November, 1985

Delta H Engineering, Ltd.

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AREA P LANDFILL CLOSURE PLAN

LOS ALAMOS NATIONAL LABORATORY

LOS ALAMOS, NEW MEXICO

Prepared for:

LOS ALAMOS NATIONAL LABORATORY
WASTE MANAGEMENT GROUP HSE-8
LOS ALAMOS, NEW MEXICO 87545

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VOLUME I OF II

TA-16 AREA P LANDFILL CLOSURE AND POST-CLOSURE PLAN

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

Originally Prepared by:

DELTA H ENGINEERING, LTD.
Santa Fe, New Mexico

November 1985

Modified by:

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL SURVEILLANCE GROUP HSE-8
LOS ALAMOS, NEW MEXICO 87545

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VOLUME I OF II

CLOSURE AND POST-CLOSURE PLAN FOR TA-16 AREA P LANDFILL

Facility ID No.....NM890010515
Facility Name.....Los Alamos National Laboratory
Legal Owner.....United States Department of Energy
Address.....Los Alamos Area Office
City, State.....Los Alamos, New Mexico 87545
Contact Person.....Mr. Harold Valencia, Area Manager
Phone.....(505)667-5105
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1.0 INTRODUCTION

Technical Area 16 Area P (TA-16 Area P) at the Los Alamos National Laboratory (LANL) has been used since the 1950's as an industrial landfill to dispose of residues resulting from burning high explosive (HE)-contaminated equipment and trash. The landfill is regulated under New Mexico Environmental Improvement Division's (NMEID) Hazardous Waste Management Regulations (HWMR) because residues containing barium in excess of EP toxicity limits (D005) have been placed in the landfill after 1980.

The recognition that Area P was a regulated hazardous waste landfill occurred in September 1984, when two of six samples of the TA-16 thermal treatment residues were found to be in excess of the EP toxicity limit for barium. Infrequent waste disposal operations at Area P were discontinued shortly thereafter and have never resumed. The late discovery of the landfill's regulatory status, and its existence prior to the Resource Conservation and Recovery Act (RCRA) have complicated compliance with interim status regulations. In addition, the TA-16 Area P landfill was never included in any RCRA Part A or B permit applications, or Part B permit revisions. Furthermore, LANL has chosen not to certify ground-water compliance at the landfill. Consequently, LANL was required under loss of interim status provisions to submit a closure and post-closure plan. Thus 40 CFR Part 265.1(b) applies, and dictates that applicable Part 265 closure and post-closure responsibilities be fulfilled. Hence, interim status closure and post-closure guidelines were originally followed for the TA-16 Area P landfill, even though this area did not enjoy interim status.

It is now recognized that once the Part B RCRA permit for LANL is issued, then the Area P landfill will be subject to applicable 40 CFR Part 264 closure and post-closure requirements, even though

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Area P has not been explicitly included in the Part B application. Hence this closure plan has been modified to reflect these changes. These modifications are submitted with the intent that a smooth transition of applicable regulatory requirements and appropriate LANL responses occur automatically without further action by either the NMEID or LANL. Data from the proposed ground-water monitoring program will be initially collected under interim status standards, and analyzed as detailed in Appendix F. This information will be used to decide which Part 264 Subpart F program (i.e., detection monitoring, compliance monitoring, or corrective action) should eventually be followed once LANL's Part B permit has been issued by NMEID. In effect, the proposed ground-water monitoring program fulfills interim status requirements, but is actually a detection monitoring methodology that will eventually be required under Part 264 Subpart F.

LANL has conducted a detailed land survey of Area P and compared the survey with the previous land survey to determine the extent of the landfill. The probability of the presence of hazardous constituents in the landfill was assessed by determining the use of regulated chemicals at the site. The geology and hydrology of Area P have been investigated by conducting surface surveys and by consulting literature. The closure plan presented is based on current knowledge of the site. Additional sampling and survey work is in progress and more will be performed to formalize the detailed closure design and contractor bidding documents. Should this work indicate the need to change the closure plan, the plan will be amended.

2.0 TA-16 AREA P DESCRIPTION

TA-16 Area P is located in a saddle of a short, eastern-trending, narrow mesa. The saddle is near the south rim of Cañon de Valle, just north of the TA-16 thermal treatment area's pad number 387. Figure 2-1 shows a recent land survey conducted to characterize Area P. This survey was compared to a pre-landfill survey to determine the area influenced by the landfill, as shown on Figure 2-2. Cross-sectional views of the landfill are shown on Figure 2-3. The general area impacted is a half-ellipse, roughly 170 feet in north-south dimension and 400 feet in the east-west dimension. Within this area are two areas of fill, one to the west and the second to the east. The estimated landfill volume is 13,000 cubic yards.

Landfilling progressed from west to east. The west portion was closed by leveling the landfill and covering with dirt. The leveling overflowed the rim in the northwest quadrant of Area P, as witnessed by the elevation changes determined by the survey. As shown in the cross-section (Figure 2-3), most of the wastes are located on the steep canyon slope. The landfill depth at the rim is 12 to 14 feet, thinning both to the south and down the slope to the north. While Figure 2-2 shows a disturbance back to the 7450 ft. elevation, much of the elevation change is only one foot and is probably the result of leveling the site, not of waste burial. The cross-section indicates that deposition of wastes reaches only 30 to 40 feet back from the rim, extends down the slope, and does not reach the canyon floor. Large items, such

as blocks of foundation concrete and pieces of structural steel, did roll to the canyon floor. A few empty cans were found on the canyon floor. These and other metal items on the canyon floor have probably been there for a number of years because they are rusted and weathered.

The west portion of the landfill has revegetated with grasses, wild rose, wormwood, and oak brush. Further information for a vegetation survey of Area P can be found in Appendix A. Based on a visual survey, the slope is stable. There are occasional protrusions of concrete rubble, pipe, and steel, which aid in binding the mass. The site shows no evidence of slippage or significant erosion, as would be shown by gully formation or silt deposition at the canyon floor.

The east landfill area was the active portion of the site. Fill has progressed from south to north with cover dirt being spread as the fill advanced. Wastes on the north face are exposed. The covered portion has no appreciable vegetation, and, as shown on Figure 2-1, surface drainage cuts through this portion of the landfill. The cross-section in Figure 2-3 indicates that the wastes in the east portion of the landfill are on a bench and have not overflowed the bench rim.

A geologic and hydrologic description of the site, based on available literature and surface surveys, can be found in Appendix B, and includes geologic and soil profiles and subsurface hydrology of the site.

The definition of the landfill is based on what is considered to be a pre-landfill survey (Figure 2-4). Unfortunately, this map is not dated, but is thought to be at least pre-1965. Further searches for older maps, as well as verification of this map by discussions with area personnel, has been unsuccessful in determining the accuracy of Figure 2-4 as the pre-landfill map.

The closure plan herein submitted requires the drilling of multiple test holes and monitoring well. Most of this work was completed in September 1987; details are shown in Appendix D. Several additional neutron moisture log test holes may be required in the alluvium and underlying tuff of Canon de Valle immediately adjacent to the Area P landfill. These additional neutron moisture log test holes may be installed to further define the behavior of moisture in the subsurface of the canyon floor if monitoring wells are consistently dry. Placement will probably be adjacent to existing valley floor monitoring wells.

2.1. Land Use

The Los Alamos National Laboratory site covers about 111 km^2 (27,500 acres) in and adjacent to Los Alamos County and includes 32 active Technical Areas (TA) involved in research and development of advanced technology.

The communities closest to the Laboratory facilities are Los Alamos, which is just north of the Laboratory, and White Rock, located a few miles to the east-southeast. The total population of Los Alamos County is between 19,000 and 20,000. Most of Los

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Alamos County, as well as adjoining portions of neighboring Sandoval, Rio Arriba, and Santa Fe Counties, is undeveloped. The only significant development in Los Alamos County is within the Laboratory facilities and the associated residential communities. Large tracts of land in the Jemez Mountains, which lie to the north, west, and south of Los Alamos, are held by the U.S. Forest Service and the National Park Service.

Area P is located in TA-16, along the western end of the Laboratory property. TA-16 has been involved in the development and testing of explosives since the 1940's. Because HE tests have occurred in the area, the Federal Government will control the area in perpetuity and the general public will not have access.

The Los Alamos townsite is roughly 2.5 miles north-northeast of Area P and White Rock is 6.5 east of Area P.

2.2 Weather

Los Alamos has a semiarid, temperate mountain climate. Average annual precipitation at the Los Alamos Townsite is approximately 45 cm (18 in). Forty percent of the annual precipitation comes as thunderstorms in July and August, and the remaining significant precipitation comes as snowfall from winter storms. The 100 year, 24-hour rainfall event is about 10 cm (4 in) for Los Alamos.

Additional precipitation frequency data can be found on Table 2-1. Precipitation pH ranged from 4.4 to 6.7 in 1984. The average precipitation pH reading is 5.7. Individual precipitation quality data is published annually in the report Environmental Surveillance at Los Alamos (Los Alamos National Laboratory, 1985).

Summers are generally sunny with moderately warm days and cool nights. Maximum temperatures are usually below 32°C (90°F). Night temperatures in the summer generally drop below 16°C (60°F). Winter temperatures can range from -10° to 10°C (20 to 50°F) during the day. (Los Alamos National Laboratory, 1985)

Annual wind rose (1983 data) for Los Alamos is shown in Figure 2-5. The major wind component is from the west-northwest.

2.3 Wells

The location of supply wells and supply galleries relative to Area P, as well as the locations of test wells, springs, observation holes, and surface water sampling stations are shown in Figure 2-6. The nearest downgradient wells are PM-2 (No. 90) and PM-4 (No. 92), approximately 3.5 miles east of the landfill. Data on these wells, as well as other wells in the same area, is shown on Table 2-2. (Purtymun 1984)

The Water Canyon Gallery, a spring, is located one mile west of Area P. This spring discharges from perched layers in the tuff in Upper Water Canyon and furnishes part of the water supply for TA-16 (Purtymun 1975).

The depth to the main aquifer below Area P is 1230 feet. The relationship of the main aquifer to Area P is described in the geology and hydrology report in Appendix B. The landfill is underlain with moderately welded and unwelded Bandelier Tuff.

2.4 Surface Drainage

Surface drainage from the landfill area is to Cañon de Valle, which drains to Water Canyon, ultimately discharging to the Rio Grande six miles to the east. Further information on surface drainage is given in Appendix B.

Surface flow in Cañon de Valle is intermittent due to the small drainage areas on the flanks of the mountain. The stream bed at Area P has some flow from industrial process waste water discharged upstream under a NPDES permit. The alluvium in the canyon is thin, and perched water in the alluvium fluctuates with the amount of runoff. There are no wells producing alluvium-perched water in either Cañon de Valle or Water Canyon, nor is the surface water downstream of TA-16 in Water Canyon used for drinking water supply or agriculture now or in the foreseable furture.

2.5 Security

TA-16 is a weapons research facility and is not open to the public. Access to the area offices is limited to personnel with security clearances. Access to burn pads and Area P is limited to personnel working in the area, and all other vistors must be escorted by TA-16 personnel. The area is fenced and partolled by the Laboratory Security Force.

TABLE 2-1

PRECIPITATION FREQUENCY ESTIMATES FOR LOS ALAMOS, NEW MEXICO (106° 19 W, 35° 51'N, ELEVATION 7410 FT) FROM PRECIPITATION FREQUENCY ATLAS "NOAA ATLAS-2" (MILLER, ET. AL. 1973)[1]

RETURN PERIOD	ESTIMATED RAINFALL DEPTHS IN INCHES FOR THE GIVEN TIME PERIOD AND THE GIVEN RETURN PERIOD							
Tr (YEARS)	15-MIN P_{15}	30-MIN P_{30}	60-MIN P_{60}	2-HR P_2	3-HR P_3	6-HR P_6	24-HR P_{24}	ANNUAL[2] P_A
2	0.56	0.77	0.98	1.11	1.20	1.36	1.76	17.99
5	0.72	1.00	1.26	1.42	1.53	1.74	2.32	24.06
10	0.82	1.13	1.43	1.62	1.75	2.00	2.67	25.79
25	0.95	1.31	1.66	1.89	2.04	2.32	3.14	27.9[3]
50	1.07	1.49	1.88	2.13	2.30	2.61	3.57	29.0[3]
100	1.19	1.64	2.08	2.36	2.55	2.90	4.00	30.24

1. Source: Miller, J.F, Frederick, R.H., and Tracey, R.J. 1973. NOAA Atlas-2, "Precipitation-Frequency Atlas of the Western United States, Volume IV-New Mexico," U.S. Dept. of Commerce, NOAA, National Weather Service, Silver Spring, MD.

2. Source: Abeele, W.V., Wheeler, M.L., and Burton, B.W. 1981. "Geohydrology of Bandelier Tuff" Los Alamos National Laboratory report, Manuscript in press.

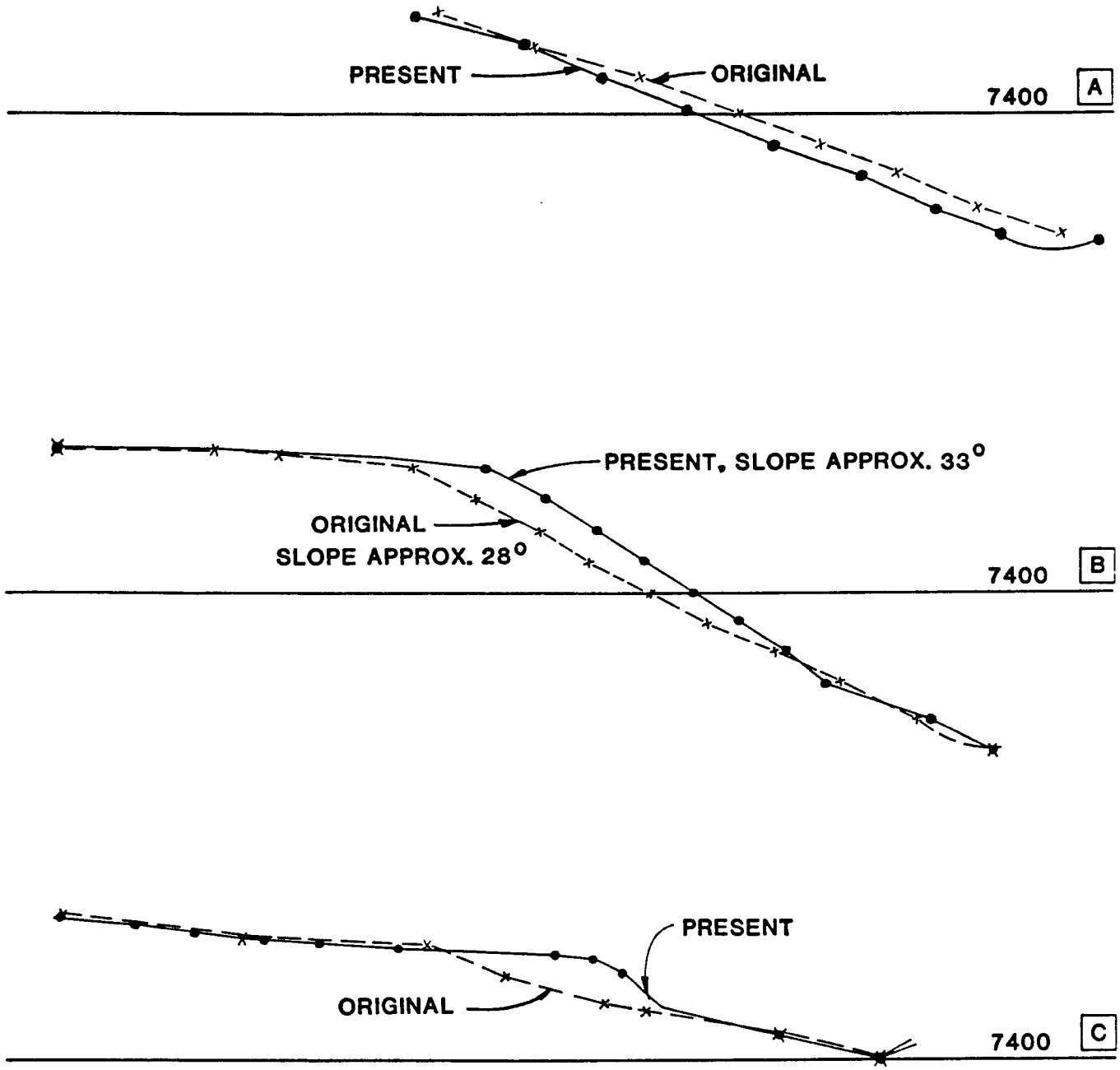
3. Interpolated values.

TABLE 2-2

WELLS DOWNGRADIENT OF AREA P

Municipal Wells					
Identification	PM-1	PM-2	PM-3	PM-4	PM-5
Drawing No.	89	90	91	92	93
Date of Completion	1965	1965	1966	1981	1982
Construction					
Elevation of LSD (ft)	6520	6715	6640	6920	7095
Depth Drilled (ft)	2501	2600	2552	2920	3120
Depth Completed (ft)	2499	2300	2552	2875	3093
Diameter (in)	12	14	14	16	16
Water Levels					
Date	1982	1982	1982	1982	1982
Depth below (LSD) (ft)	748	874	762	1047	1208
Elevation (ft)	5772	5841	5878	5873	5887
Aquifer					
Formation	Puye Conglomerate-Tesuque Formation				
Saturated thickness (ft)	1751	1426	1790	1828	1885
Yield					
Date	1982	1982	1982	1982	1982
Rate (gpm)	589	1386	1402	1473	1225
Drawdown (ft)	22	60	23	40	144
Specific Capacity (gpm/ft)	55000	40000	320000	44000	10000
Field Coefficient of Permeability (gpd/ft^2)	31	28	179	24	5.3

1. Source: Purtymun, W.D., 1984, Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Ground Water Supplies, Los Alamos National Laboratory Report LA-9957-MS UC-11



1" = 50'

CROSS SECTIONS A,B&C

FIGURE 2-3

AREA P CROSS SECTIONS

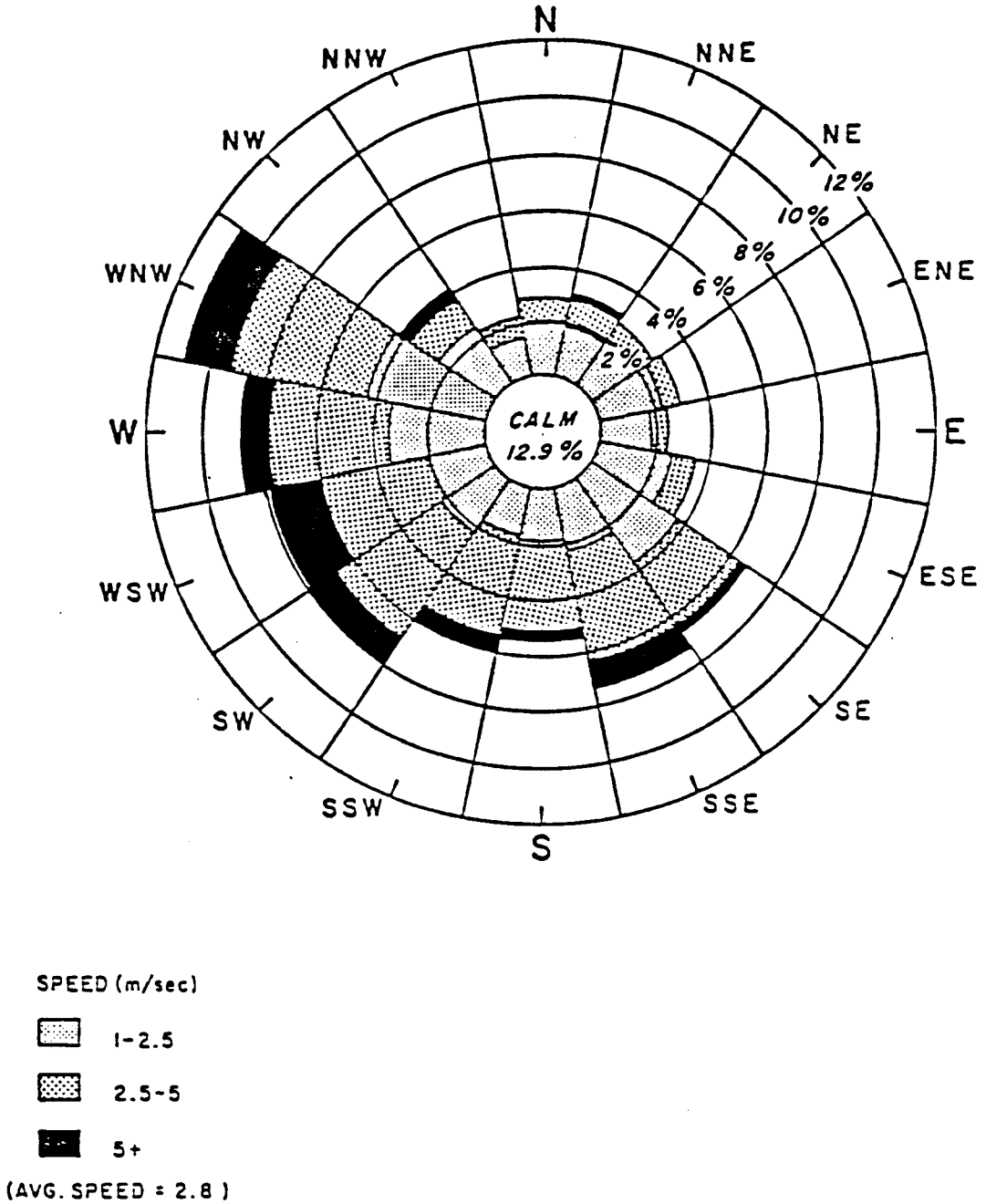


FIGURE 2-5

ANNUAL SURFACE WIND SPEED & DIRECTION, 1983

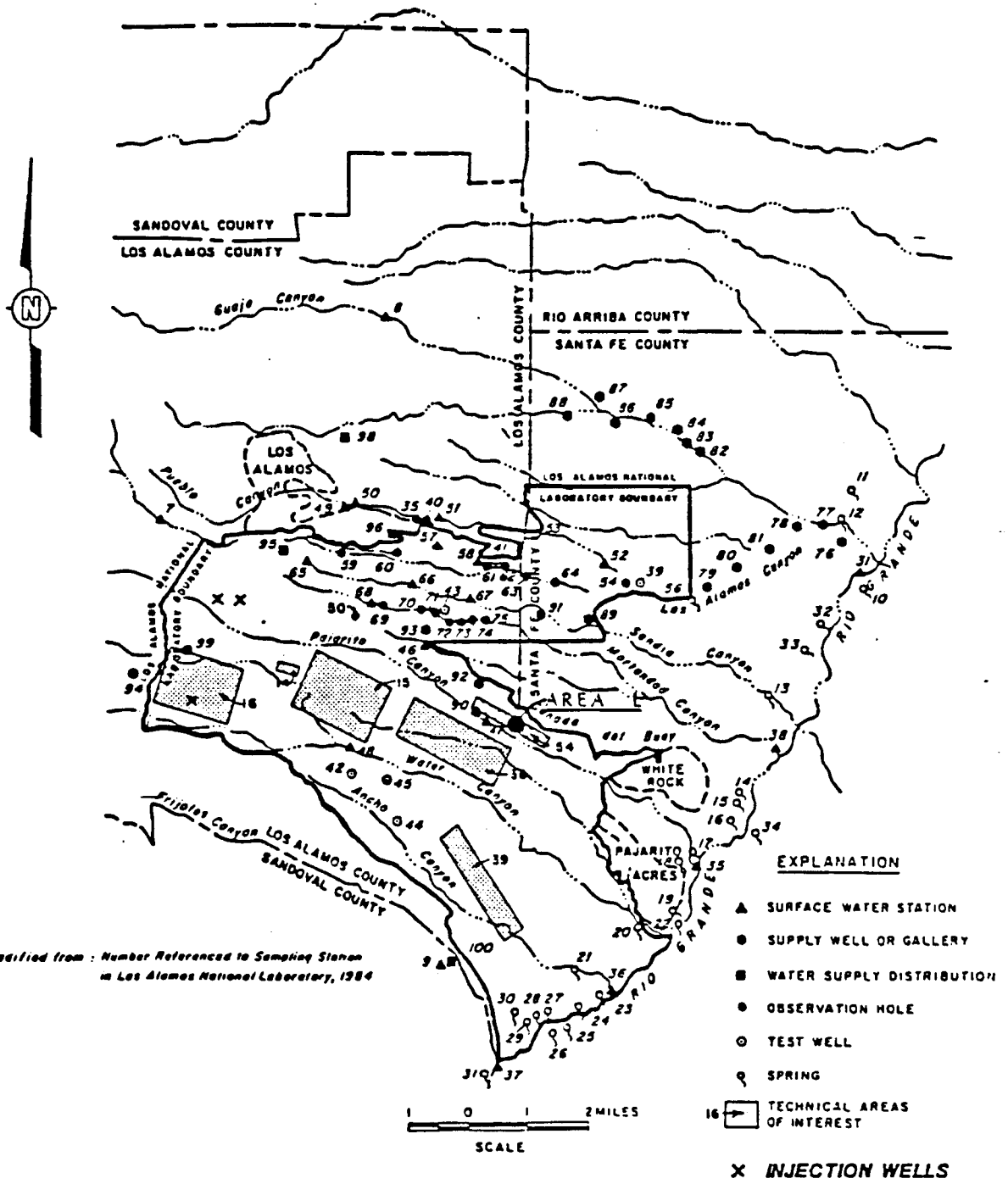


FIGURE 2-6

LOCATIONS OF TEST WELLS, SPRINGS, OBSERVATION HOLES, SURFACE WATER SAMPLING STATIONS & SUPPLY WELLS

3.0 WASTE DESCRIPTION

TA-16 Area P is a regulated landfill because it has been used for disposal of residues that exceed the EP toxicity limit for barium. HE-contaminated wastes and equipment are burned on sand covered pads at TA-16. The sand is removed after the burn and placed in the landfill. Six samples of pad sand, as well as filter vessel sand, were analyzed. Two of the samples, from pad 388 and pad 399, exceeded the EP toxic limit for barium of 100 milligrams per liter (mg/l), with concentrations of 280 mg/l and 1450 mg/l, respectively.

The source of barium in the residue is barium nitrate used in the formulation of some HE. The concentration in the pad sand varies with the barium nitrate concentration in the HE and the HE concentration in the waste.

There is very little documentation of the types or quantity of wastes landfilled at Area P. The site was initially used in the early 1950's to dispose of burned equipment that had been HE-contaminated and rubble from building demolition. Known wastes include concrete rubble, structural steel, burn pad sand, burned equipment and empty solvent cans.

The procedure for handling HE-contaminated equipment was to disassemble and clean the surfaces as well as possible. The equipment was then taken to the burn pad and flashed, along with other combustible material needed to support the fire. After the burn,

the equipment was inspected and determined to be free of HE. Considering the hazard associated with HE, the burned equipment was buried at Area P, rather than salvaged or shipped to an off-site landfill, to protect the public in case any HE residue had not burned and was not found during the final inspection. Equipment buried at Area P includes several large items, including two trucks and large pieces of concrete rubble from building demolition.

Empty solvent containers have been landfilled at Area P. A majority of these containers consist of quart metal cans and glass bottles. Larger containers, as large as 55-gallon drums, have been landfilled. During a site inspection, an empty acetone and an empty methanol can were found in the landfill. Both acetone and methanol are regulated as ignitable wastes. Both containers found were empty as defined by the regulations.

3.1 Hazardous Constituents Used in HE Production and Testing

A survey has been conducted in an attempt to determine the possibility of other regulated constituents being landfilled at Area P. Copies of the 40 CFR 261 Appendix VIII (NM HWMR 201 Appendix III) hazardous constituents were distributed to chemists and researchers involved in HE development and manufacturing, who noted which constituents were used.

Hazardous constituents used as components of HE, as determined by this survey, are shown in Table 3-1. The major hazardous component is barium, used as barium nitrate, to control the explosive's detonation rate.

Beryllium is used in propellants, and is not expected to be present in the landfill in appreciable quantities, because propellants are not burned at the TA-16 burn pads. Because beryllium waste is only regulated as beryllium dust (40 CFR 261.33 (e) -NM HWR 201.C.4.e), its disposal in the landfill is not subject to the regulations. Lead azide is present in commercial detonators, which have been occasionally used in test detonations. Scrap detonators are not burned but are detonated at a scrap detonation site, and therefore, very little lead azide would have been included in the wastes burned on the pads. Lead may have been included in waste burning as elemental lead or solder occurring as parts of the equipment burned.

Thallium azide was used in experimental HE. The use of thallium was discontinued 25 years ago.

Of the metals used, barium represents a significant risk both in the quantities that could occur in the landfill and solubility of the barium compounds. Both barium nitrate and the product of combustion, barium oxide, are soluble in water. The remainder of the metals and their oxides are not appreciably soluble.

Hazardous organic constituents used as HE components are also listed in Table 3-1. Because HE-contaminated wastes are burned before disposal, these constituents are destroyed and do not present a risk to the environment.

Hazardous constituents used as laboratory chemicals or used in HE manufacture, other than as an HE component, are listed in Table 3-2. The metals listed are small volumes and would not be included in a burn in Area P unless they were contaminated with HE. Organic hazardous constituents listed in Table 3-2 include solvents used for cleaning and used to glue plastic parts. All of these organics would be burned and only the residue put in Area P.

3.2 Potential Risks from Wastes

While HE-contaminated equipment was burned and inspected before it was landfilled, there is a potential safety risk of the presence of very small quantities of confined HE. This risk is complicated by the early operation of the landfill and the lack of records. Even though current operating procedures prevent the burial of HE, there is no guarantee that HE wastes were not buried during the earlier operation, for which there are no records or operator memory. Therefore, disturbing the landfill does pose a risk resulting from a lack of knowledge. To avoid the immediate risk to personnel closing the site, movement and drilling of the wastes will be limited.

As previously stated, the Federal Government will maintain control of the landfill in perpetuity, thus limiting future access to the public. Disturbance of the landfill waste is further limited by notice to local land authority, required by 40 CFR 264.119 (NM HWMR 206.C.2.j.).

Of the metals suspected to occur in the landfill, only barium presents a significant risk because of the potential quantity and its solubility.

The risk of regulated organics being in the landfill is small. Most organic constituents are burned before disposal. The major introduction of organics would be through the inclusion of empty containers. Most containers included were small containers emptied by hand pouring. Partially filled containers contaminated with HE were emptied, and the organics and cans burned separately. Uncontaminated, partially-filled containers were handled by HSE-7. Past practice did not provide for immediate covering of waste. The more volatile organic compounds in the containers would have evaporated before coverage. There is no evidence of acutely toxic wastes at Area P.

If left undisturbed, the major risk from the landfill is the leaching of barium. The depth to ground water is 1230 feet through 800 feet of unsaturated tuff. The landfill is underlain by welded and moderately welded tuff. The saturated hydraulic conductivity for a moderately welded tuff ranges from 0.1 to 1.7

ft/day, while that of welded tuff ranges from 0.009 to 0.26 ft/day. Assuming no tuff joints form a conduit to the main aquifer, the potential risk of leachate reaching the aquifer is small. While not probable, a joint penetrating several layers of tuff and forming a direct conduit is possible. Generally these joints are filled, particularly at the surface, with clay weathered from the tuff, effectively sealing the joint.

A greater risk for migration of waste is into the water in Cañon de Valle. The landfill overflows the canyon rim and overlays the canyon rim topsoil that interconnects to the canyon alluvium. There is no conductivity information available for the landfill. Given the low conductivity of the tuff, it is probable that if formed, leachate would migrate down the rim face to the alluvium. Leaching of barium to the alluvium is judged to be the only major pathway of waste migration.

The impact to human health from barium released to the alluvium does not present an environmental or public health threat. Barium is not acutely toxic, having an EP toxicity maximum concentration of 100 milligrams per liter (mg/l) compared to 0.2 mg/l for mercury and 5.0 mg/l for lead. Because there is no beneficial use for the perched water in Cañon de Valle or Water Canyon, the barium would have to move to the Rio Grande to present a threat to human health. Movement down the canyons would result

from storm or snow runoff, both affording dilution. Further dilution would occur when the canyon runoff joined the Rio Grande.

A low probability of volatile organic wastes exists in the landfill and there are no gas producing wastes, because a majority of the waste buried has been burned. Gas and vapor evolution and migration from the landfill is not a problem.

TABLE 3-1

HAZARDOUS CONSTITUENTS
261 CFR APPENDIX VIII (NM HWMR 201 APPENDIX III)
USED AS HIGH EXPLOSIVE COMPONENTS

METALS	COMMENTS
Barium	Barium nitrate used in explosives.
Berylliun	Used in some propellants.
Lead	Lead azide used in some commercially supplied detonators-not common
Thallium	Thallium azide used in some experimental explosives but use was discontinued 25 years ago.

ORGANICS	COMMENTS
Cyanogen	Handled as a gas
2,4 Dinitrotoluene	Discontinued 30 years ago
2,6 Dinitrotoluene	Discontinued 30 years ago
Di-n-octyl phthalate	Used as plastcizer in PBX
Di-phenylamine	
Hydrazine	
Nitroglycerine	Used during W.W.II
Nitrosamine	
Tetranitromethane	

TABLE 3-2

HAZARDOUS CONSTITUENTS
261 CFR APPENDIX VIII (NM HWR 201 APPENDIX III)
USED IN THE HIGH EXPLOSIVE AREA

METALS	COMMENTS
Antimony	
Arsenic	
Calcium Chromate	
Cadmium	Used in batteries, etc.
Chromium	
Mercury	Used in measurement equipment
Nickel	
Silver	Used in silver solder

ORGANICS	COMMENTS
Acetonitrile	Used as a solvent
Benzene	Used as a solvent in small quantities
Bromomethane	
Carbon disulfide	Used as a solvent, >100 grams/yr.
Chlorinated benzene	
Chlorinated fluorcarbon	
Chloroform	
Creosote	
Dibromoethane	Used as a solvent
Dichlorodifluoromethane	
Dinitromethane	
Diphenylamine	
Formaldehyde	
Formic acid	
Hexachlorophene	
Isobutyl alcohol	Used as a solvent
Methyl ethyl ketone	Used as a solvent
Methyl methacrylate	Used in small quantities as a plexiglass solvent
Nitrobenzene	Used as a solvent
Pyridine	Used as a solvent
Tetrachloroethane	
Tetrachloromethane	Used as a solvent, discontinued use in 1980, >100 grams/yr
Toluene	Cleaning solvent, >100 grams/yr
Trichloroethane	Used as a solvent
Vinyl chloride	Used as adhesive

4.0 CLOSURE

The interim status closure and post-closure regulations require that the owner or operator close a facility in a manner that "controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground or surface waters or the atmosphere" (40 CFR 264.111 - NM HWMR 206.C.2.b(2)). The landfill location and lack of a bottom liner excludes a closure plan that completely prohibits migration.

The proposed closure and post-closure plan herein presented is designed to minimize soluble barium or other potential contaminant migration through the control of sediment erosion and subsequent surface transport. In addition, the landfill cap and vegetation cover will control deep percolation to the subsurface. Extensive landfill subsidence survey monitoring, frequent site inspections, vadose zone characterization, subsurface moisture content monitoring, and, when present, ground and surface water quality analyses will be conducted. These activities are being performed to substantiate the unlikely occurrence of surface and subsurface contaminant migration should it occur.

The major components of the closure plan are:

- Run-on control to minimize erosion,
- Stabilization of the "active" portion of the landfill,
- Capping of the "active" portion of the landfill,

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- Moisture measurement and leachate collection for the entire landfill, and

- Ground-water monitoring in the alluvium of Canon de Valle and surface water monitoring in Canon de Valle.

4.1. Closure Considerations

The west (retired) portion and the east (active) portion of the landfill will be closed separately reflecting the difference in the disposition of the fills.

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4.1.1 West Portion-Closure

As shown in the landfill cross-section (Figure 2-3), most of the wastes buried in the west portion of the fill are located on the slope. The Laboratory has elected not to place an additional cover on the area, but to install adequate monitoring to demonstrate that this portion of the landfill does not present a threat to human health or the environment. Monitoring consists of a system of leachate collection and neutron probe test holes installed to determine the potential for leachate formation and the quality of the leachate formed. The decision for this approach is based on the following considerations.

- Risk - Although remote, a potential and immediate detonation risk is associated with earth moving at Area P. The construction of a retaining wall or cover on the west portion of the landfill would require relocation of a large percentage of the landfill, thus exposing personnel to the detonation risk.

- Barium Migration - According to the inspection, the east (active) portion of the landfill obviously contains a large quantity of burn pad sands. The west (retired) portion contains a larger portion of building rubble, as evidenced by the material at the bottom of the canyon and protrusions along the slope. Further, the waste in this area is a thin

layer, the thickest portion being only 12 to 14 feet deep. The barium, if leachable, may have already leached out or may have reached an equilibrium in this portion of the fill.

- Stability - Inspection shows that the slope on the west (retired) portion has stabilized and revegetated. All methods considered to improve the stability of the slope, such as a retainer wall, a concrete blanket, and a sloped cap, require extensive earth work on the slope. The earth work would result in temporary damage to the existing soil cover. Major storms occurring during construction would pose a risk that the slope could shift before the retaining structure was completed, or that the disturbance could cause a greater potential for barium migration during construction than if the site was left undisturbed.

- Cap and cover structure - While a cap could be placed on the horizontal section of the west portion, the cross-section shows that the cover would protect only a small percentage of the waste, because most of the wastes are located on the slope.

  The slope varies from 30 to 45 degrees. A retaining wall located to protect a major portion of the waste must be 80 to 100 feet tall. The foundation would require extensive digging and relocation of the waste at the bottom of the slope.

Although technically more feasible, a concrete blanket would still involve disturbance of the landfill slope and the risk of greater barium migration during construction.

Clay and/or fabric liners are not practical in that they must be covered and revegetated. Revegetation of the steep slope is difficult. Reducing the slope would extend the base of the cap into the canyon flow where erosion could undercut the cap soil cover.

Given these considerations, less risk to human health and the environment is posed by leaving existing cover on the west portion and controlling leachate, if any is formed.

4.1.2 East Portion-Closure

The east (active) portion presents other problems. The face of the waste fill is unstable, and is subject to inflow of water, demonstrated by sink holes in the waste and natural drainage through the fill. The recent use of this area for pad sand fill indicates that high levels of barium may be present, causing a potential migration problem. This area will therefore be stabilized with a concrete blanket and a cap.

4.2 Surface Run-on Control

As shown in Figure 2-1, the existing surface drainage is through the active portion of the landfill and includes surface drainage from the northside of the access road to the site. The road drainage will be diverted by adding fill between pads 386 and

387, as shown on Figure 4-1 to divert the flow under the short acess road to Area P and around the site. A concrete interceptor channel will be installed to divert the remainder of the surface drainage around the landfill. The location of the channel is shown on Figure 4-1 and channel details are shown on Figure 4-2. The channel is sized to handle the 24-hour 100-year rainfall event. Calculations are given in Appendix C.

4.3 Concrete Blanket Construction

As previously discussed, no additional stabilization is planned for the west (retired) portion of the landfill. Current cover and revegetation are considered adequate. The face of the east (active) portion will be stabilized with a concrete blanket. The location of the blanket is shown on Figure 4-1 and a cross-section is shown on Figure 4-3.

The face of the landfill will be prepared by pushing back the wastes that have slumped and over-rolled. The face will then be covered with a select fill to straighten the face and provide a minimum of 12 inches of cover. The fill will be placed in 6 inch lifts and compacted to 90 percent of proctor per ASTM-1557.

The compacted select fill is overlain with 6 inches of 1 to 1 1/4 inch crushed-washed gravel to serve as a drainage layer. A 2-inch SDR 13.1 (schedule 40) high-density, polyethylene (HDPE),

perforated drain pipe is set in the gravel at the inside base of the wall to collect water. This pipe provides leachate collection and will drain through the wall to a sump.

The ideal slope of the finished landfill is 30 degrees and the slope will not exceed 33 degrees. Reinforcing steel is set on the gravel and the outside of the 16-inch thick wall is formed. The form is then filled with 3000 psi Portland concrete. This construction forms a concrete blanket rather than a retaining wall. The weight of the blanket against the slope provides stabilization of the landfill face. The base of the blanket toes a minimum of 4 feet into the undisturbed tuff to keep the base from kicking out.

Details for reinforcing and joint forming will be prepared as part of the construction bid package.

The west end of the wall turns back into the east portion of the slope and may result in disturbance of a small portion of the slope cover. Disturbed areas with soil slopes greater than 5 percent will be covered with rip-rap to prevent erosion.

4.4 Leachate Collection

Leachate collection for the west (retired) portion of the landfill will be provided by two leachate interception trenches. The locations of the trenches are shown on Figure 4-4 and a cross-section of the interception trench is shown on Figure 4-5. Both trenches drain to a collection tank.

The collection tank is a 550-gallon fiberglass tank (4.3 ft diameter by 6.45 ft overall length) mounted in a subsurface concrete vault. The tank will be mounted a minimum of 4 feet below the surface and the concrete vault packed with insulation to prevent freezing. The top of the vault will be sealed against weather. The tank has tight sealing gauge ports and will be vented through a pipe up the slope to prevent inflow of water should the canyon flood. The tank will be equipped with a sump pump capable of delivering 20 gpm at 150 feet of total developed head (nominally 2 hp). Two separate level switches will be provided on the tank. One will activate the sump pump when the tank is half full and shut the pump off just before the level reaches the pump suction. The second level switch will operate a warning light mounted on a pole 10 feet high on the canyon rim, visible from the access road and the burn pad control house. The warning light will have a manual switch to allow testing of the bulb.

The sump pump will discharge through a two-inch SDR 13.1 HDPE pipe to a combination surge-evaporation tank located at the end of the access road. The 1760-gallon capacity tank has an open top and is 10 feet in diameter by 3 feet deep. The walls are 10 ga. steel coated internally with 5.5 mils vinyl (Plasite 2441-2442-2443 or equal) and externally primed and painted. The tank is set on a 25 feet by 25 feet concrete pad with 6-inch curbs Figure 4.6).

The sump pump is installed without a discharge check valve and the discharge line is sloped to drain back to the collection tank (approximately 35-gallon drain back). The line is supported on sleepers. The maximum unsupported length is 10 feet. Liquid in the tank will evaporate. Should liquid accumulate faster than can be evaporated, the excess will be hauled with a vaccum truck to TA-50-1 for treatment or to Area L for evaporation.

Leachate collection for the east (active) portion of the landfill consists of a 6 inch gravel drainage blanket between the finished slope cover and the concrete blanket. A 4-inch perforated pipe in a gravel-packed bed is located at the base of the wall and slopes from the east end of the wall to the west end. The average slope of the drain line is 5.5 degrees and is limited by the slope of undisturbed tuff, which determines the location of the concrete blanket base. The drain line exits the wall at the west end and ties into the east end of the leachate interceptor trench. It is desirable to be able to isolate the leachate from

the east and west sections to be able to observe where leachate is coming from, should it accumulate in the sump. The line outside the concrete blanket will be provided with a plastic ball valve and a pipe section installed with unions, to allow removal of the pipe section for inspection, sampling, and flow measurement. The exposed line will be enclosed in a galvanized insulated metal shelter to inhibit freezing of the line. It is not practical to bury the perforated drain at the bottom of the concrete blanket below the frost depth, but leachate flow will stop during extremely cold weather and the risk of freeze damage to the external pipe from the east portion to the east interceptor trench is low.

4.5 Cap Design

To avoid disturbing the existing vegetation cover, no additional cap work will be performed on the west (retired) portion of the landfill.

A designed cap will be placed on the east (active) portion of the fill. The cap consists of the following components listed from bottom to top:

- additional compacted fill to level the landfill surface,
- 24 inches of compacted clay to impede infiltration,
- a 40-mil HDPE fabric liner to impede infiltration and act as a biobarrier,
- HDPE drainage layer to promote drainage off the liner,

- a geotextile filter fabric to separate the upper sand layer from the drainage layer,
- 12 inches of clean washed sand to promote drainage from the liner,
- a geotextile filter fabric to separate the sand from the soil cover, and
- a 36-inch soil cover to support vegetation.

A cross-section of the cap is shown on Figure 4-7. The extent of the cap cover is shown in Figure 4-8. The depth of the cap represents a balance between the layer thickness needed to minimize infiltration, and the need to minimize the surface elevation, to keep the concrete blanket height down.

4.5.1 Compacted Fill

The existing cover will be mechanically compacted to 90 percent of proctor (ASTM-1557). Additional fill, either crushed tuff or clay loam from the mesa top, will be added in low areas to bring the landfill to within six to seven feet of the final landfill cap elevation (Figure 4-8). The fill will be placed in six-inch lifts and mechanically compacted. The surface will be graded smooth and rolled to finish.

4.5.2 Clay Liner

A 24-inch-thick clay liner will be installed on top of the compacted fill. The clay will be placed in six-inch lifts and mechanically compacted with moisture control. The type of clay

used will be selected in the preparation of the final contractor bid documents based on availability, compatibility to local soils, and compatibility with the wastes. The clay shall have a recompacted saturate hydraulic conductivity of not more than 1 x 10^{-7} cm/sec. The hydraulic conductivity of the clay liner will be verified by hydraulic testing of a test clay cover, constructed with the same techniques that will be used for the landfill cover. The hydraulic test methods to be used will be determined after selection of the clay.

The clay will be free of rock, fractured stone, or debris. The final surface slope will approximate the finished cap slope (minimum 3 percent-maximum 5 percent). The clay will be graded and rolled to finish.

4.5.3 Fabric Liner

A 40-mil, high-density, polyethylene (HDPE) liner will be placed over the clay. Installation will be per the manufacturer's recommendation. Seams will be heat sealed. Two seam samples will be taken each day during liner installation for destructive testing.

HDPE is selected as a liner material because it is compatible with local soil and is resistant to organic solvents, should any residuals be left in the landfill. The area covered by the fabric liner is shown in Figure 4-8. The liner has the same slope as the clay that slopes down to the north. Details of how

the liner is terminated at the concrete blanket are shown on Figure 4-3. The liner forms a trench at the wall-which is gravel-filled around a 4-inch, SDR 13.1, HDPE, perforated drain pipe. The drain pipe tees through the cement blanket on 20-feet intervals to drain off water from the cap drainage layer. The south and west edge of the liner will be secured using an anchor trench per the manufacturer's recommendation. Liner venting will be provided per the liner manufacturer's recommendation.

4.5.4 Drainage Layer

A drainage layer will be constructed to remove water from the top of the liner. The drainage layer consists of a synthetic drainage net (Tensar DN-3 or equal) covered with a geotextile fabric filter, 12 inches of washed sand and a second geotextile fabric filter. The drainage layer will have a conductivity of 1 x 10^{-3} cm/sec or greater, and slope 3 to 5 percent following the finished cap elevation. Drainage layer sand will meet the size distribution guidelines given in Draft RCRA Guidance Document-Landfill Systems and Final Cover, USEPA, 7/82.

Selection of the geotextiles is subject to final determination of the soil size distribution for the drainage layer and the cover soil. The textile specification will be defined in the contractor's bid package.

4.5.5 Cover Soil

A 36-inch (minimum) layer of cover soil will be placed over the drainage layer, placed in six-inch lifts, and compacted. The cover soil will be either clay-loam from the mesa top or sandy-loam from the canyon bottom. The clay-loam is preferred because its compacted saturated hydraulic conductivity is lower than for the sandy loam, and therefore provides more protection against infiltration. Clay loam is known to exist in quantity near the site, but additional prospecting must and will be conducted to ensure that adequate volumes are available.

The surface will be graded to the final contour and moderately compacted in preparation for seeding. The soil depth of 36 inches was selected to minimize root intrusion and to keep the drainage layer below the 36-inch frost depth.

Recommended revegetation species, fertilization practices, and irrigation requirements are discussed in Appendix A. The final selection of the seeding mix will depend on the season, availability of seeds, and the soil condition. Species will be selected from those recommended in Appendix A.

The topsoil will be mulched with pea gravel, applied at 60 tons per acre. The pea gravel reduces erosion by interrupting sheet flooding and absorbing kinetic energy associated with falling water droplets. Seeds will be planted by drilling. A temporary sprinkler irrigation system will be used to guarantee adequate

moisture to establish the cover. Irrigation will be limited, and only used if more than four consecutive rainless days occur during the growing season.

4.5.6 Quality Control

Quality control guidelines will be developed as part of the contractor's bid package because many of the specific control methods are subject to final definition of materials. Quality control testing shall follow good engineering practice for concrete and earth work and include, as a minimum, slump and strength testing for concrete work and compaction and moisure testing for earth fill work.

The clay and fabric liners are recognized as critical components of the cap design. A test clay cap has already been described to ensure that the hydraulic conductivity limit is met. Constant monitoring of the clay and fabric liner installation will be provided to ensure the use of proper installation techniques.

4.6 Monitoring

Monitoring facilities will be provided to ensure performance of the landfill through the post-closure period. Monitoring includes:

- sampling and anaysis of leachate collected,
- neutron probe measurements of the tuff under the site,
- erosion rate monitoring at several locations,

- ground-water monitoring of the perched water in Canon de Valle, and
- surface water monitoring.

4.6.1 Leachate Analysis

Leachate in the collection sump tank will be sampled quarterly during Year One and analyzed for those metals that are characteristic of EP toxicity in accordance with 40 CFR 261.24, for volatile and semivolatile organics, and for other water quality parameters (Table F-1 in Appendix F). During Years Two through Thirty, this leachate will be sampled according to the appropriate schedule shown in Appendix F (i.e., either Table F-3 or Table F-6). Analytical methods are those found in Test Methods for Evaluating Solid Wastes, US EPA, SW-846.

Metals, particularly barium, are the major potential pollutants. Although organics will be measured, they are not expected to leach from the landfill. Small quantities of organics may show up in the leachate as the result of plastic pipe being used in the collection system. The importance of the organics analysis is to determine the presence of toxic constituents other than those whose source might be the plastic pipe. The leachate rate will be measured using a positive displacement meter on the pump discharge and by gauging the collection tank.

4.6.2 Neutron Probe Moisture Analysis

To ensure that migration of leachate into the tuff is not significant, five neutron log test holes (wells P-0, P-12A, P-13, P-14, and P-16A) were installed during the July to September 1987 period at sites shown in Figure D-1 (Appendix D). These neutron test wells were completed with 2.5 inch I.D. aluminum casing. Final casing depths varied from 79 to 171 feet depending on surface location. Three additional boreholes (P-10, P-11, and P-15)

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were drilled for stratigraphic correlations, but have not been cased yet; these boreholes may be completed as monitor wells, neutron moisture access wells, or redrilled at a later date. The five cased neutron test holes will be logged each quarter for the first year, and thereafter on an annual basis.

Boreholes P-0 and P-12A are intended to be background neutron moisture test wells; the remaining neutron log test wells will be used to characterize deep moisture percolation below the landfill. A descriptive drilling or coring log for each of these test wells is given in Appendix D. Core samples were selectively recovered from multiple test holes at 5 and 10 foot intervals; these samples were analyzed for gravimetric moisture content, characteristics of EP toxicity, and volatile and semivolatile organics. None of the results from the metals analyses exceeded the maximum concentration of contaminants for characteristics of EP toxicity (EPA hazardous waste numbers D004 through D011). In addition no volatile or semivolatile organics exceeded detection limits. These data are contained in Appendix D (Tables D-2 and D-3). A number of selected core segments are currently being tested in order to hydrogeologically characterize the vadose zone below the landfill. These results will be made available to the EID when they are completed.

4.6.3 Erosion Rate Monitoring

Erosion monitoring stakes will be placed at the locations shown in Figure 4-9. The stakes are aluminum and sunk at least 24 inches into the top soil, protruding six inches. The soil surface is etched to the stake along with a stake identification number. The location of the stake and the soil slope is recorded at the time the stake is set. The elevation of the stake top will be surveyed from a nearby bench mark so that possible disturbance of the stake can be confirmed.

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Erosion rates are measured annually as the distance from the current soil surface to the etch mark. Soil losses equal to or greater than 2 tons per acre over one year require remedial action.

4.6.4 Ground-water Monitoring

Given the interconnection between the landfill and the canyon floor, the perched water in the alluvium of Canon de Valle is the first aquifer. Nine monitoring wells (numbered P-1 through P-9) were installed in the canyon floor, and one (P-10) was installed on the topographic saddle immediately adjacent to the landfill during the July to September 1987 period (see Appendix D). Depths varied from 9 to 150 feet. Borehole P-2 partially caved in and was later abandoned; it has been filled in with drill cuttings. Well P-10 is presently uncased; it may be completed as a monitor well or neutron moisture log access well. Two of the cased canyon wells (P-8 and P-9) are located in the alluvium upstream of the Area P landfill, while the remaining six (P-1 to P-7) are located on the canyon floor between the stream and landfill. These eight canyon floor monitor wells all penetrated several feet of alluvium before encountering unsaturated tuff; they were completed as four nests, each with two monitor wells. Each nest consists of one shallow 9 to 10 foot teflon cased (2 inch I.D.) monitor well and one deep 35 foot PVC cased (2 inch I.D.) monitor well. All of the shallow teflon wells are sand packed and screened from the lower unsaturated tuff up into the alluvium. The deeper PVC cased monitor wells are all sand packed and screened in the unsaturated tuff. Well completion data are shown in Appendix D. An additional two boreholes (P-11 and P-15A) are located approximately 800 feet south of the landfill; these were used for stratigraphic correlations across the landfill. Borehole P-11 is currently uncased; it may be converted to a background monitor well or neutron moisture log test hole if required. Borehole P-15A was abandoned when it was filled with borehole

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borehole cuttings. All of these well completions were constructed as prescribed in 40 CFR 265.90 through 265.94 (NM HWMR 206C.1.C), and fully comply with specifications in the Technical Enforcement Guidance Document (TEGD). These ground-water monitoring wells will be sampled quarterly for the first year, and annually thereafter, assuming sufficient water volumes can be collected. Water quality parameters (see Tables F-1 through F-3, and Table F-6) and analyses (see Tables 4-1 and F-4) will be conducted using EPA and EID approved sampling, record keeping, and analytical methods as found in Test Methods for Evaluating Solid Wastes, US EPA, SW 846. To date, however, all of these wells have been dry.

4.6.5 Surface Water Monitoring

Two permanent surface water sample collection stations will be established, one upstream and one downstream of the landfill in Canon de Valle. Surface water samples will be taken at the same time as the ground-water and leachate samples, and will be analyzed for the same parameters (Appendix F).

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On December 7, 1987, a reconnaissance surface water quality and stream sediment survey was conducted in Canon de Valle immediately adjacent to the Area P landfill in order to establish current conditions there. Table D-4 (Appendix D) lists results and sample collection stations from that survey. Analyses were conducted for those metals that are characteristic of EP toxicity in accordance with 40 CFR 261.24. All metals but barium were below detection limits in all water and sediment samples. Four of five water samples showed barium in excess of EPA Interim Primary Drinking Water Standards (40 CFR Section 265 Appendix II). For the eleven sediment samples, all metals but barium were below detection limits. Five of these samples showed barium concentrations between one and three milligrams per liter (mg/l) in EPA extract waters, while the remaining six samples had barium concentrations below 1.0 mg/l. A close examination of the data (Table D-4 and the location map) suggests that the majority of this barium originated from an unknown upstream source or sources. An extensive independent reconnaissance sampling program that is not part of this Closure and Post-Closure Plan will be initiated to quantify the exact barium source in Canon de Valle waters. These results should be available to the NMEID in the spring of 1988. One possible source is from historic TA-16 activities (see Appendix G). The information contained in Appendix G was taken from a recently completed draft Department of Energy (DOE) Comprehensive Environmental Assessment and Response Program (CEARP) Phase I report entitled, Installation Assessment. A major objective of this Phase I CEARP program was to determine whether waste disposal practices followed in the past, before recognition of potential environmental hazards and/or the passage of environmental legislation, have resulted in environmental problems that require remedial actions today. Many sites have been identified for future evaluation during CEARP supplemental Phase I or Phase II activities, including TA-16. Apparently both Comprehensive Environmental Response, Compensation, and Liability

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Act (CERCLA) and Resource Conservation and Recovery Act (RCRA) regulatory compliance issues will be addressed in the near future with regard to TA-16. The draft document in Appendix G suggests several potential barium sources associated with historical TA-16 activities.

4.7 Area P Identification

Identifying engineering markers will be placed at the locations indicated in Figure 4-9. The markers, at least 12 inches in diameter, will be set 2- to 3-feet deep in undisturbed tuff and will extend 0.5 to 1.0 foot above the ground. The markers will be constructed of concrete with reinforcing steel. A brass cap will be set in the marker with the inscription, "Warning - Hazardous Waste Buried - Barium" and have arrows pointing to the neighboring markers.

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4.8 Information Transfer

The NMEID and LANL will coordinate in writing to the respective contact person(s) for organization of activities and communications between the parties under this plan. The parties will provide timely written notification of any changes in the designation of contact persons during the term of the plan. LANL will provide a minimum of ten days' advance notice to the NMEID, through the NMEID contact person(s), of any sampling or activities conducted.

4.9 Closure Certification

Upon completion of closure, the engineer and the DOE shall prepare a letter certifying that the site has been closed in accordance with the closure plan. The letter shall be dated and signed by each party and stamped by the registered engineer, and the original copy submitted by the DOE to the Director of the NMEID. One copy shall be maintained at the DOE office and one copy maintained by the HSE-8 Regulatory Compliance Section.

4.10 Closure Schedule

The year of closure is 1986. Partial closure has occurred in that part of the landfill has been covered.

This closure plan will be submitted to the New Mexico Environmental Improvement Division on November 23, 1985, or the next date the NMEID office is open. LANL will prepare a contractor's bid package for closing Area P prior to the start of closure.

The bid package will not be let out for bid until the closure plan is approved. A minimum of 90 days is required to process the contractor bids.

Closure of Area P will follow the following schedule:

ACTIVITY	MAXIMUM TIME REQUIRED PER ACTIVITY
Contract for closure construction	90 days
Contractor start up time and site preparation	14 days
Initial earth work	14 days
Concrete blanket construction	30 days
Cap construction	30 days
Final survey	14 days
Weather and operations contingency	30 days

Several of the above activities run concurrently, so the time periods listed above are not additive. The total closure time is estimated at 180 days from plan approval by the NMEID. Two additional growing seasons are needed to ensure successful revegetation, but this time is considered part of post-closure care activities.

4.11 Post-Closure

Within 90 days after closure is completed, the EPA, NMEID, and the County of Los Alamos shall be furnished with a survey plat indicating the landfill location and dimensions of all new closure construction. The plat shall be prepared and certified by a professional land surveyor. The plat filed with Los Alamos County shall include a note, prominently displayed, which states the owner's or operator's obligation to restrict disturbance of the site in accordance with NM HWMR 206.C.2.g(3). In addition, the EPA, NMEID, and County of Los Alamos shall be provided with the records of type, location, and quantities of wastes stored. Information for wastes buried before the promulgation of hazardous waste regulations shall be estimated based on available records. Also in accordance with state law, a notation on the deed to the facility property (or on some other document that is normally examined during title search) will, in perpetuity, notify a potential purchaser of the property that the land has been used to manage hazardous waste.

The property deed shall be noted or documented to comply with the requirements of NM HWMR 206.C.2.j.

4.11.1 Post-Closure Care

Post-closure care activities shall be performed for 30 years as required by NM HWMR 206.C.2.g(1), and shall include site inspections, maintenance and operation of leachate and monitoring systems. An inspection schedule summarizes important Area P inspection events (see Appendix E).

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The site shall be inspected semi-annually, checking:

- o the cover system for integrity, settlement, and erosion,
- o the site surface drainage system for any blockages or evidence of poor function,
- o the concrete blanket for integrity, cracks, and settlement,
- o the integrity of the fence, gate, and locks, and
- o the condition of the surveyed benchmarks.

The site shall be inspected monthly checking:

- o proper operation of the leachate collection system, including:
  - sump pump operation,
  - accumulation tank level switches and high level warning light,
  - pipes for leaks,
  - integrity of the infiltration trench cover,
  - condition and liquid level of the surge-evaporation tank, and
  - tank levels.

Repairs shall be made to any of the items mentioned in the semi-annual checklist, should the inspection reveal conditions requiring further attention for the proper function of the closure system.

Monitoring shall include sampling of leachate, neutron probe logging, erosion measurement, ground water monitoring and surface water sampling as described in the closure plan.

4.11.2. Post-Closure Office

Records shall be kept of inspections, repairs, sampling, and analytical results for the duration of post-closure care activities. The name, address, and phone number of the person and/or office to contact about the facility during the post-closure care period is:

Harold Valencia
Area Manager, Los Alamos Area Office
U.S. Department of Energy
Los Alamos, New Mexico
Phone: (505) 662-5105

FEB. 03 1988

TABLE 4-1
SAMPLING PARAMETERS AND ANALYTICAL METHODS FOR ANALYSES

EPA Hazardous Waste No.	Name	Max Conc (1) (mg/l) for EP Toxicity	Max Conc (2) (mg/l) for Drinking H2O	Typical(3) Analytical Method
-----	Antimony	---	---	7040, 7470
D-004	Arsenic	5.0	0.05	7060, 7061
D-005	Barium	100.0	1.0	7080, 7081
D-006	Cadmium	1.0	0.01	7090, 7130
D-007	Chromium	5.0	0.05	7190, 7195
-----	Fluoride	---	1.4 to 2.4	----------
D-008	Lead	5.0	0.05	7420, 7421
D-009	Mercury	0.2	0.002	7470, 7471
-----	Nickel	---	---	7520, 7521
-----	Nitrate (as N)	---	10.0	9200
D-010	Selenium	1.0	0.01	7740, 7741
D-011	Silver	5.0	0.05	7760, 7761
D-012	Endrin	0.02	0.0002	8080, 8250
D-013	Lindane	0.4	0.004	8080, 8250
D-014	Methoxychlor	10.0	0.1	----------
D-015	Toxaphene	0.5	0.005	8080, 8250
D-016	2,4-D	10.0	0.1	8090, 8250
D-017	2,4,5-TP	1.0	0.01	8150, 8250
-----	Radium	---	5 pCi/l	9320
-----	Gross Alpha	---	15 pCi/l	9310, 9315
-----	Gross Beta	---	4 millirem/yr	9310
-----	Turbidity	---	1/TU	----------
-----	Coliform Bacteria	---	1 count/100 ml	9131, 9132

Organic Scans

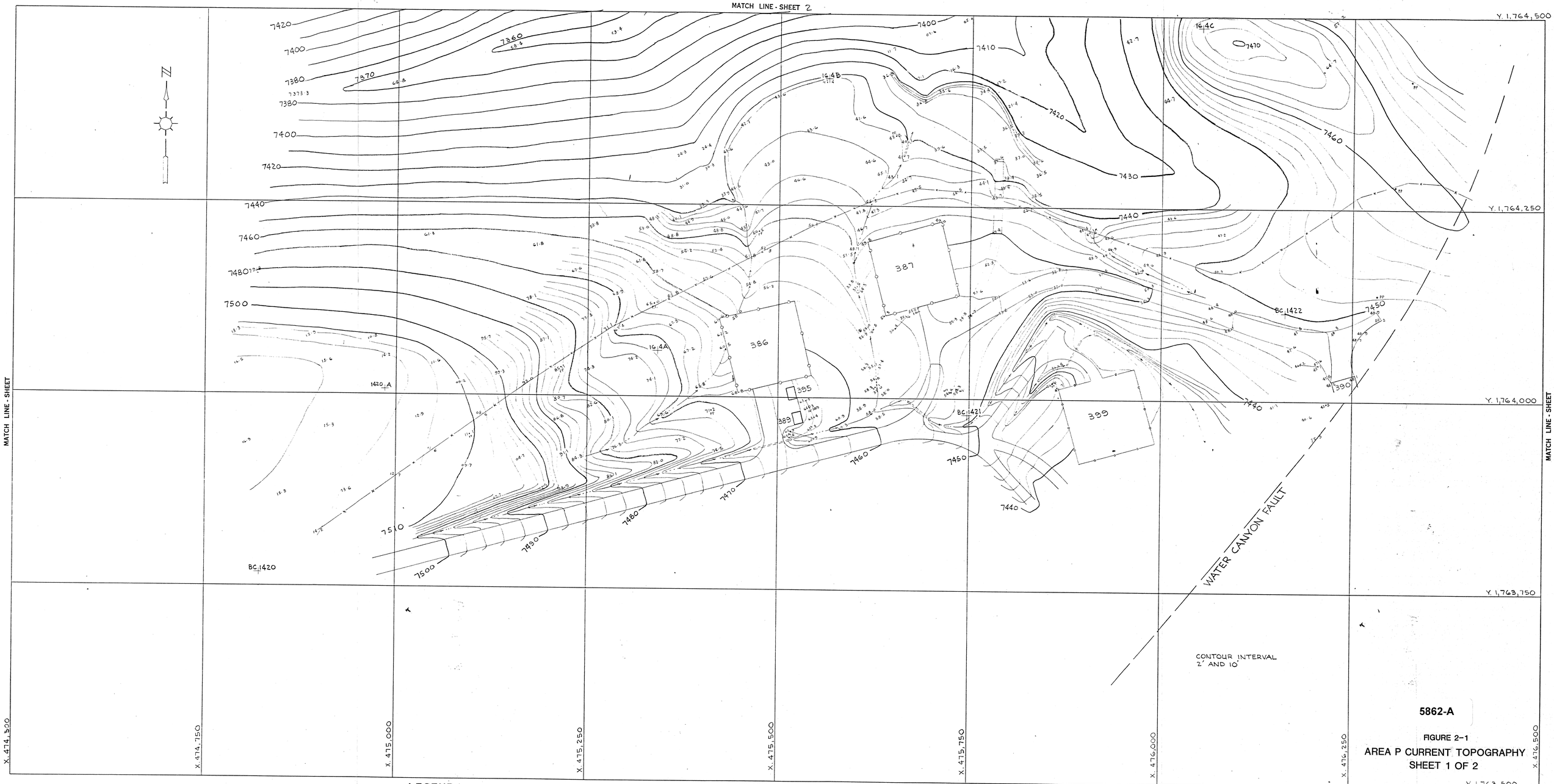
GC/MS for volatile organics (see Table F-2)	variable

Notes

(1) Maximum concentration (in mg/l unless specified otherwise) from 40 CFR Part 261.24, Characteristics of EP Toxicity.

(2) Maximum concentration (in mg/l unless specified otherwise) from 40 CFR Part 265 Appendix III, EPA Interim Primary Drinking Water Standards.

(3) All sampling and test analysis methods for inorganic and organic chemicals will be done according to Test Methods for Evaluating Solid Waste, EPA SW-846, or as superseded by more currently EPA approved alternate methods.



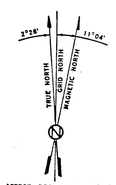
5862-A

FIGURE 2-1
AREA P CURRENT TOPOGRAPHY
SHEET 1 OF 2

LEGEND

- IMPROVED ROAD (GRADED OR PAVED)
- TRAIL ROAD
- BRIDGE
- GUARD RAIL
- CATCH BASIN IN CURB
- STORM DRAINAGE PIPE
- STORM DRAINAGE PIPE WITH HEADWALL
- STORM DRAINAGE MANHOLE
- CHAIN LINK FENCE
- BARBED WIRE FENCE
- BUILDING OR BUNKER WITH EARTH BERM
- BARRICADE WITH EARTH BERM
- BARRICADE WITH EARTH BERM
- RIM OF CANYON (CLIFF OR BEGINNING STEEP SLOPE)
- FLOW LINE OF INTERMITTENT STREAM
- SAFETY OR RAILROAD GATE
- WARNING BLINKER LIGHTS
- WARNING WIG WAG
- ACID MANHOLE
- ELECTRICAL MANHOLE
- ELECTRICAL POWER PEDESTAL
- POWER POLE AND PRIMARY ELECTRICAL CIRCUIT NO.
- POLE WITH GUY
- OVERHEAD GUY
- LIGHT POLE (METAL OR WOOD)
- GAS VALVE
- PRESSURE REGULATOR VALVE
- SANITARY SEWER MANHOLE
- SANITARY SEWER DISTRIBUTION BOX
- STEAM BOX
- STEAM LINE ON PIERS
- TELEPHONE POLE
- TELEPHONE MANHOLE
- WATER VALVE
- FIRE HYDRANT
- POST INDICATOR VALVE
- TRAVERSE POINT AND ELEVATION — 3 - AREA OR T.A. NO. / 1 - TRAVERSE NO. / A - POINT NO.
- BC 525 — BRASS CAP NO. AND ELEVATION (PERMANENT LASL SURVEY MARKER)
- LA 150 — INDIAN RUIN AND LABORATORY OF ANTHROPOLOGY NO.

MATCH LINE - SHEET



APPROX. DECLINATION 13°30'

SURVEYED	PLOTTED	CLASS REVIEW	REVIEWER	REMARKS

UNIVERSITY OF CALAFORNIA
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Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

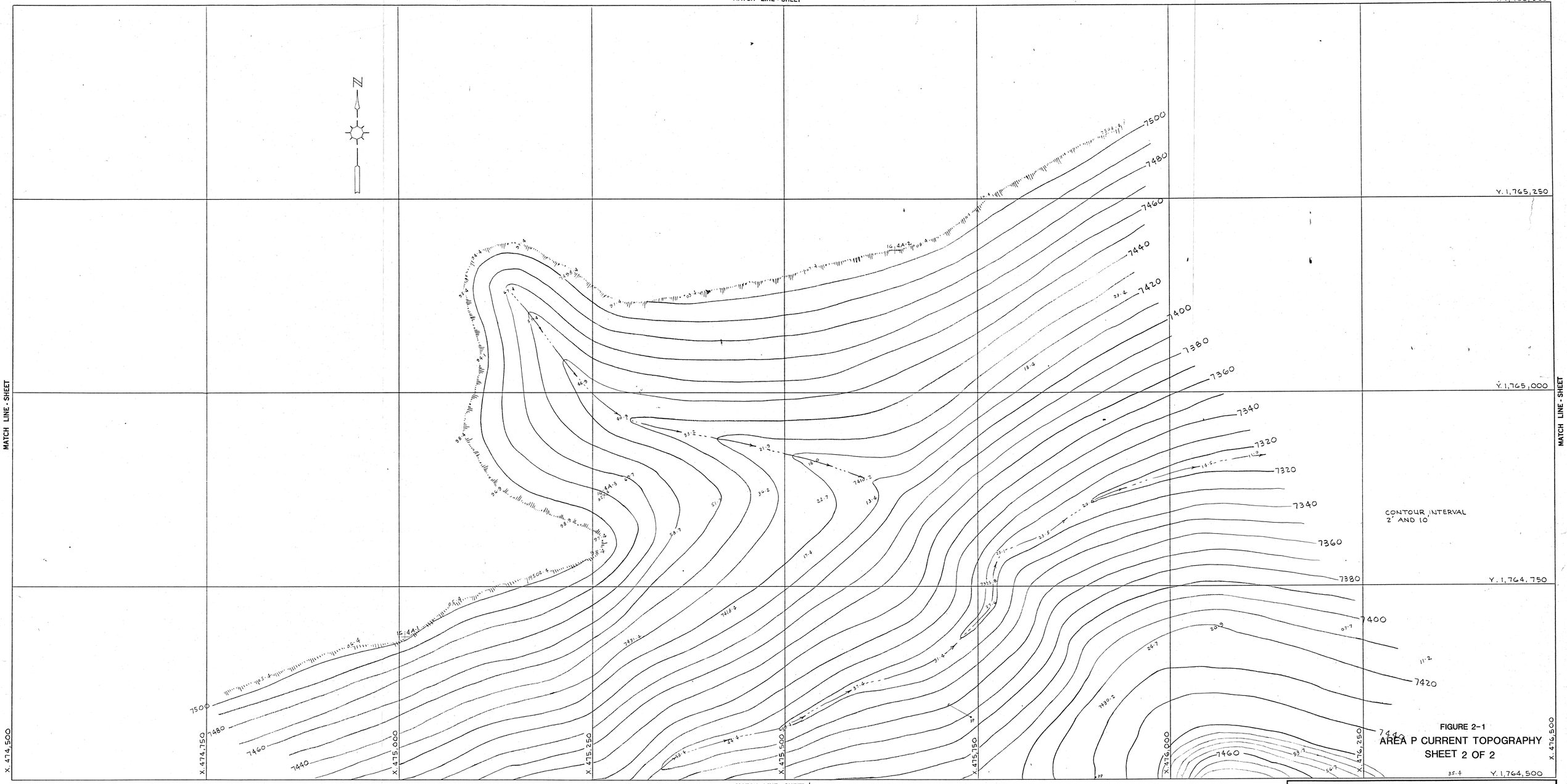
SITE CHARACTERIZATION SURVEY

AREA 'P' TA-16

DWG. CLASSIFICATION: V REVIEWER: [illegible] DATE: 11/12/85

FIELD BOOK	PAGES	DATES	SCALE	LAB JOB NO.	SHEET OF
16-2	12-27	11-8-85	1" = 50'	NONE	1 2
DRAWN		CHECKED	APPROVED	DRAWING NO.	
P.B. TRUJILLO		[illegible]	[illegible]	ENG. 16-33	

MATCH LINE - SHEET

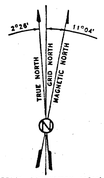


MATCH LINE - SHEET

FIGURE 2-1
AREA P CURRENT TOPOGRAPHY
SHEET 2 OF 2

LEGEND

- IMPROVED ROAD (GRADED OR PAVED)
- TRAIL ROAD
- BRIDGE
- GUARD RAIL
- CATCH BASIN IN CURB
- STORM DRAINAGE PIPE
- STORM DRAINAGE PIPE WITH HEADWALL
- STORM DRAINAGE MANHOLE
- CHAIN LINK FENCE
- BARBED WIRE FENCE
- BUILDING OR BUNKER WITH EARTH BERM
- BARRICADE WITH EARTH BERM
- BARRICADE WITH EARTH BERM
- RIM OF CANYON (CLIFF OR BEGINNING STEEP SLOPE)
- FLOW LINE OF INTERMITTENT STREAM
- SAFETY OR RAILROAD GATE
- W.W. WARNING BLINKER LIGHTS
- W.W. WARNING WIG WAG
- A-MH ACID MANHOLE
- E-MH ELECTRICAL MANHOLE
- E-PP ELECTRICAL POWER PEDESTAL
- P.P. S-9 POWER POLE AND PRIMARY ELECTRICAL CIRCUIT NO.
- POLE WITH GUY
- O.H. OVERHEAD GUY
- L.P. OR L.P. LIGHT POLE (METAL OR WOOD)
- G.V. GAS VALVE
- PRV PRESSURE REGULATOR VALVE
- S-MH SANITARY SEWER MANHOLE
- DB SANITARY SEWER DISTRIBUTION BOX
- STEAM BOX
- ST STEAM LINE ON PIERS
- TP TELEPHONE POLE
- T-MH TELEPHONE MANHOLE
- WV WATER VALVE
- FH FIRE HYDRANT
- PIV POST INDICATOR VALVE
- 3 | 1-A | 7450 | 38 TRAVERSE POINT AND ELEVATION — 3 - AREA OR T.A. NO. 1 - TRAVERSE NO. A - POINT NO.
- BC | 525 | 7449 | 38 BRASS CAP NO. AND ELEVATION (PERMANENT LASL SURVEY MARKER)
- LA 150 INDIAN RUIN AND LABORATORY OF ANTHROPOLOGY NO.



APPROX. DECLINATION 13°30'

SURVEYED	PLOTTED	CLASS REVIEW	REVIEWER	REMARKS

5862-B

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FACILITIES ENGINEERING DIVISION

SITE CHARACTERIZATION SURVEY

AREA 'P' TA-16

DWG. CLASSIFICATION: U			REVIEWER: P. Fenn		DATE: 11-8-85
FIELD BOOK 16-2	PAGES 12-27	DATE: 11-8-85	SCALE 1" = 50'	LAB JOB NO. NONE	SHEET 2 OF 2
DRAWN R.B. TRUJILLO		CHECKED Ra	APPROVED P. Fenn	DRAWING NO. ENG. 16-33	

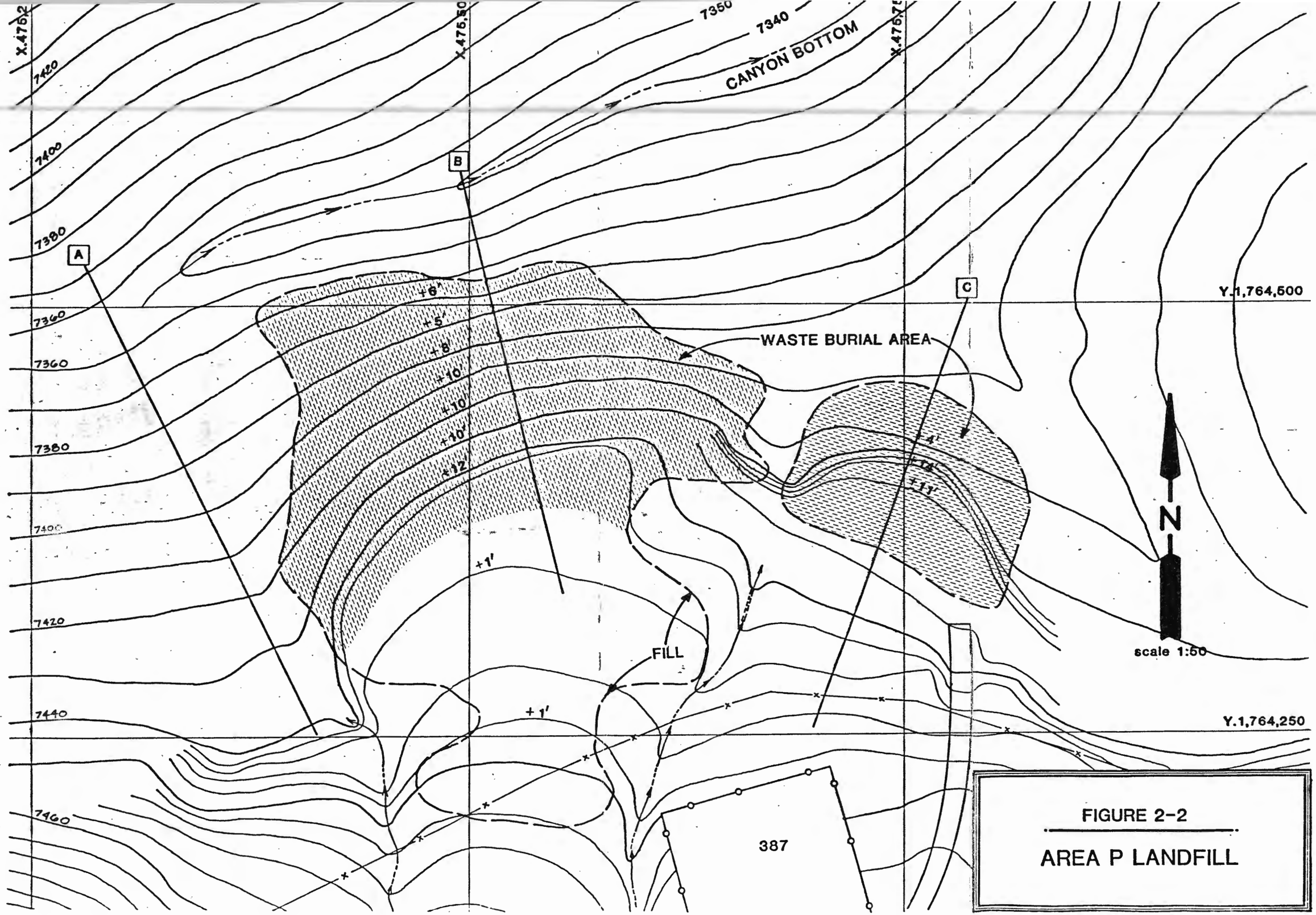

FIGURE 2-2

AREA P LANDFILL

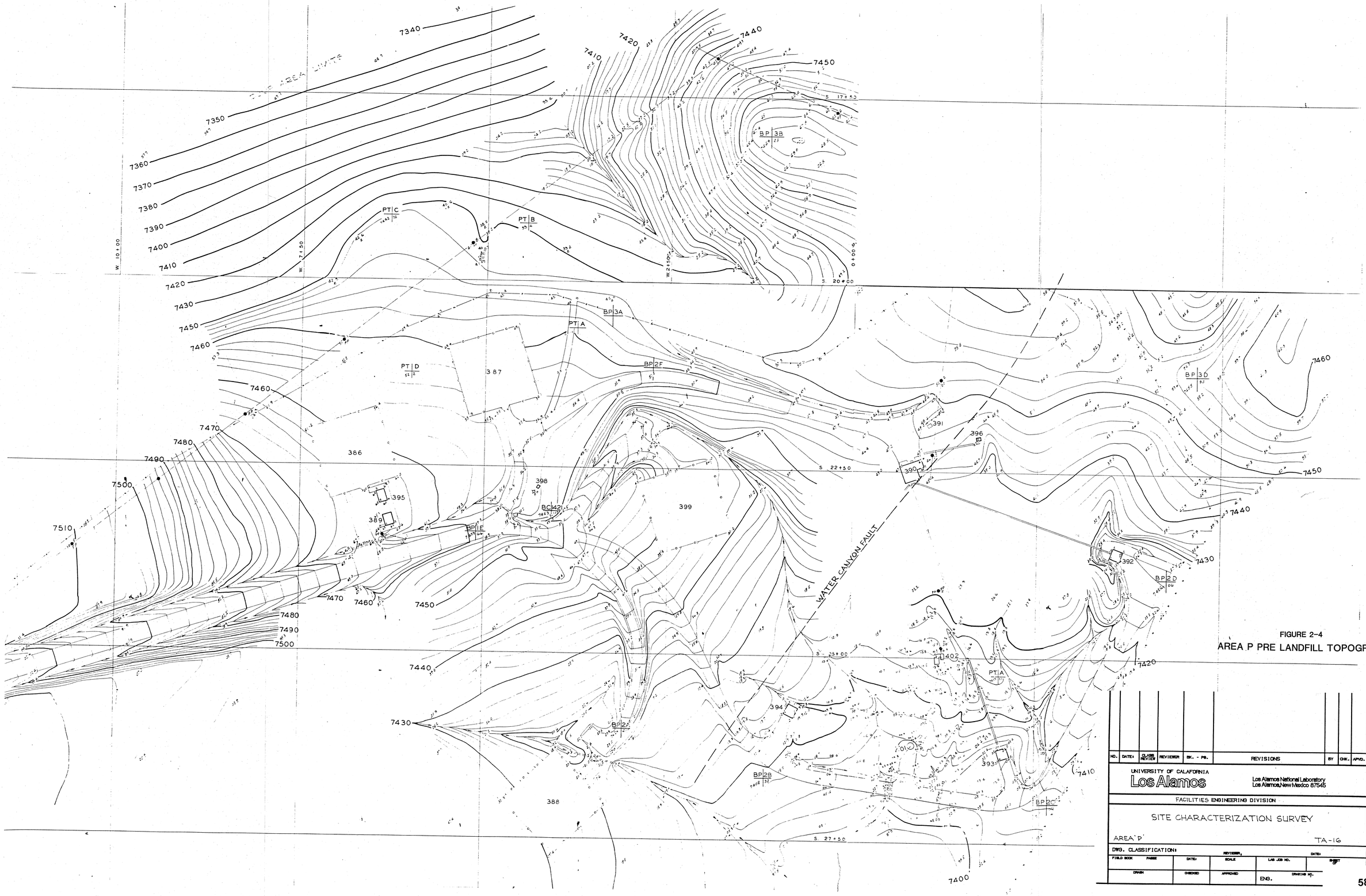

FIGURE 2-4
AREA P PRE LANDFILL TOPOGRAPHY

NO.	DATE:	CLASS REVIEW	REVIEWER	SK. - PB.	REVISIONS	BY	CHK.	APVD.

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AREA 'P' TA-16

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FIELD BOOK	PAGE	DATE:	SCALE	LAB JOB NO.	SHEET OF
DRAWN		CHECKED	APPROVED	ENG.	DRAWING NO.

5862-C

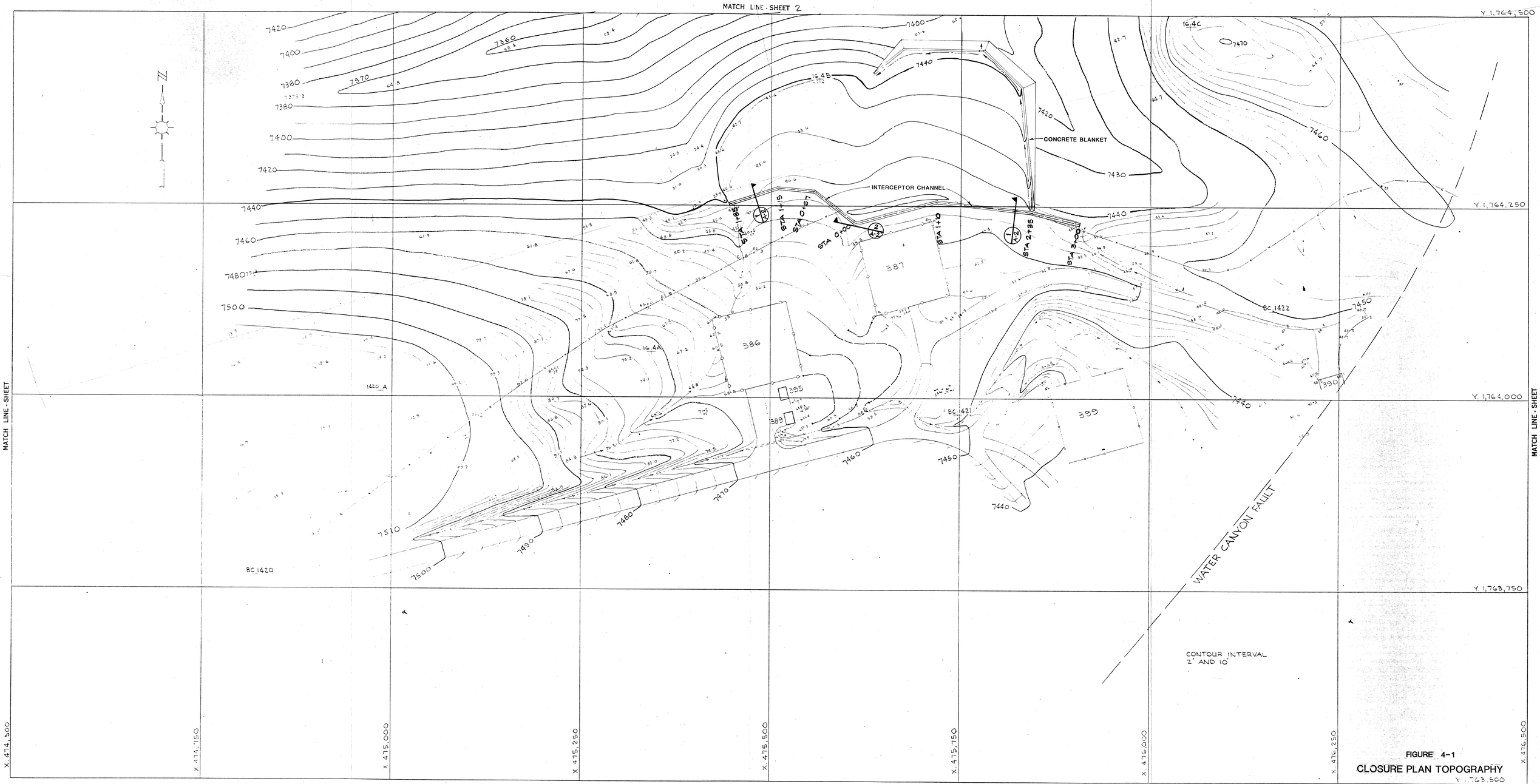

FIGURE 4-1

CLOSURE PLAN TOPOGRAPHY

LEGEND

- IMPROVED ROAD (GRADED OR PAVED)
- TRAIL ROAD
- BRIDGE
- GUARD RAIL
- CATCH BASIN IN CURB
- STORM DRAINAGE PIPE
- STORM DRAINAGE PIPE WITH HEADWALL
- STORM DRAINAGE MANHOLE
- CHAIN LINK FENCE
- BARBED WIRE FENCE
- BUILDING OR BUNKER WITH EARTH BERM
- BARRICADE WITH EARTH BERM
- BARRICADE WITH EARTH BERM
- RIM OF CANYON (CLIFF OR BEGINNING STEEP SLOPE)
- FLOW LINE OF INTERMITTENT STREAM
- SAFETY OR RAILROAD GATE
- WARNING BLINKER LIGHTS
- WARNING WIG WAG
- ACID MANHOLE
- ELECTRICAL MANHOLE
- ELECTRICAL POWER PEDESTAL
- POWER POLE AND PRIMARY ELECTRICAL CIRCUIT NO.
- POLE WITH GUY
- OVERHEAD GUY
- LIGHT POLE (METAL OR WOOD)
- GAS VALVE
- PRESSURE REGULATOR VALVE
- SANITARY SEWER MANHOLE
- SANITARY SEWER DISTRIBUTION BOX
- STEAM BOX
- STEAM LINE ON PIERS
- TELEPHONE POLE
- TELEPHONE MANHOLE
- WATER VALVE
- FIRE HYDRANT
- POST INDICATOR VALVE
- TRAVERSE POINT AND ELEVATION — 3 - AREA OR T.A. NO.; 1 - TRAVERSE NO.; A - POINT NO.
- BC 525 — BRASS CAP NO. AND ELEVATION (PERMANENT LASL SURVEY MARKER)
- LA 150 — INDIAN RUIN AND LABORATORY OF ANTHROPOLOGY NO.

TRUE NORTH 37°28' — GRID NORTH 11°04' — MAGNETIC NORTH

APPROX. DECLINATION 13°30'

SURVEYED	PLOTTED	CLASS REVIEW	REVIEWER	REMARKS
				5862-D

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FACILITIES - ENGINEERING DIVISION

SITE CHARACTERIZATION SURVEY

AREA 'P' — TA-16

DWG. CLASSIFICATION: U — REVIEWER: [illegible] DATE: 11/21/85

FIELD BOOK	PAGE	DATE	SCALE	LAB JOB NO.	SHEET
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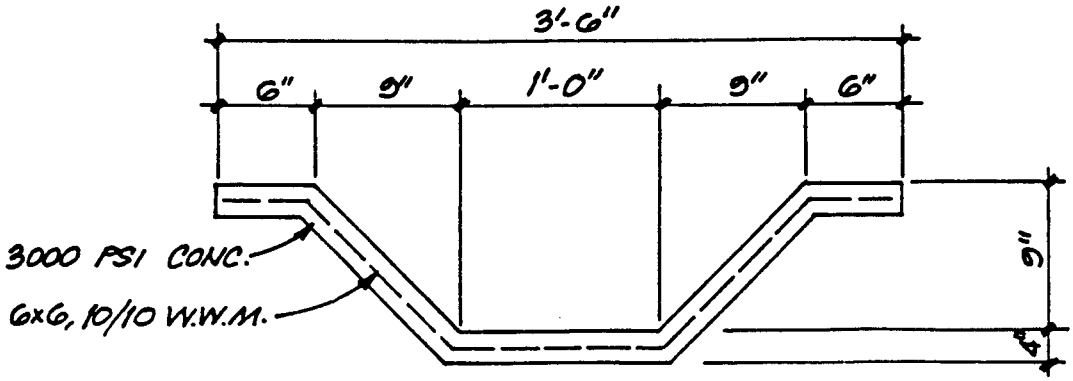
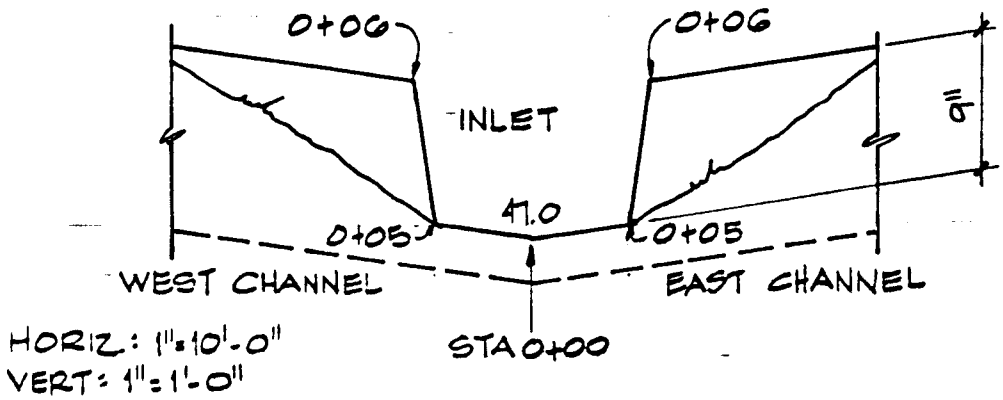
DRAWN	CHECKED	APPROVED	DRAWING NO.
P.B. TRUJILLO	[illegible]	[illegible]	ENG. 16-33



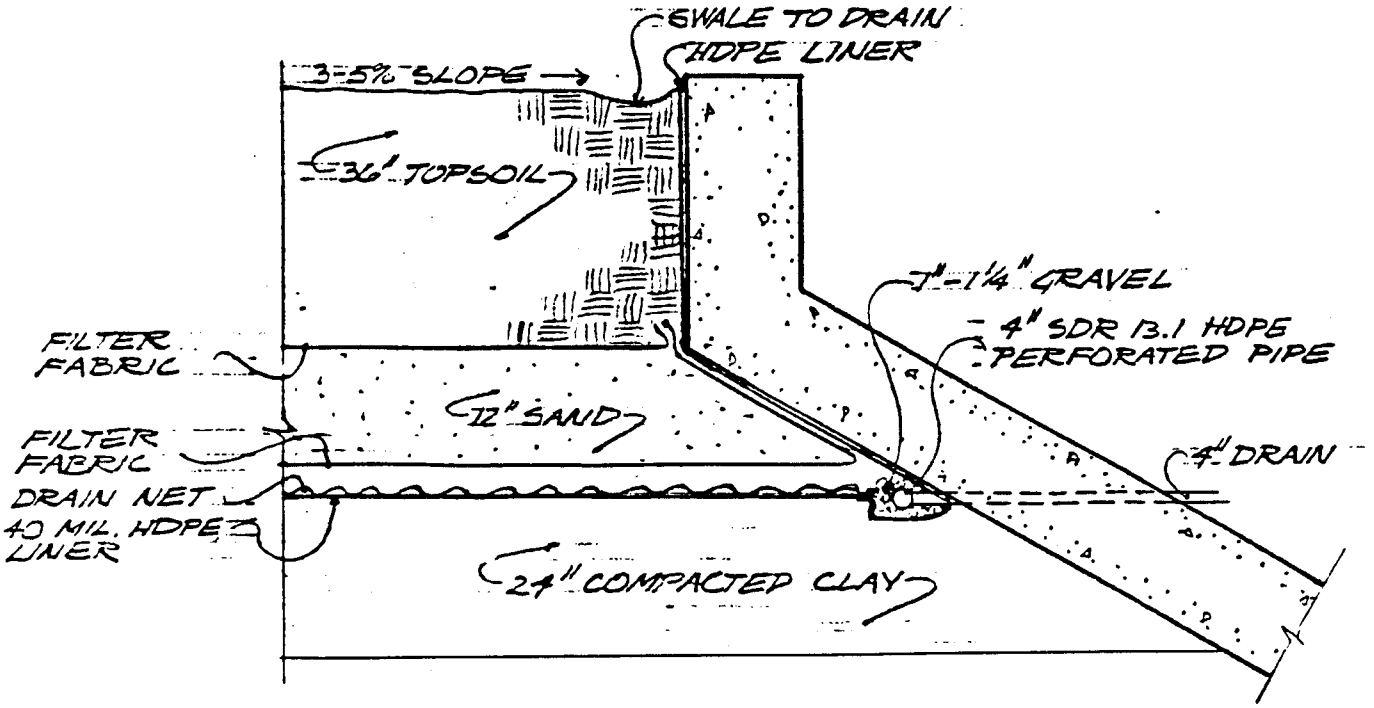
1 CHANNEL CROSS SECTION - TYPICAL



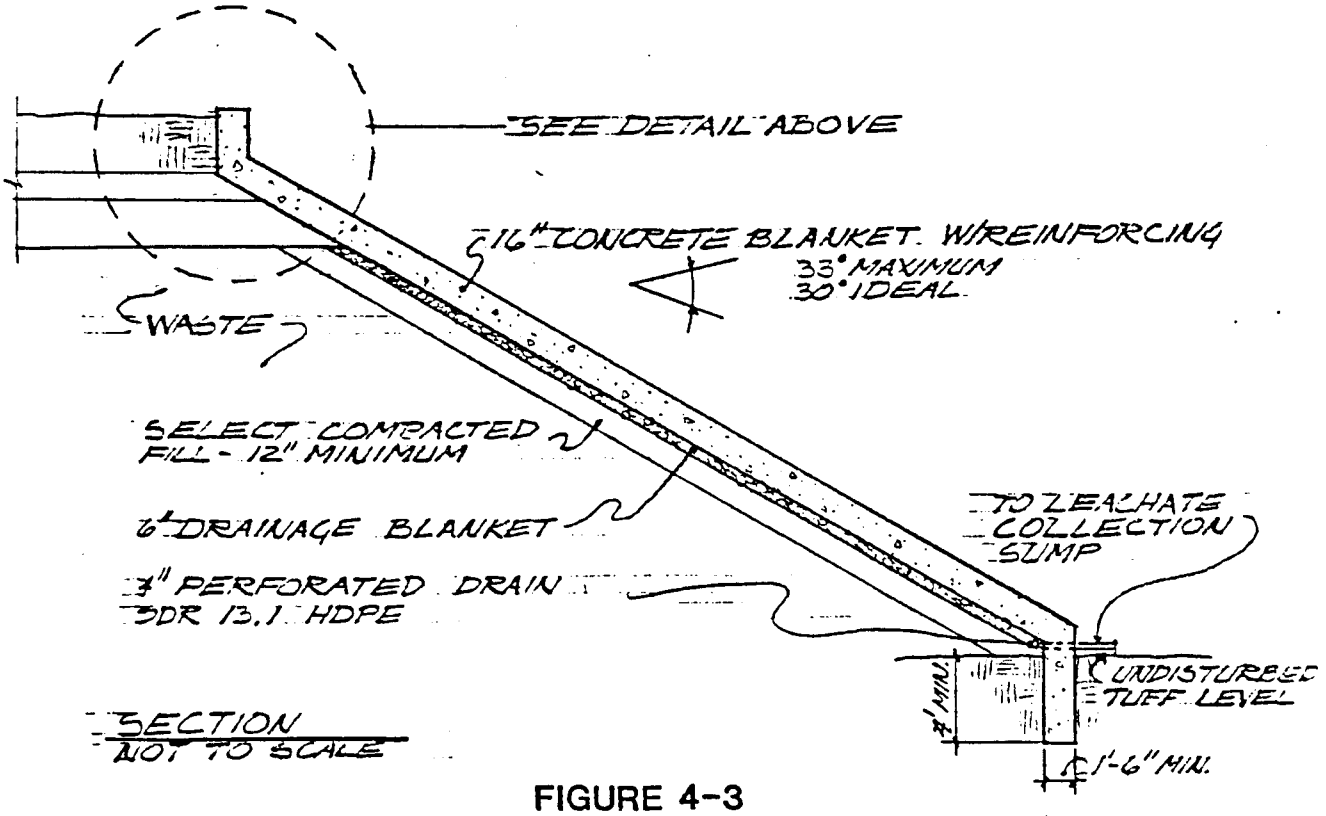
2 STA 0+00 INLET DETAIL ELEVATION

FIGURE 4-2

INTERCEPTOR CHANNEL DETAILS



DETAIL
NOT TO SCALE



SECTION
NOT TO SCALE

FIGURE 4-3

CONCRETE BLANKET CROSS SECTION

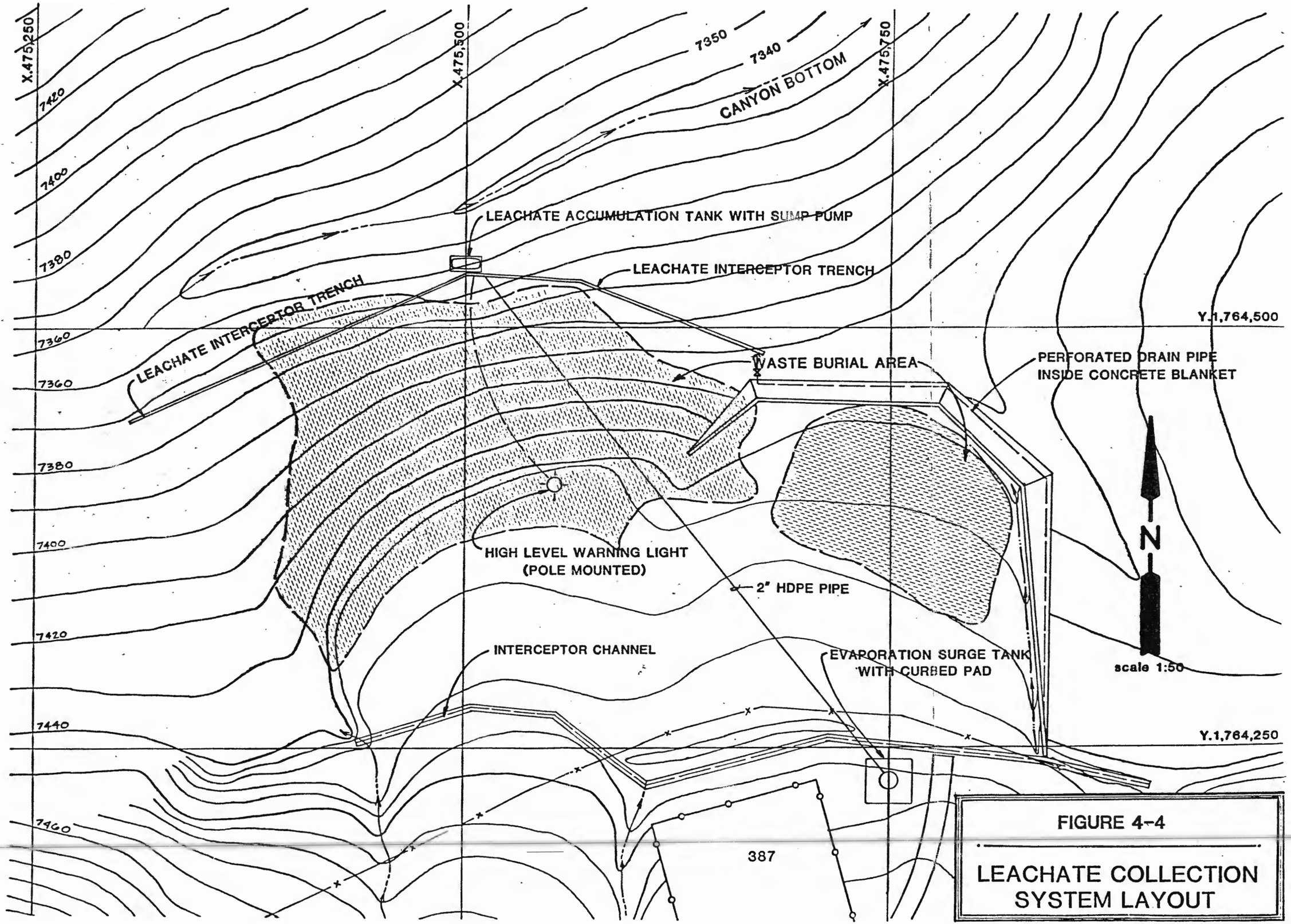


FIGURE 4-4

LEACHATE COLLECTION SYSTEM LAYOUT

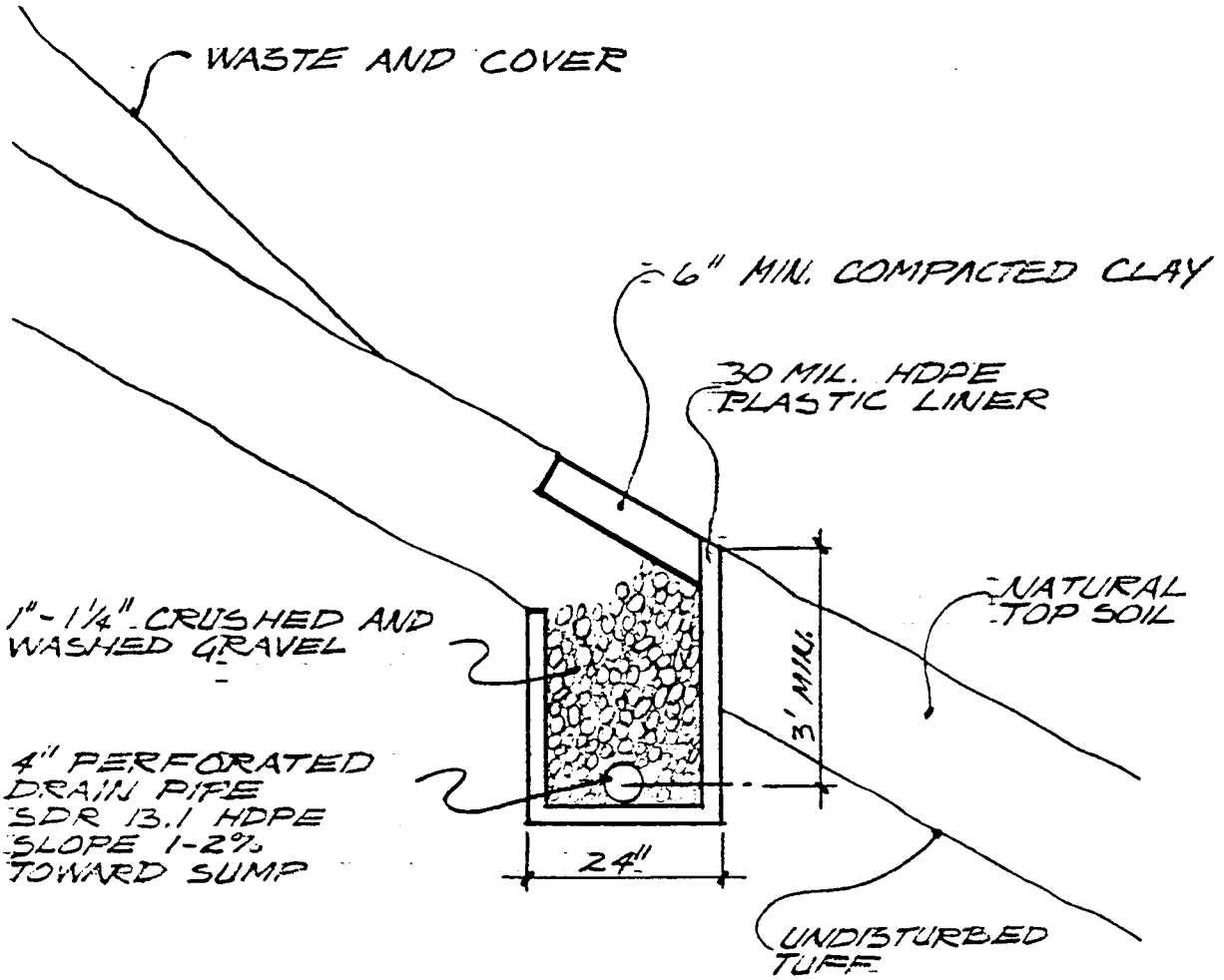


FIGURE 4-5

CROSS SECTION

LEACHATE INTERCEPTOR TRENCH

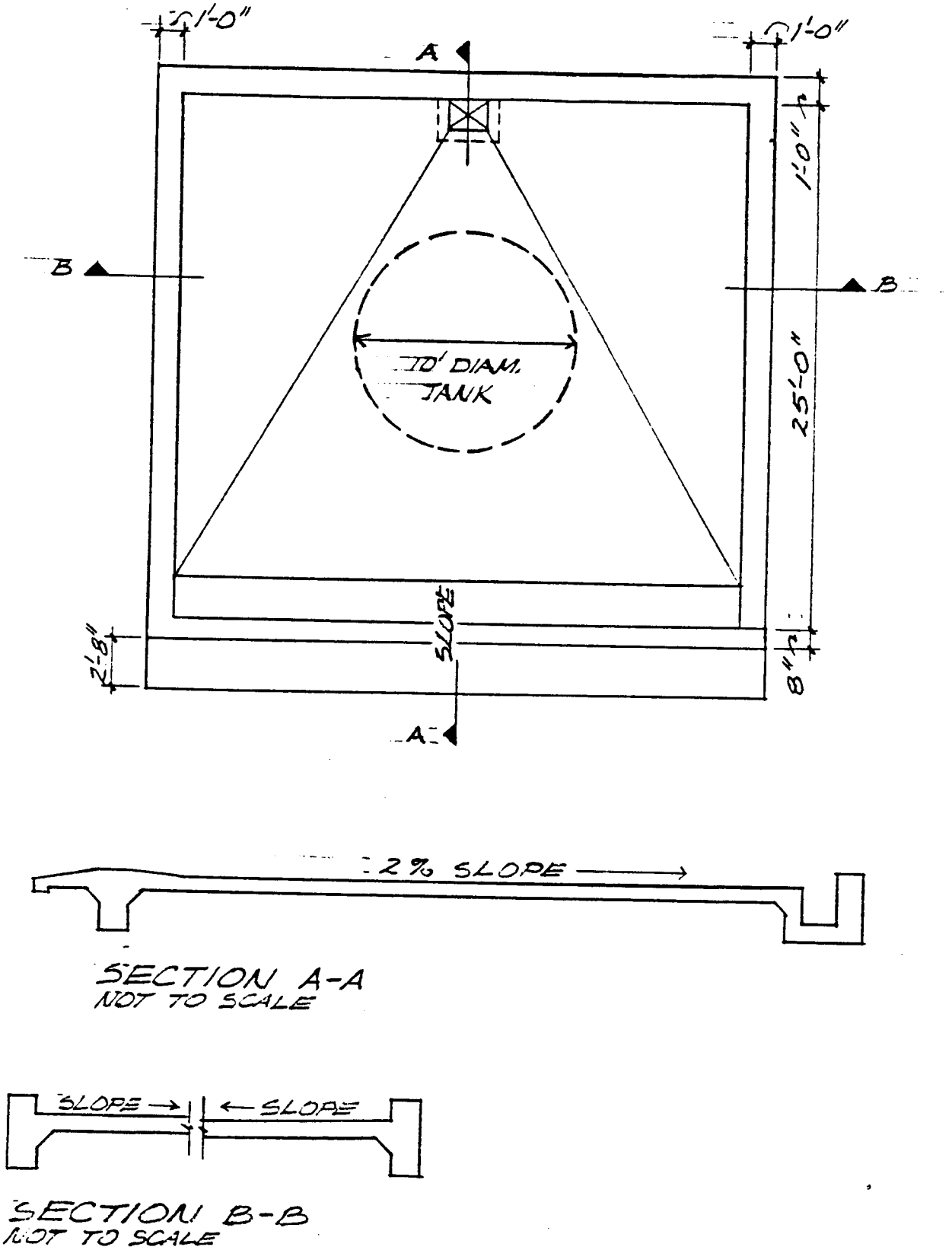


FIGURE 4-6

LEACHATE EVAPORATION TANK PAD

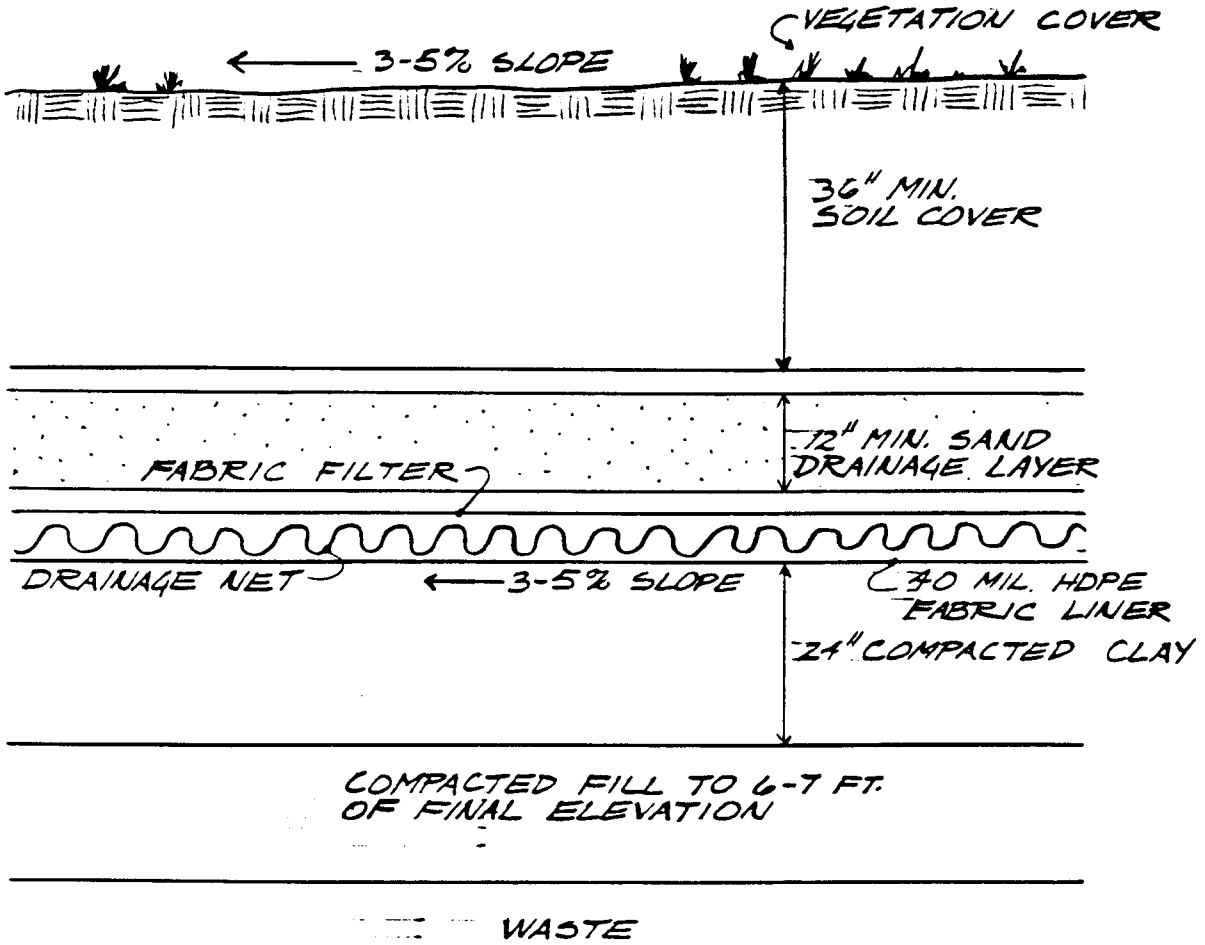


FIGURE 4-7

LANDFILL CAP CROSS SECTION

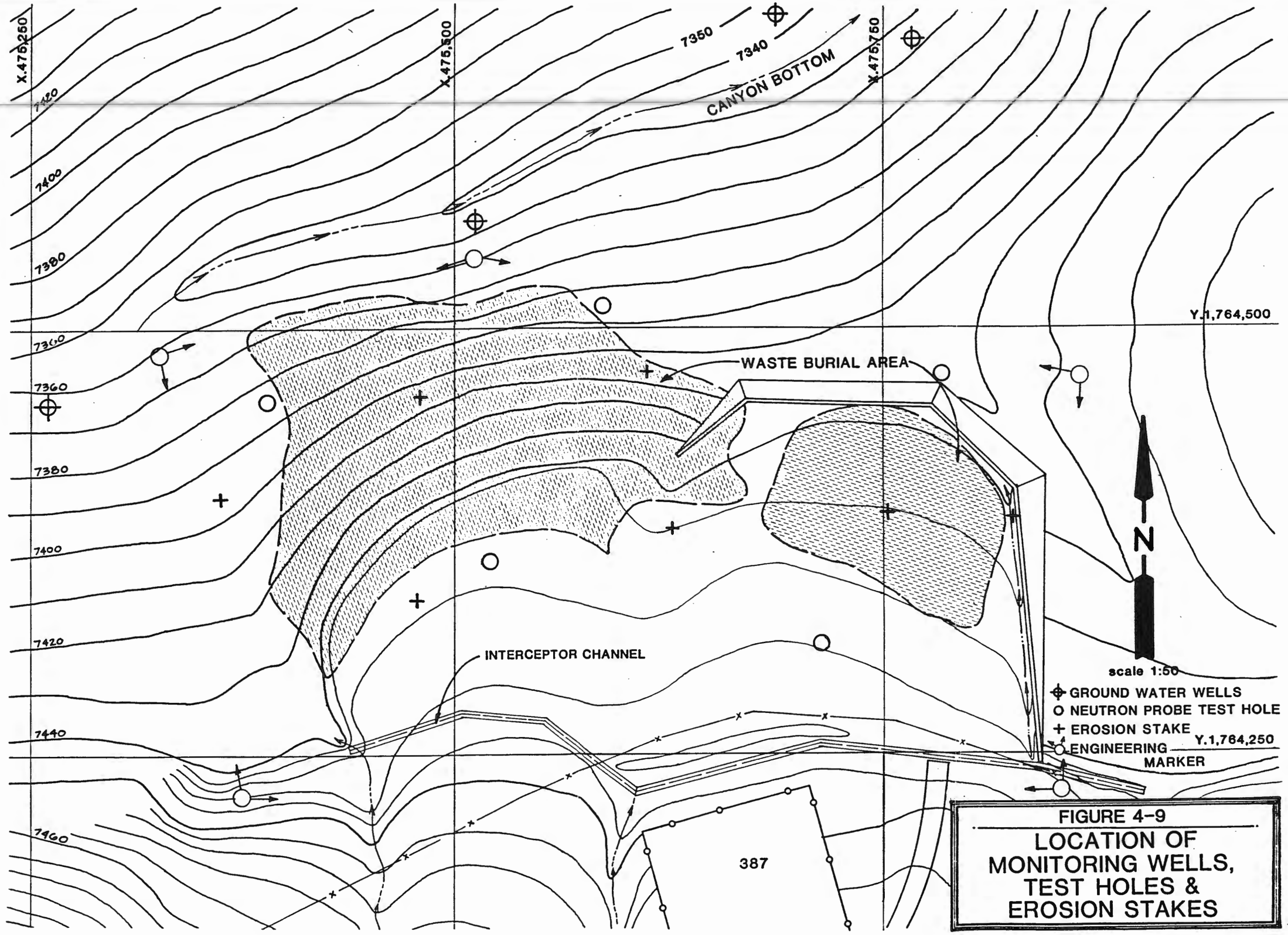


FIGURE 4-9
LOCATION OF MONITORING WELLS, TEST HOLES & EROSION STAKES

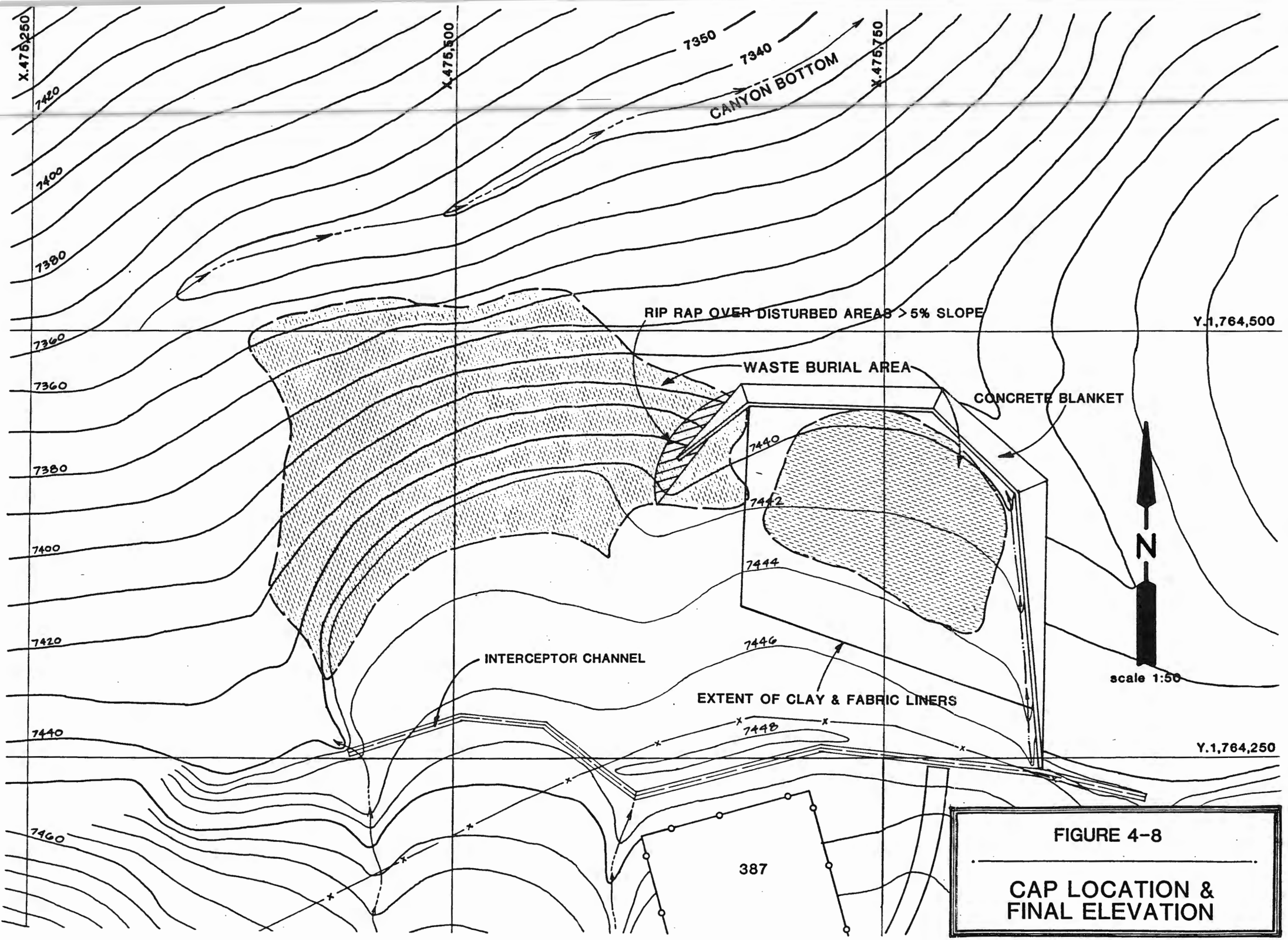


FIGURE 4-8

CAP LOCATION & FINAL ELEVATION

5.0 GENERAL CONSIDERATIONS

5.1 Contact Person

Upon approval of this closure plan, the NMEID and LANL will coordinate in writing with the respective contact person(s) for organization of activities and communications between the parties under the plan. The parties will provide timely written notification of any changes in the designation of contact persons during the term of this plan. LANL will provide a minimum of ten days advance notice to the NMEID through the NMEID contact person(s), of any construction, sampling, or other activities conducted.

5.2 Quality Assurance

Effectiveness of the programs contained in this plan is specifically dependent on proper sampling, analytical methods, and techniques. LANL will use sampling, quality assurance, quality control, and chain of custody procedures that are consistent with the USEPA Regulations throughout all activities. All analytical testing will be performed in a laboratory using appropriate USEPA procedures with QA/QC in conformance with USEPA requirements.

5.3 Split Samples

Upon request by authorized representatives of the NMEID, LANL will provide split samples of any samples collected under this plan. If any analyses are made of such samples, a copies of the

results of the analysis shall be furnished promptly to LANL. This includes all relevant technical data generated by the NMEID representatives or their agents or contractors.

5.4 Facility Access

LANL will provide reasonable access to its facility upon request to authorized representatives of the NMEID for the purpose of monitoring, sampling, and observing activities carried out under this plan. NMEID representatives shall comply with established LANL safety and security practices.

5.5 Cooperation

LANL and the EID's representative will cooperate to the fullest extent possible in the reporting and exchange of data developed under this plan. Copies within LANL's possession of results of sampling and analyses, and other relevant technical data generated by the parties or their agents or contractors under this plan, including raw data, field notes, laboratory bench sheets, and reports will be exchanged as soon as practicable. In the event LANL contracts with a laboratory to perform work hereunder and the State of New Mexico requests from the Laboratory copies of raw data, field notes, or laboratory bench sheets generated for LANL, LANL shall indicate to the laboratory that it has no objection to such documents being provided to the State of New Mexico.

REFERENCES

Los Alamos National Laboratory, 1985, Environmental Surveillance at Los Alamos During 1984, LA-10421-ENV.

Purtymun, W.D., 1984, Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Ground Water Supplies, Los Alamos National Laboratory Report LA-9957-MS UC-11.

Purtymun, W.D., 1975, Geohydrology of the Pajarito Plateau 1947-1972, Los Alamos National Laboratory Informal Report.

APPENDIX A

AREA P VEGETATION

SURVEY AND RECOMMENDATIONS

11/15/85

To: Tony Drypolcher, HSE-8
Stanley Zygmunt, Delta Engineering
From: Teralene S. Foxx, Plant Ecologist, HSE-8
Subject: Suggestions for revegetation of Area P

PRELIMINARY VEGETATION SURVEY OF AREA P

On 11-14-85 I did a brief survey of the hazardous waste site designated as Area P located on the rim of Valle Canyon at approximately 7450 ft. The purpose of the survey was to obtain background information necessary to a revegetation plan for the site. On site taxonomic identifications and visual estimates of cover were made. All specimens were dormant therefore identification to species was not alway possible (Table 1). Figure 1 shows the topography and different management areas. As can be seen aspect, slope, and management of the area have resulted in different vegetation patterns.

The upper portion of the site is situated at approximately 7450 to 7400 ft. The overstory in the adjacent undisturbed areas is a ponderosa pine plant community with and understory of little bluestem, a perennial bunch grass (Figure 1a). Just below the canyon rim the ponderosa pine forest intergrades with a mixed conifer forest composed of ponderosa pine, Douglas fir, and white fir (Figure 1b). The canyon bottom (7300 ft) has a running stream surrounded by aspen, ponderosa pine, and Douglas fir (Figure 1c). Along the major drainage channels and in the canyon bottom there are thickets of Gambel's oak, often growing tree-like (Figure 1d). Other scattered shrub species were noted including New Mexico locust, wild rose, and gooseberry.

The disturbed area, the waste deposition pit, ranged from 7450 to 7400 ft (Figure 1e). Most of that area was covered by false terragon and a variety of grasses including wheatgrass, blue grama, mountain muhly, squirreltail, bluegrass, and oatgrass. Some species appear to have been planted for surface stabilization and others have invaded from the surrounding area. Other forbs were scattered throughout the disturbed area including pinque, prairie coneflower, mullein, and aster. The estimated cover for the disturbed area was 50-75%. The highest cover percentages were near the canyon rim and the southern most upslope portion of the site. Through the middle of the site there was a reduced cover that appeared to be due to soil compaction. In the more compacted areas the primary forb cover was wormwood. A small number of trees and shrubs had invaded into the more stabilized area including juniper, chamisa, and two 4 ft ponderosa pines. With the exceptions of the shrub and tree species, maximum rooting depth of forb and grass species presently on the site would be approximately 213 cm (Foxx and Tierney 1984). In the areas covered primarily with false terragon a soil crust of moss and lichen had formed. These crusts are important to reduction of soil erosion and retaining soil moisture.

A shelf below the rim (Figure 1h) was vegetated with primarily

grasses, some invading from the surrounding forested area. An upper portion (Figure 1g) was essentially bare and was dissected by an erosion channel.

The steep northfacing slope extended from approximately 7400 to 7300 ft, was greater than 3:1 slope. The slope appeared to be well vegetated with grass, forb and shrub species (Figure 1f).

CONSIDERATIONS FOR REVEGETATION OF AREA P

Disturbed lands can seldom be returned to the original condition. Once the native plant cover has been destroyed the rebuilding of the vegetation must be done either by artificial plantings or the natural processes of succession that through time (sometmes 100 years or more) may restore the area to a similar plant cover. Successional processes are too slow and revegetation of the site by planting is always necessary.

On a waste site the vegetation layer should stabilize the soil, minimize percolation into the waste, maximize evapotranspiration from the "trench cap", enhance the aesthetics of the site, and creat a self-sustaining ecosystem of low maintance (McAneny Et. al. Draft Document). To obtain these expectations factors such as soil fertility, seed selection, seed establishment and short and long range maintance through time must be considered.

Seedbed preparation : The disturbed portions of Area P consist of a gently sloping densely vegetated canyon rim and a very steep northfacing slope along a canyon wall. Revegetation of slopes is rarely satisfactory if the slope is greater than a 3:1 (Thornburg 1982; Dittberner and Olson 1983; Nevada State Conservation Commission, No Date). Figure 2 shows the influence of slope on revegetation.

Because the slope on Area P is greater than a 3:1 (Figure 1f), it is suggested that the existing vegetation not be disturbed unless necessary. The upper gently sloping portion (Figure 1e, g, h) of the site will be engineered to cover exposed waste and will need to be "revegetated with native grasses and weeds" (forbs) (Area P Closure Postclosure plan). Topsoil should consist of a clay-loam (from mesa tops) or a sandy loam (from canyon bottoms). The seedbed should be free perennial and annual vegetation and be lightly compacted so the seeds will not be planted too deep.

Fertilization Often a good quality topsoil is not available and a poor quality subsoil or crushed tuff is used. The need for fertilization of area will be highly dependent on the soil obtained. It is suggested that simple soil tests be run to determine the amount of organic matter, phosphorus, potassium, and nitrogen present in the soils. Table 2 gives the relative levels of organic matter and major nutrients in soils. Results of soil tests and reference to the table will indicate that a given soil rates low, medium or high. Low levels indicate a need for supplemental fertilization (McAneney et. al.)

There appears to be some argument concerning the application of nitrogen. Thornburg 1982 reports that nitrogen will increase weed growth. These weeds then compete for space and moisture with the seeded species reducing the cover of planted species. A heavy nitrogen

fertilizer should not be used unless the soil tests deem it necessary.

Selection of Species : Selection of species to be planted on a site is dependent on the soil, slope, precipitation levels, exposure, biotic information, temperature, elevation etc. In addition it is important to understand the artificially created and native ecosystems presently on the site and adjacent to the site to determine species that will flourish and/or invade into the area through time.

The approach to species selection was not only confined to the above criteria but through knowledge of what occurs in the ponderosa pine forest (Foxx and Tierney 1985) and studies on previous waste sites and disturbed areas (Tierney and Foxx 1982, Tierney and Foxx In Press). In addition several references were consulted as to the environmental and biological factors affecting germination as well as short term and long term establishment of individual species (McAneny et al. , Thornburg 1982, Dittberner and Olson 1983, Flory and Marshal 1942, Wasser 1982). Species selected are ennumerated in Table 3 indicating the factors important to establishment of a good biomass for erosion control. Also important was whether or not a species was native or introduced. Introduced species were suggested only if they were non-weedy and have previously been used for reclamation in the area. It is important to note these are suggestions . Final selection is dependent on seed availability and the type of topsoil obtained. At time of site closure if seeds for specific species are not available, closely related species may be appropriate.

Another factor that was taken into consideration in species selection was rooting depths. From a literature data base, Foxx and Tierney 1984 found that the average maximum rooting depth of 1012 specimens was 2 meters. Annual and perennial grasses were shallower rooting that many forbs, shrubs and trees. Rooting depths are of concern because of 1) disruption of the barriers 2) increased percolation into the site 3) possible uptake of toxic materials. Unless the biobarrier in disrupted by mechanical means it has been observed at another waste site and by Tierney and Foxx (In Press) downward movement of the roots will be impeded. In most cases species ennumerated in Table 3 have been reported to root to depths of less than 2 meters.

It is suggested that both cool season and warm season grasses and forbs be planted. Cool season species begin growth in early spring and anthesis usually occurs during the early to midsummer. Warm season species make the maximum growth during the early to midsummer and athesis occurs in the late summer or fall. Using a mixture of both warm season and cool season grasses and forbs provides the maximum cover throughout the growing season from April to October. Table 4 indicates the seeding rates and specific information about species selected.

It is also suggested that nitrogen fixing species be in the seed mix. Most legumes are nitrogen fixing species but are very deeply rooted--particularly alfalfa that has been reported to root to depths of 19 to 32 m. In addition, species such as alfalfa attract gophers that disrupt the cap surface and affect the surface hydrology (Hakonson and Martinez 1982). Biennal legumes such as sweet clover

root to depths of no greater than 160 cm but are weedy and when dry may pose a fire hazard. Selection of leguminous species should be carefully considered. Two composites, Estafiata (Artemisia frigida) and wormwood (Artemisia ludoviciana) have been reported to be nodule forming and nitrogen fixing (Dittberner and Olson 1983). In addition, these Species have been found to occur commonly in disturbed soils at this elevation (Tierney and Foxx 1982). Planting these species would provide shallower rooted nitrogen fixing plants and help increase the cover to prevent erosion. Other shallowly rooting forb species may be included in the mix. Once the seed mixture available is determined rooting depths of individual species in that mix should be researched in Foxx and Tierney 1984.

Planting Dates : For best germination and biomass seeding of the site should be prior rainy season (July to August). Cool season grasses may be seeded in the fall for spring germination when temperatures are too cool for germination. Seeds should not be planted when the soil is frozen or snow covered.

Planting Methods : Because of the size, slope, semiarid nature of the site it is suggested that seeds be planted with a grass or grain drill. This will insure that the seed is covered to a proper depth, the seed is uniformly distributed, and the rate of seeding is controlled. On steeper slopes it is suggested that a hydroseeder be used and a hydromulch applied. Suggested seeding rates are seen in Table 4.

Irrigation : Irrigation should be used only as a temporary measure. We anticipate irrigation would only to be if rains were spaced more than 4 days apart during the establishment phase. Lycimeters would be useful in determinng exact soil moisture and development of a watering regime. An easily installed sprinkler system should be availabe to be used if planting time is droughty.

Mulching : Mulching should protect the area from excessive soil erosion for less than 1 year and help in establishment of erosion but not retard plant growth. Table 5 is a guide to short-term mulch materials. At Los Alamos National Laboratory experiments have been done of a pea-gravel mulch applied at 60 tons/acre. This mulch increased the soil moisture, plant biomass, and reduced erosion rates. The main disadvantage is that it increased infiltration rates (Nyhan 1984). It is suggested that either the pea-gravel mulch be applied or fabric. The fabric mulches must be removed immediately after germination or growth is retarded. Nyhan 1984 found the gravel mulch was functional for one year.

Fire Hazard : Establishment of a dense grass forb vegetation provides a flash (rapidly burning) fuel that may be ignited when dry. If the burning pads are still used this harzard should be addressed. Fire breaks in the vicinity of the site to could prevent fire from spreading from the disturbed site to the surrounding forested area. Fire breaks could be done mechanically by thinning or by the use of prescribed fire to reduce surface fuels in the surrounding forested area.

Succession : It is anticipated that over a 30 year period invasion of

a number of native and invader species from the surrounding forested area will occupy the site. The potential disruption of the cap by tree and shrub species should be addressed for the short term (30 year) and long term (greater than 30 years). Tree and shrub species would increase evapotranspiration rates and the removal of them may not be advisable. Techniques to monitor the soil moisture along the pit profile would be advisable. Roots will penetrate the depth of the soil moisture. Long term monitoring will be a factor in indicating the stability of the cap.

SUMMARY:

1) The slope should remain as undisturbed as possible to retain present vegetation. Revegetation of the slope will be difficult.

2) Soil test should be done prior to planting to determine fertilizing needs.

3) Species have been selected based on biological and environmental factors. The final seed mix will be determined by seed availability and time of planting. Both warm season and cool season grasses and forbs should be planted.

4) Planting before summer rains is recommended.

5) Grass or grain drill should be used on upper portions and hydroseeders on steep slopes.

6) Irrigation will be a temporary measure.

7) Either a pea-gravel or fabric mulch is suggested.

8) Fire hazards and long term successional processes should be addressed for short and long range maintance of the site.

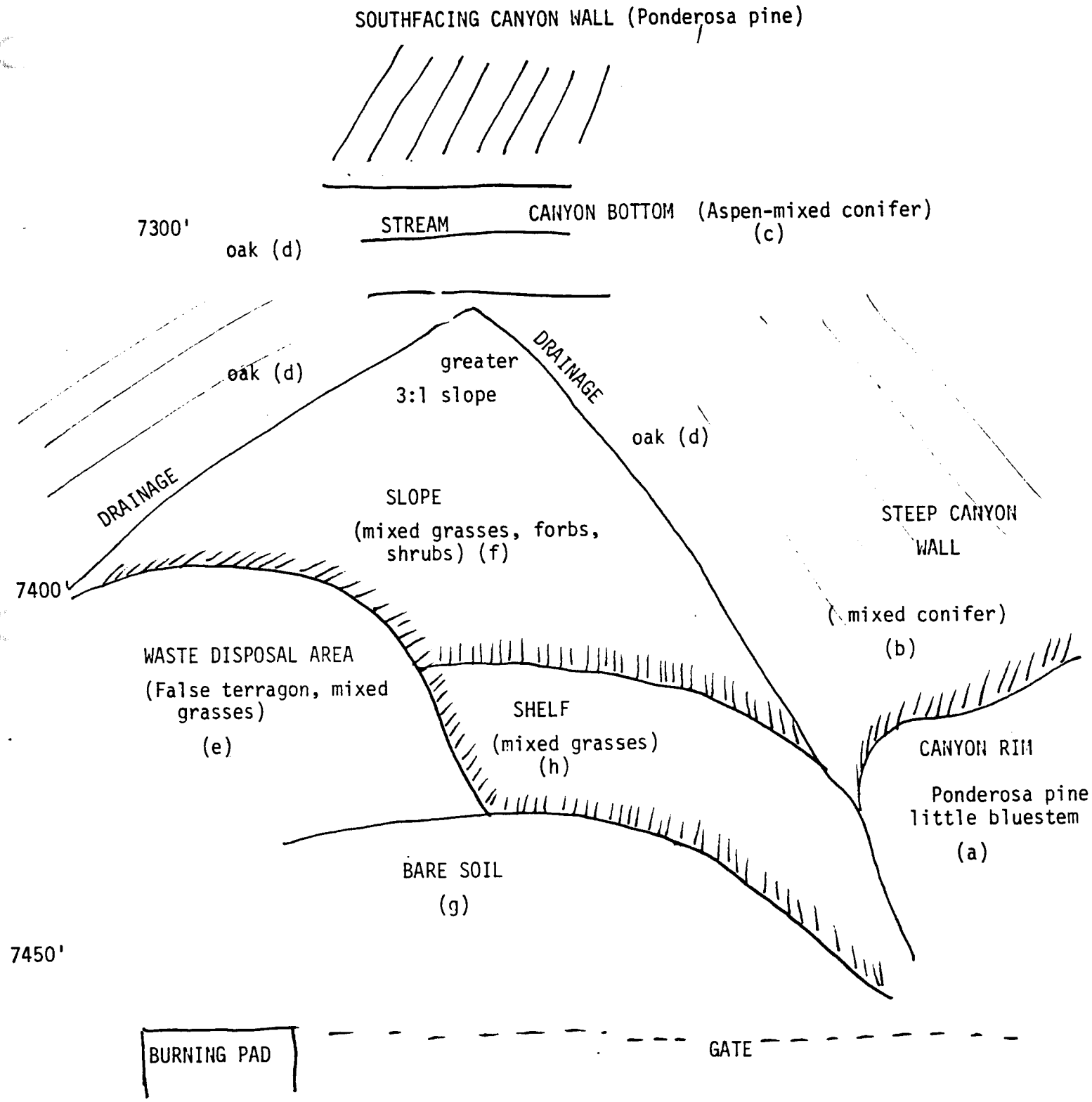


FIGURE 1 Topographic and Vegetation Map Area P

FIGURE 2

INFLUENCE OF SLOPE ON REVEGETATION
(FROM NEVADA STATE CONSERVATION COMMISSION)

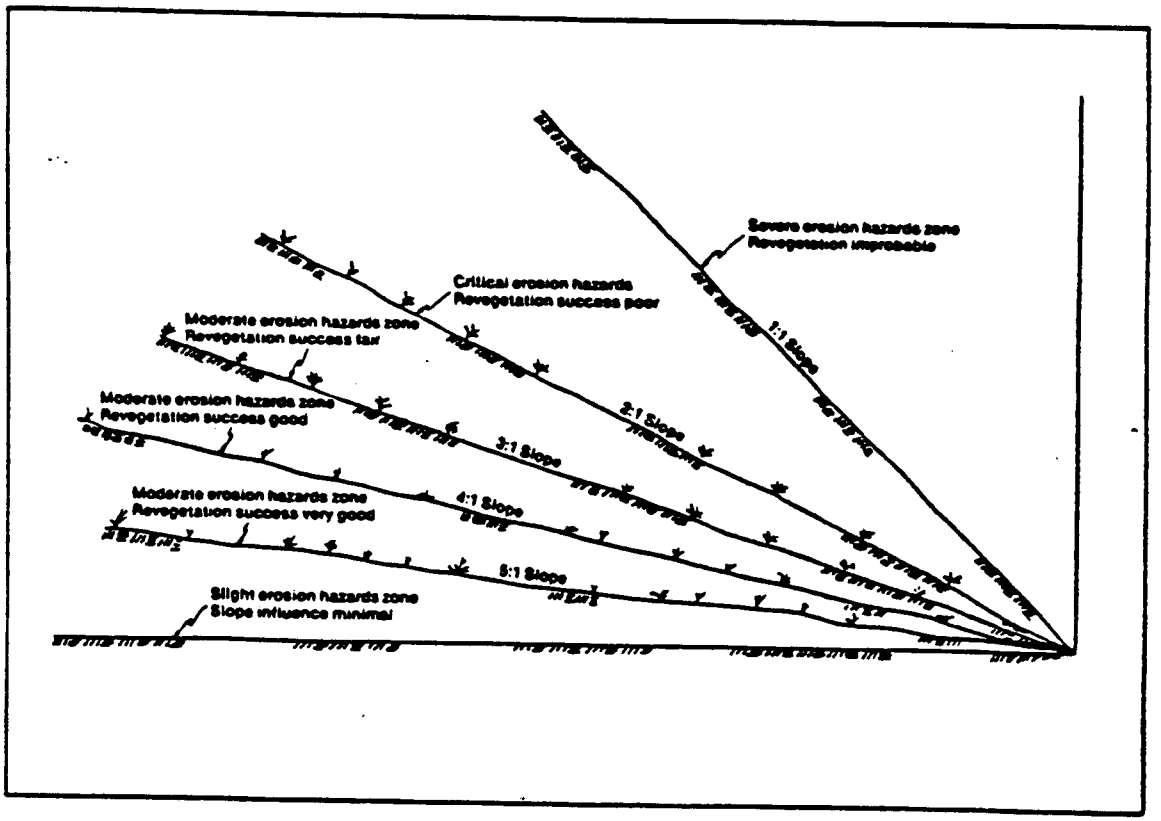


Table 1. Species Found on or Adjacent to Area P

Common Name	Species	Native/Invader/Planted		
TREES				
Ponderosa pine	Pinus ponderosa	N		
Douglas fir	Pseudotsuga menzesii	N		
White fir	Abies concolor	N		
Aspen	Populus tremuloides	N		
Oak	Quercus gambelii	N		
SHRUBS				
Oak	Quercus gambelii	N		
New Mexico locust	Robinia neomexicana	N	I	
Gooseberry	Ribes spp.	N	I	
Rose	Rosa spp.	N	I	
Chamisa	Chrysothamnus nauseosus	N	I	
GRASS				
Little bluestem	Andropogon scoparius	N		
Mountain muhly	Muhlenbergia montana	N	I	
Wheatgrass	Agropyron spp.	N		P
Bottlebrush squirreltail	Sitanion hystrix	N	I	
Fescue	Festuca spp.			P?
FORBS				
False tarragon	Artemisia dracunculus	N	I	
Wormwood	Artemisia ludoviciana	N		
Wormwood	Artemisia carruthii	N	I	
Pinque	Hymenoxys richardsonii	N	I	
Prairie coneflower	Ratibida columnifera	N	I	P
Mullein	Verbascum thapsus	Introduced	I	
Aster	Aster spp.	N	I	
Goldenweed	Chrysopsis foliosa	N	I	

Table 2. Relative Levels of Organic Matter and Major Nutrients in Soils (Bennett and Donahue, 1975; cited in Lutton, 1982)

	Organic Matter (%)					
Relative Level*	Sand, Loamy Sand	Sandy Loam, Loam, Silt Loam	Clay Loam, Sandy Clay, Clay	Nitrogen lb/acre	Phosphorus lb/acre	Potassium lb/acre
Very low	0.6	1.6	2.6	20	6	60
Low	0.6-1.5	1.6-3.0	2.6-4.5	20-50	6-10	60-90
Medium	1.6-2.5	3.1-4.5	4.6-6.5	50-85	11-20	91-220
High	2.6-3.5	4.6-5.5	6.6-7.5	85-125	21-30	221-260
Very high	3.5	5.5	7.5	125	30	260

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*Medium level is typical of agricultural loam soil. Low levels need supplemental fertilization; high levels need no fertilization under normal circumstances.

Table 3. Biological and Environmental Factors for Grass Species Selection

Species	Common Name	Habitat	Native/ Introduced	Warm/Cool Season	Life Cycle	Biomass	Erosion Control Potential	Ease of Establish-ment
Agropyron desertorum (Agde)	Crested Wheatgrass; desert wheat-grass	dry-moist	Introduced	Cool	Perennial	High	High-medium	Low-medium
Agropyron smithii (Agsm)	Western wheatgrass	Dry-moist	Native	Cool	Perennial	Medium-high	High	Medium
Agropyron trachycaulum (Agtr)	Slender Wheatgrass	Dry-moist	Native	Cool	Perennial	Medium-high	Medium-high	Low-medium
Andropogon scoparius (Ansc)	Little bluestem	Dry	Native	Warm	Perennial			
Muhlenbergia wrightii	Spike muhly	Dry	Native	Warm	Perennial			
Festuca ovina (Feov)	Sheep fescue	Dry-moist	Introduced	Cool	Perennial	Low-medium	Medium	Low-medium
Sporobolus cryptandrus (Spcr)	Sand dropseed	Dry	Native	Warm	Perennial	High-medium	Low-medium	Low-medium

Table 3 (cont)

Species	Short-Term Revegetation	Long Term Revegetation	Clay Loam Soils	G	M	H	Maximum Rooting Depth (cm)*
Agropyron desertorum (Agde)	Potential medium	Potential high-medium	Good	G	G	F	183
Agropyron smithii (Agsm)	Low-medium	High	Good	G	G	F	148
Agropyron trachycaulum (Agtr)	Low, medium to high	Medium-high	Good	G	G	F	25**
Andropogon scoparius (Ansc)	Low-medium	Low-high medium		G	G	F	165
Festuca ovina (Feov)	Low-medium	Medium	Good-Fair	G	G	F	152
Sporobolus cryptandrus (Spcr)	Low medium	Medium		G	G	P	122

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*Foxx and Tierney (1985).

**Only reported for shallow soils, probably roots deeper.

Table 4. Ecology and Culture of Selected Species

Common Name	Growth Begins	Matures	Drought Tolerance	Fire Tolerance	Planting Depth	Seed Rate	Germination Time
Crested wheatgrass	Before June	Midsummer	Good	Good	1/2-3/4"	5-15 lb/acre	14 days
Western Wheatgrass	March-early April	August	Good	Good	1/2-1"	5-15	28 days
Littleblue stem	Early spring	Fall	Good	Good	1/4"	2.5-4.5	28 days
Sheep fescue	March-April (green under snow)	Midsummer	Strongly Competitive	Damaged Fair tolerance	1/2"	2-3 lbs	21 days
Dropseed	Spring	Fall	Good	Moderate	1/4"	1/5 lb	5-10 days
Estafiata Artemisia frigida	Spring (evergreen base)	August	Remarkably		1/2-3/4"	4-8 lbs	6-10 days

Table 5. Guide to Short-Term Mulch Materials, Rates, and Uses

Mulch Material	Quality Standards	Application Per 1000 sq. ft.	Application Per Acre	Depth of Application	Advantages	Disadvantages	Remarks*
Sawdust, green or composted	Free from objectionable coarse materials	83-500 cubic feet	--	1"-7"	Protects surface Adds organic matter No weed seeds More fire resistant than straw Long lasting	Shavings and sawdust blow Nitrogen deficiency Packing may occur resulting in less aeration May float on running water	Most effective as a mulch around ornamentals, small fruits, and other nursery stock. Special application rates - fruit trees 4-7"; vegetables and flowers 2-3"; blackberries and raspberries 4-7"; strawberries 2". Good resistance to wind blowing. Requires 30-35 lbs. N/ton to prevent N deficiency while decaying mulch. One cubic foot weighs 24 pounds.
Wood chips	Green or air dried. Free from objectionable coarse materials	500-900 lbs.	10-15 tons	2"-7"	Easy to apply Chips resistant to wind movement	May prevent precipitation from reaching soil	Has about the same use and application as sawdust, but requires less N/ton (10-12 lbs.). Resistant to wind blowing. Decomposes slowly.
Wood excelsior	Green or air dried burred wood fibers .024" x .041" x 4"	90 lbs. (1 bale)	2 tons	--			Effective for erosion control. Tie-down needed on windy sites. Decomposes slowly. Packaged in 80-90 lb. bales.
Wood fiber cellulose (partly digested wood fibers)	Usually dyed green. No growth organism inhibiting factors. Air dried 30% fibers 3.7 mm	25-30 lbs.	1000-1500 lbs.	--			When used for erosion control on critical areas double application rate. Apply with hydromulcher. No tie-down required. Packaged in 100 lb. bags. Has not been very satisfactory for establishing seedings on arid sites.
Compost or manure	Well shredded, free from excessive coarse material	400-600 lbs.	8-10 tons	--	Can protect soil surface and adds nutrients, such as N, P, K, S	When used alone, it becomes wet, then dry, can lose much of N through volatilization of ammonia	Use a strawy manure when erosion control is needed. May create problems with weeds. Excellent moisture conserver. Resistant to wind blowing.
Cornstalks or sorghum stover, shredded or chopped	Air dried, shredded into 8" to 12" lengths	150-300 lbs.	4-6 tons	--			Effective for erosion control, relatively slow to decompose. Excellent for mulch crop on fields. Has about the same value as a cover crop. Resistant to wind blowing.
Grass hay or grain or straw	Air dried, free from undesirable seeds and coarse materials	75-100 lbs., 2-3 bales	1.5-2.5 T. 90-120 bales	Lightly covers 75 to 90% of surface	Generally most economical Usually satisfactory under many circumstances	Weed seeds usually present; even hay seeds may be considered a weed on a particular site Straw may "wick-out" moisture from soils in very dry conditions, thus resulting in poor germination and seedling establishment	Use straw where mulch effort to be maintained for more than 3 months. Subject to wind blowing unless kept moist or tied down. Most common and widely used mulching material. Good for erosion control in critical areas. Anchor mulch, especially on slopes, by crimping, or using plastic meshes, jute, chemical tackifiers. Long-stemmed best, especially for crimping. Uniform application important. Can be spread with modified farm manure spreader.
In situ mulches (cereal grains or summer annual crops like wheat, barley, or rye)					Produces quick cover to stabilize disturbed areas. Provides uniform mulch. More economical than artificially applied mulching materials.		Fall crops killed with herbicides in spring before maturity, summer annuals killed by frost in fall. Interseed with permanent grasses and legumes species. Produces up to 2.5 T/ac dry matter.

--Continued--

Table 5 (cont)

Mulch Material	Quality Standards	Unit Size	Unit & Weight	Area Covered Per Unit	Advantages	Disadvantages	Remarks*
Mats & Netting:					Especially useful on steep slopes Mats good in high wind areas	Expensive: 4-5 times more than tacked straw High labor input for anchoring Not effective on rough surfaces or rocky areas Erosion from beneath may be a problem	Used only on limited critical areas because of cost.
Twisted kraft paper yarn	Plain weave, warp 7 per inch, filling 4 per inch selvage edge with polypropylene filament	45" x 250 yds.	Roll 100 lbs.	312½ sq. yds.			Used to hold seed and aid in germination without mulch. Tie down according to manufacturing specifications. Not effective in seeding establishment on arid sites. Lasts about one year.
Twisted kraft paper yarn	Fungicide treated warp 1.1 pairs/in. filling 2.5/in.	45" x 250 yds.	Roll 80 lbs.	312½ sq. yds.			Use over bare soil or sod to prevent erosion and hold seed. Good for waterways and critical ditch bottoms. Tie down with staples as per manufacturing specifications and on critical areas. Lasts about one year.
Jute, twisted yarn	Undyed, unbleached plain weave. Warp 78 ends/yd. Weft 41 ends/yd	45" x 50 yds. or 48" x 75 yds.	Roll 60 lbs. 90 lbs.	60 sq. yds. 100 sq. yds.			Use without additional mulch. Tie down as per manufacturing specifications. Effective for erosion control in waterways and ditches. Lasts about one year.
Excelsior wood fiber mats	Interlocking web of excelsior fibers w/mulch net backing on one side only.	36" x 30 yds.	Roll --	10½ sq. yds.			Use without additional mulch. Tie down as per manufacturing specifications. Good for establishing seedings on critical areas.
Plastic.	2-4 mils	Variable up to 50' wide	--	--	Excellent vapor barrier Good weed control Light colored, perforated, found effective in New Mexico: soil temperature in summer 18°F lower than in soil with no mulch	Labor intensive High cost	Use black for weed control, use white for seeding establishment without organic mulch. Release plastic after seeding is established. Information on temperature effect varies. The materials allow air and water interchange but prevent evaporation of soil moisture. Usually must be renewed each season. Some users place a 1" layer of sand underneath to prevent it from tearing when stepped upon. Must be punctured with frequent small holes for penetration of air and water and weighted down around edges.

* All mulches will provide some degree of erosion control, moisture conservation, weed control, and reduction of soil crusting.

REFERENCES

Bennett, F. W. and Donahue, R. L. 1975 Methods of Quickly Vegetating Soils of Low Productivity, EPA-440/9-75-006, US Environmental Protection Agency, Washington DC.

Dittberner, P.L. and M. R. Olson. 1983. The Plant Information Network (PIN) Data Base, Colorado, Montana, North Dakota, Utah, and Wyoming. Western Energy and Land Use Team, Division of Biological Services, Research and Development, Fish and Wildlife Service, US Department of Interior, Washington, DC FWS/OBS-83/36

Flory, E.L. and C.G. Marshall, 1942. Regrassing for soil protection in the Southwest. USDA Farmer's Bull. No. 1913 US Govt. Printing Office, Washington, DC

FOXX, T.S. AND G. D. Tierney. 1984. Rooting depths of plants on low-level waste disposal sites. Los Alamos National Laboratory Report la-10253-MS,

Foxx, T. S. and G. D. Tierney. 1985. Status of the Flora of the Los Alamos National Environmental Research Park, Checklist of Vascular Plants of the Pajarito Plateau and Jemez Mountains. Los Alamos National Laboratory Report LA-8050-NERP, Vol. III.

Hakonson, T.E. and J. L. Martinez 1982 Disturbance of a low-level waste site trench cover by pocket gophers. Health Physics.

Lutton, R.J. et. Al. 1982. Parameters for Characterizing Sites for Disposal of Low-Level Radioactive Waste. NUREG/CR-2700, US Nuclear Regulatory Commission, Washington, DC

McAneny, C. C., P.G. Tucker, J. Morgan, C.R. Lee and M.F. Kelley. DRAFT DOCUMENT Draft Technical Handbook on Design and Construction of Covers for Uncontrolled Hazardous Waste Sites. EPA Interagency Agreement Number AD-96-F-2-A144. Municipal Enviromental Research Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati, Ohio 45268 pp. 4-151 to 4-210.

Nevada State Conservation Commission (No Date) Handbook of Best Management Proactices, Non-designed Area Water Quality Management Plan, Loose-Leaf notebook, Carson City, Nevada.

Nhyan, J. W., W. V. Abeel, and B.A. Perkins, and L.J. Lane. 1984. Proceedings of the Sixth Annual Participants' Information Meeting DOE Low-Level Waste Management Program. National Low-Level Radioactive Waste Management Program, Idaho Falls, Idaho

Tierney, G. D., T. S. Foxx 1982. Floristic Composition and Plant Succession on Near-Surface Radioactive Waste Disposal Facilities in the Los Alamos National Laboratory. Los Alamos National Laboratory Report LA-9219-MS 59 pp.

Tierney, G.D. and T. S. Foxx (IN PRESS) Root Lengths of Plants on Los Alamos National Laboratory Land. Los Alamos National Laboratory, Los Alamos, NM

Wasser, C.H. 1982. Ecology and Culture of Selected Species Useful in Revegetating Disturbed Lands in the West. Western Energy and Land Use Team. Office of Biological Research. Fish and Wildlife Service, US Department of Interior, Washington DC. 374 p.

APPENDIX B

GEOLOGY AND HYDROLOGY OF AREA P NEAR S-SITE

GEOLOGY AND HYDROLOGY OF AREA P NEAR S-SITE

by

William D. Purtymun

I. INTRODUCTION

Area P (Landfill) is located on the western margin of the Pajarito Plateau within the boundaries of Los Alamos National Laboratory. The Pajarito Plateau, formed by a series of ashflows and ashfall tuffs, forms an apron around the east flank of the Sierra de los Valles (Fig. 1). The surface of the plateau slopes gently eastward and terminates along the Puye Escarpment and White Rock Canyon above the Rio Grande. The surface of the mesa has been dissected into a number of narrow mesas by southeast trending streams.

This report was requested by the Regulatory Compliance Section of the Environmental Surveillance Group (HSE-8). It was prepared from published reports and reconnaissance of the area.

II. GENERAL GEOLOGY

The Pajarito Plateau is structurally a part of the Rio Grande depression--a complex series of faulted troughs or basins that extend from southern Colorado along the Rio Grande to northern Mexico (Kelley 1952). The basement rock has been down faulted in the depression to as much as 10,000 to 15,000 feet below sea level (Fig. 2). The depression is filled with sediment and volcanic rocks.

The rocks that outcrop along the edges of and form the surface of the Pajarito Plateau are from oldest to youngest:

the Tesuque Formation, Puye Conglomerate, Basaltic Rocks of Chino Mesa, Tschicoma Formation, and Bandelier Tuff (Fig. 2). For a detailed description of these rock units, see Griggs (1964). The most important rock unit at Area P is the Bandelier Tuff.

The Bandelier Tuff forms the upper surface of the Pajarito Plateau. It is composed of a series of ashfalls and ashflows of rhyolite tuff. The three members of the Bandelier Tuff in ascending order are Guaje member, a lump pumice; the Otowi Member, a massive nonwelded ashflow; and the Tshirege Member, a series of moderately welded to welded ashflows (Purtymun and Koopman 1965). The Tshirege Member forms the surface of the mesa at Area P.

The most prominent structural feature of the Pajarito Plateau is the Pajarito Fault Zone, which tends northward along the western edge of the plateau (Fig. 3). The fault is downthrown to the east and displaces rocks of the Bandelier Tuff, Puye Conglomerate and Tschicoma Formation (Fig. 2). The displacement is estimated at about 400 ft (Budding 1976). Two smaller faults occur north and east of the Fault Zone (Fig. 3). They are the Los Alamos Fault (displacement 20 ft) and the Guaje Mountain Fault (displacement 10 to 50 ft). The Water Canyon Fault is the most important fault in this study as it occurs near Area P (see section III).

III. LOCAL GEOLOGY

Area P (Landfill) lies near the western margin of the Pajarito Plateau in a saddle of a short eastern trending narrow mesa. A scarp due to the Water Canyon fault lies to the west of the landfill. To the north, the Canon de Valle has cut through the scarp and drains an area to the west on

the flanks of the Sierra de los Valles. A small canyon has cut into the edge of the scarp to the south of the saddle. This south edge of the saddle slopes gently to the south. The explosive burning facility occupies the saddle and gently sloping part of the saddle to the south.

Area P (Landfill) occupies the northern part of the saddle that slopes gently to the north for about 400 feet and then becomes very steep as Canon de Valle has cut a deep canyon into the Bandelier Tuff. To the east of Area P the saddle rises gently to the top of the narrow mesa that terminates about a mile to the east as Canon de Valle turns abruptly to the south (Fig. 4).

The Bandelier Tuff (Tshirege Member) forms the saddle and underlies the Explosive Burning Facility and part of the landfill. About 50 feet of tuff in the saddle appear to be a moderately welded tuff, while about 80 feet of welded tuff is exposed beneath the moderately welded tuff in the south wall of Canon de Valle (Fig. 5).

The following geologic section is estimated from logs of Test Hole DT-5A and PM-2 and log of supply Well PM-2 (Purtymun 1968):

Geologic Unit	Thickness (ft)	Average Depth Below Land Surface to Top of Unit (ft)
Bandelier Tuff	800	0
Puye Conglomerate	500	800
Tschicoma Formation	1000	1300
Tesuque Formation and Earlier Volcanics and Sediments	2000	2300
Precambrian Rocks	--	4300

The Water Canyon fault lies about 2 miles east of the Pajarito Fault Zone (Fig. 3). It is a normal fault with a displacement of about 30 ft as measured between marker beds in the Bandelier tuff. The fault is downthrown to the east and is abut 2.5 to 3 miles long (Budding 1976).

The scarp formed west of Area P appears to be an erosional scarp. The Water Canyon fault lies east (Fig. 4). The outcrop of the upper units of the Bandelier Tuff on the north wall of Canon de Valle shows no breaks (bed dip to the west) northwest, north, and northeast of Area P. Several hundred yards east of Area P these beds are broken by the Water Canyon fault. The fault zones of broken tuff weather rapidly with the formation of silt and clay. These zones tend to restrict the movement of water rather than promote the movement. East of fault the beds dip gently to the east.

The elevation of the saddle is about 7460 ft above sea level. The main aquifer (aquifer capable of municipal and industrial supply) lies at an elevation of about 6230 feet above sea level, or 1230 feet below the saddle in the Puye Conglomerate.

IV. LOCAL HYDROLOGY

Surface runoff from Area P is into Canon de Valle. Canon de Valle heads on the flanks of the Sierra de los Valles to the west and is tributary to a major intermittent stream in Water Canyon about 2 miles to the southeast. Water Canyon is tributary to the Rio Grande about 6 miles to the east in White Rock Canyon.

The stream in Canon de Valle below Area P is probably intermittent due to small drainage areas on the flanks of the mountain. It contains some water used in cooling machining processes from facilities to the west. This water forms base flow of the stream.

Canon de Valle is over 100 feet deep at the saddle near Area P. The canyon in this area of the plateau contains only a thin section of alluvium (probably less than 10 feet thick), which could contain water from the stream perched on the underlying tuff. This is a common occurrence with water in major stream channels that cross the plateau. In Water Canyon, about 2.5 miles to the southeast, water in a shallow observation well fluctuates with the amount of runoff in the intermittent stream. It is dry most of the time. In this area, a 200-foot deep/2-foot diameter well cased through the alluvium to shut out the water is completed in the tuff. This well has contained no water for the past 25 years.

Based on other test holes and supply wells on the plateau (Frijoles Mesa, Supply Wells PM-2, 3, 4, and 5), there is no known perched water beneath the alluvium in the stream channel and the top of the main aquifer.

The top of the main aquifer lies at a depth of about 1230 feet below the surface in rocks of the Puye Conglomerate at Area P. The main aquifer is recharged from precipitation in the mountains to the west, deep canyons cut into the mountains, and from ground water in the Valles Caldera west of the Sierra de los Valles. The movement of water is from the recharge area eastward toward the Rio Grande where part of the water is discharged into the river through seeps and springs. The movement of water in the upper 500-feet of

aquifer at Frijoles Mesa to the southwest has been calculated at about 345 feet per year, while to the east the movement in the upper 1740 feet of supply well is much less at 95 feet per year (Purtymun 1984). The movement of the water in the main aquifer is probably near an average of the two rates at about 200 feet per year in the upper 1000 ft of the aquifer. A thick section of Tschicoma Formation lying within the main aquifer has a low permeability and tends to restrict the movement of water.

V. AREA P

The landfill at Area P is located on the south wall of Canon de Valles. The elevation is about 7400 ft. The south wall of the canyon contains a thick growth of live oak, pine, and wild rose.

The Bandelier Tuff that forms the Pajarito Plateau consists of a series of ashflow and ash falls that are described as nonwelded, moderately welded, and welded. The tuff at the landfill overlies a welded tuff and laps on to a moderately welded tuff (Fig. 5). The hydrologic characteristics of the tuff depend on degree of welding; the denser the welding, the lower porosity and hydraulic conductivity. The porosity of a moderately welded tuff will range from 30 to 55 percent by volume, while that of a welded tuff will range from 15 to 40% by volume. The saturated hydraulic conductivity for a moderately welded tuff ranges from 0.1 to 1.7 ft/day, while the welded tuff ranges from 0.009 to 0.26 ft/day. The tuff at Area P is not saturated.

The tuff is dry with natural moisture contents ranging from one to six percent by volume. Soil development on the tuff and north facing slopes has restricted most, if not

all, infiltration from precipitation into the underlying tuff.

The landfill is an on-sloping bench of moderately welded tuff underlain by a welded tuff (Fig. 5). The landfill was built from west to east. To the west the surface of the landfill has been capped with soil and tuff. There is no indication of water or leachate leaving the toe of the older part of the landfill.

To the west, on the recently used part of the landfill, there is a considerable erosion, subsidence and evidence of water entering the landfill. At the toe of the landfill in this area the water appears (at time of precipitation, not continuous flow) as surface flow on the top of the welded tuff.

The toe of the dump in the older part extends over the welded tuff, to the canyon bottom; however, the main part of the landfill is well above flood stage of Canon de Valle. There are some cans and other debris scattered below the main toe of the dump.

The landfill may not be located in the best possible area; however, there are some positive geologic and hydrologic conditions at the present location.

(1) The landfill is underlain by a welded tuff, which has a low porosity and a low hydraulic conductivity.

(2) The landfill is above the maximum flood level of Canon de Valle with exception of minor amounts of material that is scattered below the main toe of the landfill.

(3) It is in an area where all runoff water can be diverted from the landfill.

(4) About 1200 ft of unsaturated volcanics and sediments lie between the landfill and main aquifer of the Los Alamos Area.

(5) The Water Canyon Fault zone lies about 400 ft east of the landfill.

The depth to the top of the main aquifer, combined with the underlying relatively impermeable welded tuff, indicates that the present location of the landfill could be ideal with stabilization and runon and runoff control.

REFERENCES

Budding, A. J. and Purtymun, W. D., "Seismicity of the Los Alamos Area Based on Geologic Data," Los Alamos Scientific Laboratory report LA-6278-MS (1976).

Griggs, R. L., "Geology and Ground-Water Resources of the Los Alamos Area, New Mexico," U.S. Geol. Survey Water Supply Paper 1753 (1964).

Kelley, V. C., "Tectonics of the Rio Grande Depression of Central New Mexico," in The Rio Grande Country, NM Geol. Soc Guidebook, 3rd Field Conference (1952).

Purtymun, W. D. and Koopman, F. C., "Physical Characteristics of the Tshirege member of the Bandelier Tuff with Reference to Use as a Building and Ornamental Stone," U.s. Geol. Survey Open-File report (1965).

Purtymun, W. D., "Geology of the Microseismograph Station at S-Site, Los Alamos County, New Mexico," U.S. Geol. Survey Admin report (1968).

Purtymun, W. D., "Hydrologic Characteristics of the Main Aquifer in the Los Alamos Area: Development of Water Supplies," Los Alamos National Laboratory report LA-9957-MS (1984).

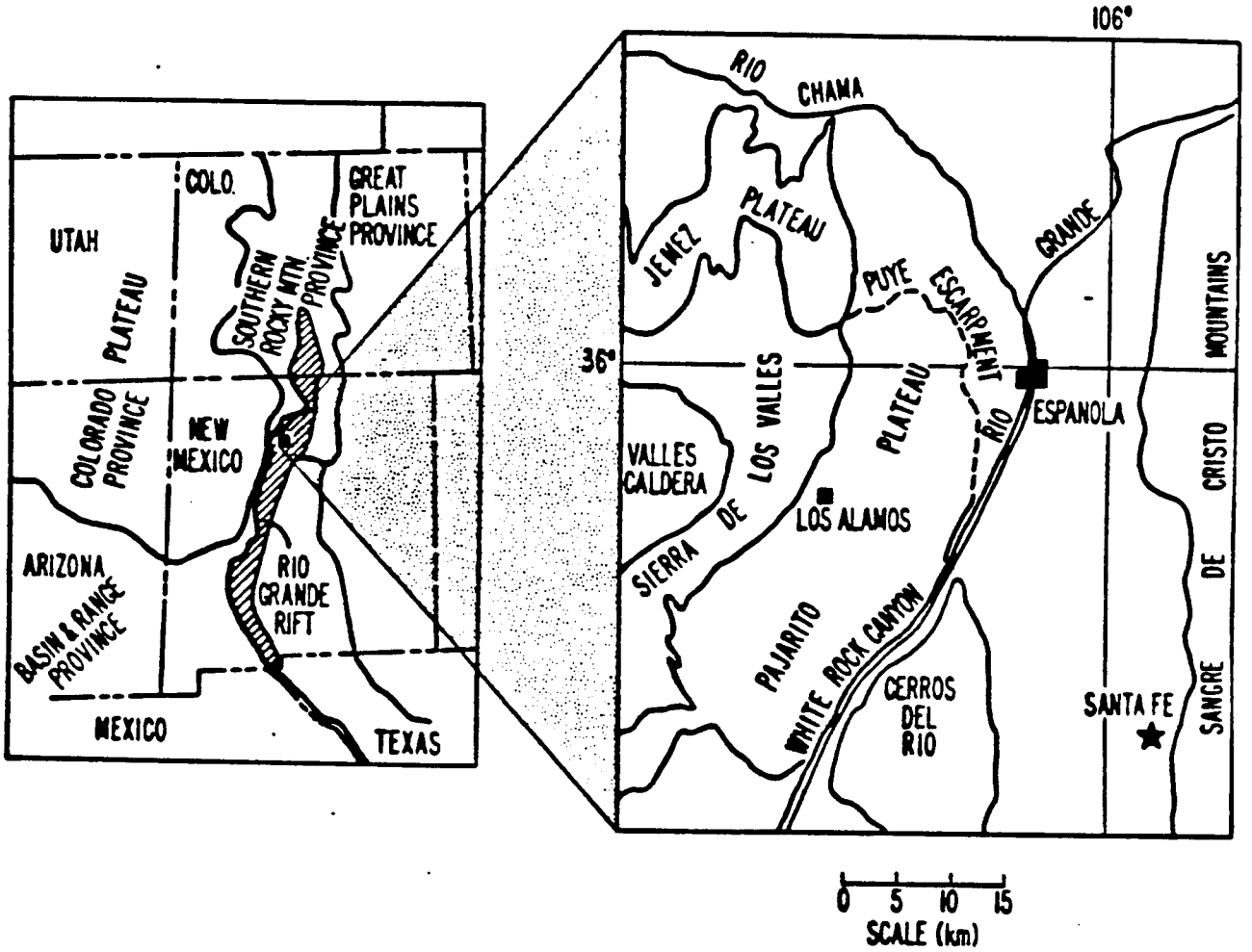


Fig. 1. Physiographic features of the Los Alamos Area.

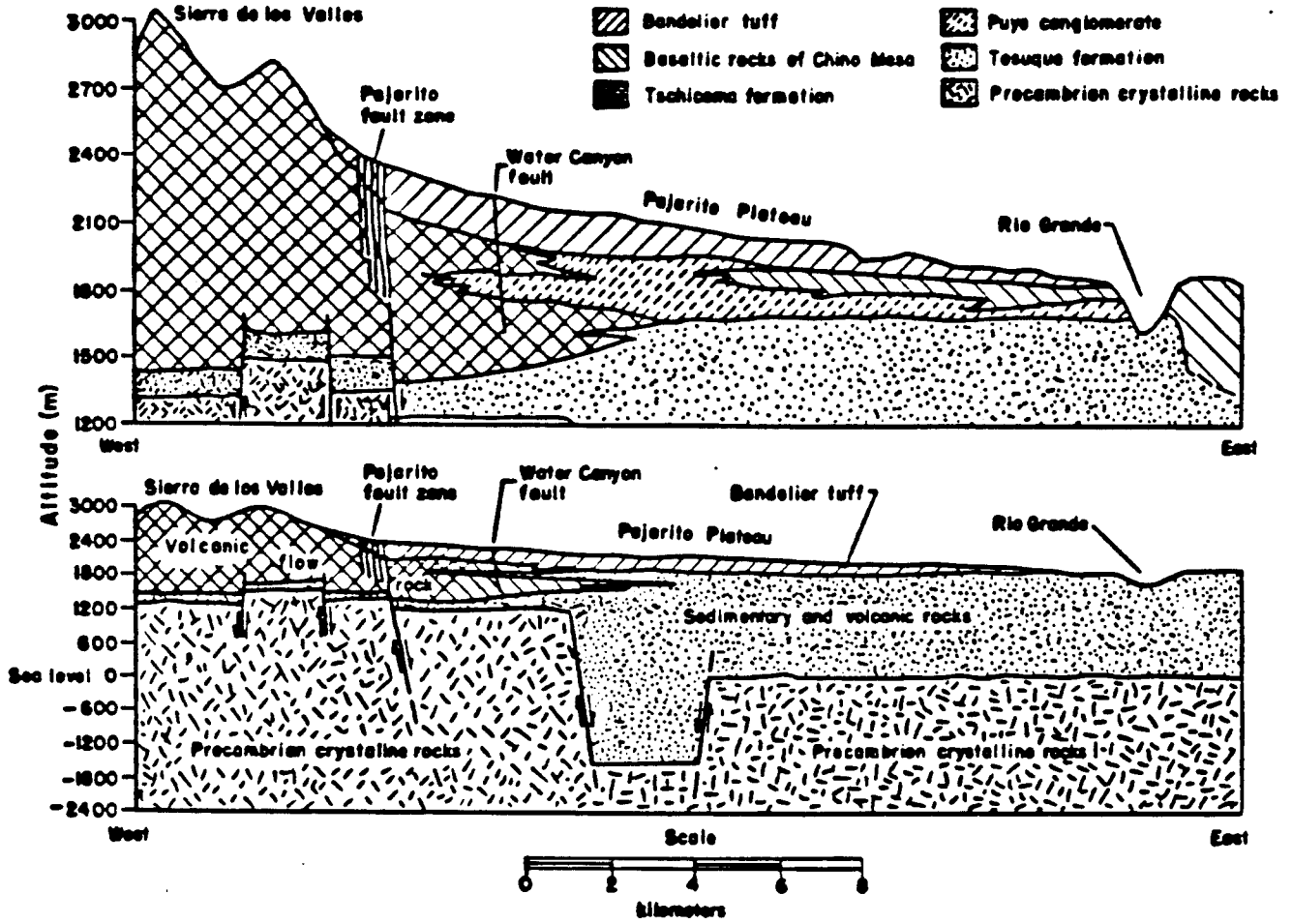


Fig. 2. Geologic section showing stratigraphic relationship of geologic unit.

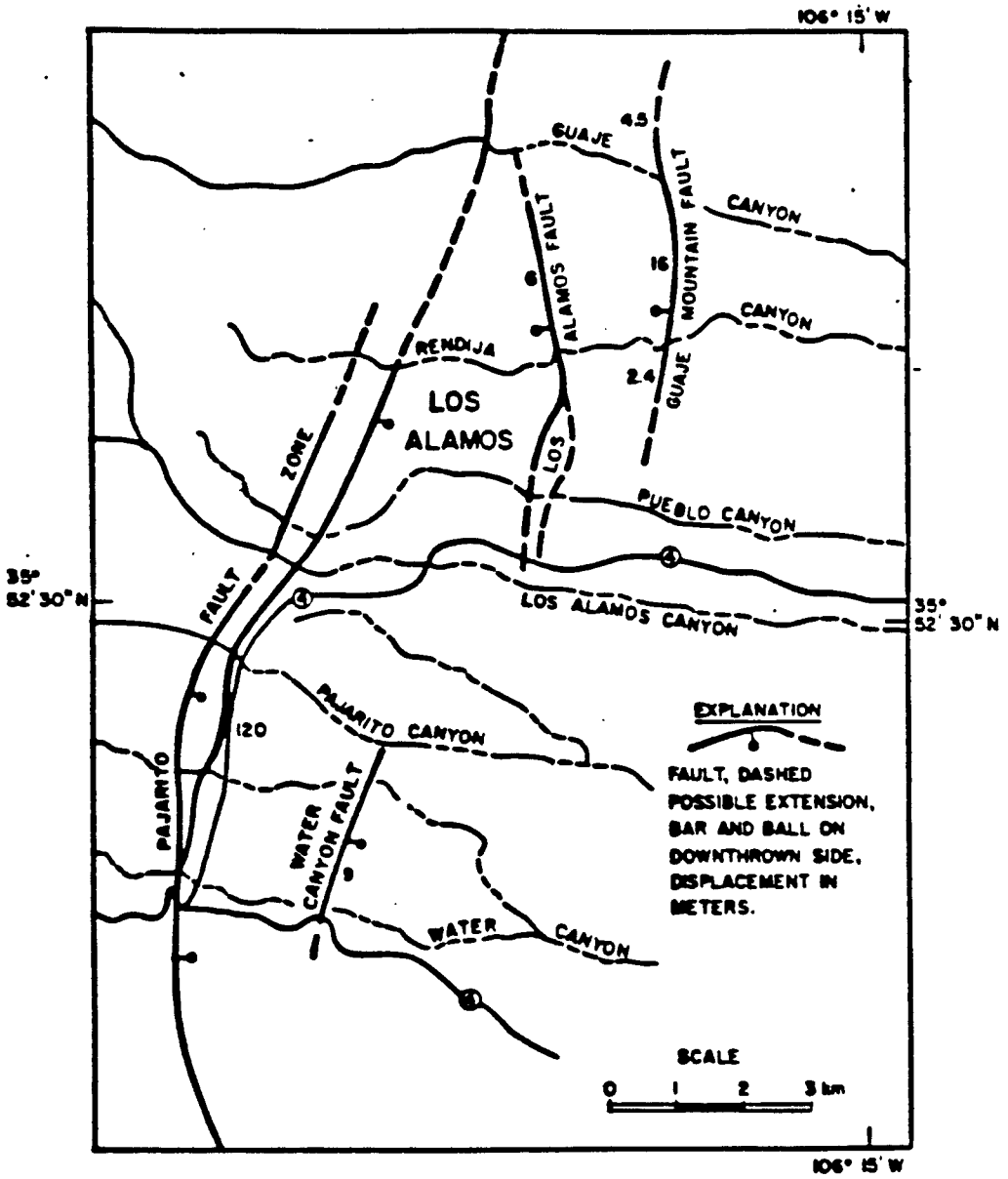


Fig. 3. Map showing faults in the Los Alamos Area.

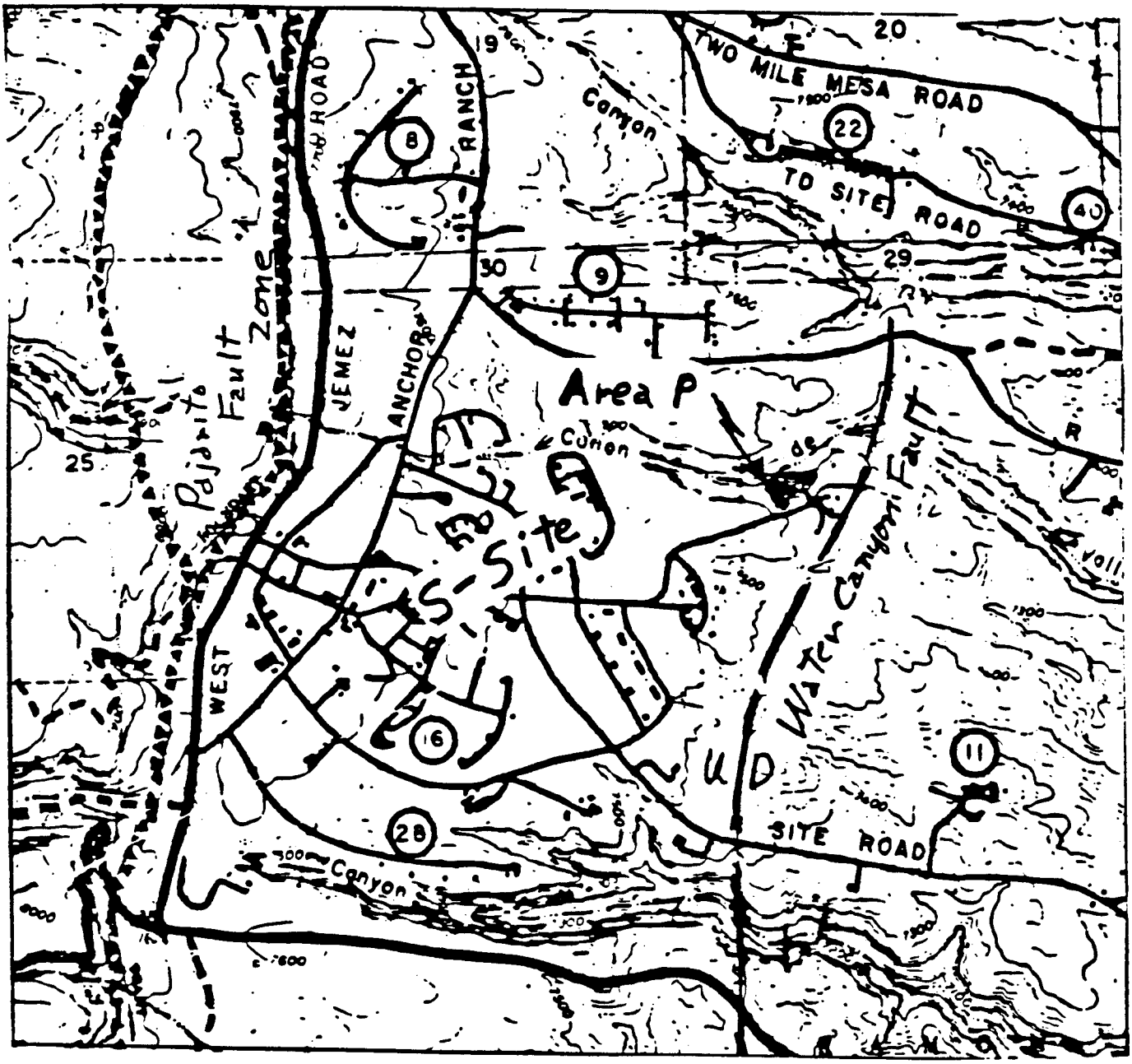
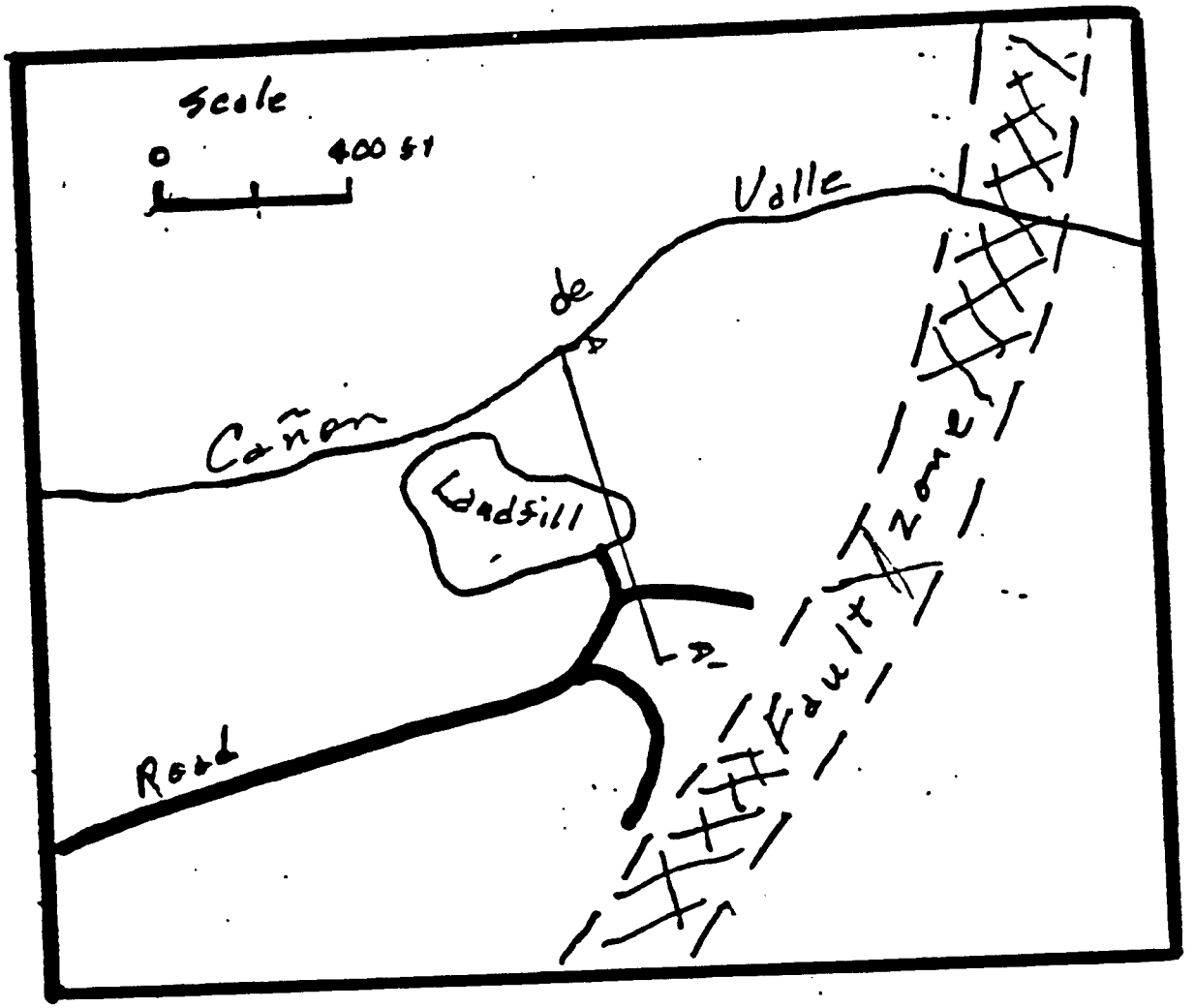


Fig. 4. Map showing S-Site, Area P and nearby faults.



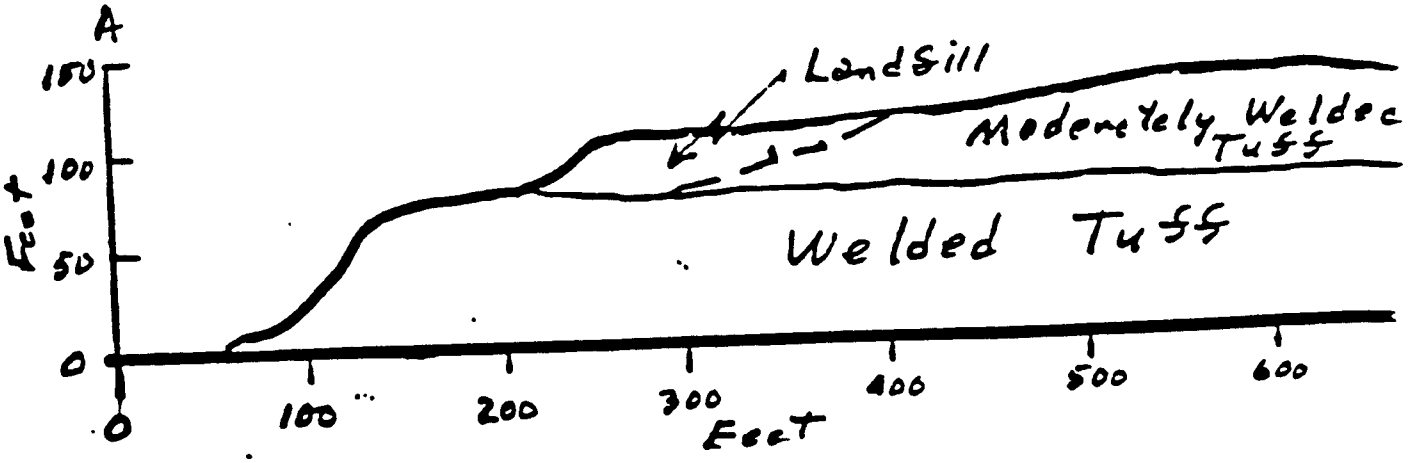


Fig. 5. Map showing landfill at Area P and generalized geologic section.

APPENDIX C

SITE DRAINAGE

APPENDIX C

SITE DRAINAGE

1.0 INTRODUCTION

Closure of Area P requires intercepting surface flows generated on Areas 1 and 2 as shown on the Facilities Engineering Division Drawing Eng.16-33, "Area P Site Characterization Survey", dated November 8, 1985. Another drainage area, Area 3 remains undisturbed by the closure and flows immediately west of the closed landfill after receiving flow from the West Channel. The West Channel intercepts flow from Area 2; the East Channel intercepts flow from Area 1. At Station 0+00, flow splits to the East and West Channels.

2.0 RUNOFF ESTIMATES

The 100-year flows from Areas 1, 2 and 3 are calculated using the SCS Method (1) and the 24-hour, 100-year frequency rainfall of Bowen (2).

A. Time of Concentration (all areas)...0.1 hr

B. Runoff Curve No. (1).....CN=79
   (Table 2-1, Soil B, Poor Range)

C. Rainfall, 24-hr, 100-year(2).....P=4.0 in

D. Direct Runoff (1).....P=2.0 in

E. Distribution Curve No. (71).....70
(Exhibit 2-3)

F. Cfs/ac-in (1) (Figure 2-5).....1.4
(Figure 2-5)

G. Peak Discharge, 100 year

q_1=.796 ac x 2 in x 1.4 cfs/ac-in=2.23 cfs

q_2=.768 ac x 2 in x 1.4 cfs/ac-in=2.15 cfs

q_3=.944 ac x 2 in x 1.4 cfs/ac-in=2.64 cfs

4. Volume Runoff, 100 year

V_1=.796 ac x 2 x 1/12 in/ft x
325,900 gal/ac-ft =43,236 gal

V_2=.768 ac x 54317 =41,715 gal

V_3=.944 ac x 54317 =51,275 gal

3.0 EAST AND WEST CHANNELS

Plan and profiles of the channel center-lines are shown in Figure A-1. The cross section is the same for both channels and is shown in Figure A-2 along with the Station 0+00 detail. Flow capacity is based on the lowest slope of 0.005. The Manning Equation (3) using n=0.014 predicts flow of 5.6 cfs at 0.5 feet flow depth. Total depth is 0.75 feet.

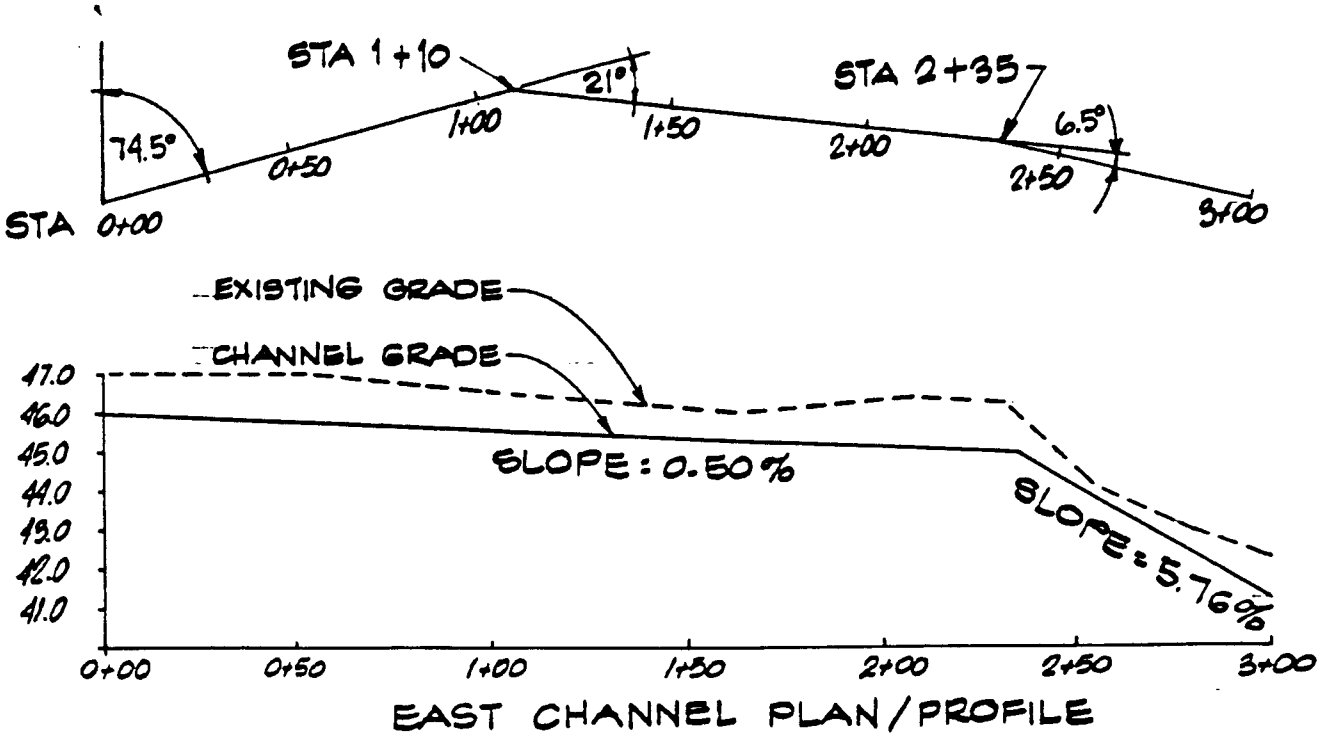
Areas 1 and 2 which are split by a natural drain, are isolated from uphill flows by extending the 7458, 7460, and 7462 contours between Building 386 and 387 as shown on Drawing Eng.16-33.

4.0 REFERENCES

(1) Chapter 2: Peak Rates of Discharge for Small Watersheds; Engineering Field Manual for Conservation Practice, Revised 1973; U.S.D.A., Soil Conservation Service.

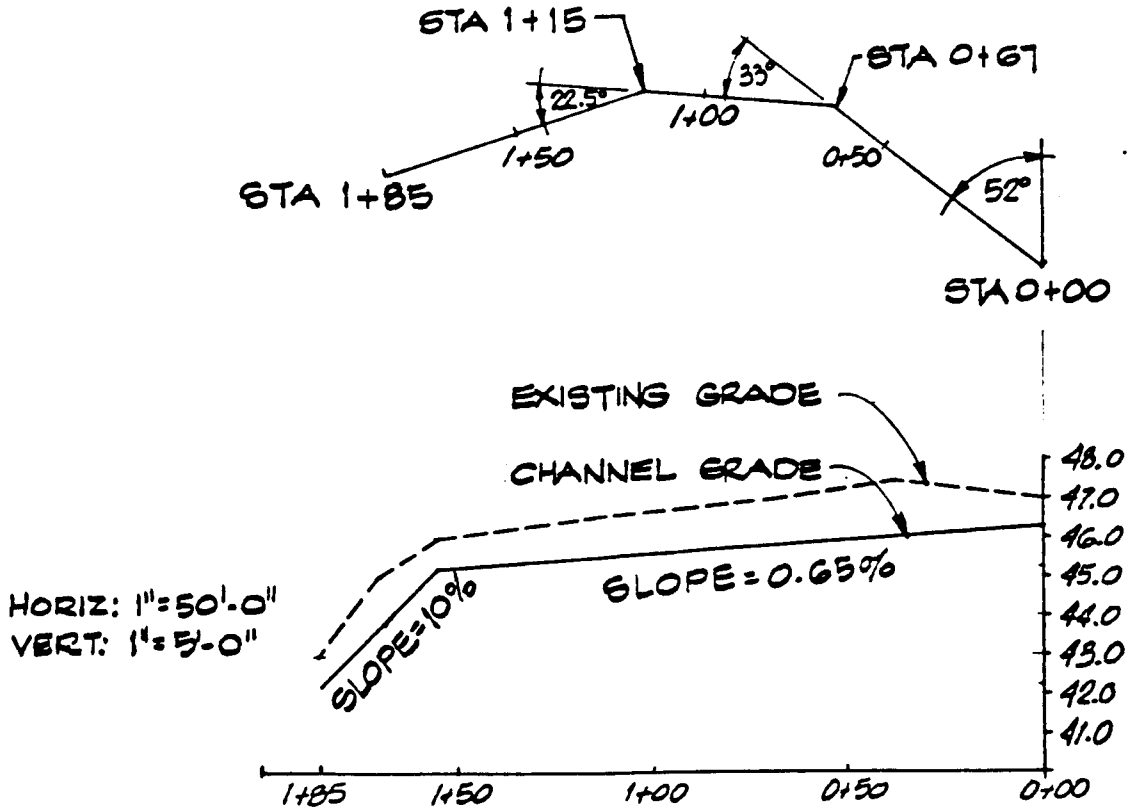
(2) Bowen, B (H-8, MS-490) Los Alamos National Laboratory; Memo to L. Lane (LS-6) dated August 11, 1981.

(3) Metcalf and Eddy, Inc. Wastewater Engineering, McGraw-Hill Book Co., New York, New York, 1972.



EAST CHANNEL PLAN/PROFILE

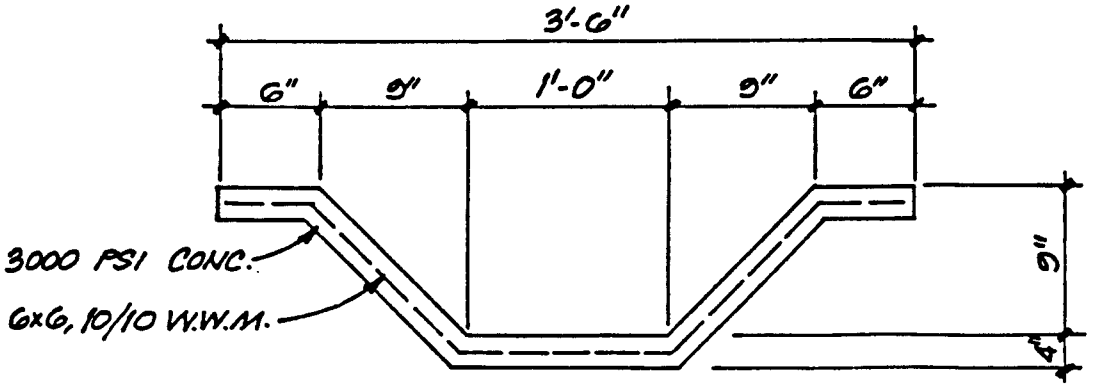
HORIZ: 1"=30'-0"
VERT: 1"=5'-0"



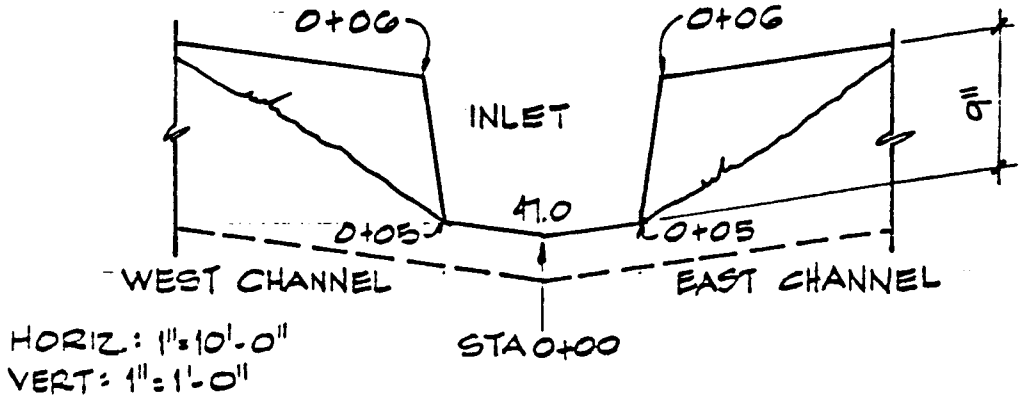
HORIZ: 1"=50'-0"
VERT: 1"=5'-0"

WEST CHANNEL PLAN/PROFILE

	FIGURE A-1	ΔH ENGINEERING Delta H Engineering, Ltd.

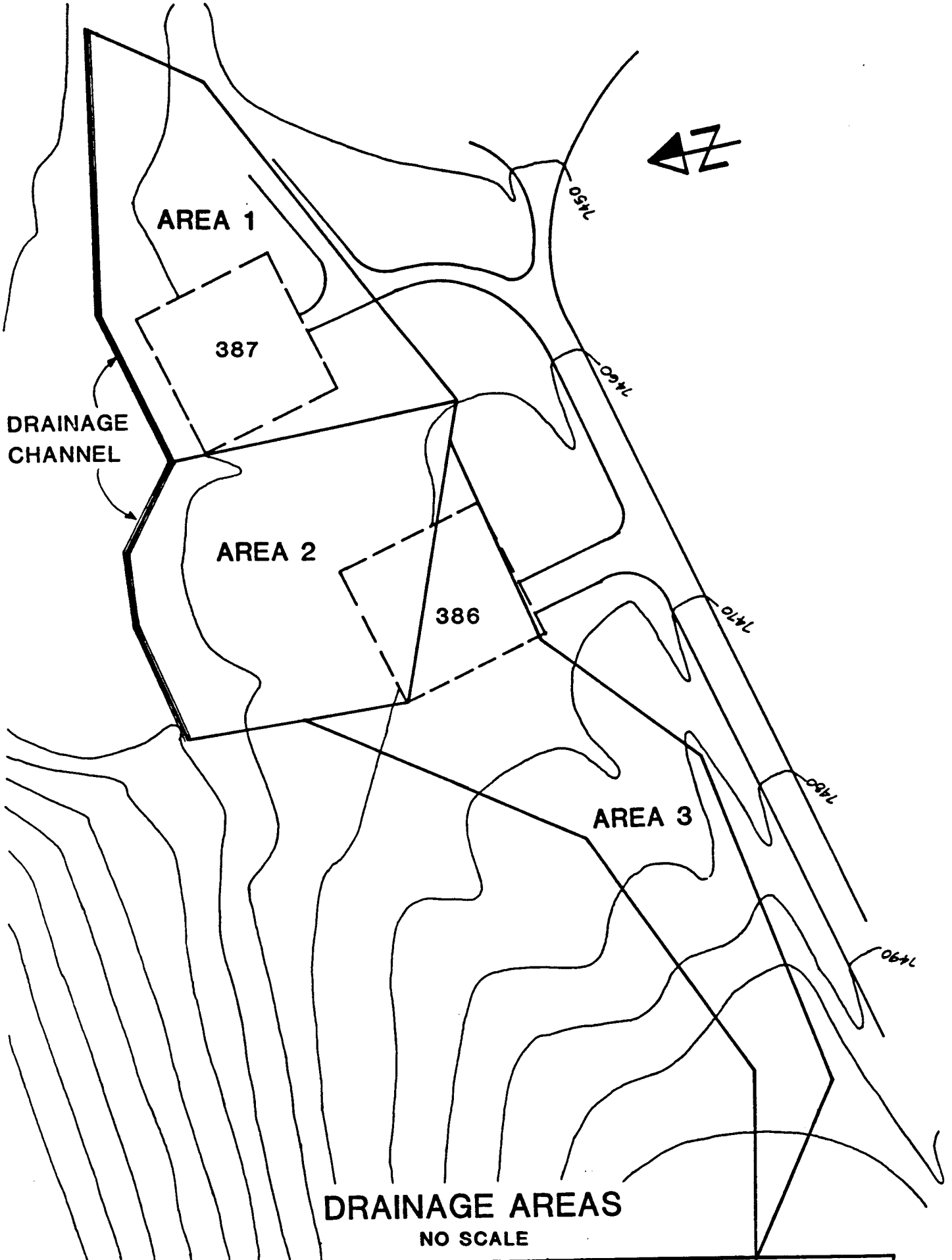


1 / A-2 CHANNEL CROSS SECTION - TYPICAL



2 / A-2 STA 0+00 INLET DETAIL ELEVATION

	FIGURE A-2	ΔH ENGINEERING Delta H Engineering, Ltd.



DRAINAGE AREAS
NO SCALE

FIGURE A-3

ΔH ENGINEERING Delta H Engineering, Ltd.

H SWA LANL 3/1082

VOLUME II OF II: APPENDICES D THROUGH H

TA-16 AREA P LANDFILL CLOSURE AND POST-CLOSURE PLAN

LOS ALAMOS NATIONAL LABORATORY
LOS ALAMOS, NEW MEXICO

Prepared by:

LOS ALAMOS NATIONAL LABORATORY
ENVIRONMENTAL SURVEILLANCE GROUP HSE-8
LOS ALAMOS, NEW MEXICO 87545

January 1988

VOLUME II OF II: APPENDICES D THROUGH H
CLOSURE AND POST-CLOSURE PLAN FOR TA-16 AREA P LANDFILL

Facility ID No.....NM890010515
Facility Name.....Los Alamos National Laboratory
Legal Owner.....United States Department of Energy
Address.....Los Alamos Area Office
City, State.....Los Alamos, New Mexico 87545
Contact Person.....Mr. Harold Valencia, Area Manager
Phone.....(505)667-5105
Date Prepared.....January 1988

APPENDIX D

Ground-water Monitor Well Installation Report

Appendix D: Geology and In-Situ Moisture Content of Technical Area 16 Area P.

Fred Brown

(extracted from Brown et al., 1987)

I. REGIONAL GEOLOGY

The regional geology of Los Alamos has been previously reported in detail (i.e., Smith and Bailey, 1966; Purtymun, 1974; Gardner and Goff, 1986). In summary, Los Alamos National Laboratory is located on the eastern flank of the Jemez Mountains, an area dominated by volcanic deposits associated with the formation and collapse of the Valle and Toledo Calderas. Eruptive activity culminated with the deposition of a large volume (about 400 km^3) of Quaternary Bandelier Tuff, a rhyolitic tuff ranging in thickness from 30 to 1000 ft. The Bandelier Tuff is composed of a series of ashfall and ashflow tuffs (ignimbrites) unconformably resting on Chino Mesa Basalt and Puye Conglomerate of the Santa Fe Group. Depth to the main aquifer in the vicinity of Area P is about 1230 ft (Purtymun, 1984). See Figure D1.

Deposits of Bandelier Tuff form broad plateaus that encircle the Jemez Mountains and dip gently away from the Valle

Caldera. The plateau on the eastern side of the Jemez Mountains, the Pajarito Plateau, consists of a series of east to southeast trending mesas separated by deeply incised canyons. The Bandelier Tuff itself consists of upper (Tshirege) and lower (Otowi) members, each containing a prominent ashfall bed at the base. Generally, the upper (Tshirege) member is the more densely welded of the two, and welding tends to increase with proximity to caldera sources (Bailey et al. 1969; Gardner et al., 1986).

The Bandelier Tuff dips 2 to 5 degrees towards the east. Four fault zones have been recognized in the Pajarito Plateau: the Pajarito, Water Canyon, Guaje Mt., and Rendija Canyon Fault Zones (Dransfield and Gardner, 1985). The Water Canyon Fault Zone, which extends through TA-16, trends roughly north to northeast, with about 30 to 100 ft of down-to-the-east displacement. Approximately 10 to 15 ft of displacement can be seen in the subsurface adjacent to Area-P, with little-or-no surface expression apparent.

II. GEOLOGY OF AREA P

Area P lies near the eastern margin of the Jemez Mountains, in the saddle of a short east-west trending mesa. The Water Canyon Fault Zone cuts through the tuff approximately 500 ft to the east. To the north the Canon de Valle has cut through the fault scarp, draining an area on the west of the Sierra

de los Valles flanks. To the south is a small unnamed canyon containing intermittent discharge from local outfalls. The main technical centers of TA-16 are located west of Area P (See Figure D2).

The mesa is capped by approximately 800 ft of Bandelier Tuff (Purtymun, 1968). Five distinct units, composed of groups of ashflows, have been recognized in the Tshirege Member of the Bandelier Tuff (Griggs, 1964; Smith and Bailey, 1966), of which two units were encountered during drilling operations at Area P (Brown, 1987). In addition, scattered outcrops of El Cajete Pumice occur in the area.

In order to establish the subsurface geology of Area P a series of 17 boreholes (numbered P-0 through P-16) was drilled in the summer of 1987. Drilling was done with a CME-55 rotary drilling rig and four-inch conventional auger. Continuous auger cuttings were retrieved for moisture analysis, and one set of continuous core was recovered using six-inch hollow stem auger and split spoon core barrels.

Borehole logging of lithology was done on the basis of four characteristics: (1) color (Goddard et al., 1984), (2) degree of welding, (3) shape and abundance of pumice lapilli, and (4) distribution of lithic fragments. Four distinct types of welding were recognized during drilling operations:

1. Non-welded: high porosity, low cohesion of glassy fragments and crumbly texture. In core samples this can be recognized by disaggregation and little or no flattening of pumice lapilli.

2. Moderately welded: less porosity, moderate cohesion, brittle texture and slight deformation of glassy fragments. In core samples this texture crumbles easily in the hand and contains some noticeably flattened pumice lapilli.

3. Welded: low porosity, good cohesion, brittle texture and noticeable deformation of glassy fragments. This texture normally requires a hammer to break, and the majority of pumice fragments are noticeably flattened.

4. Densely welded: texture noticeably impedes or halts drilling; little or no penetration; poor core recovery.

Two major lithologic units have been recognized at Area P (person. comm., W. Purtymun, 1987). Unit 3, the uppermost unit encountered during drilling operations, consists of four individual ashflows that appear to have cooled as a single unit. These ashflows are herein designated as Subunits 3a, 3b, 3c and 3d (bottom to top). Unit 3 rests conformably above Unit 2, the lowermost unit encountered. In

the vicinity of Area P dip is negligible, and the units are essentially horizontal and of uniform thickness.

Subunit 3a consists of a welded dark yellowish brown tuff, with rare pumice lapilli (slightly flattened), and abundant pebble sized red porphyritic latite and grey rhyolite lithic fragments. The contact between Subunit 3a and Unit 2 tends to be densely welded. East of the Water Canyon Fault this unit appears to be non-welded.

Subunit 3b consists of a welded pale yellowish brown tuff, with common grey and red pumice lapilli, (noticeably flattened), and rare pebble sized rhyolite lithic fragments. This unit weathers to a dark brown, and contains abundant clayey pumice lapilli to the north-west.

Subunit 3c consists of a moderately welded brownish grey to yellowish brown tuff, with common grey pumice lapilli (noticeably flattened), and rare pebble sized rhyolite lithic fragments. Clay filled vertical fractures are common throughout this subunit. The contact between 3c and 3d tends to be densely welded.

Subunit 3d outcrops along the higher rim of the saddle, and consists of a moderately welded yellowish brown tuff, with rare pebble sized rhyolite lithic fragments and common

grey pumice lapilli. Subunit 3d is overlain by scattered deposits of El Cajete Pumice.

Locally, Unit 2 consists of a welded to densely welded tuff, light grey to pinkish grey in color, with common pumice lapilli and pebble sized rhyolite fragments. Due to dense welding the drill bit was only able to penetrate the upper 5 to 10 ft of Unit 2. See Figure D3.

III. IN-SITU MOISTURE CONTENT

Hydrologic characteristics of tuff depend primarily on the degree of welding, with porosity and hydraulic conductivity decreasing as the degree of welding increases. At Los Alamos, saturated hydraulic conductivity for a moderately welded tuff ranges from 0.1 to 1.7 ft/day, and for a welded tuff ranges from 0.009 to 0.26 ft/day (Abeele et al., 1981). Samples of tuff recovered during drilling operations at Area P were not saturated.

Gravimetric moisture determinations were conducted to obtain a direct measurement of in-situ water content of the tuff. Samples were taken from drill cuttings every 5 or 10 ft, and moisture determinations were made by weighing samples immediately after collection and after oven-drying 24 hrs at 105 degrees C.

Although gravimetric moisture determinations are relatively easy to perform, care must be taken to insure that the heat produced by drilling does not bias the samples collected. In the few cases where drill cuttings were noticeably warm to the touch, or water vapor was noticed coming from the borehole, samples were not collected for analysis. Care was also taken to maintain the drying oven at 105 degrees C to ensure that no structural water was driven off.

Table D1 provides a summary of gravimetric data collected for Unit 3, and indicates a low overall moisture content for Area P. Although a range of 1.9 to 24.7% is considered low, this value slightly exceeds the gravimetric moisture content determined for technical areas further to the east (5-11% for TA-33, Abrahams 1963; 2-20% for TA-54; Kearl et al., 1986). This increase may be due to increased rainfall at TA-16 caused by orographic effects adjacent to the Jemez Mountains.

Unit	Mean (%)	STD	Range (%)
3d	5.2	3.6	2.2-17.7
3c	6.1	3.5	1.9-24.7
3b	5.7	2.1	2.3-11.4
3a	3.8	1.4	2.3-5.8
Total Unit	5.8	3.0	1.9-24.7

Table D1: Average Gravimetric Moisture Content. STD = Standard Deviation.

The energy relationship with moisture content for the Tshirege Member of the Bandelier Tuff was worked out for volumetric moisture content by Abrahams (1963). Volumetric values can be converted to gravimetric values by using the average bulk density of the tuff. Repeated neutron and gamma probe calibration runs have established an average bulk density for the Tshirege Member of 1.4 g/cm^3. In addition, the density of ten random samples was obtained after drying by weighing crushed tuff of a known volume. Average density for the ten samples was 1.47 g/cm^3, with a standard deviation of 0.12.

TA-16 Area P lies in the vadose zone of the Bandelier Tuff, a zone defined by Everett et al. (1984) as existing beneath the topsoil and above the water table, in which moisture in pore spaces coexists with air or in which geological materials are unsaturated. Based on the results of Abrahams (1963), saturation of the Tshirege Member of the Bandelier Tuff, and thus groundwater, occurs when gravimetric moisture content is about 29%. When moisture content is below 7% there is no movement of water; between 7 to 21% moisture is redistributed by diffusion; between 21 to 29% moisture distribution is by gravity and capillarity, and above 29% movement is by gravity drainage (Figure D4). From Table D1 it can be seen that the primary mechanism for moisture

distribution at Area P is diffusion. There is no evidence for the existence of groundwater at Area P.

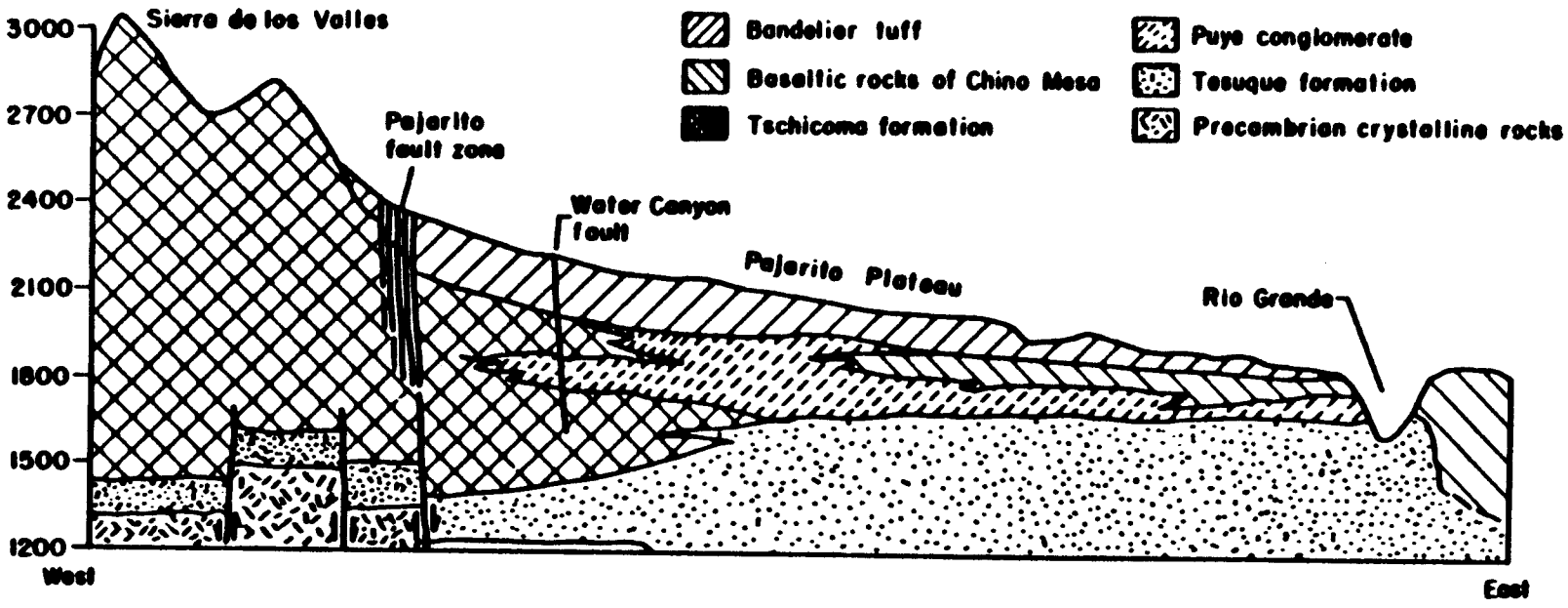


Figure D1. Geologic cross section through the Pajarito Plateau.

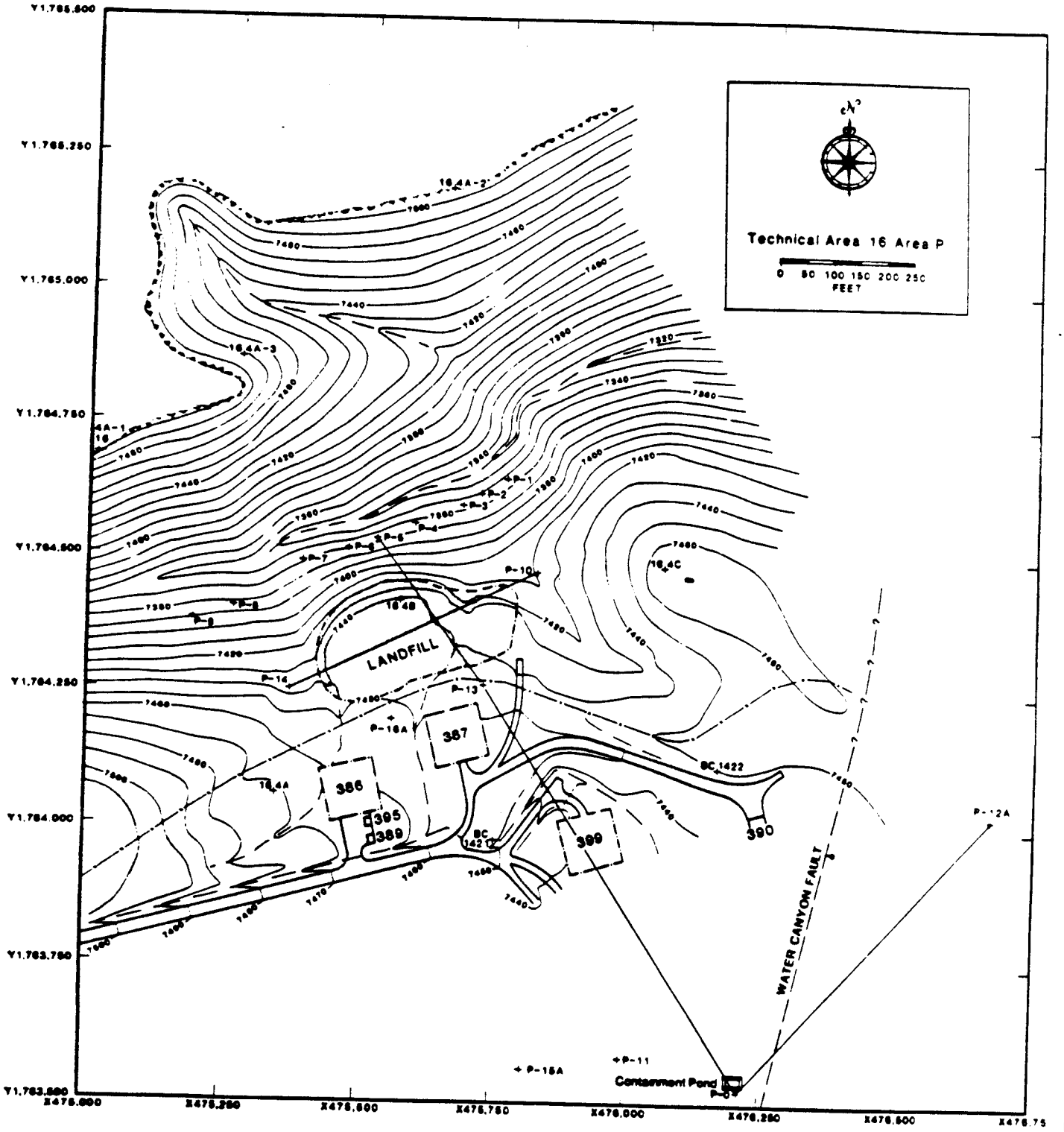


Figure D2. Site map of Technical Area 16 Area P. Boreholes are numbered P-0 through P-16A, and marked with crosses.

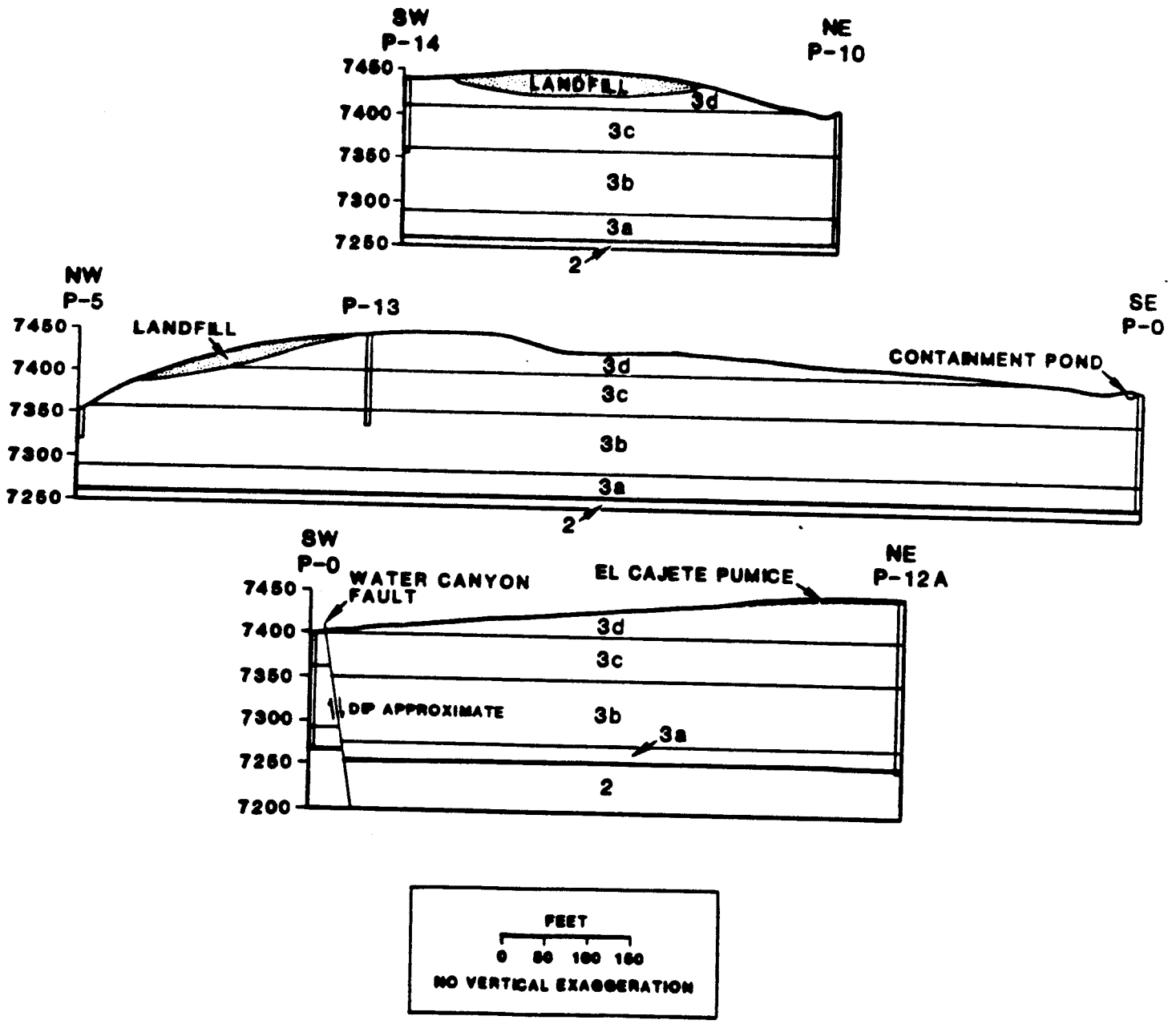


Figure D3. Geologic cross sections through Area P. Section lines are shown in Figure D2.

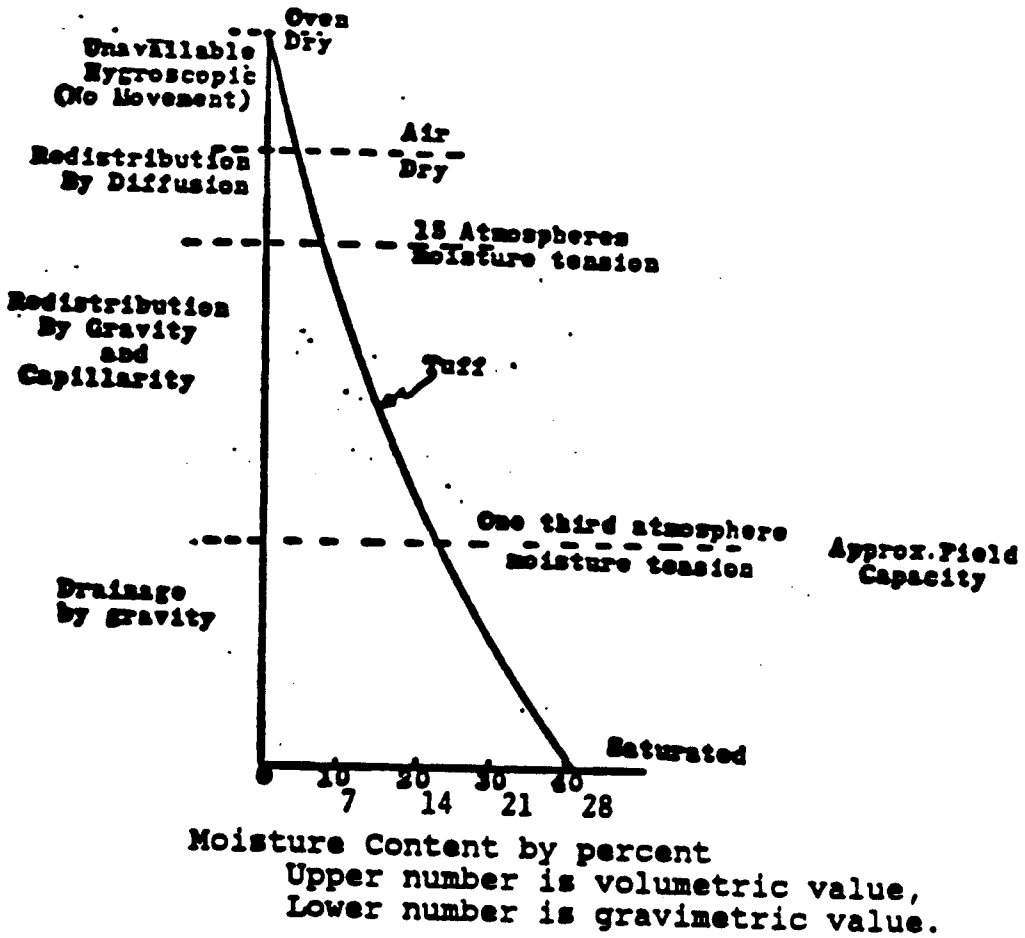


Figure D4. Energy relationship with moisture content of Bandelier Tuff (modified from Abrahams, 1963).

TABLE D-2
DATA FROM DRILLING CORES RECOVERED AT WELL P-16A

RESULTS OF HEAVY METALS ANALYSES:

EPA EXTRACT CONCENTRATIONS (in milligrams/liter)

	CORE DEPTHS (in feet)					UNCERTANITY
PARAMETER	10	50	55	60	81	(mg/l)
Arsenic	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Barium	<0.05	0.07	0.09	0.09	<0.05	<0.05
Cadmium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

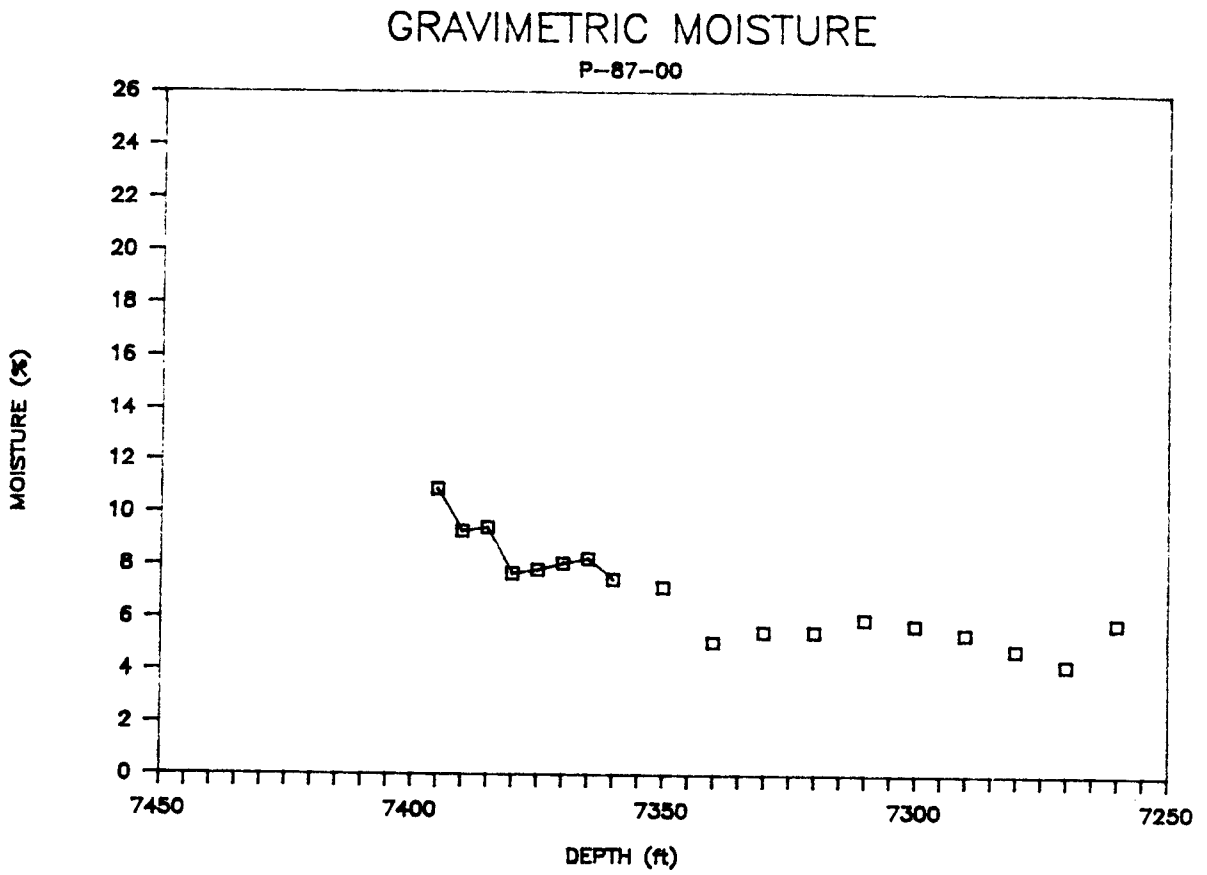
VOLUMETRIC MOISTURE CONTENT OF CORE LOGS RECOVERED FROM WELL P-16A

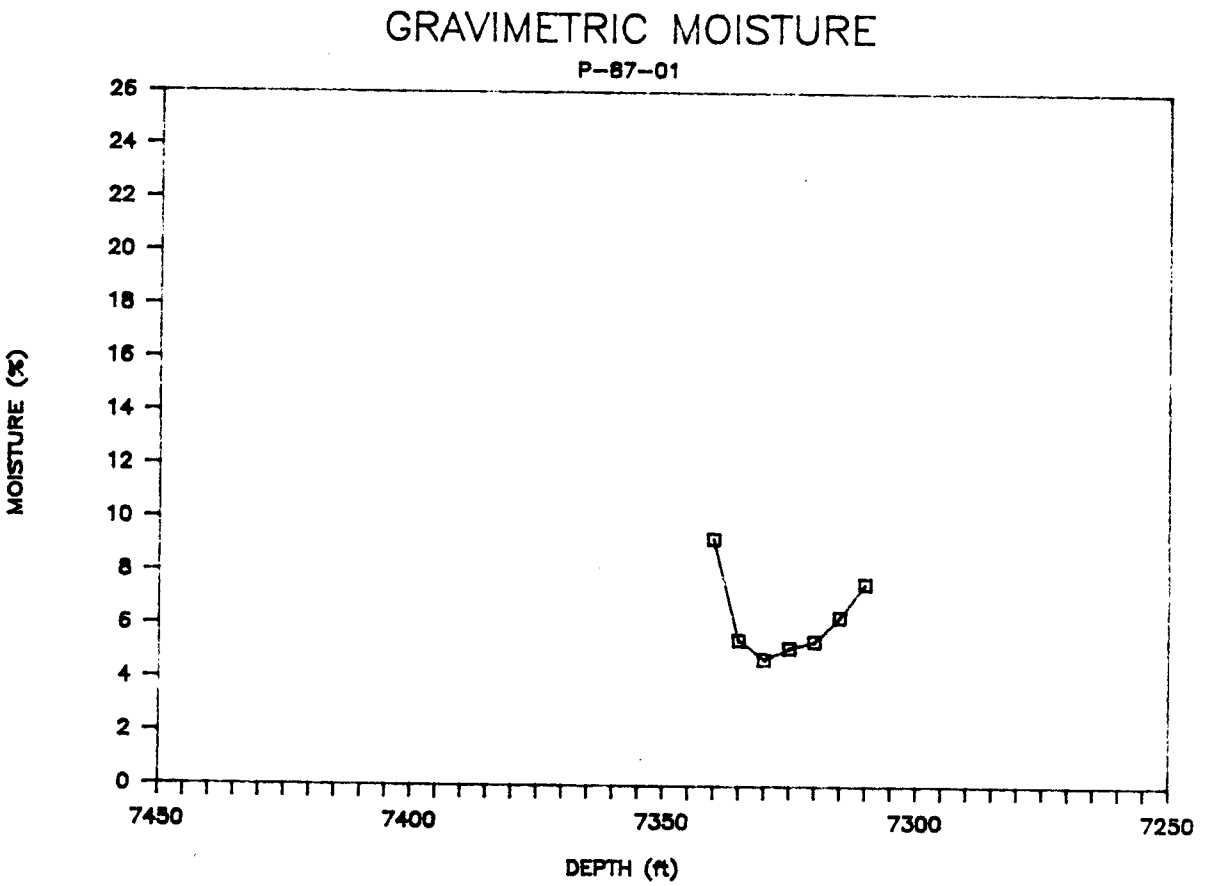
Depth	% Moisture
0.5 ft	5.6 %
5.5 ft	16.0 %
10.5 ft	10.1 %
15.5 ft	13.8 %
20.5 ft	13.1 %

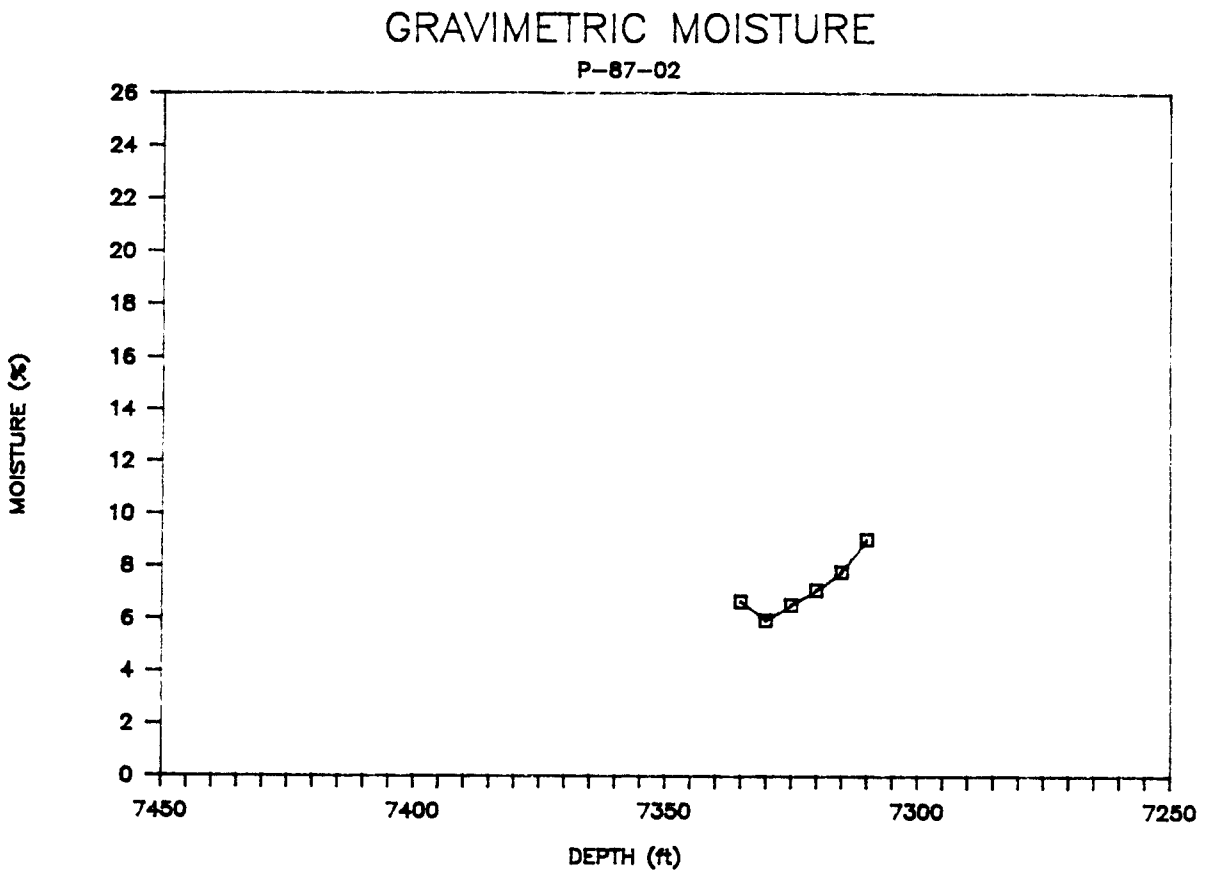
AVERAGE GRAVIMETRIC MOISTURE CONTENT (%) FROM FIFTEEN DIFFERENT CORE LOGS AT TA-16 AREA P LANDFILL

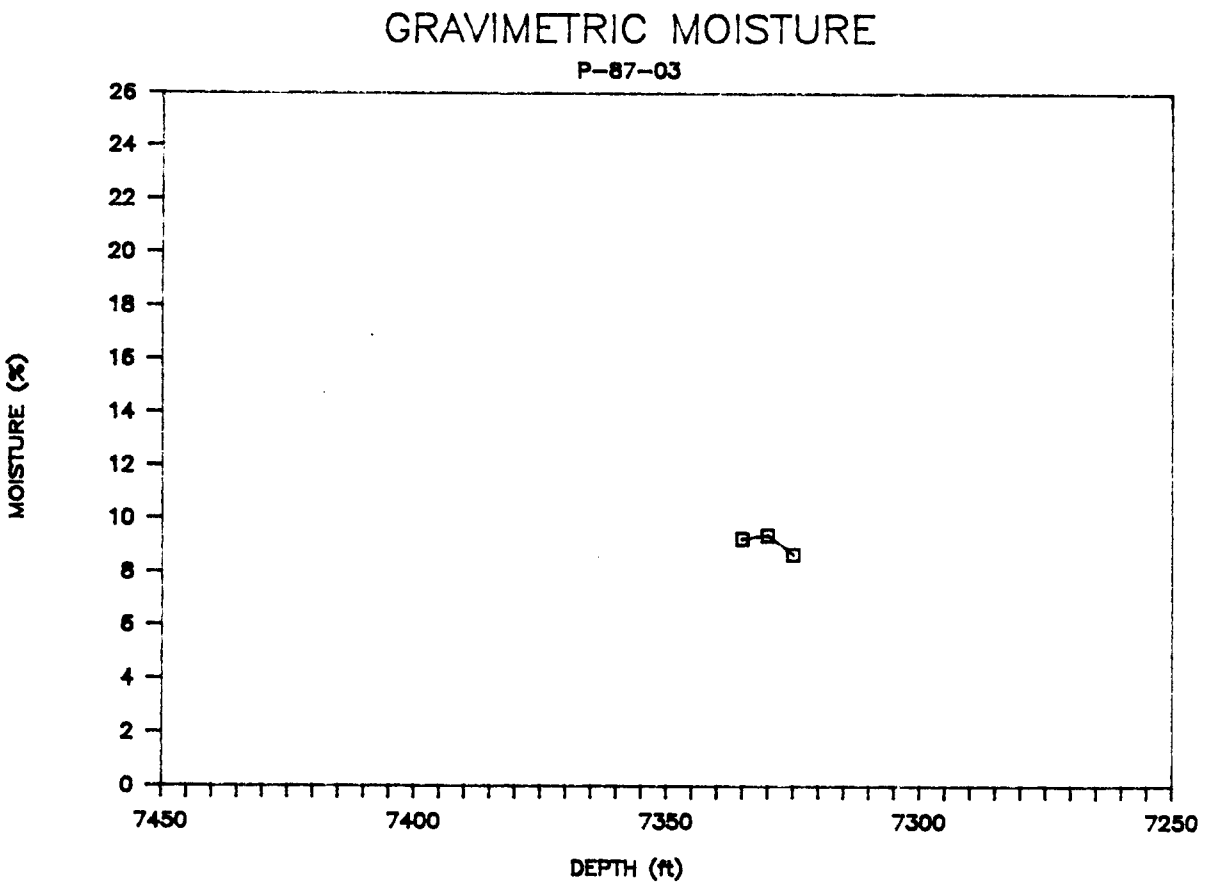
GEOLOGIC UNIT	MEAN MOISTURE (%)	STD	RANGE (%)
3 d	5.2	3.6	2.2 - 17.7
3 c	6.1	3.5	1.9 - 24.7
3 b	5.7	2.1	2.3 - 11.4
3 a	3.8	1.4	2.3 - 5.8
Total for Unit	5.8	3.0	1.9 - 24.7

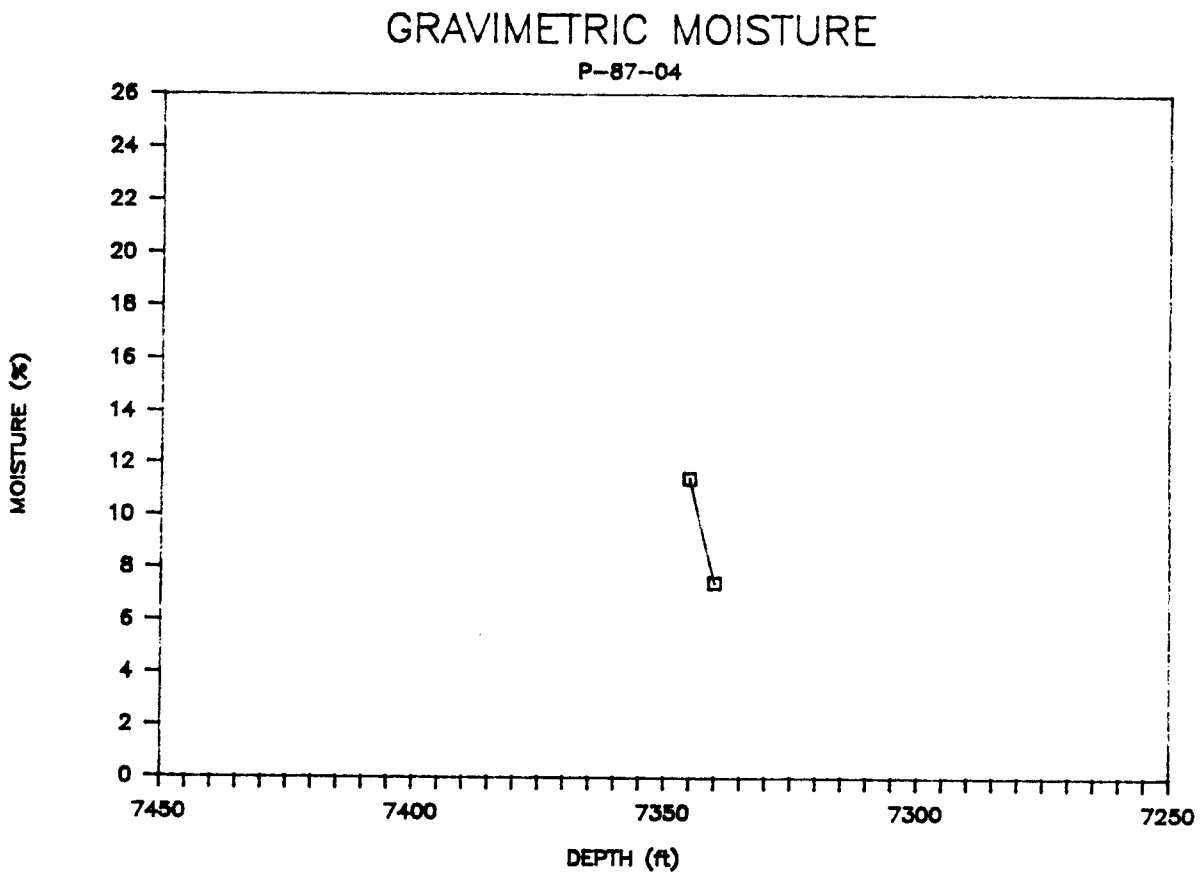
Notes: (1) See Figure D-3 for Geologic Unit Cross Section
(2) STD = standard deviation.

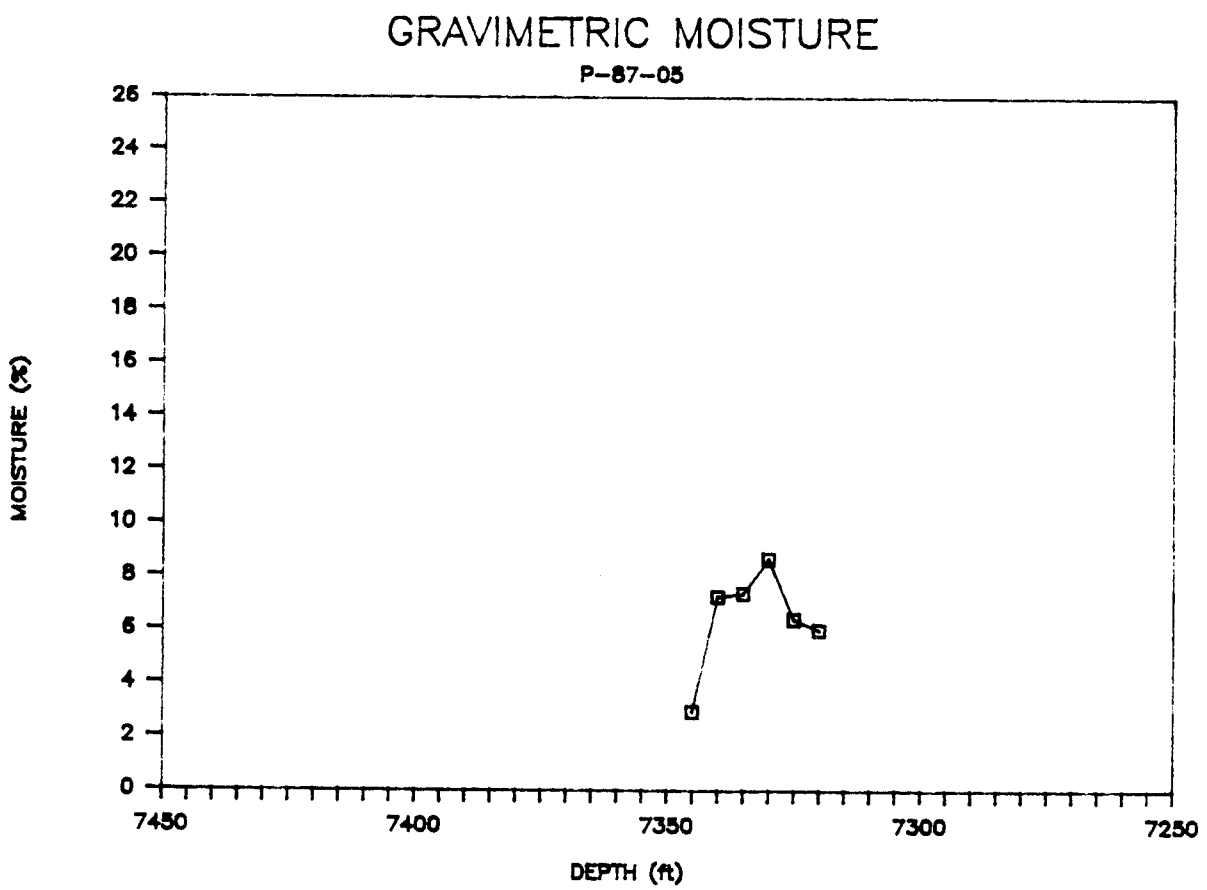

GRAVIMETRIC MOISTURE
P-87-00
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

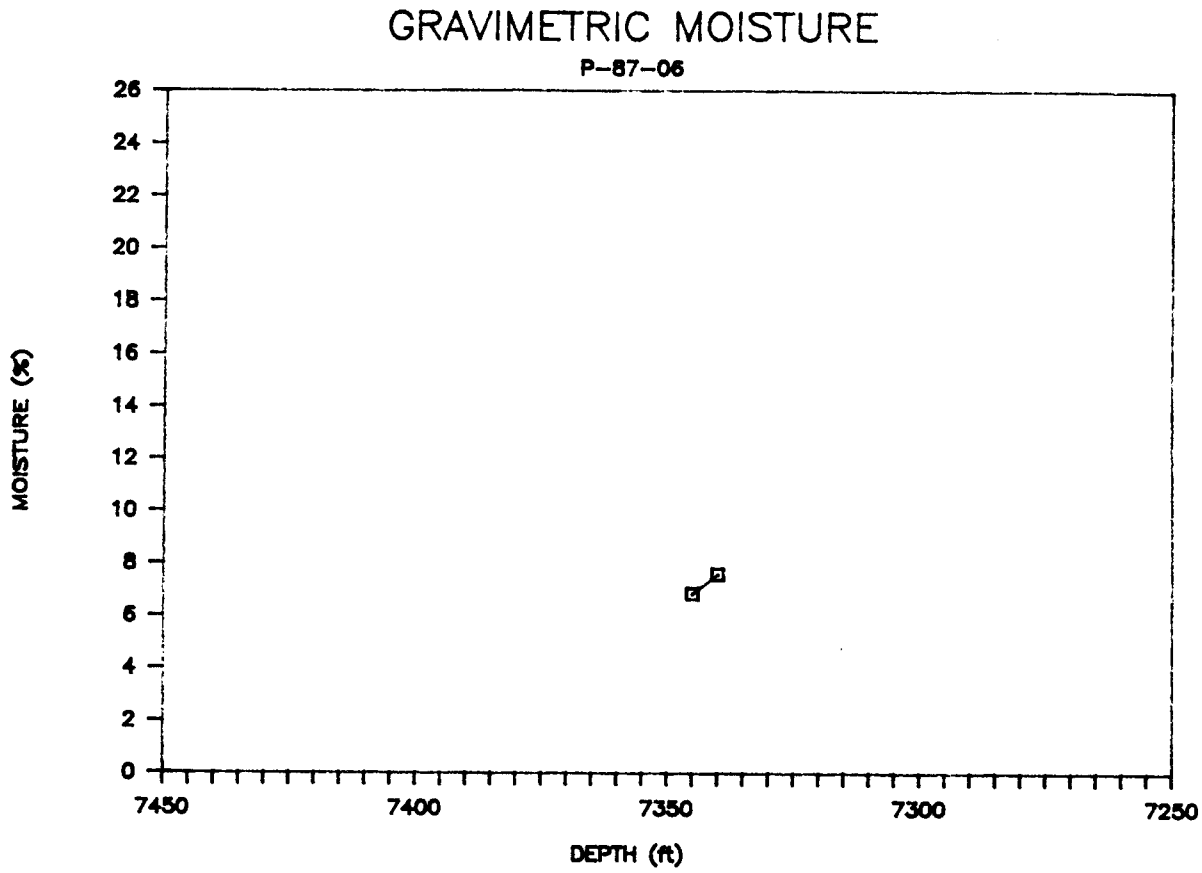

GRAVIMETRIC MOISTURE
P-87-01
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

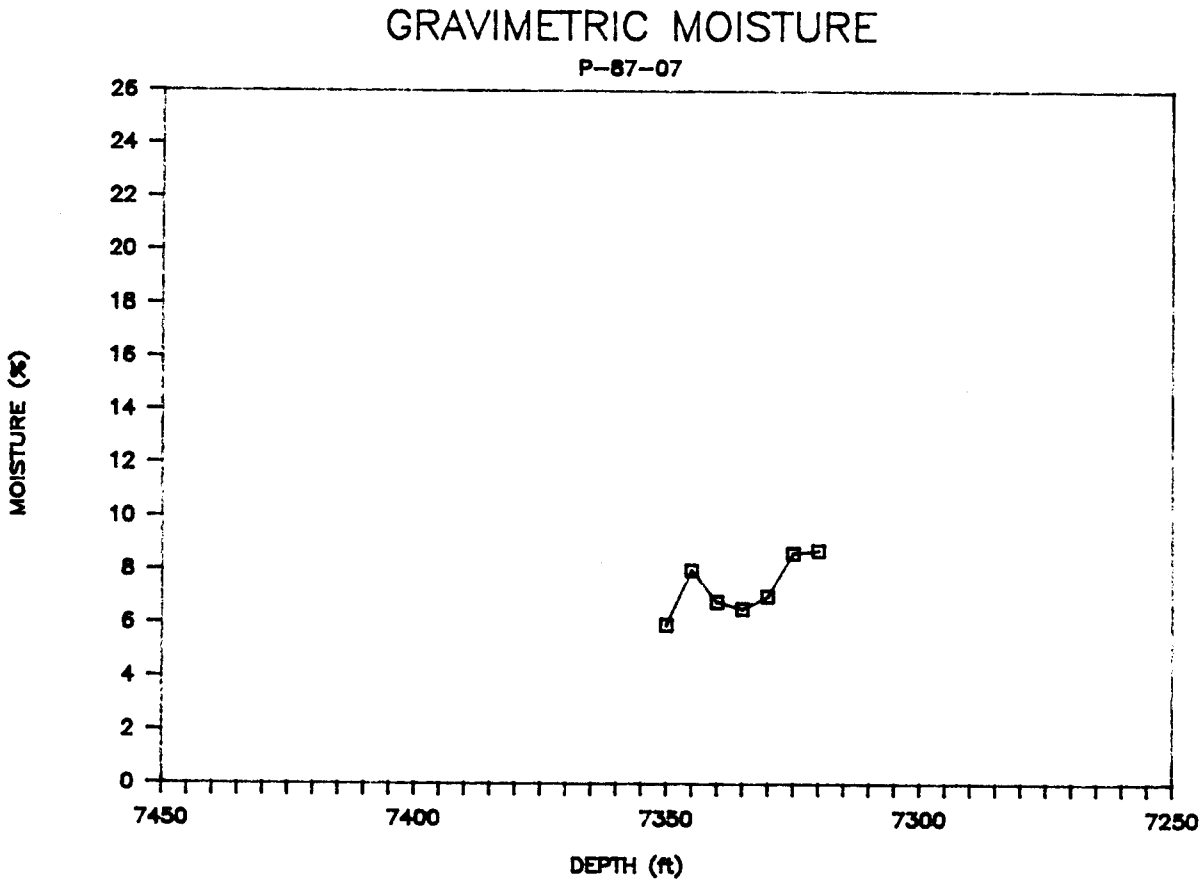

GRAVIMETRIC MOISTURE
P-87-02
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

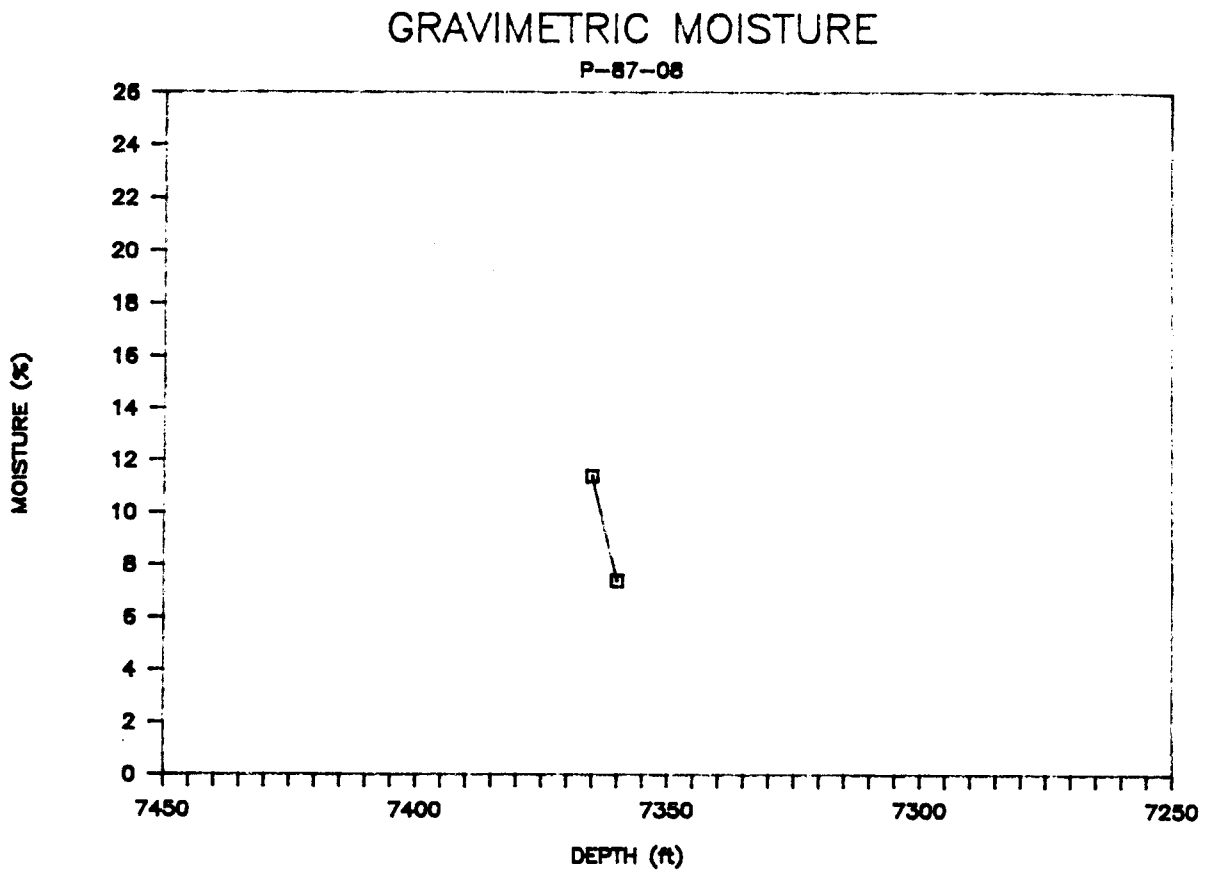

GRAVIMETRIC MOISTURE
P-87-03
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

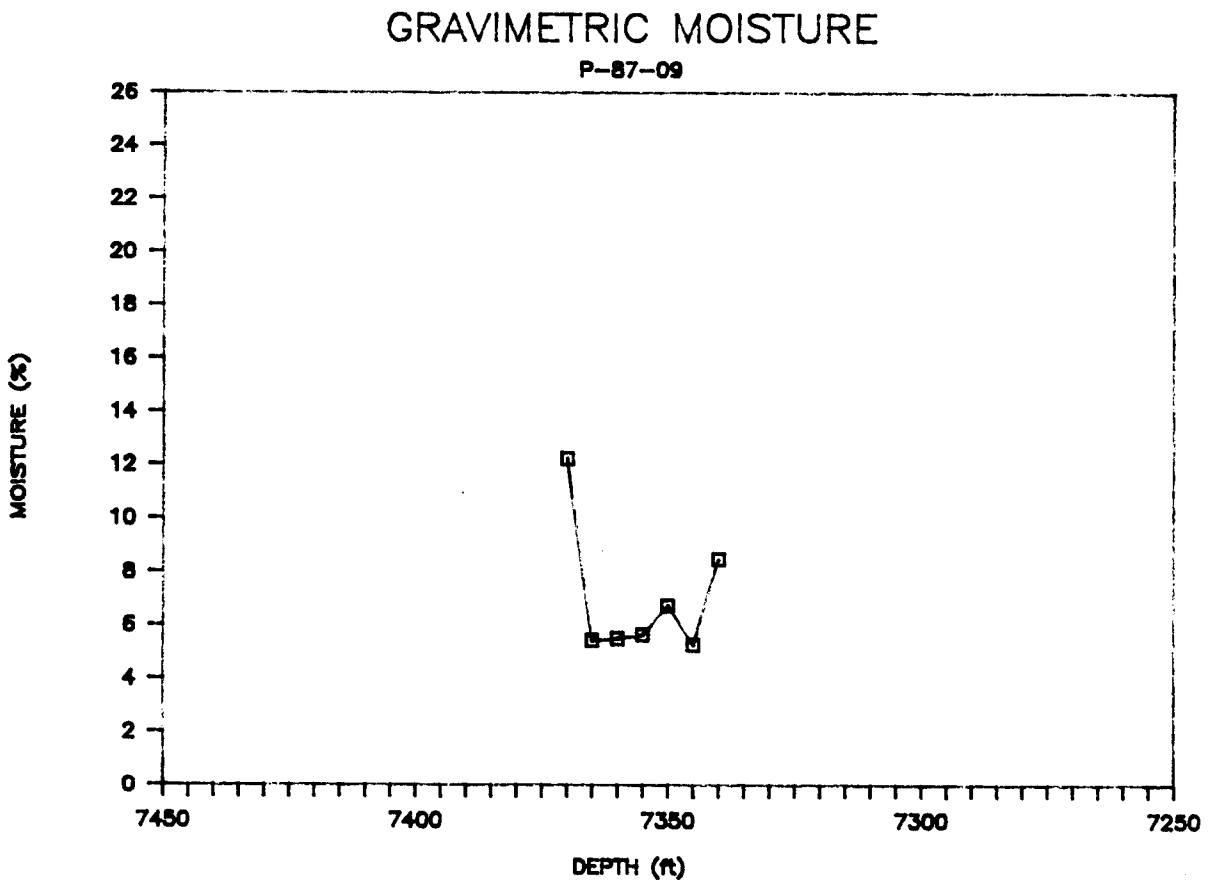

GRAVIMETRIC MOISTURE
P-87-04
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

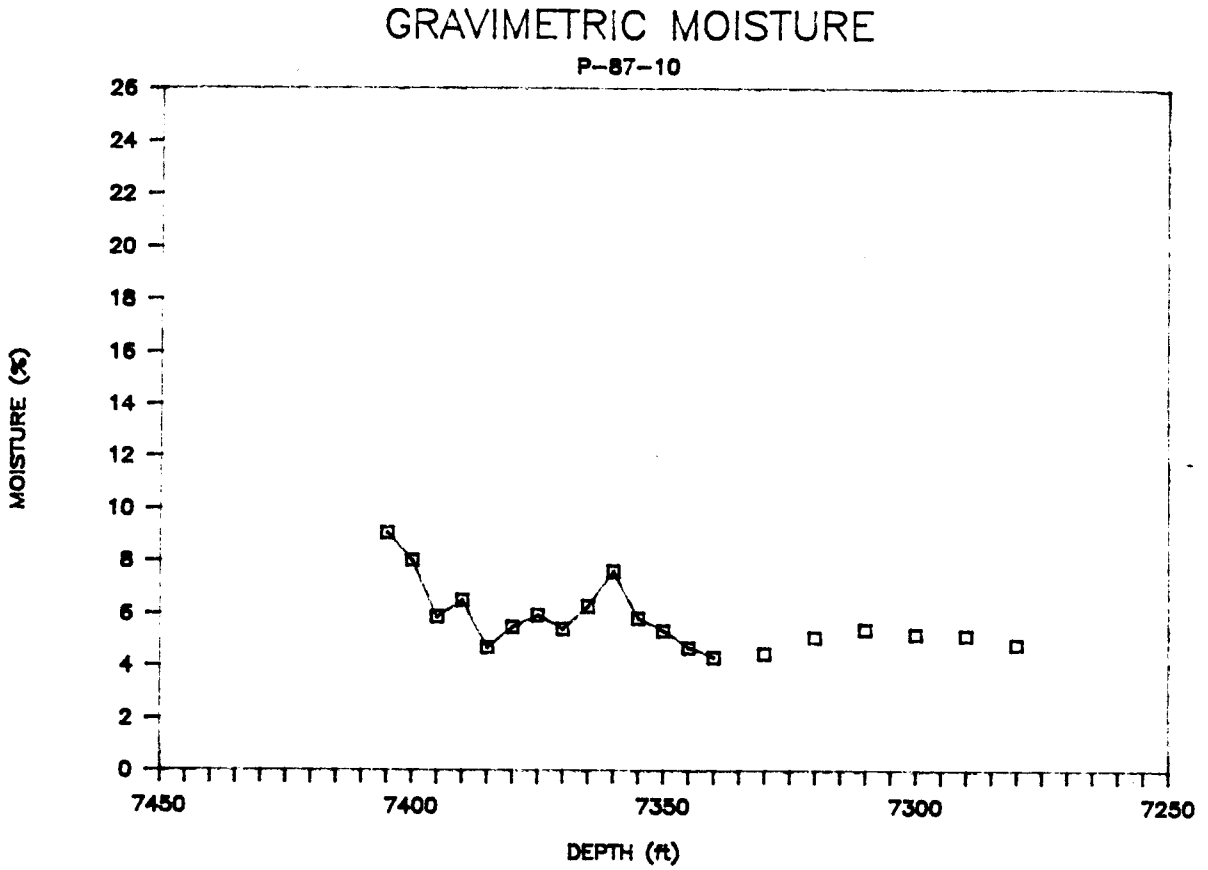

GRAVIMETRIC MOISTURE
P-87-05
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

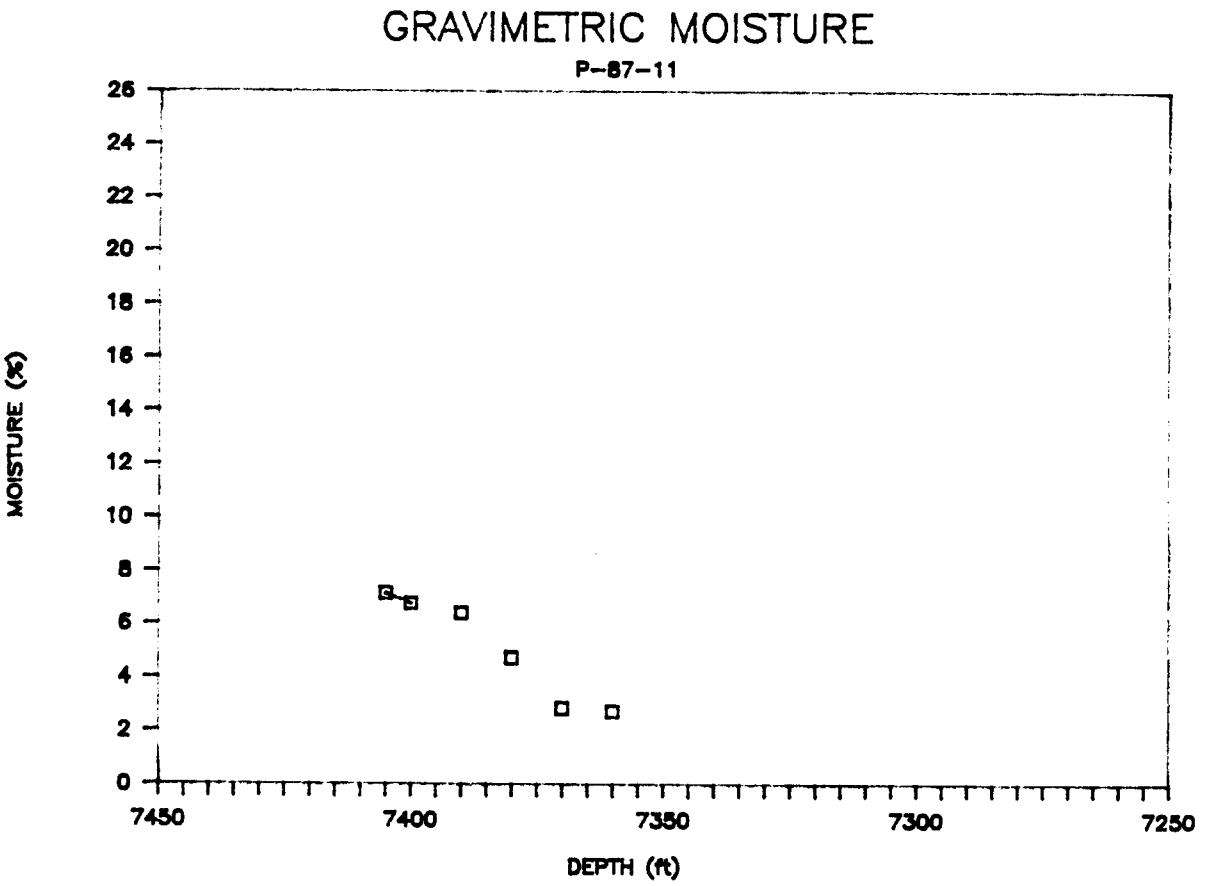

GRAVIMETRIC MOISTURE
P-87-06
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

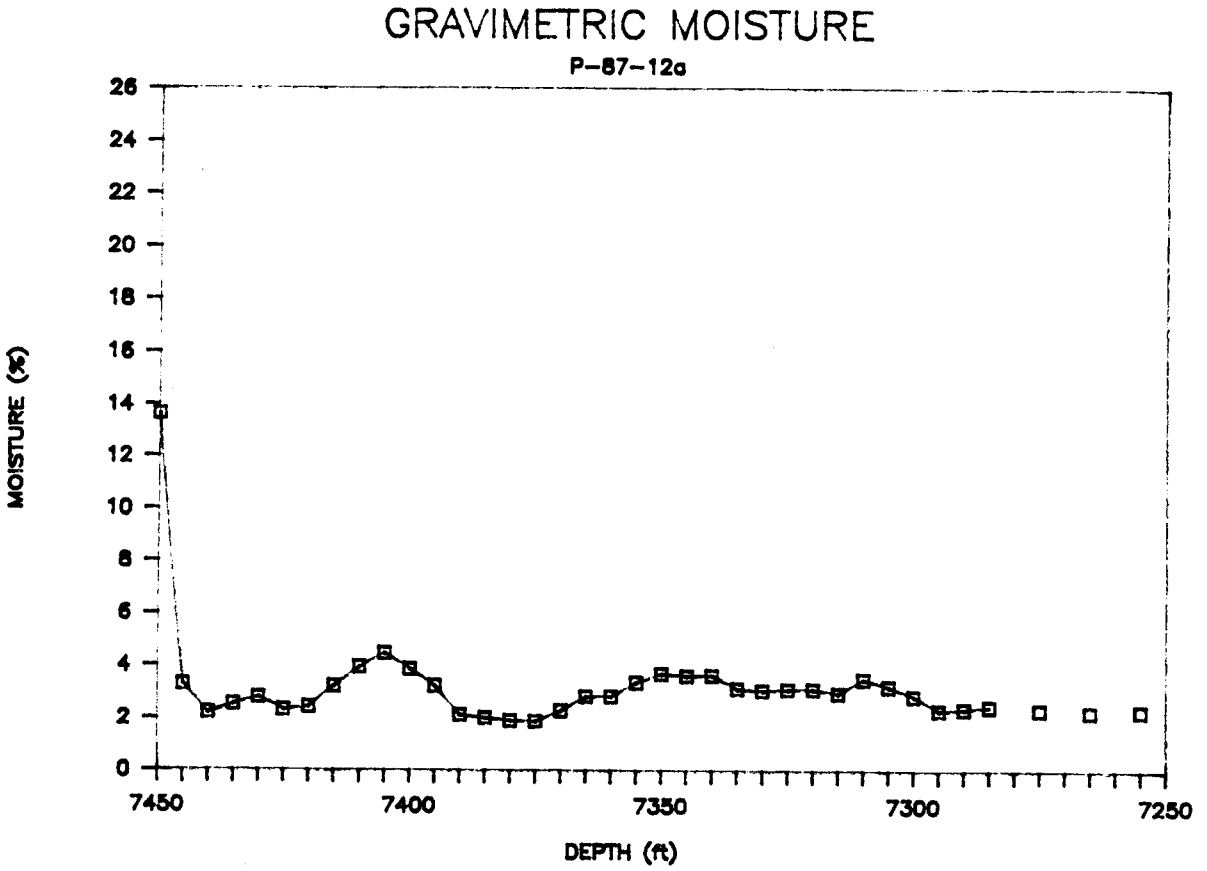

GRAVIMETRIC MOISTURE
P-87-07
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

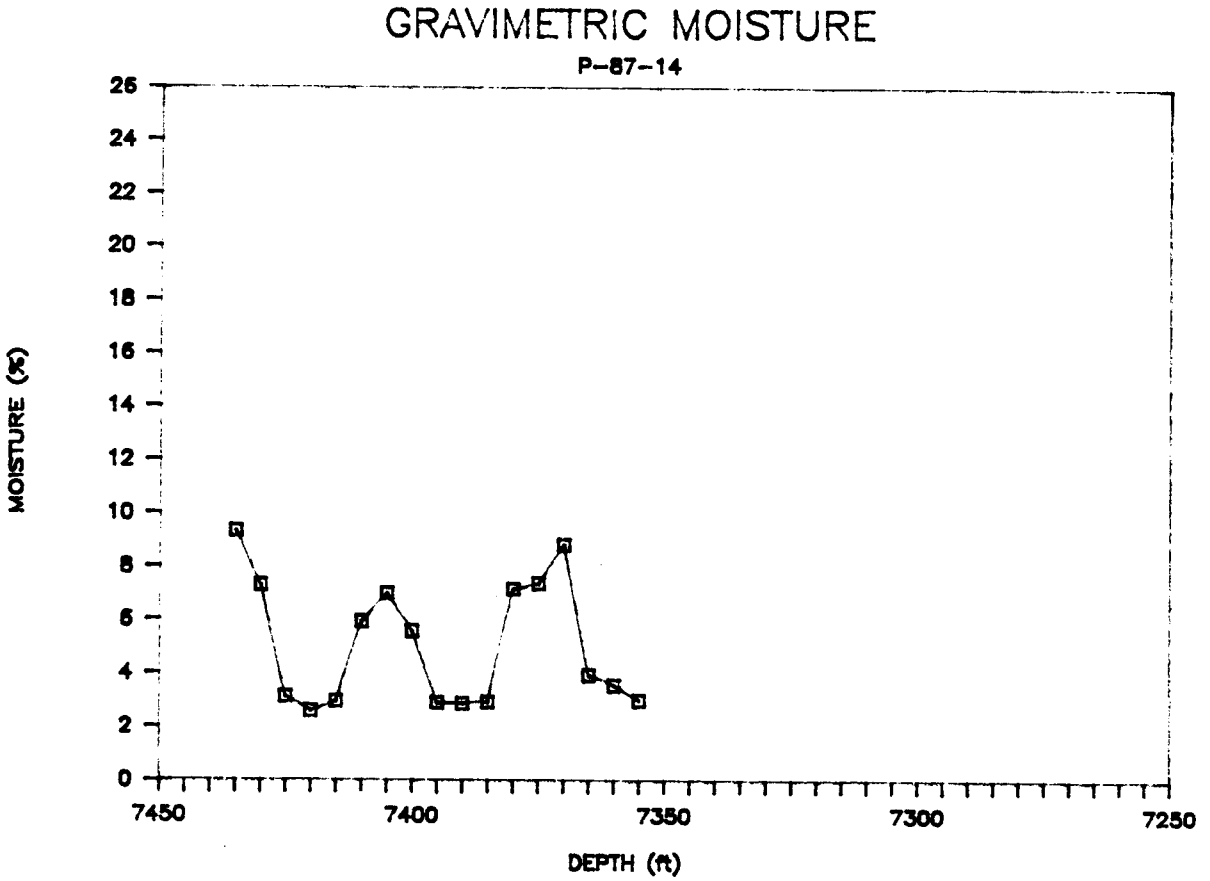

GRAVIMETRIC MOISTURE
P-87-08
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)


GRAVIMETRIC MOISTURE
P-87-09
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)


GRAVIMETRIC MOISTURE
P-87-10
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)


GRAVIMETRIC MOISTURE
P-87-11
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)


GRAVIMETRIC MOISTURE
P-87-12a
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)


GRAVIMETRIC MOISTURE
P-87-14
MOISTURE (%)
26
24
22
20
18
16
14
12
10
8
6
4
2
0
7450
7400
7350
7300
7250
DEPTH (ft)

GRAVIMETRIC MOISTURE

P-87-15

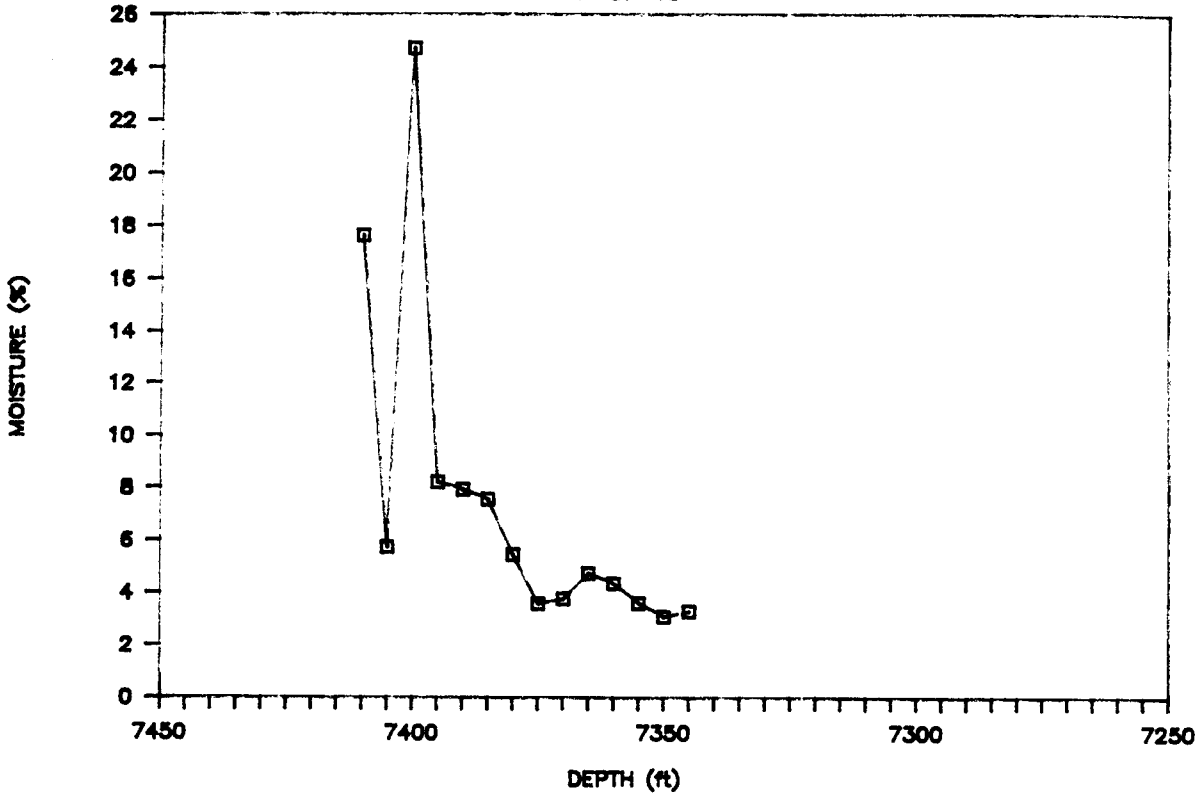


TABLE D-3
TARGET VOLATILE AND SEMI-VOLATILE ORGANIC COMPOUND
INDENTIFICATION LIST FOR WELL P-16 CORE SAMPLES

Compound Name	CAS Number
Acetone	67641
Benzene	71432
Bromodichloromethane	75274
Bromoform	75252
Bromomethane (methyl bromide)	74839
2-Butanone (methyl ethyl ketone)	78933
Carbon Disulfide	75150
Carbon Tetrachloride	56235
Chlorobenzene	108907
Chloroethane	75003
Chloroform	67663
Chloromethane (methyl chloride)	74873
1,2-Dichlorobenzene	95501
1,3-Dichlorobenzene	541731
1,4-Dichlorobenzene	106467
1,1-Dichloroethane (ethylidene dichloride)	75343
1,2-Dichloroethane	107062
1,2-Dichloroethene	540590
1,1-Dichloroethylene	75354
1,2-Dichloropropane (propylene dichloride)	78875
cis-1,3-Dichloropropene	10061015
trans-1,3-Dichloropropene	10061026
Ethyl Benzene	100414
Naphthalene	91023
Methylene Chloride	75092
4-Methyl-2-Pentanone	108101
Styrene	100425
1,1,2,2-Tetrachloroethane	79345
Tetrachloroethene	127184
Toluene	108883
1,1,2-Trichloroethane	79005
1,1,1-Trichloroethane (methyl chloroform)	71556
Trichloroethene	79016
Trichloroflouromethane	75694
Vinyl Acetate	108054
Vinyl Chloride (chloroethene)	75014
Xylenes	133027

NOTE: All of the above compounds were at concentrations below GC/MS detection limits. Sample date was 9-10-87.

TABLE D-4. RECONNAISSANCE WATER QUALITY AND SEDIMENT SAMPLING
LOS ALAMOS NATIONAL LABORATORY - TA-16 AREA P LANDFILL
SEE ATTACHED MAP FOR SAMPLE LOCATIONS

STATION ID : TA-16 AREA P - CANON DE VALLE
SAMPLE TYPE: SURFACE WATER SAMPLES - CANON DE VALLE
SAMPLE DATE: DECEMBER 7, 1987
LABORATORY : LANL HSE-9 LABORATORY (ANALYSES ON 12-15-87)

	PARAMETER CONCENTRATION ===> (all units in mg/l)							
SAMPLE NO.	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
57	< 0.05	3.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
59	< 0.05	3.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
63	< 0.05	3.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
64	< 0.05	3.30	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
70	< 0.05	.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
UNCERTAINITY	0.05	0.05	0.01	0.05	0.05	0.001	0.01	0.05

SAMPLE NO.	SAMPLE DESCRIPTION ==>
57	DOWNSTREAM SURFACE WATER SAMPLE
59	SURFACE WATER NORTH OF LANDFILL
63	SURFACE WATER NORTH OF LANDFILL
64	UPSTREAM SURFACE WATER SAMPLE
70	SNOWMELT IN INFLOW DRAINAGE CHANNEL

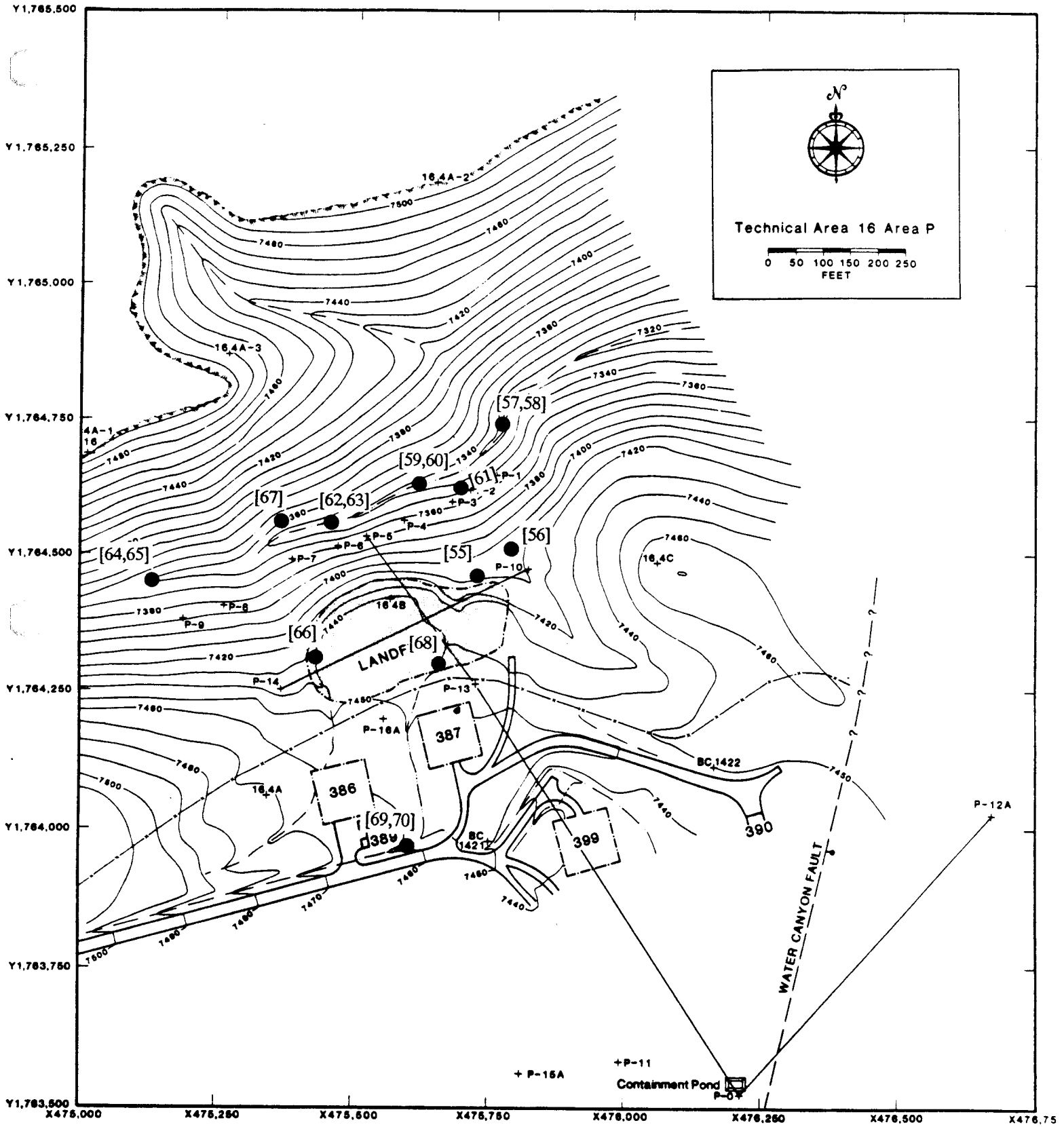
TABLE D-4. RECONNAISSANCE WATER QUALITY AND SEDIMENT SAMPLING
LOS ALAMOS NATIONAL LABORATORY - TA-16 AREA P LANDFILL
SEE ATTACHED MAP FOR SAMPLE LOCATIONS

STATION ID : TA-16 AREA P - CANON DE VALLE
SAMPLE TYPE: STREAM SEDIMENTS & SOIL SAMPLES - EPA WATER EXTRACT
SAMPLE DATE: DECEMBER 7, 1987
LABORATORY : LANL HSE-9 LABORATORY (ANALYSES ON 12-15-87)

PARAMETER CONCENTRATION ===> (all units in mg/l)

SAMPLE NO.	As	Ba	Cd	Cr	Pb	Hg	Se	Ag
55	< 0.05	.60	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
56	< 0.05	.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
58	< 0.05	.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
60	< 0.05	2.70	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
61	< 0.05	.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
62	< 0.05	2.10	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
65	< 0.05	2.70	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
66	< 0.05	.50	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
67	< 0.05	.90	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
68	< 0.05	2.70	< 0.01	< 0.05	.13	< 0.001	< 0.01	< 0.05
69	< 0.05	1.30	< 0.01	< 0.05	< 0.05	< 0.001	< 0.01	< 0.05
UNCERTAINITY	0.05	0.05	0.01	0.05	0.05	0.001	0.01	0.05

SAMPLE NO.	SAMPLE DESCRIPTION ==>
55	LANDFILL EROSION SOIL SEDIMENTS
56	BACKGROUND EROSION SOIL SEDIMENTS
58	DOWNSTREAM SURFACE CHANNEL SEDIMENTS
60	SURFACE CHANNEL SEDIMENTS NORTH OF LANDFILL
61	SURFACE CHANNEL SEDIMENTS NORTH OF LANDFILL
62	SURFACE CHANNEL SEDIMENTS NORTH OF LANDFILL
65	UPSTREAM SURFACE CHANNEL SEDIMENTS (NORTHWEST)
66	DRAINAGE CHANNEL SEDIMENTS WEST OF LANDFILL
67	DRAINAGE CHANNEL SEDIMENTS AT CANON DE VALLE
68	DRAINAGE CHANNEL SEDIMENTS SOUTH OF LANDFILL
69	INFLOW DRAINAGE CHANNEL SEDIMENTS


Technical Area 16 Area P
0 50 100 150 200 250
FEET
N
Y1,765,500
Y1,765,250
Y1,765,000
Y1,764,750
Y1,764,500
Y1,764,250
Y1,764,000
Y1,763,750
Y1,763,500
X475,000
X475,250
X475,500
X475,750
X476,000
X476,250
X476,500
X476,75
16,4A-2
16,4A-3
4A-1
16
16,4C
16,4B
16,4A
[57,58]
[59,60]
[61]
[67]
[62,63]
[64,65]
[55]
[56]
[66]
[68]
[69,70]
LANDF
387
386
389
399
390
BC,1422
BC 1421
P-1
P-2
P-3
P-4
P-5
P-6
P-7
P-8
P-9
P-10
P-13
P-14
P-16A
P-12A
P-15A
P-11
P-0
Containment Pond
WATER CANYON FAULT

BOREHOLE: P-87-00
GEOLOGIST: Fred Brown
DATE DRILLED: 21 JULY 1987
ELEVATION: 7399 ft
LOCATION: 476215,1763523
TOTAL DEPTH: 135 ft
DISPOSITION: Aluminum Casing

DEPTH	DESCRIPTION
0-3	Fill/Top Soil (sandy loam)
3-40	Unit 3c. Light brownish grey tuff Moderately welded Rare rhyolite lithic fragments Common grey pumice lapilli
40	Contact is strongly welded
40-110	Unit 3b. Pale yellowish brown tuff Moderately welded Rare rhyolite fragments Abundant grey pumice lapilli Fracture noted at 45 ft
110	Contact is strongly welded
110-135	Unit 3a. Dark yellowish brown tuff Welded Abundant rhyolite/latite lithic fragments Rare pumice lapilli
135	Unit 2. Densely welded tuff halts drilling

WELL COMPLETION DIAGRAM

P-87-00
(ALUMINUM)

```
                T|  |<--------- 0
                T|  | TOP SOIL
                T|  |<--------- 3
                T|  |
                T|  | TUFF (3c)
                T|  |
                T|  |<--------- 40
                T|  |
                T|  |
                T|  | TUFF (3b)
                T|  |
                T|  |
                T|  |
                T|  |<--------- 110
120 --------->T|  |
                |X| TUFF (3a)
                |X|
                 - <--------- 135
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-01
GEOLOGIST: Fred Brown
DATE DRILLED: 29 JULY 1987
ELEVATION: 7344 ft
LOCATION: 475756,1764645
TOTAL DEPTH: 35 ft
DISPOSITION: PVC Casing

DEPTH	DESCRIPTION
0-4	Top Soil (sandy loam)
5-10	Unit 3b. Dark yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli
10-35	Unit 3b. Pale yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

```
                P-87-01
                 (PVC)

                 C| |<--------- 0
                 C| | TOP SOIL
                 C| |<--------- 4
                 C| |
13 --------->C| |
                 B| |
15 --------->B| |
                 S|=|
                 S|=|
                 S|=| TUFF (3b)
                 S|=|
                 S|=|
                 S|=|
                 S|=|
                 S|=|
                 S|=|
                 S|=|
                   - <--------- 35
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-02
GEOLOGIST: Fred Brown
DATE DRILLED: 23 JULY 1987
ELEVATION: 7341 ft
LOCATION: 475708, 1764617
TOTAL DEPTH: 10 ft
DISPOSITION: Filled In

DEPTH	DESCRIPTION
0-3	Top Soil (sandy loam)
3-10	Unit 3b. Dark yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli

BOREHOLE: P-87-03
GEOLOGIST: Fred Brown
DATE DRILLED: 23 JULY 1987
ELEVATION: 7342 ft
LOCATION: 475676, 1764596
TOTAL DEPTH: 9 ft
DISPOSITION: Teflon Casing

DEPTH	DESCRIPTION
0-3	Top Soil, boulders and cobbles
3-9	Unit 3b. Dark yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-03
(TEFLON)

```
                C|  |<--------- 0
1 --------->C|  |
                B|  | TOP SOIL
2 --------->B|  |
                S|=|
                S|=|
                S|=|<--------- 3
                S|=|
                S|=|
                S|=|
                S|=|
                S|=| TUFF (3b)
                S|=|
                S|=|
7 --------->S|=|
                 |X|
                 |X|
                  - <--------- 9
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-04
GEOLOGIST: Fred Brown
DATE DRILLED: 28 JULY 1987
ELEVATION: 7348 ft
LOCATION: 475588, 1764562
TOTAL DEPTH: 10 ft
DISPOSITION: Teflon Casing

DEPTH	DESCRIPTION
0-4	Top Soil (sandy loam)
4-10	Unit 3b. Dark yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-04
(TEFLON)

```
                C|  |<--------- 0
1 --------->C|  |
                B|  | TOP SOIL
3 --------->B|  |
                S|=|
                S|=|
                S|=|<--------- 4
                S|=|
                S|=|
                S|=|
                S|=|
                S|=| TUFF (3b)
                S|=|
                S|=|
8 --------->S|=|
                 |X|
                 |X|
                  - <--------- 10
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-05
GEOLOGIST: Fred Brown
DATE DRILLED: 29 JULY 1987
ELEVATION: 7353 ft
LOCATION: 475520, 1764532
TOTAL DEPTH: 35 ft
DISPOSITION: PVC Casing

DEPTH	DESCRIPTION
0-3	Top Soil (sandy loam)
3-15	Unit 3b. Dark yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli
15-35	Unit 3b. Orange pink tuff Moderately welded Rare rhyolite lithic fragments Rare grey pumice lapilli

WELL COMPLETION DIAGRAM

P-87-05
(PVC)

```
                C|  |<--------- 0
                C|  | TOP SOIL
                C|  |<--------- 3
                C|  |
13 --------->C|  |
                B|  |
15 --------->B|  |
                S|=|
                S|=|
                S|=| TUFF (3b)
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                  - <--------- 35
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-06
GEOLOGIST: Fred Brown
DATE DRILLED: 28 JULY 1987
ELEVATION: 7352 ft
LOCATION: 475467, 1764514
TOTAL DEPTH: 10 ft
DISPOSITION: Teflon Casing

DEPTH	DESCRIPTION
0-4	Top Soil (sandy loam)
4-10	Unit 3b. Pale yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-06
(TEFLON)

```
                C|  |<--------- 0
1 --------->C|  |
                B|  |
2 --------->B|  | TOP SOIL
                S|=|
                S|=|
                S|=|<--------- 4
                S|=|
                S|=|
                S|=|
                S|=|
                S|=| TUFF (3b)
                S|=|
                S|=|
7 --------->S|=|
                 |X|
                 |X|
                  - <--------- 10
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-07
GEOLOGIST: Fred Brown
DATE DRILLED: 29 JULY 1987
ELEVATION: 7356
LOCATION: 475381, 1764491
TOTAL DEPTH: 35 ft
DISPOSITION: PVC Casing

DEPTH	DESCRIPTION
0-2	Top Soil (sandy loam)
2-5	Unit 3b. Pale yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli
5-6	Weathered dark reddish brown clay
6-35	Unit 3b. Pale yellowish brown tuff Moderately welded Common rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-07
(PVC)

```
                C|  |<--------- 0
                C|  | TOP SOIL
                C|  |<--------- 2
                C|  |
13 --------->C|  |
                B|  |
15 --------->B|  |
                S|=|
                S|=|
                S|=| TUFF (3b)
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                  - <--------- 35
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-08
GEOLOGIST: Fred Brown
DATE DRILLED: 28 JULY 1987
ELEVATION: 7370 ft
LOCATION: 475257, 1764405
TOTAL DEPTH: 10 ft
DISPOSITION: Teflon Casing

DEPTH	DESCRIPTION
0-3	Top Soil (sandy loam)
3-10	Unit 3c. Dark yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-08
(TEFLON)

```
              C|  |<--------- 0
1 --------->C|  |
              B|  |  TOP SOIL
2 --------->B|  |
              S|=|
              S|=|
              S|=|<--------- 3
              S|=|
              S|=|
              S|=|
              S|=|
              S|=|  TUFF (3c)
              S|=|
              S|=|
7 --------->S|=|
               |X|
               |X|
                - <--------- 10
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-09
GEOLOGIST: Fred Brown
DATE DRILLED: 29 JULY 1987
ELEVATION: 7376 ft
LOCATION: 475183, 1764381
TOTAL DEPTH: 35 ft
DISPOSITION: PVC Casing

DEPTH	DESCRIPTION
0-3	Top Soil (sandy loam)
3-15	Unit 3c. Moderate brown tuff Moderately welded Rare rhyolite lithic fragments Common grey pumice lapilli
15-33	Unit 3b. Greyish brown tuff Welded Abundant rhyolite/latite lithic fragments Common red-brown pumice lapilli
33-35	Unit 3b. Pale brown tuff and clay Moderately welded Rare rhyolite lithic fragments Abundant clayey pumice lapilli

WELL COMPLETION DIAGRAM

P-87-09
(PVC)

```
                C| |<--------- 0
                C| | TOP SOIL
                C| |<--------- 3
                C| |
13 --------->C| | TUFF (3c)
                B| |
15 --------->B| |<--------- 15
                S|=|
                S|=|
                S|=|
                S|=|
                S|=| TUFF (3b)
                S|=|
                S|=|
                S|=|
                S|=|
                S|=|
                  - <--------- 35
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-10
GEOLOGIST: Fred Brown
DATE DRILLED: 30 JULY 1987
ELEVATION: 7411 ft
LOCATION: 475814, 1764473
TOTAL DEPTH: 150 ft
DISPOSITION: Uncased

DEPTH	DESCRIPTION
0-3	Fill/Top Soil (sandy loam)
3-5	Unit 3c. Dark yellowish brown tuff Welded Rare rhyolite lithic fragments Common red pumice lapilli
5-50	Unit 3c. Pale yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Common grey pumice lapilli
50	Contact is strongly welded
50-120	Unit 3b. Pale yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Common red pumice lapilli
120-150	Unit 3a. Dark yellowish brown tuff Moderately welded Abundant latite lithic fragments Rare grey-red pumice lapilli
150	Unit 2. Pale yellowish brown tuff Densely welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-10
(UNCASED)

```
| |<--------- 0
| | TOP SOIL
| |<--------- 3
| |
| |
| | TUFF (3c)
| |
| |
| |<--------- 50
| |
| | TUFF (3b)
| |
| |
| |<--------- 120
| |
| | TUFF (3a)
| |
 - <--------- 150
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-11
GEOLOGIST: Fred Brown
DATE DRILLED: 27 AUGUST 1987
ELEVATION: 7409 ft
LOCATION: 475991, 1763584
TOTAL DEPTH: 70 ft
DISPOSITION: Uncased

DEPTH	DESCRIPTION
0-2	Top Soil (sandy loam)
2-35	Unit 3c. Dark yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Common red pumice lapilli
35-45	Unit 3c. Pale yellowish brown tuff Slightly welded Rare rhyolite lithic fragments Rare pumice lapilli
45-50	Unit 3c. Dark yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli
50-70	Unit 3b. Pale yellowish brown tuff Densely welded Rare rhyolite lithic fragments Rare pumice lapilli

BOREHOLE: P-87-12A
GEOLOGIST: Fred Brown
DATE DRILLED: 26 August 1987
ELEVATION: 7448 ft
LOCATION: 476664, 1764036
TOTAL DEPTH: 200 ft
DISPOSITION: Aluminum Casing

DEPTH	DESCRIPTION
0-1	El Cajete Pumice
1-3	Pumice/Top Soil (sandy loam)
3-5	Clay
5-50	Unit 3d. Greyish pink tuff Slightly welded Rare rhyolite lithic fragments Rare pumice lapilli
50	Contact moderately welded Abundant brown pumice lapilli
50-102	Unit 3c. Light brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli
102	Contact moderately welded Abundant rhyolite/latite lithic fragments Common grey pumice lapilli
102-173	Unit 3b. Pale yellowish brown tuff Slightly welded Rare rhyolite lithic fragments Common reddish pumice lapilli
173	Contact slightly welded Abundant rhyolite lithic fragments Rare pumice lapilli
173-195	Unit 3a. Pale yellowish brown tuff Non-welded Abundant rhyolite/latite lithic fragments Rare pumice lapilli
195-200	Unit 2. Dark yellowish brown tuff Densely welded Abundant rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-12A
(ALUMINUM)

```
                T|  |<--------- 0
                T|  | TOP SOIL
                T|  |<--------- 3
                T|  | TUFF (3d)
                T|  |
                T|  |<--------- 50
                T|  |
                T|  | TUFF (3C)
                T|  |
                T|  |<--------- 102
                T|  |
171 --------->T|  | TUFF (3b)
                 |X|
                 |X|<--------- 173
                 |X| TUFF (3a)
                 |X|<--------- 195
                 |X| TUFF (2)
                  - <--------- 200
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-86-13
GEOLOGIST: William Purtymun
DATE DRILLED: 3 OCTOBER 1986
ELEVATION: 7445 ft
LOCATION: 475720, 1764264
TOTAL DEPTH: 103 ft
DISPOSITION: Aluminum Casing

DEPTH	DESCRIPTION
0-38	Unit 3d. Light brown tuff Moderately welded Rare rhyolite/latite lithic fragments Rare pumice lapilli
38	Contact strongly welded Common rhyolite/latite lithic fragments
38-84	Unit 3c. Grey tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli
84-103	Unit 3b. Light grey tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli

WELL COMPLETION DIAGRAM

P-87-13
(ALUMINUM)

```
                T|  |<--------- 0
                T|  |
                T|  |
                T|  | TUFF (3d)
                T|  |
                T|  |
                T|  |<--------- 38
                T|  |
                T|  |
                T|  | TUFF (3c)
                T|  |
                T|  |
                T|  |<--------- 84
92 --------->T|  |
                |X| TUFF (3b)
                |X|
                |X|
                 - <--------- 103
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-14
GEOLOGIST: Fred Brown
DATE DRILLED: 28 AUGUST 1987
ELEVATION: 7437 ft
LOCATION: 475365, 1764251
TOTAL DEPTH: 85 ft
DISPOSITION: Aluminum Casing

DEPTH	DESCRIPTION
0-4	Fill/Top Soil (sandy loam)
4-30	Unit 3d. Pale yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Common grey pumice lapilli
30	Contact is strongly welded Abundant rhyolite lithic fragments Common grey pumice lapilli
30-35	Unit 3c. Pale yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli
35-75	Unit 3c. Dark yellowish brown tuff and clay Welded Rare rhyolite lithic fragments Abundant clayey pumice lapilli
75-85	Unit 3b. Pale yellowish brown pumice Densely welded Rare rhyolite lithic fragments Common grey pumice lapilli

WELL COMPLETION DIAGRAM

P-87-14
(ALUMINUM)

```
                T|  |<--------- 0
                T|  | TOP SOIL
                T|  |<--------- 4
                T|  |
                T|  | TUFF (3d)
                T|  |
                T|  |<--------- 30
                T|  |
                T|  |
                T|  |
                T|  | TUFF (3c)
                T|  |
                T|  |
                T|  |
79 --------->T|  |<--------- 75
                |X| TUFF (3b)
                |X|
                 - <--------- 85
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

BOREHOLE: P-87-15
GEOLOGIST: Fred Brown
DATE DRILLED: 27 AUGUST 1987
ELEVATION: 7413 ft
LOCATION: 475803, 1763520
TOTAL DEPTH: 70 ft
DISPOSITION: Uncased

DEPTH	DESCRIPTION
0-1	El Cajete Pumice
1-3	Pumice/Top Soil (sandy loam)
3-4	Dark yellowish brown clay
4-40	Unit 3c. Dark yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Common red-grey pumice lapilli
40-50	Unit 3c. Pale yellowish brown tuff Slightly welded Rare rhyolite lithic fragments Rare pumice lapilli
50-55	Unit 3c. Dark yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Common red-grey pumice lapilli
55-70	Unit 3b. Dark yellowish brown tuff Densely welded Rare rhyolite lithic fragments Rare pumice lapilli

BOREHOLE: P-87-16A
GEOLOGIST: Fred Brown
DATE DRILLED: 4 SEPTEMBER 1987
ELEVATION: 7452 ft
LOCATION: 475550, 1764200
TOTAL DEPTH: 105 ft
DISPOSITION: Aluminum Casing

DEPTH	DESCRIPTION
0-5	Fill/Dark Brown Clay
5-7	Top Soil (sandy loam)
7-15	Unit 3d. Pale yellowish brown tuff Slightly welded Rare rhyolite lithic fragments Rare pumice lapilli Vertical fracture at 9-12 ft
15-26	Unit 3d. Greyish orange pink tuff Moderately welded Rare rhyolite lithic fragments Oxidation halo surrounds rhyolite lithic fragments Rare brown pumice lapilli Vertical fracture 19-22 ft
26-31	Extensive clay-filled vertical fractures
31-42	Unit 3d. Greyish orange pink tuff Moderately welded Common oxidized rhyolite lithic fragments Common grey pumice lapilli
42-46	Unit 3c. Pale red tuff Welded Common oxidized rhyolite lithic fragments Common grey pumice lapilli Clay-filled vertical fracture (width to .5 in)
46-50	Unit 3c. Pale yellowish brown tuff Welded Common oxidized rhyolite lithic fragments Common grey pumice lapilli
50-60	Densly welded, no core recovered
60-68	Unit 3c. Greyish red tuff Welded Rare rhyolite lithic fragments Common large (to 2 in) pumice lapilli

68-74	Unit 3c. Pale brown tuff Moderately welded Rare rhyolite lithic fragments Rare clayey pumice lapilli
74-81	Unit 3c. Pale yellowish brown tuff Moderately welded Rare rhyolite lithic fragments Rare pumice lapilli Clay-filled vertical fracture (width to .75 in)
81-87	Unit 3c. Pale yellowish brown tuff Welded Rare rhyolite lithic fragments Rare pumice lapilli
87-105	Unit 3b. Densly welded, no core recovered

WELL COMPLETION DIAGRAM

P-87-16A
(ALUMINUM)

```
                T| |<--------- 0
                T| | TOP SOIL
                T| |<--------- 7
                T| |
                T| | TUFF (3d)
                T| |
                T| |
                T| |<-------- 42
                T| |
                T| |
                T| | TUFF (3c)
                T| |
                T| |
                T| |<--------- 87
8 --------->T| |
                |X| TUFF (3b)
                |X|
                 - <--------- 105
```

SCREEN	=
CAVED-IN	X
BACKFILLED TUFF	T
CEMENT	C
BENTONITE	B
SILICA SAND	S

(NOT TO SCALE)

IV. REFERENCES

Abeele, W.V., Wheeler, M.L., Burton, B.W. (1981): Geohydrology of Bandelier Tuff. LA-8962-MS. Los Alamos National Laboratory, Los Alamos, New Mexico.

Abrahams J.H. (1963): Physical properties of and movement of water in the Bandelier Tuff, Los Alamos and Santa Fe Counties, New Mexico. U.S.G.S. Open File Report, Santa Fe, New Mexico.

Bailey, R.A., Smith, R.L., Ross C.S. (1969): Stratigraphic nomenclature of the volcanic rocks of the Jemez Mountains, New Mexico. U.S.G.S. Bulletin 1274-P, Santa Fe, New Mexico.

Brown, F. (1987): Test Hole P-87-00, TA-16, Area P. LANL Memorandum dated July 29, 1987. Los Alamos, New Mexico.

Brown, F., Purtymun, W., Stoker, A., Barr, A. (1987): Geology and hydrology of Technical Area 16 Area P. In press. Los Alamos National Laboratory, Los Alamos, New Mexico.

Dransfield, B.J., Gardner, J.N. (1985): Subsurface geology of the Pajarito Plateau, Espanola Basin, New Mexico. LA-10455-MS. Los Alamos National Laboratory, Los Alamos, New Mexico.

Everett L.G., Wilson L.G., Holyman E.W. (1984): Vadose zone monitoring for hazardous waste sites. Noyes Data Corporation, Park Ridge, New Jersey.

Gardner J.N, Goff F. (1986): Stratigraphic relations and lithologic variations in the Jemez Volcanic Field, New Mexico. Journal of Geophysical Research, v.91, p.1763-1778.

Goddard E.N., Trask P.D., De Ford R.K., and others (1984): Rock Color Chart. Geological Society of America, Boulder, Colorado.

Griggs R.L. (1964): Geology and groundwater resources in the Los Alamos area. U.S.G.S. Water Supply Paper 1753, Santa Fe, New Mexico.

Kearl M.P., Dexter J.J, Kautsky, M. (1986): Vadose zone characterization of Technical Area 54, Waste Disposal Areas G and L. Report 3: Preliminary assessment of the hydrologic system. Bendix Field Engineering, Grand Junction, Colorado.

Purtymun W. (1968): Geology of the microseismic station at S-Site, Los Alamos County, Los Alamos. U.S.G.S. Administrative Report, Santa Fe, New Mexico.

Purtymun, W. (1974): General geohydrology of the Pajarito Plateau, in New Mexico Geologic Society Guidebook, 25th Field Conference. Socorro, New Mexico.

Purtymun, W. (1984): Hydrological characteristics of the main aquifer in the Los Alamos area. LA-9957-MS. Los Alamos National Laboratory, Los Alamos, New Mexico.

Smith, R.L., Bailey, R.A. (1966): The Bandelier Tuff - a study of ash-flow eruption cycles from zoned magma chambers. Bulletin Volcanologique v.29, p.83-104.

APPENDIX E

Post-Closure Inspection Schedule

TABLE E-1
POST-CLOSURE INSPECTION SCHEDULE

ITEM	FREQUENCY OF INSPECTION	RESPONSE
LANDFILL COVER		
1. Settlement	Quarterly	Check for ponding; regrade
2. Integrity	Quarterly	Check for cracks present in concrete; initiate repairs
3. Erosion	Quarterly or after major rainstorm	Regrade; add more topsoil and revegetate as required
4. Presence of biointrusion in soil cover	Quarterly	Remove tree-shrub seedlings via cutting or herbicide; borrowing animals via pesticide applications
5. Dead or dying vegetation	Quarterly, except winter	Fertilize as needed, check for presence of landfill gas if difficulty persists
6. Culverts and discharge channels for evidence of damage, leaks or blockage	Quarterly or after major rainstorms	Initiate repairs
APPURTENANCES		
7. Monitor well and neutron probe casings	Quarterly	Check for casing integrity; note lock condition and replace as required
8. Leachate tank fluid level and plumbing	Quarterly or after major rainstorms	Check tank fluid level and empty as required; check for leaks and repair
9. Benchmarks	Biannually	Clear vegetation
10. Gates, locks, signs	Quarterly	Repair as required

APPENDIX F

Ground-Water Sampling and Analysis Plan

INTRODUCTION

In the event recoverable volumes of ground-water are encountered in monitoring wells at the Area P landfill, samples of the ground-water will be collected and analyzed in accordance with procedures described below. All monitoring wells and neutron moisture log test holes at the Area P landfill will be checked quarterly to determine if water is present in the wells. The presence of water in wells will be determined by depth-to-water measurements which will be taken in each well to the nearest 0.01 feet using a graduated steel tape or equivalent method. When recoverable fluids are present in the wells, water samples will be collected quarterly and analyzed for constituents listed in Table F-1 during the first year after closure. The schedule shown in Table F-3 will be followed in Years Two through Thirty if sufficient water volumes continue to be present. It should be noted that these wells have been routinely checked (weekly to bimonthly) since their completion in September 1987; to date they have been consistently dry. Should these wells continue to be dry, then they will be inspected for recoverable fluids at least quarterly throughout the post-closure period. In the unlikely event that any or all of these wells yield recoverable water volumes after the first year sampling schedule has transpired, then the first year sampling schedule (Table F-1) will still be initiated before the schedule in Table F-3 is followed.

SAMPLING AND ANALYSIS PROCEDURES

The following sections define procedures and methods for sampling, analyses, and documentation applicable to this closure plan. While the procedures and methods are specific, any applicable procedure or method defined in the most current edition of Test Methods for Evaluating Solid Wastes, U.S. EPA SW-846, may be used if conditions or experience show alternate methods to be more appropriate. The sample collection personnel will be instructed to heed the following precautions:

- Do not smoke, eat, or handle any objects not necessary for sampling while performing sampling procedures.
- Do not sample downwind of any potential sources of volatile organics such as car exhausts, open fuel tanks, etc. These could result in contamination of the sample. If any such sources are unavoidable, make a note of them in the field logbook.
- Leave caps on the sample containers until just before filling.
- Avoid handling the teflon bottle cap liners. Do not use any liner which falls out of the cap and onto the ground.
- Gloves should be worn when taking samples and when handling bottles, especially those requiring preservative treatment.

To ensure that the samples collected are representative of the ground-water, monitoring wells will be purged prior to sampling, and the samples will be collected using devices that should not induce sample alteration. Well purging will be conducted according to the borehole volume removal procedure, but a check will also be made on the adequacy of the calculated purging time via measurements of pH, specific conductance, and temperature. These measurements are taken periodically during the calculated purging time. This extra check will give additional assurance that the stagnant well bore water has been removed from the well and that the samples collected are representative of the ground-water.

After the water begins to flow from the purging pump, the well will be pumped for the length of time necessary to purge three to four well volumes and until pH, temperature, and specific conductance stabilize. The pH, temperature, and specific conductance of the discharged water will be measured at least three times during purging. The pH will be considered stable when two consecutive measurements agree within 0.3 pH units. Temperature will be considered stable when two consecutive measurements agree within 0.5 degrees C. Specific conductance will be considered stable when two consecutive measurements agree within twenty-five mhos/cm.

If the well pumps dry while purging, the pump will be turned off and the well will be allowed to recharge for up to 24 hours. Af-

ter sufficient recharge has occurred, samples will be collected with a sampling pump or bailers. Should sufficient recharge not occur for sample collection within 24 hours, the well will be considered dry and samples will not be collected. All samples will be collected in EPA-approved containers and preserved in accordance with EPA methods (Table F-4). Sample bottles will be filled slowly to prevent entrapment of any air bubbles. For those samples requiring zero head space, the bottles will be filled completely such that a meniscus forms. Volatile organic analysis (VOA) samples will be collected at sample rates less than 100 milliliters per minute. The cap will be replaced immediately and the bottle will be turned upside down, tapped a few times and checked for air bubbles in the sample. If a bubble exists, the sample will be discarded and the sampling procedures repeated until an air-free sample is obtained.

Quality Control

The quality control effort will include checks performed on the laboratory through submission of blanks, spikes, and replicate samples, as well as the analytical laboratory's routine quality control procedures. A field blank and transfer blank will be submitted with each sample collected for volatile organic analysis. In addition, during the first six months of sampling under this program, blanks and replicates will be used to test for various types of possible variation in the data.

Inorganic analyses will be performed primarily using Inductively Coupled Plasma Emission Spectrometry (ICAP), Ion Chromatography and Graphite Furnace Atomic Absorption (GFAA). The following general quality control procedures will be standard for all inorganic analyses:

- Standard curve - daily
- Verification of standard (to +30 percent) - every 20 samples
- Blank - each extraction batch
- Random matrix spike for 10 percent of samples.

Organic analyses will be performed primarily using Gas Chromatography and GC/MS. The following general quality control procedures will be standard for all organic analyses:

- Five-point curve - verify every 12 hours
- Random matrix spike for 10 percent of samples
- Blank - every extraction batch
- Internal standards and surrogates.

Chain-of-Custody Procedures

To ensure the integrity of the samples from time of collection through data reporting, the history of the custody of each sample

will be documented. A sample is considered to be under a person's custody if it is: (1) in his physical possession, (2) in his view after he has taken possession, (3) secured by him so that no one can tamper with the sample, or (4) secured by him in an area which is restricted to authorized personnel. Anyone having custody of samples must comply with the procedures described below.

Sample Containers and Labels

Gummed paper labels will be filled out and affixed to all sample containers with waterproof transparent tape before field sampling. Labeled and prepared containers for all sampling constituents will be placed in a labeled box for each sampling station. Extra blank labels and prepared bottles will be taken in the field as a precaution.

After each individual sample has been collected, it will be placed into a large ice chest for transport to the laboratory. Each sample will have an attached label with a unique identification number (ID) written on it. This number will be used in all references to the collected sample; it will prevent misidentification of multiple samples. The sample ID number will be recorded in a field notebook, along with the sample location, date, boring or well number, a depth-to-water measurement from the monitoring well to the nearest 0.01 foot, parameters to be

analyzed, field preservations used, whether the sample was filtered or unfiltered, and any other important field observations or measurements. The receiving laboratory will only be informed of the following information: (1) sample ID number; (2) sample type (ie, water, sediment, etc.); (3) date of sample collection; (4) field preservation techniques used on that sample, including filtration if applicable; (5) sample field measurements for pH, temperature, and specific conductance; (6) cleaning protocol used for sample containers; (7) any unusual sampling event or field observation that might have inadvertently contributed to sample contamination; and (8) chemical, biological, and/or radiological analyses requested.

Sample Holding Container Seals

Once the field sample holding container (ice chest) has been filled with labeled samples, a completed duplicate Chain-of-Custody form will be inserted into a waterproof envelope and placed inside the chest. This Chain-of-Custody form will list the ID number for each sample contained inside that ice chest. A duplicate Chain-of-Custody form will also be attached to the outside of the ice chest so that appropriate signatures may be recorded. The chest will then be sealed with waterproof plastic tape before this chest leaves the custody of sampling personnel. This external ice chest seal will be attached in such a way that it is necessary to break the seal in order to open the ice chest.

A sufficient number of ice chests will taken into the field so that all recovered samples may be placed in a sealed ice chest. These chests will remain within sight of the sampler until a change of custody occurs.

Field Logbook

A field logbook will be utilized to record (in waterproof ink) all pertinent information about each sample collected. It will be a bound book, with consecutively numbered pages. The logbook will be kept in a locked PNL cabinet when not in field use. Minimum entries in the log book will include:

a. Purpose of sample (routine sampling, special sampling, detection or assessment monitoring, etc.)
b. Location of Sampling
c. Name and address of person making log entry
d. Type of process producing waste
e. Number and volume of sample taken
f. Description of each sampling location, equipment used, sampling methodology, etc.
g. Date and time of sample collection
h. Sample destination and transporter's name (name of laboratory, UPS, etc.)
i. Map or photograph of the sampling site, if any

j. Field observations (ambient temperature, sky conditions, past 24-hour precipitation, etc.)

k. Field measurements, if any (pH, flammability, explosivity, specific conductance, etc.)

l. Collector's sample identification number(s)

m. Signature of person responsible for the log entry

n. Analytical parameters requested

Chain-of-Custody Form

A Chain-of-Custody form will accompany all samples from the time they are collected until they are disposed of after analysis and reporting. One form will be used for as many samples as possible. Each sample handler who signs the form will return a copy of the form to the sample collection organization.

Sample Analysis Request Form

A Sample Analysis Report form will accompany all samples delivered to the lab. The field portion of the form will be completed by the sample collector; the laboratory portion will be completed by laboratory personnel. Both the Chain-of-Custody Form and the Sample Analysis Request Form will be filed in an Area P date base along with laboratory's final report on chemical analyses. This data base shall also include copies of the field logbook entries, and calculations from the statistical comparison testing. It

will be made available to the EID during site inspections, or at their written request.

Sample Delivery to the Laboratory

Samples will normally be shipped directly to the laboratory on the day of collection in an ice chest. If they cannot be shipped on the day of collection, they must be stored in a sealed refrigerator in a locked building within a secured area. All samples will be accompanied by a Chain-of-Custody form and a Sample Analysis Request form. The samples will be delivered only to authorized laboratory personnel.

PLAN FOR ESTABLISHING GROUND-WATER QUALITY DATA

The background ground-water quality values will be established during the first year of the ground-water monitoring program. Ground-water, surface water, and leachate collection tank samples will be collected following the procedures outlined above. Table F-1 outlines the constituents selected for testing. Four quarterly samples will be taken during the first year. For each of the indicator parameters specified in Table F-1 (pH, specific conductance, TOC, TOX), at least four replicate measurements will be obtained for each sample from the upgradient wells and the initial background arithmetic mean and variance will be determined by pooling replicate measurements.

After the first year, all monitoring wells, surface water sampling stations, and the leachate collection tank will be sampled according to the schedule given in Table F-3. Parameters indicating ground-water quality will be sampled annually in accordance with 40 CFR Part 265.92 (d)(1). All indicator parameters will be sampled semi-annually in accordance with 40 CFR Part 265.92 (d)(2). Selected additional hazardous waste constituents and any organic constituents (Table F-2) detected during Year One sample analyses will also be sampled for during Years Two through Thirty. Depths to ground-water in individual monitoring wells will be recorded to the nearest 0.01 foot immediately prior the collection of each sample.

STATISTICAL ANALYSIS OF DATA

A goal of the ground-water sampling and analysis program is to compare observations on ground-water quality obtained from upgradient and down gradient monitoring wells. These comparisons will be a part of the evidence pertaining to whether or not a facility is contaminating the uppermost aquifer system.

The statistical techniques used to analyze the data collected during the ground-water monitoring program are determined by the sampling strategy used. Three possible sampling strategies are:

1. One large sample of water is obtained from each sampling station, separated into four separate parts, and a chemical analysis is performed on each part.
2. Four independent water samples are obtained from each sampling station, and each submitted for chemical analysis. The definition of independence of water samples is that an adequate amount of time has elapsed (or a sufficient amount of water has been pumped) between samples so that the liquid in one sample does not influence the liquid in another sample.
3. Four independent large water samples are obtained from each monitoring station, as in (1) and (2) above. Each large sample is split into four smaller parts, and a chemical analysis is performed on each part.

The statistical techniques used to analyze this data will incorporate estimates of "error" or variability. The "error" statements associated with each of the three sampling strategies have different interpretations. For strategy (1), the error is analytical error only. It is a function of the differences between independent replicate analyses on the same water sample. For strategy (2), since independent water samples are obtained, the error is a function of both sampling error and analytical error. These two error components cannot be separated. The third strategy is the most complex. If it is followed, both the sampling component of error and the analytical component of error can be

separately estimated. This separation of errors is accomplished by analyzing a hierarchical statistical classification model (Snedecor and Cochran,(1) page 285).

The first sampling strategy leads to an underinflated estimate of error, i.e., the "errors" associated with this strategy do not reflect variability in the ground water. Consequently, statistical tests may indicate a significant difference between upgradient and downgradient observations, when in fact, there is no difference. For this reason, the first sampling strategy will be not adopted. The third strategy is not viable due to economic and logistic considerations. Therefore, the second strategy will be adopted. Independent ground-water samples will be obtained and each sample analyzed chemically. The error statements should properly reflect the variability due to the natural variability in the ground water and that due to the chemical analysis.

The water samples are to be chemically analyzed for constituents listed in Tables F-1 through F-3. For the ground-water sampling and analysis monitoring program, the following summary statistics will be computed (40 CFR Part 264, Appendix IV):

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(1)Snedecor, G. W., and W. G. Cochran, 1967, Statistical Methods, 6th Edition, Iowa State University Press, Ames, Iowa.

- Sample mean: $$x_m = \sum_{i=1}^{n} (x_i - x) / n$$

- Sample variance: $$s^2 = \sum_{i=1}^{n} (x_i - x_m)^2 / (n-1)$$

where x_i is the result of the ith analysis and n denotes the number of observations.

- Sample standard deviation: $s = (s^2)^{0.5}$
- 95 percent confidence interval for the mean: $x_m + ts/(n)^{0.5}$ and $x_m - ts/(n)^{0.5}$ where t is the Student's t statistic with n-1 degrees of freedom
- Sample maximum and minimum
- Sample range: maximum - minimum

For the ground-water sampling and analysis plan, normal background levels will be calculated by pooling values from upgradient wells. The results from individual downgradient wells will then be compared against the calculated background level.

Using the appropriately combined data, the background mean (X_b) and background variance (s^2_b) will be computed for each water quality parameter. For individual monitoring wells, surface water sample stations, and the leachate collection tank, individual

monitoring means (X_m) and monitoring variances (S^2_m) will be computed for each water quality parameter. The equations used to compute these summary statistics were previously given.

The t-test uses the above summary information to calculate a t-statistic (t^*) and a comparison t-statistic (t_c) so that one may determine whether there has been a statistically significant change in any individual water quality parameter. The calculated t-statistic (t^*) for all parameters except pH and similar monitoring parameters is:

$$t^* = (X_m - X_b) \ / \ [(S^2_m/n_m) + (S^2_b/n_b)]^{0.5}$$

where n_m and n_b denote the number of observations at the monitoring station and background sample, respectively. A separate t^* is computed for each individual water quality parameter at that monitoring point. If t^* is negative, then there is no significant difference between the given monitoring data and the background data for that water quality parameter. However, if a significantly small negative value for t^* is found, then it may be indicative of a failure of the assumption made for test validity, or that errors have been made in collecting the background data.

The comparison t-statistic (t_c) against which t^* will be compared requires that one find t_b and t_m from standard (one tailed) statistical tables (see Table F-5), where:

t_b = value from Table F-5 with (n_b-1) degrees of freedom at the 0.05 level of significance.

t_m = value from Table F-5 with (n_m-1) degrees of freedom at the 0.05 level of significance.

Special weighting factors, W_b and W_m, are computed from the equations:

$$W_b = S^2{}_b/n_b \quad \text{and} \quad W_m = S^2{}_m/n_m$$

The comparison t-statistic (t_c) is then computed from the equation:

$$t_c = (W_b * t_b + W_m * t_m)/(W_b + W_m)$$

The calculated t-statistic (t^*) will then be compared to the comparison t-statistic (t_c), using the following decision rules:

(1) If t^* is equal to or greater than t_c, then it will be concluded that there has most likely been a significant increase in that specific water quality parameter.

(2) If t^* is less than t_c, then it will be concluded that there has not been a significant change in that specific water quality parameter.

The t-statistic for testing pH and similar monitoring parameters is constructed in the same manner as described above, except that the negative sign on t^* (if any) is neglected. Furthermore, the standard (two-tail) t-values in Table F-5 are used to find t_c. The decision rules cited above remain in effect in this two-tailed test, except that the discarded negative sign on t^* (if any) would indicate a significant decrease (and not increase) in Rule (1). That is, we might have either a significant increase or decrease in pH values (or similar monitoring parameters). For the Area P landfill, the two-tailed t-test procedure will only be used for pH data. The one-tailed t-test procedure will be used for all other water quality data analyses.

PREPARATION, EVALUATION AND RESPONSE FOR GROUND-WATER QUALITY ASSESSMENT PLAN

Presently, no data exist which indicate that a release of hazardous waste or hazardous waste constituents has occurred from the Area P landfill or that any ground-water underlying the site has become contaminated as a result of waste disposal activities at Area P. Therefore, a ground-water quality assessment program to determine the rate and extent of hazardous waste migration is not applicable; rather a ground-water sampling and analysis program will be implemented.

In the event that statistical comparisons of upgradient and downgradient monitor well water quality data determine that significant increases (increases or decreases for pH) in contaminant concentrations exist in downgradient wells, the Los Alamos National Laboratory (LANL) will immediately conduct follow-up sampling. Follow-up sampling will consist of resampling those downgradient wells where a significant difference was detected. The samples will be split into two portions and analyzed to determine whether the significant difference was a result of laboratory error. Should these analyses confirm the significant increase, then LANL will provide written notice to the Director of the New Mexico Environmental Improvement Division (Director) within seven days of the date of such confirmation that the facility may be affecting ground-water quality. Within 15 days after this notification, LANL will develop and submit to the Director a specific plan for a ground-water quality assessment monitoring program at the facility in accordance with 40 CFR Part 265.93 (d)(2).

In the event that significant ground-water contamination is detected in any of the downgradient monitoring wells, or significant surface water contamination is detected in Canon de Valle, and either of these is confirmed by follow-up sampling, a ground-water quality assessment program capable of determining the following would be implemented.

1. Whether landfill hazardous waste or landfill hazardous waste constituents have entered ground-waters of the upper-most aquifer;
2. The rate and extent of migration of landfill hazardous waste or landfill hazardous waste constituents in ground-waters of the upper-most aquifer;
3. The concentration of landfill hazardous waste or landfill hazardous waste constituents in the ground-waters of the upper-most aquifer.

The methods and procedures utilized to achieve the above objectives will be presented in a specific ground-water quality assessment monitoring plan if and when it is required. At a minimum the outline of this plan, as shown below, would dictate that it include:

- The number, locations, and depths of additional wells to be installed, and a revised quarterly sampling schedule.
- The sampling and analytical methods to be used to identify landfill hazardous waste or hazardous waste constituents.
- Evaluation procedures for water quality data.
- A ground-water quality assessment monitoring program implementation schedule, and an outline of possible corrective actions.

The overall objectives of this ground-water quality assessment plan would necessarily include the following:

1. A determination of the rate and extent of migration of landfill hazardous waste or landfill hazardous waste constituents in ground-waters and Canon de Valle;
2. The concentration of landfill hazardous waste or landfill hazardous waste constituents in the ground-waters and Canon de Valle.

RECORDKEEPING AND REPORTING

The Los Alamos National Laboratory (LANL) will maintain records from the water quality monitoring program and submit information to the Director in accordance with the schedule given below. Ground-water sampling and analysis results, including laboratory and statistical data analysis results and ground-water surface elevations, will be kept throughout the post-closure care period for the Area P landfill. In addition, the following water quality monitoring information will be submitted to the Director:

- During the first year when initial background concentrations are being established for the Area P landfill, concentrations of all the parameters listed in Table F-1 for each water quality sampling station within 15 days after completing each quarterly analysis. LANL will

separately identify any analyzed parameter exceeding the EPA Primary Drinking Water Standards.

- Annually, no later than March 1 following each calendar year, concentrations or values of parameters listed in Table F-3 for each water quality sampling station along with required statistical analyses. LANL will separately identify any statistically significant differences from established background values found in the upgradient wells to those subsequently observed in upgradient and down gradient wells.
- No later than March 1 following each calendar year; results of the evaluation of ground-water surface elevations and a description of the response to that evaluation, where applicable.

Since ground and surface waters will be monitored to satisfy interim status regulatory monitoring requirements, LANL will keep records of the analyses and evaluations specified in the ground-water sampling and analysis monitoring plan throughout the landfill's active life, including the post-closure care period. Furthermore, LANL will annually until final closure of the facility, submit to the Director a report containing the results of the ground-water sampling and analysis monitoring program. This information will be submitted no later than March 1 following each calendar year. The above reporting schedules may be automatically modified in accordance with 40 CFR Section

265.93 (d)(5) through 265.93 (d)(7) if a ground-water quality assessment program is eventually required.

REGULATORY CLOSURE AND POST-CLOSURE TRANSITION STATUS

Background

The Los Alamos National Laboratory (LANL) did not choose to continue operation of the TA-16, Area P landfill after November 8, 1985. Therefore LANL did not apply for a RCRA permit at this site. In addition, LANL did not choose to certify ground-water compliance at the Area P landfill. Consequently LANL was required under the loss of interim status provisions (40 CFR Section 270.10) to submit a closure and post-closure plan for the landfill. Pursuant to 40 CFR Section 265.1 (b), the LANL closure and post-closure plan dated November 25, 1985, reflected interim status standards for such activities. LANL recognizes, however, that upon receiving a RCRA operating permit, post-closure (and possibly closure) activities will be subject to permitting standards (ie, 40 CFR 264) rather than interim status standards (ie, 40 CFR 265). These amendments to the November 25, 1985, Closure and Post-Closure Plan are submitted with the intent that a smooth transition of applicable regulatory requirements and appropriate LANL responses occur automatically without further action by either EID or LANL. Equally important, however, is the collection of a consistent and reliable water quality data base

from which critical decisions concerning potential statistically significant changes in individual water quality parameters can be made. Thus the proposed ground-water quality monitoring program for Area P has been designed with sufficient flexibility so that LANL will comply with both Sections 265 and 264 requirements, even though only a single regulatory standard will be in effect at any given time. The following paragraphs outline specific steps that will be automatically adopted by LANL for ground-water monitoring activities at the Area P landfill once the RCRA Part B permit has been issued. These monitoring activities will supplement and replace some of those requirements already presented in this Appendix.

Detection Monitoring Program

Under 40 CFR Sections 264.1 (b) and 264.91 (a)(4), detection monitoring program standards must be followed for the Area P landfill once a RCRA Part B permit is issued to LANL, even though Area P was not included in the Part B application. The proposed detection monitoring program stipulates that LANL monitor ground-water in the upper-most aquifer for indicator parameters (ie, specific conductance, total organic carbon, and total organic halogen), waste constituents, or reaction products that provide a reliable indication of the presence of hazardous waste constituents. It is suggested that the same water quality parameters listed in Tables F-1 and F-2 (ie, the required Year

One interim status monitoring parameters plus additional indicator parameters) be used in the detection monitoring plan during Year One if Section 264 standards become effective during the first year after closure has been approved. Detection monitoring requirements for Years Two through Thirty are outlined below. Several monitoring wells and neutron moisture log test holes (see Appendix D) have already been installed at the landfill boundary compliance point as specified under 40 CFR Section 264.95. To date, however, no recoverable ground-water has been detected in any of these monitoring wells.

Procedures for sampling and analysis, quality control, chain-of-custody, establishment of background ground-water quality values, and statistical analyses of water quality data have already been presented for interim status standards. These same procedures and water quality sampling stations will also be used to satisfy permitted status standards for closure and post-closure requirements. Hence they are not repeated here.

If approved by EID, the Year One monitoring parameters and sampling frequencies for detection monitoring (permitted standards) will be identical to those under the sampling and analysis plan (interim standards). During Years Two through Thirty, however, the required sampling parameters and frequencies will differ somewhat. In effect, LANL is proposing a more stringent first year interim status monitoring plan than

presently required under 40 CFR Section 265. However LANL feels that this proposed first year monitoring plan also meets the requirements of 40 CFR Section 264. Thus if a RCRA Part B permit is issued to LANL midway through this first year of the Area P landfill closure and post-closure operation, no additional ground-water quality monitoring actions will be required. During Years Two through Thirty, however, the required sampling parameters and frequencies will be different. Table F-6 shows the proposed list of water quality parameters and sampling frequencies for compliance with Section 264 detection monitoring requirements during Years Two through Thirty. Comparison of Tables F-3 and F-6 shows several differences. Under interim status standards (Table F-3), several required parameters are listed that establish ground-water quality; furthermore, except for indicator parameters, an annual sampling frequency is mandated. Under Section 264 standards (Table F-6), a semi-annual sampling frequency is required for all indicator parameters. There is no explicit requirement to sample for parameters establishing ground-water quality. In effect LANL is proposing to monitor all indicator parameters on a semi-annual basis during interim status, and to monitor those parameters establishing ground-water quality only while interim standards remain in effect. Once the Section 264 monitoring standards become effective, LANL proposes to discontinue monitoring for those parameters that establish ground-water quality under Section 265 requirements if downgradient monitor wells or surface waters have

shown no statistically significant increase in these parameters during interim status monitoring activities. LANL feels that this monitoring plan meets all regulatory monitoring requirements. More importantly, however, LANL feels that consistent monitoring at a semi-annual frequency for those indicator parameters listed in Table F-3 and F-6 will provide an adequate early signal of potential deep percolation of landfill waste constituents into the underlying ground-water.

Statistical Comparison Tests of Water Quality Parameters

The same statistical procedures previously outlined will be used to determine if there has been statistically significant increase over background (increase or decrease for pH values) in any parameter or constituent specified in Tables F-1, F-2, or F-6. These determinations will be made for each parameter or constituent each time the monitoring wells or surface water stations are sampled. These results will be routinely reported to the Director as they become available, according to the same schedule previously established for interim status standards. In the event that a statistically significant increase in any parameter or constituent is determined, then LANL will notify the Director in writing within seven days indicating exactly which parameters or constituents showed these increases. All monitor wells and surface water stations will be immediately resampled to determine whether constituents identified in the list of

constituents in CFR 40 Section 264 Appendix IX (ie, only those parameters in Tables F-1, F-2, and F-6, unless specified otherwise by EID) are present, and if so, at what concentrations. Furthermore, within ninety days after this initial notification, LANL will apply for an EID approved compliance monitoring program at the Area P landfill. This compliance plan will contain all those requirements specified in 40 CFR Section 264.98 (h)(4). Within 180 days after the original notification, LANL will submit to the Director all data to justify any variance sought under 264.94 (b), and an engineering feasibility plan for a corrective action program if it is required.

Ground-Water Protection Standards

To date no recoverable ground-waters have been detected in any monitoring wells. In all likelihood, this condition will not change in the foreseeable future. Hence no background values of ground-water for water quality and indicator parameters can be established at this time for the landfill. LANL proposes that the EPA Interim Primary Drinking Water Standards (40 CFR Section 265 Appendix V) be used in lieu of established background values for the statistical comparison tests for those indicator parameters that have established safe drinking water limits. In addition, LANL also proposes that background values for water quality and indicator parameters from the upstream surface water sampling station in Canon de Valle also be used in these

statistical comparison tests. For those indicator parameters with no established safe drinking water limits, LANL proposes to use those background values from the upstream surface water sampling station in Canon de Valle for statistical comparison tests.

TABLE F-1
CONSTITUENTS SELECTED FOR QUARTERLY GROUND-WATER MONITORING PROGRAM FOR YEAR ONE

A. Parameters characterizing the suitability of the ground-water as a drinking water supply :

Arsenic	Nitrate (as N)	2,4-D
Barium	Selenium	2,4,5-TP Silvex
Cadmium	Silver	Radium
Chromium	Endrin	Gross Alpha
Fluoride	Lindane	Gross Beta
Lead	Methoxychlor	Coliform Bacteria
Mercury	Toxaphene	

B. Parameters establishing ground-water quality :

Chloride	Manganese	Sodium
Iron	Phenols	Sulfate

C. Parameters used as indicators of ground-water contamination:

pH	Total Organic Carbon (TOC)
Specific Conductance	Total Organic Halogen (TOX)

D. Other chemical indicators of ground-water contamination:

1. Antimony and Nickel

2. Volatile and semi-volatile aliphatic halogenated and aromatic hydrocarbons (see Table F-2 for complete list).

E. Notes :

1. For each of the indicator parameters in (C) above, at least four replicate measurements will be obtained for each sample. Individual samples will be obtained from each monitor well, the surface water sample collection stations, and the leachate collection tank. The initial background arithmetic mean and variance will be determined by pooling these replicate measurements for the respective parameter concentrations, using the respective upgradient monitor wells numbered P-8, P-9, and P-11, in accordance with 40 CFR 265.92(d)(2).

2. Methods of sample preservation are listed in Table F-4.

TABLE F-2
VOLATILE ORGANIC COMPOUND IDENTIFICATION LIST FOR YEAR ONE
GROUND-WATER QUALITY MONITORING PROGRAM

Compound Name	CAS Number
Chloromethane (methyl chloride)	74873
Bromomethane (methyl bromide)	74839
Vinyl Chloride (chloroethene)	75014
Chloroethane	75003
Methylene Chloride	75092
Acetone	67641
Carbon Disulfide	75150
1,1-Dichloroethene	75354
1,1-Dichloroethane (ethylidene dichloride)	75343
1,2-Dichloroethene (total)	156605
Chloroform	67663
1,2-Dichloroethane	107062
2-Butanone (methyl ethyl ketone)	78933
1,1,1-Trichloroethane (methyl chloroform)	71556
Carbon Tetrachloride	56235
Vinyl Acetate	108054
Bromodichloromethane	75274
1,2-Dichloropropane (propylene dichloride)	78875
cis-1,3-Dichloropropene	10061015
Trichloroethene	79016
Dibromochloromethane	124481
1,1,2-Trichloroethane	79005
Benzene	71432
trans-1,3-Dichloropropene	10061026
Bromoform	75252
4-Methyl-2-Pentanone	108101
2-Hexanone	591786
Tetrachloroethene	127184
1,1,2,2-Tetrachloroethane	79345
Toluene	108883
Chlorobenzene	108907
Ethyl Benzene	100414
Styrene	100425
Xylene (total)	multiple

TABLE F-2 (Continued)
SEMI-VOLATILE ORGANIC COMPOUND IDENTIFICATION LIST FOR YEAR ONE GROUND-WATER QUALITY MONITORING PROGRAM

Compound Name	CAS Number
Phenol	108952
bis(-2-chloroethyl)Ether	111444
2-Chlorophenol	95578
1,3-Dichlorobenzene	541731
1,4-Dichlorobenzene	106467
Benzyl Alcohol	100516
1,2-Dichlorobenzene	95501
2- Methyl Phenol	95487
bis(2-chloroisopropyl)Ether	39638329
4-Methyl Phenol	106445
N-Nitroso-Di-n-Propylamine	621647
Hexachloroethane	67721
Nitrobenzene	98853
Isophorone	78591
2-Nitrophenol	88755
2,4-Dimethylphenol	105679
Benzoic Acid	65850
bis(2-chloroethoxy)Methane	111911
2,4-Dichlorophenol	120832
1,2,4-Trichlorobenzene	120821
Naphthalene	91203
4-Chloroaniline	106478
Hexachlorobutadiene	87683
4-Chloro-3-Methylphenol	59507
2-Methylnaphthalene	91576
Hexachlorocyclopentadiene	77474
2,4,6-Trichlorophenol	88062
2,4,5-Trichlorophenol	95954
2-Chloronaphthalene	91587
2-Nitroaniline	88744
Dimethyl Phthalate	131113
Acenaphthylene	208968
2,6-Dinitrotoluene	606202

TABLE F-2 (Continued)
SEMI-VOLATILE ORGANIC COMPOUND IDENTIFICATION LIST FOR YEAR ONE GROUND-WATER QUALITY MONITORING PROGRAM

Compound Name	CAS Number
3-Nitroaniline	99092
Acenaphthene	83329
2,4-Dinitrophenol	51285
4-Nitrophenol	100027
Dibenzofuran	132649
2,4-Dinitrotoluene	121142
Diethylphthalate	84662
4-Chlorophenyl-Phenylether	7005723
Fluorene	86737
4-Nitroaniline	100016
4,6-Dinitro-2-Methylphenol	534521
N-Nitrosodiphenylamine (1)	86306
4-Bromophenyl-Phenylether	101553
Hexachlorobenzene	118741
Pentachlorophenol	87865
Phenanthrene	85018
Anthracene	120127
Di-n-butylphthalate	84742
Fluoranthene	206440
Pyrene	129000
Butylbenzylphthalate	85687
3-3'-Dichlorobenzidine	91941
Benzo(a)anthracene	56553
Chrysene	218019
bis(2-Ethylhexyl)Phthalate	117817
Di-n-octylphthalate	117840
Benzo(b)fluoranthene	205992
Benzo(k)fluoranthene	207089
Benzo(a)pyrene	50328
Indeno(1,2,3-cd)pyrene	193395
Dibenz(a,h)anthracene	53703
Benzo(g,h,i)perylene	191242

TABLE F-3
CONSTITUENTS SELECTED FOR GROUND-WATER MONITORING PROGRAM FOR YEARS TWO THROUGH THIRTY UNDER INTERIM STANDARDS

A. Parameters characterizing the suitability of ground-water as a drinking water supply are not required.

B. Parameters establishing ground-water quality :

Parameter	Sampling Frequency
Chloride	Annually
Iron	Annually
Manganese	Annually
Phenols	Annually
Sodium	Annually
Sulfate	Annually

C. Parameters used as indicators of ground-water contamination :

Parameter	Sampling Frequency
pH	Semi-annually
Specific Conductance	Semi-annually
Total Organic Carbon (TOC)	Semi-annually
Total Organic Halogen (TOX)	Semi-annually

D. Selected additional chemical indicators of ground-water contamination :

Parameter	Sampling Frequency
Antimony	Semi-annually
Arsenic	Semi-annually
Barium	Semi-annually
Cadmium	Semi-annually
Chromium (total)	Semi-annually
Mercury	Semi-annually
Nickel	Semi-annually
Silver	Semi-annually
Table F-2 Organic Compounds	To be determined

E. **Notes :**

Volatile and semi-volatile organic compounds in (D) above will be determined after Year One sample analyses. It is anticipated that no such compounds will be detected during Year One, and will therefore not be included in Years Two through Thirty monitoring requirements.

Table F-4
Sample Collection and Preservation Methods

Parameter	Container	Preservative
pH Specific Conductance	Field Measurements	
T. Alkalinity (as HCO_3 or CO_3) Chloride Fluoride Sodium Sulfate	P[a], 1.0 l.	Cool 4°C
NO_3-N	P,G, 100 ml.	Cool 4°C, H_2SO_4 to pH < 2
Sulfide	P,G, 1.0 l.	Cool 4°C, $C_4H_6O_4Zn$ + NaOH to pH > 9
Total Cyanide	P,G, 1.5 l.	Cool 4°C, NaOH to pH > 12+0.6g $C_6H_8O_6$[b]
Calcium Chromium Lead Manganese Cadmium Barium Silver Iron Mercury Arsenic Selenium Magnesium Potassium	P,G, 1.0 l.	Cool 4°C, HNO_3 to pH < 2
Phenol	G, teflon cap 1.0 l.	Cool 4°C, H_3PO_4 to pH < 4 + 1 gm $CuSO_4$
Base-Neutral/Acid Extractables	G, teflon cap 2.0 l.	Cool 4°C, 0.008% $Na_2S_2O_3$[b]
Pesticides/Herbicides	G, silica/teflon septa 1.0 l.	Cool 4°C, 0.008% $Na_2S_2O_3$[b]

Table F-4 (Continued)
Sample Collection and Preservation Methods

Parameter	Container	Preservative
Volatile Organics	G, silica/teflon septa, no head-space 40 ml.	Cool 4°C, 0.008% $Na_2S_2O_3$[b]
Total Organic Halogen (TOX)	G, silica/teflon septa, no head-space 1.0 l.	Cool 4°C
Total Organic Carbon (TOC)	G, 1.0 l.	Cool 4°C H_2SO_4 to pH < 2
Purgable Organic Halogen (POX)	G, teflon septa 40 ml.	Cool 4°C
Purgable Organic Carbon (POC)	G, teflon septa 40 ml.	Cool 4°C
Radium 226, 228	P,G, 1.0 l.	HNO_3 to pH < 2
Gross Alpha	P,G, 1.0 l.	HNO_3 to pH < 2
Gross Beta	P,G, 1.0 l.	HNO_3 to pH < 2
Coliform Bacteria	P, Sterile, 200 ml.	Cool 4°C

(a) P = Plastic, G = Glass
(b) Use only in presence of residual chlorine.

TABLE F-5
STANDARD T-TABLES AT 0.05 LEVEL OF SIGNIFICANCE

Degrees of Freedom	t-values (one-tail)	t-values (two-tail)
1	6.314	12.706
2	2.920	4.303
3	2.353	3.182
4	2.132	2.776
5	2.015	2.571
6	1.943	2.447
7	1.895	2.365
8	1.860	2.306
9	1.833	2.262
10	1.812	2.228
11	1.796	2.201
12	1.782	2.179
13	1.771	2.160
14	1.761	2.145
15	1.753	2.131
16	1.746	2.120
17	1.740	2.110
18	1.734	2.101
19	1.729	2.093
20	1.725	2.086
21	1.721	2.080
22	1.717	2.074
23	1.714	2.069
24	1.711	2.064
25	1.708	2.060
26	1.706	2.065
27	1.703	2.052
28	1.701	2.048
29	1.699	2.045
30	1.697	2.042
40	1.684	2.021
>40	1.645	1.960

TABLE F-6
CONSTITUENTS SELECTED FOR GROUND-WATER MONITORING PROGRAM
FOR YEARS TWO THROUGH THIRTY UNDER PERMITTED STANDARDS

A. Parameters characterizing the suitability of ground-water as a drinking water supply are not required.

B. Parameters establishing ground-water quality are not required.

C. Parameters used as indicators of ground-water contamination :

Parameter	Sampling Frequency
pH	Semi-annually
Specific Conductance	Semi-annually
Total Organic Carbon (TOC)	Semi-annually
Total Organic Halogen (TOX)	Semi-annually

D. Selected additional chemical indicators of ground-water contamination :

Parameter	Sampling Frequency
Antimony	Semi-annually
Arsenic	Semi-annually
Barium	Semi-annually
Cadmium	Semi-annually
Chromium (total)	Semi-annually
Mercury	Semi-annually
Nickel	Semi-annually
Silver	Semi-annually
Table F-2 Organic Compounds	To be determined

E. Notes :

Volatile and semi-volatile organic compounds in (D) above will be determined after Year One sample analyses. It is anticipated that no such compounds will be detected during Year One, and will therefore not be included in Years Two through Thirty monitoring requirements.

APPENDIX G

TA-16 Background Information

TA-16 - S SITE

CURRENT OPERATIONS

Activities at TA-16 center around production of high explosives for applications in both weapons and nonweapons research and development. TA-16 is divided into isolated operational areas and contains nearly 200 buildings or manmade structures. This separation precludes sympathetic detonation of high explosives between operational areas in case of an accident.

The administration area houses a steam plant, fire station, service station, cafeteria, warehouse, shops building, main administration building, laundry, and several transportable office buildings. The new tritium facility, still under construction at TA-16, is not associated with high-explosive research and development. Structures 530 through 535 are an onsite sewage treatment facility.

The remainder of this section concerns facilities involved with high-explosive research and development. High-explosive pressing operations are performed at building 430. High-explosive material is brought into this facility in plastic-coated granular form, placed into molds, and subjected to very high pressures. This process produces solid pieces of high explosive in various shapes and sizes. Building 370 houses a machine shop that fabricates nonnuclear metal components required by research and development programs conducted at TA-16. High explosive obtained from commercial vendors is inspected at building 380. This is primarily a visual inspection for accepting or rejecting commercial material. Assembly operations are conducted at the complex comprising buildings 410 through 415. High-explosive casting, inert materials, and plastics operations are conducted at the complex comprising buildings 300 through 307. Building 300 is used for operations involving inert materials. These operations produce mock high-explosive components for a variety of display or testing purposes. Building 302 is currently used for explosives casting operations. Plastics operations are performed in buildings 304 and 306; they are strictly controlled, and high explosives are never brought into these buildings. Buildings 340 and 342 house high-explosive preparation and development operations. Activities in these buildings include coating high-explosive granules with plastics, developing new types of high

explosives, and working with crystallization processes. High-explosive machining operations are conducted in building 260. Several support buildings surround building 260 and are used to store material not being actively worked. Radiography and other nondestructive testing is done in the complex made up of buildings 220 to 225. Building 222 contains two photographic processing units capable of processing film; however, only one of these units is operational.

POTENTIAL CERCLA/RCRA SITES

About 30 buildings in the central portion of TA-16 were part of the World War II high-explosive operations. Most of these buildings are old, and many have been abandoned. Many are contaminated with high explosive, primarily 2,4,6-trinitrotoluene (TNT). Many structures at the site were removed by burning or bulldozing in the 1950s and 1960s. Residual high explosive may remain in the environment at two firing sites that were used for high-explosive test firing during World War II. High-explosive and solvent/oil contamination may remain at a burning ground.

Old drawings of firing sites indicate two locations, P Site and K Site, which were used for high-explosive test firing during World War II. The sites are addressed under TA-11 and TA-13.

The following table presents what is known about potential CERCLA/RCRA sites at this location. Phase I investigations have not been concluded. Information obtained during supplemental Phase I investigations will be documented in the CEARP Phase IIA Monitoring Plan for TA-16. CEARP findings are based on a negative, positive, or uncertain finding for FFSDIF, PA, and PSI for each potential CERCLA/RCRA site. The HRS/MHRS Migration Mode Score for TA-16 is 3.0 (Appendix B).

FIGURES

TA-16-1: Structure Location Plan for TA-16 - S Site (1983)
TA-16-2: Structure Location Plan for TA-16 - S Site (1957)

REFERENCES

Baytos, John. 1985. "Analysis of Soil Samples for Residual Explosives from Drainage Ditches at Sump Effluent Outlets," Los Alamos Scientific Laboratory memorandum to A. P. Torres, July 21, 1986.

Baytos, J. F. 1986. "Water Contaminants in the S-Site Retaining Pond TA-16," Los Alamos National Laboratory memorandum to A. P. Torres, May 14, 1986.

Blackwell, Charles D. 1983. "Structures Removed from TA-16," Los Alamos National Laboratory memorandum to A. John Ahlquist, November 17, 1983

Buckland, Carl. 1967. "Radioactive Contamination Survey: S Site Structures, TA-16," Los Alamos National Laboratory, July 10, 1967.

Campbell, Evan E. 1980. "Cleaning Copper Plates," Los Alamos Scientific Laboratory memorandum, January 22, 1960.

CEARP. n.d. undated memorandum; in CEARP files at LANL.

Converse, R. L. 1948. "Explosion at Burning Ground," Los Alamos Scientific Laboratory memorandum to L. E. Hightower, September 20, 1948.

Engineering Division. 1965. "Request for Survey Service," Los Alamos Scientific Laboratory, September 1, 1965.

Ferenbaugh, R. W. 1979. "Study of Silver Discharge from WX-3 Photographic Laboratory," Los Alamos Scientific Laboratory, March 22, 1979.

H Division. 1950. Progress Report, Los Alamos Scientific Laboratory, July 30, 1950-August 30, 1950, p. 29.

H Division. 1952. Progress Report, Los Alamos Scientific Laboratory, July 20-August 20, 1952, p. 20.

Kasunic, C. A. 1982. "The Toxicity of Spent Photographic Solutions and other Silver Compounds and Their Migrations in Soil," University of Arizona, 1982, p. 142.

Kennedy, W. R. 1970. "Contaminated Survey: Building and Structures, TA-16," Los Alamos Scientific Laboratory document, March 9, 1970.

LASL. 1947. "A Technical Maintenance Group Report on General Background Data Concerning the Los Alamos Scientific Laboratory Required for Planning Purposes," Los Alamos Scientific Laboratory report LAB-A-5, September 11, 1947, p. 12.

LASL. 1972. "Environmental Monitoring in the Vicinity of the Los Alamos Scientific Laboratory, January through June 1971," Los Alamos Scientific Laboratory report LA-4871-MS, January 1972, p. 25-26.

Miller, D. 1972. "Radioactive Contaminated Septic Tanks," Los Alamos Scientific Laboratory memorandum to Harry Jordan, January 28, 1972.

Truslow, Edith C., and Ralph Carlisle Smith. 1983. "Beyond Trinity" *Project Y: The Los Alamos Story*, Part II, Tomash Publishers, San Francisco/Los Angeles, CA, p. 211.

Wilder, Edward. 1953. "Procedure for the Operation of the S Site Burning Grounds," Los Alamos Scientific Laboratory memorandum to M. J. Brodes, November 18, 1953.

Williams, G. L. 1965. "Removal of Buried Material to Dump Area P, TA-16," Los Alamos Scientific Laboratory report, September 30, 1965.

The following references have been reviewed but not cited.

Balo, K. A., and John L. Warren. 1986. "Waste Management Site Plan," Los Alamos National Laboratory report, LA-UR-86-990, March 1986, p. 60.

Buckland, Carl. 1957. "Radiation Health Clearance of Old 'S' and 'T' Site Buildings," Los Alamos National Laboratory memorandum, August 15, 1957.

Courtright, W. C. 1980. "Contamination Survey, TA-16-517," Los Alamos Scientific Laboratory document, November 12, 1980.

Employee Interviews. 1986. Conducted in 1985-86 for Phase 1 of CEARP at Los Alamos National Laboratory; notes in the CEARP files at LANL.

H Division. 1954. Progress Report, Los Alamos Scientific Laboratory, August 20-September 20, 1954, p. 5.

H Division. 1957. Progress Report, Los Alamos Scientific Laboratory, December 20, 1951-January 20, 1952, p. 10.

LASL. 1978. Nuclear Facility Summary.

Popham, R. A., and Major J. O. Ackerman. 1945. "Explosives Requirements and Status," Los Alamos Scientific Laboratory memorandum, August 2, 1945.

Torres, A. P., and J. F. Baytos. 1986. "Water Contaminants in the S-Site Retaining Pond TA-16," Los Alamos National Laboratory document, May 14, 1986.

TABLE TA-16 - POTENTIAL CERCLA/RCRA SITES

TA16-1-CA-I-HW (Razed buildings)

Background--TA-16 was constructed early in 1944 and consisted of six buildings, including a steam plant. Several expansions took place, and by the end of the war, the site included about 80 buildings of various sizes that were used for explosives manufacture, storage, treatment, and testing (LASL 1947).

Though the primary mission of TA-16 did not change, many structures built during World War II became obsolete. Therefore, these structures were removed by burning during the 1950s and 1960s. The structures that were removed are listed as follows by structure number, name, removal date, and hazardous substance used (Blackwell 1983). Noncombustible materials were disposed of at Mesita del Buey or in the canyon north of the burning ground.

Structure Number	Structure Nomenclature	Removal Date	Hazardous Substance Used
TA-16-1	Admin. building	1956	None
TA-16-2	Office	1956	None
TA-16-3	Zia elect. building	1956	None
TA-16-4	Inflam. stock storage	1956	Various chemicals
TA-16-5	Instrument shop	1956	None
TA-16-6	Zia repair shop	1956	None
TA-16-8	Zia cabinet shop	1956	None
TA-16-9	Motor pool dispatch off.	1956	None
TA-16-11	Storage	1956	None
TA-16-12	Warehouse	1956	None
TA-16-15	Laundry and locker room	1956	High explosive
TA-16-17	Plumbing shop	1956	High explosive
TA-16-18	Steam washing house	1960	High explosive
TA-16-19	Pump house	1956	High explosive
TA-16-20	Water pump pit	1953	High explosive
TA-16-22	Office	1961	None
TA-16-23	Storage	1951	None
TA-16-24	Analytical lab.	1968	High explosive
TA-16-25	Process building	1960	High explosive
TA-16-26	Process building	1968	High explosive
TA-16-28	Water cooling tower	1968	None
TA-16-29	Fuel oil tank	1956	None
TA-16-30	Magasine	1960	High explosive
TA-16-31	Machine building	1960	High explosive
TA-16-32	Machine Building	1960	High explosive
TA-16-33	Machine Building	1960	High explosive
TA-16-34	Magasine	1960	High explosive
TA-16-35	Equipment room	1960	High explosive
TA-16-36	Steam cleaning	1960	High explosive
TA-16-37	Explosive testing	1960	High explosive
TA-16-38	Experimental casting	1960	High explosive

TA-16-39	Radiographic building	1960	Uranium-238, cobalt-60, radium-226
TA-16-40	Radiographic building	1960	Uranium-238, cobalt-60, radium-226
TA-16-41	Process lab.	1960	High explosive
TA-16-42	Process building	1960	High explosive
TA-16-43	Process building	1960	High explosive
TA-16-44	Process building	1960	High explosive
TA-16-45	Process building	1960	High explosive
TA-16-46	Process building	1960	Uranium-238, high explosive
TA-16-47	Equipment building	1960	High explosive
TA-16-48	Smoking room	1960	Uranium-238
TA-16-49	Analytical lab.	1960	High explosive
TA-16-50	Experimental casting	1960	High explosive
TA-16-51	Steam cleaning	1960	High explosive
TA-16-52	Explosive material	1960	High explosive
TA-16-53	Optical equip. storage	1960	High explosive
TA-16-55	Grinding building	1960	High explosive
TA-16-56	Testing lab.	1960	High explosive
TA-16-57	Magasine	1960	High explosive
TA-16-60	Magasine	1950	High explosive
TA-16-62	Magasine	1968	High explosive
TA-16-64	Magasine	1951	High explosive
TA-16-65	Magasine	1951	High explosive
TA-16-66	Magasine	1960	High explosive
TA-16-67	Magasine	1960	High explosive
TA-16-68	Magasine	1960	High explosive
TA-16-69	Magasine	1960	High explosive
TA-16-70	Magasine	1960	High explosive
TA-16-71	Magasine	1960	High explosive
TA-16-72	Magasine	1960	High explosive
TA-16-74	Magasine	1960	High explosive
TA-16-81	Process building & fan room	1960	High explosive
TA-16-82	Storage	1968	High explosive
TA-16-83	Laboratory	1960	High explosive
TA-16-84	Magasine	1960	High explosive
TA-16-85	Warehouse	1947	None
TA-16-86	Laboratory	1960	High explosive
TA-16-87	Machine shop trailer	1960	None
TA-16-94	Equipment & control	1960	High explosive
TA-16-95	Machine building	1960	High explosive
TA-16-96	Machine building	1960	High explosive
TA-16-97	Machine building	1960	High explosive
TA-16-98	Machine building	1960	High explosive
TA-16-100	Process building	1960	High explosive
TA-16-106	Storage	1949	High explosive
TA-16-107	Storage	1950	High explosive
TA-16-108	Storage	1950	High explosive

TA-16-109	Storage	1950	High explosive
TA-16-132	Paint shop shed	1955	None
TA-16-133	Lumber storage	1955	None
TA-16-134	Mess hall	1955	None
TA-16-135	Storage building	1953	None
TA-16-136	Implement shed	1955	None
TA-16-137	Plumbing & elect. shop	1955	High explosive
TA-16-138	Blacksmith shop	1955	None
TA-16-139	Storage building	1955	High explosive
TA-16-140	Storage building	1955	High explosive
TA-16-141	Storage building	1955	High explosive
TA-16-142	Fire house	1955	None
TA-16-143	Hose house	1955	None
TA-16-144	Equipment room	1955	None
TA-16-145	Latrine	1955	None
TA-16-146	Storage	1955	High explosive
TA-16-148	Equip. building	1968	None
TA-16-150	Hose house	1958	None
TA-16-151	Hose house	1958	None
TA-16-152	Hose house	1958	None
TA-16-161	Septic tank	--	None
TA-16-162	Latrine	1971	None
TA-16-167	Hose house	1958	None
TA-16-168	Manhole	1952	None
TA-16-172	Water storage tank relocated at TA-49-66	--	None
TA-16-174	Septic tank, sanitary	--	None
TA-16-176	Septic tank, sanitary	--	None
TA-16-177	Septic tank, sanitary	1968	None
TA-16-179	Septic tank, sanitary	--	None
TA-16-181	Tank housing	1956	None
TA-16-182	Diesel unit building	1956	None
TA-16-183	Drum storage	1968	Various chemicals
TA-16-184	Drum storage	--	Various chemicals
TA-16-185	Drum storage	--	Various chemicals
TA-16-186	Drum storage	--	Various chemicals
TA-16-187	Drum storage	--	Various chemicals
TA-16-188	Drum storage	1956	Various chemicals
TA-16-189	Cooling tower	1960	None
TA-16-190	Drum storage	1955	Various chemicals
TA-16-198	Hose house	--	None
TA-16-199	Reserve	--	None
TA-16-262	Cooling tower	1957	None
TA-16-272	Septic tank	--	None
TA-16-273	Dosing chamber	--	High explosive
TA-16-274	Distribution box	--	None
TA-16-384	Reserve	1970	None
TA-16-393	Filter bed	1964	High explosive
TA-16-396	Latrine	1968	None
TA-16-403	Reserve	1968	None
TA-16-464	Magazine	1966	High explosive
TA-16-475	Office & shop building	1951	None

TA-16-479	Storage building	1951	Uranium-238
TA-16-480	Experimental chamber	1950	Uranium-238, high explosive
TA-16-481	Magasine	1951	high explosive
TA-16-482	Storage building	1951	None
TA-16-486	Septic tank	1951	None
TA-16-487	Transformer station	1951	None
TA-16-488	Magasine	1951	high explosive
TA-16-490	Laboratory building	1960	Uranium-238
TA-16-491	Hutment	1960	Uranium-238
TA-16-492	Hutment	1960	Uranium-238
TA-16-493	Magasine	1960	High explosive
TA-16-494	Magasine	1960	High explosive
TA-16-495	Hutment	1960	Uranium-238
TA-16-496	Hutment	1960	Uranium-238
TA-16-497	Magasine	1960	High explosive
TA-16-498	Hutment	1960	Uranium-238
TA-16-499	Hutment	1960	Uranium-238
TA-16-500	Hutment	1960	Uranium-238
TA-16-502	Steam plant	1960	None
TA-16-504	Septic tank, sanitary	1960	None
TA-16-506	Manhole, steam	1968	None
TA-16-507	Sump pit, chem.	1960	Various chemicals
TA-16-508	Manhole, water	1968	None
TA-16-509	Manhole, steam	1968	None
TA-16-510	Switch box	1960	None
TA-16-511	Manhole, steam	1968	None
TA-16-512	Underground tank, oil	1968	None
TA-16-521	Tank stand	1968	None
TA-16-522	Building No. 3	1945	Beryllium
TA-16-523	Pit	1945	High explosive, beryllium
TA-16-524	Pit, elect.	1945	None
TA-16-566	Transformer station	1959	None
TA-16-567	Transformer station	1966	None
TA-16-574	Transformer station	1966	None
TA-16-575	Transformer station	1966	None
TA-16-576	Transformer station relocated to TA-15-206	--	None
TA-16-577	Transformer station	1960	None
TA-16-578	Transformer station	1960	None
TA-16-579	Transformer station	1960	None
TA-16-580	Transformer station	1966	None
TA-16-581	Transformer station	1966	None
TA-16-582	Transformer station	1960	None
TA-16-583	Transformer station	1960	None
TA-16-584	Transformer station	1966	None
TA-16-800	Manhole, industrial waste	--	High explosive
TA-16-801	Manhole, drainage	--	High explosive
TA-16-888	Manhole, elect.	1972	None
TA-16-889	Manhole, elect.	1972	None
TA-16-1079	Manhole, steam	--	None

TA-16-1083	Manhole, steam	1951	None
TA-16-1084	Manhole, steam	--	None
TA-16-1086	Reserve	1970	None
TA-16-1087	Reserve	1970	None
TA-16-1090	Reserve	1970	None
TA-16-1101	Oil switch	1966	None
TA-16-1102	Oil switch	1966	None
TA-16-1103	Oil switch	1966	None
TA-16-1104	Drum storage	--	Various chemicals
TA-16-1105	Drum storage	--	Various chemicals
TA-16-1106	Drum storage	--	Various chemicals
TA-16-1107	Drum storage	--	Various chemicals
TA-16-1108	Drum storage	--	Various chemicals
TA-16-1109	Drum storage	1956	Various chemicals
TA-16-1110	Drum storage	1958	Various chemicals
TA-16-1111	Drum storage	1968	Various chemicals
TA-16-1130	Water tank	1949	None
TA-16-1131	Water tank	1949	None
TA-16-1132	Septic tank	1956	None
TA-16-1136	Trough (basket washing facility)	--	High explosive
TA-16-1137	Manhole (grease trap)	--	High explosive
TA-16-1138	Fuel tank	--	None
TA-16-1139	Fuel tank	--	None
TA-16-1140	Fuel tank	1956	None

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--The extent of residual environmental contamination will be determined during supplemental Phase I.

TA16-2-S-A/I-HW (Sumps)

Background--For many years it has been the practice at TA-16 to route any industrial process water containing particles of high explosive through high-explosive catchment baffle-filter/sumps before discharge. The baffle-filters or settling areas have, apparently, been regularly cleaned of high explosive ever since the sumps were put in use. There may be inactive high-explosive sumps remaining in buildings not in active use or in buildings that were torn down.

The 1987 CEARP field survey observed that blowdown from the steam plant TA-16-540 is being routed through a blowdown tank, TA-16-456, and then through two manholes/sumps before being discharged. These manholes/sumps appear to have a slight amount of sludge at the bottom.

A chemical sump at TA-16-507 was located at S25, W55 (ENG-R132). It was removed in 1960 (Blackwell 1983). Whether any chemicals leaked from the sump into the environment and whether any contaminated soil was removed at the time of pit removal is not known.

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--Residual environmental contamination associated with the inactive sump systems will be investigated during supplemental Phase I. The active sump systems are covered by routine LANL operations.

TA16-3-SI-A/I-HW (Ponds)

Background--In considering ponds that may have contained high explosive, ENG-R134 indicates four ponds to the northeast of TA-16-30, 31, 32, 33, and 34. The 1940s aerial photo shows that these ponds are full of liquid. Engineering drawings ENG-R861, R869, and R870 indicate that drains from explosives machining buildings 31, 32, and 33 drained into the ponds. A Laboratory employee who supervised the removal of the pond areas remembers that the ponds were contaminated with high explosives. The high explosives were removed before the ponds were filled and the area graded. It appears that barium levels may not have been determined at the time of decommissioning.

In 1970 it was reported that the floor drains in buildings TA-16-89 through -93 emptied into a small earth tank/pond west of the buildings. A sample of water collected contained no detectable gross alpha emitters and only a trace of gross beta emitters (Kennedy 1970). The radionuclides responsible for the beta count are not mentioned. This pond is no longer here, but data on its decommissioning have not yet been obtained.

An inactive pond received liquid waste from process buildings TA-16-91, -90, and -89. Sludge from the pond was recently sampled, and no high levels of high explosive were found. Chemicals associated with plating wastes were not included in the analysis.

A Los Alamos employee remembers TA-93 being used for electroplating. A 1950 document also mentions electroplating (H Division 1950). ENG-R861 shows drains from 92 and 93 draining to the north. Whether there was a pond here to collect plating wastes is not known. The employee remembers that a drainage ditch from 92 or 93 may have connected to the inactive pond, which received waste from TA-16-91, -90, and -89.

An active lined pond located at the burn site just south of the filter beds receives liquid from the two filtration beds. This liquid contains barium nitrate. To reduce the barium nitrate level, sodium sulfate is added to the pond to precipitate barium in barium sulfate. When barium nitrate levels have been reduced to less than 100 ppm, the liquid is siphoned to the canyon outfall (Baytos 1986).

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--Residual environmental contamination associated with the inactive ponds will be investigated during supplemental Phase I. The active pond is covered by routine LANL operations.

TA16-4-CA-A/I-HW/RW (Filter/drying beds and burn areas)

Background--The 1948 topographical map and ENG-R134 indicate a burn area at S25:50, W62:50. The 1987 CEARP field survey noted that the area is not in use. Decommissioning information is lacking as well as specific information as to what was burned here.

An old burning ground is reported to have been near building TA-16-260 (Engineering Division 1965). An employee indicated that this burning ground was the one used before the present

burning ground was developed. A 1948 topographical map indicates two burning pits. A 1948 memo mentions an explosion at the burning ground and the fact that high-explosive scrap was collected, broken up, and burned (Converse 1948). This area is included in Material Disposal Area R.

A former detonator burning area is indicated as being located in Material Disposal Area P (Engineering Division 1965).

The burning area was moved from the Area R site to the present burning ground. By 1953 there were three burning pits that were used rotationally for burning high explosive in 2000-lb batches. The existence of a high-explosive filter basket washing facility at a "bag wash building" is also reported. The sludge went via troughs to sand bed filters where, after drying, the sludge was burned. About 400 lb of explosive per day were burned in this manner. The sand bed was raked, and this material was then reburned at the scrap high-explosive burning pit. Engineering drawing ENG-R135, dated 1957, notes structures TA-16-386, -387, and -388 as burning slabs and TA-16-399 as a retired burning slab. Another 1950s document states that during the cleanup, large quantities of barium oxide dust were present at the burning pits, so the areas were wetted down and respirators were used (H Division 1952).

The operation of the basket wash facility apparently continued into the 1970s. A memo notes that building TA-16-390 floor drains empty through structure numbers TA-16-1129, TA-16-1134, and TA-16-1135 (troughs) into a burning vat (Kennedy 1970).

The 1987 CEARP field survey confirmed that area TA-16-386 (former burning slab) is being used as a storage yard. Area TA-16-387 (burning slab) is being used as a flash pad for items contaminated with high explosive that must be disposed of.

Areas TA-16-399 and -388 have their old pads in place. A long tray with fire-brick lining has been erected over each pad. These trays are used for burning the waste high explosive.

Structure area TA-16-394 is now used to burn high-explosive contaminated solvents and is no longer connected to the filter wash. Filter bed TA-16-393 has been removed. Decommissioning information has not been found. Two new filter/drying beds have been constructed in this location. Filter bed TA-16-392, which was also used later as a pad for burning uranium-contaminated objects remains in place, but is not in use. Barium contamination in soils around the old filter wash/filter bed area would be expected; however, no documentation on barium levels in soils was found.

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--The extent of residual environmental contamination associated with inactive facilities will be determined during supplemental Phase I of CEARP. The active facilities are covered by routine LANL operations.

TA16-5-O/CA-A/I-HW/RW (Outfalls)

Background--For over 20 years an x-ray film processing laboratory has been in operation at TA-16-222. Beginning about 1978-1979, waste liquids from the laboratory were treated for silver recovery before being discharged into the nearby canyon outfall (073). Before that time, these liquids were discharged without silver recovery and it has been indicated that the canyon into

which these wastes were discharged is the most heavily silver-contaminated area in the laboratory (Ferenbaugh 1979; Kasunic 1982).

During the war, building 45 had a film processing facility. This operation probably discharged to an outfall (Wilder n.d.).

According to ENG-R132, several cooling towers were in operation at TA-16. These may have had blowdown containing chromium that discharged to an outfall. Data on these are given below:

Number	Location	Status
TA-16-28	S35, W50	removed 1968
TA-16-189	S40, W55	removed 1960
TA-16-262	S20, W35	removed 1957
TA-16-372	S65, W20	in place

After going through settling sumps for high-explosive wastes, industrial liquids may discharge to outfalls. Through the years, beginning in 1960, samples of soil have been taken and analyzed for high explosive in outfall ditches. The sampling points have included outfall areas from 260, 301, 303, 305, 307, 340, 300, 380, 400, 430, and 478. One major area of concern appears to be the 260 outfall drainage, where, in a natural pond about 35 yds from the outfall, total explosive content has slowly been increasing, and in July 1986, was measured as 31.4 per cent by weight high explosive. Another area of concern is the 478 outfall, where total explosive content was 4.3 per cent by weight in July 1986. Small quantities of high explosive have also been found in other outfalls.

Elevated acetone solubles and carbon tetrachloride solubles have been found in the 300 line common effluent outlet. These contaminants probably came from the plastics and solvents that were used in TA-16-306, and -304. The effluent outlet from building 430 has also shown elevated levels of acetone solubles and carbon tetrachloride solubles (Baytos 1985, 1986).

In the early 1970s sampling, Group GMX-3 at the TA-16 outfall drainages found no boron in any of the samples. Barium was found to travel farther than any of the other high-explosive components. Maximum water concentrations were 22 and 30 ppm near two outfalls, and barium was still detectable in a water sample collected about 2 miles away after a heavy rainstorm (LASL 1972).

CERCLA Finding--Uncertain for FFSDIF, PA and PSI.

Planned Future Action--The inactive outfall areas and the active outfall areas that could have received discharge of hazardous materials in the past will be evaluated during supplemental Phase I of CEARP. The active outfalls are covered by routine LANL operations.

TA16-6-IN-A-HW (Incinerator)

Background--For a number of years, possibly high-explosive-contaminated burnables such as paper wipes and rags have been burned in a cage type incinerator, TA-16-412. The incinerator is a large open mesh structure built over what appears to be an old basement foundation.

CERCLA Finding--Negative for FFSDIF, PA, and PSI.

Planned Future Action--No further action is warranted under CEARP. The active incinerator is covered by routine LANL operations.

TA16-7-CA-I-HW (Dry wells)

Background--Several dry wells were constructed at TA-16 to accept such liquid discharges as cooling tower blowdown from the steam plant and wastewater from high-explosive operations at the 300 complex. A dry well was constructed for liquid discharges from the 300 line (plastic and high explosive), but it was found that the well did not have sufficient capacity to handle the volume discharged (CEARP n.d.). The 1987 CEARP field survey found that the well is still in place; however, a bypass pipe has been installed and liquid is discharging to the ditch next to the dry well. A LANL employee has also indicated that two dry wells were constructed just north of TA-16-540 (steam plant) near TA-16-547, -542, and just outside the steam plant fence. They are apparently no longer in use. Another employee remembers the construction of a dry well to the east of TA-16-540. Additionally, engineering drawing ENG-R867, dated 1959, shows a 3-ft by 5-ft dry well located to the east of TA-16-208.

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--The quantity and types of residual hazardous substances associated with the inactive dry wells will be determined during supplemental Phase I.

TA16-8-ST/UST-A/I-HW/RW (Septic tanks and waste tanks)

Background--Several of the septic tanks at TA-16 are potentially contaminated with hazardous substances (ENG-R133; ENG-R5111; Miller 1972; Blackwell 1983).

Tank Designation	Location	Status	Potential Contamination
TA-16-175	S30, W60	active	chemicals
TA-16-371	S65, W20	active	chemicals
TA-16-527	S40, W45	inactive	high explosive

ENG-R870 notes an unnumbered septic tank south of TA-16-515. Whether it remains in place today and whether it is contaminated are unknown. Additionally, engineering drawing ENG-R876 notes a type of tank serving a drain at TA-16-55, two tanks serving drains at TA-16-53, one tank from a drain at TA-38, and one tank each from TA-42, -43, -44, and -45. ENG-R877 notes two tanks from TA-16-37 drains. ENG-R882 indicates 3 tanks from TA-16-52 drains, two tanks serving TA-16-50 drains, and at least one tank for TA-16-49 drains. What wastes were in these drains and what the function of these subsurface tanks was is not known. These buildings were process laboratories and grinding, casting, and testing buildings.

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--During supplemental Phase I, the extent of residual environmental contamination associated with the inactive septic systems will be determined. The active septic systems are covered by routine LANL operations.

TA16-9-UST/SST-A/I-PP (Petroleum storage tanks)

Background--The following abandoned/removed tanks, which could have been located underground or above ground, were identified at TA-16.

Tank Designation		Location	Status	Type
TA-16-	391	S20, W0	abandoned 1970	fuel
	29[a]	NA	removed 1956	fuel oil
	512	S25, W60	found free activity, removed 1968	oil
	1138[a]	S25, W35	removed	fuel
	1139[a]	S25, W35	removed	fuel
	1140[a]	NA	removed 1956	fuel
	541[a]	S30, W70	maybe removed	probably fuel
	1341	north, building 195 (service station)	removed 1980	fuel, 5000 gal.
	1342	north, building 195 (service station)	removed 1980	fuel, 5000 gal.

[a]may have been aboveground

In addition to these tanks, there are two underground gasoline tanks with associated fuel lines and pump bases located northwest of TA-16-10, which would put them near S35, W60. These had no structure numbers. There is also an underground gasoline tank six feet south of TA-16-200, near S40, W75 (Buckland 1967).

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--During supplemental Phase I, the extent of residual environmental contamination associated with the inactive storage tanks will be determined. The active tanks are covered by routine LANL operations.

TA16-10-L-I-HW (Landfill)

Background--In 1965 it was reported that some type of metal material was thought to be buried in the old exclusion area of TA-16. A survey with a magnetometer indicated a suspect area at S43, W51. The area was excavated and the metal material was located and disposed of at Area P. Whether any other items were buried in this region and were not detected and removed is not known (Engineering Division 1965; Williams 1965). Unburned material from the burning ground and items from TA-16 and other locations were also disposed of in Area P. More information on Area P is included under Material Disposal Areas.

The 1987 CEARP field survey encountered an area that contains broken concrete and other debris in an area east of West Jemez Road and northwest of building TA-16-540. An old, illegible sign is located in front of the debris. Another sign indicates clean fill--whether the clean fill refers to this area or another area is not clear.

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--The inactive landfills will be investigated during supplemental Phase I.

TA16-11-CA-A-HW/RW (Storage areas)

Background--A 1987 CEARP field survey noted old drums around buildings TA-16-518, -519, and -520 (the old V Site buildings now part of TA-16). A few are leaking. Some drums are marked "used solvent," some appear to contain hydraulic fluid, and some are not marked. Empty boxes and cans that contained radioactive material are sitting in the area. One open drum of barium nitrate, as well as several other drums that appear to contain barium nitrate, were observed. What appear to be empty lithium hydride drums were also noted.

CERCLA Finding--Negative for FFSDIF, PA, and PSI.

Planned Future Action--No further action is warranted under CEARP. The active storage areas are covered by routine LANL operations.

TA16-12-CA-I-HW (World War II high-explosive complex)

Background--About 30 buildings in the central portion of TA-16 were part of the World War II high-explosive operations. Most of these buildings are in poor repair and many have been abandoned. Several of the more structurally sound buildings are currently being used as storage facilities. Many are contaminated with high explosive (primarily TNT) and are not considered safe for any activity. Several of the buildings actually contain recrystallized high explosive in stalactitic formations under the floors. A real potential exists for detonation of this explosive as the buildings continue to deteriorate and collapse in on themselves. Stabilization of these structures is not practical because any mechanical perturbation of these structures would endanger the workers. The buildings also have shingles containing asbestos.

CERCLA Finding--Uncertain for FFSDIF, PA, and PSI.

Planned Future Action--The extent of residual environmental contamination will be determined during supplemental Phase I.

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-1	16-1		REMOVED 1960	
TA-16-2	16-2		REMOVED 1960	
TA-16-3	16-3		REMOVED 1960	
TA-16-4	16-4		REMOVED 1960	
TA-16-5	16-5		REMOVED 1960	
TA-16-6	16-6		REMOVED 1960	
TA-16-7	16-7	STORAGE BUILDING		335+00 W65+00
TA-16-8	16-8		REMOVED 1960	
TA-16-9	16-9		REMOVED 1960	
TA-16-10	16-10	WAREHOUSE		335+00 W60+00
TA-16-11	16-11		REMOVED 1960	
TA-16-12	16-12		REMOVED 1960	
TA-16-13	16-13	DOCK	[illegible] S-107	335+00 W60+00
TA-16-14	16-14		REMOVED 1960	
TA-16-15	16-15		REMOVED 1960	
TA-16-16	16-16	CAFETERIA	FORMERLY S-15	335+00 W65+00
TA-16-17	16-17		REMOVED 1966	
TA-16-18	16-18		REMOVED 1960	
TA-16-19	16-19		REMOVED 1966	
TA-16-20	16-20		REMOVED 1983	
TA-16-21	16-21	PUMPING STATION	FORMERLY S-17 A	335+00 W65+00
TA-16-22	16-22		REMOVED 1961	
TA-16-23	16-23		REMOVED 1961	
TA-16-24	16-24		REMOVED 1960	
TA-16-25	16-25		REMOVED 1966	
TA-16-26	16-26		REMOVED 1966	
TA-16-27	16-27	STORAGE BUILDING	ABANDONED 1970	335+00 W50+00
TA-16-28	16-28		REMOVED 1966	
TA-16-29	16-29		REMOVED 1956	
TA-16-30	16-30		REMOVED 1960	
TA-16-31	16-31		REMOVED 1960	
TA-16-32	16-32		REMOVED 1960	
TA-16-33	16-33		REMOVED 1960	
TA-16-34	16-34		REMOVED 1960	
TA-16-35	16-35		REMOVED 1960	
TA-16-36	16-36		REMOVED 1960	
TA-16-37	16-37		REMOVED 1960	
TA-16-38	16-38		REMOVED 1960	
TA-16-39	16-39		REMOVED 1960	
TA-16-40	16-40		REMOVED 1960	
TA-16-41	16-41		REMOVED 1960	
TA-16-42	16-42		REMOVED 1960	
TA-16-43	16-43		REMOVED 1960	
TA-16-44	16-44		REMOVED 1960	
TA-16-45	16-45		REMOVED 1960	
TA-16-46	16-46		REMOVED 1960	
TA-16-47	16-47		REMOVED 1960	
TA-16-48	16-48		REMOVED 1960	
TA-16-49	16-49		REMOVED 1960	
TA-16-50	16-50		REMOVED 1960	
TA-16-51	16-51		REMOVED 1960	
TA-16-52	16-52		REMOVED 1960	
TA-16-53	16-53		REMOVED 1960	
TA-16-54	16-54	[illegible] BUILDING	FORMERLY S-46	330+00 W50+00
TA-16-55	16-55		REMOVED 1960	
TA-16-56	16-56		REMOVED 1960	
TA-16-57	16-57		REMOVED 1960	
TA-16-58	16-58	MAGAZINE	FORMERLY S-57	340+00 W40+00
TA-16-59	16-59	MAGAZINE	FORMERLY S-56	335+00 W45+00
TA-16-60	16-60		REMOVED 1960	
TA-16-61	16-61	MAGAZINE	FORMERLY S-60	340+00 W45+00
TA-16-62	16-62		REMOVED 1960	
TA-16-63	16-63	STORAGE BUILDING	ABANDONED 1981	335+00 W70+00
TA-16-64	16-64		REMOVED 1981	
TA-16-65	16-65		REMOVED 1981	
TA-16-66	16-66		REMOVED 1960	
TA-16-67	16-67		REMOVED 1960	
TA-16-68	16-68		REMOVED 1960	
TA-16-69	16-69		REMOVED 1960	
TA-16-70	16-70		REMOVED 1960	
TA-16-71	16-71		REMOVED 1960	
TA-16-72	16-72		REMOVED 1960	
TA-16-73	16-73	PERSONNEL SHELTER	FORMERLY S-77	335+00 W50+00
TA-16-74	16-74		REMOVED 1960	
TA-16-75	16-75	PERSONNEL SHELTER	FORMERLY S-80	330+00 W50+00
TA-16-76	16-76	PERSONNEL SHELTER	FORMERLY S-81	335+00 W55+00
TA-16-77	16-77	PERSONNEL SHELTER	FORMERLY S-82	340+00 W55+00
TA-16-78	16-78	PERSONNEL SHELTER	FORMERLY S-83	335+00 W50+00
TA-16-79	16-79	PERSONNEL SHELTER	FORMERLY S-84	335+00 W50+00
TA-16-80	16-80	STORAGE BUILDING	FORMERLY S-85	330+00 W50+00
TA-16-81	16-81		REMOVED 1960	
TA-16-82	16-82		REMOVED 1958	
TA-16-83	16-83		REMOVED 1960	
TA-16-84	16-84		REMOVED 1960	
TA-16-85	16-85		REMOVED 1947	
TA-16-86	16-86		REMOVED 1960	
TA-16-87	16-87		REMOVED	
TA-16-88	16-88	CASTING REST HOUSE	FORMERLY S-100	330+00 W50+00
TA-16-89	16-89	PROCESS BUILDING	FORMERLY S-104	330+00 W45+00
TA-16-90	16-90	PROCESS BUILDING	FORMERLY S-103	330+00 W45+00
TA-16-91	16-91	PROCESS BUILDING	FORMERLY S-105	325+00 W50+00
TA-16-92	16-92	INSPECTION BUILDING	FORMERLY S-101	325+00 W50+00
TA-16-93	16-93	PROCESS BUILDING	ABANDONED 1970	325+00 W50+00
TA-16-94	16-94		REMOVED 1960	
TA-16-95	16-95		REMOVED 1960	
TA-16-96	16-96		REMOVED 1960	
TA-16-97	16-97		REMOVED 1960	

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-98	16-98		REMOVED 1960	
TA-16-99	16-99	STORAGE BUILDING	FORMERLY S-107	330+00 W55+00
TA-16-100	16-100		REMOVED 1960	
TA-16-101	16-101	GUARD HOUSE		300+00 W35+00
TA-16-102	16-102		REMOVED 1960	
TA-16-103	16-103		REMOVED 1966	
TA-16-104	16-104		REMOVED 1960	
TA-16-105	16-105		REMOVED 1960	
TA-16-106	16-106		REMOVED 1949	
TA-16-107	16-107		REMOVED 1960	
TA-16-108	16-108		REMOVED 1960	
TA-16-109	16-109		REMOVED 1960	
TA-16-110	16-110		REMOVED 1960	
TA-16-111	16-111	BARRICADE	ABANDONED 1959	330+00 W50+00
TA-16-112	16-112	BARRICADE	ABANDONED 1959	330+00 W50+00
TA-16-113	16-113		REMOVED 1960	
TA-16-114	16-114		REMOVED 1960	
TA-16-115	16-115		REMOVED 1960	
TA-16-116	16-116		REMOVED 1960	
TA-16-117	16-117		REMOVED 1961	
TA-16-118	16-118		REMOVED 1960	
TA-16-119	16-119		REMOVED 1949	
TA-16-120	16-120		REMOVED 1960	
TA-16-121	16-121		REMOVED 1966	
TA-16-122	16-122		REMOVED 1962	
TA-16-123	16-123		REMOVED 1955	
TA-16-124	16-124		REMOVED 1949	
TA-16-125	16-125		REMOVED 1960	
TA-16-126	16-126		REMOVED 1960	
TA-16-127	16-127		REMOVED 1960	
TA-16-128	16-128		REMOVED 1960	
TA-16-129	16-129		REMOVED 1960	
TA-16-130	16-130		REMOVED 1960	
TA-16-131	16-131		REMOVED 1960	
TA-16-132	16-132		REMOVED 1958	
TA-16-133	16-133		REMOVED 1958	
TA-16-134	16-134		REMOVED 1954	
TA-16-135	16-135		REMOVED 1953	
TA-16-136	16-136		REMOVED 1956	
TA-16-137	16-137		REMOVED 1960	
TA-16-138	16-138		REMOVED 1958	
TA-16-139	16-139		REMOVED 1954	
TA-16-140	16-140		REMOVED 1956	
TA-16-141	16-141		REMOVED 1953	
TA-16-142	16-142		REMOVED 1958	
TA-16-143	16-143		REMOVED 1958	
TA-16-144	16-144		REMOVED 1960	
TA-16-145	16-145		REMOVED 1960	
TA-16-146	16-146		REMOVED 1958	
TA-16-147	16-147		REMOVED 1954	
TA-16-148	16-148		REMOVED 1960	
TA-16-149	16-149		REMOVED 1950	
TA-16-150	16-150		REMOVED 1956	
TA-16-151	16-151		REMOVED 1950	
TA-16-152	16-152		REMOVED 1950	
TA-16-153	16-153	BARRICADE		330+00 W45+00
TA-16-154	16-154	BARRICADE		330+00 W45+00
TA-16-155	16-155	BARRICADE		325+00 W50+00
TA-16-156	16-156	BARRICADE		325+00 W50+00
TA-16-157	16-157	BARRICADE		325+00 W50+00
TA-16-158	16-158		REMOVED	
TA-16-159	16-159		REMOVED	
TA-16-160	16-160		REMOVED 1966	
TA-16-161	16-161		REMOVED	
TA-16-162	16-162		REMOVED 1971	
TA-16-163	16-163	BARRICADE	ABANDONED 1972	325+00 W45+00
TA-16-164	16-164	STORAGE BUILDING		330+00 W55+00
TA-16-165	16-165		REMOVED 1960	
TA-16-166	16-166		REMOVED 1960	
TA-16-167	16-167		REMOVED 1950	
TA-16-168	16-168		REMOVED 1952	
TA-16-169	16-169	TANK	WATER	325+00 W75+00
TA-16-170	16-170	TANK	WATER	325+00 W75+00
TA-16-171	16-171	TANK	WATER	330+00 W75+00
TA-16-172	16-172	TANK, WATER	RELOCATED TO TA-[illegible]	
TA-16-173	16-173	TANK, SEPTIC	ABANDONED 1971	335+00 W40+00
TA-16-174	16-174		REMOVED	
TA-16-175	16-175	TANK	SEPTIC	330+00 W60+00
TA-16-176	16-176		REMOVED	
TA-16-177	16-177		REMOVED 1960	
TA-16-178	16-178	TANK	SEPTIC	315+00 W55+00
TA-16-179	16-179		REMOVED	
TA-16-180	16-180	FIRE STATION NO. 3		330+00 W70+00
TA-16-181	16-181		REMOVED 1960	
TA-16-182	16-182		REMOVED 1958	
TA-16-183	16-183		REMOVED 1958	
TA-16-184	16-184		REMOVED	
TA-16-185	16-185		REMOVED	
TA-16-186	16-186		REMOVED	
TA-16-187	16-187		REMOVED	
TA-16-188	16-188		REMOVED 1960	
TA-16-189	16-189		REMOVED 1960	
TA-16-190	16-190		REMOVED 1958	
TA-16-191	16-191	STORAGE BUILDING		325+00 W50+00
TA-16-192	16-192	GUARD HOUSE		335+00 W75+00
TA-16-193	16-193	CHANGE HOUSE		340+00 W70+00
TA-16-194	16-194	JIB CRANE		340+20 W70+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-195	16-195	SERVICE STATION		340+00 W70+00
TA-16-196	16-196	TANK	FUEL, UNDERGROUND	340+00 W70+00
TA-16-197	16-197	TANK	FUEL, UNDERGROUND	340+00 W70+00
TA-16-198	16-198		REMOVED	
TA-16-199	16-199		REMOVED	
TA-16-200	16-200	ADMINISTRATION BUILDING		340+00 W75+00
TA-16-201	16-201	PROTECTIVE FORCE STA. NO. 560		335+00 W75+00
TA-16-202	16-202	SHOPS BUILDING		345+00 W70+00
TA-16-203	16-203	LUMBER STORAGE		345+00 W70+00
TA-16-204	16-204	PROGRAM SUPPORT FACILITY		340+00 W75+00
TA-16-205	16-205	TRITIUM PROCESSING FACILITY		360+00 W70+00
TA-16-206	16-206	PAINT & BOTTLE STORAGE		340+00 W70+00
TA-16-207	16-207	WAREHOUSE		340+00 W70+00
TA-16-208	16-208	STORAGE BUILDING		340+00 W70+00
TA-16-209	16-209	SAFETY OFFICE		345+00 W70+00
TA-16-210	16-210	GUARD HOUSE		315+00 W35+00
TA-16-211	16-211			
TA-16-212	16-212			
TA-16-213	16-213	MANHOLE, WATER	NOT SHOWN	
TA-16-214	16-214	EXHAUST STACK	NOT SHOWN	
TA-16-215	16-215	TANK, INDUSTRIAL WASTE	NOT SHOWN	
TA-16-216	16-216	TANK, FUEL	NOT SHOWN	
TA-16-217	16-217	MANHOLE, SANITARY	NOT SHOWN	
TA-16-218	16-218		UNASSIGNED	
TA-16-219	16-219		UNASSIGNED	
TA-16-220	16-220	X-RAY BUILDING	CONST. NO. 131-1	320+00 W50+00
TA-16-221	16-221	REST HOUSE	CONST. NO. 131-A	315+00 W55+00
TA-16-222	16-222	DARK ROOM BUILDING	CONST. NO. 131-2	315+00 W50+00
TA-16-223	16-223	REST HOUSE	CONST. NO. 131-B	315+00 W50+00
TA-16-224	16-224	X-RAY BUILDING	CONST. NO. 131-4	320+00 W50+00
TA-16-225	16-225	REST HOUSE	CONST. NO. 131-C	320+00 W45+00
TA-16-226	16-226	X-RAY BUILDING	CONST. NO. 131-3	315+00 W45+00
TA-16-227	16-227			
TA-16-228	16-228			
TA-16-229	16-229			
TA-16-230	16-230	PASSAGEWAY	BLDG. 220 TO PASS. 233	315+00 W45+00
TA-16-231	16-231	PASSAGEWAY	BLDG. 223 TO PASS. 233	315+00 W50+00
TA-16-232	16-232	PASSAGEWAY	BLDG. 225 TO PASS. 236	320+00 W45+00
TA-16-233	16-233	PASSAGEWAY	PASS. 231 TO PASS. 236	315+00 W50+00
TA-16-234	16-234	PASSAGEWAY	BLDG. 221 TO BLDG. 220	315+00 W55+00
TA-16-235	16-235	PASSAGEWAY	BLDG. 222 TO PASS. 236	315+00 W50+00
TA-16-236	16-236	PASSAGEWAY	PASS. 233 TO PASS. 237	320+00 W50+00
TA-16-237	16-237	PASSAGEWAY	BLDG 224 TO PASS. 236	320+00 W50+00
TA-16-238	16-238	PASSAGEWAY	BLDG 222 TO PASS. 234	315+00 W50+00
TA-16-239	16-239	PASSAGEWAY	BLDG 220 TO PASS. 234	315+00 W55+00
TA-16-240	16-240	TRANSFORMER STATION	NOT SHOWN	
TA-16-241	16-241	MANHOLE, STEAM	NOT SHOWN	
TA-16-242	16-242	TRANSPORTABLE OFFICE BLDG	FORMERLY TA-0-1041	340+00 W75+00
TA-16-243	16-243	TRANSPORTABLE OFFICE BLDG	FORMERLY TA-0-1192	340+00 W75+00
TA-16-244	16-244	TRANSPORTABLE OFFICE BLDG	FORMERLY TA-0-1196	340+00 W75+00
TA-16-245	16-245		UNASSIGNED	
TA-16-246	16-246		UNASSIGNED	
TA-16-247	16-247		UNASSIGNED	
TA-16-248	16-248		UNASSIGNED	
TA-16-249	16-249		UNASSIGNED	
TA-16-250	16-250		UNASSIGNED	
TA-16-251	16-251		UNASSIGNED	
TA-16-252	16-252		UNASSIGNED	
TA-16-253	16-253		UNASSIGNED	
TA-16-254	16-254		UNASSIGNED	
TA-16-255	16-255		UNASSIGNED	
TA-16-256	16-256		UNASSIGNED	
TA-16-257	16-257		UNASSIGNED	
TA-16-258	16-258		UNASSIGNED	
TA-16-259	16-259		UNASSIGNED	
TA-16-260	16-260	PROCESS BUILDING	CONST NO. 132-3	320+00 W35+00
TA-16-261	16-261	REST HOUSE	CONST NO. 132-A	320+00 W40+00

REV	DATE	REVISION	BY	CHD	APP
20	9-22-83	REVISED TITLE BLOCK & DWG TO STATUS OF 7-27-83	HS	[illegible]	[illegible]

UNIVERSITY OF CALIFORNIA
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-16 S-SITE

SEC. CLASSIFICATION — CLASS: UC — REVIEWER: [signature] — DATE: [illegible]

SUBMITTED: [signature] — RECOMMENDED: [signature] — APPROVED: [signature]
DRAWN: [signature] — CHECKED: [signature]
DATE: 9-22-83 — SHEET NO. 1 OF 7 — DRAWING NO. ENG-R 5111

TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-262	16 - 262		REMOVED 1957	
TA-16-263	16 - 263	REST HOUSE	CONST. NO. 132 - B	S20+00 W35+00
TA-16-264	16 - 264	TANK, AIR		S15+00 W35+00
TA-16-265	16 - 265	REST HOUSE	CONST. NO. 132 - C	S25+00 W35+00
TA-16-266	16 - 266			
TA-16-267	16 - 267	REST HOUSE	CONST. NO. 132 - D	S30+00 W35+00
TA-16-268	16 - 268	PASSAGEWAY	BLDG. 260 TO BLDG. 261	S20+00 W35+00
TA-16-269	16 - 269	PASSAGEWAY	BLDG. 260 TO BLDG. 263	S20+00 W35+00
TA-16-270	16 - 270	PASSAGEWAY	BLDG. 260 TO BLDG. 265	S25+00 W35+00
TA-16-271	16 - 271	PASSAGEWAY	BLDG. 260 TO BLDG. 267	S25+00 W30+00
TA-16-272	16 - 272		REMOVED	
TA-16-273	16 - 273		REMOVED	
TA-16-274	16 - 274		REMOVED	
TA-16-275	16 - 275	ROAD BLOCK		S20+00 W35+00
TA-16-276	16 - 276	ROAD BLOCK		S25+00 W30+00
TA-16-277	16 - 277	EQUIPMENT STORAGE BUILDING		S25+00 W30+00
TA-16-278	16 - 278	EQUIPMENT STORAGE BUILDING		S25+00 W35+00
TA-16-279	16 - 279		UNASSIGNED	
TA-16-280	16 - 280	INSPECTION BUILDING	CONST. NO. 133 - 1	S30+00 W40+00
TA-16-281	16 - 281	REST HOUSE	CONST. NO. 133 - A	S30+00 W40+00
TA-16-282	16 - 282	PASSAGEWAY	BLDG. [illegible] TO BLDG. 281	S30+00 W40+00
TA-16-283	16 - 283	REST HOUSE	CONST. NO. 133 - B	S30+00 W35+00
TA-16-284	16 - 284	PASSAGEWAY	BLDG. [illegible] TO PASS. [illegible]	S30+00 W40+00
TA-16-285	16 - 285	REST HOUSE	CONST. NO. 133 - C	S35+00 W40+00
TA-16-286	16 - 286	COFFEE HOUSE		S30+00 W40+00
TA-16-287	16 - 287	PASSAGEWAY	BLDG. [illegible] TO PASS. [illegible]	S30+00 W40+00
TA-16-288	16 - 288	PASSAGEWAY	BLDG. [illegible] TO PASS. 287	S35+00 W40+00
TA-16-289	16 - 289		UNASSIGNED	
TA-16-290	16 - 290		UNASSIGNED	
TA-16-291	16 - 291		UNASSIGNED	
TA-16-292	16 - 292		UNASSIGNED	
TA-16-293	16 - 293		UNASSIGNED	
TA-16-294	16 - 294		UNASSIGNED	
TA-16-295	16 - 295		UNASSIGNED	
TA-16-296	16 - 296		UNASSIGNED	
TA-16-297	16 - 297		UNASSIGNED	
TA-16-298	16 - 298		UNASSIGNED	
TA-16-299	16 - 299		UNASSIGNED	
TA-16-300	16 - 300	PROCESS BUILDING	CONST. NO. 134 - 1	S35+00 W30+00
TA-16-301	16 - 301	REST HOUSE	CONST. NO. 134 - A	S40+00 W35+00
TA-16-302	16 - 302	PROCESS BUILDING	CONST. NO. 134 - 2	S40+00 W30+00
TA-16-303	16 - 303	REST HOUSE	CONST. NO. 134 - B	S45+00 W30+00
TA-16-304	16 - 304	PROCESS BUILDING	CONST. NO. 134 - 3	S45+00 W25+00
TA-16-305	16 - 305	REST HOUSE	CONST. NO. 134 - C	S45+00 W30+00
TA-16-306	16 - 306	PROCESS BUILDING	CONST. NO. 134 - 4	S45+00 W25+00
TA-16-307	16 - 307	REST HOUSE	CONST. NO. 134 - D	S50+00 W25+00
TA-16-308	16 - 308	PROCESS BUILDING	CONST. NO. 134 - 5	S55+00 W25+00
TA-16-309	16 - 309	PASSAGEWAY	BLDG. 300 TO PASS. 310	S35+00 W30+00
TA-16-310	16 - 310	PASSAGEWAY	BLDG. 301 TO PASS. 309	S40+00 W35+00
TA-16-311	16 - 311	PASSAGEWAY	BLDG. 302 TO PASS. 310	S40+00 W30+00
TA-16-312	16 - 312	PASSAGEWAY	BLDG. 304 TO PASS. 313	S45+00 W30+00
TA-16-313	16 - 313	PASSAGEWAY	BLDG. 302 TO PASS. 312	S40+00 W30+00
TA-16-314	16 - 314	PASSAGEWAY	BLDG. 306 TO PASS. 317	S45+00 W30+00
TA-16-315	16 - 315	PASSAGEWAY	BLDG. 303 TO PASS. 312	S45+00 W30+00
TA-16-316	16 - 316	PASSAGEWAY	BLDG. 306 TO BLDG. 307	S50+00 W25+00
TA-16-317	16 - 317	PASSAGEWAY	BLDG. 304 TO PASS. 314	S45+00 W25+00
TA-16-318	16 - 318	PASSAGEWAY	BLDG. 305 TO PASS. 314	S45+00 W30+00
TA-16-319	16 - 319	COFFEE HOUSE		S40+00 W30+00
TA-16-320	16 - 320	CONDENSER	REFRIGERANT	S35+00 W30+00
TA-16-321	16 - 321	CONDENSER	REFRIGERANT	S40+00 W30+00
TA-16-322	16 - 322	CONDENSER	REFRIGERANT	S45+00 W25+00
TA-16-323	16 - 323	CONDENSER	REFRIGERANT	S45+00 W25+00
TA-16-324	16 - 324		UNASSIGNED	
TA-16-325	16 - 325		UNASSIGNED	
TA-16-326	16 - 326		UNASSIGNED	
TA-16-327	16 - 327		UNASSIGNED	
TA-16-328	16 - 328		UNASSIGNED	
TA-16-329	16 - 329		UNASSIGNED	
TA-16-330	16 - 330		UNASSIGNED	
TA-16-331	16 - 331		UNASSIGNED	
TA-16-332	16 - 332		UNASSIGNED	
TA-16-333	16 - 333		UNASSIGNED	
TA-16-334	16 - 334		UNASSIGNED	
TA-16-335	16 - 335		UNASSIGNED	
TA-16-336	16 - 336		UNASSIGNED	
TA-16-337	16 - 337		UNASSIGNED	
TA-16-338	16 - 338		UNASSIGNED	
TA-16-339	16 - 339	STORAGE BLDG.		S35+00 W15+00
TA-16-340	16 - 340	PROCESS BUILDING	CONST. NO. 140 - 1	S35+00 W15+00
TA-16-341	16 - 341	REST HOUSE	CONST. NO. 140 - A	S35+00 W20+00
TA-16-342	16 - 342	BLENDING BUILDING	CONST. NO. 140 - 2	S30+00 W20+00
TA-16-343	16 - 343	REST HOUSE	CONST. NO. 140 - B	S35+00 W20+00
TA-16-344	16 - 344	DRUM STORAGE		S40+00 W15+00
TA-16-345	16 - 345	REST HOUSE	CONST. NO. 140 - C	S40+00 W15+00
TA-16-346	16 - 346		REMOVED 1962	
TA-16-347	16 - 347		REMOVED 1962	
TA-16-348	16 - 348		REMOVED 1962	
TA-16-349	16 - 349	ROAD BLOCK		S30+00 W20+00
TA-16-350	16 - 350	PASSAGEWAY	BLDG. 341 TO PASS. 351	S35+00 W20+00
TA-16-351	16 - 351	PASSAGEWAY	BLDG. 340 TO PASS. 350	S35+00 W15+00
TA-16-352	16 - 352	PASSAGEWAY	BLDG. 340 TO PASS. 343	S35+00 W15+00
TA-16-353	16 - 353	PASSAGEWAY	BLDG. 342 TO PASS. 350	S30+00 W20+00
TA-16-354	16 - 354	PASSAGEWAY	BLDG. 340 TO BLDG. 345	S35+00 W15+00
TA-16-355	16 - 355	ROAD BLOCK		S30+00 W20+00
TA-16-356	16 - 356	ROAD BLOCK		S35+00 W15+00
TA-16-357	16 - 357		UNASSIGNED	
TA-16-358	16 - 358		UNASSIGNED	

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-359	16 - 359		UNASSIGNED	
TA-16-360	16 - 360	PROCESS BUILDING	CONST. NO. 139 - 1	S55+00 W20+00
TA-16-361	16 - 361		UNASSIGNED	
TA-16-362	16 - 362		UNASSIGNED	
TA-16-363	16 - 363		UNASSIGNED	
TA-16-364	16 - 364		UNASSIGNED	
TA-16-365	16 - 365		UNASSIGNED	
TA-16-366	16 - 366		UNASSIGNED	
TA-16-367	16 - 367		UNASSIGNED	
TA-16-368	16 - 368		UNASSIGNED	
TA-16-369	16 - 369		UNASSIGNED	
TA-16-370	16 - 370	PROCESS BUILDING	CONST. NO. 138 - 1	S65+00 W15+00
TA-16-371	16 - 371	TANK, SEPTIC		S65+00 W20+00
TA-16-372	16 - 372	COOLING TOWER		S65+00 W20+00
TA-16-373	16 - 373		UNASSIGNED	
TA-16-374	16 - 374		UNASSIGNED	
TA-16-375	16 - 375		UNASSIGNED	
TA-16-376	16 - 376		UNASSIGNED	
TA-16-377	16 - 377		UNASSIGNED	
TA-16-378	16 - 378		UNASSIGNED	
TA-16-379	16 - 379		UNASSIGNED	
TA-16-380	16 - 380	PROCESS BUILDING	CONST. NO. 137 - 1	S70+00 W 5+00
TA-16-381	16 - 381	TANK, SEPTIC		S70+00 W 5+00
TA-16-382	16 - 382		UNASSIGNED	
TA-16-384	16 - 384		REMOVED 1970	
TA-16-385	16 - 385	TANK, SEPTIC		S25+00 W 5+00
TA-16-386	16 - 386	BURNING AREA		S20+00 W 5+00
TA-16-387	16 - 387	BURNING AREA		S20+00 W 5+00
TA-16-388	16 - 388	BURNING AREA		S25+00 W 5+00
TA-16-389	16 - 389	CONTROL SHELTER		S25+00 W 5+00
TA-16-390	16 - 390	BASKET WASHING BUILDING	ABANDONED 1970	S20+00 0+00
TA-16-391	16 - 391	TANK, FUEL	ABANDONED 1970	S20+00 0+00
TA-16-392	16 - 392	FILTER BEDS		S25+00 E 5+00
TA-16-393	16 - 393		REMOVED 1964	
TA-16-394	16 - 394	FILTER BED		S25+00 0+00
TA-16-395	16 - 395	BARRICADE		S25+00 W 5+00
TA-16-396	16 - 396		REMOVED 1968	
TA-16-397	16 - 397		REMOVED 1960	
TA-16-398	16 - 398	MANHOLE, WATER		S25+00 W 5+00
TA-16-399	16 - 399	BURNING AREA		S25+00 0+00
TA-16-400	16 - 400	TRUCK WASHING BUILDING	ABANDONED 1970	S40+00 W70+00
TA-16-401	16 - 401	TANK, PRESSURE		S25+00 0+00
TA-16-402	16 - 402	AIR HEATER		S25+00 0+00
TA-16-403	16 - 403		REMOVED 1968	
TA-16-404	16 - 404	MICROSTRAINER BUILDING		S30+00 W75+00
TA-16-405	16 - 405	TANK, SURGE		S30+00 W75+00
TA-16-406	16 - 406	TANK, PRESSURE		S25+00 0+00
TA-16-407	16 - 407	MANHOLE, AIR VENT		S25+00 0+00
TA-16-409	16 - 409	MANHOLE, AIR VENT		S25 00 W00 00
TA-16-410	16 - 410	ASSEMBLY BUILDING	CONST. NO. 143 - 1	S60+00 W30+00
TA-16-411	16 - 411	REST HOUSE	CONST. NO. 143 - C	S60+00 W35+00
TA-16-412	16 - 412	INCINERATOR		S40+00 W35+00
TA-16-413	16 - 413	REST HOUSE	CONST. NO. 143 - A	S60+00 W35+00
TA-16-414	16 - 414	STORAGE BUILDING		S60+00 W35+00
TA-16-415	16 - 415	REST HOUSE	CONST. NO. 143 - B	S60+00 W30+00
TA-16-416	16 - 416	PASSAGEWAY	BLDG. 413 TO PASS. 418	S60+00 W30+00
TA-16-417	16 - 417	DRUM STORAGE		S60+00 W30+00
TA-16-418	16 - 418	PASSAGEWAY	BLDG. 415 TO PASS. 419	S60+00 W30+00
TA-16-419	16 - 419	PASSAGEWAY	BLDG. 410 TO PASS. 418	S60+00 W30+00
TA-16-420	16 - 420	TANK, SEPTIC	ABANDONED 1962	S60+00 W35+00
TA-16-421	16 - 421	F.D TRAINING FACILITY		S65+00 W25+00
TA-16-422	16 - 422		UNASSIGNED	
TA-16-423	16 - 423		UNASSIGNED	
TA-16-424	16 - 424		UNASSIGNED	
TA-16-425	16 - 425		UNASSIGNED	
TA-16-426	16 - 426		UNASSIGNED	
TA-16-427	16 - 427		UNASSIGNED	
TA-16-428	16 - 428		UNASSIGNED	
TA-16-429	16 - 429		UNASSIGNED	
TA-16-430	16 - 430	PROCESS BUILDING	CONST. NO. 136 - 1	S60+00 W45+00
TA-16-431	16 - 431		REMOVED 1968	
TA-16-432	16 - 432		UNASSIGNED	
TA-16-433	16 - 433		UNASSIGNED	
TA-16-434	16 - 434		UNASSIGNED	
TA-16-435	16 - 435	REST HOUSE	CONST. NO. 136 - B	S55+00 W45+00
TA-16-436	16 - 436		UNASSIGNED	
TA-16-437	16 - 437	REST HOUSE	CONST. NO. 136 - A	S60+00 W45+00
TA-16-438	16 - 438	ROAD BLOCK	FORMERLY TA-33-66	S60+00 W45+00
TA-16-439	16 - 439		UNASSIGNED	
TA-16-440	16 - 440		UNASSIGNED	
TA-16-441	16 - 441		UNASSIGNED	
TA-16-442	16 - 442	PASSAGEWAY	BLDG. 435 TO PASS. 443	S55+00 W45+00
TA-16-443	16 - 443	PASSAGEWAY	BLDG. 430 TO PASS. 442	S60+00 W45+00
TA-16-444	16 - 444	PASSAGEWAY	BLDG. 437 TO PASS. 443	S60+00 W45+00
TA-16-445	16 - 445		UNASSIGNED	
TA-16-446	16 - 446		UNASSIGNED	
TA-16-447	16 - 447		UNASSIGNED	
TA-16-448	16 - 448		UNASSIGNED	
TA-16-449	16 - 449		UNASSIGNED	
TA-16-450	16 - 450	PROCESS BUILDING	CONST. NO. 142 - 1	S55+00 W70+00
TA-16-451	16 - 451		UNASSIGNED	
TA-16-453	16 - 453		UNASSIGNED	
TA-16-454	16 - 454		UNASSIGNED	

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-456	16 - 456	TANK, BLOWDOWN STEAM		S30+00 W70+00
TA-16-457	16 - 457	VALVEHOUSE, WATER		S30+00 W70+00
TA-16-458	16 - 458		UNASSIGNED	
TA-16-459	16 - 459		UNASSIGNED	
TA-16-460	16 - 460	LABORATORY BUILDING	CONST. NO. 141-1	S45+00 W65+00
TA-16-461	16 - 461	PASSAGEWAY		S45+00 W65+00
TA-16-462	16 - 462	STORAGE BUILDING	CONST. NO. 141-2	S45+00 W65+00
TA-16-463	16 - 463	REST HOUSE		S45+00 W65+00
TA-16-464	16 - 464		REMOVED 1966	
TA-16-465	16 - 465	BARRICADE		
TA-16-466	16 - 466		UNASSIGNED	
TA-16-467	16 - 467		UNASSIGNED	
TA-16-468	16 - 468		UNASSIGNED	
TA-16-469	16 - 469		UNASSIGNED	
TA-16-470	16 - 470		UNASSIGNED	
TA-16-471	16 - 471		UNASSIGNED	
TA-16-472	16 - 472		UNASSIGNED	
TA-16-473	16 - 473		UNASSIGNED	
TA-16-474	16 - 474	CONCRETE PAD		S35+00 W10+00
TA-16-475	16 - 475		REMOVED 1981	
TA-16-476	16 - 476	LABORATORY BUILDING	FORMERLY P-2	S35+00 W10+00
TA-16-477	16 - 477	LABORATORY BUILDING	FORMERLY P-3	S35+00 W10+00
TA-16-478	16 - 478	PROCESS BUILDING	FORMERLY P-4	S35+00 W10+00
TA-16-479	16 - 479		REMOVED 1949	
TA-16-480	16 - 480		REMOVED 1981	
TA-16-481	16 - 481		REMOVED 1951	
TA-16-482	16 - 482		REMOVED 1949	
TA-16-483	16 - 483		REMOVED 1951	
TA-16-484	16 - 484	MANHOLE	FORMERLY P-10 CONTROL	S35+00 W10+00
TA-16-485	16 - 485		REMOVED 1963	
TA-16-486	16 - 486		REMOVED 1951	
TA-16-487	16 - 487		REMOVED 1951	
TA-16-488	16 - 488		REMOVED 1951	
TA-16-489	16 - 489	CHARGE STATION	FORMERLY P-18	S35+00 W10+00
TA-16-490	16 - 490		REMOVED 1960	
TA-16-491	16 - 491		REMOVED 1960	
TA-16-492	16 - 492		REMOVED 1960	
TA-16-493	16 - 493		REMOVED 1960	
TA-16-494	16 - 494		REMOVED 1960	
TA-16-495	16 - 495		REMOVED 1960	
TA-16-496	16 - 496		REMOVED 1960	
TA-16-497	16 - 497		REMOVED 1960	
TA-16-498	16 - 498		REMOVED 1960	
TA-16-499	16 - 499		REMOVED 1960	
TA-16-500	16 - 500		REMOVED 1960	
TA-16-501	16 - 501		REMOVED 1950	
TA-16-502	16 - 502		REMOVED 1960	
TA-16-503	16 - 503		REMOVED 1960	
TA-16-504	16 - 504		REMOVED	
TA-16-505	16 - 505		REMOVED 1960	
TA-16-506	16 - 506		REMOVED	
TA-16-507	16 - 507		REMOVED	
TA-16-508	16 - 508		REMOVED	
TA-16-509	16 - 509		REMOVED	
TA-16-510	16 - 510		REMOVED	
TA-16-511	16 - 511		REMOVED	
TA-16-512	16 - 512		REMOVED	
TA-16-513	16 - 513		REMOVED 1951	
TA-16-514	16 - 514	TRANSFORMER STATION		S35+00 W45+00
TA-16-515	16 - 515	PROCESS BUILDING	FORMERLY V-1 & V-2	S35+00 W45+00
TA-16-516	16 - 516	PROCESS BUILDING	FORMERLY V-4	S40+00 W45+00
TA-16-517	16 - 517	EQUIPMENT BUILDING	FORMERLY V-5	S40+00 W45+00
TA-16-518	16 - 518	STORAGE BUILDING	FORMERLY V-6	S40+00 W40+00
TA-16-519	16 - 519	STORAGE BUILDING	FORMERLY V-7	S40+00 W40+00
TA-16-520	16 - 520	TEST BUILDING	FORMERLY V-8	S40+00 W40+00
TA-16-521	16 - 521		REMOVED 1948	
TA-16-522	16 - 522		REMOVED 1948	

REV.	DATE	REVISION	BY	CHD	APP
12	9-22-83	REVISED TITLE BLOCK & DWG. TO STATUS OF 7-27-83	HS	[illegible]	[illegible]

UNIVERSITY OF CALIFORNIA
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-16 S-SITE

SEC. CLASSIFICATION — CLASS: U — REVIEWED: [signature] — DATE: 10-19-83

SUBMITTED: [signature] RECOMMENDED: [signature] APPROVED: [signature]
DRAWN: [signature] CHECKED: [signature] DATE: 9-22-83 SHEET NO. 2 of 2 DRAWING NO. ENG-R 5111

TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-523	16 - 523		REMOVED 1948	
TA-16-524	16 - 524		REMOVED 1948	
TA-16-525	16 - 525	STORAGE BUILDING		S40+00 W60+00
TA-16-526	16 - 526	PUMP PIT	FORMERLY V-11	S40+00 W45+00
TA-16-527	16 - 527	TANK	SEPTIC FORMERLY V-12	S40+00 W45+00
TA-16-528	16 - 528	BARRICADE	[illegible] V-8	S40+00 W45+00
TA-16-529	16 - 529	RETAINING WALL	[illegible] V-10	S40+00 W45+00
TA-16-530	16 - 530	TANK	[illegible] PLANT	S40+00 W10+00
TA-16-531	16 - 531	TRICKLING FILTER	[illegible] PLANT	S40+00 W10+00
TA-16-532	16 - 532	TANK	[illegible] PLANT	S40+00 W10+00
TA-16-533	16 - 533	SLUDGE DRYING BED	SEWAGE PLANT	S40+00 W10+00
TA-16-534	16 - 534	SCREEN	SEWAGE PLANT	S40+00 W10+00
TA-16-535	16 - 535	SLUDGE DRYING BED	SEWAGE PLANT	S40+00 W10+00
TA-16-536	16 - 536	TRANSFORMER STATION		S10+00 W45+00
TA-16-537	16 - 537	TRANSFORMER STATION		S10+00 W60+00
TA-16-538	16 - 538	TRANSFORMER STATION		S15+00 W65+00
TA-16-539	16 - 539	TRANSFORMER STATION		S25+00 W70+00
TA-16-540	16 - 540	STEAM PLANT		S30+00 W70+00
TA-16-541	16 - 541	TANK		S30+00 W70+00
TA-16-542	16 - 542	GAS REGULATOR BUILDING	ABANDONED	S30+00 W70+00
TA-16-543	16 - 543	TANK	FUEL, UNDERGROUND	S30+00 W70+00
TA-16-544	16 - 544	TANK	FUEL, UNDERGROUND	S30+00 W70+00
TA-16-545	16 - 545	TANK	FUEL, UNDERGROUND	S30+00 W70+00
TA-16-546	16 - 546	TANK	FUEL UNDERGROUND	S30+00 W70+00
TA-16-547	16 - 547	MANHOLE	GAS P.R.V.	S30+00 W70+00
TA-16-548	16 - 548	TRANSFORMER STATION		S20+00 W40+00
TA-16-549	16 - 549	TRANSFORMER STATION		S10+00 W10+00
TA-16-550	16 - 550	TRANSFORMER STATION		S20+00 W 5+00
TA-16-551	16 - 551	TRANSFORMER STATION	SERIES LIGHTING	S30+00 W80+00
TA-16-552	16 - 552	TRANSFORMER STATION	SERIES LIGHTING	S15+00 W15+00
TA-16-553	16 - 553	TRANSFORMER STATION	SERIES LIGHTING	S30+00 W40+00
TA-16-554	16 - 554	TRANSFORMER STATION	SERIES LIGHTING	S70+00 W 5+00
TA-16-555	16 - 555	TRANSFORMER STATION	SERIES LIGHTING	S45+00 W25+00
TA-16-556	16 - 556		REMOVED 1951	
TA-16-557	16 - 557		REMOVED 1966	
TA-16-558	16 - 558	TRANSFORMER STATION	SERIES LIGHTING	S20+00 W30+00
TA-16-559	16 - 559	TRANSFORMER STATION	SERIES LIGHTING	S43+00 W85+00
TA-16-560	16 - 560	CHLORINATION STATION		S30+00 W75+00
TA-16-561	16 - 561	TRANSFORMER STATION	SERIES LIGHTING	S40+00 W70+00
TA-16-562	16 - 562	UNIT SUBSTATION		S45+00 W85+00
TA-16-563	16 - 563	UNIT SUBSTATION		S60+00 W45+00
TA-16-564	16 - 564	UNIT SUBSTATION		S55+00 W25+00
TA-16-565	16 - 565	UNIT SUBSTATION		S45+00 W30+00
TA-16-566	16 - 566		REMOVED 1959	
TA-16-567	16 - 567		REMOVED 1966	S40+00 W45+00
TA-16-568	16 - 568	TRANSFORMER STATION	SERIES LIGHTING	S65+00 W30+00
TA-16-569	16 - 569	TRANSFORMER STATION	SERIES LIGHTING	S60+00 W45+00
TA-16-570	16 - 570	UNIT SUBSTATION		S60+00 W65+00
TA-16-571	16 - 571	TRANSFORMER STATION	SERIES LIGHTING	S25+00 W40+00
TA-16-572	16 - 572	UNIT SUBSTATION		S30+00 W45+00
TA-16-573	16 - 573	UNIT SUBSTATION		S30+00 W10+00
TA-16-574	16 - 574		REMOVED 1966	
TA-16-575	16 - 575		REMOVED 1966	
TA-16-576	16 - 576	TRANSFORMER STATION	RELOCATED TO TA-4-209	
TA-16-577	16 - 577		REMOVED 1960	
TA-16-578	16 - 578		REMOVED 1960	
TA-16-579	16 - 579		REMOVED 1960	
TA-16-580	16 - 580		REMOVED 1966	
TA-16-581	16 - 581		REMOVED 1966	
TA-16-582	16 - 582		REMOVED 1960	
TA-16-583	16 - 583		REMOVED 1960	
TA-16-584	16 - 584		REMOVED 1966	
TA-16-585	16 - 585	UNIT SUBSTATION		S30+00 W10+00
TA-16-586	16 - 586	UNIT SUBSTATION		S35+00 W15+00
TA-16-587	16 - 587	UNIT SUBSTATION		S35+00 W30+00
TA-16-588	16 - 588	TRANSFORMER STATION	SERIES LIGHTING	S35+00 W35+00
TA-16-589	16 - 589	UNIT SUBSTATION		S40+00 W30+00
TA-16-590	16 - 590	UNIT SUBSTATION		S45+00 W25+00
TA-16-591	16 - 591	UNIT SUBSTATION		S50+00 W25+00
TA-16-592	16 - 592	UNIT SUBSTATION		S65+00 W20+00
TA-16-593	16 - 593	UNIT SUBSTATION		S70+00 W 5+00
TA-16-594	16 - 594	UNIT SUBSTATION		S65+00 W30+00
TA-16-595	16 - 595	UNIT SUBSTATION		S30+00 W40+00
TA-16-596	16 - 596	UNIT SUBSTATION		S20+00 W50+00
TA-16-597	16 - 597	UNIT SUBSTATION		S20+00 W50+00
TA-16-598	16 - 598	UNIT SUBSTATION		S15+00 W45+00
TA-16-599	16 - 599	SWITCHGEAR		S25+00 W85+00
TA-16-600	16 - 600	BARRICADE		S20+00 W35+00
TA-16-601	16 - 601	BARRICADE		S20+00 W40+00
TA-16-602	16 - 602	BARRICADE		S20+00 W35+00
TA-16-603	16 - 603	BARRICADE		S20+00 W35+00
TA-16-604	16 - 604	BARRICADE		S25+00 W35+00
TA-16-605	13 - 605	BARRICADE		S25+00 W35+00
TA-16-606	16 - 606	BARRICADE		S25+00 W35+00
TA-16-607	16 - 607	BARRICADE		S25+00 W35+00
TA-16-608	16 - 608	TRANSFORMER STATION		S40+00 W45+00
TA-16-609	16 - 609	TRANSFORMER STATION		S40+00 W48+00
TA-16-610	16 - 610	TRANSFORMER STATION		S35+00 W45+00
TA-16-611	16 - 611	TRANSFORMER STATION		S35+00 W50+00
TA-16-612	16 - 612	BARRICADE		S15+00 W45+00
TA-16-613	16 - 613	BARRICADE		S15+00 W45+00
TA-16-614	16 - 614	BARRICADE		S15+00 W50+00
TA-16-615	16 - 615	BARRICADE		S15+00 W50+00
TA-16-616	16 - 616	BARRICADE		S15+00 W55+00
TA-16-617	16 - 617	BARRICADE		S15+00 W50+00
TA-16-618	16 - 618	BARRICADE		S20+00 W50+00
TA-16-619	16 - 619	BARRICADE		S20+00 W45+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-620	16 - 620	BARRICADE		S15+00 W30+00
TA-16-621	16 - 621	TRANSFORMER STATION		S30+00 W75+00
TA-16-622	16 - 622	TRANSFORMER STATION		S25+00 W35+00
TA-16-623	16 - 623	TRANSFORMER STATION		S15+00 W35+00
TA-16-624	16 - 624	BARRICADE		S25+00 W40+00
TA-16-625	16 - 625	BARRICADE		S30+00 W35+00
TA-16-626	16 - 626	BARRICADE		S30+00 W35+00
TA-16-627	16 - 627	BARRICADE		S30+00 W40+00
TA-16-628	16 - 628	BARRICADE		S35+00 W40+00
TA-16-629	16 - 629	BARRICADE		S35+00 W40+00
TA-16-630	16 - 630	TRANSFORMER STATION		S25+00 0+00
TA-16-631	16 - 631	TRANSFORMER STATION		S35+00 W65+00
TA-16-632	16 - 632		UNASSIGNED	
TA-16-633	16 - 633		UNASSIGNED	
TA-16-634	16 - 634	BARRICADE		S40+00 W30+00
TA-16-635	16 - 635	BARRICADE		S40+00 W30+00
TA-16-636	16 - 636	BARRICADE		S45+00 W25+00
TA-16-637	16 - 637	BARRICADE		S40+00 W35+00
TA-16-638	16 - 638	BARRICADE		S40+00 W30+00
TA-16-640	16 - 640	BARRICADE		S45+00 W30+00
TA-16-641	16 - 641	BARRICADE		S45+00 W30+00
TA-16-642	16 - 642	BARRICADE		S50+00 W25+00
TA-16-643	16 - 643	DEADMAN		S55+00 W30+00
TA-16-644	16 - 644	DEADMAN		S55+00 W40+00
TA-16-645	16 - 645	DEADMAN		S60+00 W45+00
TA-16-646	16 - 646	DEADMAN		S60+00 W45+00
TA-16-647	16 - 647	DEADMAN		S60+00 W40+00
TA-16-648	16 - 648	DEADMAN		S60+00 W75+00
TA-16-649	16 - 649	DEADMAN		S60+00 W80+00
TA-16-650	16 - 650	DEADMAN		S60+00 W80+00
TA-16-651	16 - 651		UNASSIGNED	
TA-16-652	16 - 652		UNASSIGNED	
TA-16-653	16 - 653		UNASSIGNED	
TA-16-654	16 - 654		UNASSIGNED	
TA-16-655	16 - 655		UNASSIGNED	
TA-16-656	16 - 656	BARRICADE		S60+00 W45+00
TA-16-657	16 - 657	BARRICADE		S55+00 W45+00
TA-16-658	16 - 658	BARRICADE		S55+00 W45+00
TA-16-659	16 - 659		UNASSIGNED	
TA-16-660	16 - 660		UNASSIGNED	
TA-16-661	16 - 661		UNASSIGNED	
TA-16-662	16 - 662		UNASSIGNED	
TA-16-663	16 - 663		UNASSIGNED	
TA-16-664	16 - 664		UNASSIGNED	
TA-16-665	16 - 665		UNASSIGNED	
TA-16-666	16 - 666	BARRICADE		S55+00 W25+00
TA-16-667	16 - 667		UNASSIGNED	
TA-16-668	16 - 668		UNASSIGNED	
TA-16-669	16 - 669		UNASSIGNED	
TA-16-670	16 - 670		UNASSIGNED	
TA-16-671	16 - 671	BARRICADE		S35+00 W20+00
TA-16-672	16 - 672	BARRICADE		S35+00 W20+00
TA-16-673	16 - 673	BARRICADE		S35+00 W15+00
TA-16-674	16 - 674		UNASSIGNED	
TA-16-675	16 - 675		UNASSIGNED	
TA-16-676	16 - 676		UNASSIGNED	
TA-16-677	16 - 677		UNASSIGNED	
TA-16-678	16 - 678		UNASSIGNED	
TA-16-679	16 - 679		UNASSIGNED	
TA-16-680	16 - 680		UNASSIGNED	
TA-16-681	16 - 681		UNASSIGNED	
TA-16-682	16 - 682		UNASSIGNED	
TA-16-683	16 - 683		UNASSIGNED	
TA-16-684	16 - 684		UNASSIGNED	
TA-16-685	16 - 685		UNASSIGNED	
TA-16-686	16 - 686		UNASSIGNED	
TA-16-687	16 - 687		UNASSIGNED	
TA-16-688	16 - 688	BARRICADE		S60+00 W30+00
TA-16-689	16 - 689	BARRICADE		S60+00 W30+00
TA-16-690	16 - 690	BARRICADE		S65+00 W30+00
TA-16-691	16 - 691	BARRICADE		S60+00 W35+00
TA-16-692	16 - 692	BARRICADE		S60+00 W35+00
TA-16-693	16 - 693	MANHOLE	STEAM	S30+00 W65+00
TA-16-694	16 - 694	MANHOLE	STEAM	S30+00 W65+00
TA-16-695	16 - 695	MANHOLE	STEAM	S30+00 W65+00
TA-16-696	16 - 696	MANHOLE	STEAM	S30+00 W65+00
TA-16-697	16 - 697	MANHOLE	STEAM	S30+00 W65+00
TA-16-698	16 - 698	MANHOLE	STEAM	S30+00 W65+00
TA-16-699	16 - 699	MANHOLE	STEAM	S30+00 W65+00
TA-16-700	16 - 700	MANHOLE	SANITARY	S20+00 W50+00
TA-16-701	16 - 701	MANHOLE	SANITARY	S20+00 W50+00
TA-16-702	16 - 702	MANHOLE	SANITARY	S20+00 W50+00
TA-16-703	16 - 703	MANHOLE	SANITARY	S20+00 W50+00
TA-16-704	16 - 704	MANHOLE	SANITARY	S15+00 W50+00
TA-16-705	16 - 705	MANHOLE	SANITARY	S15+00 W50+00
TA-16-706	16 - 706	MANHOLE	SANITARY	S15+00 W45+00
TA-16-707	16 - 707	MANHOLE	SANITARY	S15+00 W45+00
TA-16-708	16 - 708	MANHOLE	SANITARY	S20+00 W45+00
TA-16-709	16 - 709	MANHOLE	SANITARY	S20+00 W45+00
TA-16-710	16 - 710	MANHOLE	SANITARY	S20+00 W45+00
TA-16-711	16 - 711	MANHOLE	SANITARY	S20+00 W45+00
TA-16-712	16 - 712	MANHOLE	SANITARY	S20+00 W40+00
TA-16-713	16 - 713	MANHOLE	SANITARY	S20+00 W35+00
TA-16-715	16 - 715	MANHOLE	SANITARY	S20+00 W35+00
TA-16-716	16 - 716	MANHOLE	SANITARY	S20+00 W35+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-717	16 - 717	MANHOLE	SANITARY	S20+00 W35+00
TA-16-718	16 - 718	MANHOLE	SANITARY	S25+00 W30+00
TA-16-719	16 - 719	SEWAGE LIFT STATION		S20+00 W40+00
TA-16-720	16 - 720	MANHOLE	SANITARY	S25+00 W40+00
TA-16-721	16 - 721	MANHOLE	SANITARY	S30+00 W40+00
TA-16-722	16 - 722	MANHOLE	SANITARY	S30+00 W30+00
TA-16-723	16 - 723	MANHOLE	SANITARY	S35+00 W30+00
TA-16-724	16 - 724	MANHOLE	SANITARY	S35+00 W30+00
TA-16-725	16 - 725	MANHOLE	SANITARY	S35+00 W25+00
TA-16-726	16 - 726	MANHOLE	SANITARY	S40+00 W20+00
TA-16-727	16 - 727	MANHOLE	SANITARY	S40+00 W20+00
TA-16-728	16 - 728	MANHOLE	SANITARY	S40+00 W15+00
TA-16-729	16 - 729	MANHOLE	SANITARY	S40+00 W15+00
TA-16-730	16 - 730	MANHOLE	SANITARY	S40+00 W15+00
TA-16-731	16 - 731	MANHOLE	SANITARY	S35+00 W15+00
TA-16-732	16 - 732	MANHOLE	SANITARY	S35+00 W15+00
TA-16-733	16 - 733	MANHOLE	SANITARY	S40+00 W10+00
TA-16-734	16 - 734	MANHOLE	SANITARY	S40+00 W10+00
TA-16-735	16 - 735	MANHOLE	SANITARY	S40+00 W10+00
TA-16-736	16 - 736	MANHOLE	SANITARY	S40+00 W20+00
TA-16-737	16 - 737	MANHOLE	SANITARY	S45+00 W20+00
TA-16-738	16 - 738	MANHOLE	SANITARY	S45+00 W25+00
TA-16-739	16 - 739	MANHOLE	SANITARY	S50+00 W25+00
TA-16-740	16 - 740	MANHOLE	SANITARY	S50+00 W25+00
TA-16-741	16 - 741	MANHOLE	SANITARY	S50+00 W25+00
TA-16-742	16 - 742	MANHOLE	SANITARY	S45+00 W25+00
TA-16-743	16 - 743	MANHOLE	SANITARY	S45+00 W25+00
TA-16-744	16 - 744	MANHOLE	SANITARY	S50+00 W30+00
TA-16-745	16 - 745	MANHOLE	SANITARY	S45+00 W30+00
TA-16-746	16 - 746	MANHOLE	SANITARY	S45+00 W30+00
TA-16-747	16 - 747	MANHOLE	SANITARY	S45+00 W30+00
TA-16-748	16 - 748	MANHOLE	SANITARY	S40+00 W30+00
TA-16-749	16 - 749	MANHOLE	SANITARY	S40+00 W35+00
TA-16-750	16 - 750	MANHOLE	SANITARY	S35+00 W30+00
TA-16-751	16 - 751	MANHOLE	SANITARY	S50+00 W25+00
TA-16-752	16 - 752	MANHOLE	SANITARY	S55+00 W25+00
TA-16-753	16 - 753	MANHOLE	SANITARY	S55+00 W25+00
TA-16-754	16 - 754	MANHOLE	SANITARY	S55+00 W30+00
TA-16-755	16 - 755	MANHOLE	SANITARY	S55+00 W30+00
TA-16-756	16 - 756	MANHOLE	SANITARY	S60+00 W35+00
TA-16-757	16 - 757	MANHOLE	SANITARY	S60+00 W30+00
TA-16-758	16 - 758	MANHOLE	SANITARY	S65+00 W30+00
TA-16-759	16 - 759	MANHOLE	SANITARY	S60+00 W40+00
TA-16-760	16 - 760	MANHOLE	SANITARY	S60+00 W40+00
TA-16-761	16 - 761	MANHOLE	SANITARY	S60+00 W45+00
TA-16-762	16 - 762	MANHOLE	SANITARY	S60+00 W45+00
TA-16-763	16 - 763	MANHOLE	SANITARY	S60+00 W50+00
TA-16-764	16 - 764	MANHOLE	SANITARY	S60+00 W50+00
TA-16-765	16 - 765	MANHOLE	SANITARY	S60+00 W50+00
TA-16-766	16 - 766	MANHOLE	SANITARY	S60+00 W55+00
TA-16-767	16 - 767	MANHOLE	SANITARY	S55+00 W55+00
TA-16-768	16 - 768	MANHOLE	SANITARY	S55+00 W60+00
TA-16-769	16 - 769	MANHOLE	SANITARY	S55+00 W60+00
TA-16-770	16 - 770	MANHOLE	SANITARY	S55+00 W65+00
TA-16-771	16 - 771	MANHOLE	SANITARY	S55+00 W65+00
TA-16-772	16 - 772	MANHOLE	SANITARY	S50+00 W60+00
TA-16-773	16 - 773	MANHOLE	SANITARY	S50+00 W60+00
TA-16-774	16 - 774	MANHOLE	SANITARY	S45+00 W60+00
TA-16-775	16 - 775	MANHOLE	SANITARY	S45+00 W65+00
TA-16-776	16 - 776	MANHOLE	SANITARY	S45+00 W65+00
TA-16-777	16 - 777	MANHOLE	SANITARY	S45+00 W70+00
TA-16-778	16 - 778	MANHOLE	SANITARY	S40+00 W70+00
TA-16-779	16 - 779	MANHOLE	SANITARY	S45+00 W70+00
TA-16-780	16 - 780	MANHOLE	SANITARY	S40+00 W70+00
TA-16-781	16 - 781	MANHOLE	SANITARY	S40+00 W75+00
TA-16-782	16 - 782	MANHOLE	SANITARY	S35+00 W70+00
TA-16-783	16 - 783	MANHOLE	SANITARY	S40+00 W80+00

REV	DATE	REVISION	BY	CKD	APP
20	9-23-83	REVISED TITLE BLOCK & DWG. TO STATUS OF 7-27-83	HS		

UNIVERSITY OF CALIFORNIA
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-16 S-SITE

SEC. CLASSIFICATION — CLASS: U — REVIEWER: [signature] — DATE: [illegible]

SUBMITTED: [signature] — RECOMMENDED: [signature] — APPROVED: [signature]
DRAWN: [signature] — CHECKED: [signature] — DATE: 9-23-83 — SHEET NO. 3 OF 7 — DRAWING NO. ENG-R5111

TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-784	16 - 784		REMOVED	
TA-16-785	16 - 785	MANHOLE	SANITARY	340+00 W65+00
TA-16-786	16 - 786	MANHOLE	SANITARY	335+00 W65+00
TA-16-787	16 - 787	MANHOLE	SANITARY	335+00 W65+00
TA-16-788	16 - 788	MANHOLE	SANITARY	335+00 W65+00
TA-16-789	16 - 789	MANHOLE	SANITARY	330+00 W65+00
TA-16-790	16 - 790	MANHOLE	SANITARY	330+00 W70+00
TA-16-791	16 - 791	MANHOLE	SANITARY	330+00 W70+00
TA-16-792	16 - 792	MANHOLE	SANITARY	330+00 W70+00
TA-16-793	16 - 793	MANHOLE	INDUSTRIAL WASTE	340+00 W45+00
TA-16-794	16 - 794	MANHOLE	INDUSTRIAL WASTE	340+00 W45+00
TA-16-795	16 - 795	MANHOLE	INDUSTRIAL WASTE	340+00 W45+00
TA-16-796	16 - 796	MANHOLE	INDUSTRIAL WASTE	340+00 W45+00
TA-16-797	16 - 797	MANHOLE	INDUSTRIAL WASTE	340+00 W45+00
TA-16-798	16 - 798	MANHOLE	INDUSTRIAL WASTE	340+00 W40+00
TA-16-799	16 - 799	MANHOLE	INDUSTRIAL WASTE	340+00 W40+00
TA-16-800	16 - 800		RE[illegible]	
TA-16-801	16 - 801		RE[illegible]	
TA-16-802	16 - 802	MANHOLE	STORM [illegible]	330+00 W40+00
TA-16-803	16 - 803	MANHOLE	STORM [illegible]	[illegible]+00 W35+00
TA-16-804	16 - 804	MANHOLE	STORM [illegible]	[illegible]+00 W30+00
TA-16-805	16 - 805	MANHOLE	STORM [illegible]	325+00 W30+00
TA-16-806	16 - 806	MANHOLE	STORM [illegible]	335+00 W35+00
TA-16-807	16 - 807	MANHOLE	INDUSTRIAL WASTE	335+00 W30+00
TA-16-808	16 - 808	MANHOLE	INDUSTRIAL WASTE	340+00 W30+00
TA-16-809	16 - 809	MANHOLE	INDUSTRIAL WASTE	345+00 W25+00
TA-16-810	16 - 810	MANHOLE	INDUSTRIAL WASTE	345+00 W25+00
TA-16-811	16 - 811	MANHOLE	INDUSTRIAL WASTE	335+00 W15+00
TA-16-812	16 - 812	MANHOLE	INDUSTRIAL WASTE	330+00 W15+00
TA-16-813	16 - 813	MANHOLE	SANITARY	355+00 W20+00
TA-16-814	16 - 814	MANHOLE	SANITARY	330+00 W40+00
TA-16-815	16 - 815	MANHOLE	SANITARY	335+00 W70+00
TA-16-816	16 - 816	MANHOLE	SANITARY	335+00 W40+00
TA-16-817	16 - 817	MANHOLE	SANITARY	350+00 W40+00
TA-16-818	16 - 818		UNASSIGNED	
TA-16-819	16 - 819		UNASSIGNED	
TA-16-820	16 - 820		UNASSIGNED	
TA-16-821	16 - 821		UNASSIGNED	
TA-16-822	16 - 822		UNASSIGNED	
TA-16-823	16 - 823		UNASSIGNED	
TA-16-824	16 - 824		UNASSIGNED	
TA-16-825	16 - 825	MANHOLE	ELECTRICAL	315+00 W60+00
TA-16-826	16 - 826	MANHOLE	ELECTRICAL	315+00 W65+00
TA-16-827	16 - 827	MANHOLE	ELECTRICAL	315+00 W65+00
TA-16-828	16 - 828	MANHOLE	ELECTRICAL	315+00 W55+00
TA-16-829	16 - 829	MANHOLE	ELECTRICAL	310+00 W50+00
TA-16-830	16 - 830	MANHOLE	ELECTRICAL	315+00 W50+00
TA-16-831	16 - 831	MANHOLE	ELECTRICAL	315+00 W50+00
TA-16-832	16 - 832	MANHOLE	ELECTRICAL	315+00 W50+00
TA-16-833	16 - 833	MANHOLE	ELECTRICAL	315+00 W45+00
TA-16-834	16 - 834	MANHOLE	ELECTRICAL	320+00 W45+00
TA-16-835	16 - 835	MANHOLE	ELECTRICAL	320+00 W45+00
TA-16-836	16 - 836	MANHOLE	ELECTRICAL	320+00 W45+00
TA-16-837	16 - 837	MANHOLE	ELECTRICAL	320+00 W45+00
TA-16-838	16 - 838	MANHOLE	ELECTRICAL	330+00 W40+00
TA-16-839	16 - 839	MANHOLE	ELECTRICAL	330+00 W35+00
TA-16-840	16 - 840	MANHOLE	ELECTRICAL	330+00 W35+00
TA-16-841	16 - 841	MANHOLE	ELECTRICAL	330+00 W40+00
TA-16-842	16 - 842	MANHOLE	ELECTRICAL	330+00 W40+00
TA-16-843	16 - 843	MANHOLE	ELECTRICAL	330+00 W40+00
TA-16-844	16 - 844	MANHOLE	ELECTRICAL	335+00 W40+00
TA-16-845	16 - 845	MANHOLE	ELECTRICAL	330+00 W20+00
TA-16-846	16 - 846	MANHOLE	ELECTRICAL	335+00 W15+00
TA-16-847	16 - 847	MANHOLE	ELECTRICAL	335+00 W20+00
TA-16-848	16 - 848	MANHOLE	ELECTRICAL	335+00 W20+00
TA-16-849	16 - 849	MANHOLE	ELECTRICAL	335+00 W20+00
TA-16-850	16 - 850	MANHOLE	ELECTRICAL	335+00 W15+00
TA-16-851	16 - 851	MANHOLE	ELECTRICAL	335+00 W30+00
TA-16-852	16 - 852	MANHOLE	ELECTRICAL	335+00 W30+00
TA-16-853	16 - 853	MANHOLE	ELECTRICAL	340+00 W30+00
TA-16-854	16 - 854	MANHOLE	ELECTRICAL	340+00 W30+00
TA-16-855	16 - 855	MANHOLE	ELECTRICAL	340+00 W35+00
TA-16-856	16 - 856	MANHOLE	ELECTRICAL	340+00 W30+00
TA-16-857	16 - 857	MANHOLE	ELECTRICAL	340+00 W30+00
TA-16-858	16 - 858	MANHOLE	ELECTRICAL	340+00 W30+00
TA-16-859	16 - 859	MANHOLE	ELECTRICAL	345+00 W30+00
TA-16-860	16 - 860	MANHOLE	ELECTRICAL	345+00 W30+00
TA-16-861	16 - 861	MANHOLE	ELECTRICAL	345+00 W30+00
TA-16-862	16 - 862	MANHOLE	ELECTRICAL	345+00 W30+00
TA-16-863	16 - 863	MANHOLE	ELECTRICAL	345+00 W25+00
TA-16-864	16 - 864	MANHOLE	ELECTRICAL	345+00 W25+00
TA-16-865	16 - 865	MANHOLE	ELECTRICAL	350+00 W30+00
TA-16-866	16 - 866	MANHOLE	ELECTRICAL	345+00 W25+00
TA-16-867	16 - 867	MANHOLE	ELECTRICAL	350+00 W25+00
TA-16-868	16 - 868	MANHOLE	ELECTRICAL	350+00 W25+00
TA-16-869	16 - 869	MANHOLE	ELECTRICAL	350+00 W25+00
TA-16-870	16 - 870	MANHOLE	ELECTRICAL	350+00 W25+00
TA-16-871	16 - 871	MANHOLE	ELECTRICAL	360+00 W30+00
TA-16-872	16 - 872	MANHOLE	ELECTRICAL	360+00 W30+00
TA-16-873	16 - 873	MANHOLE	ELECTRICAL	360+00 W30+00
TA-16-874	16 - 874	MANHOLE	ELECTRICAL	360+00 W35+00
TA-16-875	16 - 875	MANHOLE	ELECTRICAL	360+00 W35+00
TA-16-876	16 - 876	MANHOLE	ELECTRICAL	360+00 W35+00
TA-16-877	16 - 877	MANHOLE	ELECTRICAL	365+00 W35+00
TA-16-878	16 - 878	MANHOLE	ELECTRICAL	360+00 W45+00
TA-16-879	16 - 879	MANHOLE	ELECTRICAL	360+00 W45+00
TA-16-880	16 - 880	MANHOLE	ELECTRICAL	355+00 W70+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-881	16 - 881	MANHOLE	ELECTRICAL	345+00 W65+00
TA-16-882	16 - 882	MANHOLE	ELECTRICAL	345+00 W65+00
TA-16-883	16 - 883	MANHOLE	ELECTRICAL	345+00 W65+00
TA-16-884	16 - 884	MANHOLE	ABANDONED 1966	340+00 W70+00
TA-16-885	16 - 885	MANHOLE	ABANDONED 1966	335+00 W70+00
TA-16-886	16 - 886	MANHOLE	ABANDONED 1966	330+00 W70+00
TA-16-887	16 - 887	MANHOLE	ELECTRICAL	340+00 W15+00
TA-16-888	16 - 888		REMOVED 1972	
TA-16-889	16 - 889		REMOVED 1972	
TA-16-890	16 - 890	MANHOLE	ELECTRICAL	345+00 W65+00
TA-16-891	16 - 891	MANHOLE	ELECTRICAL	345+00 W70+00
TA-16-892	16 - 892	MANHOLE	ELECTRICAL	365+00 W20+00
TA-16-893	16 - 893	MANHOLE	ELECTRICAL	360+00 W35+00
TA-16-894	16 - 894	MANHOLE	ELECTRICAL	330+00 W65+00
TA-16-895	16 - 895		UNASSIGNED	
TA-16-896	16 - 896		UNASSIGNED	
TA-16-897	16 - 897		UNASSIGNED	
TA-16-898	16 - 898		UNASSIGNED	
TA-16-899	16 - 899		UNASSIGNED	
NOTE	TA-16-900	THRU TA-16-999 CANNOT BE	USED FOR STR NO.	ASSIGNMENT
TA-16-1000	16 - 1000		RELOCATED TO TA-16-112	
TA-16-1001	16 - 1001		RELOCATED TO TA-1-288	
TA-16-1002	16 - 1002	MANHOLE	STEAM	315+00 W50+00
TA-16-1003	16 - 1003	MANHOLE	STEAM	315+00 W50+00
TA-16-1004	16 - 1004	MANHOLE	STEAM	315+00 W50+00
TA-16-1005	16 - 1005	MANHOLE	STEAM	315+00 W50+00
TA-16-1006	16 - 1006	MANHOLE	STEAM	320+00 W50+00
TA-16-1007	16 - 1007	MANHOLE	STEAM	320+00 W45+00
TA-16-1008	16 - 1008	MANHOLE	STEAM	325+00 W45+00
TA-16-1009	16 - 1009	MANHOLE	STEAM	325+00 W40+00
TA-16-1010	16 - 1010	MANHOLE	STEAM	325+00 W40+00
TA-16-1011	16 - 1011	MANHOLE	STEAM	320+00 W35+00
TA-16-1012	16 - 1012	MANHOLE	STEAM	330+00 W40+00
TA-16-1013	16 - 1013	MANHOLE	STEAM	330+00 W40+00
TA-16-1014	16 - 1014	MANHOLE	STEAM	330+00 W35+00
TA-16-1015	16 - 1015	MANHOLE	STEAM	335+00 W35+00
TA-16-1016	16 - 1016	MANHOLE	STEAM	335+00 W35+00
TA-16-1017	16 - 1017	MANHOLE	STEAM	340+00 W30+00
TA-16-1018	16 - 1018	MANHOLE	STEAM	335+00 W30+00
TA-16-1019	16 - 1019	MANHOLE	STEAM	335+00 W25+00
TA-16-1020	16 - 1020	MANHOLE	STEAM	335+00 W20+00
TA-16-1021	16 - 1021	MANHOLE	STEAM	335+00 W20+00
TA-16-1022	16 - 1022	MANHOLE	STEAM	335+00 W20+00
TA-16-1023	16 - 1023	MANHOLE	STEAM	335+00 W20+00
TA-16-1024	16 - 1024	MANHOLE	STEAM	335+00 W15+00
TA-16-1025	16 - 1025	MANHOLE	STEAM	335+00 W15+00
TA-16-1026	16 - 1026	MANHOLE	STEAM	335+00 W10+00
TA-16-1027	16 - 1027	MANHOLE	STEAM	340+00 W30+00
TA-16-1028	16 - 1028	MANHOLE	STEAM	340+00 W30+00
TA-16-1029	16 - 1029	MANHOLE	STEAM	345+00 W30+00
TA-16-1030	16 - 1030	MANHOLE	STEAM	345+00 W30+00
TA-16-1031	16 - 1031	MANHOLE	STEAM	350+00 W25+00
TA-16-1032	16 - 1032	MANHOLE	STEAM	350+00 W25+00
TA-16-1033	16 - 1033	MANHOLE	STEAM	350+00 W30+00
TA-16-1034	16 - 1034	MANHOLE	STEAM	355+00 W25+00
TA-16-1035	16 - 1035	MANHOLE	STEAM	355+00 W25+00
TA-16-1036	16 - 1036	MANHOLE	STEAM	360+00 W25+00
TA-16-1037	16 - 1037	MANHOLE	STEAM	360+00 W20+00
TA-16-1038	16 - 1038	MANHOLE	STEAM	365+00 W15+00
TA-16-1039	16 - 1039	MANHOLE	STEAM	355+00 W35+00
TA-16-1040	16 - 1040	MANHOLE	STEAM	355+00 W40+00
TA-16-1041	16 - 1041	MANHOLE	STEAM	355+00 W40+00
TA-16-1042	16 - 1042	MANHOLE	STEAM	360+00 W35+00
TA-16-1043	16 - 1043	MANHOLE	STEAM	360+00 W35+00
TA-16-1044	16 - 1044	MANHOLE	STEAM	355+00 W40+00
TA-16-1045	16 - 1045	MANHOLE	STEAM	355+00 W45+00
TA-16-1046	16 - 1046	MANHOLE	STEAM	355+00 W45+00
TA-16-1047	16 - 1047	MANHOLE	STEAM	355+00 W45+00
TA-16-1048	16 - 1048	MANHOLE	STEAM	360+00 W45+00
TA-16-1049	16 - 1049	MANHOLE	STEAM	355+00 W50+00
TA-16-1050	16 - 1050	MANHOLE	STEAM	355+00 W50+00
TA-16-1051	16 - 1051	MANHOLE	STEAM	355+00 W55+00
TA-16-1052	16 - 1052	MANHOLE	STEAM	355+00 W60+00
TA-16-1053	16 - 1053	MANHOLE	STEAM	350+00 W65+00
TA-16-1054	16 - 1054	MANHOLE	STEAM	355+00 W65+00
TA-16-1055	16 - 1055	MANHOLE	STEAM	355+00 W70+00
TA-16-1056	16 - 1056	MANHOLE	STEAM	345+00 W65+00
TA-16-1057	16 - 1057	MANHOLE	STEAM	345+00 W65+00
TA-16-1058	16 - 1058	MANHOLE	STEAM	340+00 W70+00
TA-16-1059	16 - 1059	MANHOLE	STEAM	340+00 W70+00
TA-16-1060	16 - 1060	MANHOLE	STEAM	340+00 W70+00
TA-16-1061	16 - 1061	MANHOLE	STEAM	340+00 W75+00
TA-16-1062	16 - 1062	MANHOLE	STEAM	330+00 W70+00
TA-16-1063	16 - 1063	MANHOLE	STEAM	330+00 W65+00
TA-16-1064	16 - 1064	MANHOLE	STEAM	330+00 W60+00
TA-16-1065	16 - 1065	MANHOLE	STEAM	335+00 W65+00
TA-16-1066	16 - 1066	MANHOLE	STEAM	335+00 W60+00
TA-16-1067	16 - 1067	MANHOLE	STEAM	340+00 W60+00
TA-16-1068	16 - 1068	MANHOLE	STEAM	340+00 W65+00
TA-16-1069	16 - 1069	MANHOLE	STEAM	340+00 W65+00
TA-16-1070	16 - 1070	MANHOLE	STEAM	330+00 W65+00
TA-16-1071	16 - 1071	MANHOLE	STEAM	325+00 W65+00
TA-16-1072	16 - 1072	MANHOLE	STEAM	325+00 W65+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-1073	16 - 1073	MANHOLE	STEAM	320+00 W60+00
TA-16-1074	16 - 1074	MANHOLE	STEAM	320+00 W60+00
TA-16-1075	16 - 1075	MANHOLE	STEAM	320+00 W60+00
TA-16-1076	16 - 1076	MANHOLE	STEAM	315+00 W55+00
TA-16-1077	16 - 1077	MANHOLE	STEAM	320+00 W55+00
TA-16-1078	16 - 1078	MANHOLE	STEAM	320+00 W50+00
TA-16-1079	16 - 1079		REMOVED	
TA-16-1080	16 - 1080	MANHOLE	STEAM	350+00 W70+00
TA-16-1081	16 - 1081	MANHOLE	STEAM	340+00 W60+00
TA-16-1082	16 - 1082	MANHOLE	STEAM	340+00 W60+00
TA-16-1083	16 - 1083	MANHOLE	ABANDONED 1958	335+00 W60+00
TA-16-1084	16 - 1084		REMOVED	
TA-16-1085	16 - 1085	MANHOLE	STEAM	360+00 W30+00
TA-16-1086	16 - 1086		REMOVED 1970	
TA-16-1087	16 - 1087		REMOVED 1970	
TA-16-1088	16 - 1088	MANHOLE	STEAM	355+00 W40+00
TA-16-1089	16 - 1089	MANHOLE	STEAM	355+00 W30+00
TA-16-1090	16 - 1090		REMOVED 1970	
TA-16-1091	16 - 1091	MANHOLE	STEAM	345+00 W[illegible]+00
TA-16-1092	16 - 1092	MANHOLE	STEAM	345+00 W[illegible]+00
TA-16-1093	16 - 1093	MANHOLE	STEAM	320+00 W60+00
TA-16-1094	16 - 1094	MANHOLE	STEAM	320+00 W55+00
TA-16-1095	16 - 1095		UNASSIGNED	
TA-16-1096	16 - 1096		UNASSIGNED	
TA-16-1097	16 - 1097		UNASSIGNED	
TA-16-1098	16 - 1098		UNASSIGNED	
TA-16-1099	16 - 1099	CONDENSATE PUMP	STEAM	350+00 W30+00
TA-16-1100	16 - 1100	MANHOLE	ABANDONED 1959	325+00 W35+00
TA-16-1101	16 - 1101		REMOVED [illegible]	
TA-16-1102	16 - 1102		REMOVED [illegible]	
TA-16-1103	16 - 1103		REMOVED [illegible]	
TA-16-1104	16 - 1104		REMOVED	
TA-16-1105	16 - 1105		REMOVED	?
TA-16-1106	16 - 1106		REMOVED	
TA-16-1107	16 - 1107		REMOVED	
TA-16-1108	16 - 1108		REMOVED 1956	
TA-16-1109	16 - 1109		REMOVED 1958	
TA-16-1110	16 - 1110		REMOVED 1956	
TA-16-1111	16 - 1111		REMOVED 1968	
TA-16-1112	16 - 1112	MANHOLE	GAS DRIP POT	345+00 W70+00
TA-16-1113	16 - 1113	MANHOLE	GAS DRIP POT	340+00 W70+00
TA-16-1114	16 - 1114	MANHOLE	GAS DRIP POT	340+00 W75+00
TA-16-1115	16 - 1115	MANHOLE	WATER P.R.V.	345+00 W70+00
TA-16-1116	16 - 1116	MANHOLE	WATER P.R.V.	325+00 W35+00
TA-16-1117	16 - 1117	MANHOLE	WATER P.R.V.	335+00 W40+00
TA-16-1118	16 - 1118	MANHOLE	WATER	340+00 W65+00
TA-16-1119	16 - 1119	MANHOLE	WATER	325+00 W40+00
TA-16-1120	16 - 1120	MANHOLE	WATER	365+00 W20+00
TA-16-1121	16 - 1121	MANHOLE	AIR RELIEF VALVE	330+00 W60+00
TA-16-1122	16 - 1122	MANHOLE	WATER P.R.V.	355+00 W30+00
TA-16-1123	16 - 1123	MANHOLE	GAS P.R.V.	365+00 W 5+00
TA-16-1124	16 - 1124	MANHOLE	WATER	330+00 W75+00
TA-16-1125	16 - 1125	MANHOLE	WATER	330+00 W75+00
TA-16-1126	16 - 1126	MANHOLE	WATER	330+00 W65+00
TA-16-1127	16 - 1127	MANHOLE	WATER	320+00 W55+00
TA-16-1128	16 - 1128	MANHOLE	GAS P.R.V.	365+00 W 5+00
TA-16-1129	16 - 1129	TROUGH		325+00 0+00
TA-16-1130	16 - 1130		REMOVED 1949	
TA-16-1131	16 - 1131		REMOVED 1949	
TA-16-1132	16 - 1132		REMOVED 1958	
TA-16-1133	16 - 1133	GUARD HOUSE	RELOCATED TO TA-21-166	
TA-16-1134	16 - 1134	TROUGH	BASKET WASHING FAC.	325+00 0+00
TA-16-1135	16 - 1135	TROUGH	BASKET WASHING FAC.	325+00 0+00
TA-16-1136	16 - 1136		REMOVED	
TA-16-1137	16 - 1137		REMOVED	
TA-16-1138	16 - 1138		REMOVED	
TA-16-1139	16 - 1139		REMOVED	

REV	DATE	REVISION	BY	CKD	APP
17	9-23-83	REVISED TITLE BLOCK & DWG TO STATUS OF 7-27-83	HS		

UNIVERSITY OF CALIFORNIA
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

FACILITIES ENGINEERING DIVISION

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-16 S-SITE

DATE 9-23-83 SHEET NO 1 OF 1 DRAWING NO ENG-R 5111

TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-1140	16 - 1140		REMOVED 1956	
TA-16-1141	16 - 1141		REMOVED 1946	
			CANCELLED	
			CANCELLED	
			CANCELLED	
			CANCELLED	
			CANCELLED	
			CANCELLED	
			CANCELLED	
TA-16-1149	16 - 1149	MANHOLE	[illegible]	S45+00 W70+00
TA-16-1150	16 - 1150		[illegible]	
TA-16-1151	16 - 1151		″	
TA-16-1152	16 - 1152		″	
TA-16-1153	16 - 1153		″	
TA-16-1154	16 - 1154		″	
TA-16-1155	16 - 1155		″	
TA-16-1156	16 - 1156		″	
TA-16-1157	16 - 1157		″	
TA-16-1158	16 - 1158		″	
TA-16-1159	16 - 1159		″	
TA-16-1160	16 - 1160		″	
TA-16-1161	16 - 1161		″	
TA-16-1162	16 - 1162		″	
TA-16-1163	16 - 1163		″	
TA-16-1164	16 - 1164		″	
TA-16-1165	16 - 1165		″	
TA-16-1166	16 - 1166		″	
TA-16-1167	16 - 1167		″	
TA-16-1168	16 - 1168		″	
TA-16-1169	16 - 1169		″	
TA-16-1170	16 - 1170		″	
TA-16-1171	16 - 1171		″	
TA-16-1172	16 - 1172		″	
TA-16-1173	16 - 1173		″	
TA-16-1174	16 - 1174		″	
TA-16-1175	16 - 1175		″	
TA-16-1176	16 - 1176		″	
TA-16-1177	16 - 1177		″	
TA-16-1178	16 - 1178		″	
TA-16-1179	16 - 1179		″	
TA-16-1180	16 - 1180		″	
TA-16-1181	16 - 1181		″	
TA-16-1182	16 - 1182		″	
TA-16-1183	16 - 1183		″	
TA-16-1184	16 - 1184		″	
TA-16-1185	16 - 1185		″	
TA-16-1186	16 - 1186		″	
TA-16-1187	16 - 1187		″	
TA-16-1188	16 - 1188		″	
TA-16-1189	16 - 1189		″	
TA-16-1190	16 - 1190		″	
TA-16-1191	16 - 1191		″	
TA-16-1192	16 - 1192		″	
TA-16-1193	16 - 1193		″	
TA-16-1194	16 - 1194		″	
TA-16-1195	16 - 1195		″	
TA-16-1196	16 - 1196		″	
TA-16-1197	16 - 1197		″	
TA-16-1198	16 - 1198		″	
TA-16-1199	16 - 1199		″	
TA-16-1200	16 - 1200		″	
TA-16-1201	16 - 1201	MANHOLE	TELEPHONE	S15+00 W45+00
TA-16-1202	16 - 1202	MANHOLE	TELEPHONE	S15+00 W45+00
TA-16-1203	16 - 1203	MANHOLE	TELEPHONE	S15+00 W45+00
TA-16-1204	16 - 1204	JUNCTION BOX	TELEPHONE	S15+00 W50+00
TA-16-1205	16 - 1205	MANHOLE	TELEPHONE	S15+00 W50+00
TA-16-1206	16 - 1206	MANHOLE	TELEPHONE	S10+00 W50+00
TA-16-1207	16 - 1207	MANHOLE	TELEPHONE	S15+00 W50+00
TA-16-1208	16 - 1208	MANHOLE	TELEPHONE	S15+00 W50+00
TA-16-1209	16 - 1209	MANHOLE	TELEPHONE	S15+00 W60+00
TA-16-1210	16 - 1210	MANHOLE	TELEPHONE	S20+00 W60+00
TA-16-1211	16 - 1211	JUNCTION BOX	TELEPHONE	S20+00 W60+00
TA-16-1212	16 - 1212	MANHOLE	TELEPHONE	S15+00 W55+00
TA-16-1213	16 - 1213	MANHOLE	TELEPHONE	S15+00 W55+00
TA-16-1214	16 - 1214	JUNCTION BOX	TELEPHONE	S20+00 W50+00
TA-16-1215	16 - 1215	MANHOLE	TELEPHONE	S20+00 W55+00
TA-16-1216	16 - 1216	JUNCTION BOX	TELEPHONE	S20+00 W60+00
TA-16-1217	16 - 1217	MANHOLE	TELEPHONE	S20+00 W60+00
TA-16-1218	16 - 1218	MANHOLE	TELEPHONE	S25+00 W65+00
TA-16-1219	16 - 1219	MANHOLE	TELEPHONE	S25+00 W65+00
TA-16-1220	16 - 1220	MANHOLE	TELEPHONE	S35+00 W70+00
TA-16-1221	16 - 1221	MANHOLE	TELEPHONE	S30+00 W70+00
TA-16-1222	16 - 1222	MANHOLE	TELEPHONE	S40+00 W65+00
TA-16-1223	16 - 1223	MANHOLE	TELEPHONE	S40+00 W70+00
TA-16-1224	16 - 1224	MANHOLE	TELEPHONE	S40+00 W75+00
TA-16-1225	16 - 1225	MANHOLE	TELEPHONE	S40+00 W65+00
TA-16-1226	16 - 1226	MANHOLE	TELEPHONE	S45+00 W65+00
TA-16-1227	16 - 1227	JUNCTION BOX	TELEPHONE	S45+00 W60+00
TA-16-1228	16 - 1228	JUNCTION BOX	TELEPHONE	S45+00 W65+00
TA-16-1229	16 - 1229	MANHOLE	TELEPHONE	S45+00 W65+00
TA-16-1230	16 - 1230	MANHOLE	TELEPHONE	S45+00 W65+00
TA-16-1231	16 - 1231	MANHOLE	TELEPHONE	S45+00 W70+00
TA-16-1232	16 - 1232	MANHOLE	TELEPHONE	S50+00 W65+00
TA-16-1233	16 - 1233	MANHOLE	TELEPHONE	S55+00 W65+00
TA-16-1234	16 - 1234	MANHOLE	TELEPHONE	S55+00 W70+00
TA-16-1235	16 - 1235	JUNCTION BOX	TELEPHONE	S60+00 W70+00
TA-16-1236	16 - 1236	MANHOLE	TELEPHONE	S55+00 W65+00

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-1237	16 - 1237	MANHOLE	TELEPHONE	S55+00 W60+00
TA-16-1238	16 - 1238	MANHOLE	TELEPHONE	S55+00 W55+00
TA-16-1239	16 - 1239	MANHOLE	TELEPHONE	S55+00 W55+00
TA-16-1240	16 - 1240	MANHOLE	TELEPHONE	S55+00 W50+00
TA-16-1241	16 - 1241	JUNCTION BOX	TELEPHONE	S55+00 W45+00
TA-16-1242	16 - 1242	MANHOLE	TELEPHONE	S60+00 W45+00
TA-16-1243	16 - 1243	MANHOLE	TELEPHONE	S55+00 W45+00
TA-16-1244	16 - 1244	MANHOLE	TELEPHONE	S55+00 W45+00
TA-16-1245	16 - 1245	MANHOLE	TELEPHONE	S55+00 W40+00
TA-16-1246	16 - 1246	MANHOLE	TELEPHONE	S55+00 W35+00
TA-16-1247	16 - 1247	JUNCTION BOX	TELEPHONE	S55+00 W35+00
TA-16-1248	16 - 1248	MANHOLE	TELEPHONE	S56+00 W35+00
TA-16-1249	16 - 1249	MANHOLE	TELEPHONE	S60+00 W35+00
TA-16-1250	16 - 1250	JUNCTION BOX	TELEPHONE	S60+00 W30+00
TA-16-1251	16 - 1251	MANHOLE	TELEPHONE	S60+00 W30+00
TA-16-1252	16 - 1252	MANHOLE	TELEPHONE	S60+00 W30+00
TA-16-1253	16 - 1253	JUNCTION BOX	TELEPHONE	S60+00 W30+00
TA-16-1254	16 - 1254	JUNCTION BOX	TELEPHONE	S60+00 W35+00
TA-16-1255	16 - 1255	MANHOLE	TELEPHONE	S65+00 W35+00
TA-16-1256	16 - 1256	MANHOLE	TELEPHONE	S65+00 W35+00
TA-16-1257	16 - 1257	MANHOLE	TELEPHONE	S60+00 W35+00
TA-16-1258	16 - 1258	MANHOLE	TELEPHONE	S60+00 W35+00
TA-16-1259	16 - 1259	JUNCTION BOX	TELEPHONE	S55+00 W25+00
TA-16-1260	16 - 1260	MANHOLE	TELEPHONE	S55+00 W25+00
TA-16-1261	16 - 1261	MANHOLE	TELEPHONE	S55+00 W25+00
TA-16-1262	16 - 1262	JUNCTION BOX	TELEPHONE	S55+00 W25+00
TA-16-1263	16 - 1263	MANHOLE	TELEPHONE	S60+00 W25+00
TA-16-1264	16 - 1264	MANHOLE	TELEPHONE	S60+00 W25+00
TA-16-1265	16 - 1265	MANHOLE	TELEPHONE	S60+00 W20+00
TA-16-1266	16 - 1266	MANHOLE	TELEPHONE	S60+00 W20+00
TA-16-1267	16 - 1267	MANHOLE	TELEPHONE	S65+00 W20+00
TA-16-1268	16 - 1268	JUNCTION BOX	TELEPHONE	S65+00 W20+00
TA-16-1269	16 - 1269	MANHOLE	TELEPHONE	S65+00 W15+00
TA-16-1270	16 - 1270	MANHOLE	TELEPHONE	S65+00 W10+00
TA-16-1271	16 - 1271	MANHOLE	TELEPHONE	S65+00 W10+00
TA-16-1272	16 - 1272	MANHOLE	TELEPHONE	S70+00 W 5+00
TA-16-1273	16 - 1273	JUNCTION BOX	TELEPHONE	S70+00 W 5+00
TA-16-1274	16 - 1274	MANHOLE	TELEPHONE	S50+00 W25+00
TA-16-1275	16 - 1275	JUNCTION BOX	TELEPHONE	S50+00 W25+00
TA-16-1276	16 - 1276	MANHOLE	TELEPHONE	S50+00 W25+00
TA-16-1277	16 - 1277	JUNCTION BOX	TELEPHONE	S50+00 W25+00
TA-16-1278	16 - 1278	MANHOLE	TELEPHONE	S50+00 W25+00
TA-16-1279	16 - 1279	MANHOLE	TELEPHONE	S50+00 W25+00
TA-16-1280	16 - 1280	MANHOLE	TELEPHONE	S50+00 W25+00
TA-16-1281	16 - 1281	MANHOLE	TELEPHONE	S45+00 W25+00
TA-16-1282	16 - 1282	JUNCTION BOX	TELEPHONE	S45+00 W25+00
TA-16-1283	16 - 1283	JUNCTION BOX	TELEPHONE	S45+00 W25+00
TA-16-1284	16 - 1284	MANHOLE	TELEPHONE	S45+00 W25+00
TA-16-1285	16 - 1285	MANHOLE	TELEPHONE	S45+00 W30+00
TA-16-1286	16 - 1286	MANHOLE	TELEPHONE	S45+00 W25+00
TA-16-1287	16 - 1287	MANHOLE	TELEPHONE	S40+00 W25+00
TA-16-1288	16 - 1288	JUNCTION BOX	TELEPHONE	S40+00 W30+00
TA-16-1289	16 - 1289	MANHOLE	TELEPHONE	S45+00 W30+00
TA-16-1290	16 - 1290	MANHOLE	TELEPHONE	S45+00 W30+00
TA-16-1291	16 - 1291	JUNCTION BOX	TELEPHONE	S38+00 W25+00
TA-16-1292	16 - 1292	MANHOLE	TELEPHONE	S35+00 W25+00
TA-16-1293	16 - 1293	MANHOLE	TELEPHONE	S35+00 W25+00
TA-16-1294	16 - 1294	JUNCTION BOX	TELEPHONE	S35+00 W25+00
TA-16-1295	16 - 1295	MANHOLE	TELEPHONE	S38+00 W20+00
TA-16-1296	16 - 1296	JUNCTION BOX	TELEPHONE	S35+00 W20+00
TA-16-1297	16 - 1297	MANHOLE	TELEPHONE	S35+00 W20+00
TA-16-1298	16 - 1298	MANHOLE	TELEPHONE	S38+00 W20+00
TA-16-1299	16 - 1299	JUNCTION BOX	TELEPHONE	S35+00 W15+00
TA-16-1300	16 - 1300	MANHOLE	TELEPHONE	S36+00 W15+00
TA-16-1301	16 - 1301	MANHOLE	TELEPHONE	S35+00 W15+00
TA-16-1302	16 - 1302	MANHOLE	TELEPHONE	S35+00 W15+00
TA-16-1303	16 - 1303	JUNCTION BOX	TELEPHONE	S35+00 W10+00
TA-16-1304	16 - 1304	MANHOLE	TELEPHONE	S35+00 W30+00
TA-16-1305	16 - 1305	MANHOLE	TELEPHONE	S40+00 W30+00
TA-16-1306	16 - 1306	JUNCTION BOX	TELEPHONE	S40+00 W30+00
TA-16-1307	16 - 1307	MANHOLE	TELEPHONE	S40+00 W35+00
TA-16-1308	16 - 1308	MANHOLE	TELEPHONE	S40+00 W35+00
TA-16-1309	16 - 1309	JUNCTION BOX	TELEPHONE	S35+00 W35+00
TA-16-1310	16 - 1310	MANHOLE	TELEPHONE	S30+00 W35+00
TA-16-1311	16 - 1311	MANHOLE	TELEPHONE	S30+00 W30+00
TA-16-1312	16 - 1312	MANHOLE	TELEPHONE	S30+00 W25+00
TA-16-1313	16 - 1313	JUNCTION BOX	TELEPHONE	S30+00 W40+00
TA-16-1314	16 - 1314	MANHOLE	TELEPHONE	S30+00 W40+00
TA-16-1315	16 - 1315	MANHOLE	TELEPHONE	S30+00 W40+00
TA-16-1316	16 - 1316	MANHOLE	TELEPHONE	S35+00 W40+00
TA-16-1317	16 - 1317	MANHOLE	TELEPHONE	S30+00 W35+00
TA-16-1318	16 - 1318	MANHOLE	TELEPHONE	S30+00 W35+00
TA-16-1319	16 - 1319	MANHOLE	TELEPHONE	S30+00 W40+00
TA-16-1320	16 - 1320	MANHOLE	TELEPHONE	S25+00 W40+00
TA-16-1321	16 - 1321	MANHOLE	TELEPHONE	S25+00 W40+00
TA-16-1322	16 - 1322	MANHOLE	TELEPHONE	S25+00 W45+00
TA-16-1323	16 - 1323	MANHOLE	TELEPHONE	S20+00 W50+00
TA-16-1324	16 - 1324	MANHOLE	TELEPHONE	S20+00 W50+00
TA-16-1325	16 - 1325	JUNCTION BOX	TELEPHONE	S20+00 W45+00
TA-16-1326	16 - 1326	MANHOLE	TELEPHONE	S20+00 W45+00
TA-16-1327	16 - 1327	MANHOLE	TELEPHONE	S20+00 W45+00
TA-16-1328	16 - 1328	MANHOLE	TELEPHONE	S20+00 W45+00
TA-16-1329	16 - 1329		CANCELLED	
TA-16-1330	16 - 1330	CAPACITOR STATION		S30+00 W30+00
TA-16-1331	16 - 1331	VALVE HOUSE	NOT SHOWN	
TA-16-1332	16 - 1332	VALVE HOUSE	NOT SHOWN	

STRUCTURE NUMBER	STRUCTURE DESIGNATION	STRUCTURE NOMENCLATURE	REMARKS	APPROXIMATE GRID LOCATION
TA-16-1334	16 - 1334	TRANSFORMER STATION	NOT SHOWN	
TA-16-1335	16 - 1335	TRANSFORMER STATION	NOT SHOWN	
TA-16-1337	16 - 1337	MANHOLE, STEAM	NOT SHOWN	
TA-16-1338	16 - 1338	MANHOLE, STEAM	NOT SHOWN	
TA-16-1339	16 - 1339	MANHOLE, SEWER	NOT SHOWN	
TA-16-1340	16 - 1340	WIND TUNNEL	NOT SHOWN	
TA-16-1341	16 - 1341	TANK, FUEL U G	NOT SHOWN	
TA-16-1342	16 - 1342	TANK, FUEL U G	NOT SHOWN	
TA-16-1343	16 - 1343	VALVE PIT	NOT SHOWN	

REV	DATE	REVISION	BY	CHD	APP
18	9-23-83	REVISED TITLE BLOCK & DWG TO STATUS OF 7-27-83			

UNIVERSITY OF CALIFORNIA
Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

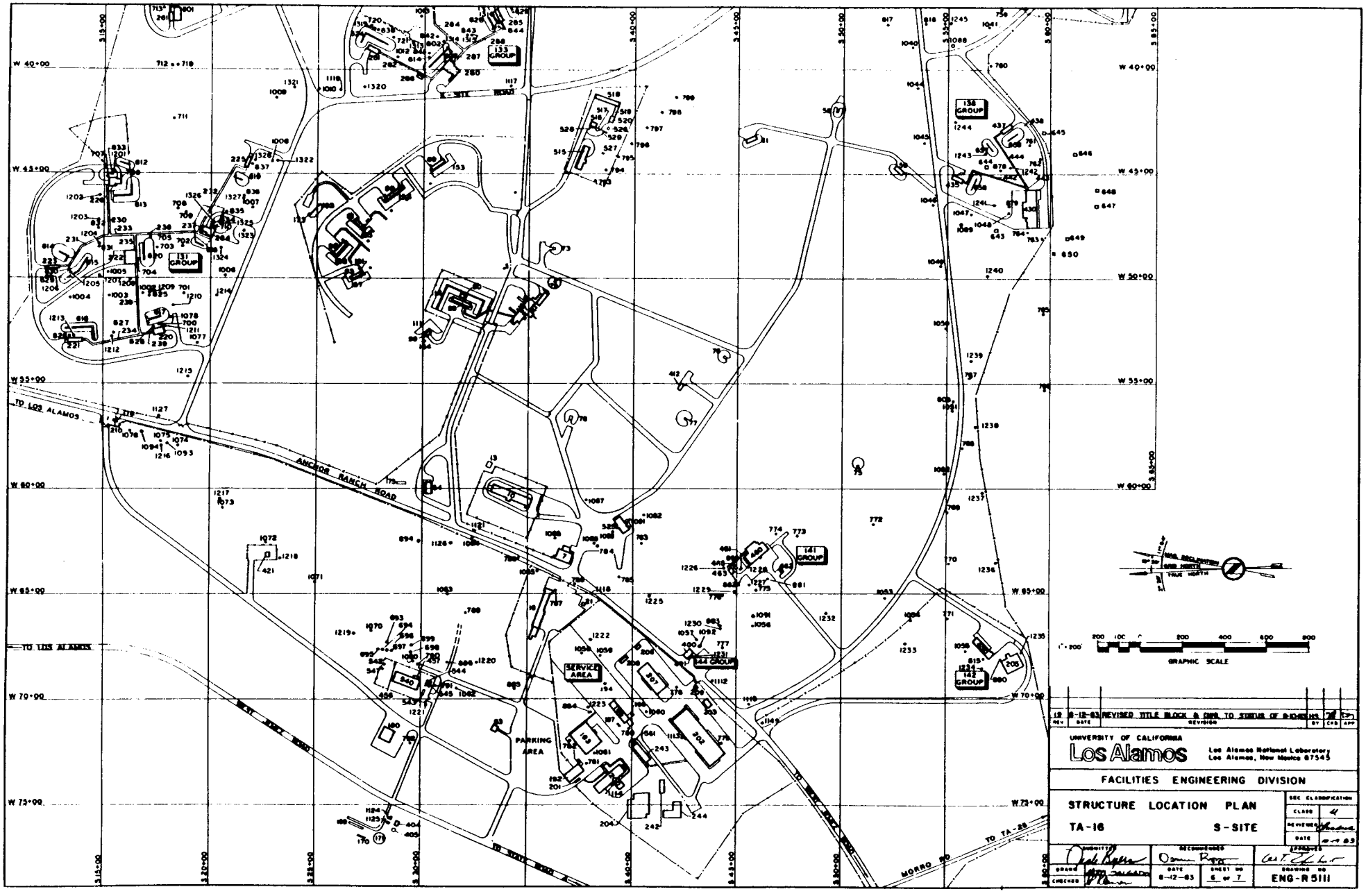
FACILITIES ENGINEERING DIVISION

INDEX SHEET
STRUCTURE LOCATION PLAN
TA-16 S-SITE

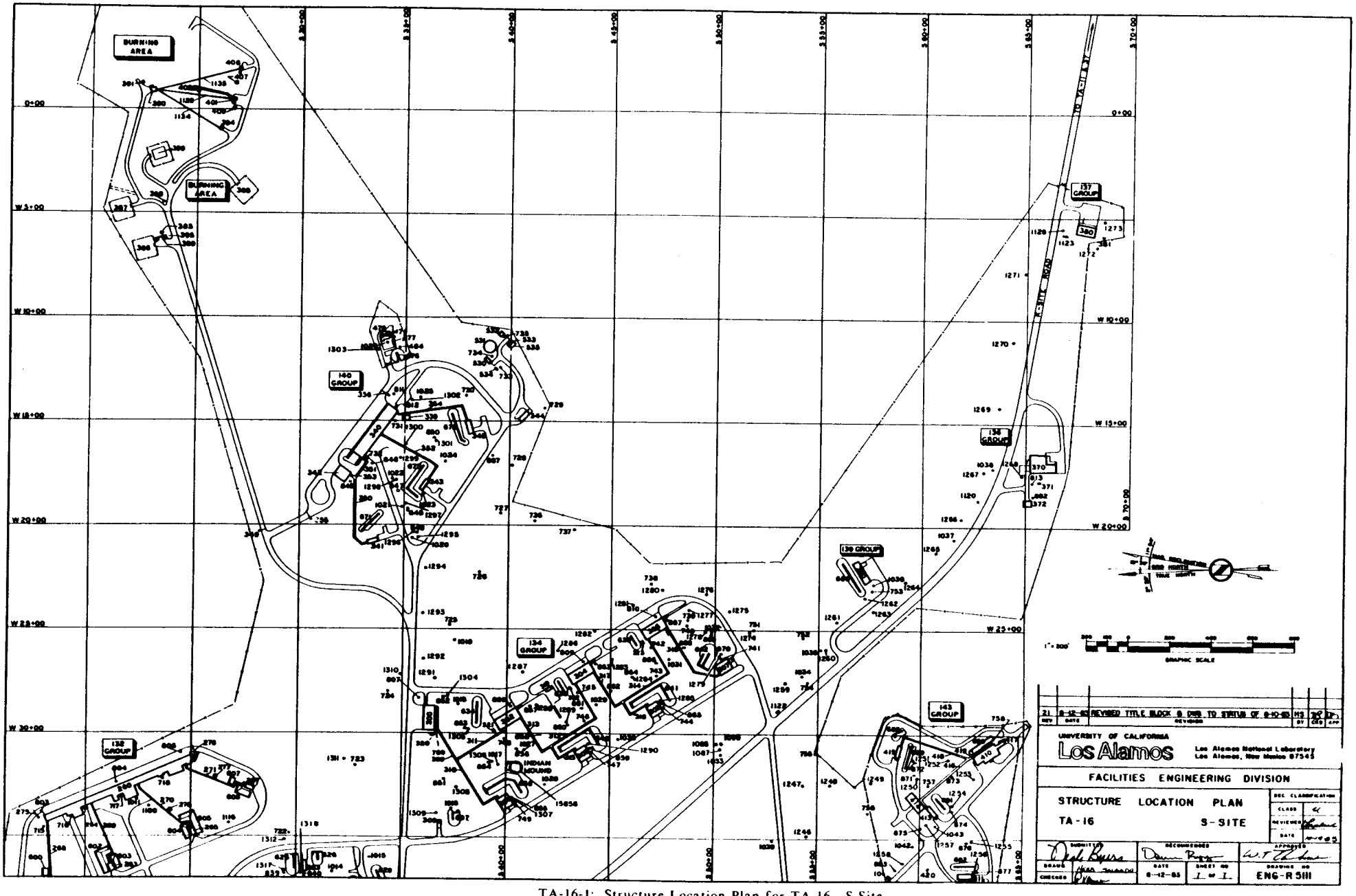
SEC CLASSIFICATION — CLASS 4

DATE 9-23-83 — SHEET NO 3 OF 7 — DRAWING NO ENG-R 5111

TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)



TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)



TA-16-1: Structure Location Plan for TA-16 - S Site
(1983 Drawing from the LANL Technical Area Structure Location Plans)

STRUCTURE NUMBER	DESIG-NATION	REMARKS & FORMER DESIGNATION	GRID
TA-16-1	16-1	ADMIN BLDG. (REMOVED 1956)	
TA-16-2	16-2	OFFICE (REMOVED 1959)	
TA-16-3	16-3	ELEC BLDG (REMOVED 1959)	
TA-16-4	16-4	INFLAM STOR (REMOVED 1956)	
TA-16-5	16-5	INSTRUMENT SHOP (REMOVED 1956)	
TA-16-6	16-6	ZIA REPAIR SHOP (REMOVED 1956)	
TA-16-7	16-7	MACHINE SHOP	S-35 W85
TA-16-8	16-8	ZIA CABINET SHOP (REMOVED 1956)	
TA-16-9	16-9	MTR POOL DISPATCH OFF (REM 1956)	
TA-16-10	16-10	WAREHOUSE	S-35 W80
TA-16-11	16-11	STORAGE (REMOVED) 1956	S-100
TA-16-12	16-12	WAREHOUSE (REMOVED) 1956	S-101
TA-16-13	16-13	DOCK	S-107 S-35 W80
TA-16-14	16-14	GUARD HOUSE (STA 612) (REM) 1956	
TA-16-15	16-15	LAUNDRY & LNR PKL (REMOVED)	S-15
TA-16-16	16-16	CAFETERIA	S-13 S-35 W80
TA-16-17	16-17	PLUMBING SHOP (REM) 1956	S-14
TA-16-18	16-18	STEAM WASHING HOUSE	S-15 S40 W80
TA-16-19	16-19	PUMP HOUSE (REMOVED) 1956	S-16
TA-16-20	16-20	WATER PUMP PIT	S-35 W80
TA-16-21	16-21	PUMPING STATION	S-17A S-35 W80
TA-16-22	16-22	OFFICE	S-18 S-35 W80
TA-16-23	16-23	STORAGE (REMOVED) 1951	S-19
TA-16-24	16-24	ANALYTICAL LAB	S-20 S-35 W50
TA-16-25	16-25	PROCESS BLDG	S-23 S-35 W50
TA-16-26	16-26	PROCESS BLDG	S-24 S-35 W50
TA-16-27	16-27	MELT & CAST	S-25 & 26 S-35 W50
TA-16-28	16-28	WATER COOLING TOWER	S-25 S-35 W50
TA-16-29	16-29	FUEL OIL TANK (REMOVED 1956)	
TA-16-30	16-30	MAGAZINE	S-28A S-30 W50
TA-16-31	16-31	MACH BLDG	S-28B S-30 W50
TA-16-32	16-32	MACH BLDG	S-28C S-30 W50
TA-16-33	16-33	MACH BLDG	S-28D S-30 W50
TA-16-34	16-34	MAGAZINE	S-28E S-35 W85
TA-16-35	16-35	EQUIPMENT ROOM	S-29 S-30 W50
TA-16-36	16-36	STEAM CLEANING	S-37 S-30 W50
TA-16-37	16-37	EXPLOSIVE TESTING	S-27 S-30 W50
TA-16-38	16-38	EXPERIMENTAL CASTING	S-28 S-45 W50
TA-16-39	16-39	RADIO GRAPHIC BLDG	S-29 S-25 W50
TA-16-40	16-40	RADIO GRAPHIC BLDG	S-29A S-25 W50
TA-16-41	16-41	PROCESS LAB	S-30 S-40 W50
TA-16-42	16-42	PROCESS BLDG	S-31 S-40 W50
TA-16-43	16-43	PROCESS BLDG	S-32 S-40 W50
TA-16-44	16-44	PROCESS BLDG	S-33 S-40 W50
TA-16-45	16-45	PROCESS BLDG	S-34 S-45 W50
TA-16-46	16-46	PROCESS BLDG	S-35 S-40 W50
TA-16-47	16-47	EQUIPMENT	S-35E S-40 W50
TA-16-48	16-48	SMOKING ROOM	S-36 S-45 W50
TA-16-49	16-49	ANALYTICAL LAB	S-41 S-50 W50
TA-16-50	16-50	EXPERIMENTAL CASTING	S-42 S-50 W50
TA-16-51	16-51	STEAM CLEANING	S-42A S-50 W50
TA-16-52	16-52	EXPLOSIVE WATL	S-43 S-50 W50
TA-16-53	16-53	OPTICAL EQUIP STORAGE	S-44 S-45 W50
TA-16-54	16-54	PROCESS BLDG	S-45 S-30 W80
TA-16-55	16-55	GRINDING BLDG.	S-45A S-45 W50
TA-16-56	16-56	TESTING LAB	S-46 S-55 W50
TA-16-57	16-57	MAGAZINE	S-56 S-45 W50
TA-16-58	16-58	MAGAZINE	S-57 S-50 W50
TA-16-59	16-59	MAGAZINE	S-58 S-55 W50
TA-16-60	16-60	MAGAZINE (REMOVED) 1950	S-58
TA-16-61	16-61	MAGAZINE	S-60 S-45 W50
TA-16-62	16-62	MAGAZINE	S-60 S-30 W70
TA-16-63	16-63	MAGAZINE	S-67 S-35 W70
TA-16-64	16-64	MAGAZINE (REMOVED)	S-68
TA-16-65	16-65	MAGAZINE	S-69 S40 W75
TA-16-66	16-66	MAGAZINE	S-70 S-45 W50
TA-16-67	16-67	MAGAZINE	S-71 S-55 W50
TA-16-68	16-68	MAGAZINE	S-72 S-55 W80
TA-16-69	16-69	MAGAZINE	S-73 S-45 W50
TA-16-70	16-70	MAGAZINE	S-74 S-50 W50
TA-16-71	16-71	MAGAZINE	S-75 S-50 W50
TA-16-72	16-72	MAGAZINE	S-76 S40 W50
TA-16-73	16-73	SMOKING ROOM	S-77 S-35 W50
TA-16-74	16-74	MAGAZINE	S-78 S-30 W50
TA-16-75	16-75	PERSONNEL SHELTER	S-80 S-40 W50
TA-16-76	16-76	PERSONNEL SHELTER	S-81 S-45 W50
TA-16-77	16-77	PERSONNEL SHELTER	S-82 S-45 W50
TA-16-78	16-78	PERSONNEL SHELTER	S-83 S-45 W50
TA-16-79	16-79	SMOKING ROOM	S-84 S-35 W50
TA-16-80	16-80	STORAGE	S-85 S-30 W50
TA-16-81	16-81	PROCESS BLDG & FAN RM	S-86 S-45 W50
TA-16-82	16-82	STORAGE	S-81 S-50 W50
TA-16-83	16-83	LABORATORY	S-82 S-45 W50
TA-16-84	16-84	MAGAZINE	S-83 S-45 W45
TA-16-85	16-85	WAREHOUSE (DESTROYED)	S-84
TA-16-86	16-86	LABORATORY	S-85 S-45 W50
TA-16-87	16-87	MACH SHOP TRAILER	S-85A S-50 W55
TA-16-88	16-88	CASTING REST HOUSE	S-100 S-30 W50
TA-16-89	16-89	PROCESS BLDG	S-102 S-30 W40
TA-16-90	16-90	PROCESS BLDG	S-102 S-30 W40
TA-16-91	16-91	PROCESS BLDG	S-103 S-25 W50
TA-16-92	16-92	INSPECT BLDG	S-101 S-30 W50
TA-16-93	16-93	PROCESS BLDG	S-103 S-35 W50
TA-16-94	16-94	EQUIPMENT & CONTROL	S-106 S-35 W50
TA-16-95	16-95	MACH BLDG	S-106N S-35 W45
TA-16-96	16-96	MACH BLDG	S-106S S-35 W45
TA-16-97	16-97	MACH BLDG	S-106W S-35 W45
TA-16-98	16-98	MACH BLDG	S-106E S-35 W45
TA-16-99	16-99	PROCESS BLDG	S-107 S-30 W50
TA-16-100	16-100	PROCESS BLDG	S-108 S40 W50
TA-16-101	16-101	GUARD HOUSE (STATION 633)	S40 W30
TA-16-102	16-102	PASSAGEWAY (27 TO 29)	S35 W50
TA-16-103	16-103	PASSAGEWAY (36 TO 41)	S35 W50
TA-16-104	16-104	PASSAGEWAY (42 TO 45)	S40 W50
TA-16-105	16-105	PASSAGEWAY (24 TO 103)	S35 W50
TA-16-106	16-106	STORAGE (REMOVED 1949) A-1	
TA-16-107	16-107	STORAGE (REMOVED 1950) A-2	
TA-16-108	16-108	STORAGE (REMOVED 1950) A-3	
TA-16-109	16-109	STORAGE (REMOVED 1950) A-4	
TA-16-110	16-110	BARRICADE	S30 W50
TA-16-111	16-111	BARRICADE	S30 W50
TA-16-112	16-112	BARRICADE	S30 W50
TA-16-113	16-113	BARRICADE	S-118 S45 W80
TA-16-114	16-114	BARRICADE	S-119 S40 W65
TA-16-115	16-115	BARRICADE	S-120 S40 W50
TA-16-116	16-116	BARRICADE	S-121 S40 W55
TA-16-117	16-117	BARRICADE (REMOVED) 1951	S-122
TA-16-118	16-118	BARRICADE (REMOVED) 1950	S-123
TA-16-119	16-119	BARRICADE (REMOVED)	S-124
TA-16-120	16-120	BARRICADE	S-125 S35 W55
TA-16-121	16-121	BARRICADE	S-126 S35 W50
TA-16-122	16-122	BARRICADE	S-127 S45 W55
TA-16-123	16-123	BARRICADE (REMOVED) 1949	S-128
TA-16-124	16-124	BARRICADE (REMOVED)	S-129
TA-16-125	16-125	BARRICADE	S-130 S35 W55
TA-16-126	16-126	BARRICADE	S-131 S35 W45
TA-16-127	16-127	BARRICADE	S-132 S35 W45
TA-16-128	16-128	BARRICADE	S-133 S35 W45
TA-16-129	16-129	BARRICADE	S-134 S35 W45
TA-16-130	16-130	GUARD HOUSE (REMOVED)	
TA-16-131	16-131	GUARD HOUSE (STATION 425)	S-136 S35 W40
TA-16-132	16-132	PAINT SHOP (SHED REM 1955)	S-137
TA-16-133	16-133	LUMBER STORAGE (REM 1955)	S-138
TA-16-134	16-134	MESS HALL (REMOVED 1955)	S-139
TA-16-135	16-135	STORAGE BLDG (REM 1955)	S-140
TA-16-136	16-136	IMPLEMENT SHED (REM 1955)	S-141
TA-16-137	16-137	ELE & ELEC SHOP (REM 1955)	S-142
TA-16-138	16-138	BLACKSMITH SHOP (REM 1955)	S-143
TA-16-139	16-139	STORAGE BLDG (REM 1955)	S-144
TA-16-140	16-140	STORAGE BLDG (REM 1955)	S-145
TA-16-141	16-141	STORAGE BLDG (REM 1955)	S-146
TA-16-142	16-142	PUMP HOUSE (REM 1955)	S-147
TA-16-143	16-143	PUMP HOUSE (REM 1955)	S-148
TA-16-144	16-144	PUMP HOUSE (REM 1955)	S-149
TA-16-145	16-145	PUMP HOUSE (REM 1955)	S-150
TA-16-146	16-146	LAVATORY (REM 1955)	S-151
TA-16-147	16-147	STORAGE (REMOVED)	S-151
TA-16-148	16-148	ROAD BLOCK (REMOVED)	
TA-16-149	16-149	EQUIPMENT BLDG.	S35 W55
TA-16-150	16-150	GUARD BLDG. (REMOVED)	
TA-16-151	16-151	HOSE HOUSE	S35 W80
TA-16-152	16-152	HOSE HOUSE	S40 W80
TA-16-153	16-153	HOSE HOUSE	S50 W50
TA-16-154	16-154	BARRICADE	S50 W45
TA-16-155	16-155	BARRICADE	S25 W50
TA-16-156	16-156	BARRICADE	S25 W50
TA-16-157	16-157	BARRICADE	S25 W50
TA-16-158	16-158	BARRICADE	S25 W50
TA-16-159	16-159	BARRICADE	S25 W55
TA-16-160	16-160	ROAD BLOCK (REMOVED) 1956	
TA-16-161	16-161	SEPTIC TANK (ABANDONED)	S35 W70
TA-16-162	16-162	LATRINE	S35 W45
TA-16-163	16-163	BARRICADE	S35 W45
TA-16-164	16-164	STORAGE BLDG	S30 W55
TA-16-165	16-165	GUARD HOUSE (REMOVED) 1956	
TA-16-166	16-166	PASSAGEWAY 50 TO 52	S50 W55
TA-16-167	16-167	HOSE HOUSE	S50 W55
TA-16-168	16-168	STORAGE (REMOVED)	
TA-16-169	16-169	STORAGE TANK (WATER)	S25 W75
TA-16-170	16-170	STORAGE TANK (WATER)	S35 W75
TA-16-171	16-171	STORAGE TANK (WATER)	S30 W75
TA-16-172	16-172	STORAGE TANK (WATER)	S25 W75
TA-16-173	16-173	SEPTIC TANK (SANITARY)	S25 W45
TA-16-174	16-174	SEPTIC TANK (SANITARY)	S25 W80
TA-16-175	16-175	SEPTIC TANK (SANITARY)	S30 W80
TA-16-176	16-176	SEPTIC TANK (SANITARY)	S30 W80
TA-16-177	16-177	SEPTIC TANK (SANITARY)	S35 W50
TA-16-178	16-178	SEPTIC TANK (SANITARY)	S35 W30
TA-16-179	16-179	SEPTIC TANK (SANITARY)	S35 W55
TA-16-180	16-180	FIRE STATION	S30 W70
TA-16-181	16-181	TANK HOUSING (REMOVED) 1956	
TA-16-182	16-182	DIESEL UNIT BLDG (REM) 1956	
TA-16-183	16-183	DRUM STORAGE	S30 W50
TA-16-184	16-184	DRUM STORAGE	S30 W50
TA-16-185	16-185	DRUM STORAGE	S30 W50
TA-16-186	16-186	DRUM STORAGE	S30 W50
TA-16-187	16-187	DRUM STORAGE	S30 W45
TA-16-188	16-188	DRUM STORAGE (REMOVED)	
TA-16-189	16-189	COOLING TOWER	S40 W55
TA-16-190	16-190	DRUM STORAGE (REMOVED) 1955	
TA-16-191	16-191	SOLVENT STORAGE	S40 W55
TA-16-192	16-192	GUARD HOUSE (STATION 610 & 611)	S35 W35
TA-16-193	16-193	CHAGE HOUSE	S40 W70
TA-16-194	16-194	RESERVE	
TA-16-195	16-195	SERVICE STATION	S40 W70
TA-16-196	16-196	UNDERGROUND TANK (FUEL)	S40 W70
TA-16-197	16-197	UNDERGROUND TANK (FUEL)	S35 W70
TA-16-198	16-198	HOSE HOUSE	S30 W80
TA-16-199	16-199	RESERVE	
TA-16-200	16-200	ADMINISTRATION BLDG	S40 W75
TA-16-201	16-201	RESERVE	
TA-16-202	16-202	SHOPS BLDG	S45 W70
TA-16-203	16-203	LUMBER STORAGE	S45 W70
TA-16-204	16-204	RESERVE	
TA-16-205	16-205	PAINT & BOTTLE STORAGE	S40 W70
TA-16-206	16-206	WAREHOUSE	S40 W70
TA-16-207	16-207	SOLVENT STORAGE	S40 W70
TA-16-208	16-208	GUARD HOUSE (STATION 612)	S40 W70
TA-16-209	16-209	GUARD HOUSE (STATION 625)	S40 W70
TA-16-210	16-210	ROAD BLOCK	S15 W55
TA-16-211	16-211	ROAD BLOCK	S15 W55
TA-16-212	16-212	ROAD BLOCK	S15 W55
TA-16-213	16-213	RESERVE	
TA-16-214	16-214	"	
TA-16-215	16-215	"	
TA-16-216	16-216	"	
TA-16-217	16-217	"	
TA-16-218	16-218	"	
TA-16-219	16-219	"	
TA-16-220	16-220	X-RAY BLDG 131-1	S20 W55
TA-16-221	16-221	REST HOUSE 131-A	S15 W55
TA-16-222	16-222	DARK ROOM BLDG 131-B	S15 W50
TA-16-223	16-223	REST HOUSE 131-C	S15 W50
TA-16-224	16-224	X-RAY BLDG 131-2	S20 W50
TA-16-225	16-225	REST HOUSE 131-2	S20 W40
TA-16-226	16-226	X-RAY BLDG 131-3	S15 W45
TA-16-227	16-227	RESERVE	
TA-16-228	16-228	"	
TA-16-229	16-229	"	
TA-16-230	16-230	PASSAGEWAY	S15 W45
TA-16-231	16-231	PASSAGEWAY	S15 W50
TA-16-232	16-232	PASSAGEWAY	S20 W50
TA-16-233	16-233	PASSAGEWAY	S15 W50
TA-16-234	16-234	PASSAGEWAY	S15 W50
TA-16-235	16-235	PASSAGEWAY	S15 W50
TA-16-236	16-236	PASSAGEWAY	S20 W50
TA-16-237	16-237	PASSAGEWAY	S20 W50
TA-16-238	16-238	PASSAGEWAY	S15 W50
TA-16-239	16-239	PASSAGEWAY	S15 W55
TA-16-240	16-240	RESERVE	
TA-16-241	16-241	"	
TA-16-242	16-242	"	
TA-16-243	16-243	"	
TA-16-244	16-244	"	
TA-16-245	16-245	RESERVE	
TA-16-246	16-246	"	
TA-16-247	16-247	"	
TA-16-248	16-248	"	
TA-16-249	16-249	"	
TA-16-250	16-250	"	
TA-16-251	16-251	"	
TA-16-252	16-252	"	
TA-16-253	16-253	"	
TA-16-254	16-254	"	
TA-16-255	16-255	"	
TA-16-256	16-256	"	
TA-16-257	16-257	"	
TA-16-258	16-258	"	
TA-16-259	16-259	"	
TA-16-260	16-260	PROCESS BLDG 5-132	S30 W50
TA-16-261	16-261	REST HOUSE 132-A	S30 W50
TA-16-262	16-262	COOLING TOWER	S30 W50
TA-16-263	16-263	REST HOUSE 132-B	S30 W50
TA-16-264	16-264	RESERVE	
TA-16-265	16-265	REST HOUSE 132-C	S25 W35
TA-16-266	16-266	RESERVE	
TA-16-267	16-267	REST HOUSE 132-D	S30 W35
TA-16-268	16-268	PASSAGEWAY	S30 W50
TA-16-269	16-269	PASSAGEWAY	S30 W50
TA-16-270	16-270	PASSAGEWAY	S30 W50
TA-16-271	16-271	PASSAGEWAY	S30 W50
TA-16-272	16-272	SEPTIC TANK (ABANDONED)	S30 W50
TA-16-273	16-273	DOSING CHAMBER (ABANDONED)	S30 W50
TA-16-274	16-274	DISTRIBUTION BOX (ABANDONED)	S30 W50
TA-16-275	16-275	RESERVE	
TA-16-276	16-276	"	
TA-16-277	16-277	"	
TA-16-278	16-278	"	
TA-16-279	16-279	"	
TA-16-280	16-280	INSPECTION BLDG. 133-1	S35 W50
TA-16-281	16-281	REST HOUSE 133-A	S35 W50
TA-16-282	16-282	PASSAGEWAY	S35 W50
TA-16-283	16-283	REST HOUSE 133-B	S35 W50
TA-16-284	16-284	PASSAGEWAY	S35 W50
TA-16-285	16-285	REST HOUSE 133-C	S35 W50
TA-16-286	16-286	SEPTIC HOUSE	S35 W50
TA-16-287	16-287	PASSAGEWAY	S35 W50
TA-16-288	16-288	PASSAGEWAY	S35 W50
TA-16-289	16-289	PASSAGEWAY	S35 W50
TA-16-290	16-290	RESERVE	
TA-16-291	16-291	"	
TA-16-292	16-292	"	
TA-16-293	16-293	"	
TA-16-294	16-294	"	
TA-16-295	16-295	"	
TA-16-296	16-296	"	
TA-16-297	16-297	"	
TA-16-298	16-298	"	
TA-16-299	16-299	"	
TA-16-300	16-300	PROCESS BLDG. 134-1	S35 W50
TA-16-301	16-301	REST HOUSE 134-A	S35 W50
TA-16-302	16-302	PROCESS BLDG. 134-2	S35 W50
TA-16-303	16-303	REST HOUSE 134-B	S35 W50
TA-16-304	16-304	PROCESS BLDG. 134-3	S35 W50
TA-16-305	16-305	REST HOUSE 134-C	S35 W50
TA-16-306	16-306	PROCESS BLDG. 134-4	S35 W50
TA-16-307	16-307	REST HOUSE 134-D	S35 W50
TA-16-308	16-308	DRYING BLDG 134-5	S35 W50
TA-16-309	16-309	PASSAGEWAY	S35 W50
TA-16-310	16-310	PASSAGEWAY	S35 W50
TA-16-311	16-311	PASSAGEWAY	S35 W50
TA-16-312	16-312	PASSAGEWAY	S35 W50
TA-16-313	16-313	PASSAGEWAY	S35 W50
TA-16-314	16-314	PASSAGEWAY	S35 W50
TA-16-315	16-315	PASSAGEWAY	S35 W50
TA-16-316	16-316	PASSAGEWAY	S35 W50
TA-16-317	16-317	PASSAGEWAY	S35 W25
TA-16-318	16-318	PASSAGEWAY	S35 W50
TA-16-319	16-319	PASSAGEWAY	S35 W50
TA-16-320	16-320	HOUSE	S30 W30
TA-16-321	16-321	RESERVE	
TA-16-322	16-322	"	
TA-16-323	16-323	"	
TA-16-324	16-324	"	
TA-16-325	16-325	"	
TA-16-326	16-326	"	
TA-16-327	16-327	"	
TA-16-328	16-328	"	
TA-16-329	16-329	"	
TA-16-330	16-330	"	
TA-16-331	16-331	"	
TA-16-332	16-332	"	
TA-16-333	16-333	"	
TA-16-334	16-334	"	
TA-16-335	16-335	"	
TA-16-336	16-336	"	
TA-16-337	16-337	"	
TA-16-338	16-338	"	
TA-16-339	16-339	"	
TA-16-340	16-340	PAINTING & BOXING BLDG 138-1	S35 W20
TA-16-341	16-341	RESERVE	
TA-16-342	16-342	"	
TA-16-343	16-343	"	
TA-16-344	16-344	"	
TA-16-345	16-345	"	
TA-16-346	16-346	"	
TA-16-347	16-347	"	
TA-16-348	16-348	"	
TA-16-349	16-349	"	
TA-16-350	16-350	"	
TA-16-351	16-351	"	
TA-16-352	16-352	"	
TA-16-353	16-353	"	
TA-16-354	16-354	"	
TA-16-355	16-355	"	
TA-16-356	16-356	"	
TA-16-357	16-357	"	
TA-16-358	16-358	"	
TA-16-359	16-359	"	
TA-16-360	16-360	"	
TA-16-361	16-361	"	
TA-16-362	16-362	"	
TA-16-363	16-363	"	
TA-16-364	16-364	"	
TA-16-365	16-365	"	
TA-16-366	16-366	"	
TA-16-367	16-367	RESERVE	
TA-16-368	16-368	"	
TA-16-369	16-369	"	
TA-16-370	16-370	PREPARATION BLDG 136-1	S45 W45
TA-16-371	16-371	SEPTIC TANK (SANITARY)	S45 W20
TA-16-372	16-372	COOLING TOWER	S45 W20
TA-16-373	16-373	RESERVE	
TA-16-374	16-374	"	
TA-16-375	16-375	"	
TA-16-376	16-376	"	
TA-16-377	16-377	"	
TA-16-378	16-378	"	
TA-16-379	16-379	"	
TA-16-380	16-380	PREPARATION BLDG 137-1	S30 W45
TA-16-381	16-381	SEPTIC TANK (SANITARY)	S30 W45
TA-16-382	16-382	RESERVE	
TA-16-383	16-383	"	
TA-16-384	16-384	"	
TA-16-385	16-385	"	
TA-16-386	16-386	RUNNING SLAB	S30 W45
TA-16-387	16-387	RUNNING SLAB	S30 W45
TA-16-388	16-388	RUNNING SLAB	S30 W45
TA-16-389	16-389	RUNNING SLAB	S30 W45
TA-16-390	16-390	RESERVE	
TA-16-391	16-391	BASKET WASH BUILDING	S25 0
TA-16-392	16-392	UNDERGROUND TANK (PROPANE)	S25 0
TA-16-393	16-393	FILTER BED	S25 0
TA-16-394	16-394	FILTER BED	S25 0
TA-16-395	16-395	FILTER BED	S25 0
TA-16-396	16-396	BARRICADE	S25 0
TA-16-397	16-397	LATRINE	S25 0
TA-16-398	16-398	ROAD BLOCK	S25 W5
TA-16-399	16-399	MANHOLE (WATER PRV)	S25 W5
TA-16-400	16-400	RUNNING SLAB (RETIRED)	S25 W5
TA-16-401	16-401	TRUCK WASHING BLDG. 142-1	S35 W70
TA-16-402	16-402	RESERVE	
TA-16-403	16-403	"	
TA-16-404	16-404	"	
TA-16-405	16-405	"	
TA-16-406	16-406	"	
TA-16-407	16-407	"	
TA-16-408	16-408	"	
TA-16-409	16-409	"	
TA-16-410	16-410	ASSEMBLY BLDG. 143-1	S45 W35
TA-16-411	16-411	REST HOUSE 143-C	S45 W35
TA-16-412	16-412	RESERVE	
TA-16-413	16-413	REST HOUSE 143-A	S45 W35
TA-16-414	16-414	MATERIAL BED	S45 W35
TA-16-415	16-415	REST HOUSE 143-B	S45 W35
TA-16-416	16-416	PASSAGEWAY	S45 W35
TA-16-417	16-417	DRUM STORAGE	S45 W35
TA-16-418	16-418	PASSAGEWAY	S45 W35
TA-16-419	16-419	PASSAGEWAY	S45 W35
TA-16-420	16-420	SEPTIC TANK (SANITARY)	S60 W35
TA-16-421	16-421	RESERVE	
TA-16-422	16-422	"	
TA-16-423	16-423	"	
TA-16-424	16-424	"	
TA-16-425	16-425	"	
TA-16-426	16-426	"	
TA-16-427	16-427	"	
TA-16-428	16-428	PRESSING BLDG 138-1	S80 W45
TA-16-429	16-429	SEPTIC TANK (ABANDONED)	S80 W45
TA-16-430	16-430	RESERVE	
TA-16-431	16-431	"	
TA-16-432	16-432	"	
TA-16-433	16-433	"	
TA-16-434	16-434	"	
TA-16-435	16-435	"	
TA-16-436	16-436	"	
TA-16-437	16-437	"	
TA-16-438	16-438	REST HOUSE 138-B	S55 W45
TA-16-439	16-439	RESERVE	
TA-16-440	16-440	REST HOUSE 138-A	S60 W45
TA-16-441	16-441	RESERVE	
TA-16-442	16-442	"	
TA-16-443	16-443	PASSAGEWAY	S55 W45
TA-16-444	16-444	PASSAGEWAY	S60 W45
TA-16-445	16-445	PASSAGEWAY	S60 W45
TA-16-446	16-446	RESERVE	
TA-16-447	16-447	"	
TA-16-448	16-448	"	
TA-16-449	16-449	"	
TA-16-450	16-450	ELECTROPLATING BLDG 142-1	S55 W70
TA-16-451	16-451	RESERVE	
TA-16-452	16-452	"	
TA-16-453	16-453	"	
TA-16-454	16-454	"	
TA-16-455	16-455	"	
TA-16-456	16-456	"	
TA-16-457	16-457	"	
TA-16-458	16-458	"	
TA-16-459	16-459	"	
TA-16-460	16-460	"	
TA-16-461	16-461	LABORATORY BLDG 141-1	S45 W65
TA-16-462	16-462	RESERVE	
TA-16-463	16-463	STORAGE BLDG 141-2	S45 W65
TA-16-464	16-464	RESERVE	
TA-16-465	16-465	MAGAZINE 141-A	S45 W65
TA-16-466	16-466	RESERVE	
TA-16-467	16-467	"	
TA-16-468	16-468	"	
TA-16-469	16-469	"	
TA-16-470	16-470	"	
TA-16-471	16-471	"	
TA-16-472	16-472	"	
TA-16-473	16-473	"	
TA-16-474	16-474	"	
TA-16-475	16-475	OFFICE & SHOP BLDG (REM.) P-1	
TA-16-476	16-476	LABORATORY BLDG P-2	S35 W10
TA-16-477	16-477	LABORATORY BLDG P-3	S35 W10
TA-16-478	16-478	LAB & MACH (TEMP) BLDG P-4	S35 W10
TA-16-479	16-479	STORAGE BLDG (REMOVED) P-5	
TA-16-480	16-480	EXPERIMENTAL STORAGE HOUSE	
TA-16-481	16-481	MAGAZINE (REMOVED) 1951 P-7	
TA-16-482	16-482	STORAGE BLDG (REMOVED) P-8	
TA-16-483	16-483	BARRICADE (REMOVED) 1951 P-9	
TA-16-484	16-484	SEPTIC TANK (REMOVED) P-10	S35 W10
TA-16-485	16-485	MANHOLE (CONTROL) P-11	S35 W10
TA-16-486	16-486	ROAD BLOCK P-12	
TA-16-487	16-487	SEPTIC TANK (REMOVED) P-13	
TA-16-488	16-488	TRANSFORMER STA (REM) P-13	
TA-16-489	16-489	MAGAZINE (REMOVED) P-14	
TA-16-490	16-490	CHARGE STATION P-15	S35 W10
TA-16-491	16-491	LABORATORY BLDG	S35 W35
TA-16-492	16-492	HUTMENT	S35 W35
TA-16-493	16-493	HUTMENT	S35 W35
TA-16-494	16-494	HUTMENT	S35 W35
TA-16-495	16-495	MAGAZINE	S35 W35
TA-16-496	16-496	HUTMENT	S35 W35
TA-16-497	16-497	HUTMENT	S35 W35
TA-16-498	16-498	HUTMENT	S35 W35
TA-16-499	16-499	HUTMENT	S35 W35
TA-16-500	16-500	HUTMENT	S35 W35
TA-16-501	16-501	GUARD HOUSE (REMOVED) 1950	
TA-16-502	16-502	SIGN PLANT	S35 W35
TA-16-503	16-503	SECTION BARRICADE	S35 W35
TA-16-504	16-504	SEPTIC TANK (SANITARY)	S35 W35
TA-16-505	16-505	PASSAGEWAY (490 TO 498)	S35 W35
TA-16-506	16-506	MANHOLE (STEAM)	S35 W35
TA-16-507	16-507	SUMP-PITCHLEIKS ALL	S35 W35
TA-16-508	16-508	MANHOLE (WATER)	S35 W35
TA-16-509	16-509	MANHOLE (STEAM)	S35 W35
TA-16-510	16-510	MANHOLE BOX	S35 W35
TA-16-511	16-511	MANHOLE (STEAM)	S35 W35
TA-16-512	16-512	UNDERGROUND TANK (OIL)	S35 W90
TA-16-513	16-513	ROAD

OFFICIAL USE ONLY

STRUCTURE NUMBER	DESIG-NATION	REMARKS & FORMER DESIGNATION	GRID
TA-16-583	16-583	TRANSFORMER STATION	
TA-16-584	16-584	TRANSFORMER STATION	S35 W65
TA-16-585	16-585	TRANSFORMER STATION	[illegible]
TA-16-586	16-586	TRANSFORMER STATION	[illegible]
TA-16-587	16-587	TRANSFORMER STATION	[illegible]
TA-16-588	16-588	TRANSFORMER STATION	[illegible]
TA-16-589	16-589	TRANSFORMER STATION	S40 [illegible]
TA-16-590	16-590	TRANSFORMER STATION	S45 [illegible]
TA-16-591	16-591	TRANSFORMER STATION	S50 [illegible]
TA-16-592	16-592	TRANSFORMER STATION	[illegible]
TA-16-593	16-593	TRANSFORMER STATION	[illegible]
TA-16-594	16-594	TRANSFORMER STATION	[illegible]
TA-16-595	16-595	TRANSFORMER STATION	[illegible]
TA-16-596	16-596	TRANSFORMER STATION	[illegible]
TA-16-597	16-597	TRANSFORMER STATION	[illegible]
TA-16-598	16-598	TRANSFORMER STATION	[illegible]
TA-16-599	16-599	TRANSFORMER STATION	[illegible]
TA-16-600	16-600	BARRICADE	S20 [illegible]
TA-16-601	16-601	BARRICADE	[illegible]
TA-16-602	16-602	BARRICADE	[illegible]
TA-16-603	16-603	BARRICADE	[illegible]
TA-16-604	16-604	BARRICADE	[illegible]
TA-16-605	16-605	BARRICADE	[illegible]
TA-16-606	16-606	BARRICADE	S25 [illegible]
TA-16-607	16-607	BARRICADE	S25 W35
TA-16-608	16-608	RESERVE	
TA-16-609	16-609		
TA-16-610	16-610		
TA-16-611	16-611		
TA-16-612	16-612	BARRICADE	S15 [illegible]
TA-16-613	16-613	BARRICADE	S15 [illegible]
TA-16-614	16-614	BARRICADE	S15 [illegible]
TA-16-615	16-615	BARRICADE	S15 [illegible]
TA-16-616	16-616	BARRICADE	S15 [illegible]
TA-16-617	16-617	BARRICADE	S15 W50
TA-16-618	16-618	BARRICADE	S20 W50
TA-16-619	16-619	BARRICADE	S20 [illegible]
TA-16-620	16-620	BARRICADE	S15 W50
TA-16-621	16-621	RESERVE	
TA-16-622	16-622		
TA-16-623	16-623		
TA-16-624	16-624	BARRICADE	S25 [illegible]
TA-16-625	16-625	BARRICADE	[illegible]
TA-16-626	16-626	BARRICADE	[illegible]
TA-16-627	16-627	BARRICADE	[illegible]
TA-16-628	16-628	BARRICADE	[illegible]
TA-16-629	16-629	BARRICADE	[illegible]
TA-16-630	16-630	RESERVE	
TA-16-631	16-631		
TA-16-632	16-632		
TA-16-633	16-633		
TA-16-634	16-634	BARRICADE	S40 [illegible]
TA-16-635	16-635	BARRICADE	S40 [illegible]
TA-16-636	16-636	BARRICADE	S45 [illegible]
TA-16-637	16-637	BARRICADE	S40 [illegible]
TA-16-638	16-638	BARRICADE	S40 W30
TA-16-639	16-639	RESERVE	
TA-16-640	16-640	BARRICADE	S45 [illegible]
TA-16-641	16-641	BARRICADE	S45 [illegible]
TA-16-642	16-642	BARRICADE	S50 [illegible]
TA-16-643	16-643	RESERVE	
TA-16-644	16-644		
TA-16-645	16-645		
TA-16-646	16-646		
TA-16-647	16-647		
TA-16-648	16-648		
TA-16-649	16-649		
TA-16-650	16-650		
TA-16-651	16-651		
TA-16-652	16-652		
TA-16-653	16-653		
TA-16-654	16-654		
TA-16-655	16-655		
TA-16-656	16-656	BARRICADE	[illegible]
TA-16-657	16-657	BARRICADE	[illegible]
TA-16-658	16-658	BARRICADE	S55 W45
TA-16-659	16-659	RESERVE	
TA-16-660	16-660		
TA-16-661	16-661		
TA-16-662	16-662		
TA-16-663	16-663		
TA-16-664	16-664		
TA-16-665	16-665		
TA-16-666	16-666	BARRICADE	[illegible] W25
TA-16-667	16-667	RESERVE	
TA-16-668	16-668		
TA-16-669	16-669		
TA-16-670	16-670		
TA-16-671	16-671	BARRICADE	S35 W20
TA-16-672	16-672	BARRICADE	[illegible]
TA-16-673	16-673	BARRICADE	S35 W15
TA-16-674	16-674	RESERVE	
TA-16-675	16-675		
TA-16-676	16-676		
TA-16-677	16-677		
TA-16-678	16-678		
TA-16-679	16-679		
TA-16-680	16-680		
TA-16-681	16-681		
TA-16-682	16-682		
TA-16-683	16-683		
TA-16-684	16-684		
TA-16-685	16-685		
TA-16-686	16-686		
TA-16-687	16-687		
TA-16-688	16-688	BARRICADE	S60 W30
TA-16-689	16-689	BARRICADE	S60 W30
TA-16-690	16-690	BARRICADE	S65 W30
TA-16-691	16-691	BARRICADE	S60 W35
TA-16-692	16-692	BARRICADE	S60 W35
TA-16-693	16-693	RESERVE	
TA-16-694	16-694		
TA-16-695	16-695		
TA-16-696	16-696		
TA-16-697	16-697		
TA-16-698	16-698		
TA-16-699	16-699		
TA-16-700	16-700	MANHOLE (SANITARY SEWER)	S20 W50
TA-16-701	16-701	MANHOLE (SANITARY SEWER)	S20 W50
TA-16-702	16-702	MANHOLE (SANITARY SEWER)	S20 W50
TA-16-703	16-703	MANHOLE (SANITARY SEWER)	S20 W50
TA-16-704	16-704	MANHOLE (SANITARY SEWER)	S15 W50

STRUCTURE NUMBER	DESIG-NATION	REMARKS & FORMER DESIGNATION	GRID
TA-16-705	16-705	MANHOLE (SANITARY SEWER)	S15 W50
TA-16-706	16-706	MANHOLE (SANITARY SEWER)	S15 W45
TA-16-707	16-707	MANHOLE (SANITARY SEWER)	S15 W45
TA-16-708	16-708	MANHOLE (SANITARY SEWER)	S20 W45
TA-16-709	16-709	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-710	16-710	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-711	16-711	MANHOLE (SANITARY SEWER)	S20 W45
TA-16-712	16-712	MANHOLE (SANITARY SEWER)	[illegible] W40
TA-16-713	16-713	MANHOLE (SANITARY SEWER)	S20 W35
TA-16-714	16-714	MANHOLE (SEWER) (ABANDONED)	[illegible]
TA-16-715	16-715	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-716	16-716	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-717	16-717	MANHOLE (SANITARY SEWER)	[illegible] W35
TA-16-718	16-718	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-719	16-719	SEWAGE LIFT STATION	[illegible] W40
TA-16-720	16-720	MANHOLE (SANITARY SEWER)	[illegible] W40
TA-16-721	16-721	MANHOLE (SANITARY SEWER)	[illegible] W40
TA-16-722	16-722	MANHOLE (SANITARY SEWER)	[illegible] W35
TA-16-723	16-723	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-724	16-724	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-725	16-725	MANHOLE (SANITARY SEWER)	[illegible] W25
TA-16-726	16-726	MANHOLE (SANITARY SEWER)	[illegible] W20
TA-16-727	16-727	MANHOLE (SANITARY SEWER)	[illegible] W20
TA-16-728	16-728	MANHOLE (SANITARY SEWER)	S40 W15
TA-16-729	16-729	MANHOLE (SANITARY SEWER)	S40 W15
TA-16-730	16-730	MANHOLE (SANITARY SEWER)	S40 W15
TA-16-731	16-731	MANHOLE (SANITARY SEWER)	[illegible] W15
TA-16-732	16-732	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-733	16-733	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-734	16-734	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-735	16-735	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-736	16-736	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-737	16-737	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-738	16-738	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-739	16-739	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-740	16-740	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-741	16-741	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-742	16-742	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-743	16-743	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-744	16-744	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-745	16-745	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-746	16-746	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-747	16-747	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-748	16-748	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-749	16-749	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-750	16-750	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-751	16-751	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-752	16-752	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-753	16-753	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-754	16-754	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-755	16-755	MANHOLE (SANITARY SEWER)	[illegible] W35
TA-16-756	16-756	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-757	16-757	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-758	16-758	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-759	16-759	MANHOLE (SANITARY SEWER)	[illegible] W40
TA-16-760	16-760	MANHOLE (SANITARY SEWER)	[illegible] W40
TA-16-761	16-761	MANHOLE (SANITARY SEWER)	[illegible] W45
TA-16-762	16-762	MANHOLE (SANITARY SEWER)	[illegible] W45
TA-16-763	16-763	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-764	16-764	MANHOLE (SANITARY SEWER)	[illegible] W30
TA-16-765	16-765	MANHOLE (SANITARY SEWER)	[illegible] W50
TA-16-766	16-766	MANHOLE (SANITARY SEWER)	[illegible] W55
TA-16-767	16-767	MANHOLE (SANITARY SEWER)	S55 W55
TA-16-768	16-768	MANHOLE (SANITARY SEWER)	S55 W60
TA-16-769	16-769	MANHOLE (SANITARY SEWER)	[illegible] W60
TA-16-770	16-770	MANHOLE (SANITARY SEWER)	[illegible] W65
TA-16-771	16-771	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-772	16-772	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-773	16-773	MANHOLE (SANITARY SEWER)	[illegible]
TA-16-774	16-774	MANHOLE (SANITARY SEWER)	S45 W60
TA-16-775	16-775	MANHOLE (SANITARY SEWER)	S45 W65
TA-16-776	16-776	MANHOLE (SANITARY SEWER)	S45 W65
TA-16-777	16-777	MANHOLE (SANITARY SEWER)	S45 W70
TA-16-778	16-778	MANHOLE (SANITARY SEWER)	[illegible] W70
TA-16-779	16-779	MANHOLE (SANITARY SEWER)	[illegible] W70
TA-16-780	16-780	MANHOLE (SANITARY SEWER)	S40 W70
TA-16-781	16-781	MANHOLE (SANITARY SEWER)	S40 W75
TA-16-782	16-782	MANHOLE (SANITARY SEWER)	S35 W70
TA-16-783	16-783	MANHOLE (SANITARY SEWER)	S40 W60
TA-16-784	16-784	MANHOLE (SANITARY SEWER)	S40 W65
TA-16-785	16-785	MANHOLE (SANITARY SEWER)	S40 W65
TA-16-786	16-786	MANHOLE (SANITARY SEWER)	S35 W65
TA-16-787	16-787	MANHOLE (SANITARY SEWER)	[illegible] W65
TA-16-788	16-788	MANHOLE (SANITARY SEWER)	[illegible] W65
TA-16-789	16-789	MANHOLE (SANITARY SEWER)	S30 W65
TA-16-790	16-790	MANHOLE (SANITARY SEWER)	[illegible] W70
TA-16-791	16-791	MANHOLE (SANITARY SEWER)	[illegible] W70
TA-16-792	16-792	MANHOLE (SANITARY SEWER)	S30 W70
TA-16-793	16-793	MANHOLE (INDUSTRIAL WASTE)	[illegible] W45
TA-16-794	16-794	MANHOLE (INDUSTRIAL WASTE)	[illegible] W45
TA-16-795	16-795	MANHOLE (INDUSTRIAL WASTE)	S40 W45
TA-16-796	16-796	MANHOLE (INDUSTRIAL WASTE)	S40 W45
TA-16-797	16-797	MANHOLE (INDUSTRIAL WASTE)	[illegible] W45
TA-16-798	16-798	MANHOLE (INDUSTRIAL WASTE)	[illegible] W40
TA-16-799	16-799	MANHOLE (INDUSTRIAL WASTE)	S40 W40
TA-16-800	16-800	MANHOLE (INDUSTRIAL WASTE)	[illegible]
TA-16-801	16-801	MANHOLE (DRAINAGE)	[illegible]
TA-16-802	16-802	MANHOLE (DRAINAGE)	[illegible] W40
TA-16-803	16-803	MANHOLE (DRAINAGE)	[illegible] W35
TA-16-804	16-804	MANHOLE (DRAINAGE)	S20 W30
TA-16-805	16-805	MANHOLE (DRAINAGE)	S25 W30
TA-16-806	16-806	MANHOLE (DRAINAGE)	[illegible] W35
TA-16-807	16-807	MANHOLE (INDUSTRIAL WASTE)	[illegible] W30
TA-16-808	16-808	MANHOLE (INDUSTRIAL WASTE)	S40 W30
TA-16-809	16-809	MANHOLE (INDUSTRIAL WASTE)	[illegible] W25
TA-16-810	16-810	MANHOLE (INDUSTRIAL WASTE)	S45 W25
TA-16-811	16-811	MANHOLE (INDUSTRIAL WASTE)	S35 W15
TA-16-812	16-812	MANHOLE (INDUSTRIAL WASTE)	S35 W15
TA-16-813	16-813	MANHOLE (SANITARY SEWER)	S65 W20
TA-16-814	16-814	MANHOLE (SANITARY SEWER)	[illegible] W40
TA-16-815	16-815	MANHOLE (SANITARY SEWER)	[illegible] W70
TA-16-816	16-816	MANHOLE (SANITARY SEWER)	S55 W40
TA-16-817	16-817	MANHOLE (SANITARY SEWER)	S50 W50
TA-16-818	16-818	RESERVE	
TA-16-819	16-819		
TA-16-820	16-820		
TA-16-821	16-821		
TA-16-822	16-822		
TA-16-823	16-823		
TA-16-824	16-824		
TA-16-825	16-825	MANHOLE (ELECTRICAL)	S15 W50
TA-16-826	16-826	MANHOLE (ELECTRICAL)	S15 W55

STRUCTURE NUMBER	DESIG-NATION	REMARKS & FORMER DESIGNATION	GRID
TA-16-827	16-827	MANHOLE (ELECTRICAL)	S15 W55
TA-16-828	16-828	MANHOLE (ELECTRICAL)	S15 W50
TA-16-829	16-829	MANHOLE (ELECTRICAL)	S10 W50
TA-16-830	16-830	MANHOLE (ELECTRICAL)	S15 W50
TA-16-831	16-831	MANHOLE (ELECTRICAL)	S15 W50
TA-16-832	16-832	MANHOLE (ELECTRICAL)	S15 W50
TA-16-833	16-833	MANHOLE (ELECTRICAL)	S15 W45
TA-16-834	16-834	MANHOLE (ELECTRICAL)	S20 W45
TA-16-835	16-835	MANHOLE (ELECTRICAL)	S20 W45
TA-16-836	16-836	MANHOLE (ELECTRICAL)	S20 W45
TA-16-837	16-837	MANHOLE (ELECTRICAL)	S20 W45
TA-16-838	16-838	MANHOLE (ELECTRICAL)	S30 W40
TA-16-839	16-839	MANHOLE (ELECTRICAL)	S30 W35
TA-16-840	16-840	MANHOLE (ELECTRICAL)	S30 W35
TA-16-841	16-841	MANHOLE (ELECTRICAL)	S30 W40
TA-16-842	16-842	MANHOLE (ELECTRICAL)	S30 W40
TA-16-843	16-843	MANHOLE (ELECTRICAL)	S30 W40
TA-16-844	16-844	MANHOLE (ELECTRICAL)	S35 W40
TA-16-845	16-845	MANHOLE (ELECTRICAL)	S30 W20
TA-16-846	16-846	MANHOLE (ELECTRICAL)	S35 W15
TA-16-847	16-847	MANHOLE (ELECTRICAL)	S35 W20
TA-16-848	16-848	MANHOLE (ELECTRICAL)	S35 W20
TA-16-849	16-849	MANHOLE (ELECTRICAL)	S35 W20
TA-16-850	16-850	MANHOLE (ELECTRICAL)	S35 W15
TA-16-851	16-851	MANHOLE (ELECTRICAL)	S35 W30
TA-16-852	16-852	MANHOLE (ELECTRICAL)	S35 W30
TA-16-853	16-853	MANHOLE (ELECTRICAL)	S40 W30
TA-16-854	16-854	MANHOLE (ELECTRICAL)	S40 W30
TA-16-855	16-855	MANHOLE (ELECTRICAL)	S40 W30
TA-16-856	16-856	MANHOLE (ELECTRICAL)	S40 W30
TA-16-857	16-857	MANHOLE (ELECTRICAL)	S40 W30
TA-16-858	16-858	MANHOLE (ELECTRICAL)	S40 W30
TA-16-859	16-859	MANHOLE (ELECTRICAL)	[illegible]
TA-16-860	16-860	MANHOLE (ELECTRICAL)	[illegible]
TA-16-861	16-861	MANHOLE (ELECTRICAL)	[illegible]
TA-16-862	16-862	MANHOLE (ELECTRICAL)	S45 W30
TA-16-863	16-863	MANHOLE (ELECTRICAL)	[illegible]
TA-16-864	16-864	MANHOLE (ELECTRICAL)	[illegible]
TA-16-865	16-865	MANHOLE (ELECTRICAL)	[illegible]
TA-16-866	16-866	MANHOLE (ELECTRICAL)	S45 W20
TA-16-867	16-867	MANHOLE (ELECTRICAL)	S50 W25
TA-16-868	16-868	MANHOLE (ELECTRICAL)	S50 W25
TA-16-869	16-869	MANHOLE (ELECTRICAL)	S50 W25
TA-16-870	16-870	MANHOLE (ELECTRICAL)	S50 W25
TA-16-871	16-871	MANHOLE (ELECTRICAL)	S60 W30
TA-16-872	16-872	MANHOLE (ELECTRICAL)	S60 W30
TA-16-873	16-873	MANHOLE (ELECTRICAL)	[illegible]
TA-16-874	16-874	MANHOLE (ELECTRICAL)	[illegible]
TA-16-875	16-875	MANHOLE (ELECTRICAL)	[illegible]
TA-16-876	16-876	MANHOLE (ELECTRICAL)	S60 W35
TA-16-877	16-877	MANHOLE (ELECTRICAL)	S65 W35
TA-16-878	16-878	MANHOLE (ELECTRICAL)	S60 W45
TA-16-879	16-879	MANHOLE (ELECTRICAL)	S60 W45
TA-16-880	16-880	MANHOLE (ELECTRICAL)	S35 W70
TA-16-881	16-881	MANHOLE (ELECTRICAL)	S45 W65
TA-16-882	16-882	MANHOLE (ELECTRICAL)	S45 W65
TA-16-883	16-883	MANHOLE (ELECTRICAL)	[illegible]
TA-16-884	16-884	MANHOLE (ELECTRICAL)	S55 W70
TA-16-885	16-885	MANHOLE (ELECTRICAL)	S35 W70
TA-16-886	16-886	MANHOLE (ELECTRICAL)	S30 W70
TA-16-887	16-887	MANHOLE (ELECTRICAL)	S40 W15
TA-16-888	16-888	MANHOLE (ELECTRICAL)	S35 W15
TA-16-889	16-889	MANHOLE (ELECTRICAL)	S35 W10
TA-16-890	16-890	MANHOLE (ELECTRICAL)	S45 W65
TA-16-891	16-891	MANHOLE (ELECTRICAL)	S45 W70
TA-16-892	16-892	MANHOLE (ELECTRICAL)	S65 W20
TA-16-893	16-893	RESERVE	
TA-16-894	16-894		
TA-16-895	16-895		
TA-16-896	16-896		
TA-16-897	16-897		
TA-16-898	16-898		
TA-16-899	16-899		
NOTE: 900 SERIES		RESERVED FOR UTILITIES DESIGNATIONS	
TA-16-1000	16-1000	GUARD HOUSE (NOW TA-16-1121)	
TA-16-1001	16-1001	GUARD HOUSE (NOW TA-1-288)	
TA-16-1002	16-1002	MANHOLE (STEAM)	S15 W50
TA-16-1003	16-1003	MANHOLE (STEAM)	S15 W50
TA-16-1004	16-1004	MANHOLE (STEAM)	S15 W50
TA-16-1005	16-1005	MANHOLE (STEAM)	S15 W50
TA-16-1006	16-1006	MANHOLE (STEAM)	S20 W30
TA-16-1007	16-1007	MANHOLE (STEAM)	S20 W45
TA-16-1008	16-1008	MANHOLE (STEAM)	S25 W45
TA-16-1009	16-1009	MANHOLE (STEAM)	[illegible] W40
TA-16-1010	16-1010	MANHOLE (STEAM)	[illegible] W40
TA-16-1011	16-1011	MANHOLE (STEAM)	S20 W35
TA-16-1012	16-1012	MANHOLE (STEAM)	S30 W40
TA-16-1013	16-1013	MANHOLE (STEAM)	S30 W40
TA-16-1014	16-1014	MANHOLE (STEAM)	S30 W35
TA-16-1015	16-1015	MANHOLE (STEAM)	[illegible] W35
TA-16-1016	16-1016	MANHOLE (STEAM)	S35 W35
TA-16-1017	16-1017	MANHOLE (STEAM)	S40 W30
TA-16-1018	16-1018	MANHOLE (STEAM)	S35 W30
TA-16-1019	16-1019	MANHOLE (STEAM)	S35 W25
TA-16-1020	16-1020	MANHOLE (STEAM)	S35 W20
TA-16-1021	16-1021	MANHOLE (STEAM)	[illegible] W20
TA-16-1022	16-1022	MANHOLE (STEAM)	[illegible] W20
TA-16-1023	16-1023	MANHOLE (STEAM)	S35 W20
TA-16-1024	16-1024	MANHOLE (STEAM)	S35 W15
TA-16-1025	16-1025	MANHOLE (STEAM)	S35 W15
TA-16-1026	16-1026	MANHOLE (STEAM)	S35 W10
TA-16-1027	16-1027	MANHOLE (STEAM)	S40 W30
TA-16-1028	16-1028	MANHOLE (STEAM)	S40 W30
TA-16-1029	16-1029	MANHOLE (STEAM)	S45 W30
TA-16-1030	16-1030	MANHOLE (STEAM)	S45 W30
TA-16-1031	16-1031	MANHOLE (STEAM)	S50 W25
TA-16-1032	16-1032	MANHOLE (STEAM)	S50 W25
TA-16-1033	16-1033	MANHOLE (STEAM)	S50 W30
TA-16-1034	16-1034	MANHOLE (STEAM)	S55 W25
TA-16-1035	16-1035	MANHOLE (STEAM)	[illegible] W25
TA-16-1036	16-1036	MANHOLE (STEAM)	[illegible] W25
TA-16-1037	16-1037	MANHOLE (STEAM)	S60 W20
TA-16-1038	16-1038	MANHOLE (STEAM)	S65 W15
TA-16-1039	16-1039	MANHOLE (STEAM)	S55 W35
TA-16-1040	16-1040	MANHOLE (STEAM)	S55 W40
TA-16-1041	16-1041	MANHOLE (STEAM)	S55 W40
TA-16-1042	16-1042	MANHOLE (STEAM)	S60 W35
TA-16-1043	16-1043	MANHOLE (STEAM)	S60 W35
TA-16-1044	16-1044	MANHOLE (STEAM)	S55 W40
TA-16-1045	16-1045	MANHOLE (STEAM)	S55 W45
TA-16-1046	16-1046	MANHOLE (STEAM)	S55 W45
TA-16-1047	16-1047	MANHOLE (STEAM)	S55 W45

STRUCTURE NUMBER	DESIG-NATION	REMARKS & FORMER DESIGNATION	GRID
TA-16-1048	16-1048	MANHOLE (STEAM)	S40 W45
TA-16-1049	16-1049	MANHOLE (STEAM)	S55 W50
TA-16-1050	16-1050	MANHOLE (STEAM)	S55 W50
TA-16-1051	16-1051	MANHOLE (STEAM)	S55 W55
TA-16-1052	16-1052	MANHOLE (STEAM)	S55 W60
TA-16-1053	16-1053	MANHOLE (STEAM)	S50 W60
TA-16-1054	16-1054	MANHOLE (STEAM)	S55 W65
TA-16-1055	16-1055	MANHOLE (STEAM)	S55 W70
TA-16-1056	16-1056	MANHOLE (STEAM)	S43 W65
TA-16-1057	16-1057	MANHOLE (STEAM)	S45 W65
TA-16-1058	16-1058	MANHOLE (STEAM)	S40 W70
TA-16-1059	16-1059	MANHOLE (STEAM)	S40 W70
TA-16-1060	16-1060	MANHOLE (STEAM)	S40 W70
TA-16-1061	16-1061	MANHOLE (STEAM)	S40 W75
TA-16-1062	16-1062	MANHOLE (STEAM)	S30 W70
TA-16-1063	16-1063	MANHOLE (STEAM)	S30 W65
TA-16-1064	16-1064	MANHOLE (STEAM)	S30 W60
TA-16-1065	16-1065	MANHOLE (STEAM)	S35 W60
TA-16-1066	16-1066	MANHOLE (STEAM)	S35 W60
TA-16-1067	16-1067	MANHOLE (STEAM)	S40 W60
TA-16-1068	16-1068	MANHOLE (STEAM)	S40 W65
TA-16-1069	16-1069	MANHOLE (STEAM)	S40 W65
TA-16-1070	16-1070	MANHOLE (STEAM)	S30 W65
TA-16-1071	16-1071	MANHOLE (STEAM)	S25 W65
TA-16-1072	16-1072	MANHOLE (STEAM)	S25 W65
TA-16-1073	16-1073	MANHOLE (STEAM)	S20 W60
TA-16-1074	16-1074	MANHOLE (STEAM)	S20 W60
TA-16-1075	16-1075	MANHOLE (STEAM)	S20 W60
TA-16-1076	16-1076	MANHOLE (STEAM)	S15 W55
TA-16-1077	16-1077	MANHOLE (STEAM)	S20 W55
TA-16-1078	16-1078	MANHOLE (STEAM)	S20 W50
TA-16-1079	16-1079	MANHOLE (STEAM)	S25 W60
TA-16-1080	16-1080	MANHOLE (STEAM)	S30 W70
TA-16-1081	16-1081	MANHOLE (STEAM)	S40 W90
TA-16-1082	16-1082	MANHOLE (STEAM)	S40 W80
TA-16-1083	16-1083	MANHOLE (STEAM) (REMOVED)	
TA-16-1084	16-1084	MANHOLE (STEAM)	S25 W80
TA-16-1085	16-1085	RESERVE	
TA-16-1086	16-1086		
TA-16-1087	16-1087		
TA-16-1088	16-1088		
TA-16-1089	16-1089		
TA-16-1090	16-1090		
TA-16-1091	16-1091		
TA-16-1092	16-1092		
TA-16-1093	16-1093		
TA-16-1094	16-1094		
TA-16-1095	16-1095		
TA-16-1096	16-1096		
TA-16-1097	16-1097		
TA-16-1098	16-1098		
TA-16-1099	16-1099	CONDENSATE PUMP	S30 W30
TA-16-1100	16-1100	MANHOLE (DRIP POT) GAS	S25 W35
TA-16-1101	16-1101	OIL SWITCH	S55 W35
TA-16-1102	16-1102	OIL SWITCH	S55 W25
TA-16-1103	16-1103	OIL SWITCH	S20 W30
TA-16-1104	16-1104	DRUM STORAGE	S40 W35
TA-16-1105	16-1105	DRUM STORAGE	S40 W55
TA-16-1106	16-1106	DRUM STORAGE	S40 W55
TA-16-1107	16-1107	DRUM STORAGE	S40 W55
TA-16-1108	16-1108	DRUM STORAGE (REMOVED) 1955	
TA-16-1109	16-1109	DRUM STORAGE (REMOVED) 1956	
TA-16-1110	16-1110	DRUM STORAGE (REMOVED)	
TA-16-1111	16-1111	DRUM STORAGE	S35 W65
TA-16-1112	16-1112	MANHOLE (DRIP POT) GAS	S45 W70
TA-16-1113	16-1113	MANHOLE (DRIP POT) GAS	S40 W70
TA-16-1114	16-1114	MANHOLE (DRIP POT) GAS	S40 W75
TA-16-1115	16-1115	MANHOLE (WATER PRV)	S45 W70
TA-16-1116	16-1116	MANHOLE (WATER PRV)	S30 W35
TA-16-1117	16-1117	MANHOLE (WATER PRV)	S35 W40
TA-16-1118	16-1118	MANHOLE (WATER)	S40 W65
TA-16-1119	16-1119	MANHOLE (WATER)	S25 W40
TA-16-1120	16-1120	MANHOLE (WATER)	S65 W20
TA-16-1121	16-1121	MANHOLE (WATER)	S30 W65
TA-16-1122	16-1122	MANHOLE (WATER PRV)	S55 W30
TA-16-1123	16-1123	MANHOLE (GAS PRV)	S65 W5
TA-16-1124	16-1124	MANHOLE (WATER)	S30 W75
TA-16-1125	16-1125	MANHOLE (WATER)	S30 W75
TA-16-1126	16-1126	MANHOLE (WATER)	S30 W65
TA-16-1127	16-1127	MANHOLE (WATER)	S20 W55
TA-16-1128	16-1128	MANHOLE (GAS)	
TA-16-1129	16-1129	RESERVE	
TA-16-1130	16-1130	WATER TANK (REMOVED)	
TA-16-1131	16-1131	WATER TANK (REMOVED)	
TA-16-1132	16-1132	SEPTIC TANK (REMOVED)	
TA-16-1133	16-1133	GUARD HOUSE (REMOVED)	
TA-16-1134	16-1134	TROUGH (BASKET WASHING FAC.)	S25 E5
TA-16-1135	16-1135	TROUGH (BASKET WASHING FAC.)	S25 E5
TA-16-1136	16-1136	TROUGH (BASKET WASHING FAC.)	S25 E5
TA-16-1137	16-1137	MANHOLE (GREASE TRAP)	S40 W80
TA-16-1138	16-1138	FUEL TANK (ABANDONED)	S25 W35
TA-16-1139	16-1139	FUEL TANK (ABANDONED)	S25 W35
TA-16-1140	16-1140	FUEL TANK (REMOVED) 1956	
TA-16-1141	16-1141	GUARD TOWER (REMOVED) 1948	
TA-16-1142	16-1142	RESERVE	
TA-16-1143	16-1143		
TA-16-1144	16-1144		
TA-16-1145	16-1145		
TA-16-1146	16-1146		
TA-16-1147	16-1147		
TA-16-1148	16-1148		
TA-16-1149	16-1149		
TA-16-1150	16-1150		
TA-16-1151	16-1151		
TA-16-1152	16-1152		
TA-16-1153	16-1153		
TA-16-1154	16-1154		
TA-16-1155	16-1155		
TA-16-1156	16-1156		
TA-16-1157	16-1157		
TA-16-1158	16-1158		
TA-16-1159	16-1159		
TA-16-1160	16-1160		
TA-16-1161	16-1161		
TA-16-1162	16-1162		
TA-16-1163	16-1163		
TA-16-1164	16-1164		
TA-16-1165	16-1165		
TA-16-1166	16-1166		
TA-16-1167	16-1167		
TA-16-1168	16-1168		
TA-16-1169	16-1169		

STRUCTURE NUMBER	DESIG-NATION	REMARKS & FORMER DESIGNATION	GRID
TA-16-1170	16-1170	RESERVE	
TA-16-1171	16-1171		
TA-16-1172	16-1172		
TA-16-1173	16-1173		
TA-16-1174	16-1174		
TA-16-1175	16-1175		
TA-16-1176	16-1176		
TA-16-1177	16-1177		
TA-16-1178	16-1178		
TA-16-1179	16-1179		
TA-16-1180	16-1180		
TA-16-1181	16-1181		
TA-16-1182	16-1182		
TA-16-1183	16-1183		
TA-16-1184	16-1184		
TA-16-1185	16-1185		
TA-16-1186	16-1186		
TA-16-1187	16-1187		
TA-16-1188	16-1188		
TA-16-1189	16-1189		
TA-16-1190	16-1190		
TA-16-1191	16-1191		
TA-16-1192	16-1192		
TA-16-1193	16-1193		
TA-16-1194	16-1194		
TA-16-1195	16-1195		
TA-16-1196	16-1196		
TA-16-1197	16-1197		
TA-16-1198	16-1198		
TA-16-1199	16-1199		
TA-16-1200	16-1200		
TA-16-1201	16-1201		
TA-16-1202	16-1202		
TA-16-1203	16-1203		
TA-16-1204	16-1204		
TA-16-1205	16-1205		
TA-16-1206	16-1206		
TA-16-1207	16-1207		
TA-16-1208	16-1208		
TA-16-1209	16-1209		
TA-16-1210	16-1210		
TA-16-1211	16-1211		
TA-16-1212	16-1212		
TA-16-1213	16-1213		
TA-16-1214	16-1214		
TA-16-1215	16-1215		
TA-16-1216	16-1216		
TA-16-1217	16-1217		
TA-16-1218	16-1218		
TA-16-1219	16-1219		
TA-16-1220	16-1220		
TA-16-1221	16-1221		
TA-16-1222	16-1222		
TA-16-1223	16-1223		
TA-16-1224	16-1224		
TA-16-1225	16-1225		
TA-16-1226	16-1226		
TA-16-1227	16-1227		
TA-16-1228	16-1228		
TA-16-1229	16-1229		
TA-16-1230	16-1230		
TA-16-1231	16-1231		
TA-16-1232	16-1232		
TA-16-1233	16-1233		
TA-16-1234	16-1234		
TA-16-1235	16-1235		
TA-16-1236	16-1236		
TA-16-1237	16-1237		
TA-16-1238	16-1238		
TA-16-1239	16-1239		
TA-16-1240	16-1240		
TA-16-1241	16-1241		
TA-16-1242	16-1242		
TA-16-1243	16-1243		
TA-16-1244	16-1244		
TA-16-1245	16-1245		
TA-16-1246	16-1246		
TA-16-1247	16-1247		
TA-16-1248	16-1248		
TA-16-1249	16-1249		
TA-16-1250	16-1250		
TA-16-1251	16-1251		
TA-16-1252	16-1252		
TA-16-1253	16-1253		
TA-16-1254	16-1254		
TA-16-1255	16-1255		
TA-16-1256	16-1256		
TA-16-1257	16-1257		
TA-16-1258	16-1258		
TA-16-1259	16-1259		
TA-16-1260	16-1260		
TA-16-1261	16-1261		
TA-16-1262	16-1262		
TA-16-1263	16-1263		

NO.	DATE	REVISIONS	BY	CHKD
7	7-57	REVISED TO STATUS OF 7-1-57	JAS	
6		REDRAWN TO STATUS OF JULY 1, 1956	JAS	

LOS ALAMOS SCIENTIFIC LABORATORY
UNIVERSITY OF CALIFORNIA
ENGINEERING DEPARTMENT — LOS ALAMOS, N.M.

STRUCTURE LOCATION PLAN
INDEX SHEET
TA-16 S-SITE

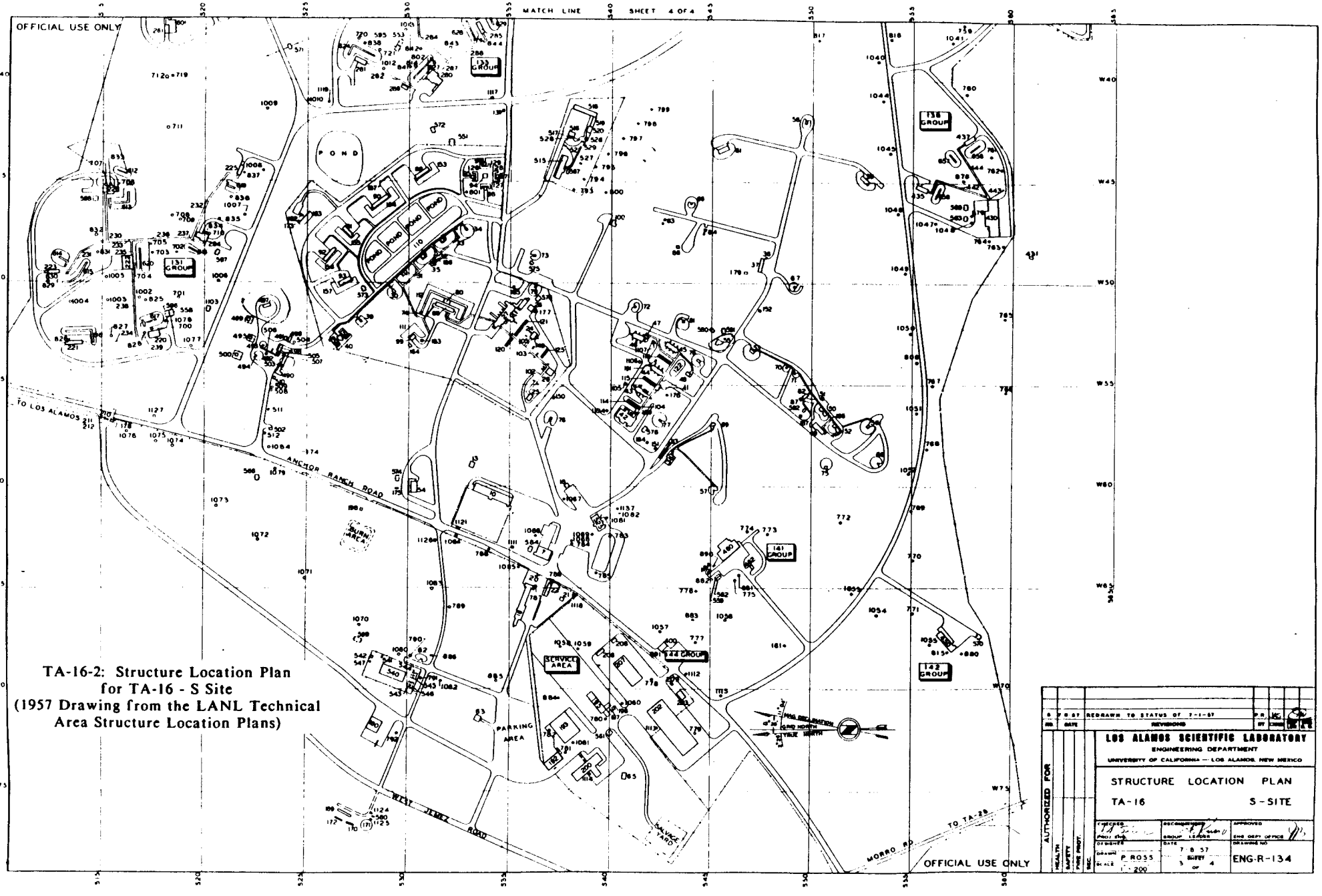
DRAWN: N. BYERS — DATE: 11/28/55 — SCALE: NONE — SHEET 2 of 4 — ENG-R133

AUTHORIZED FOR: HEALTH / SAFETY / FIRE PROT. / SEC.

OFFICIAL USE ONLY

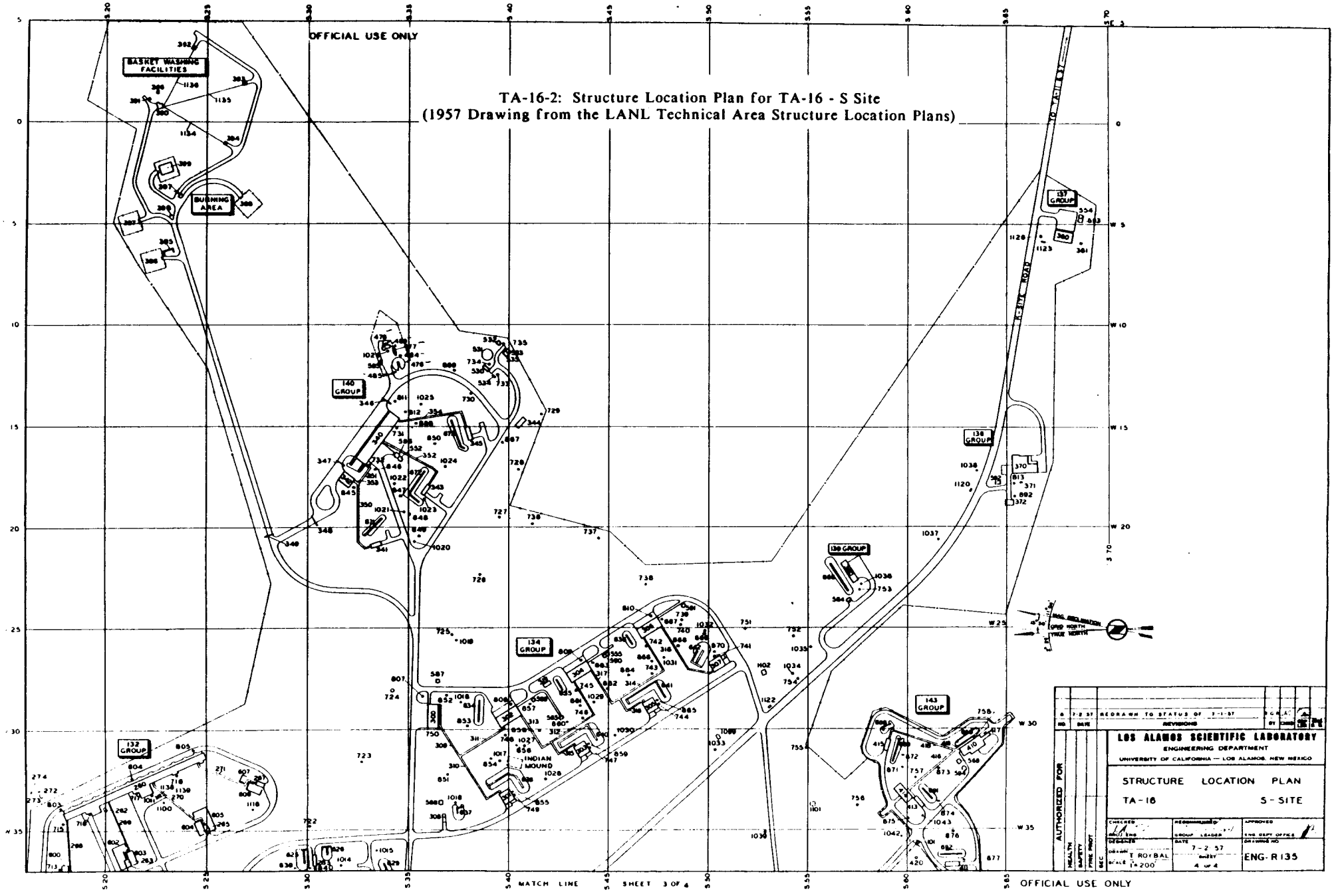
TA-16-2: Structure Location Plan for TA-16 - S Site

(1957 Drawing from the LANL Technical Area Structure Location Plans)



TA-16-2: Structure Location Plan for TA-16 - S Site (1957 Drawing from the LANL Technical Area Structure Location Plans)

TA-16-2: Structure Location Plan for TA-16 - S Site
(1957 Drawing from the LANL Technical Area Structure Location Plans)



APPENDIX H

Hydrogeologic Report for Vadose Zone

DANIEL B. STEPHENS & ASSOCIATES, INC.
CONSULTANTS IN GROUND-WATER HYDROLOGY

• GROUND-WATER CONTAMINATION • UNSATURATED ZONE INVESTIGATIONS • WATER SUPPLY DEVELOPMENT •

January 5, 1988

Mr. Fred Brown
Hydrogeologist
Los Alamos National Laboratory
Group HSE-8
Los Alamos, NM 87545

Subject: Results of Testing for Hydraulic Properties of Welded Tuff

Dear Mr. Brown:

Please find enclosed the final data report on laboratory analyses for hydraulic properties of 10 cores of welded tuff. This report constitutes completion of the analyses requested.

We are continuing our own in-house research on unsaturated hydraulic conductivity using the additional cores that you provided us. I will report to you the results of the investigation when they have been completed.

We would like to point out that the porosity values we have reported are those computed from degree of saturation to water, and therefore represent the effective porosity to that fluid.

Daniel B. Stephens & Associates, Inc. cannot verify that samples are representative of the formation from which they were collected, and we do not assume any responsibility for interpretations or analyses based on this data.

We are very grateful to provide this service to Los Alamos National Laboratory. Please do not hesitate to call us if you have any questions.

Sincerely yours,

Daniel B. Stephens & Associates, Inc.

Warren B. Cox
Laboratory Manager

WBC:bdf
Enclosure

P.O. BOX 740 SOCORRO, NEW MEXICO 87801 (505) 835-3162

DANIEL B. STEPHENS & ASSOCIATES, INC.

CONSULTANTS IN GROUND-WATER HYDROLOGY SOCORRO, NEW MEXICO

FINAL DATA REPORT ON LABORATORY ANALYSES OF SOIL HYDRAULIC PROPERTIES OF WELDED TUFFS AT LOS ALAMOS NATIONAL LABORATORY

PREPARED FOR

LOS ALAMOS NATIONAL LABORATORY

JANUARY, 1988

Final Data Report on Laboratory Analyses

Of

Soil Hydraulic Properties

Of

Welded Tuffs

At

Los Alamos National Laboratory

Prepared For

Los Alamos National Laboratory

January, 1988

DANIEL B. STEPHENS & ASSOCIATES, INC.

LIST OF TABLES

1. Summary of Tests Performed

2. Unit Conventions

3. Summary of Sample Characteristics

4. Summary of Saturated Hydraulic Conductivity Tests

5. Summary of Moisture Retention Characteristics

6. Summary of Initial Moisture Content, Dry Bulk Density and Porosity

7. Summary of Unsaturated Hydraulic Parameters

SCOPE OF WORK

Scope of Work

Daniel B. Stephens & Associates, Inc. (DBS) was requested by Los Alamos National Laboratory of Los Alamos, New Mexico, to perform laboratory analyses for properties of soil, as outlined in written communication of September 9, 1987. The scope of work included the following laboratory tests on 10 cores:

1. Sample Preparation
2. Saturated Hydraulic Conductivity
3. Moisture Retention (main drainage curve), Hanging Column Method, 2 points
4. Moisture Retention (main drainage curve), Pressure Plate Method, 4 points
5. Initial Moisture Content, Bulk Density and Porosity
6. Unsaturated Hydraulic Conductivity

In execution of the foregoing request, DBS has performed the work as summarized below and in Table 1.

The cores of welded tuff were cut by hand to fit soil retaining rings in which all tests were performed. Descriptions of the sample characteristics are presented in Table 3. Laboratory analyses to determine the hydraulic properties of the ten samples are summarized in Tables 4-7. The sample reference numbers were taken as those marked on the outside of each individual sample bag.

Included in this data report are summary tables, graphs where presentation in this form was required, and raw laboratory data. The Principles and Methods section describes the basic principles of the analyses and methods of calculation. All calculation results are expressed in metric units according to Table 2.

Table 1. Summary of Tests Performed

Sample Number	Hydraulic Conductivity		Moisture Retention		Initial Moisture Content	Porosity	Dry Bulk Density
	Saturated	Unsaturated	Hanging Column	Pressure Plate			
7-8	X	X	X	X	X	X	X
11-12	X	X	X	X	X	X	X
16-17	X	X	X	X	X	X	X
21-22	X	X	X	X	X	X	X
25-26	X	X	X	X	X	X	X
35-36	X	X	X	X	X	X	X
42-43	X	X	X	X	X	X	X
61-62	X	X	X	X	X	X	X
75-76	X	X	X	X	X	X	X
80-81	X	X	X	X	X	X	X

Table 2. Unit Conversions

Hydraulic Conductivity: cm/sec

Moisture Content: % volume

Bulk Density: g/cc

Porosity: dimensionless (cm^3/cm^3)

Note: Unless otherwise stated, lengths are in units of centimeters, and masses are in units of grams.

SAMPLE CHARACTERISTICS

Table 3. Summary of Sample Characteristics

Sample No.	Depth (ft)	Color	Texture	Comments
7-8	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
11-12	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
16-17	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
21-22	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
25-26	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
35-36	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
42-43	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
61-62	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals
75-76	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals and a small area of clay at one end
80-81	Unknown	Reddish Brown	Volcanic Ash	Contained Olivine Crystals

SATURATED HYDRAULIC CONDUCTIVITY

Table 4. Summary of Saturated Hydraulic Conductivity Tests

Sample No.	K_s (cm/sec)
7-8	1.58E-04
11-12	2.84E-04
16-17	2.78E-04
21-22	2.00E-04
25-26	9.18E-05
35-36	2.25E-05
42-43	8.57E-05
61-62	5.15E-04
75-76	2.28E-04
80-81	4.41E-05

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 7-8
RING NUMBER: 14
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/5	0.00		19.0	0.0	70.5		
11/5	0.00	705	19.0	0.0	24.8	1.58E-04	1.61E-04
TEST # 2:							
11/5	0.00		19.0	0.0	70.5		
11/5	0.00	590	19.0	0.0	30.4	1.52E-04	1.55E-04

AVERAGE K SAT: 1.58E-04 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 11-12
RING NUMBER: 22
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/10	839:33		15.0	0.0	74.6		
11/10	845:39	423	15.0	0.0	29.4	2.35E-04	2.59E-04
TEST # 2:							
11/10	854:11		15.0	0.0	74.6		
11/10	900:20	369	15.0	0.0	28.3	2.80E-04	3.09E-04

AVERAGE K SAT: 2.84E-04 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 16-17
RING NUMBER: 2
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/5	0.00		19.0	0.0	69.8		
11/5	0.00	302	19.0	0.0	32.7	2.68E-04	2.73E-04
TEST # 2:							
11/5	0.00		19.0	0.0	69.8		
11/5	0.00	276	19.0	0.0	34.0	2.78E-04	2.83E-04

AVERAGE K SAT: 2.78E-04 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 21-22
RING NUMBER: F
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/5	0.00		19.0	0.0	76.1		
11/5	0.00	364	19.0	0.0	38.7	1.98E-04	2.02E-04
TEST # 2:							
11/5	0.00		19.0	0.0	76.1		
11/5	0.00	497	19.0	0.0	30.7	1.95E-04	1.99E-04

AVERAGE K SAT: 2.00E-04 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 25-26
RING NUMBER: C
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/5	0.00		19.0	0.0	76.5		
11/5	0.00	1116	19.0	0.0	29.6	9.08E-05	9.25E-05
TEST # 2:							
11/5	0.00		19.0	0.0	76.5		
11/5	0.00	736	19.0	0.0	41.3	8.94E-05	9.11E-05

AVERAGE K SAT: 9.18E-05 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 35-36
RING NUMBER: G
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/10	845:16		15.0	0.0	70.7		
11/10	941:03	3347	15.0	0.0	36.9	2.07E-05	2.29E-05
TEST # 2:							
11/10	942:22		15.0	0.0	70.7		
11/10	1110:48	5306	15.0	0.0	26.1	2.00E-05	2.21E-05

AVERAGE K SAT: 2.25E-05 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 42-43
RING NUMBER: 4
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/10	841:17		15.0	0.0	76.5		
11/10	904:42	1405	15.0	0.0	29.6	7.21E-05	7.96E-05
TEST # 2:							
11/10	905:46		15.0	0.0	76.5		
11/10	923:33	1067	15.0	0.0	33.3	8.32E-05	9.18E-05

AVERAGE K SAT: 8.57E-05 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 61-62
RING NUMBER: A4
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/10	840:53		15.0	0.0	79.8		
11/10	844:18	265	15.0	0.0	28.8	4.11E-04	4.53E-04
TEST # 2:							
11/10	855:36		15.0	0.0	79.8		
11/10	859:14	218	15.0	0.0	27.4	5.23E-04	5.78E-04

AVERAGE K SAT: 5.15E-04 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 75-76
RING NUMBER: 19
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/10	840:27		15.0	0.0	76.1		
11/10	849:03	576	15.0	0.0	26.8	1.93E-04	2.13E-04
TEST # 2:							
11/10	855:03		15.0	0.0	76.1		
11/10	903:29	506	15.0	0.0	26.8	2.20E-04	2.43E-04

AVERAGE K SAT: 2.28E-04 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

FALLING HEAD TEST DATA

JOB NAME: Los Alamos
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 80-81
RING NUMBER: 18
DEPTH: unknown
TYPE OF WATER USED: 0.01N CaCl2 SOLUTION
SAMPLE X-SECTION AREA: 22.060 (sq. cm)
STANDPIPE X-SECTION AREA: 0.785 (sq. cm)
SAMPLE LENGTH: 3.0 (cm)

DATE (1987)	TIME (DAY)	DEL T (SEC)	TEMP (C)	RESERVOIR HEAD(CM)	SAMPLE HEAD(CM)	K SAT (CM/SEC)	K SAT @ 20 C (CM/SEC)
TEST # 1:							
11/10	840:02		15.0	0.0	74.9		
11/10	921:11	2469	15.0	0.0	27.4	4.35E-05	4.80E-05
TEST # 2:							
11/10	923:49		15.0	0.0	74.0		
11/10	1015:03	3074	15.0	0.0	25.9	3.65E-05	4.02E-05

AVERAGE K SAT: 4.41E-05 (CM/SEC)

COMMENTS:

LABORATORY ANALYSIS BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION

Table 5. Summary of Moisture Retention Characteristics

Sample No.	Pressure Head (cm of water)	Moisture Content (cm^3/cm^3)
7-8	-0.0	51.8
	-100.0	49.4
	-195.0	49.0
	-1019.8	15.0
	-3059.4	13.9
	-5099.0	12.5
	-15297.0	8.3
11-12	-0.0	56.1
	-98.0	53.3
	-198.0	52.7
	-1019.8	37.6
	-3059.4	29.3
	-5099.0	26.1
	-15297.0	19.9
16-17	-0.0	54.9
	-101.0	53.6
	-199.0	52.9
	-1019.8	42.2
	-3059.4	29.2
	-5099.0	26.0
	-15297.0	20.4
21-22	-0.0	56.2
	-97.0	56.1
	-1019.8	28.1
	-3059.4	22.8
	-5099.0	19.5
	-15297.0	12.4
25-26	-0.0	52.0
	-98.5	51.4
	-1019.8	23.3
	-3059.4	21.3
	-5099.0	16.6
	-15297.0	10.0

Table 5. Summary of Moisture Retention Characteristics (continued)

Sample No.	Pressure Head (cm of water)	Moisture Content (% vol)
35-36	-0.0	42.8
	-205.0	41.4
	-1019.8	30.2
	-3059.4	14.2
	-5099.0	13.4
	-15297.0	9.4
42-43	-0.0	42.3
	-100.5	42.3
	-209.0	42.2
	-1019.8	33.5
	-3059.4	30.5
	-5099.0	28.9
	-15297.0	22.8
61-62	-0.0	36.4
	-95.5	34.8
	-202.0	32.6
	-1019.8	19.3
	-3059.4	11.2
	-5099.0	10.4
	-15297.0	7.9
75-76	-0.0	41.6
	-95.0	37.9
	-199.0	33.1
	-1019.8	24.0
	-3059.4	12.5
	-5099.0	11.6
	-15297.0	8.3
80-81	-0.0	34.6
	-1019.8	27.5
	-3059.4	18.3
	-5099.0	17.1
	-15297.0	10.7

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 7-8
RING NUMBER: 14
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 189.1 (g)
TARE RING: 72.1 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 82.7 (g)
SATURATED MOISTURE CONTENT: 51.8 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 34.3 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/23	1025	0.0	37.1	--	--	51.8	0.0
11/25	800	100.0	35.5	1.6	1.6	49.4	0.0
11/30	810	195.0	35.2	0.3	1.9	49.0	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME:	LOS ALAMOS
JOB NUMBER:	87-L-070
SAMPLE NUMBER:	7-8
RING NUMBER:	14
DEPTH:	unknown
SAMPLE VOLUME:	66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION (WITH CAP AND RING):	189.1 (g)
TARE RING:	72.1 (g)
TARE CAP:	0.0 (g)
DRY WEIGHT OF SAMPLE:	82.7 (g)
SATURATED MOISTURE CONTENT:	51.8 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE:	30.1 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP:	184.9 (g)
FINAL TENSION ON HANGING COLUMN:	195.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	184.9	--	--	--
12/2	735	1.0	164.7	20.2	20.2	15.0
12/6	830	3.0	164.0	0.7	20.9	13.9
12/8	840	5.0	163.1	0.9	21.8	12.5
12/13	1655	15.0	160.3	2.8	24.6	8.3

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

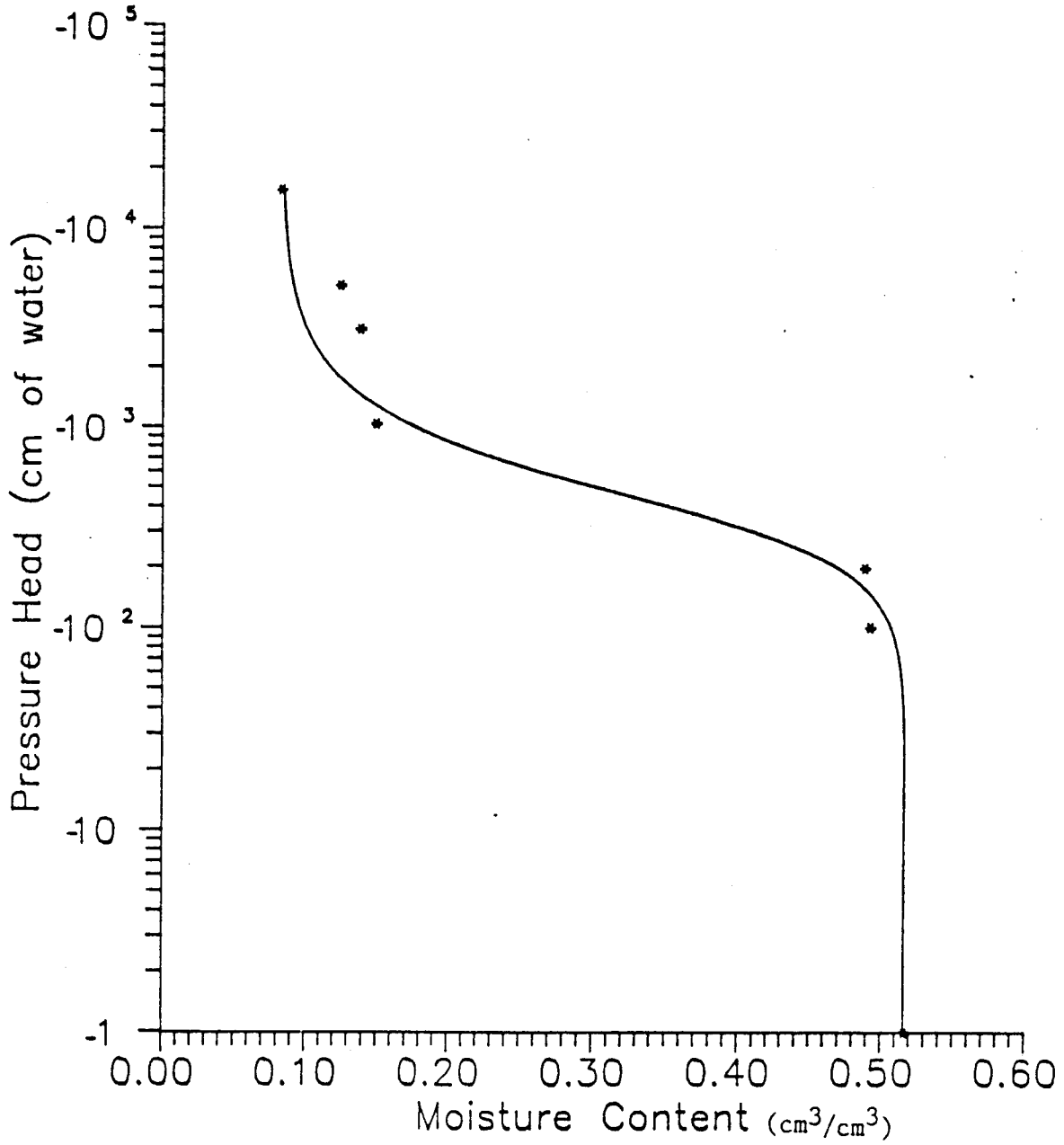


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 7-8.				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR:	PROJECT NO:	DATE:	PLOTTED BY:	CHECKED BY:	
Los Alamos	87-L-070	1/4/88	SLS	WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 11-12
RING NUMBER: 22
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 193.6 (g)
TARE RING: 73.3 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 83.2 (g)
SATURATED MOISTURE CONTENT: 56.1 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 37.1 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/23	1025	0.0	36.4	--	--	56.1	0.0
11/25	800	98.0	34.6	1.8	1.8	53.3	0.0
11/30	810	198.0	34.2	0.4	2.2	52.7	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Staller
CALCULATION MADE BY: S. Staller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 11-12
RING NUMBER: 22
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 193.6 (g)
TARE RING: 73.3 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 83.2 (g)
SATURATED MOISTURE CONTENT: 56.1 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 32.6 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 189.1 (g)
FINAL TENSION ON HANGING COLUMN: 198.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	189.1	--	--	--
12/2	740	1.0	181.4	7.7	7.7	37.6
12/6	830	3.0	175.9	5.5	13.2	29.3
12/8	840	5.0	173.8	2.1	15.3	26.1
12/13	1700	15.0	169.7	4.1	19.4	19.9

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

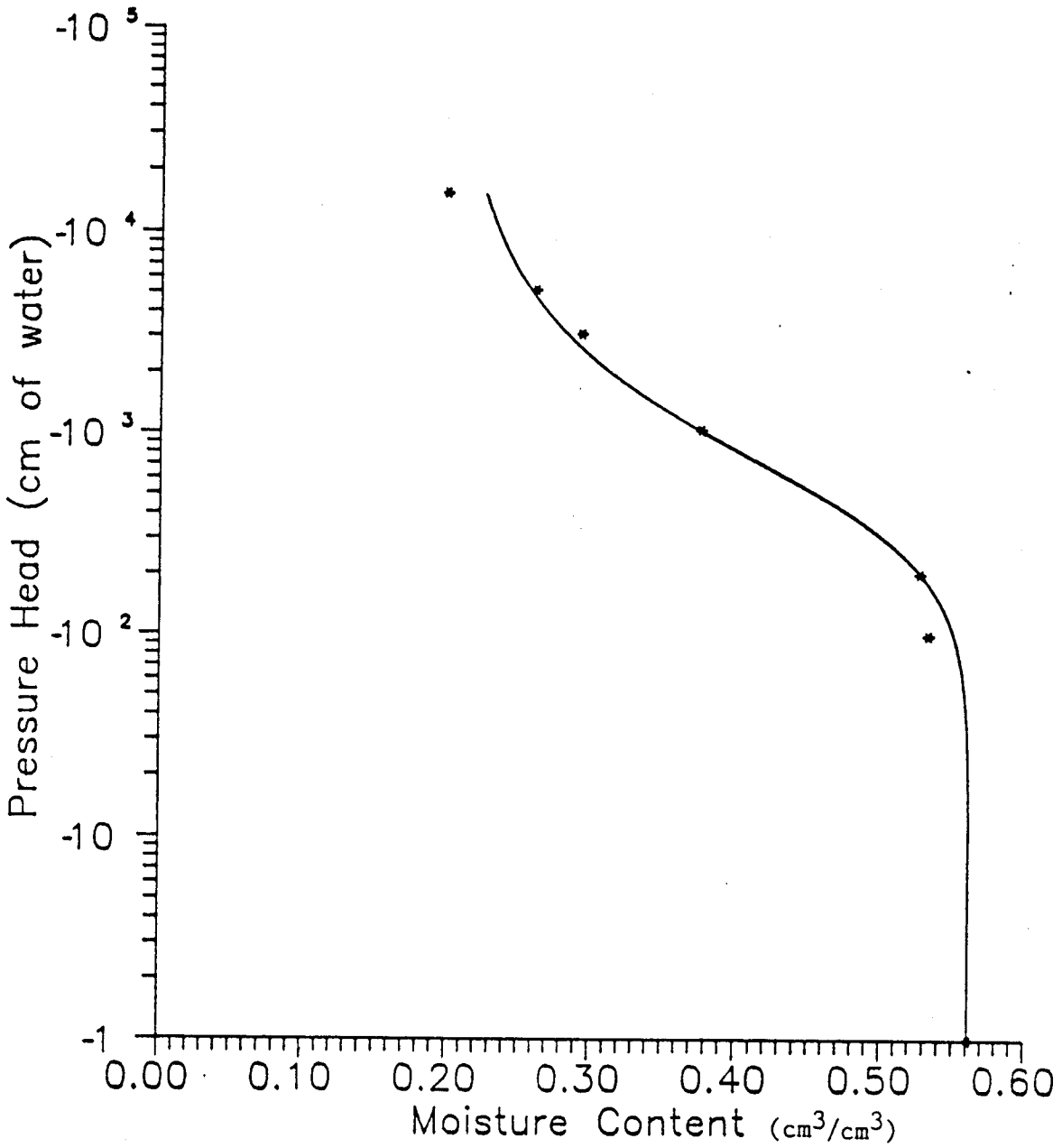


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 11-12				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 16-17
RING NUMBER: 2
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 193.6 (g)
TARE RING: 73.1 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 84.2 (g)
SATURATED MOISTURE CONTENT: 54.9 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 36.3 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/23	1025	0.0	33.7	--	--	54.9	0.0
11/25	800	101.0	32.9	0.8	0.8	53.6	0.0
11/30	810	199.0	32.4	0.5	1.3	52.9	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 16-17
RING NUMBER: 2
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 193.6 (g)
TARE RING: 73.1 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 84.2 (g)
SATURATED MOISTURE CONTENT: 54.9 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 33.4 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 190.7 (g)
FINAL TENSION ON HANGING COLUMN: 199.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	190.7	--	--	--
12/2	740	1.0	185.2	5.5	5.5	42.2
12/6	830	3.0	176.6	8.6	14.1	29.2
12/8	840	5.0	174.5	2.1	16.2	26.0
12/13	1700	15.0	170.8	3.7	19.9	20.4

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

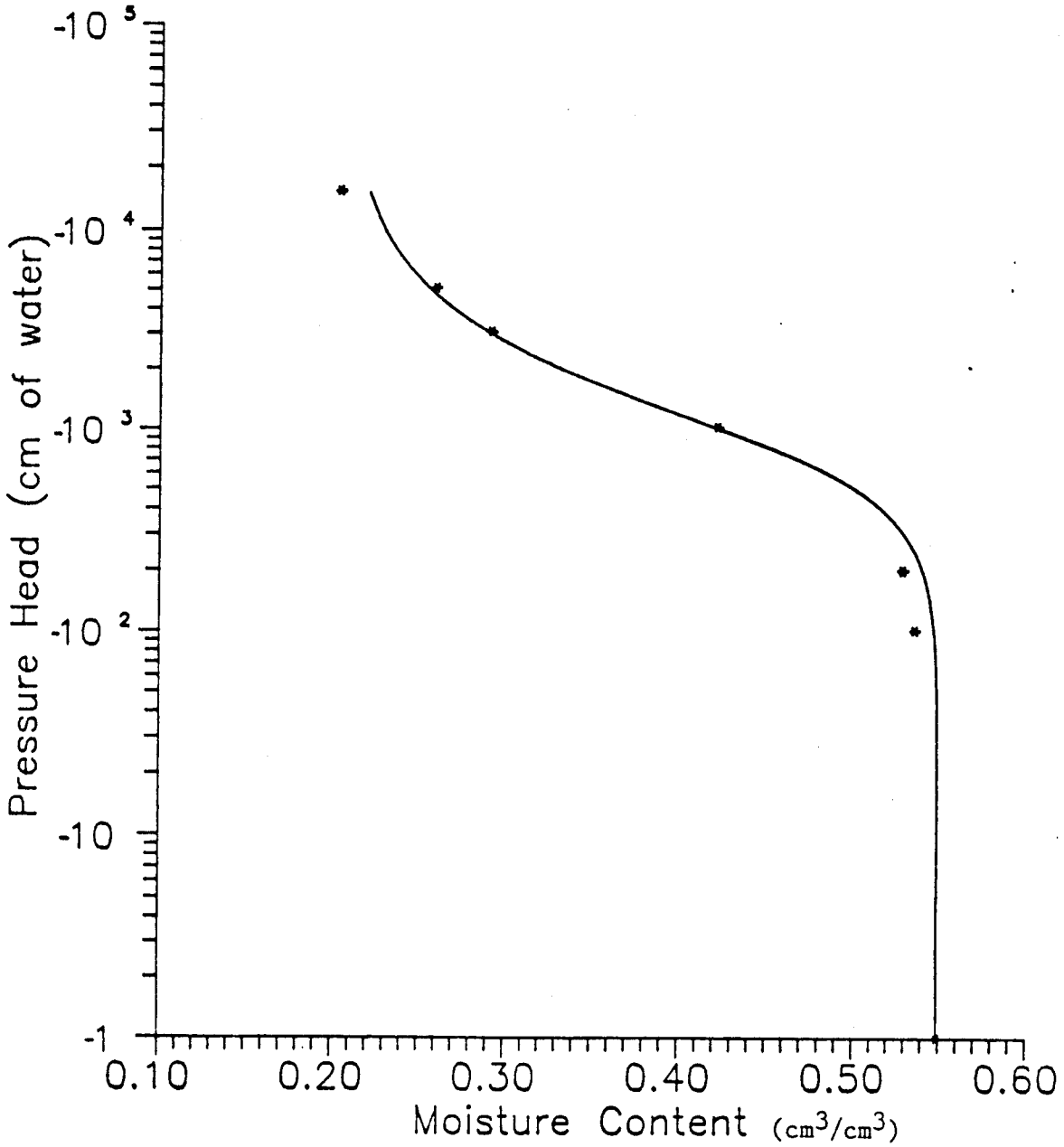


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 16-17				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 21-22
RING NUMBER: F
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 194.0 (g)
TARE RING: 73.8 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 83.0 (g)
SATURATED MOISTURE CONTENT: 56.2 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 37.2 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/23	1025	0.0	34.5	--	--	56.2	0.0
11/25	800	97.0	34.4	0.1	0.1	56.1	0.0
11/30	810	198.0	37.6	-3.2	-3.1	60.9	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 21-22
RING NUMBER: F
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 194.0 (g)
TARE RING: 73.8 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 83.0 (g)
SATURATED MOISTURE CONTENT: 56.2 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 32.7 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 189.5 (g)
FINAL TENSION ON HANGING COLUMN: 198.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	189.5	--	--	--
12/2	740	1.0	175.4	14.1	14.1	28.1
12/6	830	3.0	171.9	3.5	17.6	22.8
12/8	840	5.0	169.7	2.2	19.8	19.5
12/13	1710	15.0	165.0	4.7	24.5	12.4

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

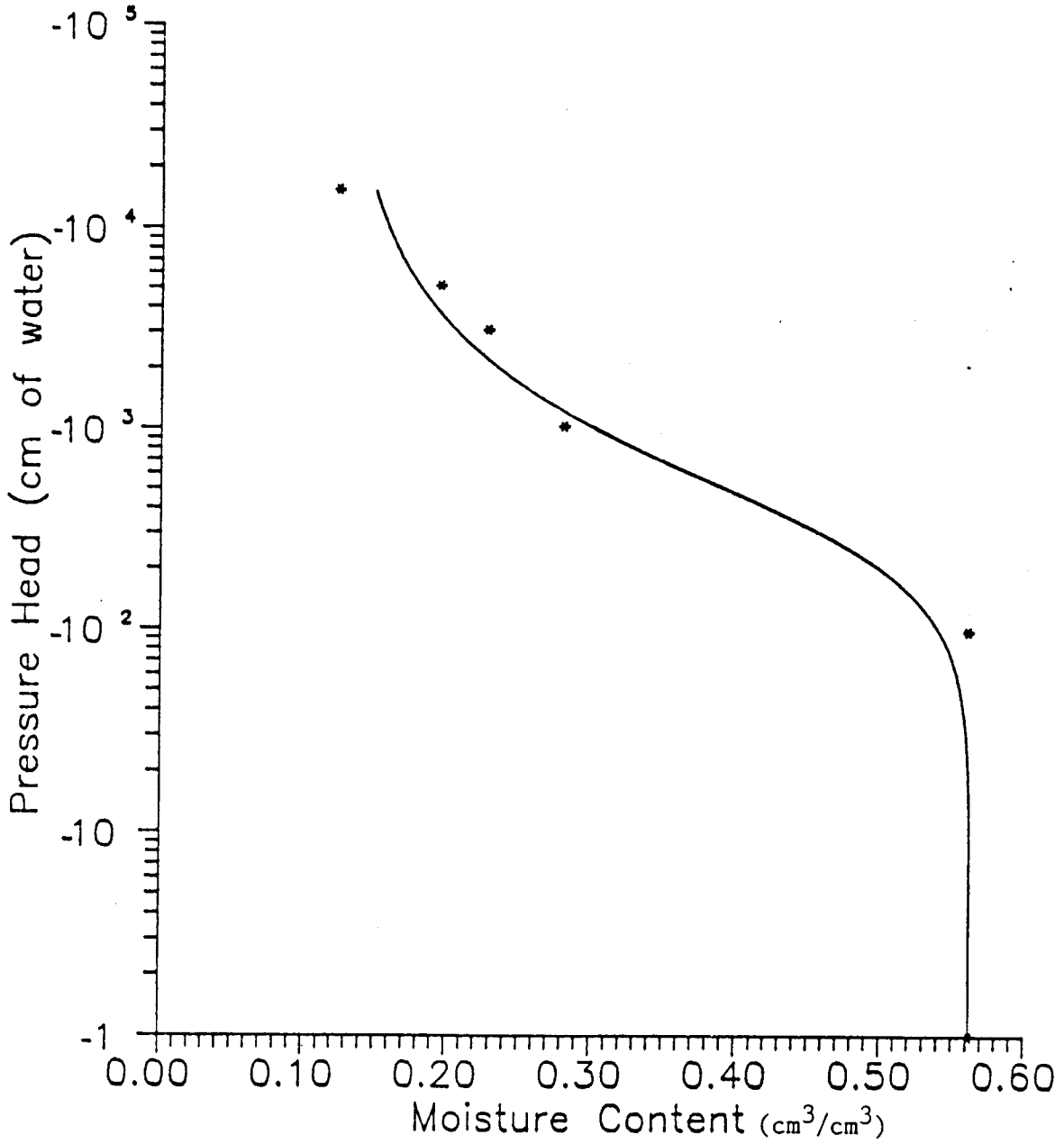


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 21-22				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 25-26
RING NUMBER: C
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 198.3 (g)
TARE RING: 72.8 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 91.1 (g)
SATURATED MOISTURE CONTENT: 52.0 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 34.4 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/23	1025	0.0	35.6	--	--	52.0	0.0
11/25	800	98.5	35.2	0.4	0.4	51.4	0.0
11/30	810	203.0	36.5	-1.3	-0.9	53.3	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 25-26
RING NUMBER: C
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 198.3 (g)
TARE RING: 72.8 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 91.1 (g)
SATURATED MOISTURE CONTENT: 52.0 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 30.9 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 194.8 (g)
FINAL TENSION ON HANGING COLUMN: 203.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	194.8	--	--	--
12/2	740	1.0	179.3	15.5	15.5	23.3
12/6	830	3.0	178.0	1.3	16.8	21.3
12/8	840	5.0	174.9	3.1	19.9	16.6
12/13	1710	15.0	170.5	4.4	24.3	10.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

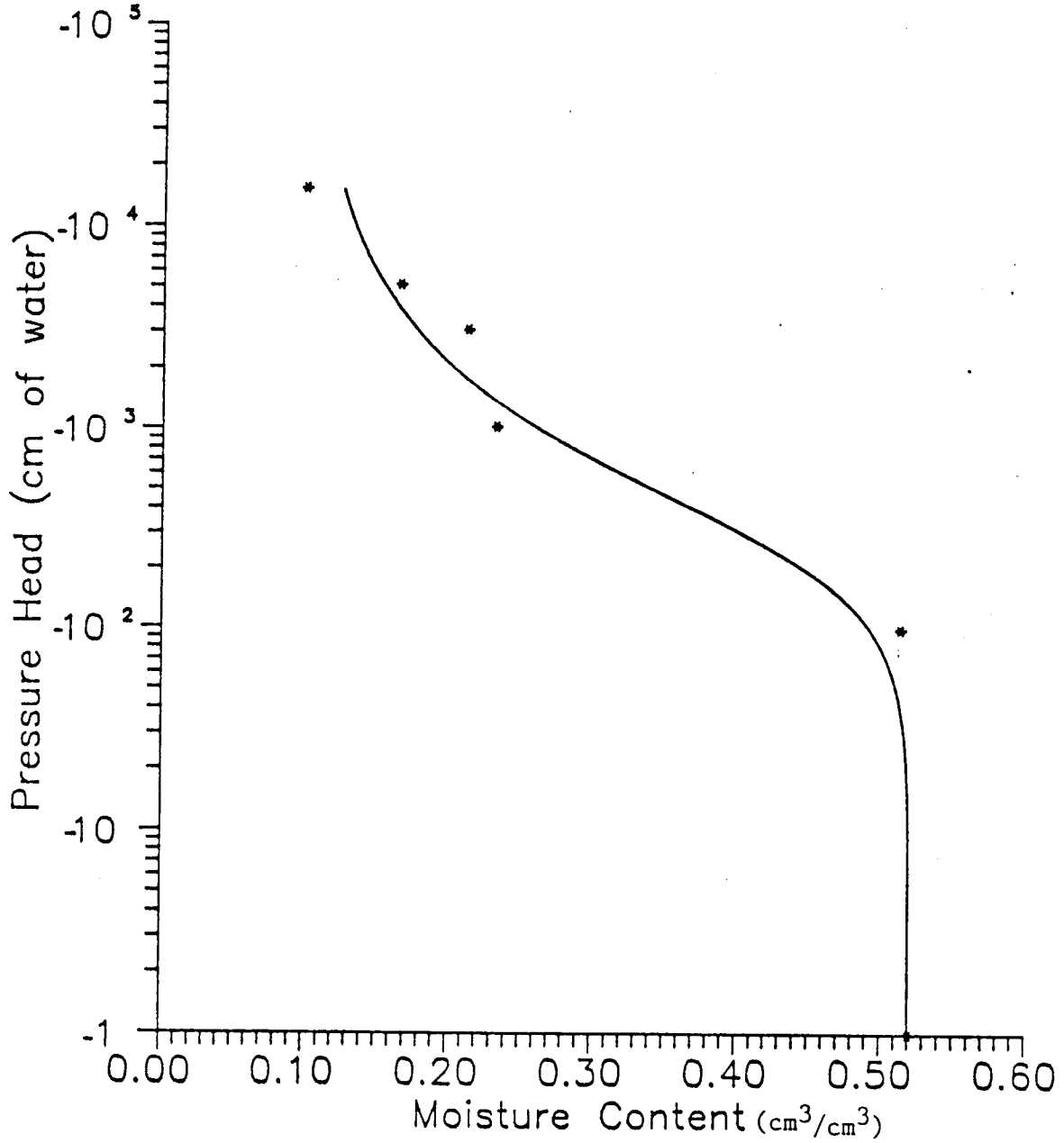


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 25-26				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 35-36
RING NUMBER: G
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 208.4 (g)
TARE RING: 73.3 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 106.8 (g)
SATURATED MOISTURE CONTENT: 42.8 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 28.3 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/24	1120	0.0	33.0	--	--	42.8	0.0
11/28	1125	96.0	32.1	0.9	0.9	41.4	0.0
11/30	810	205.0	32.1	0.0	0.9	41.4	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 35-36
RING NUMBER: G
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 208.4 (g)
TARE RING: 73.3 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 106.8 (g)
SATURATED MOISTURE CONTENT: 42.8 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 27.0 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 207.1 (g)
FINAL TENSION ON HANGING COLUMN: 205.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	207.1	--	--	--
12/2	740	1.0	200.1	7.0	7.0	30.2
12/6	830	3.0	189.5	10.6	17.6	14.2
12/8	840	5.0	189.0	0.5	18.1	13.4
12/13	1715	15.0	186.3	2.7	20.8	9.4

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

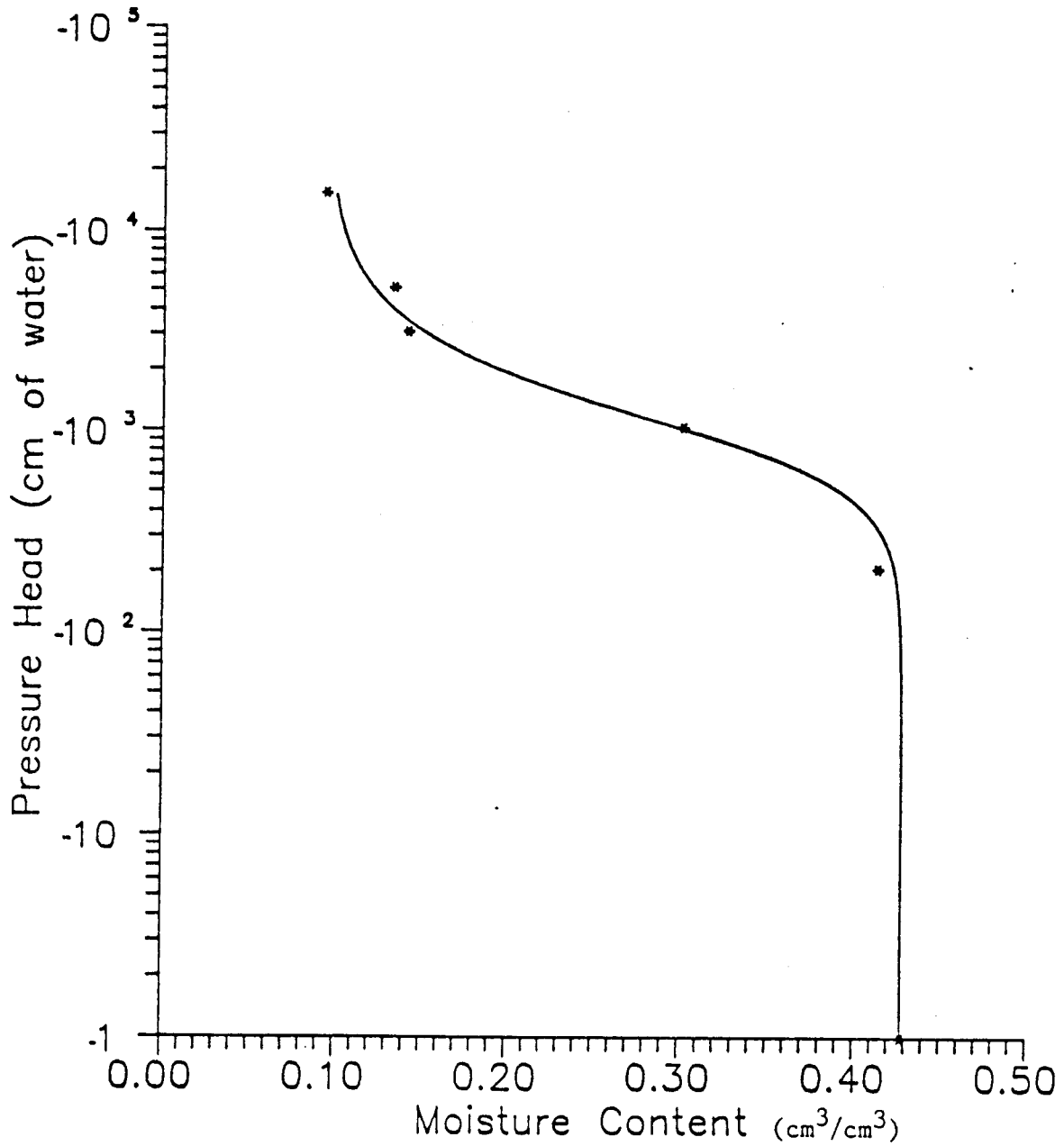


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 35-36				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR:	PROJECT NO:	DATE:	PLOTTED BY:	CHECKED BY:	
Los Alamos	87-L-070	1/4/88	SLS	WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 42-43
RING NUMBER: 4
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 208.0 (g)
TARE RING: 72.6 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 107.4 (g)
SATURATED MOISTURE CONTENT: 42.3 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 28.0 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/24	1120	0.0	32.7	--	--	42.3	0.0
11/28	1125	100.5	32.7	0.0	0.0	42.3	0.0
11/30	810	209.0	32.6	0.1	0.1	42.2	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 42-43
RING NUMBER: 4
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 208.0 (g)
TARE RING: 72.6 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 107.4 (g)
SATURATED MOISTURE CONTENT: 42.3 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 26.4 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 206.4 (g)
FINAL TENSION ON HANGING COLUMN: 209.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	206.4	--	--	--
12/2	740	1.0	202.2	4.2	4.2	33.5
12/6	830	3.0	200.2	2.0	6.2	30.5
12/8	840	5.0	199.1	1.1	7.3	28.9
12/13	1720	15.0	195.1	4.0	11.3	22.8

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

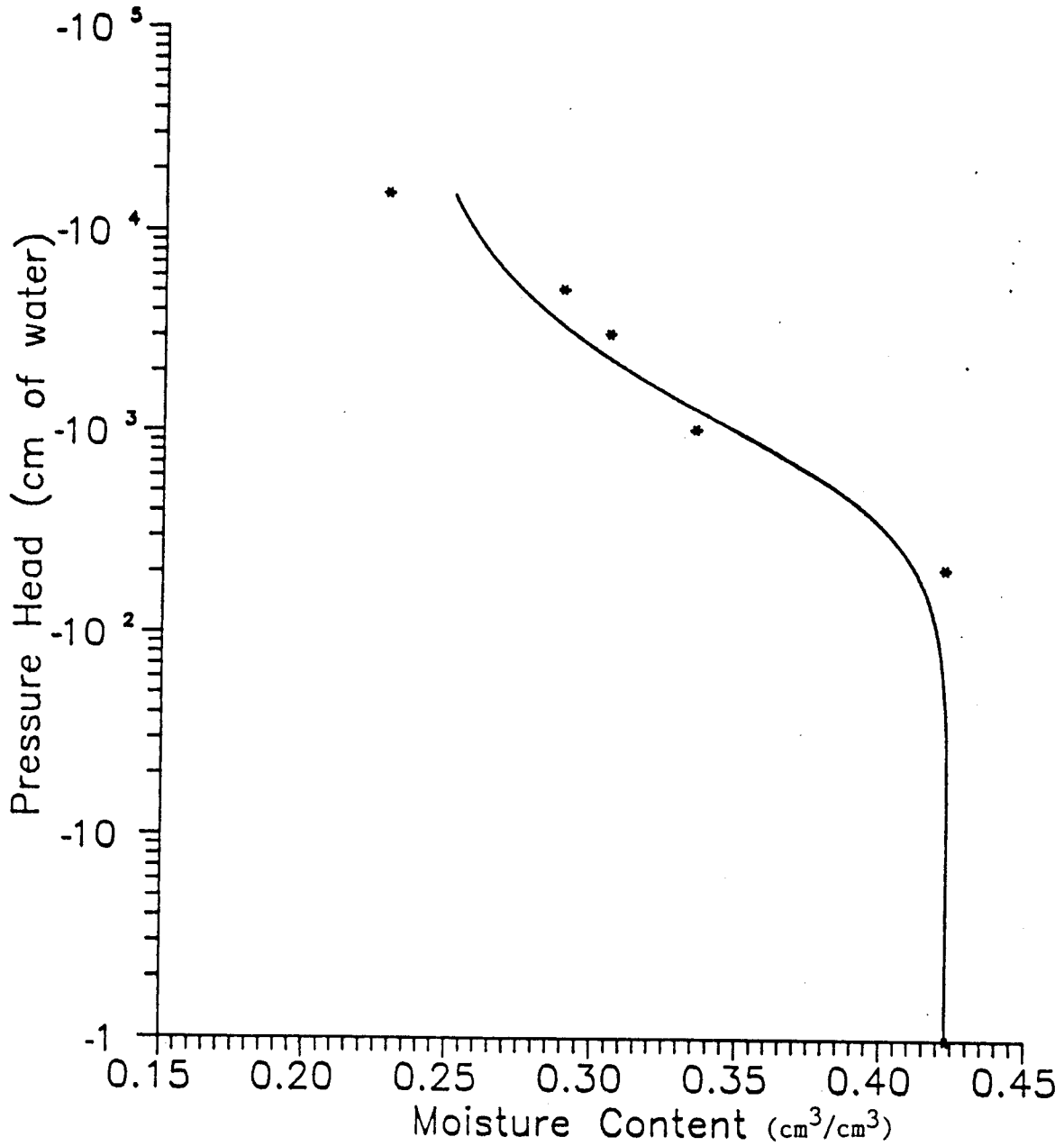


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 42-43				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 61-62
RING NUMBER: A4
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 210.1 (g)
TARE RING: 73.4 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 112.6 (g)
SATURATED MOISTURE CONTENT: 36.4 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 24.1 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/24	1120	0.0	36.1	--	--	36.4	0.0
11/28	1125	95.5	35.0	1.1	1.1	34.8	0.0
11/30	810	202.0	33.6	1.4	2.5	32.6	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 61-62
RING NUMBER: A4
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 210.1 (g)
TARE RING: 73.4 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 112.6 (g)
SATURATED MOISTURE CONTENT: 36.4 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 20.8 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 206.8 (g)
FINAL TENSION ON HANGING COLUMN: 202.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	206.8	--	--	--
12/2	740	1.0	198.8	8.0	8.0	19.3
12/6	830	3.0	193.4	5.4	13.4	11.2
12/8	840	5.0	192.9	0.5	13.9	10.4
12/13	1720	15.0	191.2	1.7	15.6	7.9

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

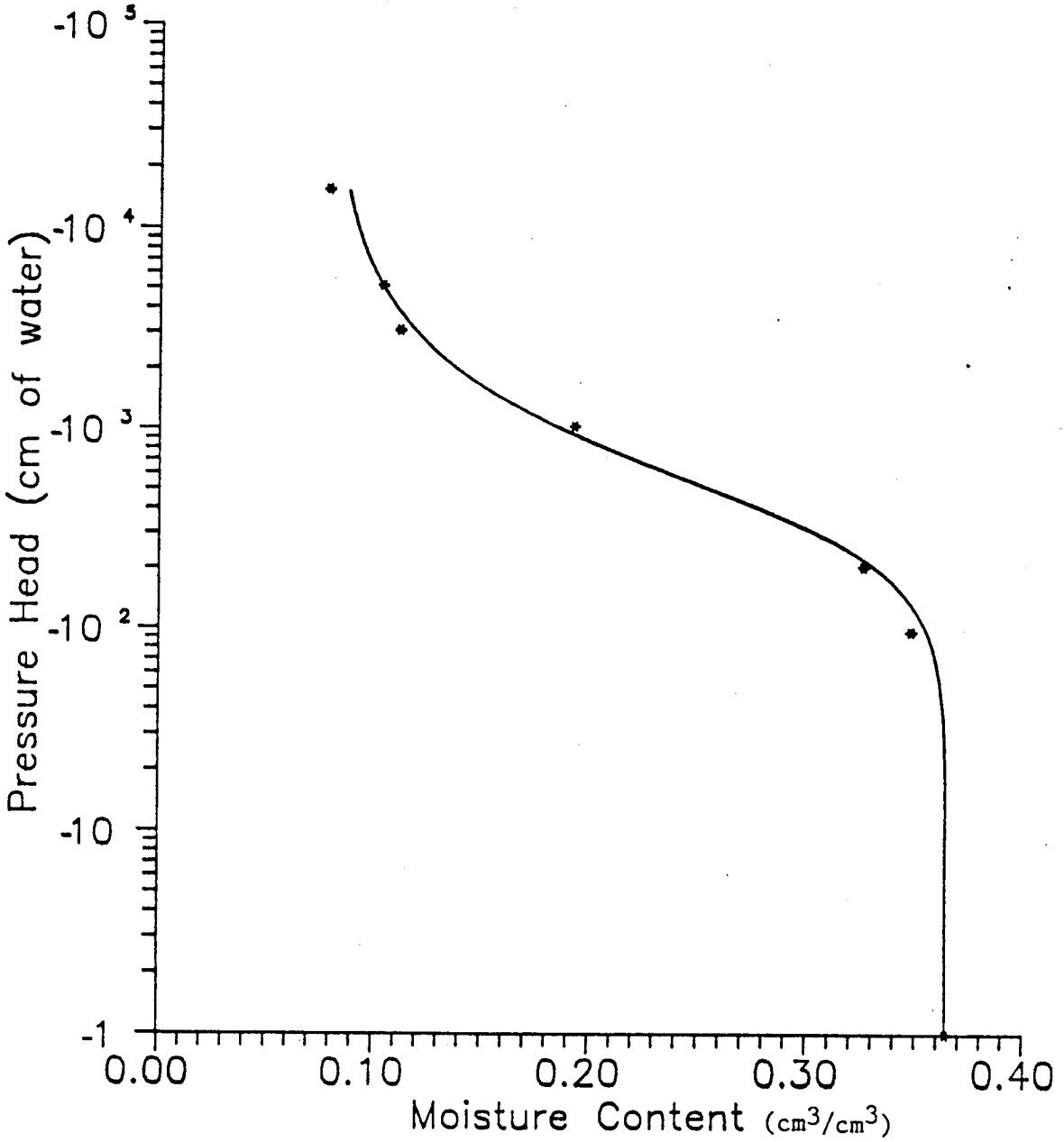


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 61-62				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 75-76
RING NUMBER: 19
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 204.5 (g)
TARE RING: 73.4 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 103.6 (g)
SATURATED MOISTURE CONTENT: 41.6 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 27.5 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/24	1120	0.0	34.4	--	--	41.6	0.0
11/28	1125	95.0	32.0	2.4	2.4	37.9	0.0
11/30	810	199.0	28.8	3.2	5.6	33.1	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 75-76
RING NUMBER: 19
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 204.5 (g)
TARE RING: 73.4 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 103.6 (g)
SATURATED MOISTURE CONTENT: 41.6 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 21.9 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP: 198.9 (g)
FINAL TENSION ON HANGING COLUMN: 199.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	198.9	--	--	--
12/2	740	1.0	192.9	6.0	6.0	24.0
12/6	830	3.0	185.3	7.6	13.6	12.5
12/8	840	5.0	184.7	0.6	14.2	11.6
12/13	1725	15.0	182.5	2.2	16.4	8.3

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

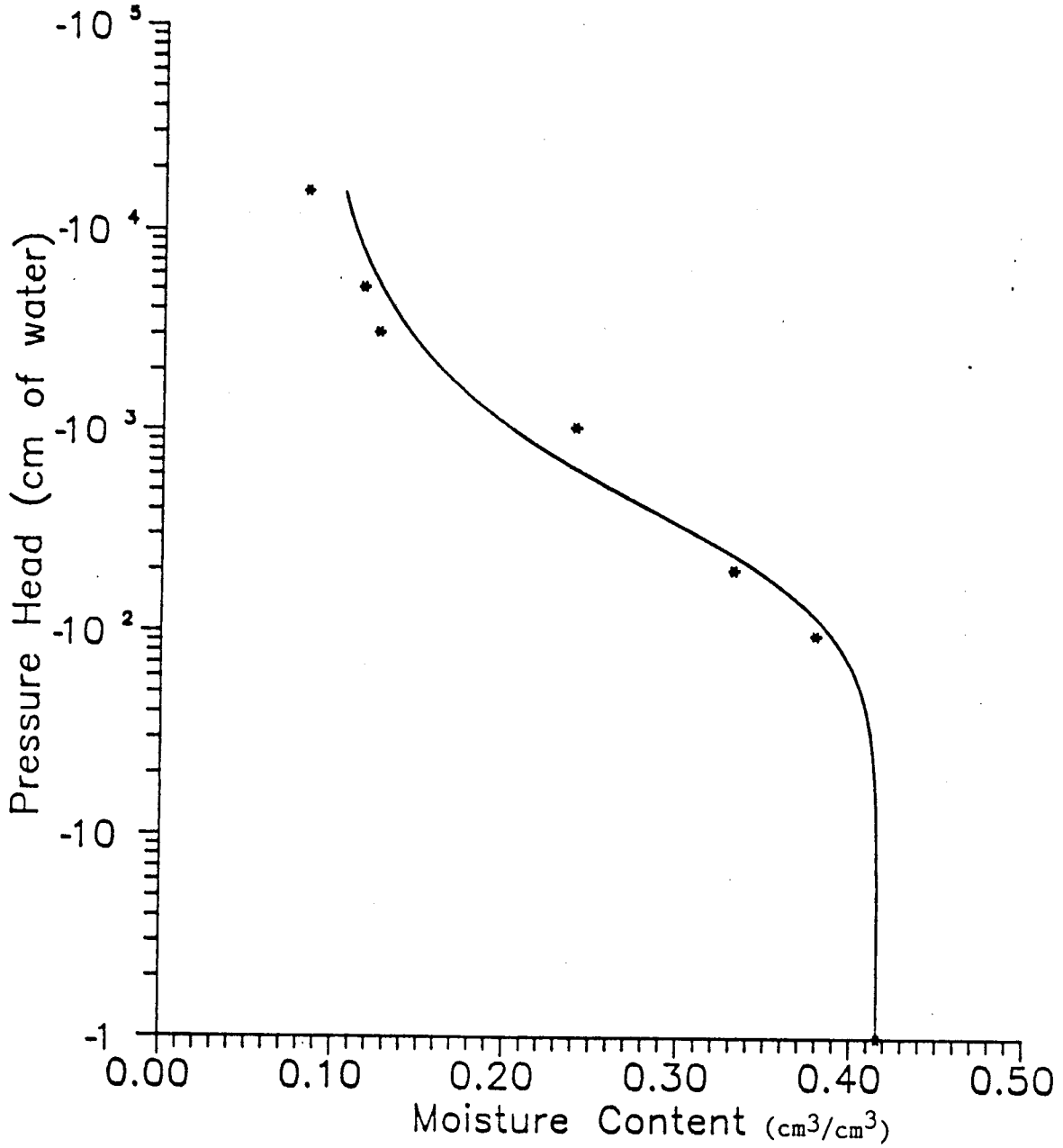


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 75-76				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

MOISTURE RETENTION DATA - HANGING COLUMN
(PORE SIZE DISTRIBUTION)

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 80-81
RING NUMBER: 18
DEPTH: unknown
SAMPLE VOLUME: 66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION
(WITH CAP AND RING): 215.1 (g)
TARE RING: 73.1 (g)
TARE CAP: 0.0 (g)
DRY WEIGHT OF SAMPLE: 119.1 (g)
SATURATED MOISTURE CONTENT: 34.6 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE: 22.9 (cc)

DATE (1987)	TIME	SUCTION (CM)	BURET VOL (CC)	CHANGE VOL (CC)	CHANGES VOL (CC)	MOISTURE CONTENT(% VOL) DRYING	WETTING
11/24	1120	0.0	34.0	--	--	34.6	0.0
11/28	1125	98.5	34.1	-0.1	-0.1	34.8	0.0
11/30	810	205.0	38.1	-4.0	-4.1	40.8	0.0

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

MOISTURE RETENTION DATA - 15 BAR PRESSURE PLATE
(PORE SIZE DISTRIBUTION)

JOB NAME:	LOS ALAMOS
JOB NUMBER:	87-L-070
SAMPLE NUMBER:	80-81
RING NUMBER:	18
DEPTH:	unknown
SAMPLE VOLUME:	66.18 (cc)
SATURATED WEIGHT AT 0 CM TENSION (WITH CAP AND RING):	215.1 (g)
TARE RING:	73.1 (g)
TARE CAP:	0.0 (g)
DRY WEIGHT OF SAMPLE:	119.1 (g)
SATURATED MOISTURE CONTENT:	34.6 (% vol)
INITIAL VOLUME OF WATER IN SAMPLE:	21.4 (cc)
WEIGHT FROM HANGING COLUMN, W/O CAP:	213.6 (g)
FINAL TENSION ON HANGING COLUMN:	205.0 (cm)

DATE (1987)	TIME	PRESSURE (BAR)	WEIGHT W/RING(G)	CHANGE WT (G)	CHANGES WT (G)	MOISTURE CONTENT (% VOL)
11/30	845	0.0	213.6	--	--	--
12/2	740	1.0	210.4	3.2	3.2	27.5
12/6	830	3.0	204.3	6.1	9.3	18.3
12/8	840	5.0	203.5	0.8	10.1	17.1
12/13	1725	15.0	199.3	4.2	14.3	10.7

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATION MADE BY: S. Stoller
CHECKED BY: W. Cox

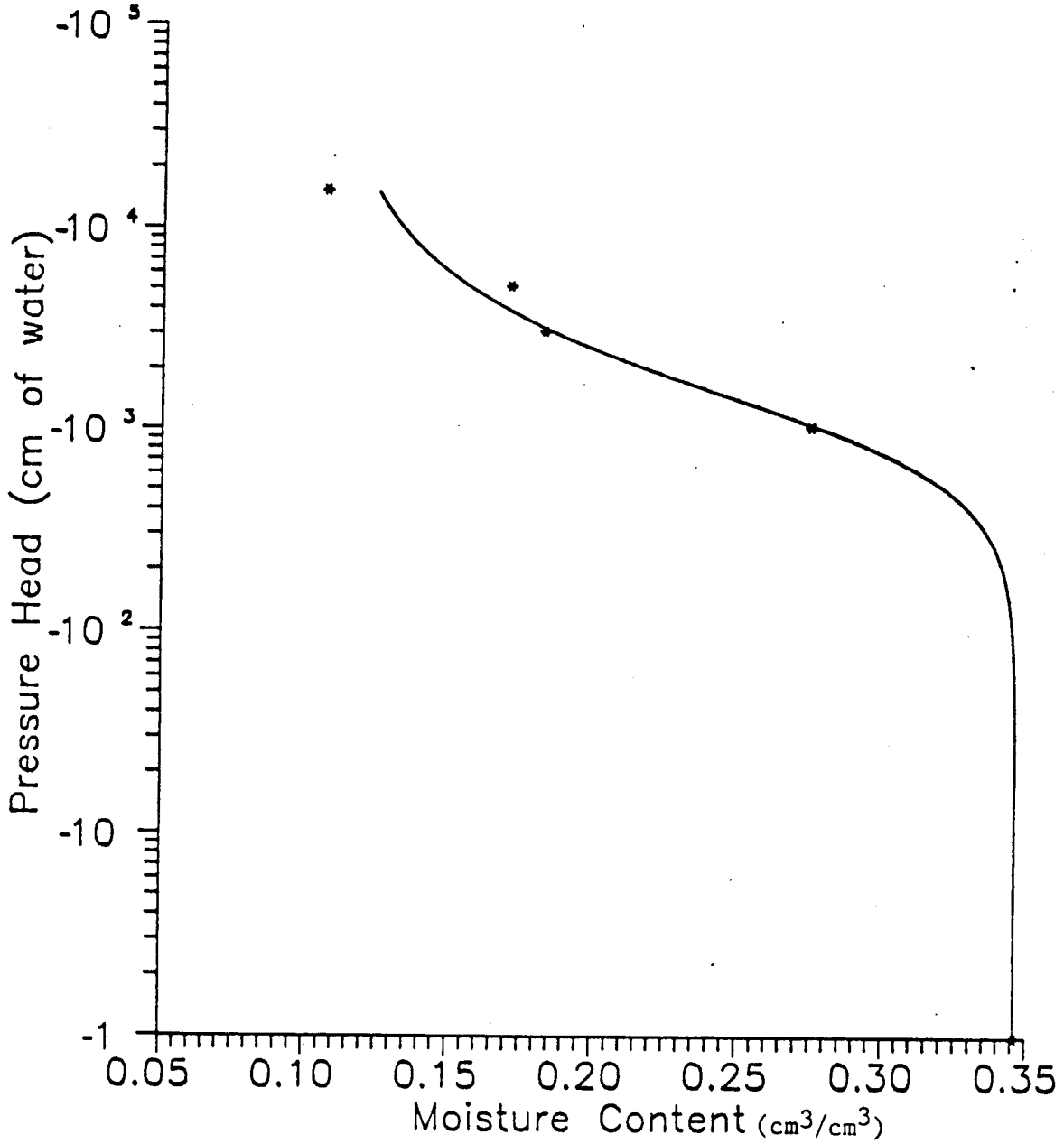


FIGURE NUMBER:	Pressure Head (cm of water) vs. Moisture Content (cm^3/cm^3), Sample No. 80-81				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

INITIAL MOISTURE CONTENT, DRY BULK DENSITY AND POROSITY

Table 6. Summary of Initial Moisture Content, Dry Bulk Density and Porosity

Sample No.	Initial Moisture Content Gravimetric (g/g)	Initial Moisture Content Volumetric (cm^3/cm^3)	Dry Bulk Density (g/cc)	Porosity* (% vol)
7-8	28.30	35.36	1.25	51.8
11-12	14.90	18.74	1.26	56.1
16-17	17.46	22.21	1.27	54.9
21-22	15.90	19.95	1.25	56.2
25-26	13.94	19.19	1.38	52.0
35-36	14.51	23.42	1.61	42.8
42-43	22.53	36.57	1.62	42.3
61-62	11.55	19.64	1.70	36.4
75-76	14.77	23.12	1.57	41.6
80-81	11.17	20.10	1.80	34.6

*Taken as saturated moisture content

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 11-12
RING NUMBER: 22
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 168.9 (g)
TARE WEIGHT, RING: 73.3 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 83.2 (g)
DRY BULK DENSITY: 1.26 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 52.56 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 18.74 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 14.90 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 16-17
RING NUMBER: 2
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 172.0 (g)
TARE WEIGHT, RING: 73.1 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 84.2 (g)
DRY BULK DENSITY: 1.27 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 51.99 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 22.21 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 17.46 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 21-22
RING NUMBER: F
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 170.0 (g)
TARE WEIGHT, RING: 73.8 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 83.0 (g)
DRY BULK DENSITY: 1.25 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 52.67 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 19.95 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 15.90 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 25-26
RING NUMBER: C
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 176.6 (g)
TARE WEIGHT, RING: 72.8 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 91.1 (g)
DRY BULK DENSITY: 1.38 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 48.05 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 19.19 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 13.94 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 35-36
RING NUMBER: G
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 195.6 (g)
TARE WEIGHT, RING: 73.3 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 106.8 (g)
DRY BULK DENSITY: 1.61 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 39.10 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 23.42 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 14.51 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 42-43
RING NUMBER: 4
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 204.2 (g)
TARE WEIGHT, RING: 72.6 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 107.4 (g)
DRY BULK DENSITY: 1.62 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 38.76 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 36.57 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 22.53 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 61-62
RING NUMBER: A4
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 199.0 (g)
TARE WEIGHT, RING: 73.4 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 112.6 (g)
DRY BULK DENSITY: 1.70 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 35.80 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 19.64 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 11.55 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 75-76
RING NUMBER: 19
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 192.3 (g)
TARE WEIGHT, RING: 73.4 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 103.6 (g)
DRY BULK DENSITY: 1.57 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 40.93 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 23.12 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 14.77 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

DATA FOR INITIAL MOISTURE CONTENT,
BULK DENSITY, AND POROSITY

JOB NAME: LOS ALAMOS
JOB NUMBER: 87-L-070
SAMPLE NUMBER: 80-81
RING NUMBER: 18
DEPTH: unknown

FIELD WIEGHT OF SAMPLE (W/CAP AND RING): 205.5 (g)
TARE WEIGHT, RING: 73.1 (g)
TARE WEIGHT, PAN: 0.0 (g)
SAMPLE VOLUME: 66.18 (cc)
DATE AND TIME INTO OVEN: 12/13/87 1700
DATE AND TIME OUT OF OVEN: 12/17/87 940

DRY WEIGHT OF SAMPLE: 119.1 (g)
DRY BULK DENSITY: 1.80 (g/cc)
PARTICLE DENSITY: 2.65 (g/cc)
(METHOD: ASSUME MEAN PARTICLE DENSITY = 2.65 g/cc)

CALCULATED POROSITY: 32.09 (% vol)

INITIAL MOISTURE CONTENT (VOLUMETRIC): 20.10 (% vol)

INITIAL MOISTURE CONTENT (GRAVIMETRIC): 11.17 (%)

COMMENTS:

LABORATORY ANALYSIS PERFORMED BY: S. Stoller
CALCULATIONS MADE BY: S. Stoller
CHECKED BY: W. Cox

UNSATURATED HYDRAULIC PROPERTIES

Table 7. Summary of Parameters for Calculating Unsaturated Hydraulic Conductivity

Sample No.	α (cm^{-1})	N (dimension-less)	θr (cm^3/cm^3)	θs (cm^3/cm^3)	K_s (cm/sec)
7-8	0.00272	2.49734	0.083	0.518	1.58E-04
11-12	0.00231	1.73884	0.199	0.561	2.84E-04
16-17	0.00119	2.04731	0.204	0.549	2.78E-04
21-22	0.00313	1.73941	0.124	0.562	2.00E-04
25-26	0.00371	1.69308	0.100	0.520	9.18E-05
35-36	0.00108	2.44961	0.094	0.428	2.25E-05
42-43	0.00164	1.66466	0.228	0.423	8.57E-05
61-62	0.00263	1.93720	0.079	0.364	5.15E-04
75-76	0.00452	1.65070	0.083	0.416	2.28E-04
80-81	0.00098	1.96205	0.107	0.346	4.41E-05

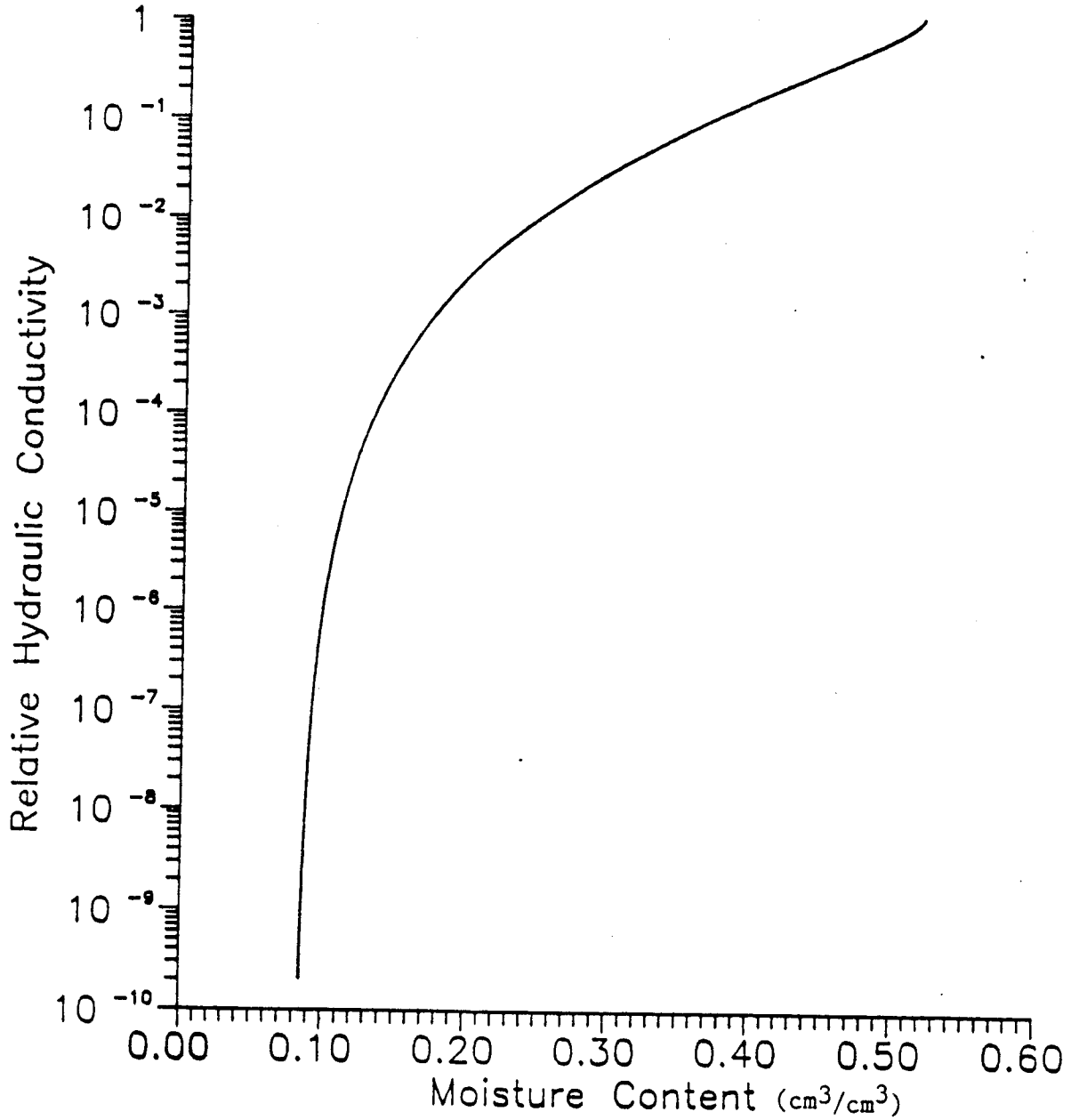


FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 7-8				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

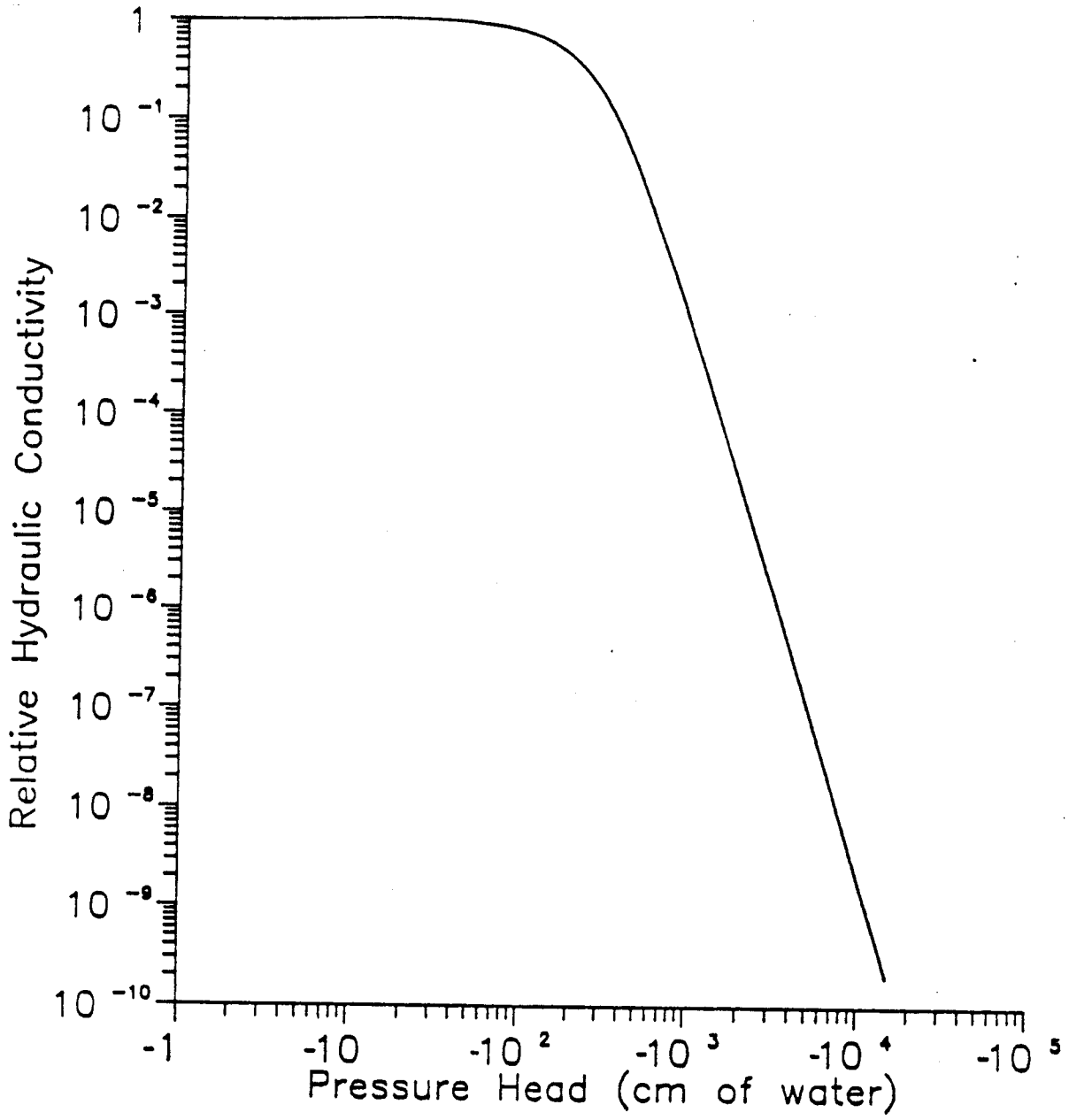


FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No.7-8				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

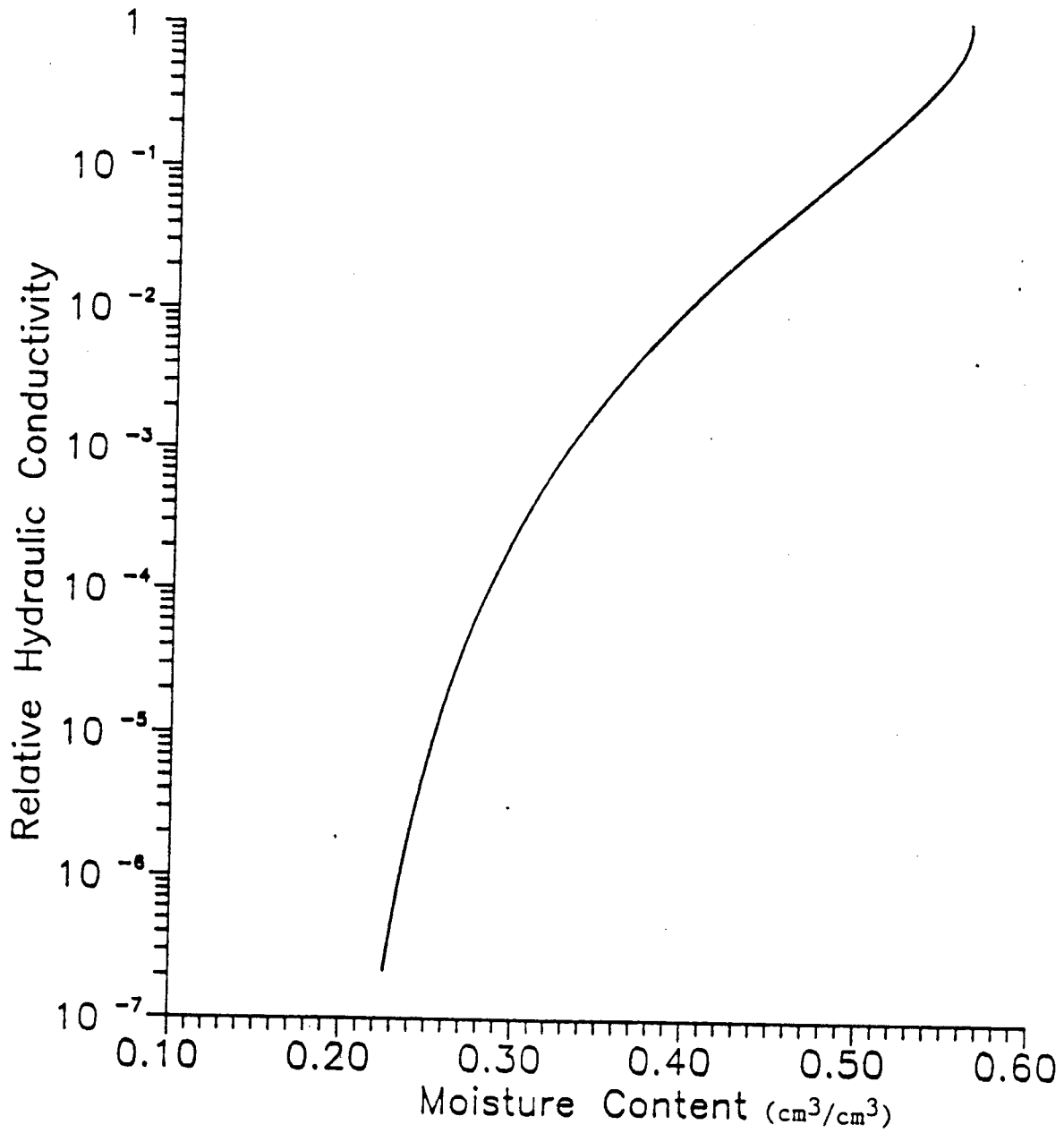


FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 11-12				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

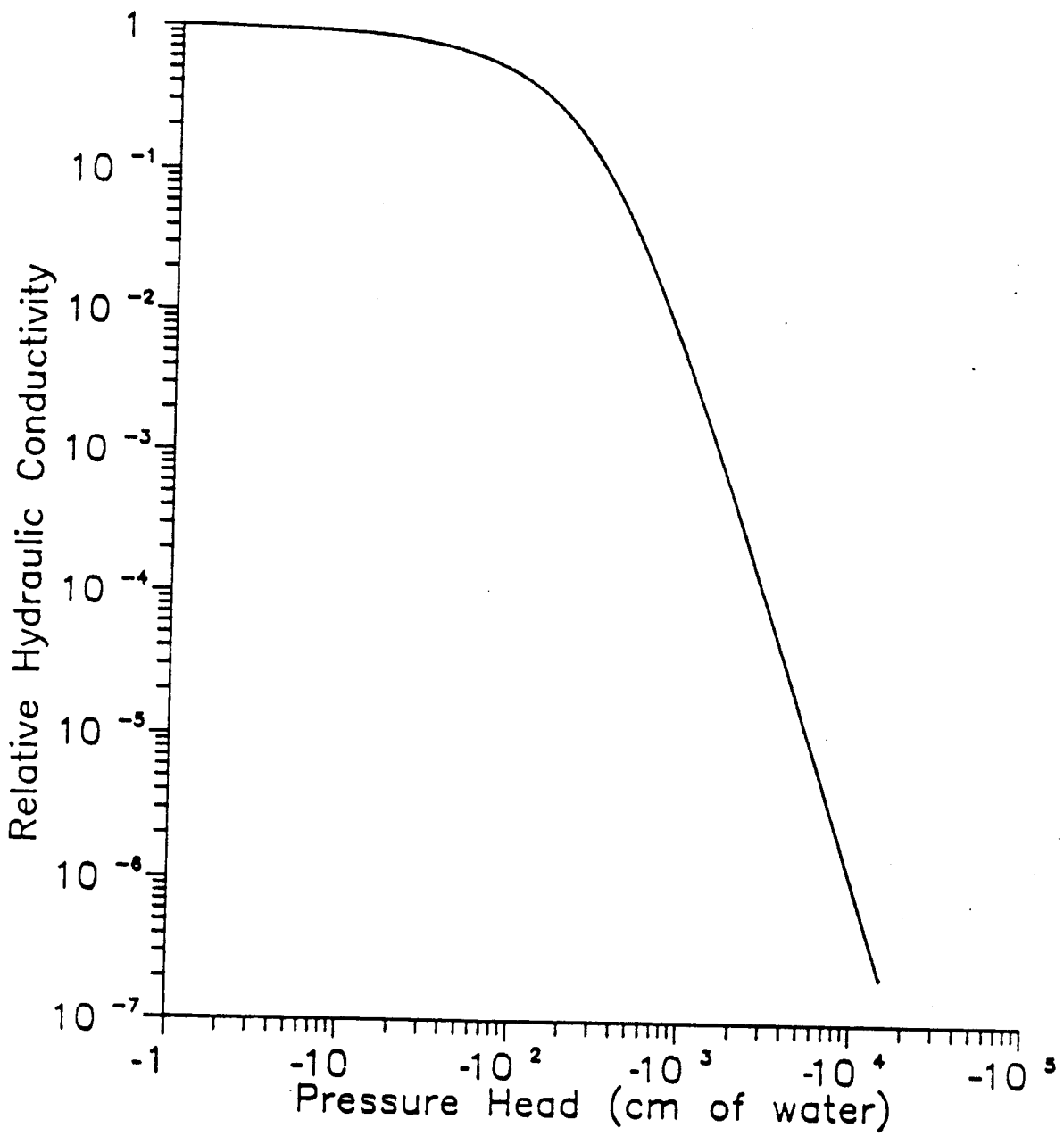


FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 11-12				DANIEL B. STEPHENS & ASSOCIATES, INC.
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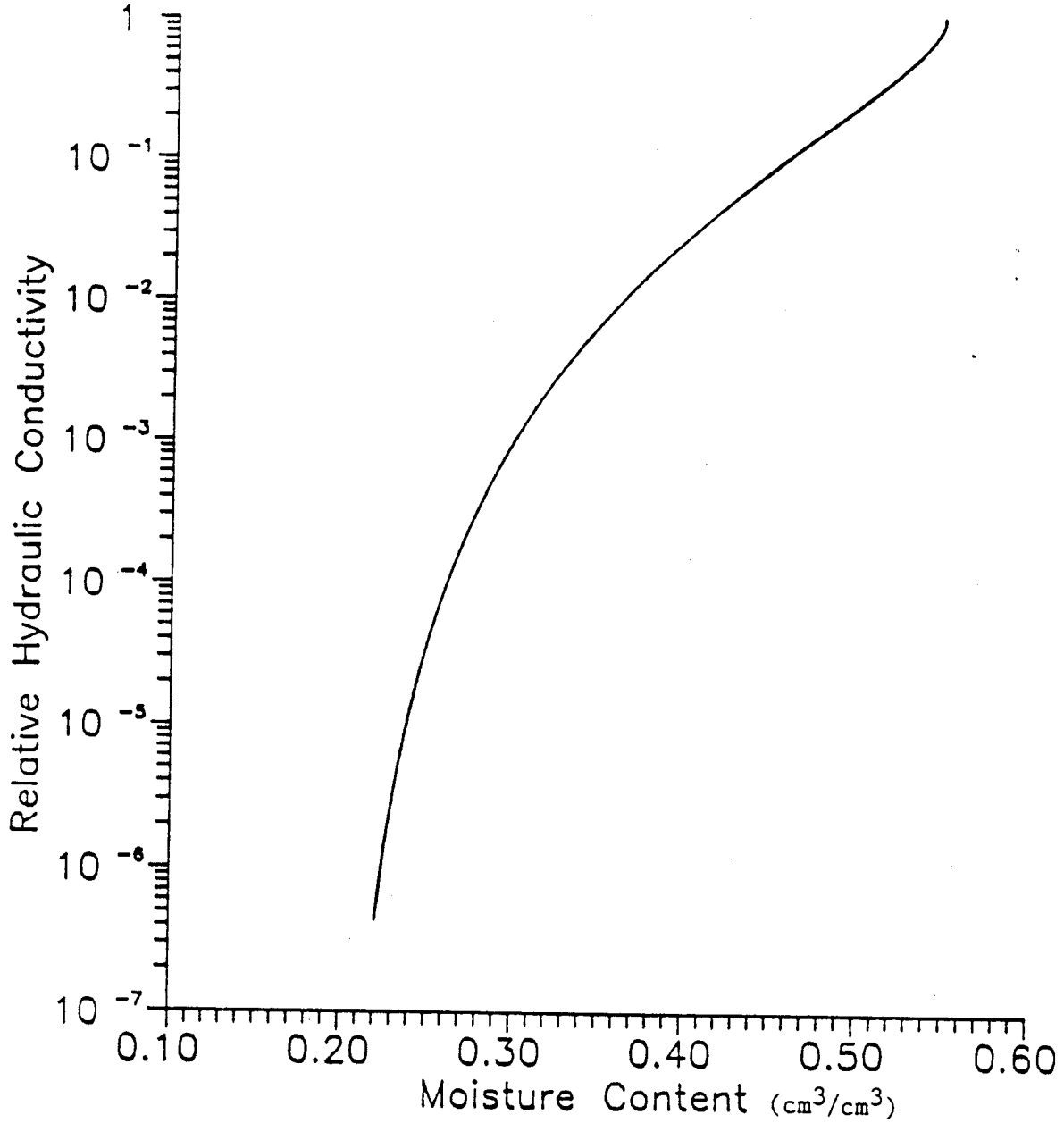

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 16-17				DANIEL B. STEPHENS & ASSOCIATES, INC.
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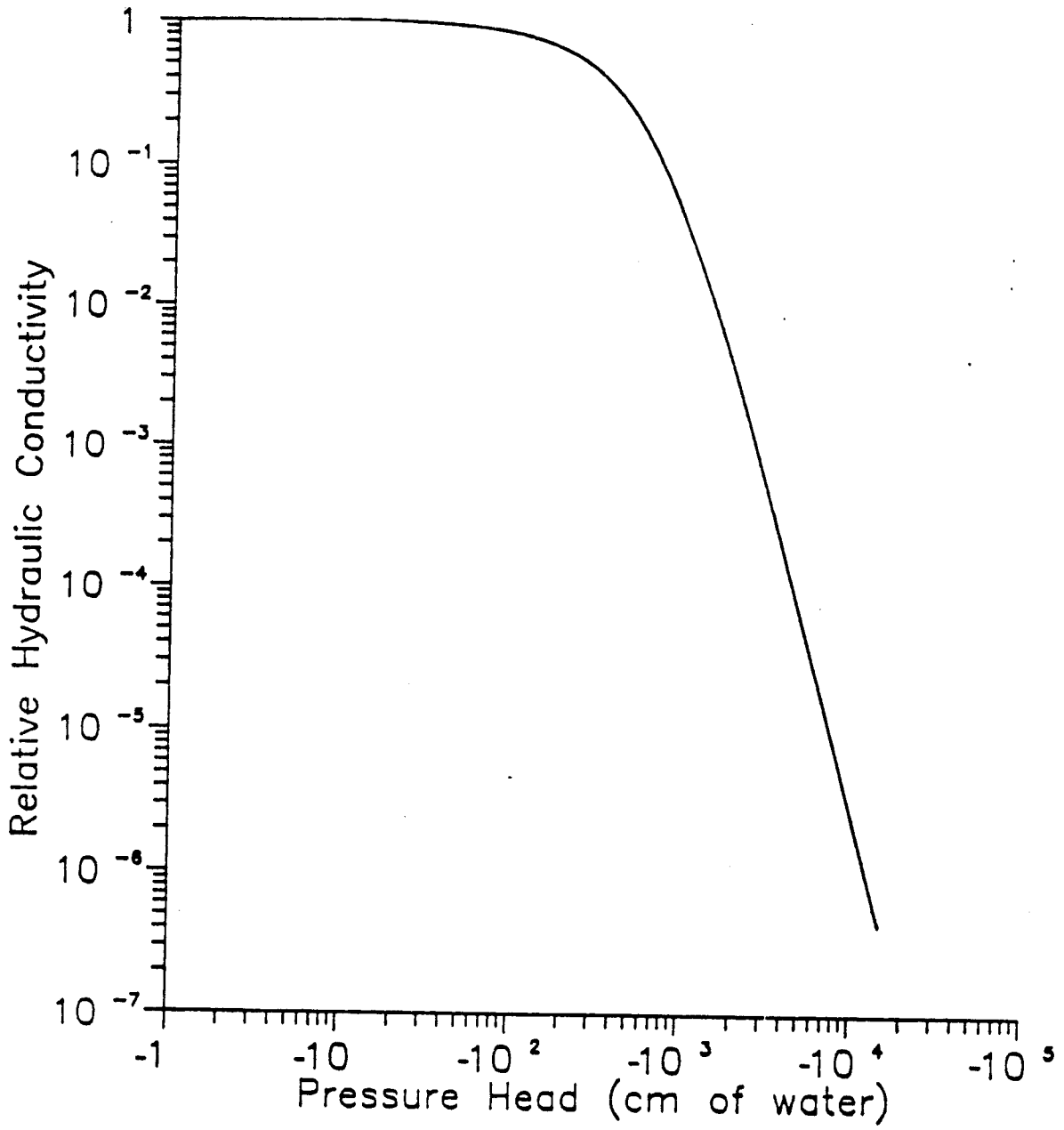

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 16-17				DANIEL B. STEPHENS & ASSOCIATES, INC.
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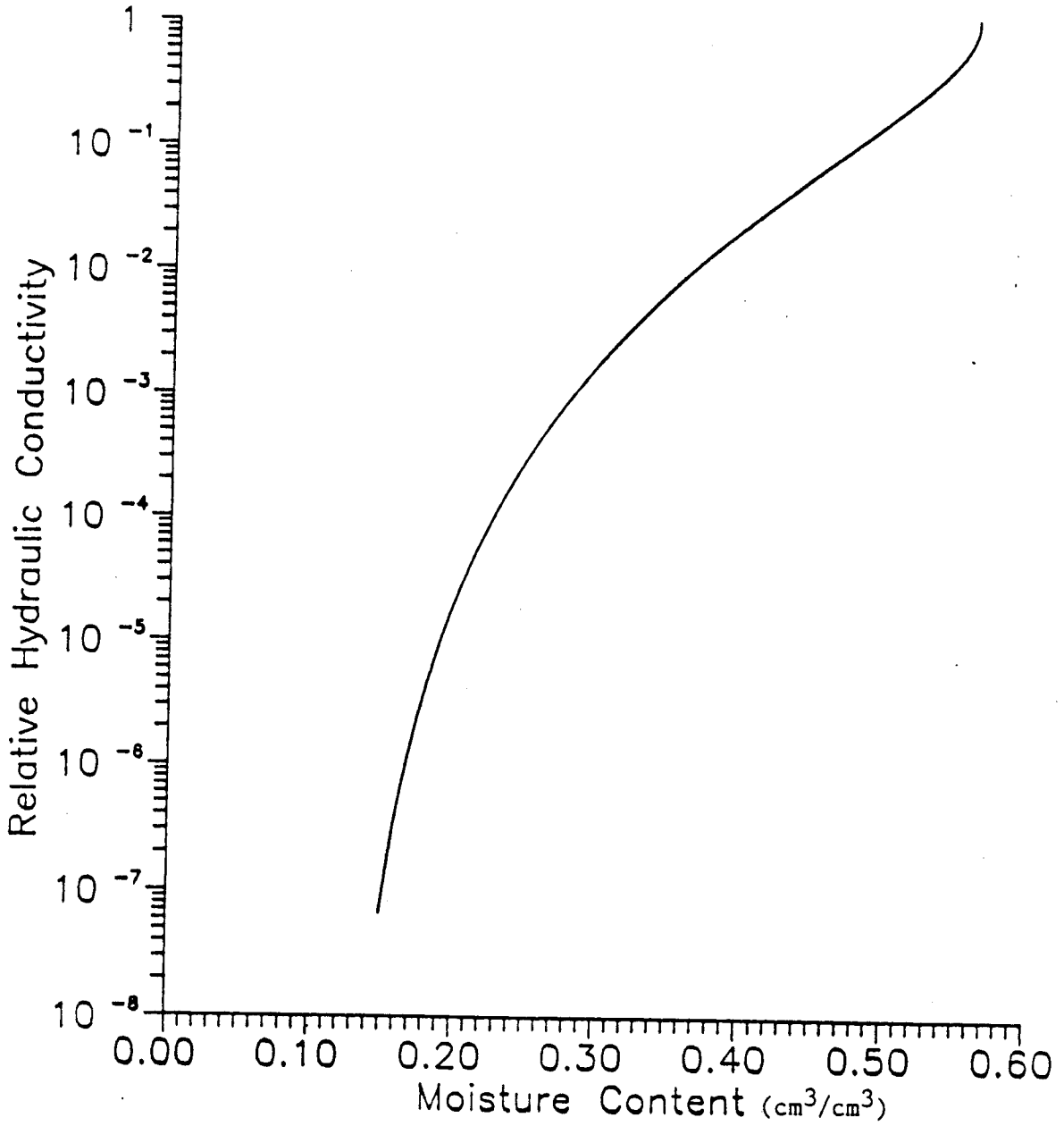

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 21-22				DANIEL B. STEPHENS & ASSOCIATES, INC.
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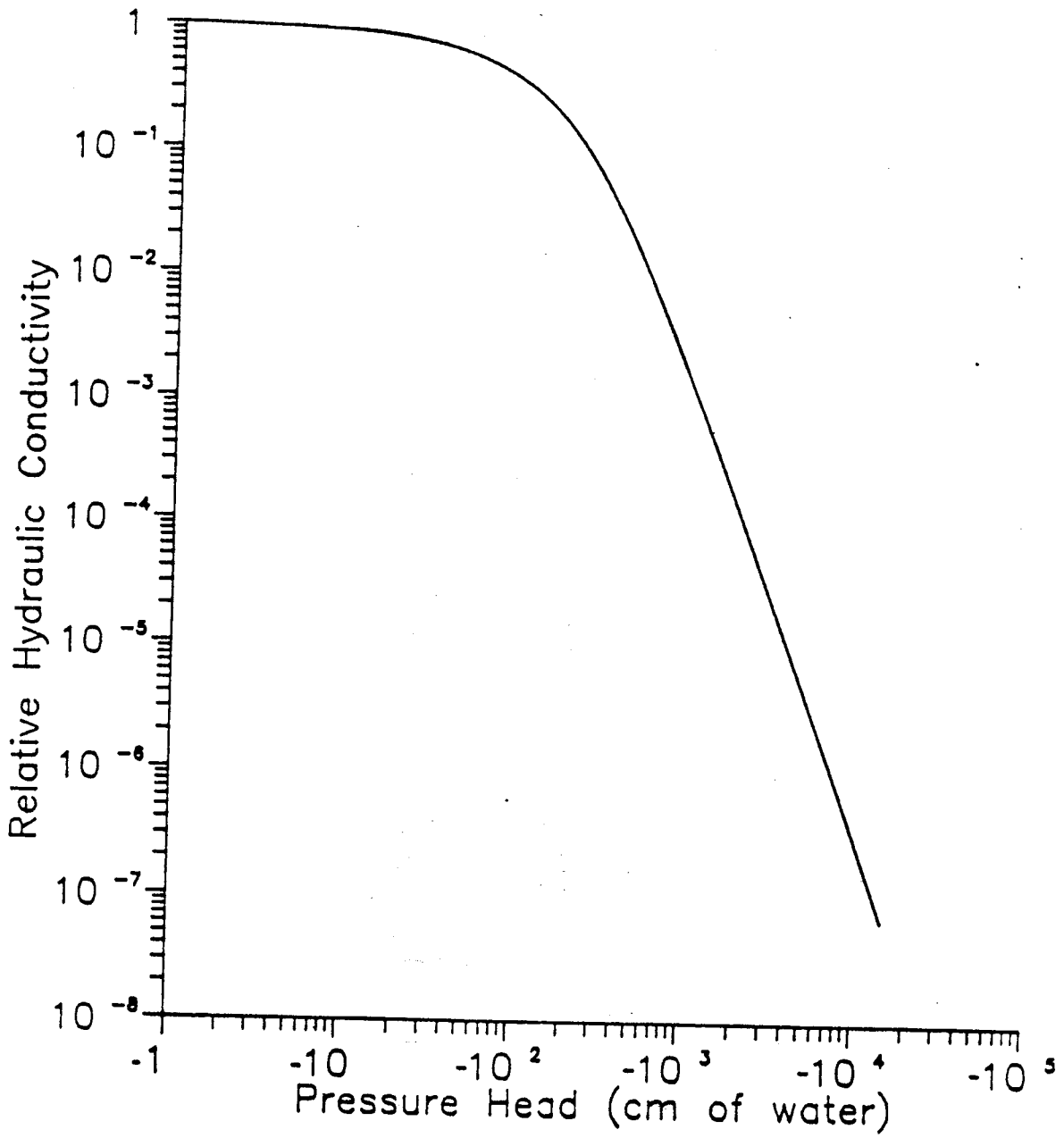

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 21-22				DANIEL B. STEPHENS & ASSOCIATES, INC.
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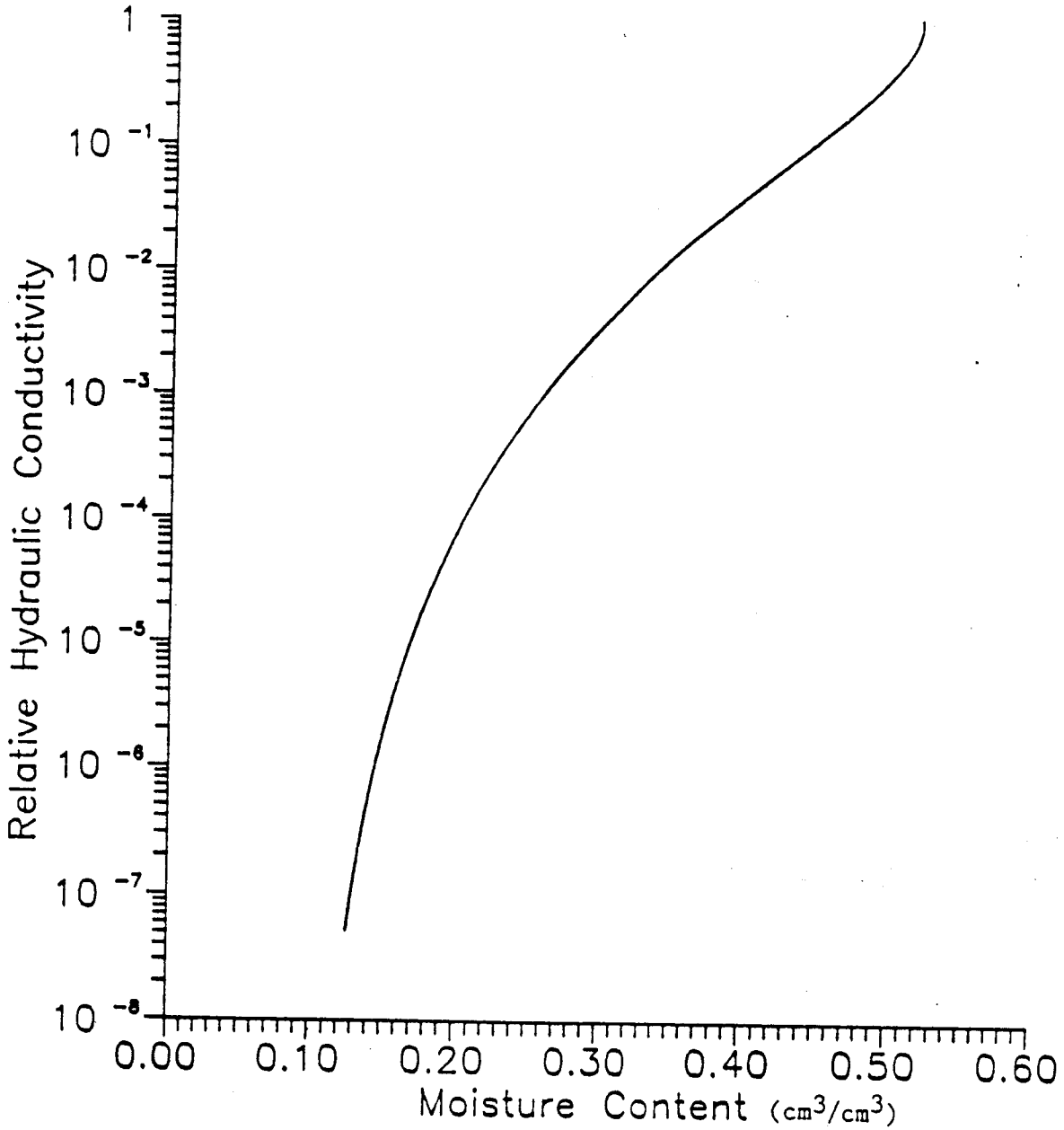

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 25-26				DANIEL B. STEPHENS & ASSOCIATES, INC.
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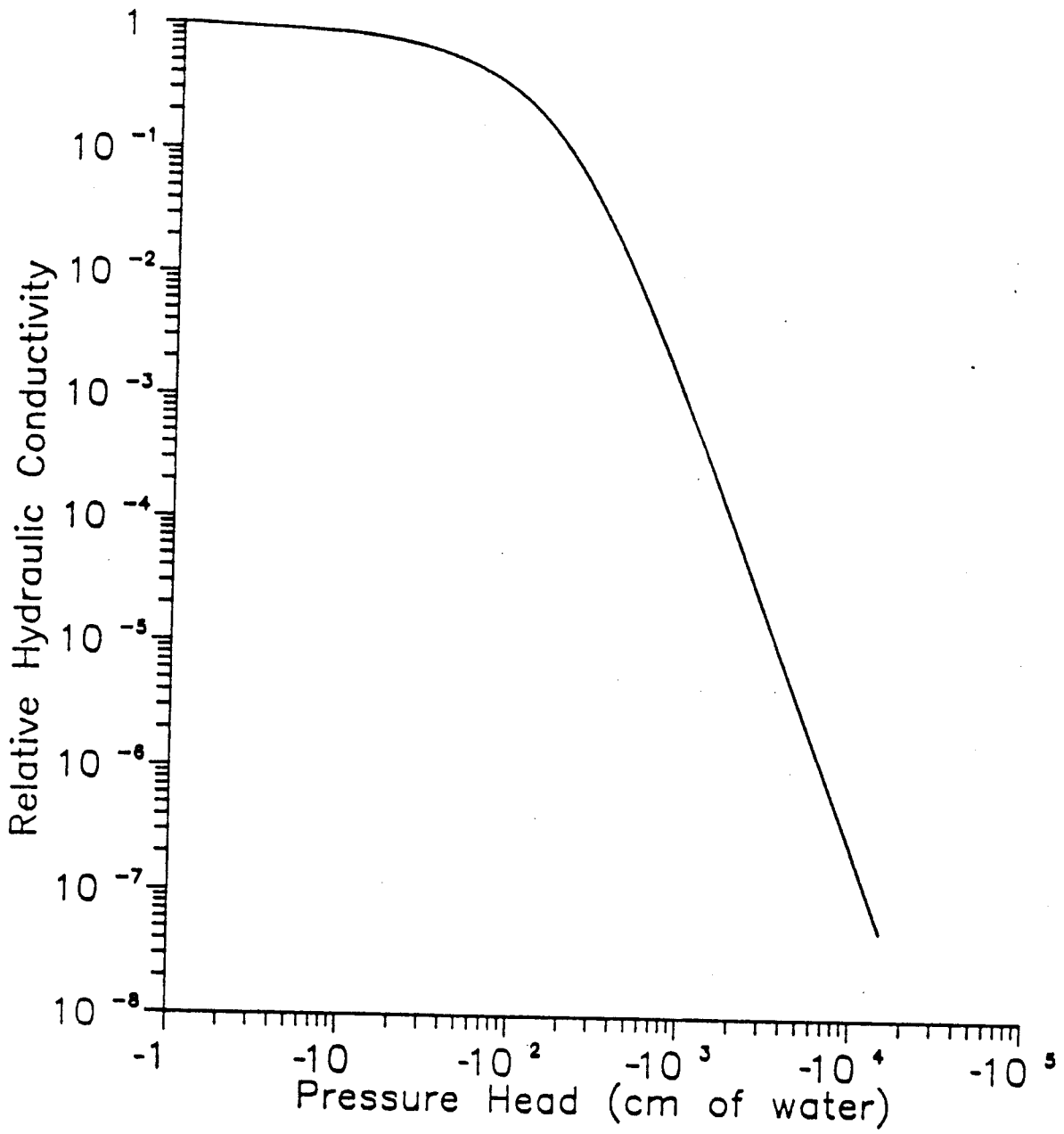

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 25-26				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

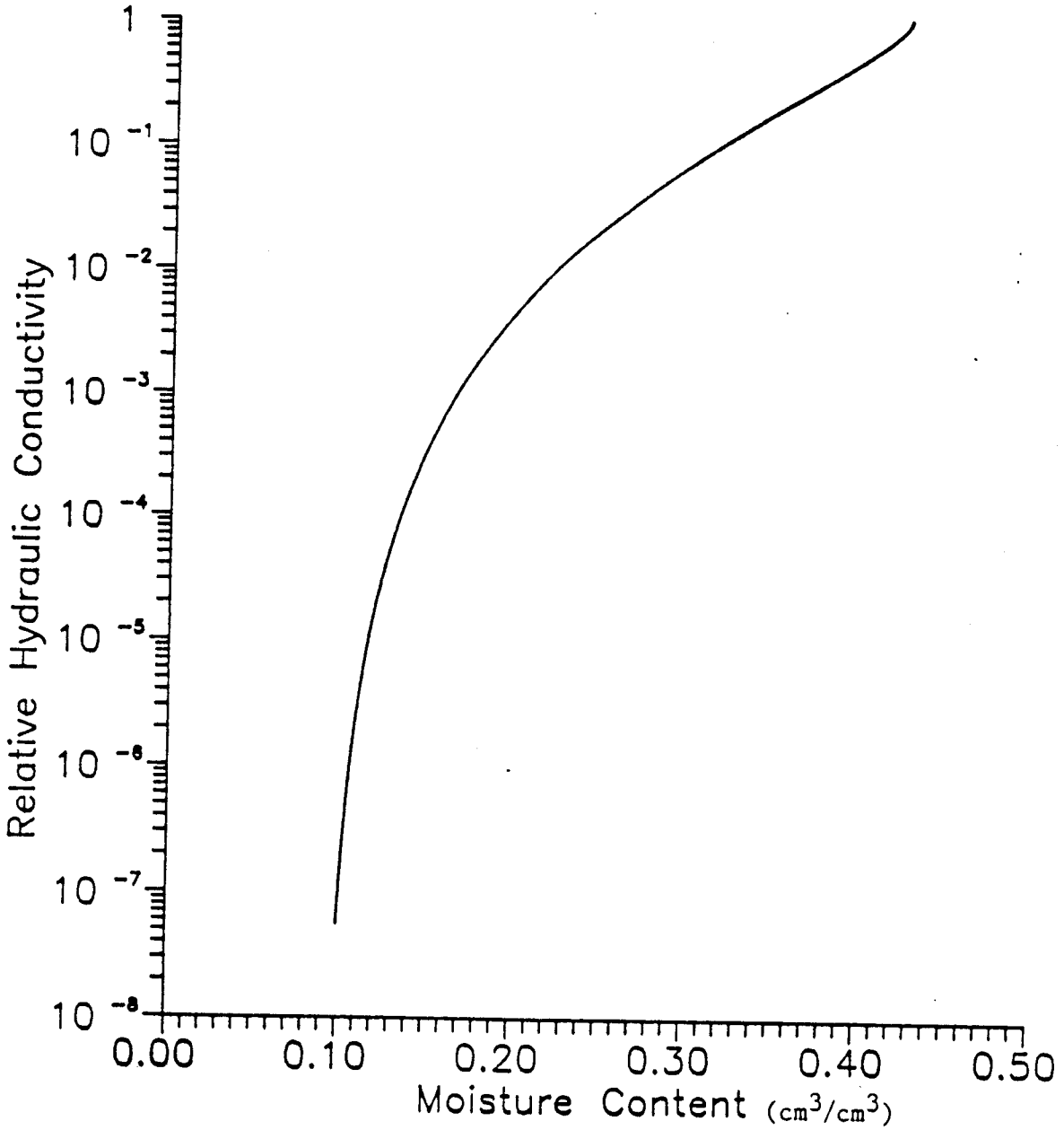

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 35-36				DANIEL B. STEPHENS & ASSOCIATES, INC.
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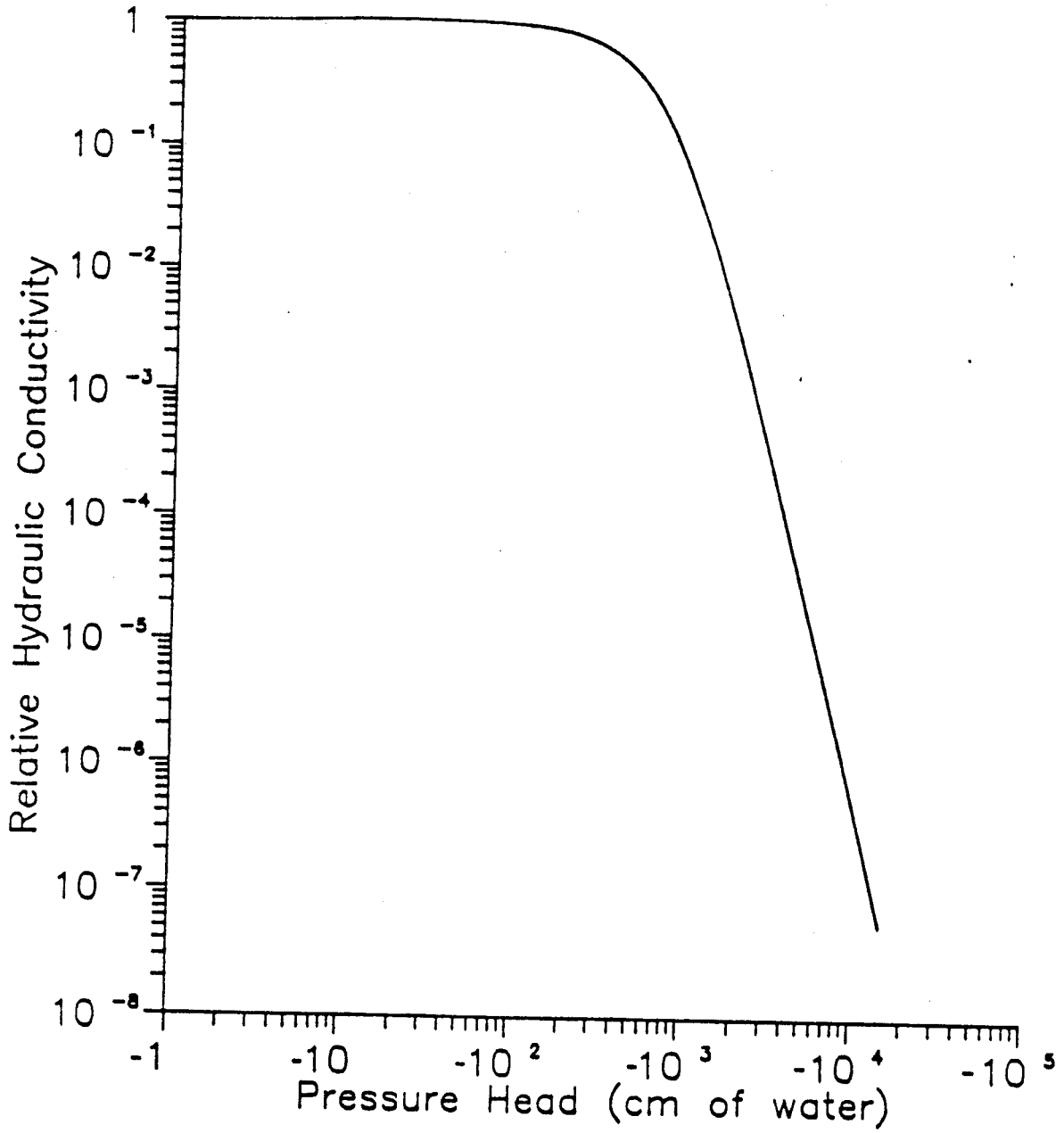

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 35-36				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

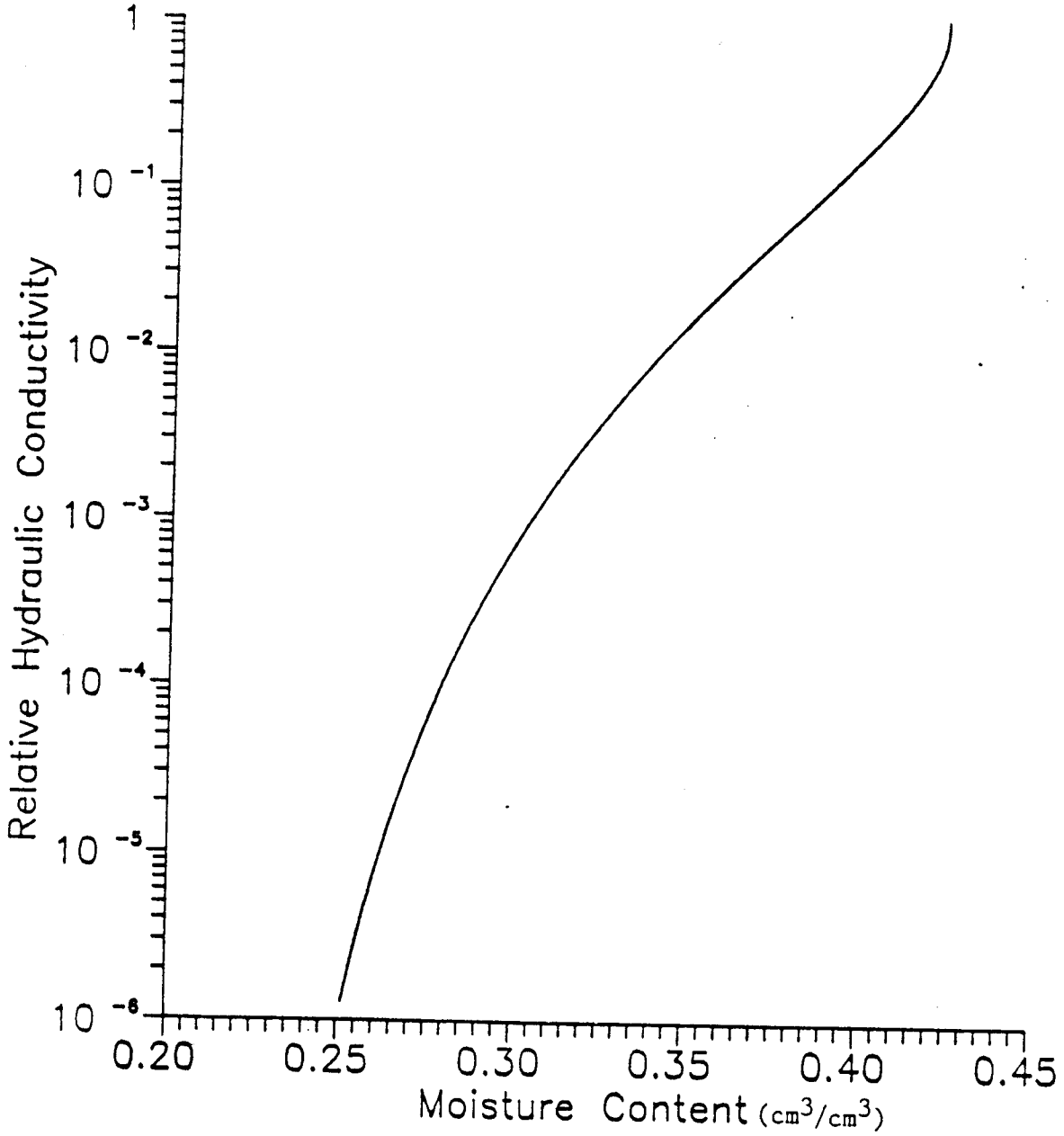

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 42-43				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

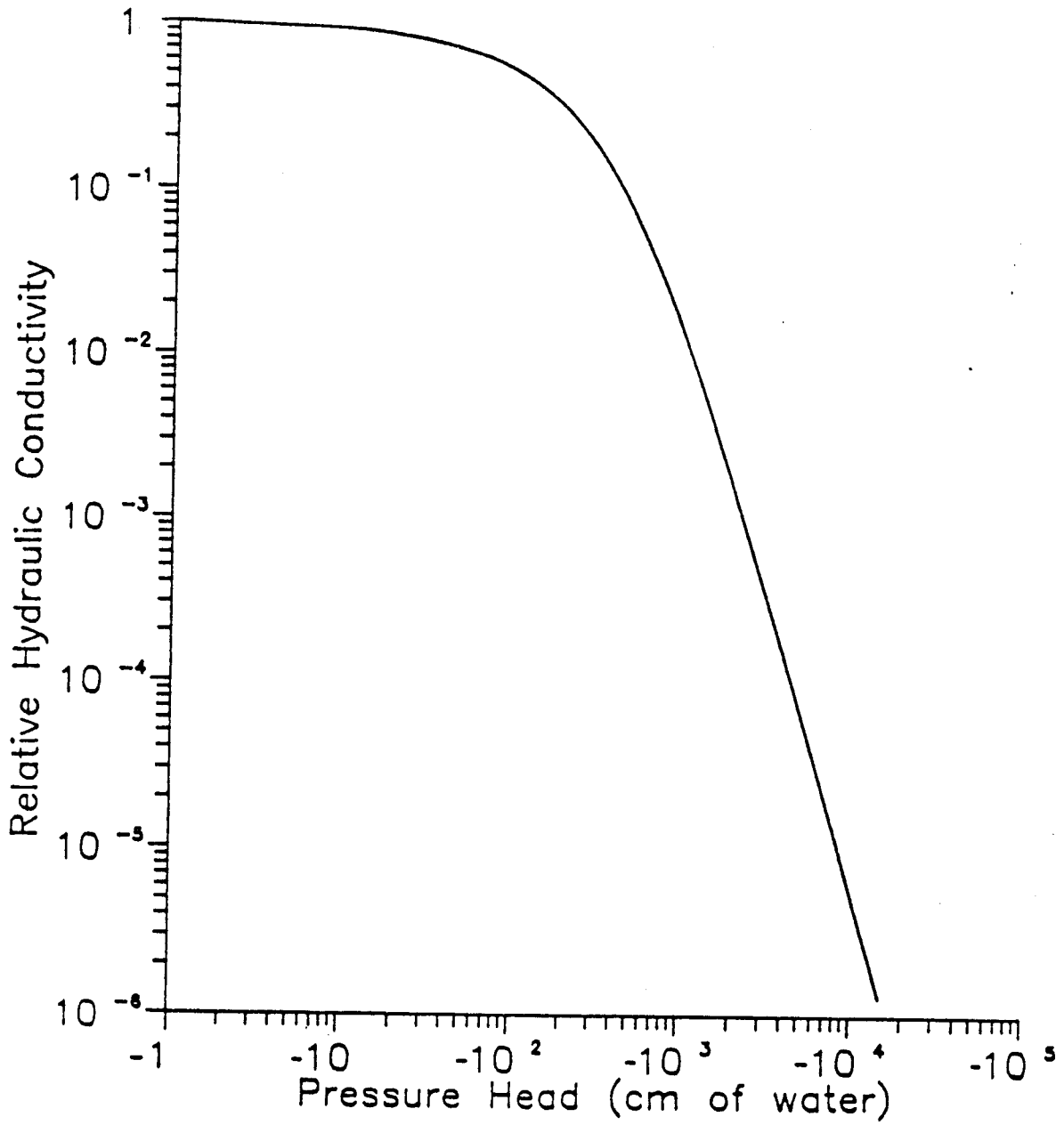

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 42-43				DANIEL B. STEPHENS & ASSOCIATES, INC.
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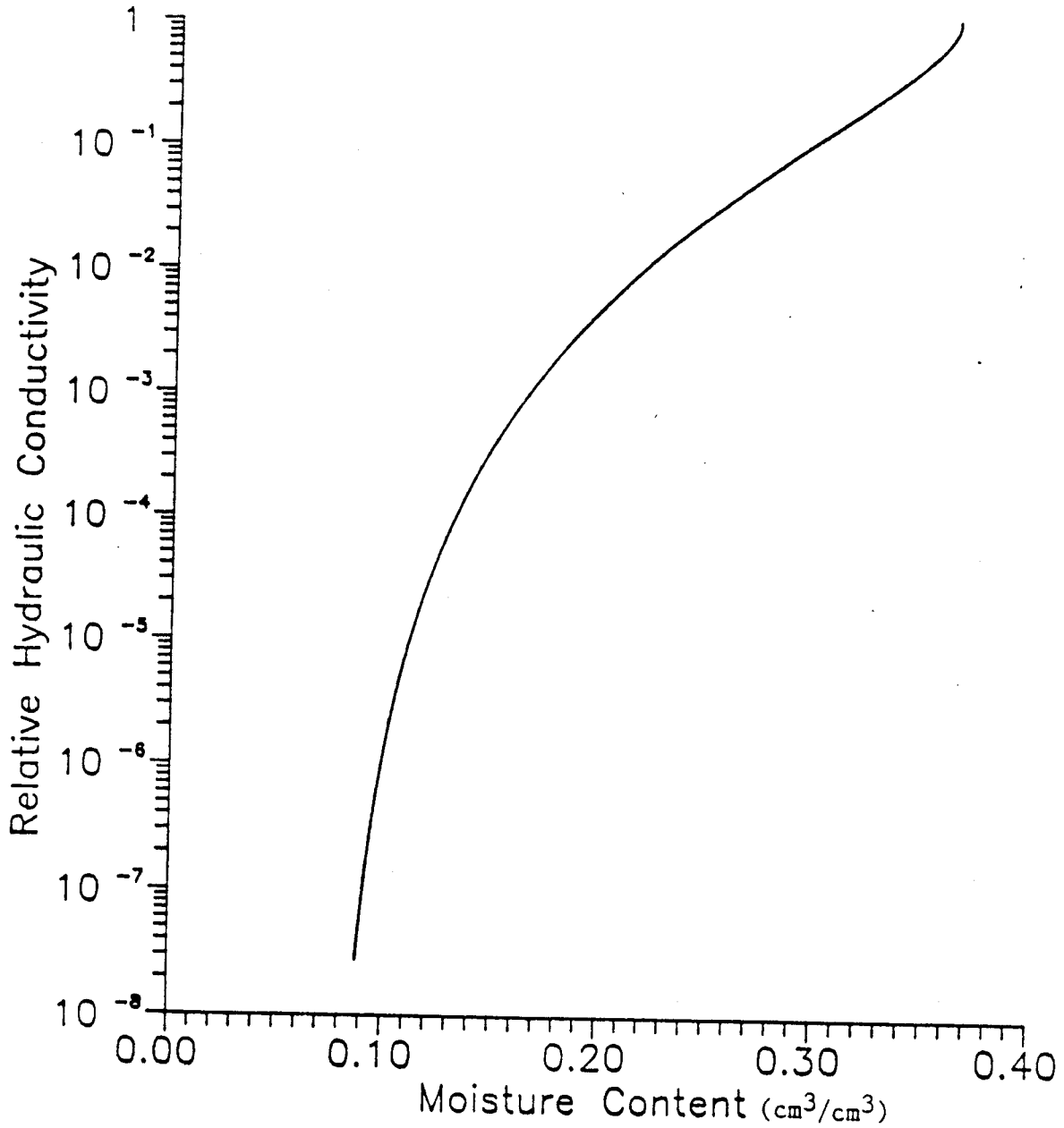

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 61-62				DANIEL B. STEPHENS & ASSOCIATES, INC.
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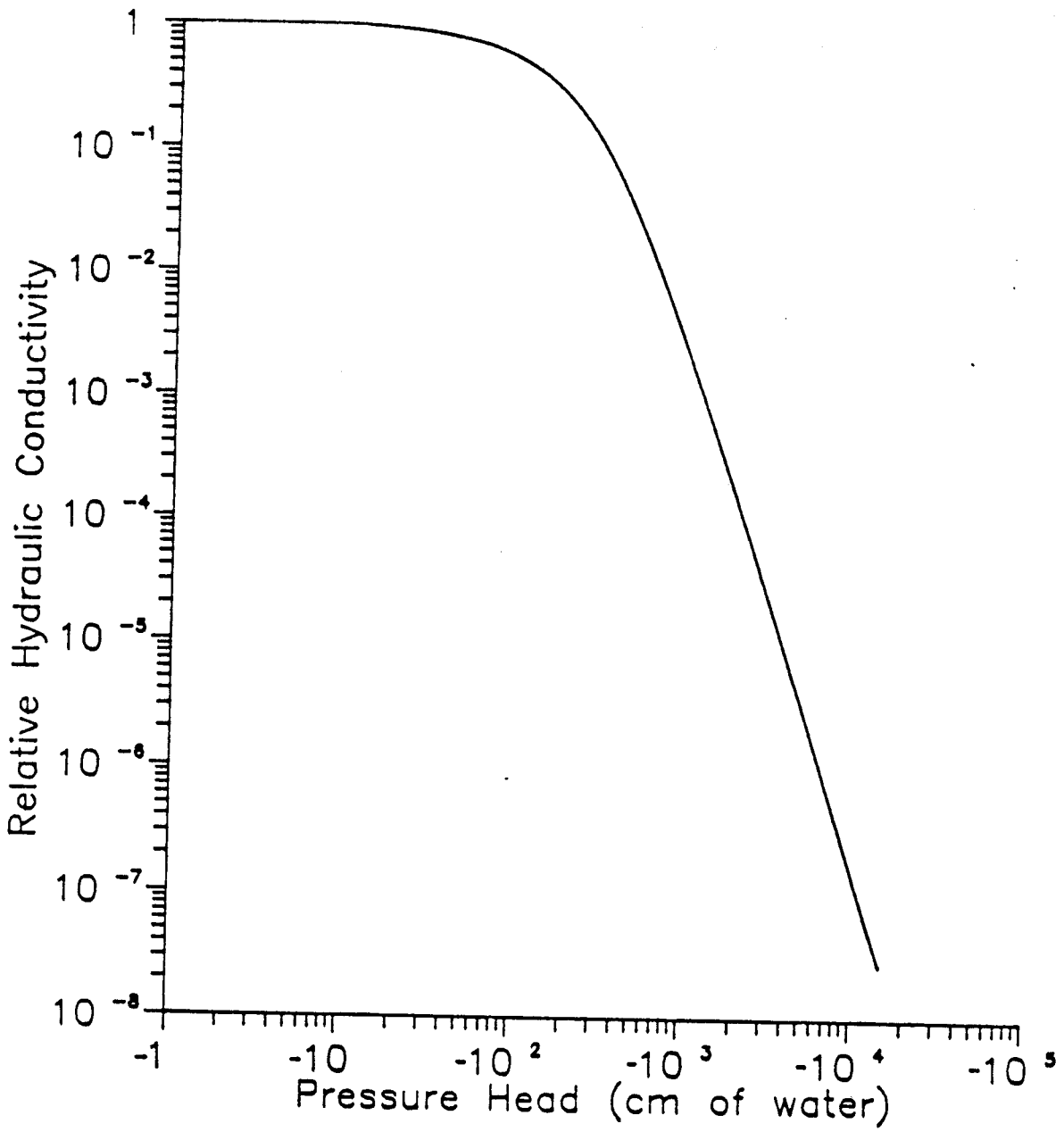

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 61-62				DANIEL B. STEPHENS & ASSOCIATES, INC.
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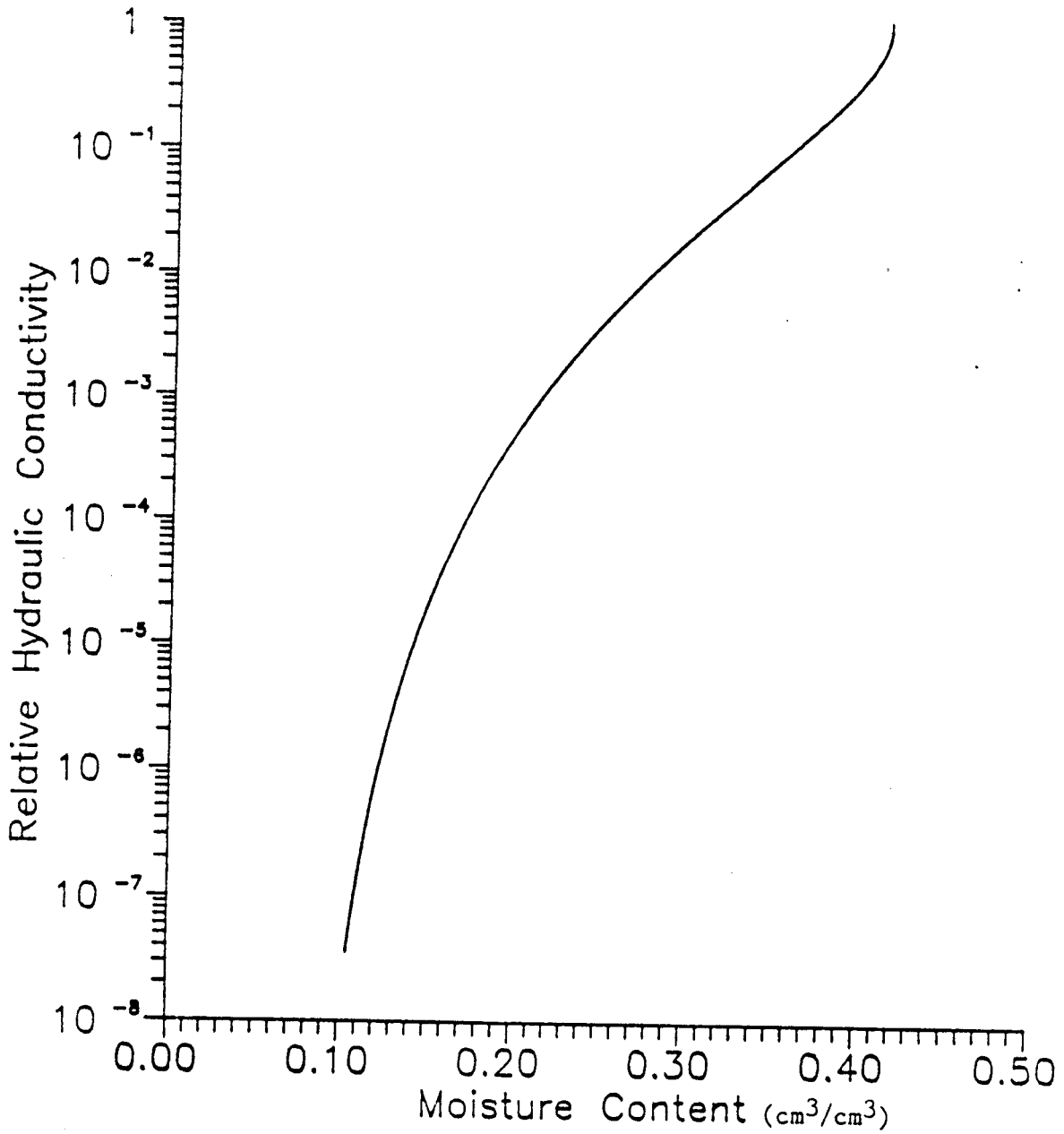

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample No. 61-62				DANIEL B. STEPHENS & ASSOCIATES, INC.
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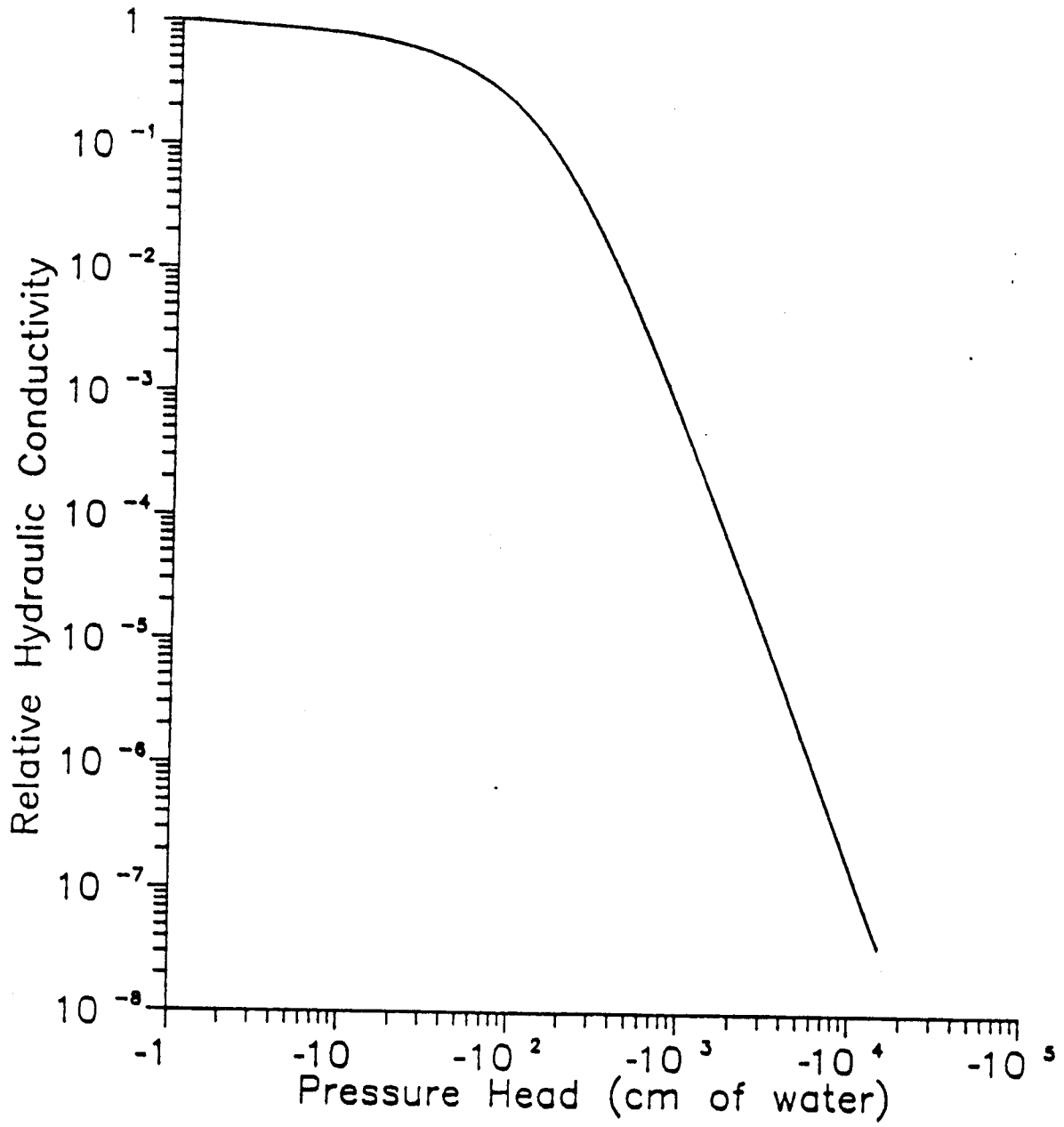

FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 75-76				DANIEL B. STEPHENS & ASSOCIATES, INC.
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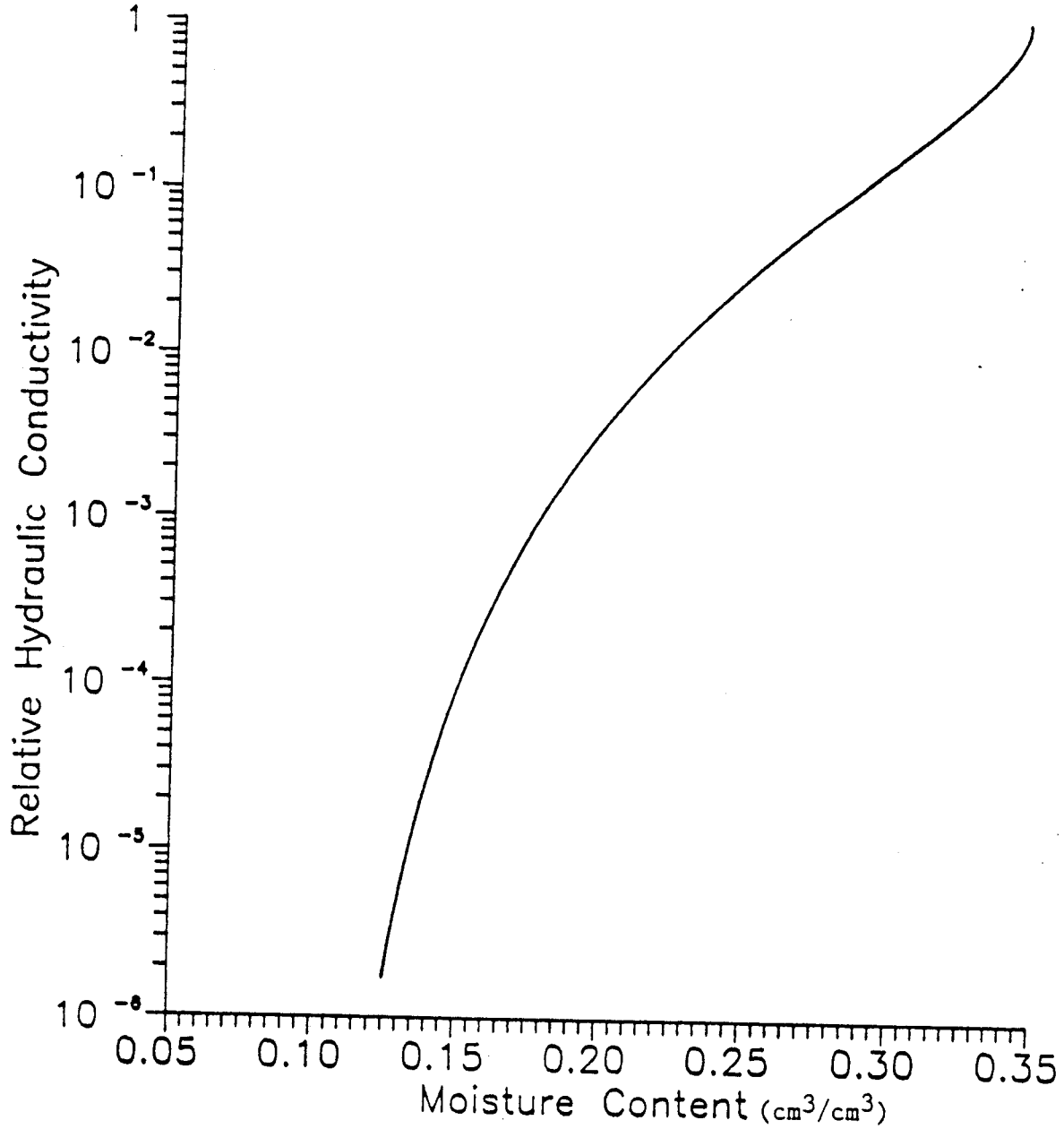


FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Moisture Content (cm^3/cm^3), Sample NO. 80-81				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

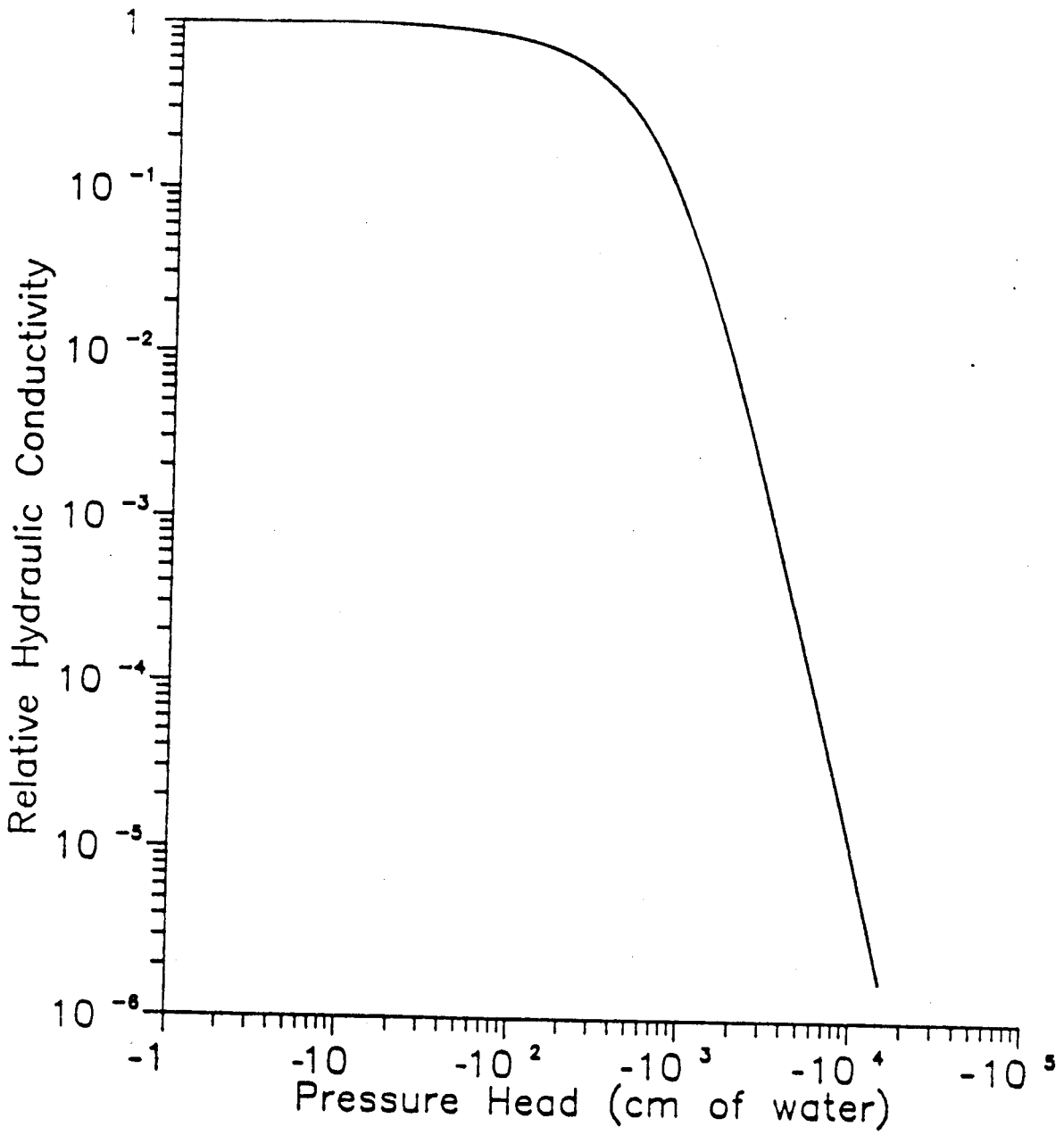


FIGURE NUMBER:	Relative Hydraulic Conductivity vs. Pressure Head (cm of water), Sample No. 80-81				DANIEL B. STEPHENS & ASSOCIATES, INC.
FOR: Los Alamos	PROJECT NO: 87-L-070	DATE: 1/4/88	PLOTTED BY: SLS	CHECKED BY: WBC	

PRINCIPLES AND METHODS

SATURATED HYDRAULIC CONDUCTIVITY

Method

The saturated hydraulic conductivity of a soil sample can be measured in two types of laboratory apparatus: a constant head permeameter or a falling head permeameter.

Constant head. The hydraulic conductivity K is defined here as the ratio of q, the volume flux of water passing through a unit cross sectional area of soil per unit time, and $(\Delta h/L)$ or gradient of hydraulic head in the direction of flow, corrected to 20°C:

$$K = (q/[\Delta h/L])(V_T/V_{20}) \qquad (1)$$

where $V_{20,T}$ is the kinematic viscosity at 20°C and observed temperature, T.

A soil sample of length, L, and cross-sectional area, A, is placed in a sample holder which prevents any loss of soil or change in volume and establishes laminar unidirectional flow through the sample. A constant head differential, Δh, is then set up across the sample and maintained. Periodic readings of volumetric outflow are taken until stable values for conductivity, K are obtained. Temperature of the fluid is measured with a thermometer. Figure B-1 is a diagram of the apparatus used. A constant head system is best suited to samples with conductivities greater than 10^{-4} cm/sec.

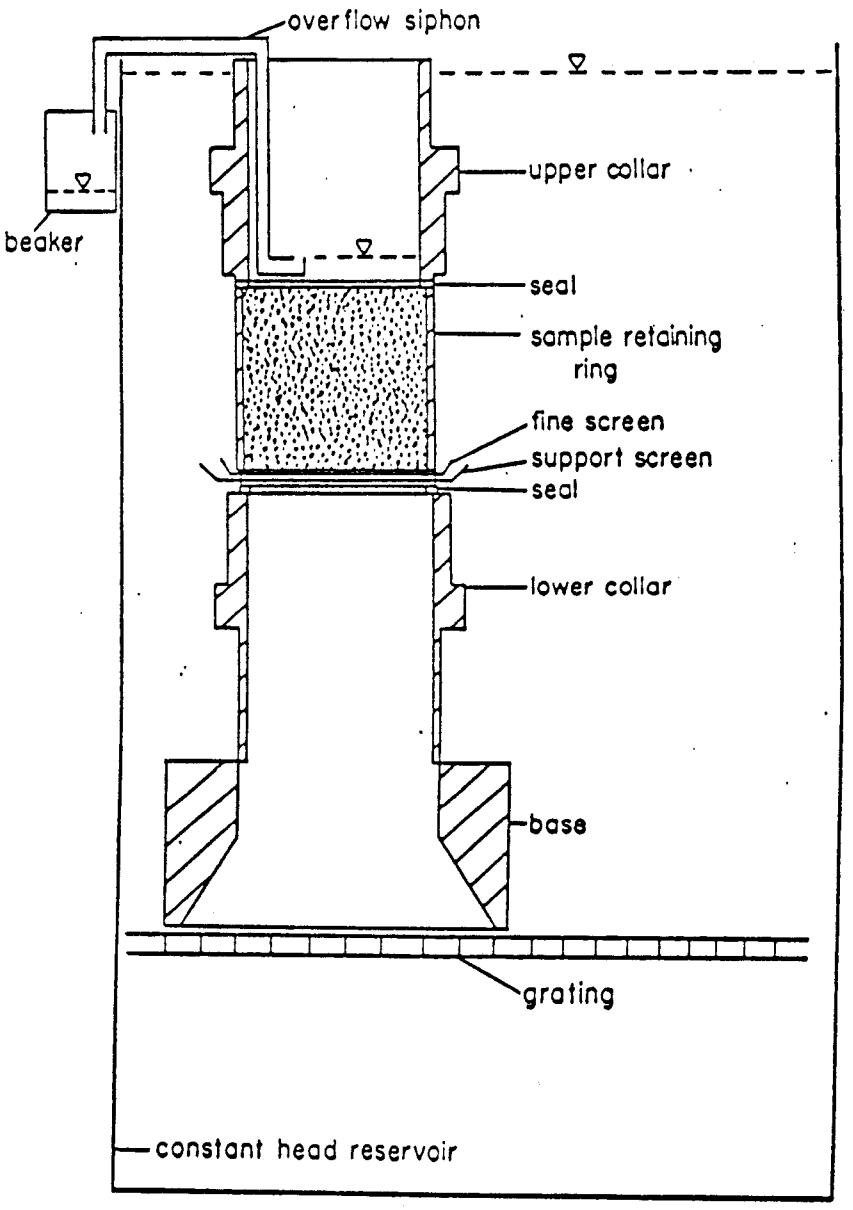


Figure B-1. Constant Head Permeameter

Falling head. A soil sample of length L and cross sectional area, A, is placed in a sample holder which has a standpipe with cross-sectional area, a. A head of H_1, is established in the standpipe above the sample, then the water level is allowed to fall to H_2 in time t. Figure B-2 is a diagram of the apparatus used. A falling head system is best suited to samples with conductivities less than 10^{-4} cm/sec. The hydraulic conductivity, is then defined as:

$$K = (a \times L/A \times t) \ \ell n \ (H_1/H_2)(V_T/V_{20}) \qquad (2)$$

Procedures:

Constant head. Cylinders containing the soil sample are covered on both ends with loose fitting caps and placed in a shallow pan containing de-aired water. The samples are allowed to wet slowly from below for 24 hours. The samples are removed from the pan, and two screens are placed over one end; a very stiff one of coarse mesh for support and a fine one of either 80 to 100 mesh to prevent any sample from being washed out. The cylinder, with screens attached, is then clamped into the sample retainer and placed in the permeameter. The level of the water in the permeameter reservoir is then slowly raised over a period of hours. When the level in the reservoir reaches to within a few centimeters above the top of the sample, a siphon is placed in the sample retainer assembly to remove water from above

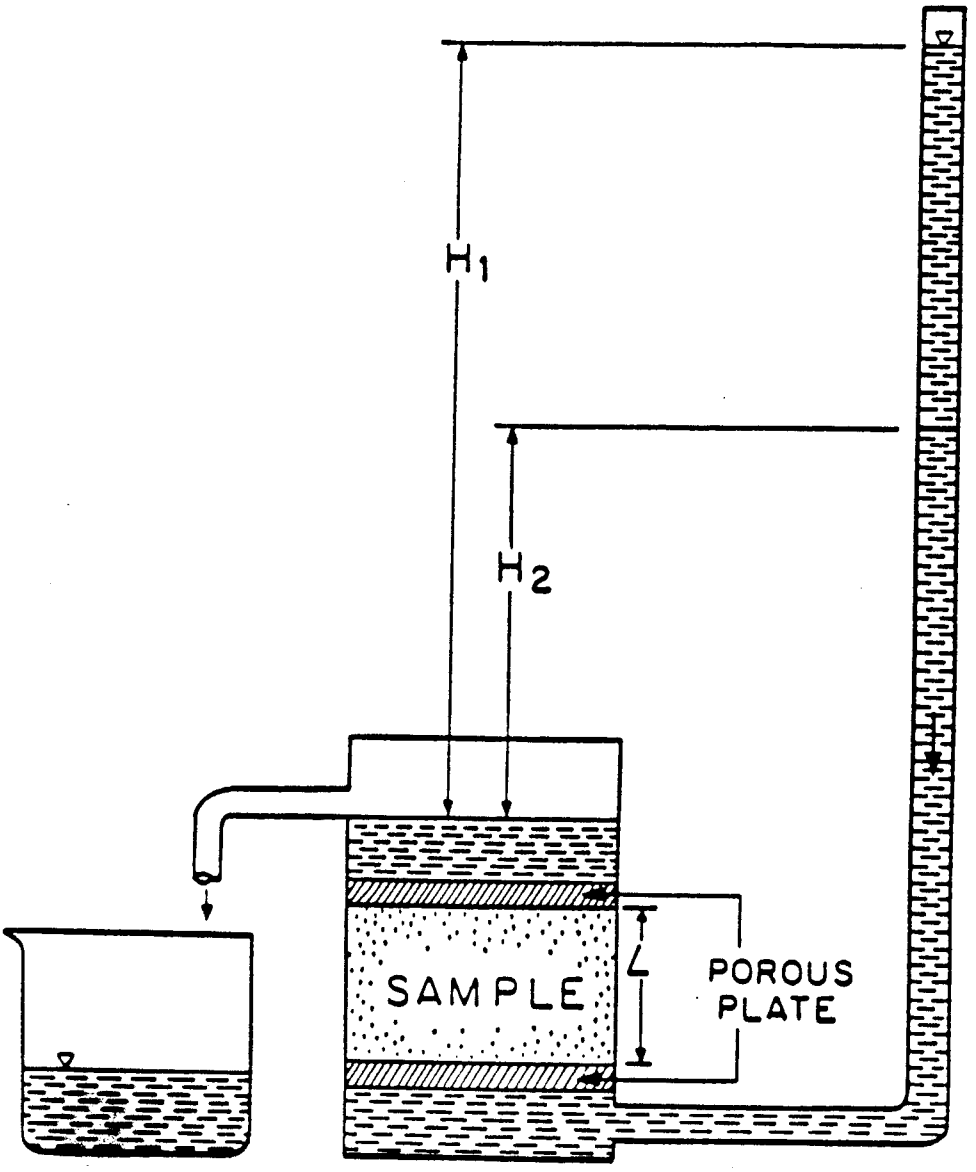


Figure B-2. Falling Head Permeameter

the sample. Water flows upward through the sample due to the hydraulic head difference across the sample. Periodic measurements of discharge and the head difference across the sample are made, and the hydraulic conductivity is calculated. A correction to 20 C is then applied for differences in kinematic viscosity. Measurement continues until the calculated hydraulic conductivity value stabilizes.

Falling head. Saturation of the sample is obtained by the same procedures described under constant head test. Screens are also attached as outlined under constant head test. The ring with screens is then placed in the falling head sample retainer and set in a constant head reservoir. Water is added to the standpipe and the difference between the water level in the standpipe and that in the constant head reservoir are recorded over time. The water level in the standpipe is allowed to fall, while the fluid level in the lower level is constant. After a period of time the difference in water levels between that in the standpipe and that in the constant head reservoir are measured and the elapsed time noted. Correction is applied for kinematic viscosity.

Calculations:

Experimental values are substituted into the appropriate equation as outlined under methods.

MOISTURE RETENTION - HANGING COLUMN

(PORE SIZE DISTRIBUTION)

Principle

Use of pore size distribution as a soil characteristic is based upon acceptance of the capillary model. This model is described by:

$$h' = 2 \cos \gamma / \rho g r \qquad (3)$$

where h' is the height to which a liquid will rise in a clean capillary tube of radius r, γ is the surface tension of the liquid, ρ is its density, and g is acceleration due to gravity. If water is extracted from an initially saturated sample of soil by a tension equal to h', the volume of water extracted is equal to the volume of pores having an effective radius greater than the radius, r. As the tension applied to the sample increases, additional water drains from progressively smaller pores.

Method

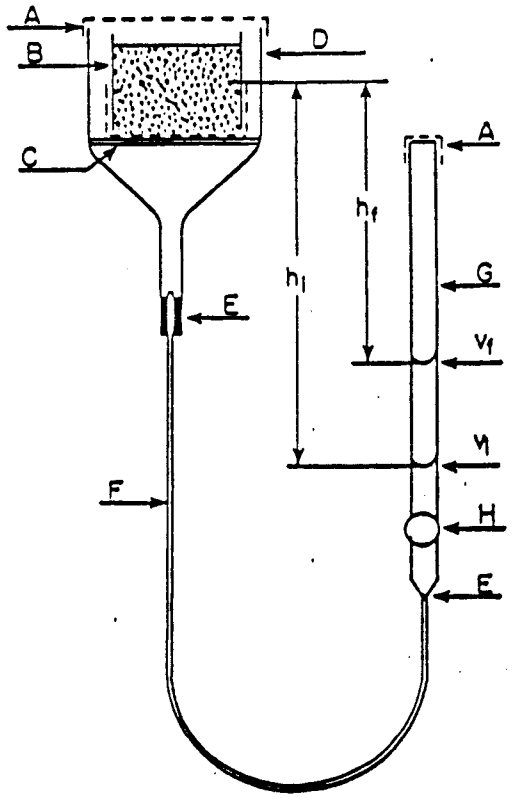
The key component of the apparatus for measuring the retention of moisture at different pressure heads or pore size distribution is a fritted glass porous plate that conducts water, but when wet the plate is impermeable to air. The fritted glass

plates have an air-entry pressure of about 300 to 400 cm of water. These plates are affixed in a glass funnel which is connected to a buret with stopcock by means of flexible tubing. A diagram of the apparatus is shown in Figure 3. A soil sample is placed on the plate and tension, h' is applied to the sample by positioning the fluid level in the buret at different levels below the center of the sample. Water flows out of the sample into the buret until equilibrium is achieved. The tension is again increased or decreased to obtain another state of equilibrium between moisture held by capillary forces in the sample and the applied tension.

Laboratory Procedure

Air is first removed from the porous plate by allowing de-aired water to pass continuously through it for 24 hours. The funnel with porous plate and the buret are supported on vertical rods by means of clamps. A saturated sample within its sample ring is then placed on the porous plate, making certain that good hydraulic contact is established between the soil particles and the plate. With the stopcock of the buret closed, the initial level of the water in the buret is recorded.

The buret is then lowered a small increment to about 10 to 15 cm below the center of the soil sample. When the stopcock is opened, the soil may begin to desaturate, and the drainage will flow into the buret. When drainage has ceased, the stopcock is



A Aluminum foil covers
B Sample in cylinder
C Fritted glass porous plate (part of D)
D Büchner funnel with porous plate
E Joints must be secure
F Flexible tubing
G Burette, least division not more than 0.1% sample volume
H Stopcock of burette
h_i cm of water suction, initial
h_f cm of water suction, final
v_i Burette reading, initial
v_f Burette reading, final

Figure B-3. Hanging Column Apparatus

closed and we record the water level in the buret and the vertical distance from the bottom of the meniscus of the water in the buret to the middle of the soil sample. The procedure is repeated in a stepwise manner until the maximum tension desired is reached. A reversal of the process is used to gather data on the wetting behavior of the sample.

Calculation

Saturated moisture content , θ_{sat} , (volume percent) is determined as follows:

$$\theta \text{ sat} = [\text{M sat} - \text{M dry}]/[V_T \times \rho_w] \times 100 \quad (\% \text{ vol}) \quad (4)$$

where M sat = mass of sample saturated, M dry = mass of sample, oven dried to a constant weight, V_T = volume of the sample, ρ_w = density of the water at temp when saturated mass was determined. The quantity $[\text{M sat} - \text{M dry}]/\rho_w$ is the volume, in cubic centimeters, of water initially contained in the sample volume. The drainage is subtracted from the initial volume of water and then divided by the sample volume to arrive at the moisture content in percent volume at the given value of tension.

$$[V_i - V_D]/V_T \times 100 = \theta_{h'} \quad (\% \text{ vol}) \quad (5)$$

where V = volume of water initial, V_D = cumulative volume drained from sample, V_T = volume of sample, $\theta_{h'}$ = moisture content at the tension value h'. This gives then a paired set of values of tension, or pressure head, versus volumetric moisture content.

MOISTURE RETENTION - PRESSURE PLATE

Principle

The operation of the pressure plate moisture extractor requires maintaining a pressure difference between the liquid phase of the water in the soil and water on the opposite side of a porous plate which supports the soil sample. The sample and porous plate are sealed in a rigid container so that positive gas pressure applied above the plate causes flow to occur across the plate (Figure B-4). The porous ceramic plate is supported by a fine mesh screen which also provides a passage way for the extracted solution. The water beneath the plate is open to the atmosphere through the outflow tube. The illustration in Figure B-5 shows a magnified view of soil particles in contact with the plate inside the pressure plate extractor during an extraction run.

As soon as air pressure inside the chamber is raised above atmospheric pressure, the higher pressure inside the chamber forces excess water through the microscopic pores in the plate. Air, however, will not flow through the pores of the plate, because the plate remains saturated due to its high air-entry pressure. When the pressure in the chamber increases, water leaves the sample until the tension of the water

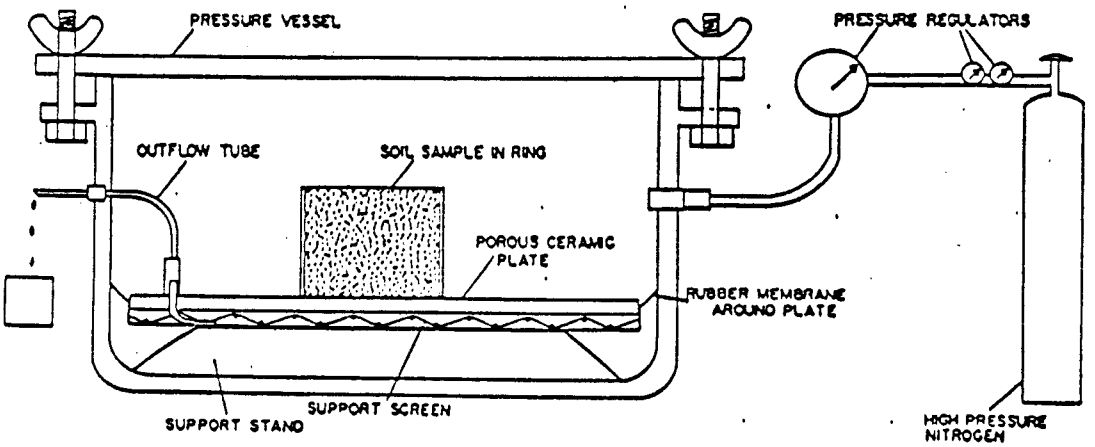


Figure B-4. Pressure Plate Extractor

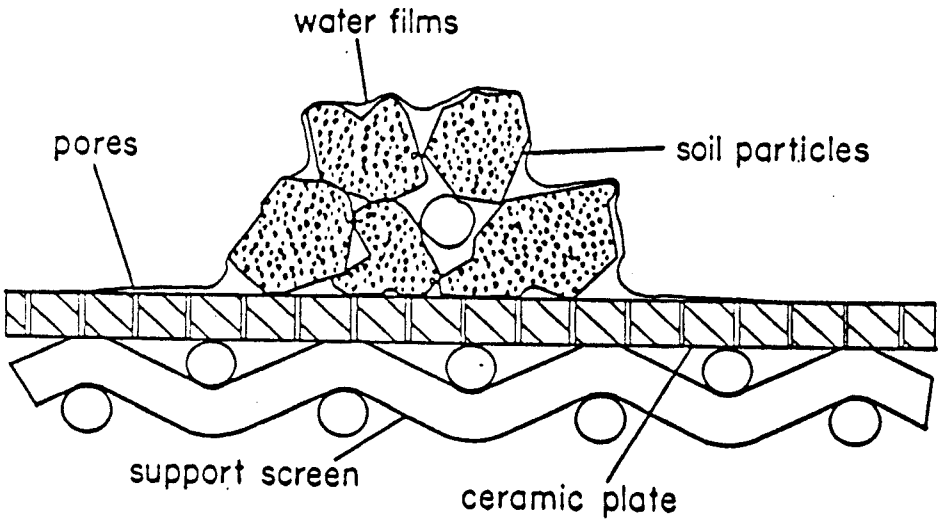


Figure B-5. Magnified View of Soil Particles

due to capillary and adsorptive forces is in equilibrium with the applied pressure.

Method

Moisture retention is obtained using a pressure plate extractor (Soil Moisture Inc., Santa Barbara, CA, Model 1500), with 1, 3 and 15 bar ceramic plates. Pressure is provided by high pressure nitrogen from cylinders.

Laboratory Procedure

The porous ceramic plate is placed is a shallow pan with deaired distilled water and allowed to stand overnight. The plate is then removed from the pan and placed in the extractor. De-aired distilled water is poured over the plate to the limit allowed by the rubber skirt, which generally just submerges the plate. The pressure plate is sealed and pressure brought to 50% of the plates maximum rated pressure. This pressure is maintained until outflow ceases. The extractor is opened and any excess water around the plate is removed.

The soil samples in their sample rings are then placed on the plate, making certain good hydraulic contact is established. The extractor is then sealed and the pressure brought to the level desired. The pressure is maintained until outflow ceases. The extractor is then opened and the samples weighed quickly on an electronic top-loading balance. Subsequently, the samples are

returned to the extractor, and the pressure is increased to the next increment.

Calculations

The decrease in mass of water in the sample during a period of applied pressure is converted to an equivalent decrease in volume of water according to:

$$V_w = \Delta m/\rho_T \qquad \text{(cc)} \qquad (6)$$

where Δm = change in mass of soil sample (g), ρ_T = density of water at temperature of experiment (g/cc), V_w = equivalent volume of water (cc).

Volumes of water calculated from equation 6 are then used to determine the moisture content at that pressure:

$$\theta_p = (V_i - \Sigma\Delta V_w)/V_T \times 100 \qquad \text{(\% vol)} \qquad (7)$$

where θ_p = moisture content at pressure p (% vol), V_i = initial volume of water in sample (cc), $\Sigma\Delta V_w$ = cumulative water volume change (cc), V_T = total volume of the sample (cc).

INITIAL MOISTURE CONTENT

Method

Core method, with oven drying.

Laboratory Procedure

The field weight of the soil sample is determined as soon as possible after the sample is removed from the packing container. The tare of the ring which holds the sample, as well as the mass of the caps for the ends of the ring, are determined. The volume of soil in the sample ring is also calculated. After all specified analyses have been performed on the sample, the sample is removed from its ring and spread in an aluminum pan. When necessary, soil aggregates are broken up by motar and pestal. Care is taken not to change the natural particle size distribution. The sample is placed in a convection oven at 110° C for at least 24 hours until dried to a constant weight.

Calculations

The initial moisture content is determined on a percent volume basis according to:

$$\theta_i = [M_i - M_f]/[V_T \times \rho] \times 100 \quad (\%vol) \qquad (8)$$

where θ_i = initial moisture content (% vol), M_i = initial mass of soil only (g), M_f = final mass of soil only (g), V_T = total

volume of sample (cc), ρ = density of pore fluid in the soil when initial mass was determined (g/cc). The density of the pore fluid initially present in the sample is assumed to be 1.0 g/cc.

BULK DENSITY

Method

Core method, with oven drying.

Laboratory Procedure

The volume of the soil sample is determined from sample geometry measurements, and the sample is dried in the oven at 110 C until no additional mass loss occurs.

Calculations

$$\rho_b = M_D/V_T \qquad (g/cc) \qquad (9)$$

where ρ_b = dry bulk density (g/cc), M_D = mass of oven dried soil sample (g), V_T = total volume of soil sample (cc).

POROSITY

Method

Calculated from bulk density and measured or assumed values of particle density.

Laboratory Procedure

Bulk density, ρ_b, is determined by oven drying, as described in the section outlining the bulk density determination. For this series of analyses particle density, ρ_s, is assumed to be 2.65 g/cc.

Calculation

$$n = [1 - (\rho_b/\rho_s)] \times 100 \qquad \text{(percent)} \qquad (10)$$

UNSATURATED HYDRAULIC CONDUCTIVITY

Method

Mualem (1976) described the theoretical basis for a procedure used to estimate unsaturated hydraulic conductivity from the soil-water release curve according to the following equations;

$$K_r = S_e^{\frac{1}{2}}\left[\int_0^{S_e} 1/h(x)dx / \int_0^1 1/h(x)\ dx\right]^2 \qquad (11)$$

where K_r = relative hydraulic conductivity, $h = h(S_e)$ is the negative pressure head, given here as a function of dimensionless moisture content:

$$S_e = \theta - \theta_r / \theta_s - \theta_r \qquad (12)$$

where subscripts s and r indicate saturated and residual values of the soil moisture (θ). The expression relating dimensionless moisture content to the pressure head, and thus the soil moisture release curve is given by:

$$S_e = [\ 1/1+(\alpha h)^n]^m \qquad m = 1 - 1/n \qquad (13)$$

where α, and n are obtained by a non-linear least squares numerical procedure applied to measured moisture retention data using the technique developed by Van Genuchten (1978).

Laboratory procedure

The data input to the computer model of Van Genuchten (1978)

consists of the saturated moisture content, residual moisture content and values of observed pressure head versus moisture content. The residual moisture content is taken to be the moisture content at -15 bars. The paired values of observed pressure head and moisture content are obtained as described under the procedures for determining moisture retention by the hanging column and pressure plate methods. Saturated moisture content is determined through gravimetric measurements and sample geometry.

References

Mualem, Y., 1976, A New Model for Predicating the Hydraulic Conductivity of Unsaturated Porous Media, Water Resources Research, vol. 12, no. 3, p. 513-522.

Van Genuchten, R., 1978, Calculating the Unsaturated Hydraulic Conductivity With a New Closed-Form Analytical Model, Research Report No. 78-WR-08, Princeton University, Department of Civil Engineering, September 1978, 65pp.