECT: TEST HOLES, BLDG. SM-200 TA-3; L.J. N7954-3

Nine test holes were drilled at or adjacent to location shown on Figure 1 as requested in Eng-2-85-1085.

The logs of the holes are as follows:

	Depth (ft) From	To
Test Hole 1		
Fill, dark gray to brown, sands and gravels with lots of silts and clay; extremely wet (15-25% moisture by volume) above contact with underlying tuff.	0	3
Tuff, light brownish gray, quartz and sanidine crystals and crystal fragments, a few small rock fragments of gray rhyolite and dark gray pumice in an ash matrix; moderately welded.	3	8
Test Hole 2		
Fill, dark gray to brown as described in Test Hole 1.	0	4
Tuff, light reddish brown, a few quartz and sanidine crystals and crystal fragments, a few small rock fragments of latite and pumice in an ash matrix; moderately welded.	4	8
Tuff, light brownish gray as described in Test Hole 1.	8	13

<u>Test Hole 3</u>		
Fill, dark gray to brown as in Test Hole 1.	0	6
Tuff, light brownish gray as in Test Hole 1.	6	13
<u>Test Hole 4</u>		
Fill, dark gray to brown as in Test Hole 1.	0	4
Tuff, light brownish gray as in Test Hole 1.	4	8
<u>Test Hole 5</u>		
Fill, dark gray to brown as in Test Hole 1.	0	7
Tuff, light brownish gray as in Test Hole 1.	7	13
<u>Test Hole 6</u>		
Fill, dark gray to brown as in Test Hole 1.	0	5
Tuff, light brownish gray as in Test Hole 1.	5	8
<u>Test Hole 7</u>		
Fill, dark gray to brown as in Test Hole 1.	0	7
Tuff, light brownish gray as in Test Hole 1.	7	13
<u>Test Hole 8</u>		
Fill, dark gray to brown as in Test Hole 1.	0	8
Tuff, light brownish gray as in Test Hole 1.	8	13
<u>Test Hole 9</u>		
Fill, dark gray to brown as in Test Hole 1.	0	8
Tuff, light brownish gray as in Test Hole 1.	8	13

The foundations should be set into the tuff. The moderately welded tuff has a safe bearing capacity of about 5,000 lb/sq ft. The test borings encountered no anomalies in the tuff that would effect the proper foundation design.

WDP:brm

Enclosure: Figure 1 (Map)

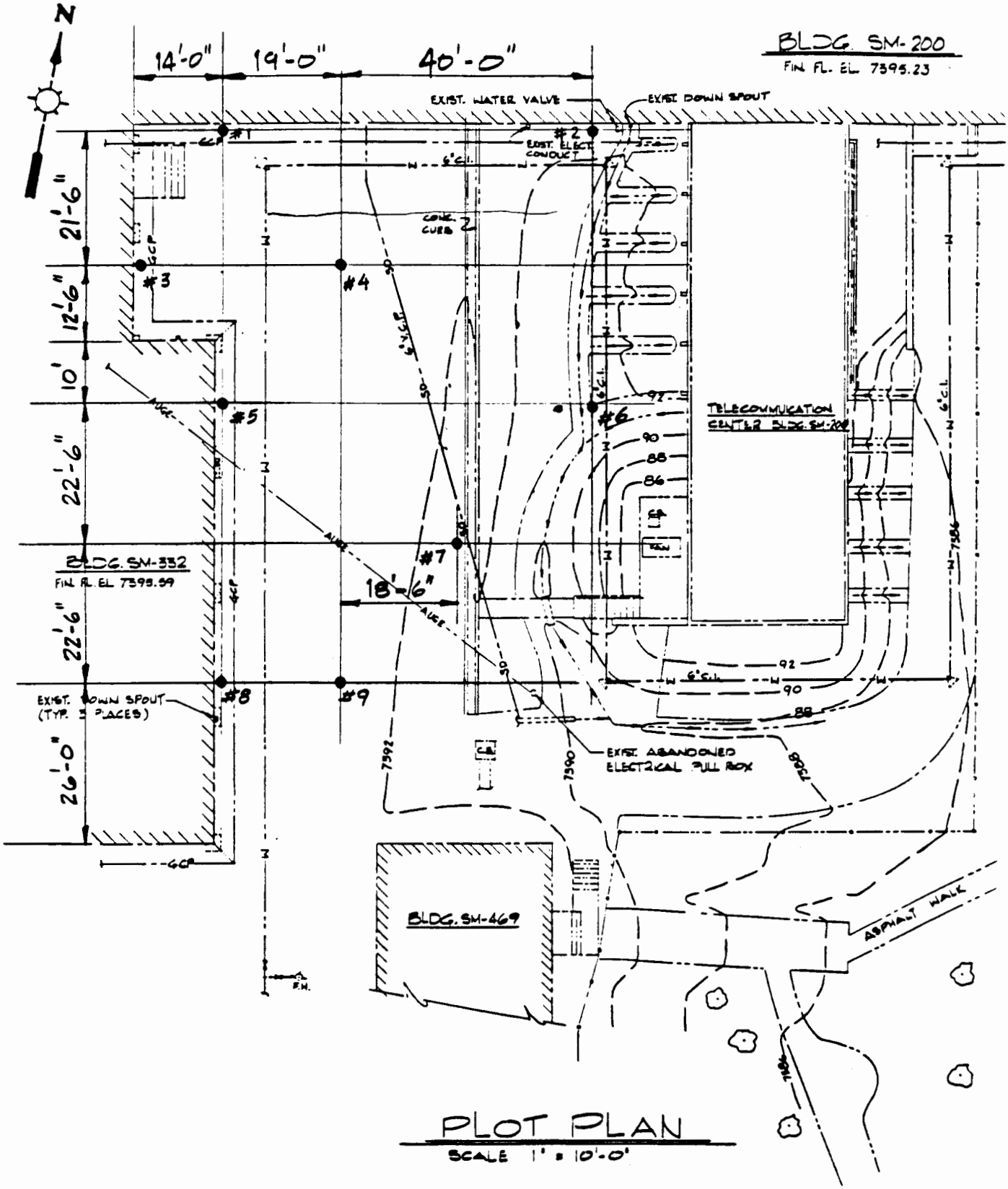

Figure 1. - Location of Test Holes 1 through 9 near Bldg. SM-200

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker,
INC-5 Group Leader, MS G776

DATE: October 16, 1985

THRU: Thomas C. Gunderson,
HSE-8 Group Leader, MS K490 TG

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 WP

SYMBOL: HSE8-85-1278

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

A reconnaissance was made of the north wall of Los Alamos Canyon above the site on October 6, 1985 at the request of Merle Bunker, Isotope and Nuclear Chemistry Group (INC-5). The last inspection was made of the canyon walls on June 15, 1984.

Since the last inspection there have been no rock falls or movement of rocks or blocks of tuff on the slope or cliff above TA-2. The security fence and rock catchers on the north wall above TA-2 were inspected and are in good shape.

There are a number of rocks and blocks of tuff on the slope and cliffs above TA-2 that have the potential to cause rock falls. If any rocks should dislodge, the slope below, rock catchers, and security fence above the buildings should prevent the rock falls from causing any damage.

WDP:brm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Ralph G. Martinez, ENG-2, MS M984 — DATE: February 18, 1986

THRU: Thomas C. Gunderson, HSE-8 Group Leader — MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 — SYMBOL: HSE8-86-216

SUBJECT: TEST BORINGS AT BUILDING 200, TA-3, LJ 8233-3

Two test holes were drilled at or adjacent to locations shown on Figure 1. The holes were requested in memorandum ENG-2-86-95 (February 5, 1986). Previous Test Holes 1 through 9 were drilled in October 1985 and reported in memorandum HSE8-85-1213.

The logs at holes 10 and 11 are as follows:

	Depth (ft) From	To
Test Hole 10		
Fill, dark gray to brown, silts and clay, with some gravel, wet (est. 10-20% moisture by volume) above contact with underlying tuff	0	4
Tuff, light brownish gray, quartz and sanidine crystals and crystal fragments, a few small fragments of gray rhyolite and dark gray pumice in an ash matrix; moderately welded.	4	7
Test Hole 11		
Fill, dark gray to brown as described in Test Hole 10.	0	3
Tuff, light brownish gray, moderately welded as described in Test Hole 10.	3	7

The foundations should be set into the tuff. The moderately welded tuff has a safe bearing capacity of about 5,000 lbs/sq ft. It should be noted that just east of Test Holes 10 and 11 a north-south water line is present. The test borings encountered no anomalies in the tuff that would effect foundation design.

WDP:brm

Enclosure: Figure 1 (map)

Cy: C. Sanchez, ENG-2, MS M984
K. Ellard, ENG-DO, MS P915
Liaison Office, MS K717
A. Loya, ENG-4, MS B252
T. Lansford, Kaiser Engr., MS M703

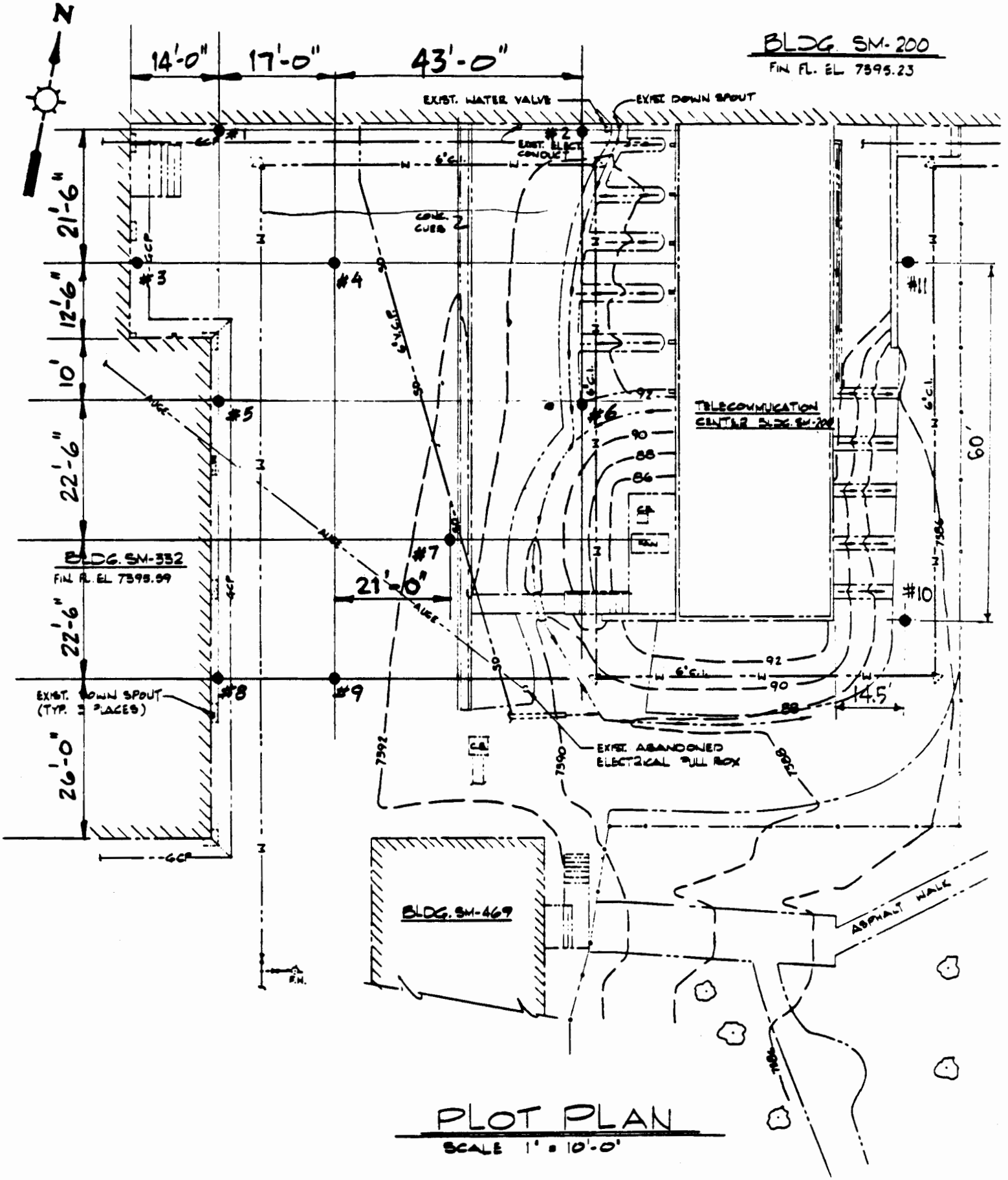

Figure 1. - Location of Test Holes 1 through 11 near Bldg. SM-200

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Los Alamos, New Mexico 87545

memorandum

TO: Dean Miller, ENG 9, MS M702

DATE: April 7, 1986

THRU: Thomas C. Gunderson, HSE-8 Group Leader, K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-86-376

SUBJECT: SOIL BORINGS AT TA-35 AND TA-16

A subsurface investigation was made at TA-35 and TA-16 on March 26, 1986 as requested in ENG-9-200-86.

The test borings at TA-35 are just to the southeast of a nest of injection and monitoring wells that were used by the U.S. Geological Survey and old "Group H-6" to study the behavior of liquids injected into the tuff. As I recall about 0.5×10^6 gal of water was injected into the tuff through an injection zone about 55 to 65 ft below land surface. The tests ran about 6 months in 1964 and 1965. Capillary movement in low moisture range was about 20 ft above the top of the injection zone. Moisture moved horizontal about 90 ft in the low moisture range (20% near injection zone to <5% by volume outward to 90 ft) as the result of capillary movement. The major movement was downward to about 240 ft. beneath the injection zone when capillarity hung the moisture (injected water) in the tuff. The spindle shape was a maximum of 25 to 30% by volume in the spindle beneath the injection zone. Three attachments, map and tables, are for your information. The two test holes (1986) at TA-35 penetrated and were completed in a moderately welded tuff.

Test Hole 1	Depth (ft) From	To
Gravel and soil dark brown, soil clayey.	0	3
Tuff, dark gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few rock fragment pumice, latite, and mylonite in a ash matrix; Moisture content estimate's at 10 - 15% by volume.	3	32

Test Hole 2	Depth (ft) From	To
Gravel and soil as in Test Hole 1	0	2
Tuff, light gray moderately welded as in Test Hole 1; moisture of tuff lower them in TH-1, <5 to 10% by volume (est).	2	43

The moderately welded tuff is about 110 ft thick at the proposed location. The water injected in the tuff should not cause any problem with the foundation design. The bearing capacity of this unit at TA-55 (about 0.5 mi west) has a safe bearing capacity of about 5000 lbs/ft^2. Location of test holes 1 and 2 are shown on figure 9 (enclosed). Locations are approximate and were not surveyed.

Four test holes were augered at TA-16 at the location of the proposed building. Locations are numbered clockwise, test holes 1 through 4, starting with test hole 1 near transformer. Three of the holes were completed through fill and soil, a silt and clay into the top of a badly weathered tuff. The fourth hole penetrated the above section and was completed in a weathered tuff containing numerous pumice fragment. Test holes 1 and 2 encounters excess moisture in the fill and soil and in the upper part of silt and clay unit.

Test Hole 1	Depth (ft) From	To
Fill and soil, clayey, dark brown, excess moisture (estimate 20 to 25% by vol.) from 4 to 6 ft, fine grained, plastic.	0	6
Silt and clay, brown, moisture content decrease from estimated 20% by volume at base of soil to about 10% at increasing depth, fine grained, plastic in places.	6	21
Tuff, badly weathered, light brown, contain an abundance of silt and clay, a few small rock fragments of rhyolite, and sand size quartz and ramidine crystal and crystal		

Test Hole 1 (Cont)	Depth (ft) From	To
fragments.	6	28

Test Hole 2	Depth (ft) From	To
Fill and soil, clayey, dark brown, as in Test Hole 1; plastic.	0	6
Silt and clay, brown as in Test Hole 1; plastic.	6	18
Tuff, badly weathered, light brown, as in Test Hole 1.	18	23
Test Hole 3		
Fill and soil clayey, dark brown, dryer than Test Hole 1, (estimate 10 to 15% by volume), plastic.	0	6
Silt and clay, brown, as in Test Hole 1; plastic in places.	6	17
Tuff, badly weathered, light brown as in Test Hole 1.	17	23
Test Hole 4		
Soil and fill, dark brown as in Test Hole 3, (estimate moisture 10 to 15% by volume).	0	7
Silt and clay, brown, fine grained plastic in places.	7	19
Tuff, brown, badly weathered as in Test Hole 1.	19	34
Tuff, brown, weathered, contain numerous pumice fragments.	34	42

I have no recommendations for bearing capacities or foundation design due to the thick section of unconsolidated material, silt and clay, and excessive moisture content especially in

test holes 1 and 2. I would look at the foundation design of the new building under construction and nearing completion west of the entrance to TA-16. The test boring at this location encountered similar conditions as were encountered in the present locations (HSE8-84-932; October 18, 1984).

WDP:tp

Attachments: Figure 9.--Location of test holes at site 1 and 2, TA-50 and site 1, TA-52

Table 1.--Geologic section and estimated and effective porosity of tuff units at sites 1 and 2. (Approximate altitude of land-surface 7,250 feet)

Table 2.--Hydrologic characteristics in relation to porosity of a unit of the Tshirege Member in the Los Alamos area. (Analysis by the U.S. Geol. Survey)

Table 3.--Construction data of wells at Site 2.

Table 62.--Site 2, TA-50, liquid injection test holes.

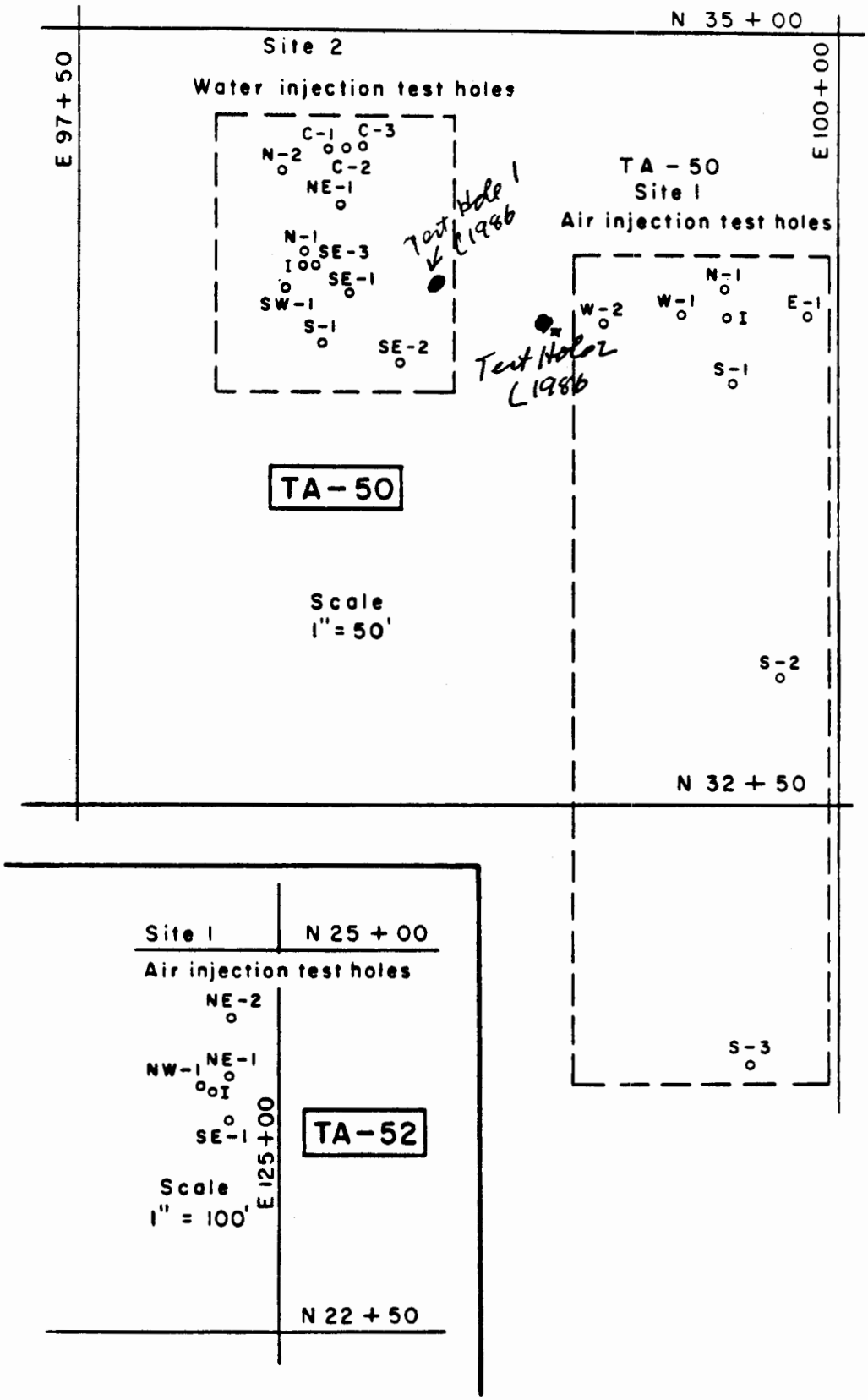


Figure 9.--Location of test holes at site 1 and 2,

TA-50 and site 1, TA-52.

Map from "Records of wells, Test holes, springs and Surface Water Stations in the Los Alamos Area, New Mexico," U.S. Geol. Survey Admin. Rept. (1966), in files of HSE-8 - shown on map are approximate location of Test Holes 1 and 2 (1986).

Table 1.--Geologic section and estimated and effective porosity of tuff units at sites 1 and 2. Approximate altitude of land-surface 7,250 feet).

Unit	Thickness (feet)	Depth (feet)	Effective 1/ porosity (percent)	Porosity 1/ (percent)
Tshirege Member				
Moderately welded tuff	110	110	38	46
Welded tuff	120	230	33	37
Moderately welded tuff	20	250	38	46
Nonwelded tuff	45+	295+	54	60

1/ Estimated from moisture and density logging.

Table 2.--Hydrologic characteristics in relation to porosity of a unit of the Tshirege Member in the Los Alamos area. (Analysis by the U.S. Geol. Survey)

Sample	Porosity (percent)	Specific yield (percent)	Specific retention (percent)	Coefficient of permeability (gdp per sq ft)
1	54	38	16	6
2	50	34	16	3
3	47	27	20	2
4	41	24	17	0.1
5	38	18	20	.9

Note: Decrease in porosity indicates an increase in degree of welding.

Table 3.--Construction data of wells at Site 2.

Hole designation	Date Drilled	Diameter (inches)	Depth (feet)	Remarks
N-2	Sept. 1965	5	112	
NE-1	Sept. 1965	5	118	
N-1	Nov. 1964	5	97	
I	Nov. 1964	5	67	Tests 1 and 2, Disposal well.
SE-3	Oct. 1965	4	295	
SW-1	Nov. 1964	5	97	Test 3 Disposal well.
SE-1	Nov. 1964	5	97	
S-1	Oct. 1965	4	295	
SE-2	Sept. 1965	5	112	

Note: Holes were augered except for SE-3 and S-1 which were drilled by air-rotary.

Tables from "Test on and design of disposal wells at Los Alamos, New Mexico" U.S. Geol. Survey unpublished rept. in files of HSE-8

Table 62.--Site 2, TA-50, liquid injection test holes (cont)

USGS hole designation	USGS location number	AEC-LASL designation (structure number)	AEC-LASL coordinates	Drilling date	Altitude of land surface (feet above mean sea-level)	Diameter of hole (inches)	Depth (feet)	Type of drilling
C-2	19.6.22.3121	TA-509-14	N 34+62 E 98+38	Dec 1964	Approx. 7,248	5	8	Do.
C-3	19.6.22.312m	TA-50-15	N 34+63 E 98+43	Dec 1964	Approx. 7,248	5	8	Do.

Note: All holes are drilled in tuff. Hole I, the injection well, has an injection tube and an observation tube set in gravel from 55 ft to 65 ft. The bottom 2 ft from 65 ft to 67 ft are filled with crushed tuff. The hole is cemented from the surface to the top of the gravel pack at 55 ft. Hole C-1, a calibration hole, cased with 1.5 in. steel tubing. Hole C-2, a calibration hole, open hole; Hole C-3, a calibration hole, is cased with 2 in. plastic tubing.

Tables from "Records of Wells, Test Holes, Springs, and Surface Water Stations in the Los Alamos Area, New Mexico," U.S. Geol. Survey Admin. Rept (1966) in bits of HSE-8

Table 62.--Site 2, TA-50, liquid injection test holes

USGS hole designation	USGS location number	AEC-LASL designation (structure number)	AEC-LASL coordinates	Drilling date	Altitude of land surface (feet above mean sea-level)	Diameter of hole (inches)	Depth (feet)	Type of drilling
N-2	19.6.22.312a	TA-50-16	N 34+55 E 98+18	Sept 1965	7,247.7	5	1[illegible]2	Auger
NE-1	19.6.22.312b	TA-50-17	N 34+34 E 98+36	Sept 1965	7,246.6	5	1[illegible]8	Do.
N-1	19.6.22.312c	TA-50-18	N 34+29 E 98+26	Nov 1964	7,245.2	5	[illegible]7	Do.
I	19.6.22.312d	TA-50-19	N 34+24 E 98+26	Nov 1964	7,244.7	5	67	Do.
SE-3	19.6.22.312e	TA-50-20	N 98+23 E 98+28	Oct 1965	7,244.6	4	2[illegible]5	Rotary, air
SW-1	19.6.22.312f	TA-50-21	N 34+17 E 98+19	Nov 1964	7,244.4	5	[illegible]7	Auger
SE-1	19.6.22.312g	TA-50-22	N 34+15 E 98+39	Nov 1964	7,234.9	5	[illegible]7	Do.
S-1	19.6.22.312h	TA-50-23	N 33+99 E 98+30	Oct 1965	7,242.9	4	2[illegible]5	Rotary, air
SE-2	19.6.22.312j	TA-50-24	N 33+92 E 98+56	Sept 1965	7,241.6	5	1[illegible]2	Auger
C-1	19.6.22.312k	TA-50-13	N 34+62 E 98+33	Dec 1964	Approx. 7,248	5	8	Do.

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: A. D Miller, ENG-9, MS M702

DATE: June 13, 2986

THRU: Thomas C. Gunderson, HSE-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-5021

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-86-706

SUBJECT: TEST HOLE TA-48, RADIOCHEMICAL DATA WING FOR WEAPONS DIAGNOSTIC

Only one test hole was drilled due to limited access to the area of investigation. The location is shown as Test hole #2 on attached sketch. Work was completed on June 11, 1986.

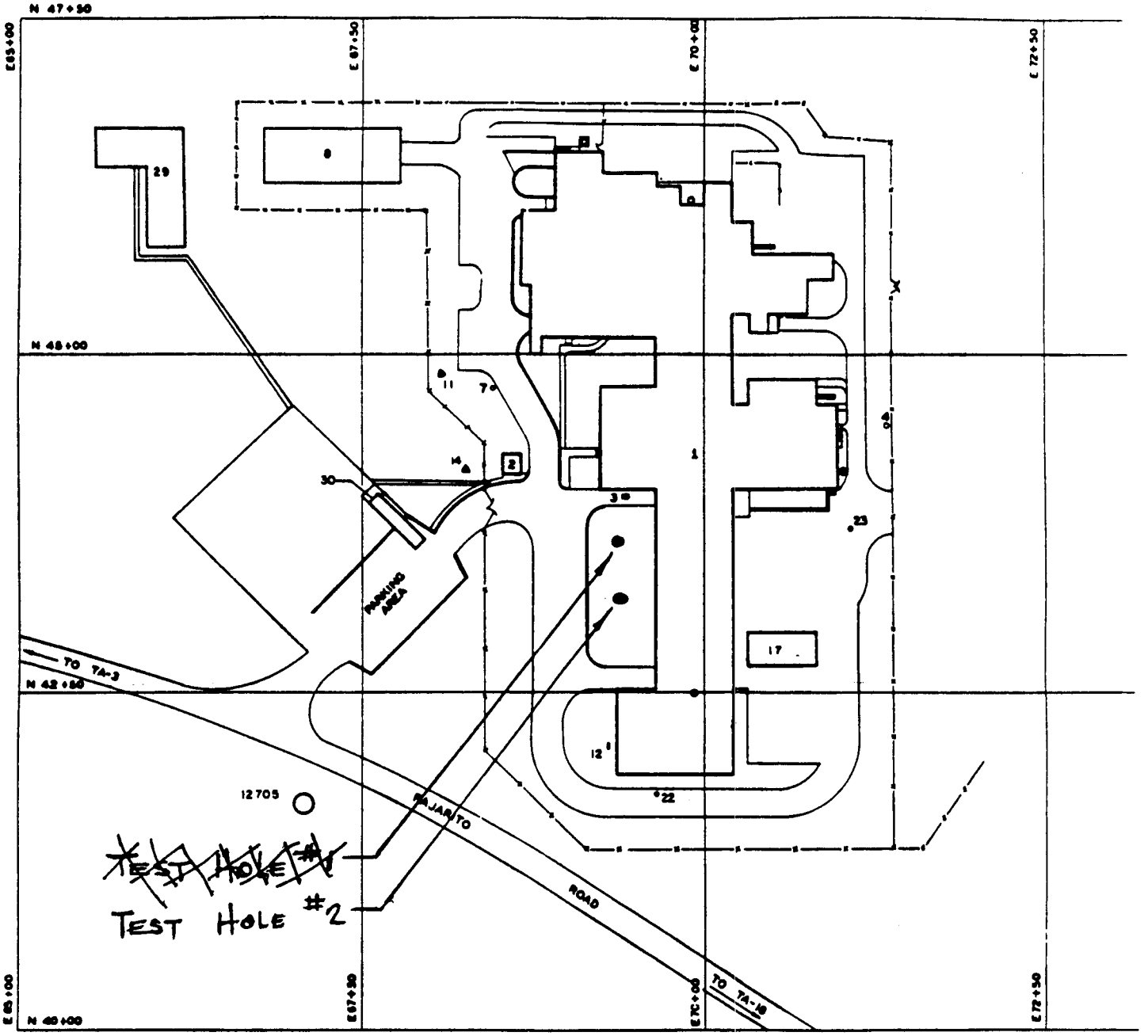
Log of Test Hole

	Depth (ft) from	to
Soil, brown, clayey, with some gravel and sand, wet (10% to 15% by moisture volume estimated) in places up to about 6ft, dryer (5% to 10% moisture by volume estimated) 6 to 8 ft.	0	8
Tuff, gray, moderately welded, a few quartz and sanidine crystals and crystal fragments, a few rock fragments of dark gray rhyolite, devitrified dark gray pumice fragments in a fine ash matrix	8	18

The tuff is moderately welded with a safe bearing capacity of about 5000 lbs\sq ft. No anomalies were encountered in the tuff that would effect formulation design.

WDP:tp

Cy: T. Buhl, HSE-8, MS K490



TA-48

1" = 50'

GRAPHIC SCALE

Sketch Map showing location of Test Hole drilled at TA-48

The Zia Company
Memorandum

Thru: Will Hobbs, Department Head - EMTD
Materials Testing/Inspection Dept. - 667-7098

To: Dean Miller, LANL **Date:** June 27, 1986
ENG-9

From: Karl Horner, QA Engineer 3 - EMTD
Materials Testing/Inspection Dept. - 667-7098

Subject: TEST HOLE AT TA-48 - RADIOCHEMICAL DATA WING FOR DIAGNOSTIC - GEOTECHNICAL INVESTIGATION
W.O. #5-55-0097

EMTD-192

Submitted herewith is the above subject final report. This report presents the investigation and test work through June 26, 1986. Should you have any questions concerning this report, please contact at your convenience.

WH:KH/rr

Attachment

cc: ARMD (No Attachment)

TEST HOLE TA-48

RADIOCHEMICAL DATA WING

FOR WEAPONS DIAGNOSTIC

W.O. #6-5509-36

I. Summary of Conclusions

This structure may be founded on the undisturbed clayey sand soil found below the buried A horizon soil at a depth of approximately 3.5 feet. Footings thus founded may be designed using a safe soil pressure of 4,000 pounds per square foot for round or square footings and 3,800 pounds per square foot for continuous wall footings.

II. Introduction

Proposed for construction at this site is an addition to the existing Building No. 1. The proposed addition will consist of a single storied, slab-on-grade structure utilizing bar joist framing and steel stud bearing walls. The approximate dimensions of the addition are 29 feet wide by 96 feet long.

III. Site Description

The site of the proposed construction slopes gently to the west and is covered by a layer of landscaping gravel which contains various trees and shrubs. It is most likely that the site is covered by some amount of fill material.

IV. Conclusions and Recommendations

The upper 3.0 to 4.0 feet at the location of the only boring that was possible to make indicates a fill material overlying an A horizon soil. This buried soil acts as a permeability barrier which causes the overlying materials to have a higher than normal moisture content.

The overlying fill material as well as A horizon soil exhibit a low bearing capacity when tested by Standard Penetration Tests. Immediately underlying the soil horizon the soils are noticeably dryer and the Standard Penetration blow counts increase to more than 30 BPF.

Soft weathered Tuff was encountered at a depth of 9.5 feet and refusal of Standard Penetration test was encountered at a depth of 10.9 feet.

It is recommended that this structure be founded on undisturbed soils found immediately below the buried A horizon soil. Such footings may be designed using a safe soil pressure of 4,000 pounds per square foot for round or square footings and 3,800 pounds per square foot for continuous wall footings.

The in-place fill soils appear to be reasonably well compacted and capable of sustaining an area loading of 1500 pounds per square foot. It is recommended that the materials supporting the floor slab be tested to insure uniform compaction of at least 93% of maximum dry density as determined by ASTM D-1557.

KH/rr - June 25, 1986

Descriptive Terms

Standard Penetration Test		
Granular Soils	Blows Per Foot	Cohesive Soils
Very Loose	0 - 5	Very Soft
Loose	6 - 10	Soft
Slightly Compact	11 - 20	Stiff
Compact	21 - 35	Very Stiff
Dense	36 - 70	Hard
Very Dense	70+	Very Hard

Dry - No apparent soil moisture

Moist - Slight soil moisture content

Damp - Soil moisture content below the Plastic Limit

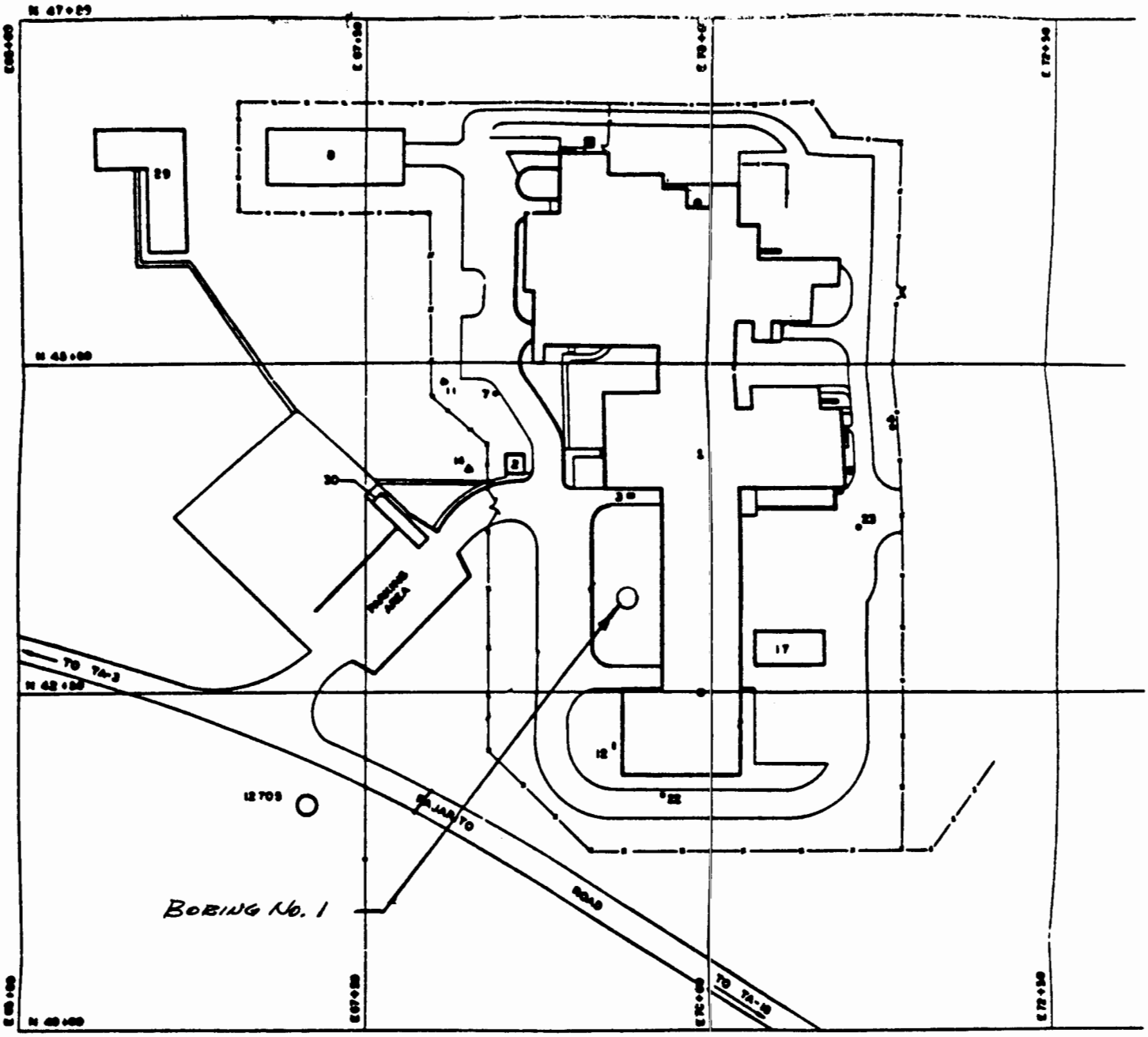
Very Damp - At or near the Plastic Limit

Wet - Soil moisture above the Plastic Limit near Liquid Limit

Very Wet - Minor amount of free water above Liquid Content

Saturated - Free water

Test Hole at TA-48
Radiochemical Data Wing
for Weapons Diagnostic
W.O. #6-5509-36



TA-48

BORING LOCATION PLOT

Test Hole at TA-48
Radiochemical Data Wing
for Weapons Diagnostic
W.O. #6-5509-36

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Phillip C. Hunt, ENG-2, MS M984 — DATE: July 22, 1986

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490 — MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 — SYMBOL: HSE8-86-861

SUBJECT: TEST BORINGS, GROUND TEST ACCELERATOR NO 2, TA-53, LJ 7770-53

Six test holes were drilled at the site as requested in memorandum 7770-53 TST (July 1, 1986). The holes were located in and around the transformer station (Fig. 1).

Test holes 3, 4, 5, and 6 encountered a fill material of tuff ranging from 3 to 8 ft in thickness overlying the undisturbed moderately welded bed rock. Test holes 1 and 2 encountered undisturbed tuff at a depth of about 2 ft. The logs of the test holes are as follows.

Test Hole 1	Depth (ft) From	To
Fill material, same asphalt underlain by gravel	0	2
Tuff, gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of dark gray dense rhyolite and pumice in an ash matrix.	2	18

Test Hole 2	Depth (ft) From	To
Fill material, some asphalt underlain by gravel	0	2
Tuff as in Test Hole 1, upper surface of tuff wet (moisture content est. 10 to 15% by volume).	2	13

TEST BORING LOG

Radin Chemical Data Wing for Weapons Diagnostic

BORING NO. 1 LOC See Boring Location Plot

SCALE: 1 IN = 5 FT. BORING DATE 6-19-86 BY Fox / G.W. LEVELS BY --- CHECKED ---

EL. WATER LEVEL None DATE 6-19-86 EL _____ DATE _____ EL _____

BM NO. LOC.

BS	HI	FS	EL	REMARKS
				Top of Ground

FM	LOG	ELEVATION	REMARKS	S NO.	TOOL	BPF	% M	WT. #/CU. FT.
			Top of Ground					
Probable Fill		3.0	Slightly compact brown clayey sand.					
	3.5	4.0	Slightly compact brown clayey sand	1	S.P.	11	wet	
Soil "A" Horizon		5.0	Black organic soil (A Horizon) 8 to 10 inches Thick					
	5	6.0	Slightly compact brown clayey sand	2	S.P.	12		
Soil Mantle		8.0						
		9.0	Compact brown clayey sand & some Tuff fragments	3	S.P.	34	slightly damp	
	10	9.5	Weathered Tuff	4	SP	Refusal at 10.9 feet.		
Bandelier Tuff		10.9	Bottom Hole					

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Phillip C. Hunt, ENG-2, MS M984 — DATE: July 22, 1986

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490 — MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 — SYMBOL: HSE8-86-861

SUBJECT: TEST BORINGS, GROUND TEST ACCELERATOR NO 2, TA-53, LJ 7770-53

Six test holes were drilled at the site as requested in memorandum 7770-53 TST (July 1, 1986). The holes were located in and around the transformer station (Fig. 1).

Test holes 3, 4, 5, and 6 encountered a fill material of tuff ranging from 3 to 8 ft in thickness overlying the undisturbed moderately welded bed rock. Test holes 1 and 2 encountered undisturbed tuff at a depth of about 2 ft. The logs of the test holes are as follows.

Test Hole 1	Depth (ft) From	To
Fill material, same asphalt underlain by gravel	0	2
Tuff, gray, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of dark gray dense rhyolite and pumice in an ash matrix.	2	18

Test Hole 2	Depth (ft) From	To
Fill material, some asphalt underlain by gravel	0	2
Tuff as in Test Hole 1, upper surface of tuff wet (moisture content est. 10 to 15% by volume).	2	13

TEST BORING LOG

Radin Chemical Data Wing for Weapons Diagnostic

BORING NO. 1 LOC See Boring Location Plot

SCALE: 1 IN= 5 FT. BORING DATE 6-19-86 BY Fox / G.W. LEVELS BY ___ CHECKED ___

EL. WATER LEVEL None DATE 6-19-86 EL ___ DATE ___ EL ___

BM NO. LOC.

BS	HI	FS	EL	REMARKS
				Top of Ground

FM	LOG	ELEVATION	REMARKS	S NO.	TOOL	BPF	% M	WT. #/CU. FT.
			Top of Ground					
Probable Fill			Slightly compact brown clayey sand. 3.0					
	3.5		Slightly compact brown clayey sand 4.0	1	S.P.	11	wet	
Soil - 'A' Horizon			Black organic soil (A Horizon) 8 to 10 inches Thick 5.0					
	5		Slightly compact brown clayey sand 6.0	2	S.P.	12		
			8.0					
Soil Mantle			Compact brown clayey sand & some 9.0	3	S.P.	34	slightly damp	
			Tuff fragments 9.5					
	10		Weathered Tuff 10.9	4	SP	Refusal at 10.9 feet.		
Bandelier Tuff			Bottom Hole					

Test Hole 3	Depth (ft) From	To
Fill material, same asphalt underlain by gravel.	0	1
Fill material tuff gray to light brown, some clay weathering.	1	4
Tuff, light gray to light brown, moderately welded, quartz and sanidine crystals and crystal fragments, same small rock fragments of gray rhyolite and pumice.	4	13

Test Hole 4	Depth (ft) From	To
Fill material gravel.	0	2
Fill material, tuff, gray light brown, some clay weathering (moisture est. 10-20% by volume).	2	7
Tuff as in Test Hole 3.	7	13

Test Hole 5	Depth (ft) From	To
Fill material, tuff as in Test Hole 4.	0	8
Tuff as in Test Hole 4.	8	15

Test Hole 6	Depth (ft) From	To
Fill material, tuff as in Test Hole 4.	0	3
Tuff, light brown, moderately welded, quartz and sanidine crystals and crystal fragments, small rock fragments, rhyolite and pumice	3	8
Tuff, gray to light brown, moderately		

welded	8	12

The undisturbed tuff (moderately welded) has a safe bearing capacity of about 5,000 lbs per sq ft. The fill material (tuff) can be compacted to result in a bearing capacity of 3,000 to 4,000 lbs per sq ft. The test holes encountered no anomalies in the fill material or bed rock tuff which would cause problems in foundation design.

WDP:brm

Cy: T. Buhl, HSE-8, MS K490

Attachment: Figure 1

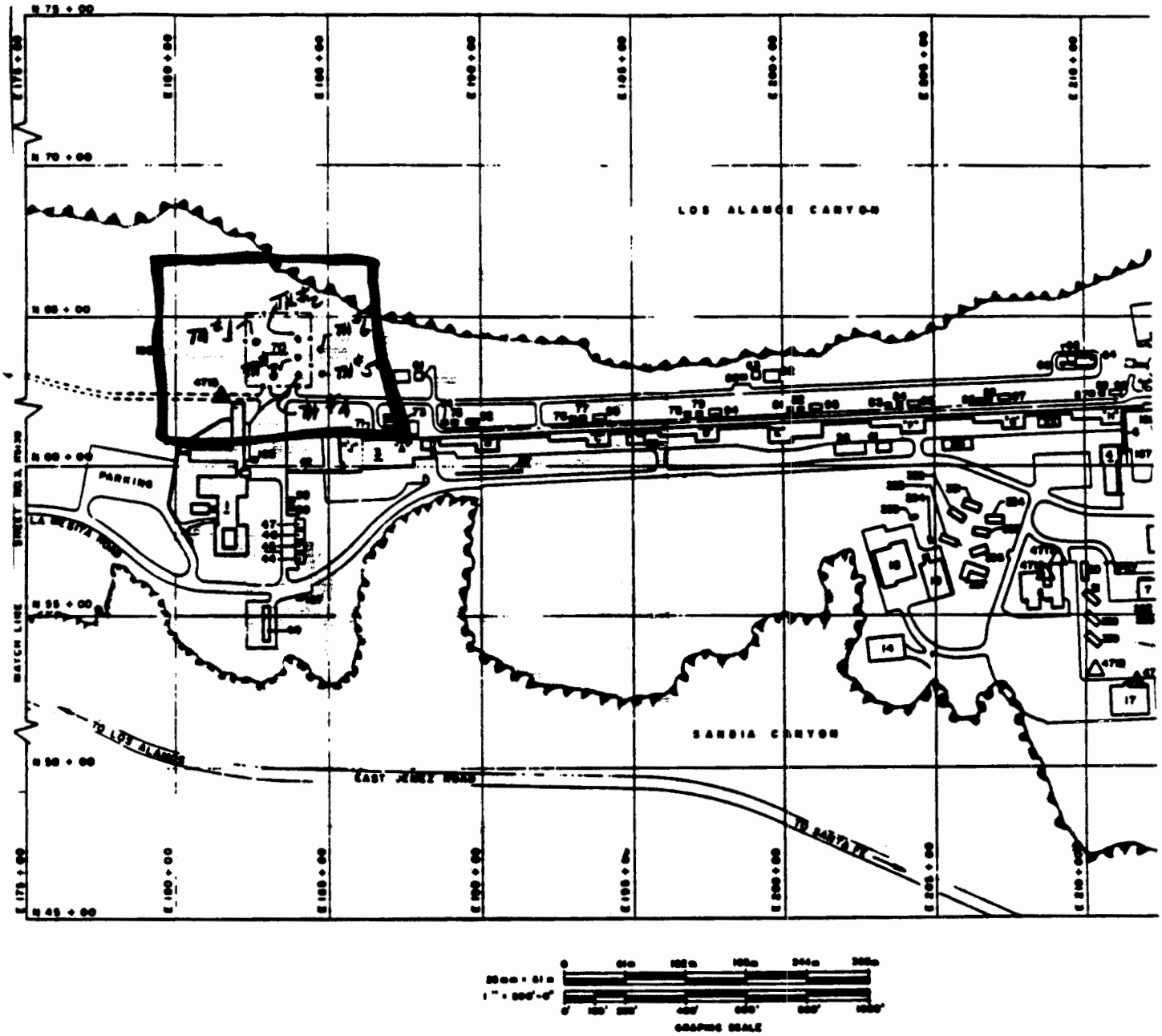


Figure 1. Location of Test Holes in and adjacent to Transformer Station, TA-53

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Thomas C. Gunderson,
HSE-8 Group Leader

DATE: August 1, 1986

THRU: Thomas E. Buhl, HSE-8
Associate Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun and
Donald VanEtten, HSE-8

SYMBOL: HSE8-86-883

SUBJECT: CONSTRUCTION OF RETENTION PONDS IN MORTANDAD CANYON

Industrial liquid effluents from Laboratory operations contain radionuclides and are processed at the plant at TA-50. The treatment removes most of the radionuclides before the remaining effluents are released into Mortandad Canyon. Mortandad Canyon has a small drainage area that heads on the Pajarito Plateau. Steam flow occurs in the upper-reach of the canyon as the result of the effluent release and storm runoff. The effluents and storm runoff recharge a small body of perched water in the alluvium. This shallow aquifer is of limited extent, confined within the Laboratory.

The major transport of radionuclides in the effluent-release area from TA-50 is by storm runoff. The radionuclides remaining in the effluent are adsorbed or attached to silts and clays in the sediments of the stream channel. Storm runoff transports 90 to 95% of the radionuclides in the suspended and bed load sediments while the remaining 5 to 10 % is transported in solution. Contamination is high near the effluent outfall and decreases down gradient in the canyon. The largest surface water losses occur in the mid-reach of the canyon where the stream is not well defined as it braids out on the canyon floor. The canyon widens and the alluvium thickens. It is within this area that efforts have been undertaken to insure that contamination is retained within the Laboratory. The purpose of injection wells and retention ponds was to store the runoff and sediments until the runoff is lost by infiltration into the unsaturated alluvium and evapotranspiration. The depth to water in the alluvial aquifer ranges from 40 to 45 ft in this reach of the canyon.

Five injection wells were constructed in the stream channel in 1974. The wells were 12 in. in diameter and about 20 ft deep. They were filled with course gravel. Runoff events during 1974 and 1975 filled the gravels in the wells with fine sediments,

decreasing the permeability of the alluvium adjacent to the shaft wall. The wells lost their effectiveness to control the runoff. In the spring of 1976 two retention ponds were constructed in the stream channel. The ponds were about 15 ft wide, 25 ft long, and averaged about 7 ft in depth. The average capacity for each pond was about 20,000 gallons (740 cubic yards) for a total of 40,000 gallons (1,480 cubic yards).

As the ponds began to fill with sediments a third pond was constructed in 1980 below the upper two ponds. This pond had a diameter of about 80 ft and had a depth of about 6 ft. The capacity was estimated at 225,000 gallons (1100 cubic yards).

In September 1983 the upper two ponds were filled with sediments and were of no use to control runoff. The third pond was about half full of sediments. Rehabilitation or new retention ponds were needed. The location of a proposed barrow pit was in an uncontaminated reach of the canyon bottom down gradient from the shafts and retention ponds. Rehabilitation of the retention ponds was needed to protect the proposed barrow pit fill material. The study indicated that the lower reach of the canyon on the Laboratory west of the boundary contained about 3,000,000 cubic yards of fill material that could be used for construction (HSE-8-83-608).

In the spring of 1986 the remaining pond was filled to capacity with sediments. Runoff events in the preceeding period had been small. There had been no transport of contaminated sediments from the upper canyon into the proposed barrow pit area or on to San Ildefonso Pueblo Land.

Three ponds were constructed in June 1986. Pond 1 is about 45 ft by 55 ft and ranged in depth from 4.5 to about 10 ft (Fig. 1). This pond has a capacity of about 118,000 gallons (581 cubic yards). Shortly after the pond was finished runoff filled a part of the pond. A week later the pond was dry as the runoff infiltrated into the unsaturated alluvium was lost to evaporation. Pond 2 is about 80 ft by 105 ft and about 10 ft deep. It has a capacity of about 628,000 gallons (3111 cubic yards). Pond 3 is about 32 ft wide and 150 ft long with a depth ranging from 6 to 10 ft. This pond has a capacity of about 287,000 gallons (1,422 cubic yards). No runoff has accumulated in Pond 2 or 3 as of this date (July 1986). Total capacity of the three ponds is about 1,033,000 gallons (5,114 cubic yards).

The ponds were constructed with front loaders. They are dug into the alluvium on the canyon floor. The lithology ranges from a silty-clay sand to a clean sand. There are no cobbles or boulders as the canyon heads on the plateau and is cut into the tuff. All materials range from silt and clay to a small amount of gravel size rock fragments of tuff, latite, or rhyolite. The inlet to the ponds is at stream level with no confining dams or berms. The berms around the ponds built from the excavated alluvium have a surface area of about 10,000 sq.ft. This surface area was planted with 30 lbs of blue grama grass seed and 20 lbs of yellow sweet clover on July 8, 1986. The cost of the excavation was about $5,898 or about $1.15 per cubic yard.

Those who worked on this project deserve recognition and a vote of thanks. They are Max Maes, Dave McInroy, and Fred Brown.

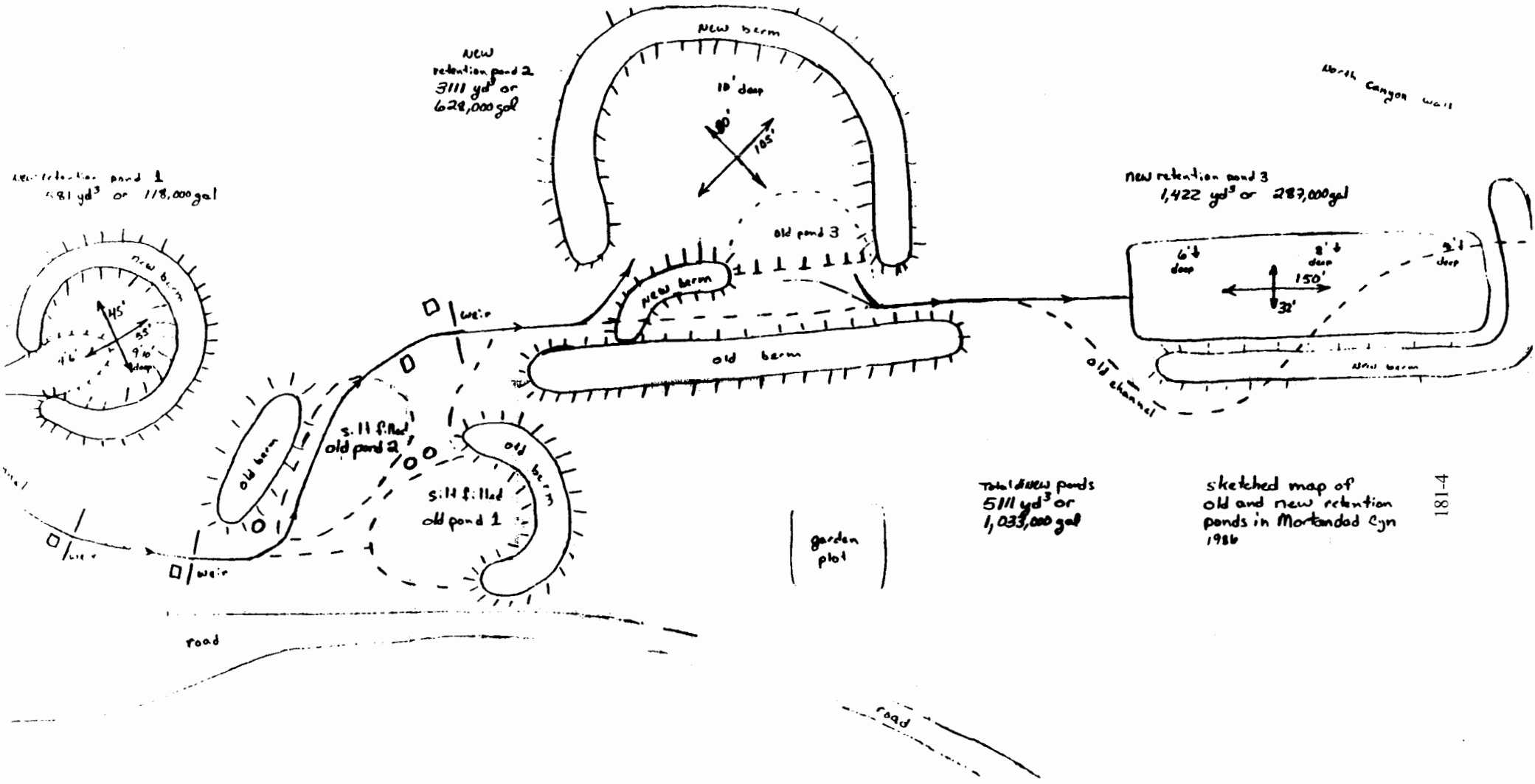
Pictures of the ponds constructed in 1977, 1980, and in 1986 are attached. Sketch map showing location of old and new retention ponds is also attached.

WDP:DVE:brm

Attachments: a/s

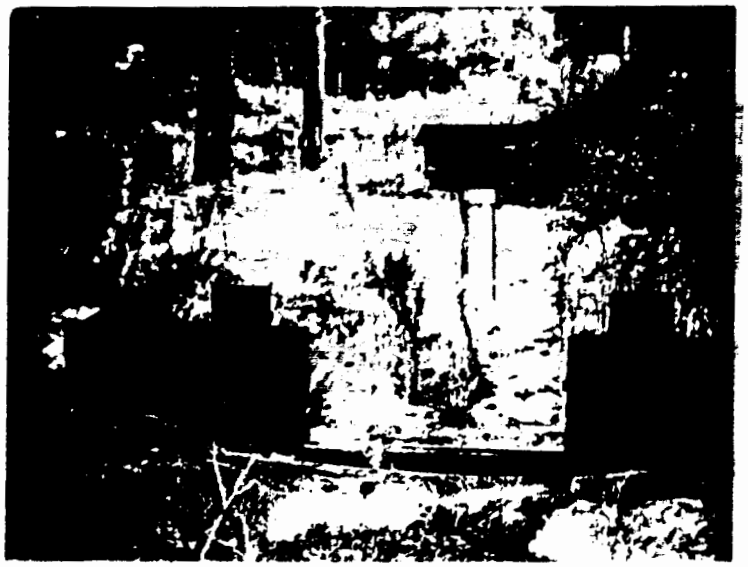
Cy: W. Hansen, HSE-DO, MS K491
M. Maes, HSE-8, MS K490
D. McInroy, HSE-8, MS K490
F. Brown, HSE-8, MS K490

SKETCH MAP SHOWING LOCATION OF OLD AND NEW RETENTION PONDS



sketched map of
old and new retention
ponds in Mortandad Cyn
1986

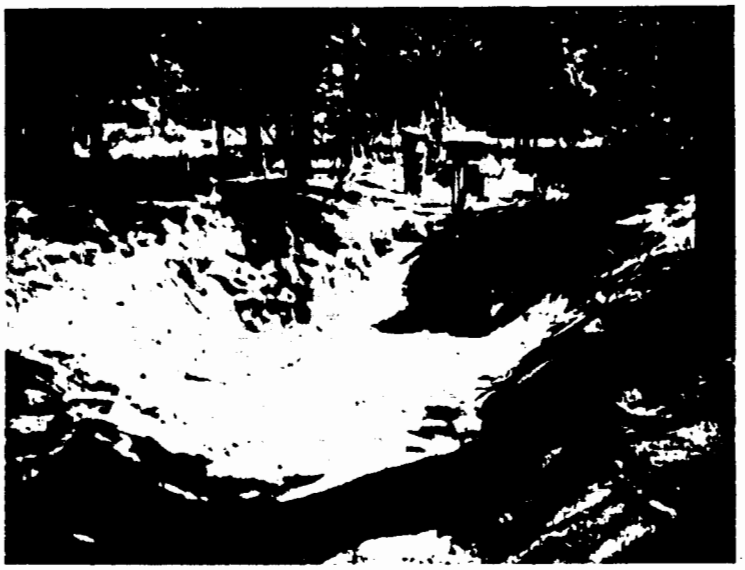
Old Pond 1 - filled with water; looking upstream, August 1976.



Old Pond 2 - filled with runoff; looking upstream through weir, 1977.

Runoff heading into Old Pond 2 in August 1977.

Old Pond 2 (1977) filled with runoff, August 1976.



Old Pond 2 after construction (1977) looking downstream.

Old Ponds 1 and 2 (1977) filled with sediments May 1986

Inlet of Ponds 1 and 2 showing runoff in Pond 1, August 1976.

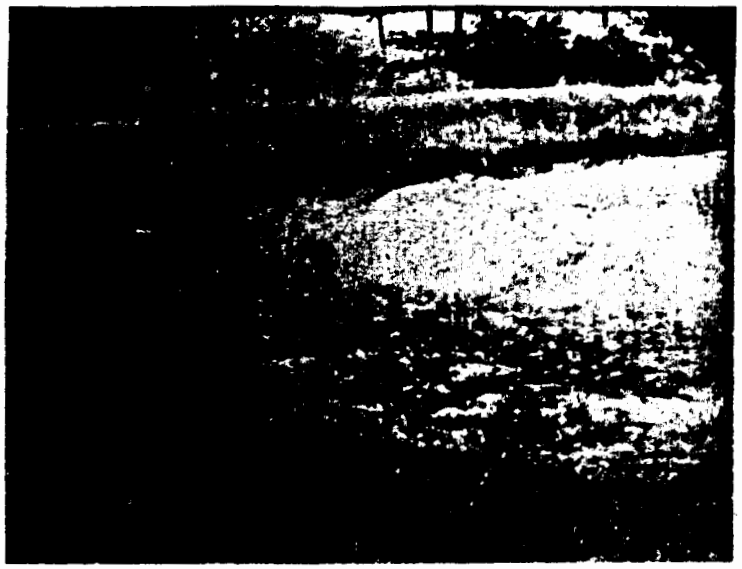
Old Pond 1 filled with sediments, May 1986.

Old Pond 1 (right) and Old Pond (left) filled with sediments, May 1986.

New Pond 1 - looking down from north rim of canyon.

New Pond 1 - showing ponded runoff, June 1986.

New Pond 1 - showing runoff through inlet, June 1986.

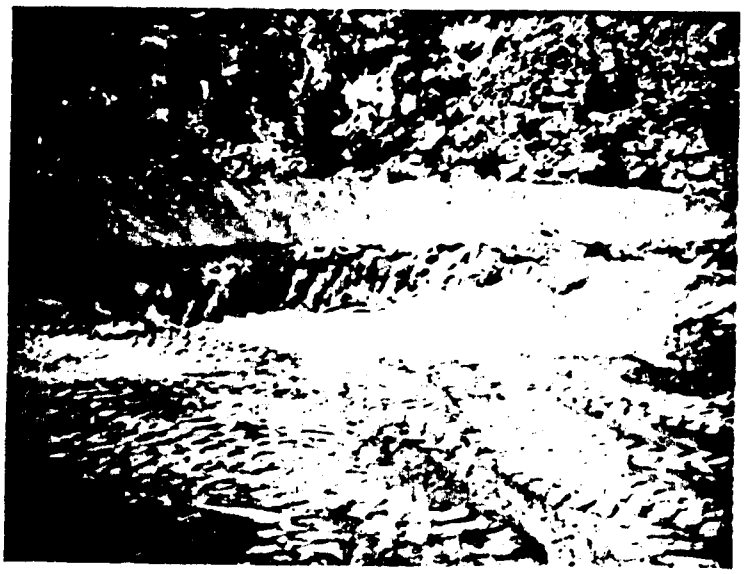


Lower End of Pond 1 filled with sediments, May 1986.

Old Pond 3 filled with sediments; looking across inlet, May 1986.

Old Pond 3, full of sediments, looking downstream, May 1986.

New Pond 2 during construction; looking through inlet to Old Pond 3, June 1986.



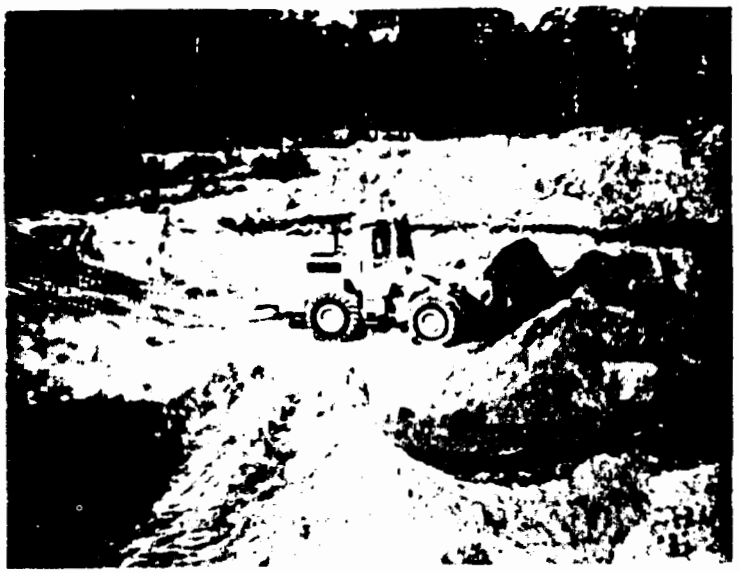
New Pond 2 during construction; looking through inlet, June 1986.

New Pond 2 - looking down from north rim of canyon, July 1986.

New Pond 3 during construction; looking downstream, June 1986.

New Pond 3 - looking down from north rim of canyon.

New Pond 3 - looking upstream. June 1986.



New Pond 2 during construction, June 1986.

New Ponds 1 (top) and 2 (center) and (bottom) - looking up the canyon from north rim, July 1986.

New Pond 1 (top) and 2 - looking down from north rim of canyon, July 1986

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Roy Lucht, Deputy
Group Leader, M-8, J960

DATE: August 15, 1986

THRU: Thomas C. Gunderson
HSE-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8

SYMBOL: HSE8-86-943

SUBJECT: TEST HOLES IN POTRILLO CANYON AT PROPOSED LOCATION FOR A ROCKET SLED TRACK (TA-36-12)

Seven test holes were augered in Potrillo Canyon on August 1 and 4, 1986. The holes were located along a 2000 ft line, the proposed location for a rocket sled track. Potrillo Canyon is cut into a series of ashfalls and ashflows of rhyolite tuff. The canyon floor is formed by a brown silty soil. The soil itself is underlain by a rhyolite tuff which is weathered in place, and which in turn is underlain by a light gray pumiceous tuff. The end products of the weathering of the ash matrix of the rhyolite tuff is montmorillonite and illite clay minerals. Montmorillonite clays are characterized by swelling when wet and shrinkage with water loss.

A description of the soils and tuff encountered in the test holes is presented in the following text. The logs of the test holes are summarized on Table 1 and are shown in a generalized cross-section in Figure 1.

1. SOILS: Soil, silty, brown, loose consolidated; clay to sand size fragments of quartz, sanidine crystals and crystal fragments, scattered small rock fragments of tuff, pumice, dense rhyolite and dense latite, in a matrix of clay-silt to very-fine sand. The upper part of the unit is a reworked ashflow rhyolite tuff weathered to a soil, while the lower unit is a soil that has developed in place from an ashflow tuff. The total thickness of the soil in the canyon ranges from 8 to 14 ft.

2. WEATHERED TUFF: Tuff, light brown, weathered to a silty sand containing quartz, sanidine crystals and crystal fragments, scattered rock fragments of pumice, dense rhyolite,and dense latite, a few lenses of clay (probably the end product of weathered pumice fragments) The lower one to four feet at the base of the unit contains numerous pebble size

rock fragments of dense rhyolite and latite. The ashflow tuff is weathered in place and ranges in thickness from 15 to 26 ft.

3. PUMICEOUS TUFF: Tuff, light gray, pumiceous, non-welded to moderately welded, consisting of quartz, sanidine crystals and crystal fragments, scattered small rock fragments of dense rhyolite and dense latite, numerous pumice fragments up to 3/4 in. in length, in a matrix of light gray pumaceous ash. The sections near the upper contact appear to be weathered to a light brown in some of the test holes. Total thickness of the pumiceous tuff is unknown as the depth of test holes did not extend below this unit.

4. MOISTURE: The cuttings from the test holes were fairly dry. Estimated soil moisture in the silty soil and weathered tuff ranges from about five percent to eight percent by volume and in a few places may reaches about twelve percent by volume. The underlying pumiceous tuff has an estimated soil moisture of less than than 10% by volume.

The test holes encountered no perched water in the soil or underlying tuffs. Based on previous studies there is little chance that any perched water exists in the tuff or in the underlying volcanic sediments above the top of the main aquifer. The top of the main aquifer is at a depth of about 750 ft below canyon bottom.

Soil characteristics will require that the access road along the rocket track be surfaced in order to assure all weather travel. The road and track foundation will have to be constructed to allow free drainage of surface runoff in the area. At present there is no well defined surface drainage across the proposed location for the track. Combining the road with the track foundation will simplify the drainage, eliminating any ponding of water between the road and track.

The test borings encountered no perched water, no excessive soil moisture,or other anomalies in the soil, weathered tuff, or pumiceous tuff that could effect a proper foundation design for the proposed rocket sled track.

WDP:brm

Attachments: a/s

Cy: J. Steiger, M-8, MS J960
J. Repa, M-8, MS J960
D. Miller, ENG-4, MS 702
T. Buhl, HSE-8, MS K490

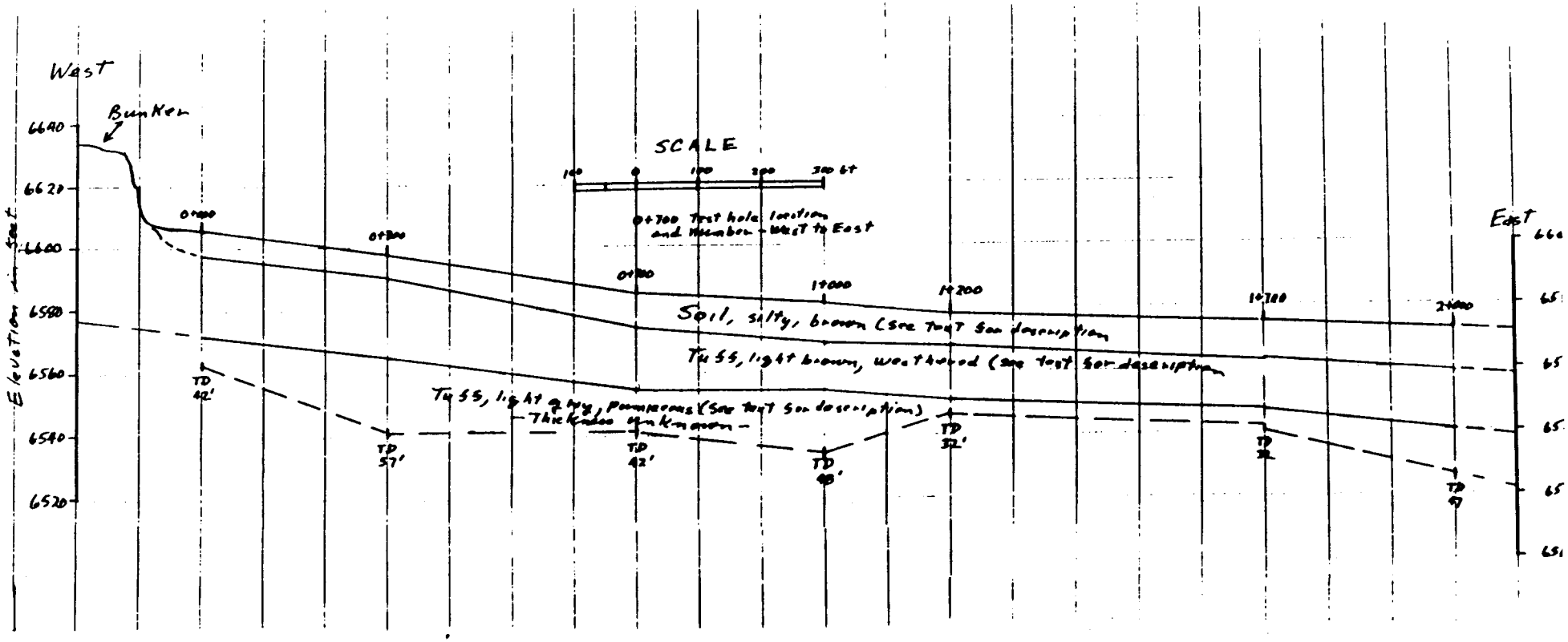


Figure 1. - Generalized geologic section showing units across Potrillo Canyon

Table I
LOG OF TEST HOLES
(Log depth in feet)

Log[1]	0+000	0+300	0+700	1+000	1+200	1+700	2+000
Soil, silty, brown	0-8	0-8	0-10	0-12	0-10	0-11	0-14
Tuff, light brown, weathered	8-34	8-33	10-30	12-27	11-27	11-26	14-32
Tuff, light gray, pumiceous	34-42	33-57	30-42	27-48	27-32	26-32	32-47
Elevation (feet)[2]	6605	6598	6585	6581	6578	6575	6573
Total Hole depth (feet)	42	57	42	48	32	32	47

.....

[1] See text for log description
[2] Estimated from LANL topographic sheet 16 of 25 (Lab. Job No. 5682).

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: A. D. Miller, ENG-9, MS M702

DATE: May 19, 1986

THRU: Thomas C. Gunderson, HSE8 Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0818

FROM: W. D. Purtymun, HSE-8,

SYMBOL: HSE8-86-584

SUBJECT: SOIL BORINGS - PROCESS EQUIPMENT STORAGE BUILDING, TA-16 (REF. ENG-9-330-86)

Four holes were augered at the proposed building site on May 13, 1986. In general the investigation indicated a soil zone 5 to 6 ft. thick of a brown to dark brown clayey soil. The soil was underlain by the "El Cajate Pumice", a clay to sand with pumice fragments ranging from very small sand to pebble size pumice fragments. In the four holes the "El Cajate" exhibited various degrees of weathering with different moisture contents. The location of the holes are keyed to the sketch map attached.

Test Hole 1	Depth (ft.) From	To
Soil-clayey, brown to dark brown with a few small rock fragments of latite and pumice; wet clayey soil at base (15 to 20% moisture by volume est.).	0	6
Sand-loosely consolidated, weathered, tan, quartz, sandine, latite and pumice fragments; few lenses of wet clay (plastic).	6	10
Sand-loosely consolidated, with stringers of wet clay, plastic, contain numerous pumice fragments.	10	18

Test Hole 2	Depth (ft.) From	To
Soil-clayey, brown to dark brown as in Test Hole 1.	0	5
Clay-black, plastic, wet, (15 to 25% by volume est.) with a few sand size rock or crystal fragments (tests at site indicate no explosives) probably contain excess organics.	5	14
Sand-loosely consolidated, weathered tan, includes stringers of wet clay, material becomes dryer at depth, contains numerous pumice fragments.	14	27

Test Hole 3	Depth (ft.) From	To
Soil-clayey, brown to dark brown as in Test Hole 1	0	6
Sand-loosely consolidated, tan to brown, some weathered stringers of wet clay, numerous pumice fragments wet in places (15 to 20% by volume, est.).	6	11
Sand-brown, as above but some what drier.	11	18

Test Hole 4	Depth (ft.) From	To
Soil-brown to dark brown as in Test Hole 1.	0	5
Sand-loosely consolidated tan to brown, some clay.		

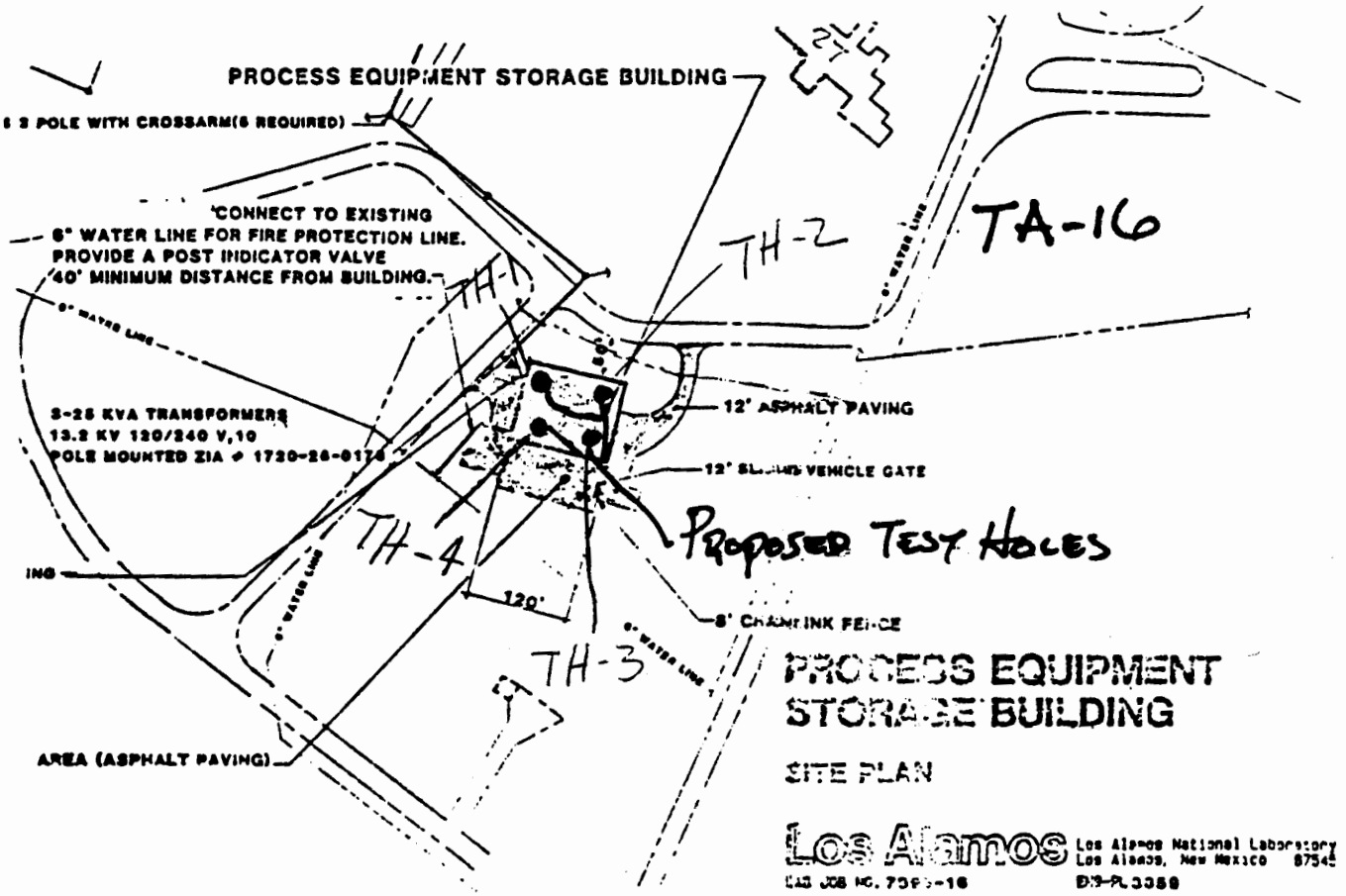
stringers and numerous pumice fragments, moisture content (10 to 15% by volume est.).	5	13
Pumice-tan to brown, some weathering, fragments from sand to pebble size pumice.	13	15

I have no recommendations for bearing capacities or foundation design because of the presence of the El Cajate Pumice. There is no data available on the El Cajate for bearing capacities. We need a detail foundation study at the site for design criteria and for reference on future design where the El Cajate Pumice is encountered.

WDP:tp

Attachments: a/s

Cy: T. E. Chandler, WX-12, MS C932



SKETCH MAP SHOWING LOCATION OF TEST HOLES

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: David A. Sprenkle,
MS M703 (Merrick)

THRU: Thomas C. Gunderson,
HSE-8 Group Leader, MS K490

DATE: May 27, 1986

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8

SYMBOL: HSE8-86-608

SUBJECT: TEST HOLES - METEOROLOGICAL TOWER INSTALLATION, TA-0

Four test borings were performed at the tower installation, TA-0, on Frijoles Mesa, May 21, 1986. The test borings were requested by ENG-2 (Foley) for Merrick, an engineering company.

Logs of hole indicate a thin clayey soil, layer of pumice (El Cajete Pumice), and underlain by a moderately welded tuff.

Test Hole North	Depth (ft) From	- To
Soil, dark brown, clayey, some pumice fragments	0	1
Pumice, light brown to brown, weathered in places, some clay lenses, loosely consolidated	1	6
Tuff, light grey, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of rhyolite, latite, and devetrified pumice in an ash matrix	6	13

Test Hole Southeast	Depth (ft) From	- To
Soil, clayey as in Test Hole North	0	1
Pumice, as in Test Hole North	1	6

Tuff, moderately welded, as in Test Hole North	6	17

Test Hole Southwest	Depth (ft) From	- To
Soil, clayey as in Test Hole North	0	1
Pumice, as in Test Hole North	1	5
Tuff, as in Test Hole North	5	17

Test Hole Tower	Depth (ft) From	- To
Soil, clayey as in Test Hole North	0	1
Pumice as in Test Hole North	1	6
Tuff as in Test Hole North	6	17

The foundations or footings should be set into the tuff. The pumice is unconsolidated and has a poor bearing capacity. The moderately welded tuff at the site has a safe bearing capacity of about 5,000 lbs/sq ft. The test boring encountered no anomalies in the tuff that would effect foundation design.

WDP:brm

Cy: W. Eberhardt, ENG-DO, MS K721
W. Foley, ENG-2, MS M984
R. Kull, MS 703 (Merrick)

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Marvin Tillery, HSE-7, MS J592

DATE: July 14, 1986

THRU: Thomas C. Gunderson, JG
HSE-8 Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8 WDP

SYMBOL: HSE8-86-811

SUBJECT: INSPECTION OF SHAFTS, AREA G, TA-54

Two shafts in the new tritium disposal field, No. 136 and No. 137, were inspected July 9. The shafts are 6 ft in diameter and about 65 ft deep. The shafts are completed in the Tshirege Member of the Bandelier tuff. The shafts penetrated about 50 ft of Unit 2B and are completed about 15 ft in to the top of Unit 2A. Both units are moderately welded. No anomolies in the tuff exposed in the shaft walls were noted.

Two shafts in the PCB shaft disposal field, No. 12 and No. 13, were also inspected on July 9. The shafts are about 6ft in diameter and about 65 ft deep. They are also completed in the moderately welded tuff units of the Tshirege Member. The shafts penetrated about 40 ft of Unit 2B and are completed about 25 ft in to Unit 2A. No anomolies in the tuff exposed in the shaft walls were noted.

The four shafts are suitable for the disposal of wastes.

WDP:tp

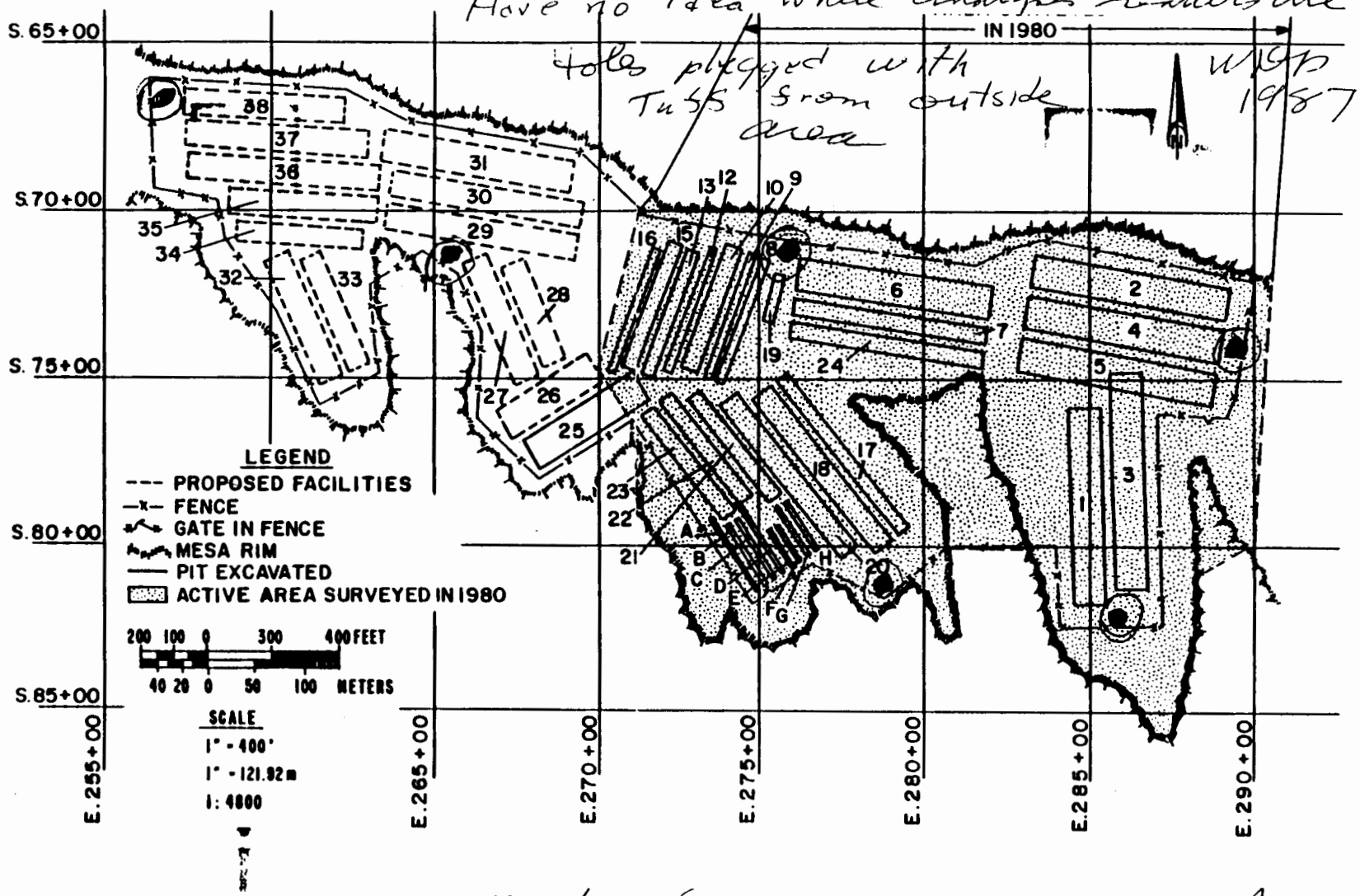
Cy: T. Buhl, HSE-8, MS K490
A. Drypolcher, HSE-8, MS K490
C. Nylander, HSE-8, MS K490

No IC

HSE-7 B-87-12

Renumber shafts
C 12 = 13 as of 4/17/87
C 13 = 12 as of 4/17/87

Test Holes Drilled Son
Don Mayfield ≈ 1979 – 6 Holes
≈ 60 ft deep – Sampled 0-3,
Then after in 5 ft intervals,
Have no idea where analyses results are!



Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Will Polzer, HSE-12, MS K495

DATE: May 7, 1987

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8

SYMBOL: HSE8-87-527

SUBJECT: GEOLOGIC DATA, TA-21

I could not find a geologic section published for TA-21. The following was prepared from a log of Test Well 3 and geologic maps. Mean altitude of TA-21 used was 7150 ft.

	(feet)		
	Thickness	From	To
Bandelier Tuff			
Tshirege Member			
Nonwelded to Welded			
Ashflows	400	0	400
Otowi Member			
Massive Nonwelded ashflow	220	400	620
Guaje Member			
Pumice fall	50	620	670
Puye formation			
Volcanic Debris	90	670	760
Basalt			
Flow and interflow Sedments	100	760	860
Puye formation			
Volcanic Debris	450	860	1310
Tesuque formation			
Silstone and sandstone with some interbedded Basalts	2500 +	1310	3810 +

The main aquifer occurs in the lower part of the Puye Formation at a depth of about 1250 ft below the surface of the mesa at TA-21. There is no perched water above the main aquifer based on data from Hole H-19 (Below Bridge at Los Alamos Canyon). Test Well 3 (in Los Alamos Canyon) and Test Well 4 (at TA-45, abandoned). Perched waters occurs in the alluvium of Los Alamos Canyon south of TA-21. There is no hydrologic connection between wastes in the ground at TA-21 and perched

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Thomas C. Gunderson,
HSE-8 Group Leader, MS K490

DATE: April 23, 1987

THRU: Thomas Buhl, TB
HSE-8 Associate Group Leader

MAIL STOP/TELEPHONE: K490/7-0818

FROM: William D. Purtyman, HSE-8 WDP
Allan Stoker, HSE-8 AS

SYMBOL: HSE8-87-502

SUBJECT: TEST HOLES EAST OF HSE-8 TRAILER, TA-59

Three test holes were drilled east of the Environmental Surveillance Group (HSE-8) trailer (OH-22) at TA-59. The holes were to determine thickness of fill (soil and gravels) overlying the tuff.

Hole 1, located 15 ft east of the trailer, encountered about 14 ft of fill over the tuff. The hole was drilled to a depth of 28 ft.

Hole 2, located about 50 ft east of Hole 1, encountered about 15 ft of fill. The hole was drilled to a depth of 28 ft.

Hole 3, located about 10 ft north of Hole 2, encountered 11 ft of fill over the tuff. The hole was drilled to a depth of 23 ft.

The fill consisted of soil and gravels derived from tuff. The soil encountered in lenses was dark brown siltly sandy loam. The gravels consisted of sand-gravel to boulder size fragments of tuff. The moisture content of fill encountered in hole 1 was high, estimated moisture content ranged from 20 to 30% by volume. The hole is located in an area that receives runoff from parking area and drive way. The moisture content of fill encountered in holes 2 and 3 was somewhat less, estimated ranging from 10 to 20% by volume.

The tuff underlying the fill is a rhyolite, moderately welded, consisting of quartz and sanidine crystals and crystal fragments, a few small dense rock fragments dark gray rhyolite and some dark gray pumice in an ash matrix.

WDP:AS:lh

Cy: M. Ragsdale, ENG-2, MS M984
S. Rhodes, ENG-2, MS M984
J. Lindahl, ENG-DO, MS K717

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: E. F. Homuth, ESS-3, MS F659

DATE: June 9, 1986

THRU: Thomas C. Gunderson, HSE-8 Group Leader

MAIL STOP/TELEPHONE: K490/7-5021

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-86-661

SUBJECT: LOG OF HOLE DRILLED FOR STRAIN GAGE AT TA-33-24 (CONTROL BLDG)

The lithology, color, and changes in drilling were used to establish the contacts between ash flow units. The upper section of the Mesa at TA-33 is composed of Unit 2b of the Tshirege Member of the Bandelier tuff. The hole was completed in to the top of Unit 1a at a depth of about 97 ft. Elevation of land surface at the hole is about 6412 ft.

	Depth (ft) From	To
Unit 2b		
Tuff, light reddish brown, moderately welded, quartz and sanidine crystals and crystal fragments, a few small rock fragments of dense dark gray rhyolite, dark gray devetrified pumice fragments, in a fine ash matrix.	0	38
Unit 2a		
Tuff, light gray, moderately welded, a few quartz and sanidine crystals, and fragments, a few rock fragments of dense dark gray rhyolite increase in number and size of dark gray devetrified pumice fragments, in a fine ash matrix.	38	61

	Depth (ft) From	To
Unit 1b		
Tuff, gray to pink, moderately welded. Tuff brown, quartz and sanidine crystals and crystal fragments, slight increase in rock fragments of dense gray rhyolite, dark brown devetrified pumice fragments in a fine ash matrix.	61	89
Unit 1a		
Tuff, light pinkish gray, non-welded to moderately welded, tuff brown, quartz and sanidine crystal fragments, rock fragments of dense dark gray rhyolite, and large gray devetrified fragments pumice in a fine ash matrix.	89	97

WDP:tp

Cy: T. Buhl, HSE-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Thomas Gunderson, HSE-8, MS-K490

DATE: June 11, 1987

FROM: Timothy H. Larkin

MAIL STOP/TELEPHONE: MS-J980/7-1101

SYMBOL: ESS-4-87-133

SUBJECT: ROOT TOMOGRAPHY RESEARCH PROGRAM

In support of the Root Tomography Research Program, we need several shallow holes greater than 2-in. diam drilled into the ground. The proposed locations of these holes is TA-33 near Bldg 87. The ground near Bldg 87 is fairly uniform volcanic tuff. This may take about one afternoon of William Purtyman's time. Please contact me if you have any questions. We will appreciate any support in drilling these holes as soon as possible but at your convenience.

THL/jm

Cy: T. Larkin, ESS-4, MS-J980 7-1101
ESS-4 File

Drilled 8 holes - 4-inch dia
6/25/87 2 ft deep

at TA-33
12 inches to 36 inches
apart

Tuesday

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker,
INC-5 Group Leader, MS G776

THRU: Thomas C. Gunderson,
HSE-8 Group Leader, MS K490

DATE: June 17, 1987

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 WDP

SYMBOL: HSE8-87-655

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TA-2

A reconnaissance was made of the north and south walls of Los Alamos Canyon above the site on June 11, 1987 at the request of Merle Bunker. The last inspection was made of the canyon wall on October 6, 1985.

There have been no rock falls or movement of rocks or blocks of tuff on the slope or cliff above TA-2 since the last inspection. The security fence north and south around the site are in good condition. These provide a barrier to small rock falls or slides. The rock catcher, steel posts, cables, and wire spacers, on the north wall are in good repair.

There are a number of rocks and blocks of tuff on the slope and cliffs above TA-2 that have a potential to cause rock falls. This inspection failed to detect any rocks or block of tuff that were unstable, however, if rocks should dislodge, the slope below, rock catchers, and the security fence above the buildings should prevent the rock falls from causing any damage.

WDP:tms

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Melvin McCorkle,
ENG-DO, MS K717

DATE: July 16, 1987

THRU: Thomas C. Gunderson,
HSE-8 Group Leader, MS K490
Thomas E. Buhl,
Associate Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun and Alan Stoker,
HSE-8

SYMBOL: HSE8-87-762

SUBJECT: TEST HOLE TA-16 PACKAGE TREATMENT SYSTEM (FOR OUTFALL 005)

A test hole, requested by Anthony Drypolcher, of the Environmental Surveillance Group, (HSE-8), of the proposed site was augered to a depth of about 10 ft on July 9. There is little or no soil or fill material overlying the tuff. The tuff is light gray, moderately welded containing a few crystals and crystal fragments of quartz and sanidine, a few small rock fragments of dark gray rhyolite and pumice.

The tuff has a bearing capacity of 5,000 to 8,000 lbs/sq ft. The foundation should be set 2 to 2.5 ft into the tuff.

WDP:lh

Cy: A. Drypolcher, HSE-8, MS K490
S. Carson, Delta H. Engineering, P.O. Box 2023, Santa Fe, NM 87504
CRM-4 (2), MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Gilbert Montoya, ENG-2, MS H822

DATE: March 24, 1987

THRU: Thomas C. Gunderson, HSE-8 Group Leader, MS K490

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtyman, HSE-8

SYMBOL: HSE8-87-359

SUBJECT: TEST BORINGS MPF -3, TA-53 ENG - 2JRS-87-5205

Three test borings were completed March 18 on the beam line east of MPF-3. The three test holes were completed in tuff that is representative of the materials that will be excavated for the beam-channel. The locations of the holes were at stations 5+97, 7+90, and 12+90 of the sketch map furnished with the request memorandum.

The three test borings were drilled into and completed in to Unit 3 of the Tshirege Member of the Bandelier Tuff. There was little or no soil cover at the three locations and the lithology of the tuff penetrated at each hole was the same. The tuff is rhyolite in composition, light gray, moderately welded, containing quartz and sanidine crystals and crystal fragments, rock fragments of dense rhyolite, latite, and pumice in a gray ash matrix.

Cooling joints in the tuff will be near vertical with random orientation. To prevent large blocks from falling from the walls of the excavation, the slope of the walls should about 1 to 3. The excavation should be inspected upon completion to determine stability with regards to loose blocks caused by intersecting joints within the walls.

The moderately welded tuff can be excavated with heavy equipment. No anomalies were encountered in the tuff that would effect excavation.

Cy: T. Montoya, ENG-2, MS H822
T. Buhl, HSE-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Richard Romero, HSE-8, MS K490 DATE: August 31, 1987

FROM: William D. Purtymun, HSE-8 MAIL STOP/TELEPHONE: K490/7-0810

SYMBOL: HSE8-87-925

SUBJECT: LOG OF HOLES AT JUNCTION SR-4 AND MAIN HILL ROAD, AUGUST 19, 1987

Hole 1
Located near stream channel and pits

	(ft) From	To
Soil, silty to medium sand	0	1
Gravels, fine to very coarse sand, a few cobbles and boulders	1	3
Gravels, cobbles and boulders in a matrix of sand.	3	7

Note: Three holes in area; no penetration below 7 to 8 ft.

Hole 2
Located south of Hole 1 about 70 ft

	(ft) From	To
Soil, silty to medium sand	0	1
Gravels, fine to coarse sand, a few pebbles, cobbles and boulders	1	3
Gravels, cobbles and boulders in a matrix of sand	3	8
Clay, plastic, light gray to reddish brown	8	12

Note: Four holes in area; three holes, no penetration below 6 to 7 ft; fourth hole bottomed in clay at 12 ft.

Hole 3
East of hole 2, outside fence

	(ft)	
	From	To
Soil, silty to medium sand	0	1
Gravels, few cobbles and boulders in sand matrix	1	6
Clay, plastic	6	7

Note: Three holes in area, bottomed in clay.

Term "no penetration" indicates basalt, the auger did not "walk" as would occur in cobbles and boulders.

Samples collected using continuous core (3 1/4 inch ID) hollow stem auger. Core recovery from 0 to 60%. As sand and gravel unconsolidated, at least 3 holes were required at each location to obtain enough sample for the various analyses.

WDP:tms

Cy: T. Buhl, HSE-8, MS K490
L. Soholt, HSE-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Edward J. Hoth, ENG-2, MS M984 DATE: September 28, 1987

THRU: Thomas E. Buhl, HSE-8, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-87-1057

SUBJECT: SOIL BORINGS, NEAR INTERSECTION PAJARITO AND PUYE ROADS

Five test holes were augered at the site as requested by ENG-2. The area on top of the mesa is relatively flat; however, there are several shallow depressions and low berms that indicate the soil zone has been disturbed. The log of the test holes is given in the following table.

	Range in feet	
	Soil	Tuff
TH-1	0-3	3-12
TH-2	0-3	3-12
TH-3	0-4	4-12
TH-4	0-5	5-11
TH-5	0-4	4-12

The soil zone ranged in thickness from 3 to 5 feet. The soil is a brown clayey loam at the surface grading to a light brown sandy loam (tuff weathered in place) above the tuff.

The tuff ranged in color from a light reddish brown to a light gray. The tuff is moderately welded, composed of quartz and sanidine crystals and crystal fragments, a few small rock fragments of dense dark gray rhyolite and gray pumice.

Foundation should be set into tuff. The moderately welded tuff have a safe bearing capacity of 3,000 to 5,000 square feet. No anomalies were encountered in the tuff that would affect foundation design.

WDP:smm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Miguel Salazar, HSE-7, MS J592 DATE: October 30, 1987

THRU: Thomas Buhl, HSE-8 Section Leader, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: William Purtymun, HSE-8 SYMBOL: HSE8-87-1220

SUBJECT: INSPECTION OF SHAFTS AT AREA G, TA-54

Shaft 140, 6 ft dia, 61 ft deep; Shaft 141, 6 ft dia, 60 ft deep; Shaft 142 4 ft dia, 60 ft deep; and Shaft 143, 4 ft dia, 63 ft deep were inspected on August 30, 1987. The shafts are completed in the Tshirege Member of the Bandelier Tuff. They penetrated about 50 ft of Unit 2b and are completed into the top of Unit 2a. Both units are moderately welded. No anomolies in the tuff exposed in the shafts were noted.

Also inspected was Shaft 196, a double shaft (6 ft dia, intersecting NE 56 ft deep and SW 53 ft deep) used for disposal or storage of wastes from the Los Alamos Meson Physics Facility. Numerous fractures occured in both shafts along with blocks of tuff pulled from the shaft walls. The shafts are in the Tshirege Member with the contact between Unit 2b and Unit 2a at a depth of about 18 ft. Both units are moderately welded.

The shafts are suitable and meet the guidelines for disposal of wastes at Area G.

WDP:TB:smm

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Joe Skalski, ESS-4, MS J981

DATE: December 2, 1987

FROM: William D. Purtyman, HSE-8

MAIL STOP/TELEPHONE: K490/7-0810

SYMBOL: HSE8-87-1308

SUBJECT: NEW PUMP WELL FH-1

When the old pump is pulled from well FH-1 call us (Purtyman 7-0810 or Stoker 7-0818) and we will come over and sound the depth of the well and get a water-level measurement. FH-1 was completed at a depth of about 450 ft. (slotted screen 389 to 449 ft.) In 1980 it was reported open to a depth of 445 ft. When pulled in October 1985, the well depth was reported at 430 ft.

At the same time we will get a water-level measurement and sound the depth of well FH-2. The well was completed at a depth of 450 ft. with the lower 59 ft. consisting of torch slotted pipe. Tests on the well indicate a specific capacity of about 1 gpm/ft. of drawdown at a discharge rate of 40 gpm at the end of 40 minutes.

The current water-level is about 374 ft. below land surface. The saturated thickness of the aquifer penetrated by the aquifer is about 76 ft. When the old pump from FH-1 is installed in well FH-2 it should be set about 15 ft. off the bottom. When we sound the well we can give you the exact depth. It should be in the range of 430 to 435 ft.

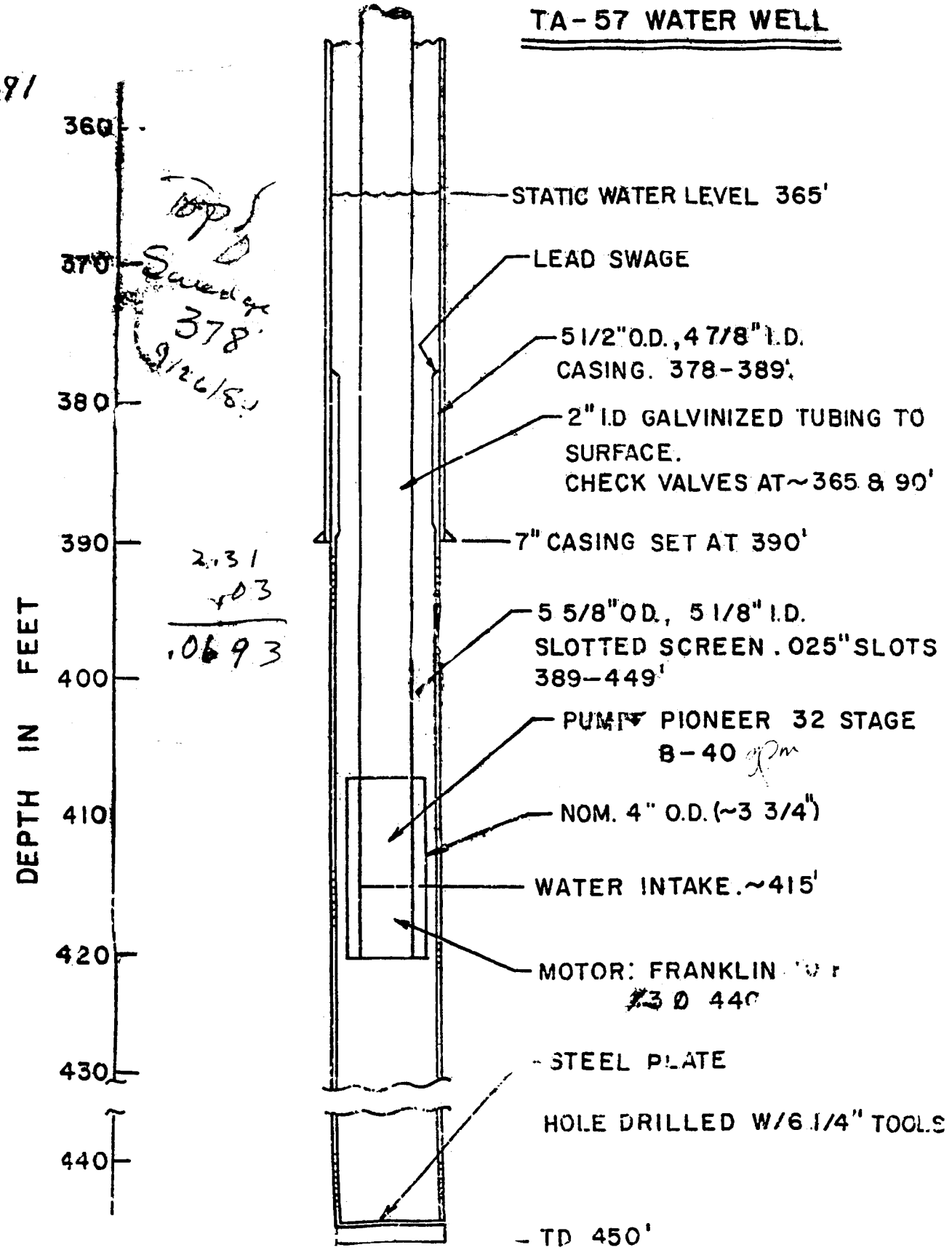
Attached is a copy of the construction record of Well FH-1 for your information.

WDP:jm

Attachment: a/s

Cy: A. Stoker, HSE-8, MS K490

TA-57 WATER WELL



Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: R. M. Joppa, ENG-1, MS K721

DATE: March 16, 1988

FROM: W. D. Purtymun, HSE-8

MAIL STOP/TELEPHONE: K490/7-0810

SYMBOL: HSE8-88-179

SUBJECT: TEST HOLE EAST JEMEZ ROAD TELEPHONE DUCT BANK

As you requested, thirteen test holes were augered along the proposed East Jemez Road Telephone Duct Bank from the bridge eastward to Technical Area (TA) 53. Attached is a log of the holes with locations keyed to Engineering Drawing No. ENG-C 45383.

Outwash of cobbles and boulders in a matrix of gravels overlie the tuff at the Bridge and eastward to TH-5 (54+40). Pockets of cobbles and gravels may be encountered eastward from TH-5 to TH-6 (71+90). Eastward from TH-6 to TA-53 the surface of the mesa is underlain by Unit 3 of the Tshirege member of the Bandelier Tuff. Unit 3 is a light gray to light brown (dependent on weathering) moderately welded tuff consisting of quartz and sanidine crystals and crystal fragments, and a few small rock fragments (pebble size) of dark gray latite and rhyolite in a gray ash matrix. The moderately welded tuff should be easy to excavate. Only a thin soil (up to 2 feet) overlies the tuff eastward from TH-6.

If I can be of further assistance please call me at 667-0810.

WDP:bjh

Cy: K. K. Martinez, PAA, EBED, MS A199

TEST HOLE	LOCATION	LOG	FT FROM	FT TO
TH-1	1 + 25	Cobbles, boulders in sands and gravels	0	5
		Reworked tuff with a few cobbles and boulders	5	8
TH-2	14 + 15	Cobbles, boulders in silts, sands, and gravels	0	8
TH-3	19 + 05	Cobbles, boulders in silts, sands,and gravels	0	8
TH-4	35 + 50	Cobbles, boulders in silts, sands, and gravels	0	5
		Tuff, light pinkish gray, moderately welded	5	8
TH-5	54 + 40	Clayey soil, light brown	0	4
		Tuff light gray, moderately welded	4	8
TH-6	71 + 90	Clayey soil, light brown	0	2
		Tuff, light gray, moderately welded	2	8
TH-7	85 + 15	Tuff, light gray, moderately welded	0	8
TH-8	99 + 65	Clayey soil, light brown	0	1
		Tuff, light gray, moderately welded	1	8
TH-9	117 + 75	Clayey soil, light brown	0	2
		Tuff, light gray moderately welded	2	6
TH-10	146 + 60	Tuff, light gray to light brown moderately welded	0	8

TH-11	156 + 80	Tuff, light gray moderately welded	0	8
TH-12	160 + 30	Tuff, light brown, weathered sandy	0	4
		Tuff, light gray moderately welded	4	8
TH-13	163 + 80	Tuff, light brown to light gray, weathered, sandy	0	8

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker, INC-5, MS-G776

DATE: November 1, 1988

THRU: Thomas Buhl, HSE-8

MAIL STOP/TELEPHONE: K490/7-0810

FROM: W. D. Purtymun, HSE-8

SYMBOL: HSE8-88-653

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TECHNICAL AREA (TA) 2

A reconnaissance was made of the north wall of Los Alamos Canyon above the site on October 28, 1988 at the request of Gerald Ramsey of the Research Reactor Group (INC-5). The last inspection was made of the canyon walls on June 11, 1987. The north wall of the canyon presents the greatest rock fall potential with damage to the buildings at the site.

There have been no rock falls or movements of rocks or blocks of tuff on the slopes or cliff above TA-2 since the last inspection. The rock catcher on the north wall above the sites (steel posts, cables, and spacers) is in good repair. The rock catcher is the primary containment of any rock falls that may occur. The security fence around the site and below the rock catcher provides the secondary containment for any rock falls that may break and penetrate the rock catcher.

A rock fall occurred in early June 1988 at TA-41 to the west of TA-2. A block of welded tuff estimated from 10 to 11 tons penetrated the rock catcher and one security type fence and came to rest at the second security fence. Other than damage to the rock catcher (which did its job) and the two fences there was no damage or injury at the site.

As stated in past inspections, there are a number of rocks and blocks of tuff on the slope and cliffs above TA-2 that are potential rock falls that could cause damage. This inspection failed to detect any rocks or blocks of tuff that were unstable. However, as the potential exists and coupled with the recent rock fall at TA-41 it is suggested that the security fence be modified to provided additional strength for the secondary containment.

The strength of the security fence could be improved by attaching and stringing 0.5-inch steel cables to reinforce the

fence. Four cables set at different heights should be set in to a dead man at the east and west end of the fence. The security fence as it is provides some secondary containment; however, with the attached cables the entire fence would take up the shock of a rock fall and provide additional protection to the building and personnel at the site.

WDP:bjh

Cy: William Radzinski, Eng-6, MS-M700
Gerald Ramsey, INC-5, MS-G776

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: William Radzinski, ENG-6, MS M700 DATE: November 10, 1988

THRU: Thomas Buhl, HSE-8, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: William D. Purtymun, HSE-8 SYMBOL: HSE8-88-671

SUBJECT: POTENTIAL ROCK FALLS ON THE NORTH WALL OF LOS ALAMOS CANYON AT TECHNICAL AREA (TA)41

The buildings and other facilities at TA-41 are located north of the east west trending stream channel of Los Alamos Canyon. The depth of the canyon at TA-41 is over 200 feet. The walls of the canyon are formed by several units of Tshirege Member of the Bandelier Tuff. The tuff of the south wall of the canyon has weathered to a steep slope that is covered with a heavy growth of trees and vegetation. The tuff on the north wall of the canyon has weathered into a slopes and benches (nonwelded and moderately welded tuff) broken shear drops or cliffs (moderately and welded tuff). There is little or no vegetation on the north wall except pine on the slopes and benches. The moderately welded and welded tuff are broken by numerous vertical to near vertical joints that formed as the tuff cooled after emplacement from the Valles Caldera. The moderately welded and welded tuff (broken by the numerous joints) that form the cliffs on the north wall form the greatest potential for rock falls that can cause damage to the buildings and facilities at TA-41.

H8-77-871 dated 12/28/77

A reconnaissance was made of the rock fall potential at TA-41 (Rock falls at Proposed Location for New Tritium Handling Facility at TA-41, Memo H8-77-871, November 28, 1977, attached). The memo describes the rock fall potential at the site and recommending remedial action with the installation of rock catchers. The rock catchers were installed across the area of greatest concern. These rock catchers took the blunt of the rock fall that occurred in early June 1988.

The rock fall that occurred in June 1988 dislodged from the second bench, rolled down the slope and pitched over the first bench into the rock catcher and two security fences on the slope. It came to rest on slope after it had penetrated the rock catcher and the security fences. Other than damage to the rock catcher and the fences there was no damage or injuries at the site.

A earlier rock fall (late 1950s or early 1960s) penetrated the security fence and came to rest next the building. This occurred along the western part of the site. Damage was confined to the fence.

A reconnaissance was made of the north wall of the canyon above TA-41 on October 28, 1988 in the company of Bill Radzinski, Eng-6. The inspection failed to detect any rock or blocks of tuff that are unstable and could possible become a hazard as a rock fall. Potential rock falls are impossible to detect. They are triggered by weathering, excessive precipitation, freezing and thawing, and possible seismic activity.

The emplacement of the ash flows and the condition of the tuff units that exist above the site indicate that the potential for rock falls are present. This potential and the occurrence of past and the recent rock fall at the site indicate that protection should be taken in the areas not covered by the rock catcher.

Protection to the buildings and personnel can be accomplished by using the security fence as a rock catcher; however, these fences must be modified. This can be accomplished with additional posts (5-inch diameter steel cemented up right in 6-foot holes) and by attaching four lines of 0.5-inch diameter cables to the posts and existing posts and fence. The security fence thus modified will take up the shock of a rock fall and provide additional protection to the buildings and personnel at the site.

Rock catchers similar to the present ones should be considered in the areas designated as high risk areas (buildings near the fence or little slope between the fence and building).

WP/TB:jm

Attachment: a/s

Cy: B. Banks, WX-5, MS G780

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Stanley Zygmunt, HSE-7, MS E518

DATE: July 7, 1988

THRU: Marjorie Martz Emerson, HSE-8

MAIL STOP/TELEPHONE: K490/7-0810

FROM: William B. Furtymun, HSE-8

SYMBOL: HSE8-88-368

SUBJECT: METEOROLOGICAL TOWER TEST HOLES

In response to memo (HSE-7-88-256), five test holes were augered on June 22 at the proposed site for the meteorology tower. The site is located on the top of Two-Mile Mesa, north of TA-40. The soil forming the surface of the mesa is well developed; however, it thins to the north at the edge of the canyon. The tuff underlying the soil, ranges from light gray to a brick red, depending on the amount of weathering. It is a moderately welded tuff containing quartz and sanidine crystals and crystal fragments and a few rock fragments of dense rhyolite, latite, and pumice in an ash matrix. The foundation for the tower should be set through the soil zone into the tuff. The moderately welded tuff has a safe bearing capacity of about 5,000 lbs/square foot.

You indicated the anchors at 120 and 240 feet from the tower will be set below the frost line in the soil or tuff. The soil or tuff underlying the tower and anchors should be compacted prior to pouring the concrete. After the concrete has set, the fill material along side of the foundation and anchors should be compacted to minimize the infiltration of precipitation.

No anomalies were encountered in the tuff that would affect the foundation or anchor design. The logs of the test holes are as follows:

Log of Holes	(Feet) From	To
Center Location		
Soil, light brown, clayey	0	4
Tuff, light gray, moderately welded, weathered to light brownish gray from 4 to 6 ft.	4	12
22.5° - 240 ft. Location		
Soil, light brown, sandy	0	2
Tuff, light gray, moderately welded	2	13
142.5° - 120 ft. Location		
Soil, light brown, clayey	0	4
Tuff, light pinkish brown to brick red, moderately welded, weathered	4	11
Tuff,light gray, moderately welded	11	13
142.5° 240 ft. Location		
Soil, light brown, clayey	0	4
Tuff, light gray to light pink, moderately welded	4	9
Tuff, light reddish brown to brick red, moderately welded	9	13
262.5° - 240 ft. Location		
Soil, light brown, clayey	0	3
Tuff, light gray moderately welded	3	13

WDP:MME:smm

Cy: R. Koenig, HSE-7, MS E518
B. Bowen, HSE-8, MS K490

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: John Harper, HSE-7, MS-J592 DATE: May 4, 1989

THRU: Thomas Buhl, HSE-8, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

FROM: Bill Purtymun, HSE-8 SYMBOL HSE8-89-265

SUBJECT: **COMPLETION INSPECTION OF SHAFTS AREA G, TA-54**

The following is a list of shafts inspected on May 1, 1989. The shafts are completed in the Tshirege Member of the Bandelier Tuff. They penetrated about 50 feet of Unit 2B, and are completed into the top of Unit 2A. Both units are a moderately welded tuff. No anomalies were detected in the tuff exposed in the walls of the shafts. The shafts are suitable and meet the guidelines for disposal of wastes at Area G (H7-70-660, December 10, 1980).

Shaft No.	Diameter (ft)	Approximate Depth (ft)
142	4	65
143	4	65
144	6	65
145	6	65
146	6	65
147	4	65
148	4	65
149	4	65

BP:lrc

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Gilbert M. Montoya, HSE-7, MS E520 DATE: July 7, 1989

FROM: W.D Purtyman and Alan Stoker, HSE-8 MAIL STOP/TELEPHONE: K490/7-5021

SYMBOL: HSE8-89-421

SUBJECT: LOG SIX TEST HOLE TA-35, LAPRE REACTOR (JUNE 26-30, 1989)

Test hole numbers are in sequence that they were drilled, ie. line west to east (holes 1, 2, 3, 4, and 5) and south of line (hole 6).

	Feet From	Feet To
Test Hole 1		
Asphalt and gravel	0	1
Fill, gravels and clay	1	3
Tuff, light gray, moderately welded tuff, quartz, sanidine crystals, and crystal fragments, few very small rock fragments of pumice and rhyolite in gray ash matrix; fractures at 8 ft. (45 degrees) and at 21 ft. (near horizontal) clay filled; moisture content about 15% by volume (tuff in place, not fill)	3	23
Test Hole 2		
Asphalt and gravel	0	1
Fill, tuff and clay, boulders of tuff at 3, 5, and 6 ft, brown clay 6.5 to 8 ft., mixture of clay, tuff, and tuff boulders 8 to 16 ft.	1	16
Tuff, light gray, similar to that in hole one (1), moisture content about 15% by volume, horizontal fracture at 20 ft. clay filled (tuff in place, not fill).	16	23
Test Hole 3		
Asphalt and gravel	0	1
clay and gravels	1	2
Fill, medium to course sand apparently placed around		

reactor, moisture content est. 10 to 15% by volume.	2	19
Concrete pad at 19 ft., Pulled out with bit. Stainless steel tubing about 1/4 in. in diameter, 6 ft. long. Hole caved to 3 ft. when auger was removed.		19
<u>Test Hole 4</u>		
Asphalt and gravel	0	1
Clay and gravel	1	2
Fill, alternating clay, tuff, and tuff boulders, about 25% in clay, less in tuff 15 to %.	2	17
Tuff, light gray, similar to that in Hole 1 and 2 moisture content about 15% by volume (tuff in place, not fill).	17	23
<u>Test Hole 5</u>		
Ashpalt and gravel	0	1
Silty, clayish, brown soil, (in place, not fill)	1	4
Tuff, light gray, similar to that in Holes 1, 2, and 4, fracture at 11 ft.. (horizontal) and 18 ft. (45 degrees) clay filled (tuff in place, not fill).	4	23
<u>Test Hole 6</u>		
Asphalt and gravel	0	1
Fill, alternating clay and tuff, tuff boulders increase below 13 ft. clay lens 14 to 15 ft..	1	16
Tuff, light gray, similar to that in Holes 1, 2, 4, and 5 (tuff in place, not fill).	16	23

The test holes were filled with cement (1.5 yd 3/ 200 lbs. of gravel, 100 lbs of bentonite) on June 30, 1989.

WDP/AS:cac

Cy: Eddie Lujan, HSE-8 , MS K490
Lars Soholt, HSE-8, MS K490

To: William Radzinski ENG-6, MS-D451

From: W. D. Purtymun, HSE-8

Subject:POTENTIAL ROCK FALL ON THE NORTH WALL OF LOS ALAMOS CANYON AT TECHNICAL AREA 41

An inspection of the rock fall potential at TA-2 was made on November 29, 1989 at the request of INC-5. At the same time a brief inspection was made of the rock fall potential at TA-41. The last inspection was made October 28,1988.

The inspection failed to detect any rock or blocks of tuff forming the slope and rim rock of the canyon that are unstable and could possible become a hazard as a rock fall. Potential rock falls are near impossible to detect as they are triggered by weathering, erosion, excessive precipitation, freezing and thawing, and possible seismic activity.

The physical characteristics of the tuff and block of tuff on the slope and cliffs above the site indicate that potential for rock falls are present. This potential and the occurrence of past (late 1950s or early 1960s) and the recent rock fall (1988) at the site indicate that protection should be taken in the areas not covered by the rock catcher.

Other than the security fence from Bldg. 4 to the western end of the site there is no protection from rock falls. Additional protection could be added by modifying the fence with 0.5 inch steel cable. This and other suggested remedial action related to rock fall at the site is covered in the enclosure ((HSE8-88-6710).

Cy:C.B. Banks, WX-5, MS-G780

Memo never sent - file WP41.DOC recovered from BD Purtymun's computer, dated 12/7/89

See memo #HSE-8:90-62

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Merle Bunker, INC-5, MS G776 DATE: January 29, 1990

THRU: Thomas Buhl, HSE-8, MS K490 MAIL STOP/TELEPHONE: K490/7-0810

TB for WDP 1/31/90

FROM: William Purtymun, HSE-8 SYMBOL: HSE-8:90-62

SUBJECT: STABILITY OF ROCKS ON WALLS AND SLOPES OF LOS ALAMOS CANYON ABOVE TECHNICAL AREA (TA) 2

A reconnaissance was made of the north and south walls of Los Alamos Canyon above TA-2 on November 29, 1989 at the request of Mike Kaufman (INC-5). The last inspection was made of the canyon walls on October 28, 1988.

There have been no rock falls or movements of rocks or blocks of tuff on the slopes or cliff above TA-2 since the last inspection. The north wall of the canyon presents the greatest potential for rock fall that could damage the buildings at the site. The rim of the north wall of the canyon is formed by near vertical to vertical cliffs underlain by a steep slope that extends to the canyon floor. There are only a few trees on the slope. Major rock fall that could cause damage would be from the tuff outcrops that form the rim of the canyon. This potential for rock fall has been recognized as a rock catcher (steel posts set in to concrete, cables, and cable spacers) has been installed on the slope. A security fence for the site is located 10 to 20 ft.down from the rock catcher. The rock catcher on the slope is in good repair. The rock catcher is the primary containment of any rock fall that may occur. The security fence around the site and below the rock catcher provides the secondary containment for any rock fall that may penetrate the rock catcher.

The south wall of the canyon above the site has a low potential for rock fall as this steep, north facing slope has only a few small tuff outcrops that could contribute rock fall blocks. The slope is covered with a growth of trees that would contain and break up a rock fall block if it should occur. The security fence at the base of the slope would also serve as a rock catcher.

As stated in previous inspections, there are a number of rocks and blocks of tuff on the slope and cliffs above TA-2 that have the potential for rock falls that could cause damage. This inspection failed to detect any rocks or blocks of tuff that were iminently unstable. However, as the rock fall potential exists it is suggested that the security fence on the north canyon wall be modified to provide additional strength for secondary containment.

The strength of the security fence could be improved by attaching and stringing 0.5-inch steel cables to reinforce the fence to take additional shock. Four cables set at different heights should be set into anchors at the east and west ends of the fence. The security fence as it exists provides secondary containment; however, with the attached cables the entire fence would take up the shock of a rock fall and provide additional protection to the building and personnel at the site.

WP:TB:smm

Cy: W. Radzinski, ENG-6, MS D415
M. Kaufman, INC-5, MS G776

Los Alamos

Los Alamos National Laboratory
Los Alamos, New Mexico 87545

memorandum

TO: Micheline Devaurs, HSE-DO/ER, MS K491 DATE: June 19, 1990

FROM: A. Stoker and S. McLin, HSE-8 MAIL STOP/TELEPHONE: K490/7-0817

SYMBOL: HSE-8:90-538

SUBJECT **REVIEW OF INSTALLATION WORK PLAN SECTION (HSE-DO/ER:131)**

We have reviewed the subject draft and offer some comments and suggestions. The first several paragraphs identify some general issues.

From an overall viewpoint, we basically prefer the modelling approach being taken in this effort compared to others seen recently. There is a more focused attempt to utilize information from the actual setting.

In terms of the objectives stated in your cover memo, only objective 2 appears to be fulfilled, and objective 3 is partly addressed. However, there doesn't seem to be any attempt, either by comparing alternate cap designs or by comparing a cap to no cap, to assess the advantages of capping. This objective seems essential to address if the Workplan is to propose capping and prevention of infiltration as a principal generic remediation method.

Some of the assumptions should probably be adjusted to more completely reflect actual knowledge of the geohydrology and other characteristics. For example, why not call tritium the non-reactive tracer. Tritium is present in the wastes, and moves directly as part of the water molecule. To assume plutonium is non-reactive simply invites unnecessary criticism when it is known to adsorb fairly well on the tuff. Further, if you want to model plutonium, why not use some of the information developed by Essington and Polzer over the years on adsorption on the local tuff?

We strongly endorse and applaud the effort to represent the actual geologic section. Again, some adjustments would make better use of actual knowledge. The geologic section at TA-21 can be interpolated with reasonable confidence using data from Test Wells 2 and 3 (T-2 and T-3) and the recently drilled water supply well Otowi 4 (O-4). The approximate locations of these wells are depicted in the attached figure. (Test wells T-2 and T-3 were drilled in November of 1949.) The attached table summarizes our interpretation of the geologic section likely to be encountered beneath TA-21. This table also includes suggested values of porosity and intrinsic permeabilities

interpreted from US Geological Survey records and the in-situ studies performed at Area G by Bendix Field Engineering Co. in the mid-1980s. Bill Purtymun provided much of the insight in suggesting appropriate values.

The following comments are keyed to paragraphs in the draft, which we numbered sequentially for convenience of reference.

Paragraph 2 (Abstract). We don't see any discussion in the draft to indicate how effective the capping is at inhibiting movement. Seems you would at least need to run a comparison with no cap. We don't find any clear identification in the discussion as to which parameters are the most influential.

Paragraph 3. We don't find any discussion or supporting analysis of the effect of the engineered barriers or monitor station locations.

Table 1. What is the rationale for making the "near" and "far" field saturated hydraulic conductivities so different?

Paragraph 6. If you have not already done so, we suggest using some of the data developed by BFEC in their study of Areas L and G to establish the parameters for the relative permeability and capillary pressure models.

Paragraph 8. Were the Langmuir parameters representative of any particular contaminant-matrix combination? We suggest that you get some input from Ed Essington and Eric Fowler (EES-15) about parameters that could represent plutonium on local tuff based on their experiments over the years.

Paragraph 9. Again, try to get some real sorption data from Essington and Fowler.

Paragraph 10. Calling the generic non-reactive tracer "plutonium" will not serve the Laboratory very well from a perception standpoint. We suggest you either call it tritium, which is present in the waste and moves with the water as part of the water molecules, or simply use the "non-reactive tracer" terminology without associating it with a particular contaminant. To model a "reactive" tracer, plutonium might be acceptable if appropriate parameters could be used.

Paragraph 11. This is a much better attempt to model the real geohydrologic section that any previous modelling effort and we applaud your efforts. We suggest you take the next step and make use of the good data that is available on what the geologic section beneath TA-21 really is to refine Figure 10 and Table 2.

Our best current interpretation is presented in the attached Table. This conceptual section would also represent many other locations fairly well. It includes some features, in addition to those in your Figure 10 and Table 2, that may be important in terms of migration. Specifically we call your attention to the inclusion of a Basalt layer interfingered in the Puye Conglomerate and to the Totavi Lentil, a cobble and boulder layer, just below the fanglomerate member where the water surface of the main aquifer often appears. The table also includes some suggested representative values for porosities and intrinsic permeabilities from actual field measurements. An additional detail is the fact that the Tshirege tuff, the uppermost portion of the Bandelier tuff, generally has four major cooling units, each with different hydrologic properties, but generally decreasing permeability with depth (see footnotes in table). The point you note about inapplicability of Darcy's law to cobbles may also apply to modelling of the Totavi Lentil.

Paragraph 12. Wouldn't it be more appropriate to assume all the contaminant to be in the crushed tuff? The cobbles and gravel were added as "clean" capping materials.

Paragraph 14. Please call the non-reactive material tritium or don't associate it with a particular contaminant. In the case of tritium, the half-life is about 13.5 years so there would be increasingly greater reduction in concentrations with time.

Paragraph 17. As noted before, it should not be necessary to rely on "distant site" (NTS we presume ?) data if you would talk to Essington and Polzer and get some local data.

Paragraph 18. We agree and endorse the need for more actual field data to provide a basis for better modelling. One detail, in relation to the discussion of fracture distribution and characteristics, is that the in-situ BFEC work at Area G found no major differences between measured conductivities in the injection tests in fractured and unfractured zones.

AS:SM:bjh

Cy: T. Buhl, HSE-8, MS K490

INTERPOLATED GEOLOGIC SECTION FOR TA-21
Based on Logs from T-2, T-3, and O-4

	Thickness (feet)	Depth (feet)	Porosity (percent)	Permeability (darcies)
Bandelier Tuff				
Tshirege Tuff	350	350	30-40	0.1-0.5[a]
Unit 2b				0.5-2[b]
Unit 2a				0.3-1[b]
Unit 1b				0.6[b]
Unit 1a				0.2-0.3[b]
Tsankawi pumice	10	360	50-60	0.5
Otowi tuff	230	590	40-60	1.0
Guaje pumice	40	630	55-65	0.5
Puye Conglomerate				
Fanglomerate[c]	100	730	35	5
Basalts	125	855	10-15	1
Fanglomerate	360	1215	35	5
Totavi Lentil[d]	70	1285	50	400
Water Surface		1285		

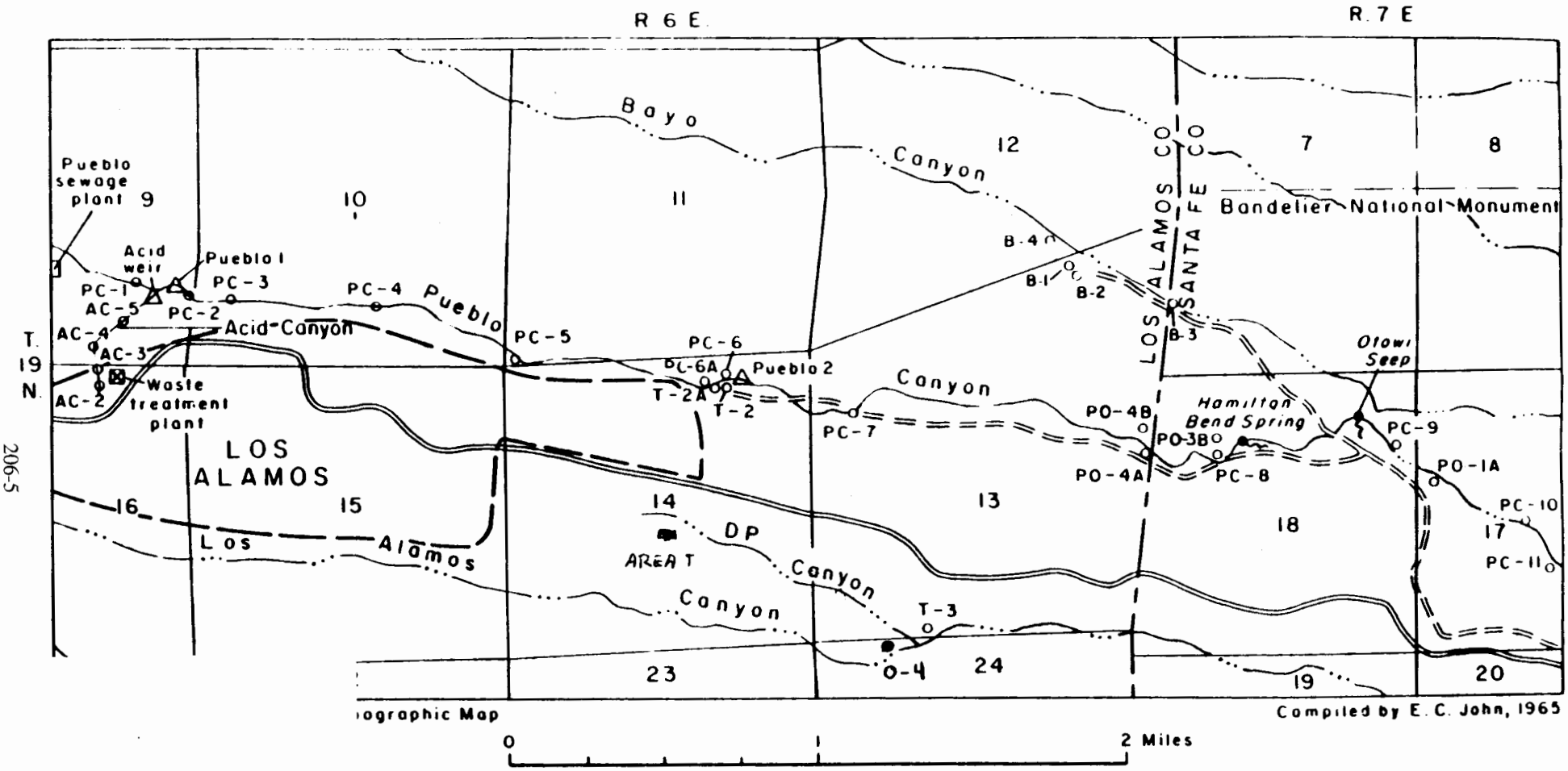
NOTES:

[a] Ranges of permeabilities from US Geological Survey work in 50s and 60s probably representing a reasonable average for the Tshirege member. BFEC work at Area G included a water injection test that gave a range of about 0.5 to 1.0 with an average of about 0.8 for all four units.

[b] Ranges of permeabilities for each individual cooling unit of the Tshirege member from BFEC work, includes values from in-situ vacuum and water injection tests and laboratory analyses of cores.

[c] The upper fanglomerate layer contains one significant clay layer, 5-10 feet thick, that is probably responsible for a perched zone of water that occurs at depths of 117 ft in T-2 and about 253 ft in O-4.

[d] The Totavi lentil includes large cobbles and boulders a foot or more in dimension in a matrix of sand and clays, permeability from pump tests in T-2 and T-3.



EXPLANATION

o PC-6
Test or observation well

△ Pueblo 1
Surface water sampling station

ition of well, spring, stream, and alluvium sampling points in Acid, Pueblo, and Bayo Canyons.

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GROUND WATER BRANCH PROGRAMS WITH THE U.S. ATOMIC ENERGY COMMISSION AND THE LOS ALAMOS SCIENTIFIC LABORATORY AT LOS ALAMOS, NEW MEXICO, 1946-1972

by

William D. Purtymun

The Ground Water Branch operating out of the Albuquerque began a series of studies at Los Alamos in 1946 that continued to 1972. The contracts were with the Atomic Energy Commission [AEC (now U.S. Dept. of Energy)] and with the Los Alamos Scientific Laboratory [LASL (now Los Alamos National Laboratory)]. The studies were mainly related to low level radioactivity disposal and their effects on the environment, and with the development of a municipal and industrial water supply.

The District Engineers during this period were C.V. Theis, C.S. Conover, W.E. Hale, and S.W. West. Project Chiefs were R.L. Griggs (1946-1954), J.E. Weir (1954-1957), J.H. Abrahams (1957-1962), W.D. Purtymun (1962-1969), and T.E. Kelly (1969-1972).

Little was known of the geology and water resources of the area in 1946 so that basic investigations were conducted to determine geology, the occurrence of surface and ground water, quality of water (waste and natural), and the effects of waste disposal on the environment. The number of reports that resulted from the investigations and studies reflects the work of the Water Resource Division. These early efforts laid the basic frame for work that is being carried on today (1990) at Los Alamos (i.e., environmental restoration and monitoring; and long ranging planning and development of a dependable municipal-industrial water supply).

The reports by the Survey were published (Water-Supply Papers and Prof. Papers) and unpublished (Open-file and Administrative release) reports. A history of the Ground Water Branch (type of programs and results) and personnel that worked at Los Alamos is best exemplified by listing reports and authors. Other people that spent short tours of duty at Los Alamos that are not mentioned as authors are Fred Bush, Al LaSala, and George Dinwiddie. Drilling of test wells and moisture access tubes were performed by the Survey's Hydrologic Laboratory in Denver, with Ivan Johnson and Gene Shuter supervising.

Copies of published and unpublished reports (many are not accessible, especially the Admin rel reports in Survey libraries) are available for inspection at the Environmental Community Reading Room, 2101 Trinity Drive, Los Alamos, NM. The Reading Room is maintained by the Los Alamos National

Laboratory as part of the operating permit granted to the Laboratory by the U.S. Environmental Protection Agency.

I. WATER-SUPPLY PAPERS AND PROFESSIONAL PAPERS

Report titles are listed below and indicate respective programs. Also shown are report number, year issued, and author or authors. These data are sufficient to identify reports for documentation of the history of Survey involvement at Los Alamos, and represents a comprehensive literature search.

1. "Geology and Hydrology of the Valle Grande and Valle Toledo", WSP-1619Y, (1963), C.S. Conover and C.V. Theis.

2. "Pumping Tests in the Los Alamos Canyon Well Field", WSP-1619-I, (1962), C.V. Theis and C.V. Conover.

3. "Geology and Ground-Water Resources of the Los Alamos Area", WSP-1753, (1964), R.L. Griggs.

4. "An Aquifer Evaluation of Aquifer and Well Characteristics", WSP-1809D, (1963), R.L. Cushman.

5. "Distribution of Moisture in Soil and Tuff", Prof-Paper, 424-D, (1961), J.H. Abrahams, J.E. Weir, and W.D.Purtymun.

6. "Movement of Snowmelt Water in the Alluvium", Prof-Paper, 450-B, (1962), J.H. Abrahams, E.H. Baltz, and W.D. Purtymun.

7. "Source of Carbon Dioxide in Tuff", Prof-Paper 650-B, (1969), J.L. Kunkler.

8. "The Measurement of Atmospheric Pressure and Subsurface-Gas Pressure In Tuff", Prof-Paper 650-D, (1969), J.L.Kunkler.

9. "Equipment Used to Map Shafts", Prof-Paper 424-D, (1961), J.E. Weir and E.H. Baltz.

10. "Distribution of Radioactivity in Alluvium", Prof-Paper, 550-D, (1966), W.D. Purtymun, G.L. Jackson, and E.C. John.

11. "Development of Ground-Water Supplies on the Pajarito Plateau", Prof-Paper 650-D, (1969), W.D. Purtymun and J.B. Cooper.

II. UNPUBLISHED REPORTS

The unpublished reports consist of Open-file reports and Administrative reports released to the AEC and LASL. These reports as previously stated are available for inspection at the LANL Library at Los Alamos. The reports fall in to three categories: Water Supply, Waste Studies, and General Reports. These are discussed in order. The general category contains reports of specific locations or sites related to geohydrology, waste studies, or engineering. Brief tiles, type of issue and date, and author or authors are used to document this section of the history and activities of the Ground Water Branch.

A. WATER SUPPLY

Water supply studies began in 1947 in the Valle Grande west of Los Alamos. When a supply could not be obtained there, test wells drilled along the Rio Grande indicated a supply could be obtained from the main aquifer in Los Alamos and Guaje Canyons east of Los Alamos. The main aquifer is the only aquifer in the area capable of municipal and industrial supply. The aquifer rises westward from the Rio Grande beneath the plateau (Los Alamos). The water in the aquifer moves is eastward beneath the plateau with some discharge through seeps and springs into the Rio Grande in White Rock Canyon. The depth of water ranges from over 1,200 ft along the western edge of the plateau to about 600 ft along the eastern edge. Test holes and wells located near the Rio Grande were artesian. Eventually 13 wells were drilled from 1946 through 1952 in Los Alamos and Guaje Canyons east of Los Alamos. Their depths ranged from 870 to 2,000 ft with water levels from near land surface (some were artesian when completed) to 470 ft. Their yields ranged from 300 to 600 gpm. One additional well was added to the Los Alamos field in 1960 (550 gpm) and another well added to the Guaje field in 1964 (350 gpm). Three high yield wells (600 to 1,500 gpm) were drilled on the Pajarito Plateau in 1965 through 1967. The completed depth of these wells ranged from about 2,300 ft to 2,500 ft. The Ground Water Branch selected well sites, determined geology, performed aquifer tests, and advised on well construction. Using the hydrologic data collected during the construction of these early wells, four additional high yield wells (1,000 to 1,500 gpm) were developed on the plateau in the period 1980-1990 by the Department of Energy and the Laboratory.

The Survey collected hydrologic data on a weekly and monthly basis on the aquifer when each well was placed on line. These data were reviewed annually and results submitted in a letter report to the AEC with recommendations for well and well field operations for the coming year. Few of the letter reports survived the different administrations; however, the hydrologic data (1947-1971)

scattered throughout a number documents has been compiled into a single Laboratory report (LA-5040-MS, 1972). The Laboratory has continued to compile this data and issue annual reports which are invaluable to insure a continuing dependable water supply. Survey reports related to documentation and development of water supply included the following reports:

1. "Site Location for a Supply Well adjacent to State Road 4", Admin rel (1961), W.D. Purtymun and R.L. Cushman.

2. "Site Location For A Supply Well in Guaje or Rendija Canyon", Admin rel (1963), W.D. Purtymun.

3. "Site Location for a Supply Well in Pajarito Canyon", Admin rel (1964), W.D. Purtymun and E.C. John.

4. "Site Locations for Five Water Supply-Wells", Admin rel (1965), W.D. Purtymun and J.B. Cooper.

5. "Pumping Tests of February and March 1965 of Guaje Well No. 6", Admin rel (1965), J.B. Cooper.

6. "Records of Water-Supply Wells Guaje 6, Pajarito PM-1 and PM-2", Admin rel (1966), J.B. Cooper, W.D. Purtymun, and E.C. John.

7. "Records of Water-Supply Well Pajarito PM-3", Open-file rept (1966), W.D. Purtymun.

B. WASTE STUDIES

The initial waste studies were to determine the effect of the release of untreated liquid radioactive wastes from 1943-50, and of treated wastes from 1950-1964 on the environment. The main treatment plant released effluents into Acid-Pueblo Canyon, while the smaller treatment plant released effluents in to DP-Canyon, a tributary to Los Alamos Canyon near the middle of the plateau. Acid-Pueblo is confluent with Los Alamos Canyon, which in turn is a tributary to the Rio Grande. The initial studies were made to establish the chemical and radiochemical quality of surface water, ground water in the alluvium (observation wells generally less than 25 ft in depth), perched water in the fanglomerate (test well 120 ft in depth) and basalts (test well 210 ft) in Pueblo Canyon, and the main aquifer (7 test wells and all supply wells with water levels from near land surface to about 1,200 ft). Surface water in the Rio Grande and Rio Chama were also part of the monitoring network. This monitoring network is part of the present monitoring system used by the Laboratory (1990).

The Survey reports related to monitoring of the quality of water are as follows:

1. "Chemical and Radiochemical Quality of Surface and Ground Water 1949-1955", Admin rel (1962), J.E. Weir, J.H. Abrahams, J.R. Waldon, and W.D. Purtymun.

2. "Chemical and Radiochemical Quality of Surface and Ground Water, 1956 through June 1957", Admin rel (1966), J.H. Abrahams.

3. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1957 through June 1961", Admin rel (1966), J.H. Abrahams and W.D. Purtymun.

4. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1961 through June 1962", Admin rel (1966), W.D. Purtymun.

5. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1962 through June 1963", Admin rel (1966), W.D. Purtymun.

6. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1963 through June 1964", Admin rel (1966), W.D. Purtymun and E.A. Enyart.

7. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1964 through June 1965", Admin rel (1966), W.D. Purtymun.

8. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1965 through June 1966", Admin rel (1967), W.D. Purtymun and J.L. Kunkler.

9. "Chemical and Radiochemical Quality of Surface and Ground Water, July 1966 through June 1967", Admin rel (1969), W.D. Purtymun and J.L. Kunkler.

10. "U.S. Geological Survey Chemical and Radiochemical Analyses of Water in the Los Alamos Area, 1960 through 1968", Admin rel (1969), W.D. Purtymun.

11. "Hydrology of Waste Disposal Systems, Los Alamos, New Mexico, 1949 through 1961", Admin rel (1964) Submitted for WSP, W.D. Purtymun, J.H. Abrahams, and, J.R. Avrett.

The chemical and radiochemical quality of water and hydrologic data in these and later reports related to disposal areas. These data are summarized in an informal Laboratory report entitled, "Geohydrology of the Pajarito Plateau with reference to Quality of Water 1949-1972" (W.D. Purtymun). The quality of water data from the Survey is also found in a Laboratory report (LA-8890-ENV, DOE/ENV-0005/30, 1981).

A new waste treatment plant for radioactive liquid wastes was built in 1960. The effluent from this plant is released in to Mortandad Canyon. The Ground Water Branch did a preliminary investigation of the canyon and set up a monitoring system (observation holes in the alluvium that range in depth from 11 to 67 ft). The Survey also installed a test well into the main aquifer (WL 960 ft, depth 1065 ft), moisture access holes, and gaging stations in Mortendad Canyon. The Survey reports related to evaluation to the release of effluents in to this canyon are as follows:

1. "Preliminary Report on the Geology and Hydrology of Mortandad Canyon", Open-file rept (1963), E.H. Baltz, J.H. Abrahams, and W.D. Purtymun.

2. "Progress Report on the Hydrology of Mortandad Canyon, July 1961 to June 1963", Admin rel (1964), W.D. Purtymun.

3. "Disposal of Industrial Effluents in to Mortandad Canyon, Los Alamos County", Admin rel (1966), Submitted for a WSP, W.D. Purtymun.

C. GENERAL REPORTS

The following reports were prepared by the Ground Water Branch at the request of AEC or the Laboratory. These reports relate to the geohydrology or waste investigations at Los Alamos.

1. "Geology of the Micro-Seismograph Station at S-Site", Admin rel (1968), W.D. Purtymun.

2. "Geology and Hydrology of Area G, Mesita del Buey", Admin rel (1966), W.D. Purtymun (reprinted as LA-4660 by LASL).

3. "Geology and Hydrology of White Rock Canyon from Otowi to Frijoles", Admin rel (1966), W.D. Purtymun (reprinted as LA-8635-MS by LASL).

4. "Records of Wells, Test Holes, Springs, and Surface Water Stations in the Los Alamos Area", Open-file rept (1967), E.C. John, E. Enyart, and W.D. Purtymun.

5. "Geology and Physical Properties of the Near-Surface Rocks at Mesita del Los Alamos", Open-file rept (1966), W.D. Purtymun (reprinted as LA-3728 by LASL).

6. "Distribution of Moisture and Radioactivity is the Soil and Tuff at the Contaminated Waste Pit near TA-21", Open-file rept (1966), W.D. Purtymun and W.R.Kennedy.

7. "Physical Properties of the Tshirege Member of the Bandelier Tuff with Reference to Use as Building and Ornamental Stone", Open-file rept (1965), W.D. Purtymun and F.C. Koopman.

8. "Geologic and Hydrologic Environment of Radioactive Waste-Disposal Sites at Los Alamos", Admin rel (1963), J.H. Abrahams.

9. "Equipment Used to Study Movement of Water in the Bandelier Tuff", Admin rel (1966), J.H. Abrahams.

10. "Hydrologic Characteristics of the Tshirege Member of the Bandelier Tuff with Reference to the Injection of Treated Low-Level Radioactive Liquids", Admin rel (1964), F.C. Koopman and W.D. Purtymun.

11. "Tests and Design of Disposal Wells", Admin rel (1967), (reprinted in part as LA-11511-MS by LASL) W.D. Purtymun and E.A. Enyart.

12. "Volume, Rate, and Energy of Air Transferred Through Test Holes in the Bandelier Tuff", Admin rel (1968), (reprinted in part as LA-5725-MS by LASL), W.D. Purtymun and F.C. Koopman.

13. "Geology and Hydrology of TA-49, Frijoles Mesa, Los Alamos County, New Mexico", Admin rel (1962), (reprinted in part as LA-11135-MS by LASL), J.E. Weir and W.D. Purtymun.

14. "The Distribution of Moisture in Soil and Underlying Tuff at TA-49, Frijoles Mesa Los Alamos County, New Mexico", Admin rel (1962), W.D. Purtymun.

15. "Physical Properties of and Movement of Water in The Bandelier Tuff, Los Alamos and Santa Fe Counties, New Mexico", Admin rel (1963), J.H. Abrahams.

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