UCRL-15850
P.O. 5665905

Received by OSTI

MAR 1 1987

HAZARDOUS WASTE SITE ASSESSMENT: INACTIVE LANDFILL, SITE 300, LLNL

CH2M HILL CALIFORNIA, INC.

January 1985

Lawrence Livermore National Laboratory

HAZARDOUS WASTE SITE ASSESSMENT

UCRL--15850

DE87 006696

INACTIVE LANDFILL SITE 300 LAWRENCE LIVERMORE NATIONAL LABORATORY

Prepared for

University of California

Lawrence Livermore National Laboratory

Prepared by

CH2M HILL California, Inc.
2200 Powell St, 8th Floor
Emeryville, California 94608

January, 1985

CH2M HILL Engineers Planners Economists Scientists

January 31, 1984

F18728.A0

University of California
Lawrence Livermore National Laboratory
7000 East Avenue
Livermore, California 94550

Attention: Ms. Judith C. Steenhoven

Subject: Final Report
Hazardous Waste Site Assessment
Inactive Landfill Site 300

CH2M HILL is pleased to submit the enclosed final report presenting the results of our investigation of an inactive landfill (Pit 6) at Site 300. The report is the result of work by the undersigned CH2M HILL personnel and was completed under Purchase Order No. 5665905.

We appreciate the opportunity to have worked with you on this very interesting project. If you have any questions regarding the enclosed draft report, please contact us.

Very truly yours,

Debbie Wallace

Debbie L. Wallace
Hydrogeologist

Michael Concannon MGL

Michael O. Concannon
Environmental Scientist

Michael Kemp MGL

Michael C. Kemp, P.E., No. C038333
Project Manager

Enclosure
SFR89/003

<u>Disclaimer</u>

CONTENTS

TABLES

FIGURES

Chapter 1

EXECUTIVE SUMMARY

Chapter 1
EXECUTIVE SUMMARY

This report presents the results of an investigation of an inactive landfill (Pit 6) at Lawrence Livermore National Laboratory's (LLNL) Site 300. The primary objectives of this investigation were to:

- Collect and review background information pertaining to past waste disposal practices and previous environmental characterization studies

- Conduct a geophysical survey of the landfill area to locate the buried wastes

- Conduct a hydrogeologic investigation to provide additional data on the rate and direction of groundwater flow, the extent of any groundwater contamination, and to investigate the connection, if any, of the shallow groundwater beneath the landfill with the local drinking water supply

- Conduct a risk assessment to identify the degree of threat posed by the landfill to the public health and environment

- Compile a preliminary list of feasible long-term remedial action alternatives for the landfill

- Develop a list of recommendations for any interim measures necessary at the landfill should the long-term remedial action plan be needed.

Neither the results of the previous investigation (Raber and Carpenter, 1983 and Carpenter and Piefer, 1983) nor the results of this investigation clearly identify a significant threat to public health or an adverse impact on the environment caused by the contents of Pit 6. The following paragraphs present a summary of the results obtained during this investigation.

Containerized wastes from the LLNL, Livermore Site and the Lawrence Berkeley National Laboratory were buried at Pit 6 between July 1, 1964, and February 20, 1973. A log book contains records of 55 shipments of wastes that are believed to be buried in the landfill. Wastes contained in these shipments included various construction materials, laboratory equipment and chemicals, scrap metal, electrical parts, and biomedical research animals.

Potential sources of hazards to public health and the environment at Pit 6 are the contents of the landfill which include, but are not limited to, the following: over 2000 capacitors suspected to contain fluids with polychlorinated biphenyls (PCB's); over 1000 crushed or intact waste drums containing unknown chemicals; compressed gas cylinders with unknown contents; and, wastes potentially contaminated with beryllium and mercury.

The landfill is completely covered by native soil of unknown thickness. Erosion of the soil and subsequent exposure of wastes has occurred in the past and will probably continue in the future. The landfill is directly underlain by the Carnegie Fault, alluvial terrace deposits and the Neroly and Cierbo Formations. The Carnegie Fault underlies the landfill striking northwestward. Shallow groundwater exists beneath the landfill in an unconfined aquifer. Groundwater flow in the shallow aquifer on the north side of the Carnegie Fault is in a southeasterly direction. The influence of the Carnegie Fault on shallow groundwater flow is not completely understood. Data currently available do not identify the Carnegie Fault as a barrier to groundwater flow. The direction of groundwater flow south of the Carnegie Fault is not available at this time.

Previous surface radiation surveys did not reveal any radiation levels above background across Pit 6. Shallow soil samples taken previously contained low levels of methylene chloride, toluene, and benzene. Previous groundwater samples from both perimeter monitoring wells and the nearest water supply well have not shown chemicals in concentrations exceeding State or Federal guidelines.

Results of analyses conducted on groundwater samples collected during the present investigation have shown a sample from well K6-3 with a low concentration (160 micrograms per liter (ug/l)) of methylene chloride and samples from wells K6-1 and K6-4 with trace amounts of phthalates, 40 and 78 ug/l, respectively. These organic compounds appear to be due to laboratory contamination and/or sampling technique error. Samples from two wells (K6-3 and K6-4) have slightly elevated levels of iron (2.4 and 4.0 milligrams per liter (mg/l), respectively) and manganese (0.31 and 0.62 mg/l, respectively) that, though in excess of federal drinking water standards, are within limits of natural groundwater. None of the samples analyzed for radioactive indicators have shown any values above background concentrations.

Recommendations were made in addition to the ongoing groundwater monitoring program. The recommendations were made to characterize the Pit 6 environment, to further evaluate the potential threat to public health and environment, and to develop a remedial action plan. The recommendations made are summarized below.

- Conduct one-time surface soil sampling (to a maximum depth of 3 feet) and ambient air quality sampling investigations to determine whether there are safety hazards to the people currently using the site or visitors to the area. If warranted, install a perimeter fence and/or post, "Hazardous Waste Site" warning signs at the landfill and re-evaluate site access restrictions.

- Conduct a limited investigation of the unsaturated zone adjacent to the trench area to substantiate or negate the presence of organic compounds previously detected in the subsurface soils.

- Install an additional monitoring well east of Pit 6 in the fault zone to provide additional information on water movement along the fault.

- After collecting all additional information, conduct a feasibility study to identify alternatives and determine the best long-term remedial action plan.

SFR89/005

Chapter 2
INTRODUCTION

The Lawrence Livermore National Laboratory (LLNL) operates a field test facility known as Site 300. This facility is located in the eastern portion of the Altamont Hills, approximately 13 miles southeast of Livermore, California. There are nine solid waste landfills (two active and seven inactive) located within Site 300.

This report presents the results of the investigation of an inactive landfill (Pit 6) at Site 300. The location of Pit 6 is shown in Figure 2-1. The purposes of the investigation were: to assess the existing or potential impacts of the landfill on the surrounding environment; to assess the associated risks of these impacts (if any); and, to provide a preliminary list of feasible remedial alternatives for the affected environment(if necessary).

The scope of work for the investigation included:

- o Characterizing the waste contained in Pit 6
- o Further characterizing the subsurface geology in the vicinity of Pit 6
- o Installing permanent groundwater monitoring wells outside the perimeter of Pit 6
- o Characterizing the water-bearing properties of the aquifer beneath Pit 6
- o Determining the lateral and vertical flow direction and rates of the shallow groundwater beneath Pit 6
- o Further characterizing the chemical quality of the groundwater beneath Pit 6
- o Assessing the potential exposure associated with the potential migration of chemicals away from Pit 6
- o Identifying potential remedial actions if needed.

This report is organized into several chapters and appendices according to the scope of the work outlined above. Chapter 3 presents a review of the available data including historical records of the materials buried at Pit 6 and the results of a previous hydrogeologic study of the landfills at Site 300 conducted by LLNL staff. Chapter 4 presents the work performed, the methodology followed, and the results obtained during the field investigation for the current investigation of Pit 6. Chapter 5 presents an assessment of the risks to the environment and public health and safety posed by the contents of Pit 6. Chapter 6 is composed of a preliminary list of remedial action alternatives for Pit 6. Chapter 7 presents conclusions based on the work described in Chapters 3 through 6 and recommendations for future work at Pit 6. Following Chapter 7 are a list of references and four Appendices (A through D). The appendices contain supporting data for the investigation.

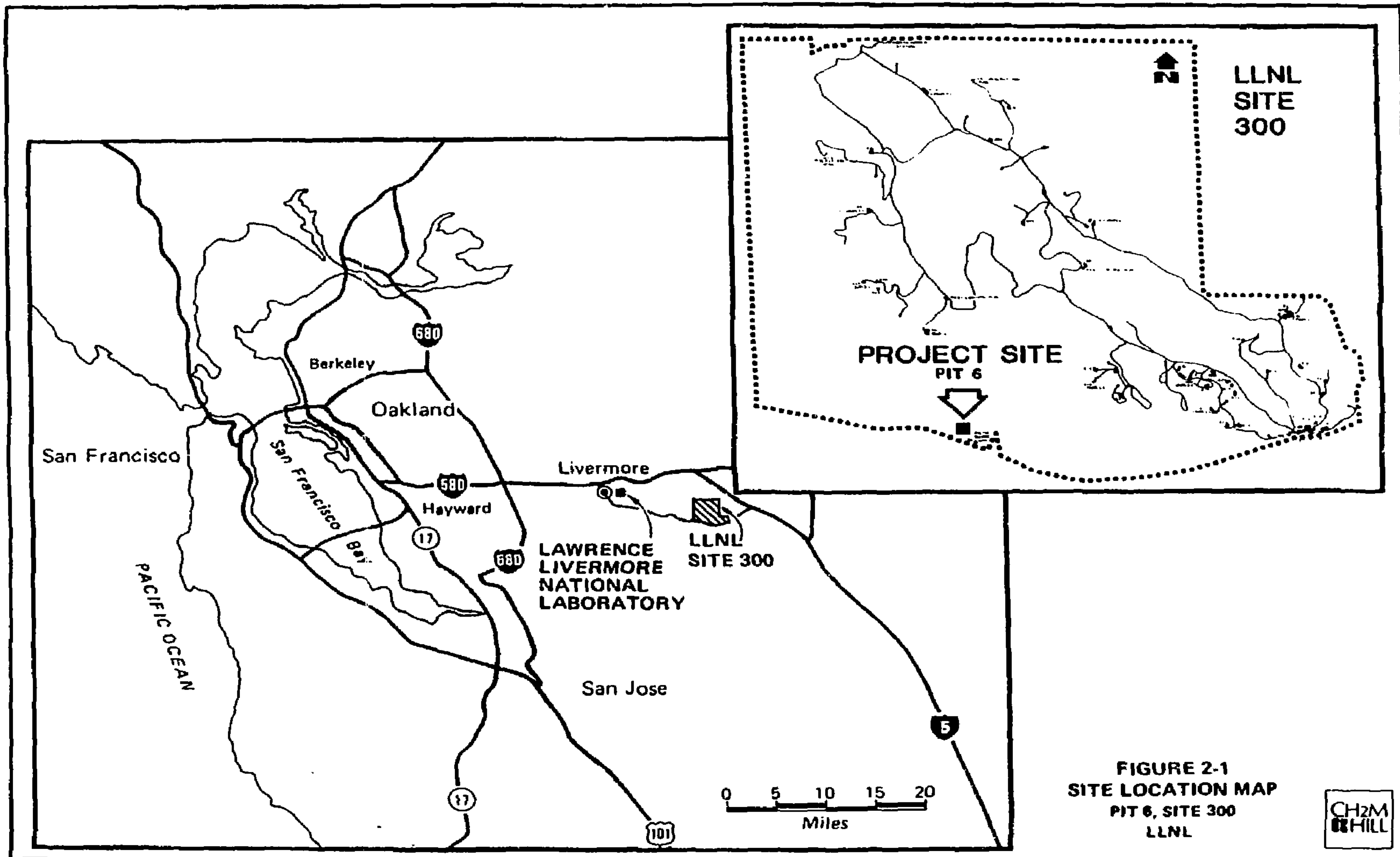


FIGURE 2-1
SITE LOCATION MAP
PIT 6, SITE 300
LLNL

F18728.A0

Chapter 3
BACKGROUND

The purposes of the investigation of Pit 6 were to assess the potential impacts and associated risks of the landfill to the environment, and, if necessary, to identify potential remedial alternatives. To this end, available data were first collected and reviewed. These available data comprise two categories; the history of the landfill and the environmental setting of the landfill. The follcwing paragraphs present a summary of the findings.

3.1 LANDFILL HISTORY

Solid, liquid, and gaseous wastes from the Lawrence Livermore National Laboratory, Livermore Site and the Lawrence Berkeley National Laboratory were buried at Pit 6 between July 1, 1964 and February 20, 1973. To date, the only known records of the wastes buried at Pit 6 are a log book and site plan kept by the landfill operator. The log book contains a brief description of the origin, type, quantity, and final burial location within the landfill of 55 shipments of wastes. A summary of the contents of this log book is presented in Appendix A. Historic site plans show the location of 4 trenches within the boundaries of Pit 6. It is believed that the wastes were originally buried in cells within these trenches. Copies of the historic site plans of Pit 6 are presented in Appendix A.

In general, the log book mentioned above contains the following information for each shipment:

- Size of Shipment: Size and number of trucks and trailers.
- Origin of Wastes: Location of storage area or building number on the Livermore or Berkeley sites where the wastes originated.
- Quantity of Wastes: Rough estimates of volume of wastes (number of containers).
- Radiation Exposure History: History of radiation exposure for most lab animals and waste products.
- Disposition of Shipment: Beginning with Shipment No. 18 in February 24, 1965, a sketch shows the trench and cell intc which the shipment was placed.

The wastes identified as being contained in Pit 6 can be grouped into categories based on their use before becoming a waste. Table 3-1 presents the general waste categories and examples of the wastes contained in each category.

Although the landfill log book provides information about the general types and quantities of wastes that may be buried at Pit 6, specific information needed to assess potential hazards is missing. Information missing from the Pit 6 log book are described below.

- <u>Identification of Specific Chemicals.</u> Specific information about the chemicals contained in the landfill is, for the most part, unavailable. The log book describes the wastes with such phrases as "drums of dry waste chemicals," "red chemical drum," and "capacitors"

- <u>Quantity and Physical State of Chemicals</u>. Although the log book contains gross volume estimates for the containers present in each shipment, the contents of the containers are usually not recorded.

- <u>Waste Contamination</u>. The description of the shipments in the log book does not say whether the wastes had been in contact with hazardous or toxic substances, and if so, whether they had been sufficiently decontaminated. The log book contains descriptions such as "one pallet of pumps" and "one pallet of ducting".

- <u>Radioactive Materials</u>. Many of the wastes originated in areas where experiments with radioactive substances were taking place. The wastes shipped to Pit 6 were screened to exclude burial of materials with high levels of radioactivity. Some of the wastes, however, may have contained low levels of radioactivity. In addition, several shipments of depleted uranium (D-38) were buried in the landfill between 1969 and 1971. Although most of the D-38 is reported to have been exhumed in 1971, it is not clear whether all of the D-38 (such as two boxes from Shipment 49 on July 2, 1969) was exhumed.

To date, there is no known record that describes the disposal operations at Pit 6. The Pit 6 log book reports that wastes arrived by truck on pallets. Because the dimensions of the cells roughly correspond to the numbers and sizes of truck and trailer loads, the assumption is made that wastes were off-loaded at the landfill and placed in the cells. There are no known reports of bulk dumping, liquids disposal, or burning of waste materials.

3.2 ENVIRONMENTAL SETTING

Eight of the nine solid waste landfills at Site 300 were the subject of a recent hazardous waste assessment project by LLNL staff. The primary objective of the LLNL project was to assess whether the disposal operations at the landfills on Site 300 have introduced chemicals into the local groundwater system. To this end, the initial phase of the LLNL investigation included reviewing and compiling available regional and local geologic and hydrogeologic information. Later phases included supplementing the available data with field mapping, drilling activities, and airphoto interpretation. The results of this recent LLNL hazardous waste assessment project are presented in two publications; Raber and Carpenter (1983) and Carpenter and Peifer (1983). These two publications provided the background information for the environmental setting of Pit 6. The following paragraphs present a brief summary of the environmental setting of Pit 6 described in Raber and Carpenter (1983) and Carpenter and Peifer (1983).

3.2.1 GEOLOGY

Site 300 is located on the eastern side of the Altamont Hills in the Coast Range physiographic province. The Coast Range physiographic province is composed of a series of fault-bounded, antiformal mountain ranges and synformal valleys that trend north-northwestward. The bedrock is composed of igneous, metamorphic, and sedimentary rocks that range in age from Cretaceous to Pleistocene. This bedrock is locally overlain by Pleistocene and Holocene unconsolidated sediments. A detailed discussion of the depositional and tectonic history of the region surrounding Site 300, and the resulting stratigraphy and structural features is presented in Raber and Carpenter (1983).

For purposes of this study, the most important aspects of the regional geology discussed by Raber and Carpenter (1983) are those aspects that directly effect the shallow hydrogeologic environment beneath Pit 6; the Patterson Anticline, the Carnegie Fault, the Neroly Formation, and the Terrace Alluvium. The remainder of the discussion of the geologic environment thus focuses on these four aspects and their influence on the subsurface geology beneath Pit 6. Figure 3-1 presents a summary stratigraphic section and geologic cross section of Pit 6.

The Patterson Anticline is the dominant structural feature underlying Site 300. This anticline is an east-west trending anticline which plunges gently to the east. The axis of the Patterson Anticline roughly bisects Site 300. The bedrock formations south of the Patterson Anticline dip gently to the southeast. North of the Patterson Anticline axis bedrock formations generally dip to the northeast. Pit 6 is located on the southern edge of Site 300. Thus, in the vicinity of Pit 6, the bedrock formations dip 10° to 30° to the southeast.

The Carnegie Fault passes directly beneath Pit 6 striking approximately northwestward. As noted by Raber and Carpenter (1983), the dip of the bedrock units beneath Pit 6 changes at the Carnegie Fault. On the north side of the fault, the bedrock units dip 10° to 30° to the southeast as described above. On the south side of the Carnegie Fault, the bedrock units are vertical to overturned.

The Neroly Formation is the uppermost bedrock unit beneath Pit 6. The Neroly Formation is of Miocene and Pliocene age and comprises a distinctive blue weathering sandstone and siltstone, a coarse conglomerate, and interbedded tuffaceous shales. A detailed description of the lithologic units within the Neroly Formation is presented in Raber and Carpenter 1983.

The terrace alluvium underlying Pit 6 is of Pleistocene-Holocene age and is composed of sandy silts and clays grading downward to sands and locally coarse cobble-and-boulder-bearing gravels (Raber and Carpenter, 1983). Beneath Pit 6 these deposits range from approximately 20 to 55 feet in thickness.

The importance of the four geological aspects discussed above is in defining the hydrogeologic environment beneath Pit 6. As noted by Raber and Carpenter (1983), the direction of groundwater flow beneath Site 300, and specifically beneath Pit 6, is probably controlled primarily by geologic structure and secondarily by horizontal and vertical heterogeneities within the saturated materials. Thus, southeasterly and vertical dip of the bedding planes resulting from the Patterson Anticline and the Carnegie Fault, respectively, exert the greatest influence on groundwater flow beneath Pit 6. The lithologic character of the Neroly sandstone and the terrace alluvium may provide for some local variations on this regional flow pattern and more importantly, on the local rates of groundwater flow.

3.2.2 HYDROGEOLOGY

Raber and Carpenter (1983) discuss two zones of the hydrogeologic environment beneath Site 300; the unsaturated zone and the saturated zone. The unsaturated zone consists of the water in the soils and rock between the ground surface and the water table. The saturated zone is composed of the water contained in soil and rock below the water table. The unsaturated zone beneath the landfills at Site 300 is a possible pathway for waste migration. The immediate destination of any wastes that migrate through this pathway is the water table. This water table is thus the most likely pathway of waste migration away from Pit 6. The present investigation focused on characterizing the saturated zone beneath Pit 6.

Because the scope of the investigation did not include characterizing the unsaturated zone, the following summary of available data on the hydrogeologic environment beneath Pit 6 is limited to the saturated zone. A discussion of the unsaturated zone beneath Site 300 is presented in Raber and Carpenter (1983).

The saturated zone beneath Site 300 includes at least two aquifers; a shallow unconfined (water table) aquifer, and a deeper confined aquifer. The water table aquifer is found in the Neroly Formation (first bedrock unit) and the confined aquifer appears to be found beneath the contact between the Neroly and Cierbo (second bedrock unit) Formations. The water in these aquifers appears to flow in the fractures of the bedrock. As noted by Raber and Carpenter (1983), groundwater flow beneath Site 300 is probably controlled primarily by geologic structures (anticlines, synclines, and faults), and secondarily by horizontal and vertical heterogeneities within the aquifer material. The geologic structures and their influence on the groundwater system beneath Site 300 was discussed in Section 3.2.1.

The results presented by Raber and Carpenter (1983) indicate that there is a shallow water table aquifer beneath Pit 6. The groundwater in this aquifer appears to exist in fractured portions of the bedrock at depths between approximately 20 and 60 feet below ground surface. Raber and Carpenter (1983) calculated a water table gradient of 0.00757 foot/foot (ft/ft) in a S15°E direction. The water table surface intersects the land surface approximately 300 feet south of Pit 6. This intersection results in a perennial spring.

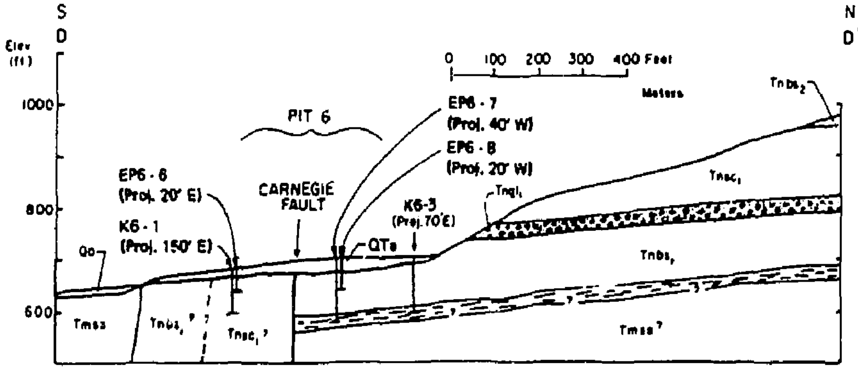
Table 3-1

General Categories of Wastes Believed to be Buried at Pit 6

WASTE CATEGORY

Chemicals	Laboratory Equipment	Laboratory Animals	Construction Materials	Containers	Electrical Parts
Varnish	Tanks	Animal Wastes	Lumber	Carboys	Mercury lights
Dry Chemicals	Metal Parts	Lab Animals	Pipe	Cans	Ignition tubes
Gas Cylinders	Tank Trailer		Concrete Debris	Large Pallets	Electron tubes
	Glove Boxes		Ducting	Wooden Box	Electrical coils
	Hoods		Styrofoam	Drums	Capacitors
	Shell Furnace				
	Degreaser				
	Pumps				
	Manifold				
	Tables				
	Benches				
	Doors				

Source: Pit 6 log book



NOTE: CONTACT ________ INFERRED _ _ _ _ _ UNCERTAIN _ _ _ ? _

LITHOLOGIC UNITS

- Alluvium — HOLOCENE
- Landslide deposits — HOLOCENE
- Terrace Alluvium — PLEISTOCENE-HOLOCENE

Local unconformities

- Nonmarine conglomerates, sands and clays (Tps unit of Dibblee, 1980) — PLIO-PLEISTOCENE

Unconformity

NEROLY FORMATION — UPPER MIOCENE LOWER PLIOCENE

- Interbedded siltstone, sandstone and clay
- Upper conglomerate
- Upper blue sandstone, some interbedded clay, tuff, and limestone
- Interbedded sandstone, siltstone and clay, some tuff, massive sandstone at bottom
- Lower conglomerate, contains lenses of blue sandstone
- Lower blue sandstone with interbedded clay and tuff. Lower claystone/siltstone unit shown on sections

CIERBO FORMATION

Unconformity

TESLA FORMATION - Eocene

Unconformity

GREAT VALLEY SEQUENCE - Upper Cretaceous

MODIFIED FROM RABER AND CARPENTER (1983)

FIGURE 3 - 1
STRATIGRAPHIC SECTION, SITE 300
GEOLOGIC CROSS SECTION, PIT 6
LLNL

CH2M HILL

F16728.A0

Chapter 4
FIELD INVESTIGATION

The field investigation of Pit 6 included both geophysical and hydrogeological investigations. The geophysical investigation consisted of terrain conductivity (TC) and ground penetrative radar (GPR) surveys. The hydrogeologic investigation consisted of monitoring well drilling and completion, water level measurements, aquifer testing, and groundwater sampling. These activities were completed between September 18, 1984 and October 29, 1984. The following paragraphs describe the methodology followed and results obtained during the field investigation of Pit 6.

4.1 GEOPHYSICAL INVESTIGATION

As part of a previous investigation, a terrain conductivity - (TC) survey was conducted at Pit 6 (Raber and Carpenter, 1983). The purpose of the Raber and Carpenter survey was to determine whether there was evidence of the presence of leachate beneath the landfill. The results of the Raber and Carpenter survey revealed three zones of apparent low resistivity in the vicinity of Pit 6 (Figure 4-1). Raber and Carpenter concluded, however, that the TC data primarily reflected the effects of local geology and topography with one exception; the apparent zone of low resistivity located near the southeast corner of Pit 6 (Figure 4-1).

A geophysical investigation was conducted for the current investigation by Detection Sciences, Inc. (DSI). The results of the DSI investigation are presented in their report dated November 8, 1984. A copy of the DSI report is presented in Appendix B of this report. The purpose of the DSI geophysical investigation was twofold: (1) to verify the locations and contents of the trenches described in the Pit 6 log book and site plan mentioned previously and, (2) to delineate, if possible, any leachate emanating from the landfill. The DSI investigation consisted of measuring the electrical properties of the subsurface using TC and ground penetrating radar (GPR).

The theory of operation, general procedures and instrumentation for TC and GPR methods are discussed in the report by DSI (Appendix B). The report also contains the procedures their field geophysicist followed to obtain the TC and GPR data.

The results of the TC and GPR surveys are shown on Plates 1 through 4 in the DSI report. Plate 1 shows the site plan, the TC stations, the GPR tracklines, site features such as berms, paved areas, and the suspected trench locations as shown on the University of California Radiation Laboratory drawing No. PSC-73-300-002EB. Plates 2 and 3 are the

Terrain Conductivity Contour Map and the GPR Tracklines and Anomaly Locations, respectively. Plate 4 presents a sample GPR record with anomalies identified.

4.1.1 TERRAIN CONDUCTIVITY RESULTS

In general, the TC data show an area of higher conductivity (> 60 mm/m) in the eastern portion of the site (Plate 2, Appendix B and Figure 4-1). DSI staff have cited three conditions which could contribute to this zone of higher conductivity: a higher moisture content in the soil; a higher concentration of free ions in the saturated pore water; and/or, a shallower water table. The water level and quality data collected from the perimeter wells during the hydrogeologic investigation (described in Section 4.2) do not indicate either that the water table is shallower on the eastern side of Pit 6 or that the groundwater on the eastern side of the landfill has a significantly higher concentration of free ions. A higher soil moisture content could result from local infiltration and near surface recharge. The northward extension of the zone of higher conductivity may represent near surface recharge from the higher ground and steep slopes adjacent to the northern perimeter of Pit 6.

4.1.2 GROUND PENETRATING RADAR RESULTS

DSI staff have interpreted three types of anomalies on the GPR records. (Refer to Plates 3 and 4, Appendix B.) These anomalies are designated Type A, Type B, and Type C, and have been generally interpreted as follows:

- Type A: buried object(s)
- Type B: disturbed strata
- Type C: localized areas of high conductivity.

The GPR records show few Type A anomalies that have distinctive reflections typical of buried metal parts. These images appear significantly different than the faint Type B anomalies that may be indicative of animal burrows or simply rough terrain interferences. The high soil resistivities limit the depth of penetration to only about 4 to 6 feet. Thus, the data on deeper burial containers and any leakage being formed is very limited.

DSI staff reported that the GPR results generally exhibited limited penetration depth and limited resolution of subsurface features. The radar anomalies discussed in the DSI report appear to be, for the most part, weak anamolies that are randomly distributed over the site with the exception of three general trends. DSI staff describe the three general trends of the radar anomalies as follows:

- Type A anomalies are concentrated in the eastern half of the site
- A northwest trending alignment of radar anomalies exists in the southwest
- Type B anomalies (weak) are concentrated in the western half of the site.

As shown in Plate 4 of Appendix B, however, the GPR data appear to become less distinct below 3.5 feet below ground surface. The historical records of the landfill indicate that the original soil cover was 4 to 5 feet thick and recent observations indicate that the soil cover may locally be significantly less than 4 feet. Thus, many of the anomalies and reported patterns of anomalies may be due to non-waste related objects (i.e. animal burrows) in this cover soil. It is unlikely that the GPR data represent objects deeper than 4 feet.

4.1.3 INTERPRETATION

As noted by DSI staff, there appears to be only one very general correlation between the results of the TC and GPR surveys; the zone of high conductivity in the eastern portion of the site and the zone Type A anomalies concentrated in the eastern half of the site.

DSI staff offer two possible explanations for this correlation:

(1) The landfill is a single large pit rather than distinct trenches as described in the landfill log book

(2) There is a conductive leachate present between trenches.

No other data are currently available to support either of these explanations. The results of the hydrogeologic investigation described in Section 4.2 do not indicate that leachate is escaping from the landfill area. The contents and map of the Pit 6 log book do not support the presence of a single burial pit at the landfill. However, because there is not a detailed description of the disposal operations currently available, it is possible that the original trenches depicted in the log book and map were not as distinct as shown. Furthermore, there is at least one reference to excavation of wastes from the landfill; the exhuming of the D-38. Again, a detailed description of the procedures followed for this excavation is not available and such an operation could have effected the configuration of the trenches. The results of the geophysical survey are, at this time, inconclusive.

A more extensive records search as described in our recommendations (Chapter 7) may reveal more information on landfill operations.

4.2 HYDROGEOLOGIC INVESTIGATION

Results of an initial investigation of the hydrogeologic environment beneath the landfills at Site 300 are presented in Raber and Carpenter (1983) and Carpenter and Peifer (1983). This initial investigation did not address two components of the groundwater system beneath Pit 6:

- o The vertical hydraulic gradient
- o The effect of the Carnegie Fault on the rate and direction of groundwater movement.

The results of the Raber and Carpenter investigation did not indicate that organic compounds were present in the shallow groundwater beneath Pit 6.

The focus of the current hydrogeologic investigation was to provide information on the vertical hydraulic gradient, on the effect of the Carnegie Fault on local groundwater flow, and to further document the absence of organic compounds in the groundwater beneath Pit 6. The following paragraphs present a summary of the field work performed and results obtained to address these issues.

4.2.1 MONITORING WELL INSTALLATION AND DEVELOPMENT

Five boreholes were drilled and four monitoring wells were installed outside the perimeter of Pit 6. The locations of the borehole (EP6-5) and the four wells (EP6-6, EP6-7, EP6-8, and EP6-9) are shown in Figure 4-1. The exploratory borehole, EP6-5, was initially intended to be a monitoring well. Difficult drilling conditions were encountered, however, and the borehole could not be advanced deeper than 37 feet below ground surface. The borehole was thus abandoned and grouted to the surface.

The four monitoring wells were originally located to provide information on both aquifer hydraulics and water quality. The wells were to be located to provide the following information:

EP6-6:
- o Water level and quality data in the shallow unconfined aquifer south of the Carnegie Fault
- o Information on the low resistivity anomaly on the southeastern perimeter of Pit 6 as described by Raber and Carpenter (1983)

EP6-7:
- o Water level and quality data in the deeper aquifer on the north side of the Carnegie Fault
- o Aquifer parameters (transmissivity and storage) in the deeper confined aquifer on the north side of the Carnegie Fault

EP6-8:
- o Water level and quality data in the shallow unconfined aquifer north of the Carnegie Fault
- o Aquifer parameters (transmissivity and storage) in the shallow unconfined aquifer north of the Carnegie Fault

EP6-9:
- o Water level and quality data in the shallow unconfined aquifer south of the Carnegie Fault
- o Aquifer parameters (transmissivity and storage) in the shallow unconfined aquifer south of the Carnegie Fault.

Some of the information cited above was not obtained from the monitoring wells. A summary of the data not obtained and an explanation for not obtaining the information is provided at the end of this section.

The field procedures followed for drilling the boreholes and completing and developing the monitoring wells are summarized below.

- o The drill rig and equipment were decontaminated by steam cleaning.
- o An 8-1/2-inch diameter borehole was drilled with an 8-1/2-inch drag bit to a depth of 6 feet.
- o A section of 8-inch diameter temporary surface casing six feet long was placed in the borehole.
- o A 7-1/2-inch diameter borehole was drilled using a 7-1/2-inch drag bit.
- o The drill cuttings were logged by a CH2M HILL hydrogeologist.
- o Geophysical logs were run in an open borehole including natural gamma, spontaneous potential, point resistivity, and 6-foot lateral resistivity logs.

- The screened interval was selected based on the geologic and geophysical logs.

- The well casing and screen were installed.

- The gravel pack was tremmied to the desired interval with a one-inch diameter tremmie pipe and flowing clean water.

- An annular grout seal was placed from the top of the gravel pack to the ground surface. The grout was pumped from the bottom of the annular space up through a one-inch diameter tremmie pipe.

- The well was developed by air lifting.

- The well head was completed with a locking steel cover and a concrete slab base.

- The water produced during drilling and development of the monitoring wells was temporarily stored in polyethylene tanks onsite.

- The casing and ground surface elevations of the monitoring wells surveyed to the nearest 0.01 foot by LLNL personnel.

A brief summary of well construction details for the four monitoring wells is presented in Table 4-1. Locations of the exploratory boring and monitoring wells are shown in Figure 4-1. Diagrams summarizing the geologic logs, geophysical logs, and well construction details for EP6-5 through EP6-9 are shown in Figures 4-2 through 4-7.

As shown in Table 4-1, the wells constructed for this investigation were screened in three different zones. These zones are different than those originally planned. The following paragraphs describe the data that is available from the wells as they were constructed.

Water was not encountered while drilling the borehole for monitoring well EP6-6. As shown in Figure 4-3, the bedrock encountered while drilling EP6-6 was claystone. This borehole was apparently drilled into the same, or a similar, steeply dipping claystone bed as K6-2 (Raber and Carpenter, 1983). Because no water was encountered, obtaining information on water level and quality at that location was not possible. However, the borehole was completed as a monitoring well, EP6-6, screened between 15 and 35 feet below ground surface. This monitoring well was designed to provide a means of evaluating whether the contact between the bedrock and the overlying alluvium is an intermittent pathway for groundwater migration.

As shown in Figure 4-4, the borehole for EP6-7 was drilled into the deeper confined aquifer to a total depth of 150 feet below ground surface. Monitoring well EP6-7 was not screened in this deeper aquifer, however, because the amount of water produced during drilling below 130 feet below ground surface (approximately 100 gallons per minute (gpm)) was much greater than expected and containing the water produced was not practical. EP6-7 was thus completed as a monitoring well screened in the shallow unconfined aquifer (approximately 108 to 128 feet below ground surface) beneath Pit 6. This well will provide water level and quality data for the shallow unconfined aquifer.

Monitoring wells EP6-8 and EP6-9 were also completed in the shallow unconfined aquifer (approximately 30 to 70 feet below ground surface) beneath Pit 6. EP6-8 is located on the north side of the Carnegie Fault and EP6-9 is located on the south side of the fault. The locations of these wells will provide the water level and quality data as originally planned from the shallow unconfined aquifer.

4.2.2 WATER LEVEL MEASUREMENTS

Static water levels in all of the monitoring wells at Pit 6 were measured with a steel tape periodically throughout the period of field work. These measurements were made in order to prepare a water level elevation map and to establish the horizontal hydraulic gradient magnitude and direction. Table 4-2 presents a summary of the water level data available for the Pit 6 area. A water table elevation map for October 12, 1984 is presented in Figure 4-8.

Water level data are used to calculate horizontal and vertical hydraulic gradients within and between aquifers. Calculation of a horizontal hydraulic gradient requires water levels from three wells screened in the same aquifer. Calculation of a vertical hydraulic gradient requires two adjacent wells which are screened in different aquifers or different zones within an aquifer.

At Pit 6 the shallow, unconfined (water table) aquifer is under investigation. All of the monitoring wells at Pit 6 are screened in this shallow aquifer. The exact influence of the Carnegie Fault on shallow groundwater flow is not known at this time. Water level elevation data are thus not contoured and a horizontal hydraulic gradient is not calculated across this feature. Rather, an average horizontal hydraulic gradient of 0.002 foot/foot (ft/ft) in a S 35°E direction is calculated for the north side of the fault using water level data from monitoring wells K6-4, K6-3, EP6-7, and EP6-8.

As shown in Figures 4-4 and 4-5, monitoring wells EP6-7 and EP6-8 are screened in differemt zones of the shallow unconfined aquifer. Based on the water level data from monitoring wells EP6-7 and EP6-8, there does not appear to be a vertical hydraulic gradient within the shallow aquifer on the north side of the Carnegie Fault. The difference in water level elevation between the two wells ranges from less than 0.1 foot to 0.45 foot (Table 4-2). This small difference in elevation may be due to field measurement error.

The southeasterly horizontal gradient on the north side of the Carnegie Fault is supported by the geology known to exist beneath Pit 6 (Chapter 3). On the north side of the Carnegie Fault, the dip of the bedrock units are between 10° and 30° to the southeast. Assuming that the majority of the groundwater within these beds moves down dip along the bedding planes, the direction of the horizontal hydraulic gradient would be southeasterly. It is possible, however, that some of the water may also move along strike of the bedrock beds (and the Carnegie Fault) or across the beds. Data are not available at this time to evaluate the possibilities of groundwater movement along strike or across-beds in the shallow aquifer.

On the south side of the Carnegie Fault, the bedrock units are vertical to overturned. Groundwater contained within these beds could move down the dip of the beds, along the strike of the beds, or across the beds. As discussed previously, water was not encountered while drilling K6-2 and EP6-6 on the south side of the fault. These boreholes were apparently drilled into a steeply dipping claystone bed. Water levels south of the Carnegie Fault do not appear, however, significantly different than those north of the fault. Although the Carnegie Fault and the steeply dipping beds south of the fault would appear to be barrier to groundwater flow, available water level data and aquifer test results (Section 4.2.3) do not confirm this.

An additional possible pathway of shallow groundwater flow beneath Pit 6 is along the contact between the bedrock and the alluvium. Figure 4-9 presents the elevation of the top of the bedrock as determined from the geologic logs of the monitoring wells and exploratory boreholes at Pit 6. Comparison of the bedrock elevations with the water level elevations (Table 4-2 and Figure 4-8) shows that in all of the perimeter monitoring wells except EP6-6 and K6-3, the water table is or has been at an elevation equal to or higher than the contact between the alluvium and the bedrock. Evidence of at least intermittent groundwater flow along this pathway is the spring located approximately 300 feet southeast of Pit 6 (Figure 4-1).

4.2.3 AQUIFER TESTING

Aquifer tests (constant discharge and recovery) were conducted in two monitoring wells, EP6-7 and EP6-9. A slug test was conducted in one monitoring well, EP6-8. The purposes of the aquifer and slug tests were to provide estimates for the hydraulic properties (transmissivity and storage) of the shallow aquifer beneath Pit 6 and to provide information on the effect of the Carnegie Fault on the shallow ground-water flow.

For the constant discharge tests, a generator-powered, 4-inch diameter submersible pump was lowered into the pumping well with one-inch diameter PVC pipe. Discharge was controlled with a gate valve and measured with a flowmeter, bucket, and stop watch. Water levels in the pumping well and observation wells were measured with electric sounders calibrated with a steel tape. Because no previous aquifer test data were available, only the two monitoring wells closest to the pumping well were chosen as observation wells. The water produced during the aquifer tests was contained in polyethylene tanks and temporarily stored onsite.

For the slug test, a slug was lowered and suspended in the well on polypropylene rope. The water level was recorded with an electric sounder calibrated with a steel tape. The slug consisted of a 6-feet long section of 2.5-inch diameter PVC pipe that was filled with sand and sealed on both ends.

The EP6-7 aquifer test consisted of collecting four hours of drawdown data at a constant discharge of 20 gallons per minute (gpm) followed by collecting 1.5 hours of recovery data. During the EP6-7 test, water levels were measured in EP6-7, EP6-8 and K6-3 during both drawdown and recovery periods. The EP6-9 aquifer test consisted of collecting 2.5 hours of drawdown data at a constant discharge of 15 gpm followed by collecting one-hour of recovery data. During the EP6-9 test, water levels were measured in EP6-9, K6-1, and K6-4 during the drawdown period and in EP6-9 and K6-1 during the recovery period.

The drawdown data from each observation well and pumping well were analyzed, where possible, by the Jacob straight-line method and the This curve-fitting method (Lohman, 1976). The recovery data were analyzed by the Theis recovery method (Lohman, 1976). The slug test data were analyzed by the method presented in Bouwer and Rice (1976). The results of the aquifer tests are summarized in Table 4-3. The raw data, drawdown graphs, and recovery graphs are organized by aquifer test and presented in Appendix C.

As shown in Table 4-3, the aquifer tests conducted at monitoring wells EP6-7 and EP6-8 provide estimates for transmissivity and storage in the shallow aquifer on the north side of the Carnegie Fault. The transmissivity values calculated from the EP6-7 and EP6-8 data range from 207 to 1720 square feet per day (ft^2/d). The two low transmissivity values, 207 and 696 ft^2/d, are probably not representative of the transmissivity in the shallow aquifer on the north side of the Carnegie Fault for the following reasons:

- The value of 207 ft^2/d was based on drawdown data from EP6-7 while pumping EP6-7

- The value of 696 ft^2/d was based on drawdown data from EP6-8 while pumping EP-6-7.

Under field conditions the discharge rate during constant discharge aquifer tests may vary slightly. The effects of this slight variation in discharge rate is most apparent in drawdown data recorded in the pumping well and in observation wells located very close to the pumping well. In the case of the aquifer test conducted at EP6-7, the low values calculated for transmissivity (207 and 696 ft^2/d) are from the pumping well and an observation well located adjacent to the pumping well. The observation well is screened in a zone approximately 70 feet above the zone screened in the pumping well. Thus, the calculated low transmissivities are probably the result of slight variations in the discharge rate. If the two low transmissivity values are not considered, a mean and standard deviation of the transmissivity values for the north side of the Carnegie Fault can be calculated as 1336 and 257 ft^2/d, respectively. Furthermore, because the storage coefficient of an aquifer is proportional to the transmissivity, the values for the storage coefficient calculated from drawdown data from EP6-7 and EP6-8 are probably also not representative. The storage coefficient for the shallow aquifer on the north side of the Carnegie Fault thus ranges from 0.001 to 0.003 with a mean of 0.002 and standard deviation of 0.001.

As shown in Table 4-3, the aquifer test conducted at monitoring well EP6-9 provides estimates for the transmissivity and storage of the shallow aquifer on the south side of the Carnegie Fault. The calculated transmissivity values range from 189 to 238 ft^2/d. The low value, 189 ft^2/d, was calculated from drawdown data recorded in EP6-9 during pumping. As discussed above, this value is probably not a representative value for the transmissivity of the shallow aquifer on the south side of the Carnegie Fault. The calculated mean transmissivity is thus 234 with a standard deviation of 6. The storage coefficient on the south side of the Carnegie Fault ranges from 0.0002 to 0.0003.

An important result of the aquifer tests described above is the unanswered issue of the exact effect of the Carnegie Fault on groundwater flow beneath Pit 6. Because the aquifer tests described above were exploratory in nature, this issue was not completely resolved. Although the water level in

K6-4 did not respond while pumping EP6-9, assuming a transmissivity of 234 ft /d and a storage coefficient of 0.00025, the maximum radius of influence for the EP6-9 aquifer test is approximately equal to the radial distance between EP6-9 and K6-4; 300 feet. Thus, a longer-term aquifer test is necessary to determine whether K6-4 would respond while pumping EP6-9. Another observation that cannot be explained by available data is that the transmissivity and storage values of the shallow aquifer appear to change across the Carnegie Fault. Thus, the two unanswered questions about the effect of the Carnegie Fault on groundwater flow are:

- o Is groundwater in the beds on the north side of the Carnegie Fault is hydraulically connected to groundwater in beds on the south side of the fault

- o Does groundwater in the bedrock units on the south side of the fault flow across beds.

Further investigation to answer the above questions about the influence of the Carnegie Fault on groundwater flow would probably include longer term aquifer tests (3 to 5 days) on existing wells on the north and south side of the Carnegie Fault and installation of a monitoring well in the fault zone on the east side of Pit 6.

4.2.4 GROUNDWATER SAMPLING

Groundwater in the monitoring wells located around the perimeter of Pit 6 was sampled to determine whether chemicals associated with the landfill were present in the groundwater.

Water samples were obtained from EP6-7, EP6-8, EP6-9, K6-1, K6-3, K6-4, and a water supply well located approximately 1000 feet east of the eastern perimeter stake of Pit 6 (herein called the Ranger Well).

The field procedures followed to obtain water samples from the monitoring wells are summarized below.

- o All sampling equipment was decontaminated by steam cleaning.

- o A minimum of four casing volumes of water was removed from the well and temporarily stored in polyethylene tanks onsite.

- o While evacuating water from the well, field measurements of pH, conductivity, and temperature were made and observed for stabilization.

- A water sample was obtained by bailing with a teflon bailer and decanting the water into the appropriate laboratory containers.

- Water samples were then labeled, placed in zip-lock plastic bags, stored in an ice chest and transported to the analytical laboratory.

Two methods of evacuating water from the monitoring wells were used. For monitoring wells EP6-7, EP6-8 and EP6-9, the same 4-inch diameter submersible pump used during the aquifer tests was used. For monitoring wells K6-1, K6-3 and K6-4, water was evacuated from the well by hand with a 2-inch diameter PVC bailer.

To sample the Ranger Well, the installed pump was turned on for approximately 15 minutes. The pump is estimated to pump approximately 20 gpm. A water sample was obtained from a faucet in the nearby water treatment shed.

Water samples from all the wells were analyzed for pH, electrical conductivity, chloride, the complete priority pollutant list (including volatile, base-neutral and acid-extractable compounds, pesticides, PCB's, and metals), and radioactivity (gross alpha, gross beta and radium). The results of these analyses and the analytical methods used are presented in Table 4-4.

As shown in Table 4-4, the groundwater samples from only four of the monitoring wells sampled contained low levels of three organic compounds and/or slightly elevated levels of four metals. Samples from K6-1 and K6-4 contained bis (2-ethylhexyl) phthalate and benzyl butyl phthalate and samples from K6-3 contained methylene chloride. Monitoring wells K6-3 and K6-4 also contain slightly elevated levels of cadmium, chromium, iron, and manganese. The level of iron was also slightly elevated in EP6-9. The slightly elevated metal levels discussed above are, however, within levels commonly found in groundwater.

Because the results summarized above and shown in Table 4-4 are the results of only one sampling round, there are questions regarding their representativeness and reliability. One factor which may have effected the reliability of the results reported in Table 4-4 is the sampling method. As noted previously, the water in monitoring wells EP6-7, EP6-8, and EP6-9 was evacuated before sampling with a submersible pump. Furthermore, a large volume of water (much greater than four casing volumes) was evacuated from these wells because the water samples were taken after the aquifer tests. The water in monitoring wells K6-1, K6-3, and K6-4 was removed with a bailer. The volume of water evacuated from these wells was much less (between four and five casing volumes as necessary for the field measurements of pH, temperature and conductivity to stabilize).

Further evidence that the data presented in Table 4-4 may not be representative or reliable are the results of previous groundwater sampling. Results of previous groundwater analyses are presented in Raber and Carpenter (1983), Carpenter and Peifer (1983), and Table 4-5. The data contained in Table 4-5 are the results of groundwater samples that have been analyzed since the Raber and Carpenter (1983) and Carpenter and Peifer (1983) reports. In none of the previous groundwater sampling data have organic compounds been detected.

4.2.5 DISPOSAL OF CUTTINGS AND WATER

The cuttings from the boreholes drilled for the monitoring wells were spread on the ground surface next to the monitoring wells.

The water produced during drilling, developing, testing, and sampling of the monitoring wells was temporarily stored in polyethylene tanks on site. At the end of the field activities, the water in each of these tanks was sampled. These water samples were analyzed for volatile organic compounds. The results of these water samples are presented in Table 4-6. After discussion with representatives of the Regional Water Quality Control Board (RWQCB), the stored water was released.

Table 4-1
Summary of Monitoring Well Construction Details

Monitoring Well	Casing I.D.[1] (inches)	Total Depth (ft, bgs)[2]	Screened Interval (ft, bgs)	Elevation of Top of Concrete Pad[3] (ft, MSL)	Elevation of Top of PVC Casing (ft, MSL)	Elevation of Top Steel Casing (ft, MSL)
EP6-6	4	45	15-35	686.01	686.56	686.78
EP6-7	4	128	108-128	705.50	706.00	706.40
EP6-8	4	62	47-62	706.38	706.87	707.18
EP6-9	4	65	35-65	692.26	692.83	683.39

Notes:

[1] inner diameter
[2] feet below ground surface
[3] feet above mean sea level

SFR99/012

Table 4-2

Summary of Water Level Data for Monitoring Wells Adjacent to Pit 6

Well Number	Reference Elevation	Water Level Elevations 10/82[1]	12/82[1]	1/83[1]	2/28/84[2]	2/29/84[2]	6/15/84[2]	7/22/84[2]	8/31/84[2]
K6-1	698.26	666.70	666.50	666.90	667.01		666.75	666.99	666.01
K6-3[4]	724.62	670.40	670.10	671.40		671.04			
K6-4[4]	706.53	669.80	669.30	671.20	670.11				
EP6-7	706.00								
EP6-8	706.87								
EP6-9	692.83								

Well Number	Reference Elevation	Water Level Elevations 10/12/84[3]	10/16/84[3]	10/17/84[3]	10/18/84[3]	10/19/84[3]	10/19/84[2]	10/29/84[3]
K6-1	698.26	665.66	665.64		665.62	665.34	665.26	
K6-3[4]	724.62	667.13	667.54	667.28	667.07			
K6-4[4]	706.53	667.33	667.58			667.24		
EP6-7	706.00	666.91	667.29	666.68	666.78			
EP6-8	706.87	666.87	667.26	667.23				667.36
EP6-9	692.83	664.15	665.66			665.64		

NOTES: All elevations are in feet above mean sea level.

Sources of data include:

[1]Carpenter and Peifer (1983)

[2]McConahie (1985)

[3]Current investigation

[4]Wells located upgradient of Pit 6

SFR99/012

Table 4-3
Summary of Results from Aquifer Tests

Monitoring Well	Screened Interval (feet below Ground Surface)	Approximate Ground Surface Elevation ft, MSL[a]	EP6-7 Aquifer Test: Radial Distance from Pumping Well (feet)	EP6-7 Transmissivity (T) ft²/day[b]: Semi-Log Drawdown	EP6-7 Transmissivity (T) ft²/day[b]: Semi-Log Recovery	EP6-7 Transmissivity (T) ft²/day[b]: Log-Log Drawdown	EP6-7 Storage Coefficient (S): Semi-Log Drawdown	EP6-7 Storage Coefficient (S): Log-Log Drawdown	EP6-9 Aquifer Test: Radial Distance from Pumping Well (feet)	EP6-9 Transmissivity (T) ft²/day: Semi-Log Drawdown	EP6-9 Transmissivity (T) ft²/day: Semi-Log Recovery	EP6-9 Transmissivity (T) ft²/day: Log-Log Drawdown	EP6-9 Storage Coefficient (S): Semi-Log Drawdown	EP6-9 Storage Coefficient (S): Log-Log Drawdown	EP6-8 Slug Test: Hydraulic Conductivity ft/day[c,d]	EP6-8 Slug Test: Transmissivity ft²/day[b]
K6-1	35-65	688.75	--	--	--	--	--	--	147	238	•	229	.0002	.0003	--	--
K6-3	75-93	723.62	188	1438	--	1226	.001	.003	--	--	--	--	--	--	--	--
K6-4	43-63	706.11	--	--	--	--	--	--	315	•	•	•	•	•	--	--
EP6-7	108-128	705.50	--	207	1720	*	.06	*	--	--	--	--	--	--	--	--
EP6-8	47-62	706.38	19	1258	--	696	.04	.06	--	--	--	--	--	--	13	1040
EP6-9	35-65	692.26	--	--	--	--	--	--	*	189	•	•	•	--	--	--

Notes:

*data inadequate to calculate aquifer parameters
--water level not measured
[a] feet above mean sea level; elevations are approximate
[b] square feet per day
[c] feet per day
[d] assume aquifer thickness 80 feet
[e] no measurable water level change during aquifer test

SFR72/112

Table 4-4 Results of Laboratory Analyses of Water Samples from Monitoring Wells near Pit 6 (in micrograms per liter of solution, ug/l, unless otherwise noted)

	Well							
	K6-1	K6-3	K6-4	EP6-7	EP6-8	EP6-8 (Duplicate)	EP6-9	Ranger
PRIORITY POLLUTANT / Sample Date	10/18/84	10/19/84	10/19/84	10/17/84	10/18/84	10/18/84	10/19/84	10/26/84
VOLATILE COMPOUNDS 1								
acrolein	<100.	<100.	<100.	<100.	<100.	<100.	<100.	<100.
acrylonitrile	<100.	<100.	<100.	<100.	<100.	<100.	<100.	<100.
benzene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
carbon tetrachloride	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
chlorobenzene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,2-dichloroethane	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,1,1-trichloroethane	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,1-dichloroethane	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,1,2-trichloroethane	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,1,2,2-tetrachloroethane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
chloroethane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
2-chloroethylvinyl ether	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
chloroform	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,1-dichloroethene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
trans-1,2-dichloroethene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
1,2-dichloropropane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
1,3-dichloropropene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
ethylbenzene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
methylene chloride	<5.	160.	<5.	<5.	<5.	<5.	<5.	<5.
chloromethane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
bromomethane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
bromoform	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
bromodichloromethane	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
fluorotrichloromethane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
dichlorodifluoromethane	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
chlorodibromomethane	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
tetrachloroethene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
toluene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
trichloroethene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
vinyl chloride	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS 1								
acetone	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
2-butanone	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
carbondisulfide	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
2-hexanone	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
4-methyl-pentanone	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
styrene	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
vinyl acetate	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.
total xylenes	<5.	<5.	<5.	<5.	<5.	<5.	<5.	<5.

SFR72/101

Table 4-4 (continued)

PRIORITY POLLUTANT BASE/NEUTRAL COMPOUNDS 2	Sample Date	K6-1 10/18/84	K6-3 10/19/84	K6-4 10/19/84	EP6-7 10/17/84	EP6-8 10/18/84	EP6-8 (Duplicate) 10/18/84	EP6-9 10/19/84	Ranger 10/26/84
		Well							
acenaphthene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
benzidine		<40.	<40.	<40.	<40.	<40.	<40.	<40.	<40.
1,2,4-trichlorobenzene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
hexachlorobenzene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
hexachloroethane		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
bis(2-chloroethyl)ether		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
2-chloronaphthalene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
1,2-dichlorobenzene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
1,3-dichlorobenzene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
1,4-dichlorobenzend		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
3,3'-dichlorobenzidine		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
2,4-dinitrotoluene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
2,6-dinitrotoluene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
1,2-diphenylhydrazine (as azobenezene)		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
fluoranthene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
4-chlorophenyl phenyl ether		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
4-bromophenyl phenyl ether		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
bis(2-chloroisopropyl) ether		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
bis(2-chloroethoxy) methane		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
hexachlorobutadiene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
hexachlorocyclopentadiene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
isophorone		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
naphthalene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
nitrobenzene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
N-nitrosodiphenylamine		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
N-nitrosodipropylamine		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
bis(2-ethylhexyl) phthalate		44.	<10.	70.	<10.	<10.	<10.	<10.	<10.
benzyl butyl phthalate		50.	<10.	78.	<10.	<10.	<10.	<10.	<10.
di-n-butyl phthalate		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
di-n-octyl phthalate		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
diethyl phthalate		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
dimethyl phthalate		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
benzo(a)anthracene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
benzo(a)pyrene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
benzo(b)fluoranthene		<20.*	<20.*	<20.*	<20.*	<20.*	<20.*	<20.*	<20.*
benzo(k)fluoranthene		<20.*	<20.*	<20.*	<20.*	<20.*	<20.*	<20.*	<20.*
chrysene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
acenaphthylene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
anthracene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
benzo(ghi)perylene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
fluorene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
phenanthrene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
dibenzo(a,h)anthracene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
indeno(1,2,3-cd)pyrene		<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
pyrene		<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.

SFR72/102

Table 4-4 (continued)

Well / Sample Date	K6-1	K6-3	K6-4	EP6-7	EP6-8	EP6-8 (Duplicate)	EP6-9	Ranger
PRIORITY POLLUTANT ACID COMPOUNDS 2	10/18/84	10/19/84	10/19/84	10/17/84	10/18/84	10/18/84	10/19/84	10/26/84
2,4,6-trichlorophenol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
p-chloro-m-cresol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
2-chlorophenol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
2,4-dichlorophenol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
2,4-dimethylphenol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
2-nitrophenol	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
4-nitrophenol	<50.	<50.	<50.	<50.	<50.	<50.	<50.	<50.
2,4-dinitrophenol	<50.	<50.	<50.	<50.	<50.	<50.	<50.	<50.
4,6-dinitro-o-cresol	<20.	<20.	<20.	<20.	<20.	<20.	<20.	<20.
pentachlorophenol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
phenol	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES AND PCB's 3								
alpha-BHC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
gamma-BHC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
beta-BHC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
heptachlor	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
delta-BHC	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
aldrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
heptachlor epoxide	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
endosulfan I/II	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
dieldrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
endrin	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
endrin aldehyde	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
endosulfan sulfate	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
chlordane	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
toxaphene	<10.	<10.	<10.	<10.	<10.	<10.	<10.	<10.
PCB-1242	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
PCB-1254	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
PCB-1221	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
PCB-1232	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
PCB-1248	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
PCB-1260	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
PCB-1016	<1.	<1.	<1.	<1.	<1.	<1.	<1.	<1.
OTHER PARAMETERS								
pH	8.3	8.4	8.3	8.8	8.4	8.3	8.6	8.6
electrical conductivity (micromhos per centimeter)	1100.	1200.	960.	850.	1000.	1100.	1200.	1200.
chloride (milligrams per liter)	92.	87.	98.	98.	100.	98.	110.	110.

SFR72/103

Table 4-4 (continued)

PRIORITY POLLUTANT METALS 4,5	Sample Date	Well K6-1 10/18/84	K6-3 10/19/84	K6-4 10/19/84	EP6-7 10/17/84	EP6-8 10/18/84	EP6-8 (Duplicate) 10/18/84	EP6-9 10/19/84	Ranger 10/26/84
Antimony		0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Arsenic		0.018	0.014	0.012	0.015	0.015	0.013	0.011	<0.01
Beryllium		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium		<0.05	0.089	0.060	<0.05	<0.05	<0.05	<0.05	<0.05
Chromium		<0.01	0.017	0.019	<0.01	<0.01	<0.01	0.011	<0.01
Copper		<0.05	0.078	0.093	<0.05	<0.05	<0.05	<0.05	<0.05
Lead		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Mercury		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Nickel		<0.05	0.051	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Selenium		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Thallium		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Zinc		0.014	0.99	0.97	<0.01	0.016	<0.01	0.032	0.036
ADDITIONAL ELEMENTS 4,5									
Aluminum		<0.2	5.2	3.0	<0.2	<0.2	<0.2	0.26	<0.2
Barium		<0.1	<0.1	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron		1.8	1.2	1.8	1.2	0.93	1.1	1.8	1.9
Cobalt		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Iron		0.05	2.4	4.0	0.064	<0.05	<0.05	0.35	<0.05
Manganese		0.099	0.31	0.62	0.023	0.015	0.016	0.048	0.058
Vanadium		<0.02	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
RADIOCHEMISTRY 6,7									
gross-a		1.4±2.4	3.9±2.7	2.3±2.6	3.5±2.6	2.9±2.6	1.4±2.4	<3	<3
gross-b		<10	5.2±6.4	6.5±6.5	<10	<10	<10	<10	<10
radium (Ra228)		<3	<3	<3	<3	<3	<3	<3	<3

Notes:

The less than symbol (<) means "not present at or above the indicated value (detection limit)".
The organic compounds occurring above the detection limit are underlined.
1) Samples analyzed by EPA Method 624
2) Samples analyzed by EPA Method 625
3) Samples analyzed by EPA Method 608
4) All values are milligrams per liter (mg/l)
5) Samples analyzed by Atomic Adsorption (AA) or Induced Coupled Argon Plasma (ICAP)
6) All values are picocuries/liter (pci/l)
7) Samples analyzed by standard radiochemical techniques
*Compounds co-elute - analyzed as a single compound

SFR72/104

Table 4-5 Summary of Previous Laboratory Analyses of Water Samples from Monitoring Wells Near Pit 6 (in micrograms per liter of solution, ug/l, unless otherwise noted)

PRIORITY POLLUTANT	Sample Date	Well K6-1	Well K6-3	Well K6-4
		2/28/84	2/29/84	2/28/84
VOLATILE COMPOUNDS				
acrolein		<10.	<10.	<10.
acrylonitrile		<10.	<10.	<10.
benzene		<1.	<1.	<1.
carbon tetrachloride		<1.	<1.	<1.
chlorobenzene		<1.	<1.	<1.
1,2-dichloroethane		<1.	<1.	<1.
1,1,1-trichloroethane		<1.	<1.	<1.
1,1-dichloroethane		<1.	<1.	<1.
1,1,2-trichloroethane		<1.	<1.	<1.
1,1,2,2-tetrachloroethane		<1.	<1.	<1.
chloroethane		<1.	<1.	<1.
2-chloroethylvinyl ether		<1.	<1.	<1.
chloroform		<1.	<1.	<1.
1,1-dichloroethene		<1.	<1.	<1.
trans-1,2-dichloroethene		<1.	<1.	<1.
1,2-dichloropropane		<1.	<1.	<1.
1,3-dichloropropene		<1.	<1.	<1.
ethylbenzene		<1.	<1.	<1.
methylene chloride		<1.	<1.	<1.
chloromethane		<1.	<1.	<1.
bromomethane		<1.	<1.	<1.
bromoform		<1.	<1.	<1.
bromodichloromethane		<1.	<1.	<1.
fluorotrichloromethane		<1.	<1.	<1.
dichlorodifluoromethane		<1.	<1.	<1.
chlorodibromomethane		<1.	<1.	<1.
tetrachloroethene		<1.	<1.	<1.
toluene		<1.	<1.	<1.
trichloroethene		<1.	<1.	<1.
vinyl chloride		<1.	<1.	<1.
BASE/NEUTRAL COMPOUNDS[2]				
acenaphthene		<10.	<10.	<10.
benzidine		<40.	<40.	<40.
1,2,4-trichlorobenzene		<10.	<10.	<10.
hexachlorobenzene		<10.	<10.	<10.
hexachloroethane		<10.	<10.	<10.
bis(2-chloroethyl)ether		<10.	<10.	<10.
2-chloronaphthalene		<10.	<10.	<10.
1,2-dichlorobenzene		<10.	<10.	<10.
1,3-dichlorobenzene		<10.	<10.	<10.

Table 4-5 (Continued)

BASE NEUTRAL COMPOUNDS (continued)	Sample Date	Well K6-1 2/28/84	K6-3 2/29/84	K6-4 2/28/84
1,4-dichlorobenzend		<10.	<10.	<10.
3,3'-dichlorobenzidine		<10.	<10.	<10.
2,4-dinitrotoluene		<10.	<10.	<10.
2,6-dinitrotoluene		<10.	<10.	<10.
1,2-diphenylhydrazine (as azobenezene)		<10.	<10.	<10.
fluoranthene		<10.	<10.	<10.
4-chlorophenyl phenyl ether		<10.	<10.	<10.
4-bromophenyl phenyl ether		<10.	<10.	<10.
bis(2-chloroisopropyl) ether		<10.	<10.	<10.
bis(2-chloroethoxy) methane		<10.	<10.	<10.
hexachlorobutadiene		<10.	<10.	<10.
hexachlorocyclopentadiene		<10.	<10.	<10.
isophorone		<10.	<10.	<10.
naphthalene		<10.	<10.	<10.
nitrobenzene		<10.	<10.	<10.
N-nitrosodiphenylamine		<10.	<10.	<10.
N-nitrosodipropylamine		<10.	<10.	<10.
bis(2-ethylhexyl) phthalate		<10.	<10.	<10.
benzyl butyl phthalate		<10.	<10.	<10.
di-n-butyl phthalate		<50.	<50.	<50.
di-n-octyl phthalate		<10.	<10.	<10.
diethyl phthalate		<10.	<10.	<10.
dimethyl phthalate		<25.	<25.	<25.
benzo(a)anthracene		<10.	<10.	<10.
benzo(a)pyrene		<10.	<10.	<10.
benzo(b)fluoranthene		<10.	<10.	<10.
benzo(k)fluoranthene		<10.	<10.	<10.
chrysene		<10.	<10.	<10.
acenaphthylene		<10.	<10.	<10.
anthracene		<10.	<10.	<10.
benzo(ghi)perylene		<10.	<10.	<10.
fluorene		<10.	<10.	<10.
phenanthrene		<10.	<10.	<10.
dibenzo(a,h)anthracene		<10.	<10.	<10.
indeno(1,2,3-cd)pyrene		<10.	<10.	<10.
pyrene		<10.	<10.	<10.
PRIORITY POLLUTANT ACID COMPOUNDS				
2,4,6-trichlorophenol		<10.	<10.	<10.
p-chloro-m-cresol		<10.	<10.	<10.
2-chlorophenol		<10.	<10.	<10.
2,4-dichlorophenol		<10.	<10.	<10.
2,4-dimethylphenol		<10.	<10.	<10.

Table 4-5 (Continued)

PRIORITY POLLUTANT ACID COMPOUNDS (continued)	Sample Date	Well K6-1 2/28/84	K6-3 2/29/84	K6-4 2/28/84
2-nitrophenol		<20.	<20.	<20.
4-nitrophenol		<25.	<25.	<25.
2,4-dinitrophenol		<25.	<25.	<25.
4,6-dinitro-o-cresol		<50.	<50.	<50.
pentachlorophenol		<10.	<10.	<10.
phenol		<10.	<10.	<10.
PRIORITY POLLUTANT ORGANOCHLORINE PESTICIDES AND PCB's				
lindane		<0.05	<0.05	0.05
endrin		<0.1	<0.1	<0.1
methoxychlor		<0.2	<0.2	<0.2
toxaphene		<1.	<1.	<1.
2,4,-D		<0.5	<0.5	<0.5
2,4,5-TP		<0.1	<0.1	<0.1
aroclors 1016-1262		<0.3	<0.3	<0.3

PRIORITY POLLUTANT METALS	Well K6-1 7/22/83	K6-1 6/15/84	K6-1 2/28/84	K6-3 2/29/84	K6-4 2/28/84	K6-1 8/31/84
Arsenic			0.033	0.024	0.018	
Beryllium	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium			<0.01	0.001	<0.01	
Chromium		<0.02	<0.02	<0.02	<0.02	<0.02
Copper		<0.01				<0.01
Lead		<0.1	<0.001	<0.001	<0.001	<0.1
Mercury			<0.0001	<0.0001	<0.001	
Nickel		<0.02				<0.02
Selenium			<0.001	<0.001	<0.001	
Silver			<0.01	<0.01	<0.01	
ADDITIONAL ELEMENTS 3						
Barium		<0.1	<0.1	<0.1	<0.1	<0.1
Iron			0.19	<0.02	<0.02	
Manganese			0.09	0.09	<0.01	
Vanadium		<0.02				<0.02

Table 4-5 (Continued)

Sample Date	Well K6-1 2/28/84	K6-1 6/15/84	K6-1 8/31/84	K6-3 2/29/84	K6-4 2/28/84
Sodium	140.			120.	100.
Fluroide	0.41			0.48	0.49
Chloride	89.			90.	84.
Sulfate	263.			250.	154.
Nitrite (as N)		<0.1	<0.01		
Nitrate Nitrogen (as N)	0.1	<0.1	<0.10	<0.1	2.6
Ammonia Nitrogen (as N)	0.25	<0.1	<0.10	0.37	0.13
Phenol	<0.05			<0.05	<0.05
Specific Conductance (umhos @ 25° C)$_1$	1167			1105	900
Specific Conductance (umhos @ 25° C)$_2$	1167			1106	937
Specific Conductance (umhos @ 25° C)$_3$	1191			1130	924
Specific Conductance (umhos @ 25° C)$_4$	1156			1105	924
Average	1170			1112	921
Standard Deviation	18			14	7.5
Total Organic Carbon$_1$	<5			<5	<5
Total Organic Carbon$_2$	<5			<5	<5
Total Organic Carbon$_3$	<5			<5	<5
Total Organic Carbon$_4$	<5			<5	<5
Average	<5			<5	<5
Standard Deviation	0			0	0
Total Kjeldahl Nitrogen (as N)	0.88	0.26	0.13	0.52	0.28
Total Organic Halides$_1$	0.25			0.40	0.22
Total Organic Halides$_2$	0.14			0.30	0.21
Total Organic Halides$_3$	0.48			0.44	0.24
Total Organic Halides$_4$	0.27			0.23	0.19
Average	0.28			0.34	0.21
Standard Deviation	0.14			0.09	0.02

Table 4-5 (Continued)

RADIOCHEMISTRY [4]	Sample Date	WELL K6-1 7/22/83	K6-1 2/28/84	K6-1 6/15/84	K6-1 8/31/84	K6-3 2/29/84	K6-4 2/28/84
gross-alpha		0±2	0±3	0±4	0±2	0±3	0±2
gross-beta		12±6	11±3	14±4	10±4	12±4	11±3
^{3}H		0±100	0±1000	0±1000	0±1000	0±1000	0±1000
^{238}U			0.7±0.2			0.2±0.1	0.5±0.1
^{235}U			0±0.1			0±0.1	0±0.1
^{234}U			0.7±0.2			0.1±0.1	0.6±0.1

Notes:

The source of the data presented in this table is a letter from Bill McConachie dated 1/7/85. Blanks indicate that no data are available. The less than symbol (<) means "not present at or above the indicated value (detection limit)."

1) Samples analyzed by EPA Method 624
2) Samples analyzed by EPA Method 625
3) All values are milligrams per liter (mg/l)
4) All values are picocuries/liter (pci/l)

SFR72/113

Table 4-6 Results of Laboratory Analyses of Water Samples from Polyethylene Tanks Containing Water Produced During Drilling, Development, Aquifer Testing, and Sampling of Monitoring Wells (in micrograms per liter of solution)

		Tank Number					
VOLATILE HALOGENATED ORGANIC COMPOUND	*Sample* Date	619 10/18/84	622 10/19/84	0000 10/19/84	4002 10/19/84	4008 10/19/84	6560 10/18/84
1,1-dichloroethylene		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,1-dichloroethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
trans-1,2-*dichloroethylene*		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
chloroform		3.0	§0.5	§0.5	§0.5	§0.5	§0.5
1,1,2-trichloro-2,2,1-trifluoroethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,2-dichloroethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,1,1-trichloroethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
carbon tetrachloride		2.5	§0.5	§0.5	§0.5	§0.5	§0.5
bromodichloromethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,2-dichloropropane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
cis-1,3-dichloropropylene		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
trichloroethylene		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
trans-1,3-dichloropropylene		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,1,2-trichloroethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
dibromochloromethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,2-dibromoethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
bromoform		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
tetrachloroethylene		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
1,1,2,2-tetrachloroethane		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5
chlorobenzene		§0.5	§0.5	§0.5	§0.5	§0.5	§0.5

Notes:

The less than symbol(§) means "not present at or above the indicated value (detection limit)."
All samples were analyzed by EPA Method 601.

SFR72/105

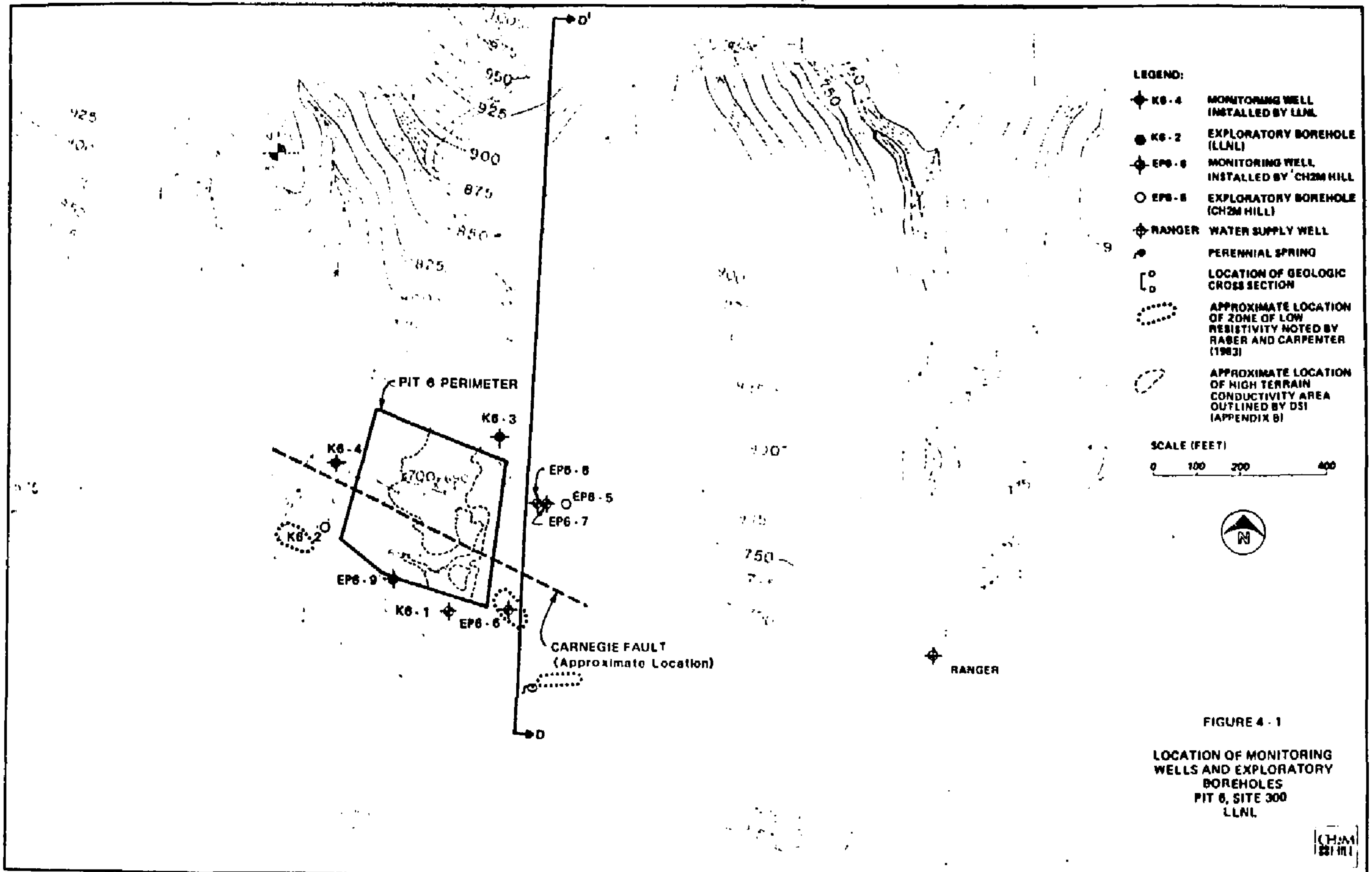
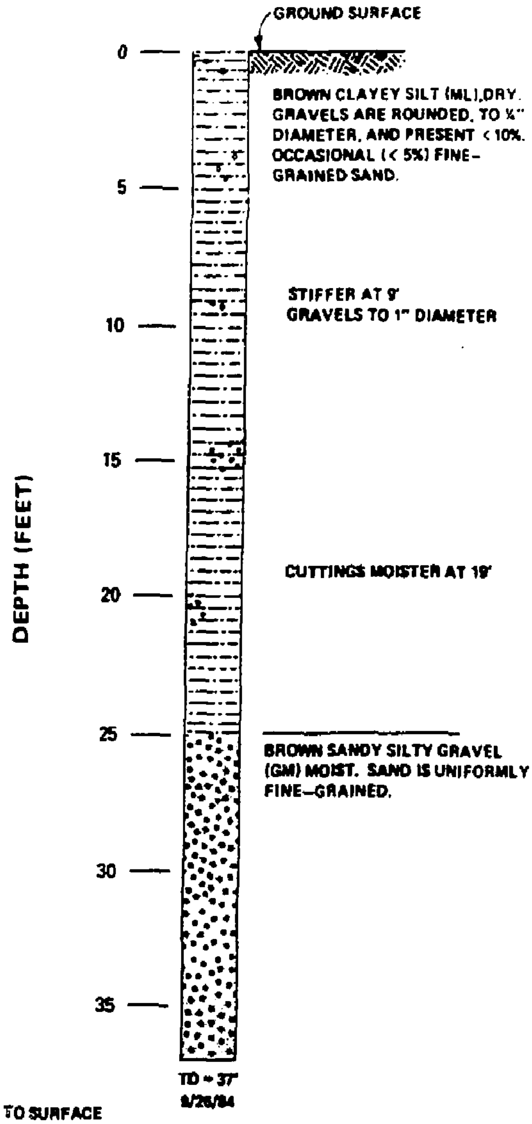


FIGURE 4-1

LOCATION OF MONITORING WELLS AND EXPLORATORY BOREHOLES
PIT 6, SITE 300
LLNL

CH2M HILL

F18728.A0



NOTES: BORING GROUTED TO SURFACE

FIGURE 4-2
EXPLORATORY BOREHOLE EPB-5

GEOLOGIC LOG
PIT 6, SITE 300
LLNL

CH2M HILL

F18728.A0

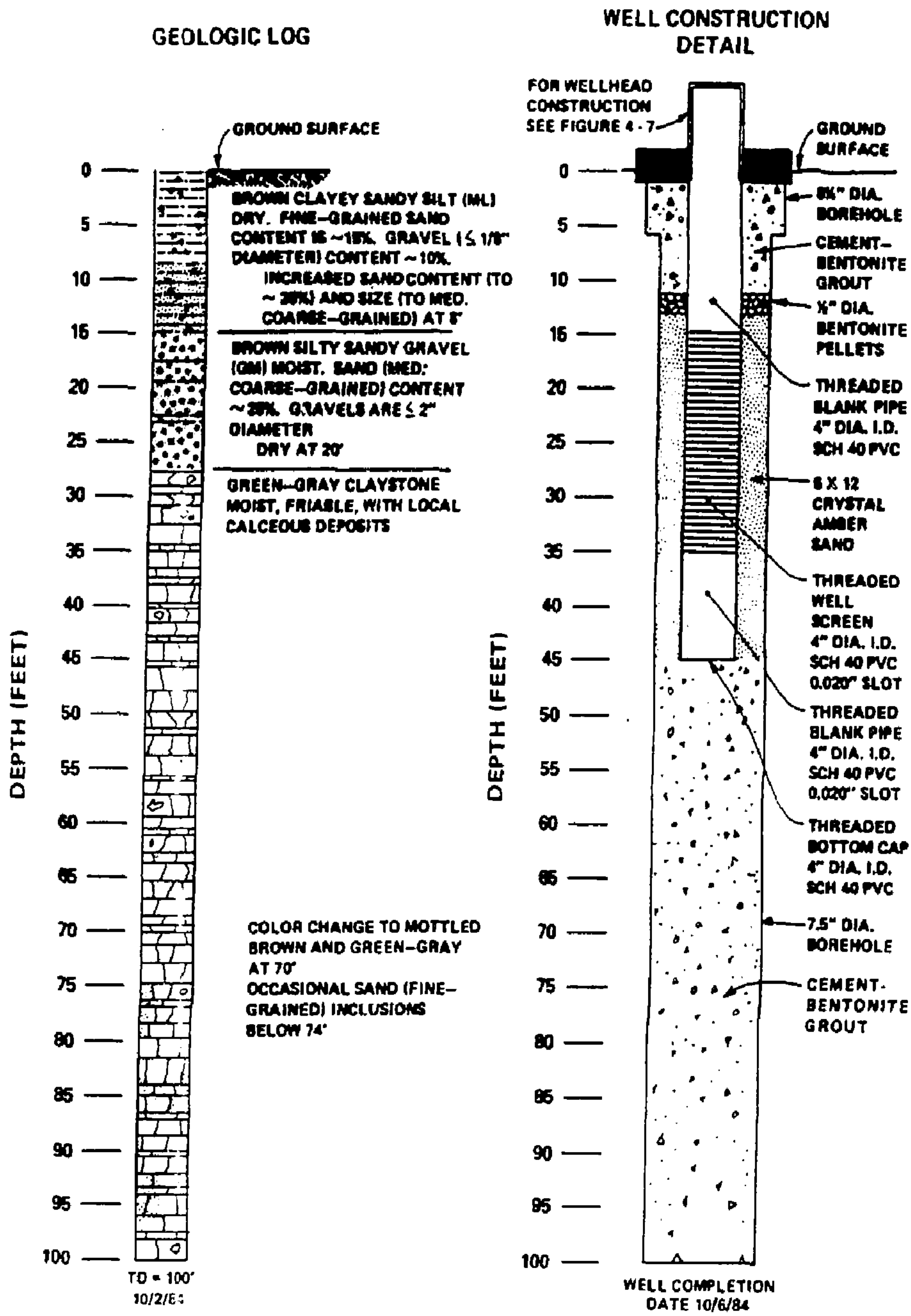
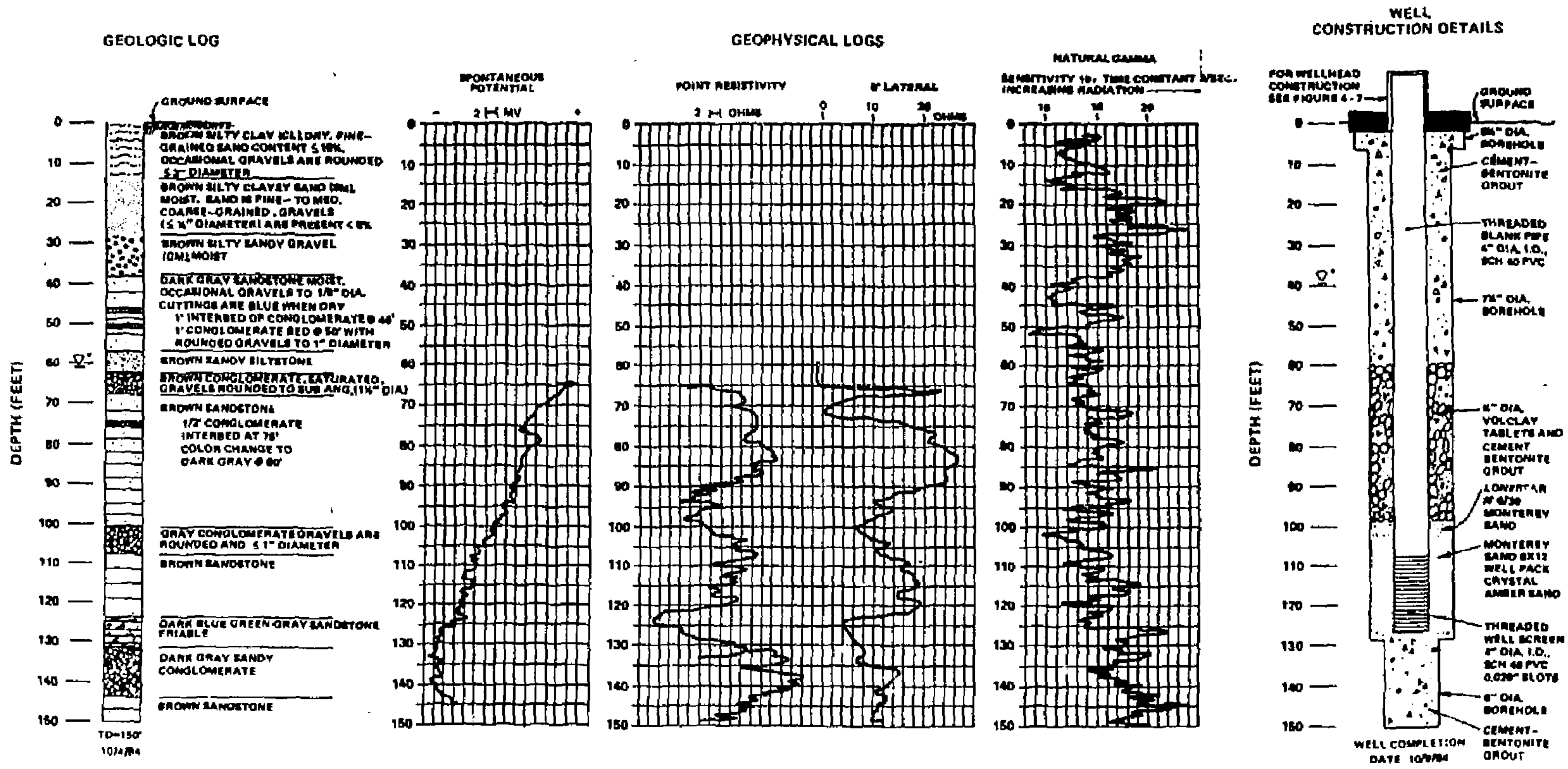


FIGURE 4-3
MONITORING WELL EP6-6

GEOLOGIC LOG AND WELL CONSTRUCTION DETAILS
PIT 6, SITE 300
LLNL

CH2M HILL

F18728.A0



* WATER FIRST ENCOUNTERED DURING DRILLING

* APPROXIMATE STATIC WATER LEVEL

FIGURE 4-4
MONITORING WELL EP6-7
GEOLOGIC LOG, GEOPHYSICAL LOGS AND WELL CONSTRUCTION DETAILS
PIT 6, SITE 300
LLNL

F18178.A0

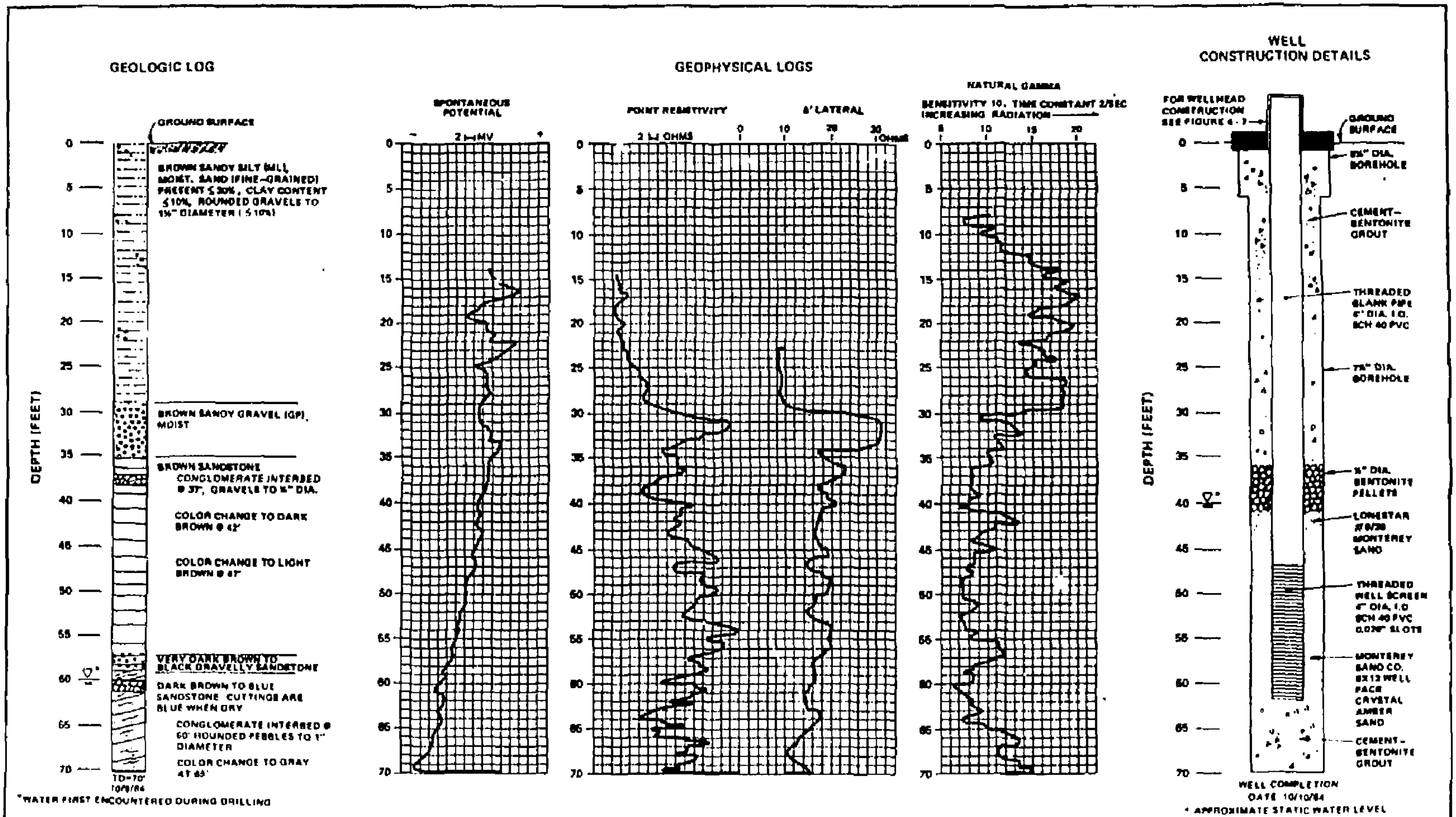


FIGURE 4-5
MONITORING WELL EP6-8
GEOLOGIC LOG, GEOPHYSICAL LOGS AND WELL CONSTRUCTION DETAILS
PIT 6, SITE 300
LLNL

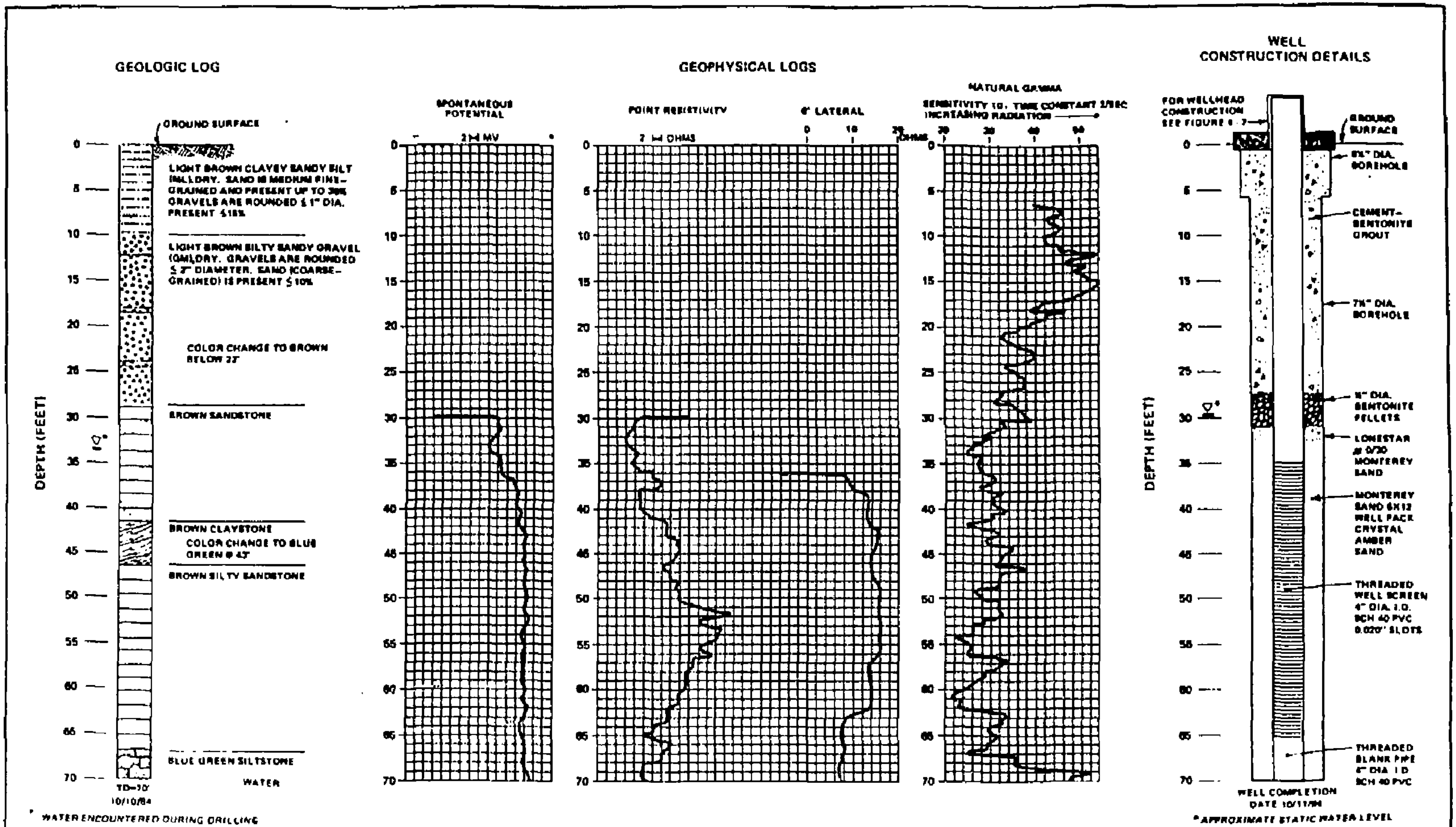
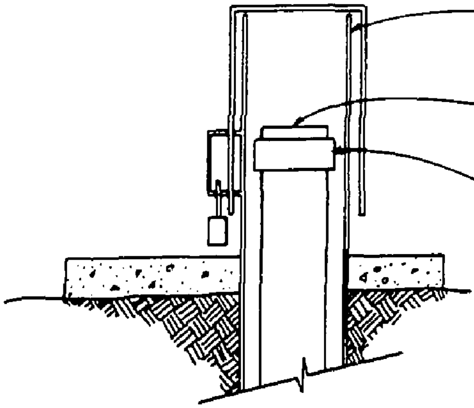


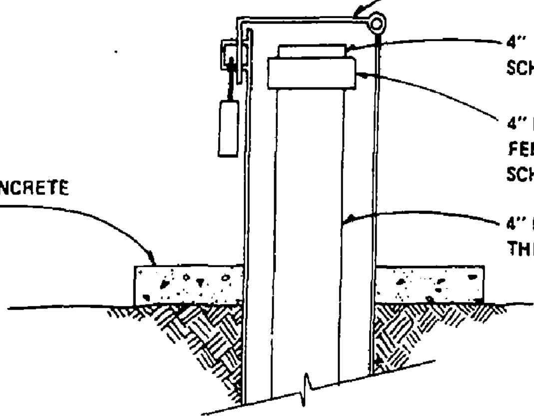
FIGURE 4-6
MONITORING WELL EP6-9
GEOLOGIC LOG, GEOPHYSICAL LOGS AND WELL CONSTRUCTION DETAILS
PIT 6, SITE 300
LLNL

CH2M HILL

F18728.A0



WELL HEAD COMPLETION
MONITORING WELLS EP6 - 6, EP6 - 7, EP6 - 8



WELL HEAD COMPLETION
EP6 - 9

NOTE: DRAWINGS NOT TO SCALE

FIGURE 4 - 7
WELL HEAD COMPLETION
MONITORING WELLS
EP6 - 6 , EP6 - 7 , EP6 - 8 , AND 6 - 9
PIT 6, SITE 300
LLNL

CH2M HILL

F18728.A0

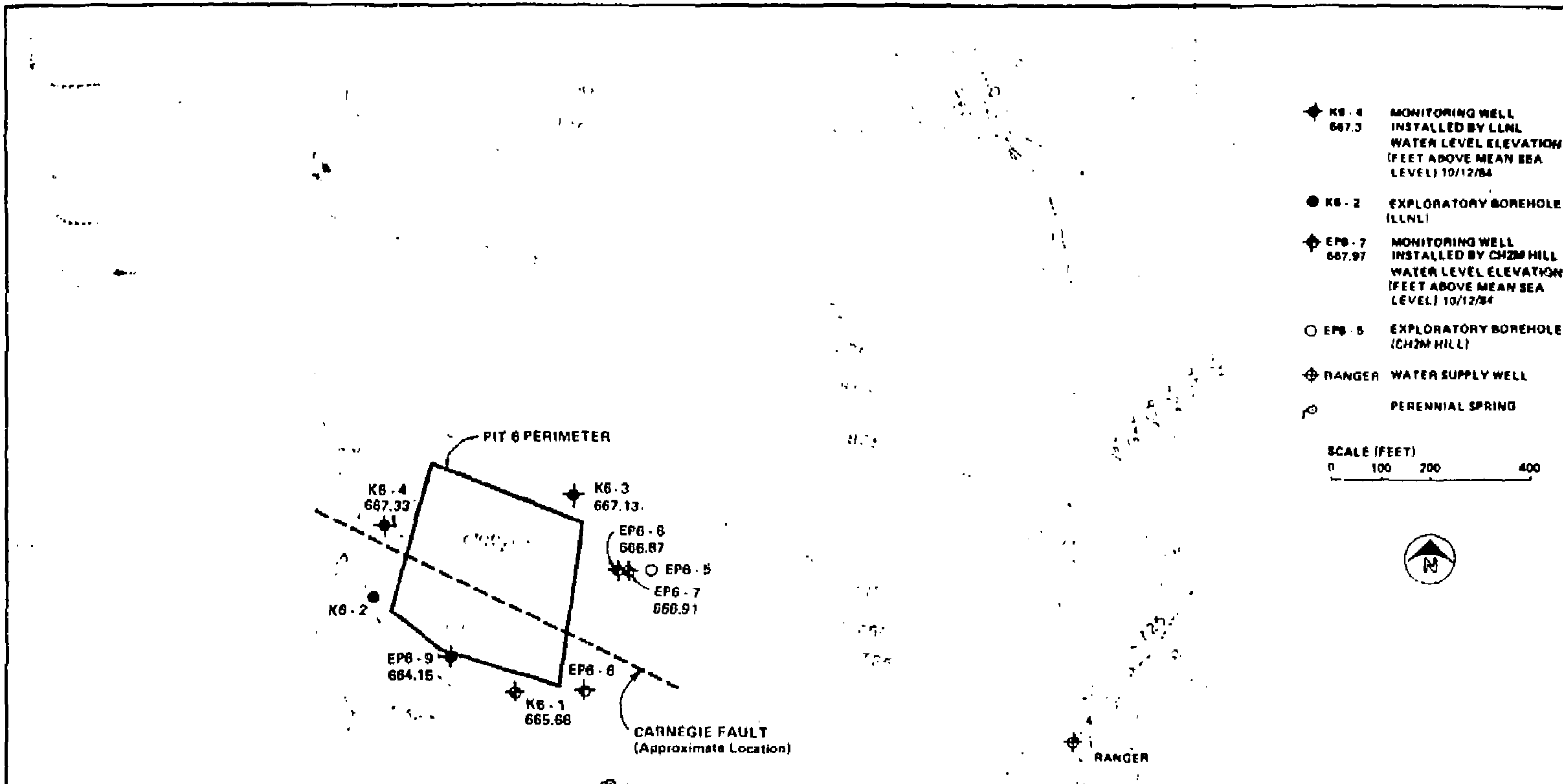


FIGURE 4-8

WATER TABLE ELEVATION MAP,
PIT 6, SITE 300
LLNL

CH2M HILL

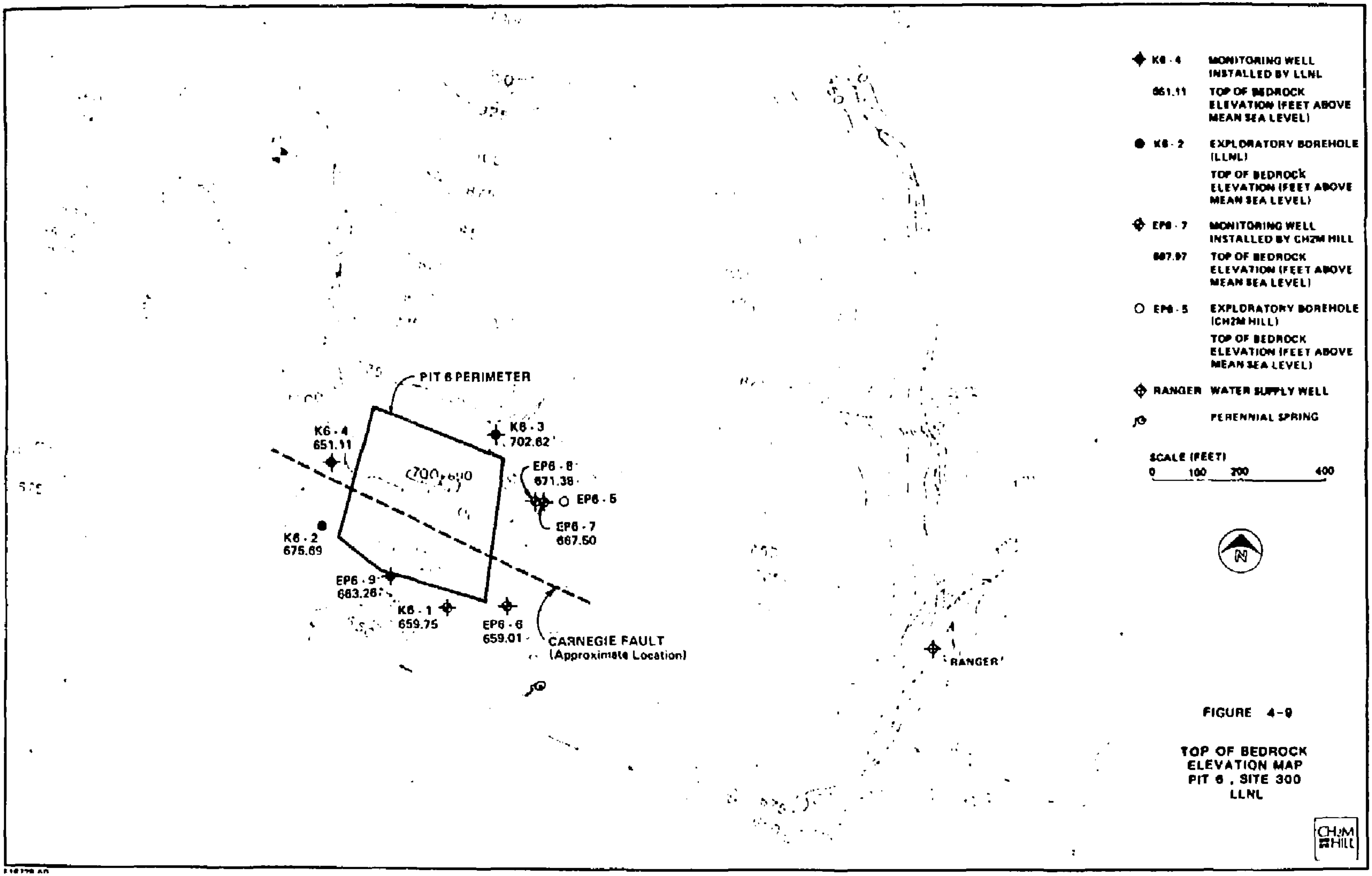


FIGURE 4-9

TOP OF BEDROCK ELEVATION MAP PIT 6, SITE 300 LLNL

Chapter 5
RISK ASSESSMENT

A risk assessment is an evaluation of scientific and technical data to identify the nature and extent of health hazards resulting from exposure to environmental contaminants. A risk assessment provides a review of the physical features of a site, a summary of contaminants, the environmental fate and methods of transport of observed contaminants, an assessment of the potential exposed population and an evaluation of impacts. The following sections identify and evaluate these issues as they relate to Pit 6.

5.1 ENVIRONMENTAL RELEASE

Source releases of hazardous waste can be caused by a variety of mechanisms. Such releases can directly or indirectly impact four environmental media. The following sections provide a qualitative assessment of the potential release mechanisms, in their respective environmental media, that are present at Pit 6.

5.1.1 AIR

Contaminated materials present at a waste site can be released to the air through volatilization, fugitive dust generation, and combustion. This section evaluates the first two of these processes. No evidence has been discovered that indicates waste combustion may occur at Pit 6.

5.1.1.1 Volatilization

Chemicals with high vapor pressure or low solubility can be released to the environment through volatilization. Chemical and physical properties of wastes and site specific factors such as surface soil contamination, soil porosity, depth of soil cover, wind speed, and wind access to the wastes are factors effecting volatilization.

At Pit 6, the possibility of hazardous substances reaching conditions conducive to volatilization is remote. No evidence is available that indicates volatile substances were dumped on the surface soils. No odors are present at the site. Air monitoring with an organic vapor detector during drilling operations for the current investigation did not detect organic vapors in concentrations above background. The equipment used for air monitoring during drilling, however, does not detect organic vapors below 1 part per million (ppm). Thus, it is not known whether organic vapors below 1 ppm are present in the ambient air above the landfill.

Compressed gas cylinders are believed to be buried at Pit 6. It is possible that a buried gas cylinder, if pressurized, could rupture and release its contents to the environment. No data are presently available, however, that describe the type, contents or condition of the buried gas cylinders. Consequently it is not possible to evaluate the hazard posed by the compressed gas cylinders.

5.1.1.2 Fugitive dust

Any hazardous particulate that becomes entrained in the atmosphere can be considered a fugitive dust release. Waste particulates and soil particles onto which hazardous substances have adhered are the most common sources of fugitive dust. Site specific meteorological conditions, topography, waste characteristics and on-site traffic are factors affecting the release of fugitive dust.

Sources of fugitive dust at Pit 6 include the surface soil cover and any shallow deposits of wastes that may have been exposed during the landfill history. No evidence is available at this time that suggests fugitive dust is present at the landfill. Site vehicular activity is largely restricted to fire trail roads on the perimeter of the landfill.

5.1.2 SURFACE WATER

Release of hazardous substances to surface water results from overland flow and/or direct discharge. No evidence exists that suggests such releases from Pit 6 have occurred to either Corral Hollow Creek or its tributary arroyos.

Overland flow resulting in runoff containing chemicals from Pit 6 and moving offsite is a potential problem in either of the following situations.

- During the active period of the landfill the excavated trenches may have trapped runoff. This water may have contacted soluble wastes and overflowed the trench. The relatively light local precipitation, the depth of the trench excavations (approximately 12 feet), the soil porosity of the terrace deposits, and assuming the cellular method of burying containerized wastes, it is unlikely that such a release occurred.

- Surface runoff may contact the surface of the landfill and then move offsite to Corral Hollow Creek. Because the landfill has a soil cover, such an event is considered a hazard only if hazardous substances are present in the surface soils or in fugitive dusts. As discussed previously, evidence does not suggest that either surface soils or dust at Pit 6 contain chemicals.

5.1.3 SOILS

Soil contamination can result from surface runoff, land application of wastes, leakage of wastes and leaching of water through the wastes. The extent of soil contamination, if any, at Pit 6 is unknown. Both surface and subsurface soils may have been contaminated during the disposal operations. Disposal practices such as temporary storage of leaking containers on the surface, spills, and handling accidents such as crushing or puncturing of containers could have contaminated surface soils. Buried waste containers may also leak, corrode, or decompose. Such reactions may lead to failure of the container and the loss its contents to surrounding soils.

No direct evidence is available to indicate that disposal operations or the loss of the integrity of buried containers have resulted in extensive soil contamination at Pit 6. Very low levels of volatile organics (toluene, benzene, and methylene chloride) in subsurface soil samples from the apparent upgradient monitoring wells K6-3 and K6-4 (Table 4-2), and the slightly elevated concentrations of iron and manganese in water samples from monitoring wells K6-3, K6-4 and K6-9 support the need for continued monitoring of groundwater at Pit 6.

5.1.4 GROUNDWATER

The most likely pathway of chemical migration away from Pit 6 that could potentially impact public health is the shallow groundwater. Leachate from wastes buried at Pit 6 could migrate downward through the unsaturated zone to the water table. There are two pathways whereby the wastes could reach the unsaturated zone: (1) direct application of the waste to the soils, and (2) dissolution of wastes by infiltrating water and subsequent vertical downward migration of the chemicals to the water table. No available data suggest that wastes were ever directly applied to the ground surface at Pit 6.

Infiltration and runoff of rain water may act as a mechanism for corroding buried waste containers. This water could then carry any released chemicals downward to the water table. The landfill was not designed with any measures to prevent either infiltration or leachate migration. A potential therefore exists for this release mechanism to effect the landfill integrity and subsequently effect public health.

The reported depth of waste burial (12 feet below ground surface) and the relatively shallow water table (18 to 20 feet below the bottom of the trenches) provide a short potential pathway for chemicals to enter the groundwater. The rate of chemical migration is a function of chemical solubility, mobility, groundwater flow, local soil type, and contact with recharge water. The results of previous groundwater analyses and samples analyzed for this study do not indicate that chemicals have migrated to the water table in any significant concentration. The types of potential chemical sources also limits the likelihood of significant waste migration. There are no references to the disposal of highly mobile hazardous liquid sludges or other quantities of soluble solid materials at Pit 6.

5.2 EXPOSURE ASSESSMENT

There are two populations that may be affected by a potential release of hazardous substances from Pit 6; LLNL personnel and subcontractors, and the general public. While the present risk of exposure to both populations is considered low, the potential exposures for each population are described below.

- LLNL Personnel and Subcontractors. Security personnel using the firing range can contact potentially hazardous substances through fugitive dusts, volatilizing chemicals, escaping gases, and surface soils. While these media do not appear to be contaminated at present, the potential for exposure still exists.

- General Public. The residents and visitors of the adjacent Carnegie State Vehicular Recreation Area and passing motorists on Corral Hollow Road comprise the general public. Strict security controlled access prohibits the general public from entering Pit 6. This system of controlled access effectively limits the potential exposure of the general public to potential hazards of Pit 6.

5.3 SUMMARY

Considerable effort has been expended in assessing whether Pit 6 is an imminent hazard with substantial risk threatening the local environment and/or public health. After an extensive investigation of the environmental setting of Pit 6 which included geological mapping, geophysical surveys, installation, testing, and sampling of shallow monitoring wells, a better understanding of the relationship of the landfill to the surrounding environment has been developed. Although the landfill has several features which could pose a threat to the surrounding environment, no data available to date suggest that an environmental release has occurred or is occurring.

Available information about Pit 6 including the physical features, the potential contaminants, the exposure pathways, and the population at risk suggests that Pit 6 is a potential threat to the environment, site personnel and general public. Continued monitoring of the soils and groundwater is necessary to assess the need for long term remedial actions.

The most likely exposure pathway of hazards from Pit 6 to the general public is groundwater movement along the Carnegie Fault. If groundwater moves along the fault, chemicals from the landfill could be present in water that may be flowing toward the Ranger Well (Plate 4-1). There are no data currently available to show that this pathway has been affected. Long-term pumping test(s) and an additional monitoring well are recommended for the purpose of improving the groundwater quality monitoring network and gathering additional data that will be useful in a feasibility study to determine the acceptable long-term remedial solution to the potential threat.

Surface soils, fugitive dusts and volatilized wastes are potential mechanisms for release and subsequent exposure of LLNL personnel using the firing range at Pit 6. To completely assess the risk of exposure to LLNL personnel, a limited amount of additional information about the surface is recommended so that an assessment can be made to determine whether use of the site may be continued by LLNL personnel security staff and/or other users.

Chapter 6
REMEDIAL ACTION ALTERNATIVES

The general approach to remedial action alternative selection at hazardous waste sites is outlined in Section 300.68 (g), (h), and (i) of the National Oil and Hazardous Substances Contingency Plan (NCP). The process of identifying, developing, evaluating, and selecting a remedial action alternative is stated in the NCP as follows:

> (g) Development of Alternatives. A limited number of alternatives should be developed for either source control or offsite remedial actions (or both) depending upon the type of response that has been identified...as being appropriate.
>
> (h) Initial Screening of Alternatives. The alternatives developed...will be subjected to an initial screening to narrow the list of potential remedial actions for further detailed analysis.
>
> (i) Detailed Analysis of Alternatives. (1) A more detailed evaluation will be conducted of the limited number alternatives that remain after the initial screening....

Development, initial screening, and detailed analysis of the remedial alternatives and evaluation of the findings of the risk assessment are conducted within a feasibility study. The feasibility evaluates these potential actions in terms of cost, engineering feasibility, public health, and environmental impacts.

6.1 SOURCE CONTROL REMEDIAL ACTIONS

Source control remedial actions are designed to mitigate or minimize contaminant migration by controlling the source of contamination at or near the area where the suspect hazardous substances were originally located. Contaminant sources at Pit 6 have not been specifically identified. However, a number of materials known to be buried in the landfill (i.e. capacitors, mercury tubes, or dry chemical drums) could contain sufficient quantities of hazardous substances to pose a potential threat to the environment. Source control remedial action alternatives considered for Pit 6 would likely include, in addition to the ongoing groundwater monitoring program, the following:

- No action
- Develop alternative water supply plans for wells in vicinity of landfill
- Partial removal of materials buried and associated soils in selected areas of the landfill for treatment or disposal at an approved hazardous waste disposal facility
- Complete removal of the buried materials and contaminated soil (if any) for treatment or disposal at an approved hazardous waste disposal facility
- Capping of the landfill with low-permeability materials
- Complete encapsulation of the landfill and contaminated soils (if any) with impermeable materials
- Diversion of groundwater flow around the site
- Installation of an on-site groundwater pumping system which would prevent the migration of potentially contaminated groundwater away from the site
- Any feasible combination of alternatives.

6.2 OFFSITE REMEDIAL ACTIONS

Offsite remedial actions are used to mitigate or minimize the effects of hazardous substances that have migrated away from the site. At Pit 6 such actions are those considered for chemicals potentially found outside the perimeter of the landfill. Results from previous investigations, the ongoing monitoring program, and the current investigation have not shown evidence of groundwater quality degradation. With continued monitoring of the existing wells and installing one additional well as described in Section 7.2.2, no offsite remedial actions are warranted until data are available that indicate potentially hazardous conditions exist offsite. A list of potential offsite remedial actions that would likely be evaluated in the event of groundwater degradation include the following:

- No action
- Interceptor wells to prevent further migration of contaminated groundwater.
- Extraction wells to remove contaminated groundwater from the aquifer.

- Treatment facilities to remove contaminants by air stripping, activated carbon absorption, evaporation ponds or other methods.

- Development of alternative drinking water supplies.

- Grout sealing of private wells at elevations that prevent contact with, or withdrawal from, contaminated aquifers.

- Any feasible combination of alternatives.

6.3 SUMMARY

Based on the findings of the current investigation, all of the alternatives listed in the previous sections are feasible for Pit 6. A detailed feasibility study is a method for systematically reviewing all possible alternatives and eventually choosing the best remedial action for a specific site. A feasibility study would likely require the completion of the recommended additional work and continued groundwater monitoring to provide a thorough data base upon which to evaluate the potential remedial actions.

Chapter 7
CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

Neither the results of the previous investigation (Raber and Carpenter, 1983 and Carpenter and Piefer, 1983) nor the results of this investigation clearly identify a significant threat to public health or an adverse impact on the environment caused by the contents of Pit 6.

There are, however, issues from two categories of information concerning the landfill that need further clarification before a final judgement on the possible impact of Pit 6 on the environment can be made. These categories are:

- o Waste characterization
- o Environmental characterization.

The following paragraphs present a summary of the results of the current investigation and a discussion of the issues left unresolved by the current investigation.

The wastes buried at Pit 6 are composed of solid, liquid, and gaseous containerized wastes from the LLNL, Livermore and Lawrence Berkeley Laboratory. Most of the information about these wastes has been obtained from a log book that was kept by the landfill operator during the active period of the landfill. The chemicals contained in the wastes described in this log book are, for the most part, not identified. Because specific chemicals contained within the landfill have not been identified, a complete assessment of risks to the environment posed by the landfill is difficult.

Results of a geophysical investigation at Pit 6 raised questions as to the actual disposal procedures that were followed at landfill. Further investigation of historic records is necessary to determine whether the wastes buried at the landfill were disposed of in distinct trenches as described in the log book.

Shallow groundwater occurs beneath Pit 6 in an unconfined aquifer. The water table in the vicinity of Pit 6 lies between approximately 20 and 60 feet below ground surface. Groundwater flow in the vicinity of Pit 6 is primarily controlled by two regional structural features; the Patterson Anticline and the Carnegie Fault. The influence of the Patterson Anticline is the gently southeastward dipping bedrock units in the vicinity of Pit 6 on the north side of the Carnegie Fault. The dip of these bedrock units changes abruptly at the Carnegie Fault. The Carnegie Fault passes beneath Pit 6 striking approximately northwestward. The dip of the bedrock units south of the Carnegie Fault is near vertical to overturned. On the north side of the fault, groundwater apparently flows southeastward (down-dip) in the bedrock units within which it occurs. At the Carnegie Fault and on the south side of the fault this water may then flow down the dip of the beds, along the strike of the fault or across the beds. Sufficient data are currently not available to determine which of the pathways groundwater south of the Carnegie Fault migrates. Water levels do not change significantly across the Carnegie Fault. Results of drilling and aquifer testing still do not answer the question whether groundwater north of the Carnegie Fault is in direct hydraulic connection with the groundwater south of the fault.

The results of groundwater sampling completed for previous and current investigations indicate that the shallow groundwater beneath Pit 6 does not appear to contain chemicals associated with the contents of the landfill. The organic chemicals detected in water samples from the current investigation appear to be due to laboratory contamination or field techniques. Slightly elevated levels of metals are within natural limits.

7.2 RECOMMENDATIONS

As discussed previously, the results of the current investigation summarized above indicate that there are two categories of information in which further investigation may help clarify the potential hazards at Pit 6. The following paragraphs present a short discussion of the recommendations for each of these categories; waste characterization and environmental characterization.

7.2.1 WASTE CHARACTERIZATION

As discussed previously, the data reviewed during this investigation are insufficient to characterize the specific chemicals associated with the buried wastes. Additional information on the specific chemicals which may be a hazard at Pit 6 may be obtained using the methods discussed below.

- Conducting a more extensive records search. In this extended records search more information may be obtained, for example, on the following topics: specific projects that were mentioned in the Pit 6 log book and decontamination procedures for radiologically and chemically contaminated materials. Such information would provide further information on the hazards associated with the materials believed to be buried at Pit 6.

- Conducting interviews with long-term employees. In these interviews, further information may be obtained on the wastes as generated at their origins and on disposal practices at the landfill.

7.2.2 ENVIRONMENTAL CHARACTERIZATION

The results of our investigation still leave several questions about the hydrogeologic environment beneath Pit 6 unanswered. Further investigation at Pit 6 should focus on answering these questions should the ongoing monitoring reflect a change in groundwater quality. Future work recommended for Pit 6 might include the following:

- Unsaturated Zone. Work in the unsaturated zone should include sampling of the surface soils and water in the unsaturated zone adjacent to Pit 6. As discussed previously, the results presented by Raber and Carpenter (1983) showed that organic chemicals may be present in the shallow soils on the perimeter of Pit 6.

  Surface soil sampling should be limited to the top 1 - 2 feet of cover material that is easily sampled with a standard hand-held soil sampler. Two to ten soil cores may be composited to form representative area samples or they may be discretely analyzed. Field screening for the presence of organic compounds, metals and/or radioactive indicators should be conducted. If contaminants are detected during field screening, the use of the site should be permanently restricted until the hazard is remedied.

  Sampling the water of the unsaturated zone may be accomplished using any of several pore space sampling devices that collect samples under suction (negative pressure). Three common types of samplers used for unsaturated media are: ceramic-type samplers; hollow filter samplers; and, membrane filter samplers. Ceramic-type samplers are also known as suction lysimeters. These lysimeters operate at variable soil depths depending on the type of sample withdrawal mechanism. Very simple vacuum operated devices can be installed in shallow soils to 6 feet, while pressure-vacuum operated systems may extract samples from deeper than the suction lift of water (approximately 25 feet). Several samplers (3 to 6) should be placed at depths of 10 to 15 feet below the ground surface within the trench zone and at the downgradient, southeasterly perimeter of the trench zone to collect pore space moisture for screening analyses.

If the contents of the landfill are excavated, a more extensive soil characterization program may be necessary for those soils beneath the landfill. This sampling should be done only after the wastes have been removed. The extent of any sampling program should be based on contaminant levels found beneath the wastes and any soil clean-up levels established by regulatory agencies.

- Saturated Zone. Work in the saturated zone should include the following: a water level monitoring program; a water quality sampling program; installation of an additional monitoring well to provide more information on the influence of the Carnegie Fault on groundwater flow direction and rate; and, additional long-term aquifer tests in one or more wells not previously tested and/or in wells previously tested.

  The additional monitoring well should be located within the Carnegie Fault zone to the east of Pit 6 and screened in the shallow unconfined aquifer. Exact location of the Carnegie Fault may be more closely identified using one or more of the following techniques: additional local detailed geologic mapping; trenching in the arroyo adjacent to the western edge of Pit 6; and/or, geophysical surveys such as gravity, magnetic, and seismic. Potential success of the geophysical techniques may be first tested on the geologic section exposed approximately 1,000 feet east of Pit 6 near the Ranger Well (see Raber and Carpenter, 1983 and Carpenter and Peifer, 1983). The borehole for the new monitoring well should be cored and/or geophysically logged with a log that measures the dip of the formations traversed by the borehole.

- Air Quality. Ambient air monitoring for volatile organics should be designed and implemented to assess whether potential exposure of personnel currently using the facility to hazardous materials exists.

  The air monitoring programs should be limited to detection of escaping organics and gases. Several (4-6) stations should be established along the suspected burial trench areas as well as at upwind and downwind perimeter stations to collect ambient air samples with midgit impingers, charcoal tubes, silica gel samplers or other adsorping media collection systems. Qualitative analyses may be used to screen all samples to assess if any differences in ambient air quality at the near-ground surface can be detected. If differences are noted, a series of potential detection methods for volatile organics, trace gases and other conventional contaminants may be employed to quantify the specific compounds present.

7.2.3 INTERIM MEASURES

- Site Access. Access to Pit 6 should be restricted to reduce the possibility of exposure to hazardous substances. The likelihood of volatilization of wastes or the release of gases from buried cylinders is an unquantifiable hazard to persons in the immediate area of the landfill.

  While site access is restricted to authorized personnel and visitors, an accidental release or chronic exposure to hazardous substances will remain a potential hazard to personnel using the landfill area. As a minimum, restricted access and use of the area should be implemented until the air quality and shallow surface soils analyses are completed. Alternatively, a security fence could be erected around the pit perimeter and access restricted.

- Additional Soil Cover. As a precautionary measure to provide additional protection to range users, the landfill could be covered with one to three feet of additional soil. The cover soil would serve as a buffer against contact with landfill soils.

REFERENCES

Raber, E. and Carpenter, D.W., 1983 An Evaluation of the Hydrogeology and Groundwater Chemistry Associated with Landfills at LLNL's Site 300 Lawrence Livermore National Laboratory University of California Livermore, California UCRL-53416 Distribution Category UC-11.

Carpenter, D.W. and Peifer, D.W., 1983 Supplementary Data Report Site 300 Chemical and Hydrogeological Assessment Lawrence Livermore National Laboratory University of California UCID-19801.

Bouwer, H. and Rice, R.C., 1976 A Slug Test for Determining the Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells Water Resources Research, Vol. 12, No. 3, June 1976.

Lohman, S.W., 1979 Groundwater Hydraulics United States Geological Survey Professional Paper 708.

Inventory of Waste Disposal at Pistol Range

Shipment 1, 7/1/64

1 truck load
- misc. dry waste drums, cargo pallets, metal parts
- 1 metal tank
- 2 glove boxes
- 2 shell furnaces

Shipment 2, 7/8/64

1 truck load
- 1 lg. glove box
- 2 sm. glove boxes
- 1 degreaser
- 2 pallets of filters
- misc. dry waste drums
- 1 lg. u-shaped ducting and other ducting
- waste lumber and metal parts

Shipment 3, 7/15/64

1 truck load
- 8 pallets of dry non-rad. wasto
- 1 metal tank
- 2 drums full of varnish
- 4 pallets of capacitors
- 1 pallet electron tubes
- 1 pallet non-rad. wasto paper
- misc. ducting

Shipment 4, 7/22/64

1 truck load
- 4 pallets sewer pipe and concrete
- 1 pallot gas bottles
- 1 pollet filters
- 1 stack old pallets
- 4 pallets of waste drums
- 2 pallets of 5 inch piping

Shipment 5, 7/29/64

1 truck load
- 3 pallets capacitors (2 sm. and 2 lg.)
- 1 pallet gas bottles
- 18 pallets empty oil drums
- 2 stacks old pallets

Shipment 6, 8/5/64

1 truck load
- 24 pallets empty oil drums

Shipment 7, 8/12/64

1 truck load
24 pallets empty oil drums

Shipment 8, 8/19/64

1 truck load
1 pallet capacitors
1 pallet waste drums
22 pallets empty oil drums

Shipment 9, 8/26/64

1 truck load
22 pallets empty oil drums

Shipment 10, 9/2/64

1 truck load
22 pallets empty oil drums

Shipment 11, 9/9/64

1 truck load
1 2000-gal. tank
20 pallets of waste drums and waste oil drums

Shipment 12, 9/16/64

1 truck load
1 824-gal. tank full of waste paper and green basket waste
8 stacks of 4x4 cargo pallets
2 pallets of capacitors
2 pallets of waste drums

Shipment 13, 9/23/64

1 truck load
1 2000-gal. tank full of carboys, lard cans (not contaminated) and misc. parts
2 pallets of wooden boxes of misc. chemicals
1 pallet with 2 55-gal. waste drums and 2 30-gal. waste drums full of misc. chemicals
1 wooden box full of waste paper
4 pallets waste oil drums
8 pallets dry waste drums full of cans, boards, trash and misc. parts)
2 stacks of 4x4 cargo pallets

1 pallet of capacitors
2 sm. glove boxes

Shipment 14, 9/30/64

1 truck load
2 2000-gal. tanks full of empty carboys (not hot), empty cans and misc. parts
8 pallets of empty waste drums (black)
2 stacks of pallets

Shipment 15, 10/7/64

1 truck load
1 steel tank 4x2x20 (rack)
5 small tanks 1x3x4 (w/lids)
7 stacks cargo pallets
2 pallets misc. parts

Shipment 16, 10/12/64

1 sm. lowboy trailer
1 glove box, 10x4x8
2 stacks cargo pallets
1 pallet empty 5-gal. cans
2 filters
2 pallets of 3 inch pipe

Shipment 17, 12/15/64

1 truck and 2 trailers
2 pallets of chips (18 drums)
3 pallets empty oil and waste drums
1 pallet of dry chemicals
2 pallets of capacitors
5 AL shelves
1 sink
3 filters, 2x2x2
5 glove box
2 furnaces and hardware
1 lg. incloser (8x8x5)
1 glove box (4x4x4) w/vacuum cleaner
1 metal rack, hood, and table
Ducting
1 lg. wooden box full of misc. trash

Shipment 18, 2/24/65

1 truck load and 2 trailers
- 2 glove boxes
- 1 bench
- 1 PVC hood
- 5 pallets of ducting
- 6 pallets of filters
- 2 stacks of old pallets
- 2 pallets of capacitors
- 2 small furnaces
- 4 pallets of waste drums
- 1 lg. mercury contaminated manifold

Shipment 19, 3/22/65

4 lard cans and 1 pkg. of dead animal waste (rats)

Shipment 20, 5/4/65

1 truck load with 2 trailers
- 5 pallets capacitors
- 7 pallets of filters
- 1 4x4x6 enclosure
- 1 3x4x5 furnace
- 1 small glove box
- 5 pallets of trash cans
- 1 pallet of dollies

Shipment 21, 6/8/65

1 set of doubles (8x20x3)
- 2 pallets of drums
- 6 pallets capacitors
- 3 glove boxes
- 1 shop table
- 3 pallets of pumps
- 1 pallet of transformers
- misc. ducting
- 3 pallet ducting

Shipment 22, 6/8/65

2 lard cans containing animal waste

Shipment 23, 6/18/65

5 55-gal. drums of animal waste (rats, dogs and rabbits)
2 55-gal. drums of wasto animals (rats'

Shipment 24, 7/20/65

1 2000 gal. empty truck tanker

Shipment 25, 7/27/65

1 truck and 2 trailers
- 1 lg. work table
- 5 pallets of capacitors
- 1 empty 500-gal. water tanker
- 3 pallets of empty drums
- 1 pallet of filters
- 20 4x4 pallets

Shipment 26, 8/6/65

1 truck and 2 trailers
- 16 pallets of empty drums
- 4 pallets of capacitors

Shipment 27, 9/17/65

1 truck and 1 trailer
- 6 pallets of capacitors
- 1 pallet of drums
- 1 pallet of filters
- 2 pallets of misc. cans
- 1 pallet of carboys
- 1 pallet of pipe

Shipment 28, 10/22/65

1 truck and 1 trailer
- 1 lg. glove box
- 3 sm. glove boxes
- 1 work table
- 1 pallet of filters and ducting

1 pallet of capacitors
2 lg. boxes
1 pallet drums

Shipment 29, 2/25/66

1 drum animal waste (ram)

Shipment 30, 3/1/66

1 truck and 1 trailer
3 pallets of drums
13 pallets of capacitors
1 lg. wooden box
15 4x4 pallets

Shipment 31, 3/28/66

1 truck and 1 trailer
2 lg. wooden boxes of trash
1 pallet of pipe and ducting
1 pallet of trash
1 1000-gal. portable tank
5 pallets of capacitors
3 stacks of pallets

Shipment 32, 4/19/66

1 truck and 1 trailer
8 pallets capacitors
3 glove boxes
2 pallets drums
2 pallets misc. and pipe
2 boxes mercury lights

Shipment 33, 5/10/66

3 cows
5 bags of lime to cover animals and pit filled with dirt

Shipment 34, 6/21/66

1 truck and 1 trailer
1 lg. wooden box
3 pallets of ducting and tubing
4 pallets of lg. filters
5 pallets capacitors
1 pallet misc. metal bracing

Shipment 35, 7/1/66

1 truck and 1 trailer
- 1 vent hood
- 3 pallets of capacitors
- 1 glove box
- 10 drums
- 3 pallets of filters
- 1 pallet filter fittings
- 1 pallet misc.
- 1 metal stand
- 1 pallet piping and duct work

Shipment 36, 9/9/66

1 trailer load
- 5 glove boxes
- 6 pallets of capacitors
- 2 55-gal. drums
- 1 55-gal. drum of small capacitors
- 1 pallet assorted misc.
- 1 pallet of round capacitors

Shipment 37, 9/28/66

1 trailer load
- 1 pallet 7.5-gal. carboys
- 1 box capacitors
- 2 pallets misc.
- 10 55-gal. drums
- 1 roll flooring
- 2 30-gal. waste cans
- 2 pallets capacitors
- 2 pallets filters
- 1 300-gal. gas tank

Shipment 38, 1/13/67

1 trailer
- 2 chemical (sink type) lab work benches
- 4 pallets ducting
- 2 hood vent tops
- 3 lg. filters
- 2 pallets capacitors
- 3 pallets misc. cans and containers
- 1 pallet drums (4)
- 4 hood tops
- 2 wooden glove boxes
- 1 lg. furnace
- 1 pallet metal sheets (sections)

Shipment 39, 1/16/67

3 cows

Shipment 40, 5/10/67

1 trailer
- 1 pallet sm. plastic pipes
- 1 pallet glass doors
- 1 pallet filters
- 1 pallet lg. plastic pipes
- 1 pallet ventilating ducting
- 2 pallets canvas and pipes
- 1 lg. pallet filters, motors, pipe
- 1 box pal capacitors, filters
- 12 pieces rectangular ducting

Shipment 41, 5/13/67

1 cow

Shipment 42, 8/11/67

1 40 foot trailer
- 1 glove box
- 6 pallets of lard cans
- 1 1000-gal. tank
- 10 pallets of capacitors
- 1 box pallet misc. capacitors
- 1 pallet of red chemical drums
- 1 pallet misc. pieces of equipment
- 1 pallet of flexible tubing of various sizes
- several lg. (15 ft.) pieces of pipe and ducting

Shipment 43, 9/1/67

2 cows

Shipment 44, 10/25/67

1 40 ft. trailer
- 6 pallets capacitors
- 6 carboys
- 2 10 ft. wooden boxes
- 14 drums misc.
- 2 pallets filters
- 2 pallets concrete blocks
- 1 3 ft. wooden box
- 4 lard cans misc. gas bottles

Shipment 45, 11/1/67

4 technically contaminated calves

Shipment 46, 5/12/68

1 40 ft. trailer
- 9 pallets capacitors
- 1 glove box
- 4 pallets drums
- 1 pallet wooden case filters
- 2 pallets wood planks
- 1 lg. wood box
- 1 pallet styrofoam
- 6 pcs. aluminium ducting
- 1 pallet lg. electrical coils

Shipment 47, 5/26/68

1 40 ft. trailer
- 4 pallets of wood from pit covers
- 4 pallets of drums
- 2 pallets of capacitors
- 2 pallets of misc. ducting
- 1 20 ft. section al. ducting
- 1 pallet misc. metal (Fe) parts

Shipment 48, 9/19/68

1 40 ft. trailer
- 9 retention tanks, no activity using portable alpa meta, no alpha, beta readings with geiger E-400
- 1 pallet technically contaminated waste (al brackets and cross braces for storage shelves)

Shipment 49, 7/2/69

1 40 ft. trailer
- 1 box 3x6x4.5 misc. small junk
- 2 boxes approx. 200 sm. capacitors
- 2 lg. boxes approx. 50 sm. capacitors
- 1 ignition tube filled with Hg
- 3 mercury tubes
- 1 pallet PVC pipe
- 87 capacitors

1 lg. pallet soil samples
2 boxes depleted U238
166 drums, 55-gal. compressed
1 pallet of ducting - air
1 mercury lamp

Shipment 50, 8/29/69

3 drums of biomed waste (calf: carcass, feces, urine cow: feces, urine, milk, blood)

Shipment 51, 9/17/69

28 ignition tubes
8 lid-filled drums
2 boxes sm. capacitors
25 capacitors
approx. 100 boxes S.E.D.A.N. dirt
1 filter/D-38
1 drum Hg waste, later exhumed
3 boxes/prefilters
19 drums/D-38, later exhumed
1 drum/Mulberry, later exhumed

Shipment 52, 9/24/69

1 cow

Shipment 53, 9/1/70

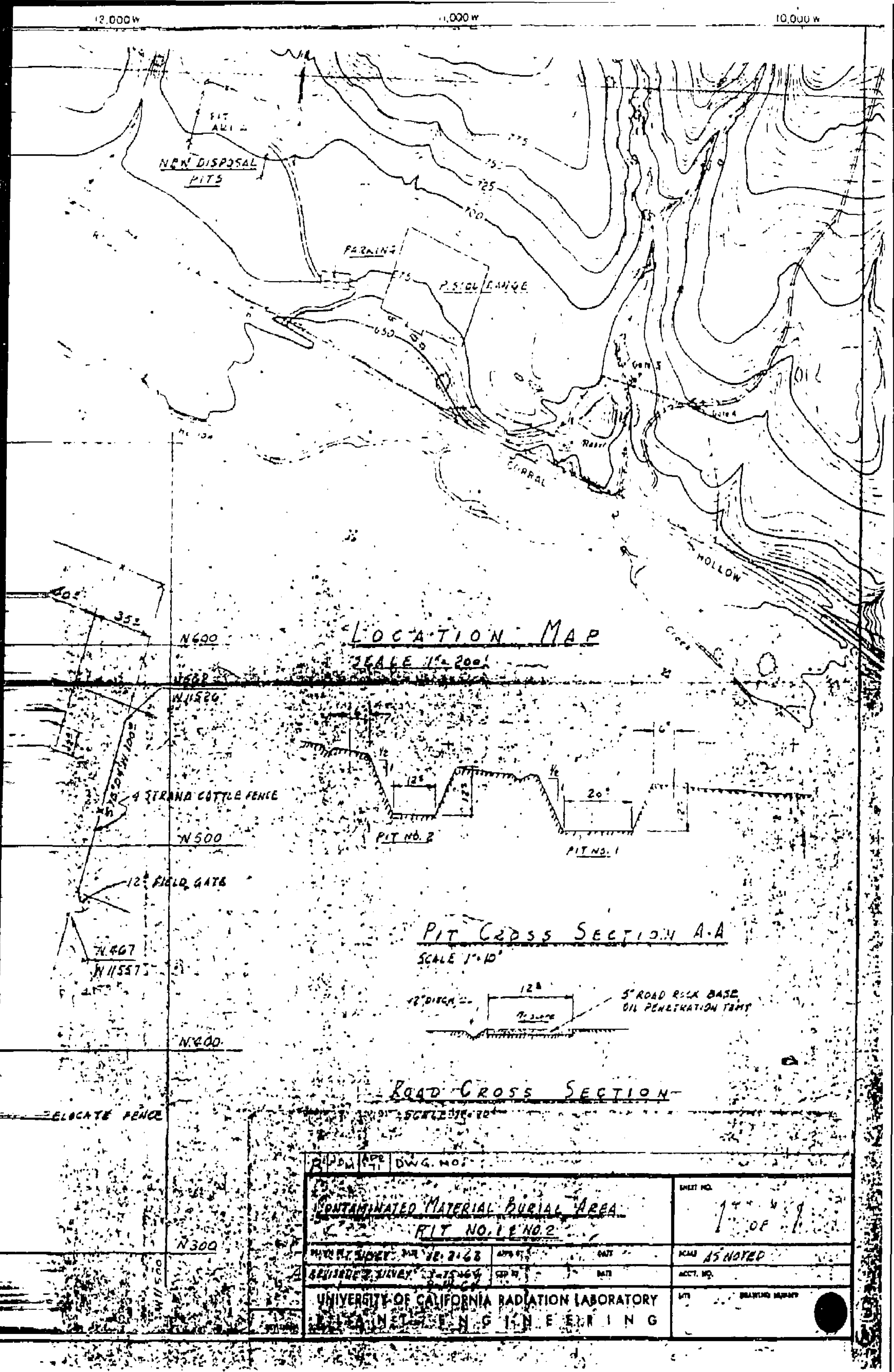
1 mercury stripper, and 34 drums (D-38)
771 capacitors

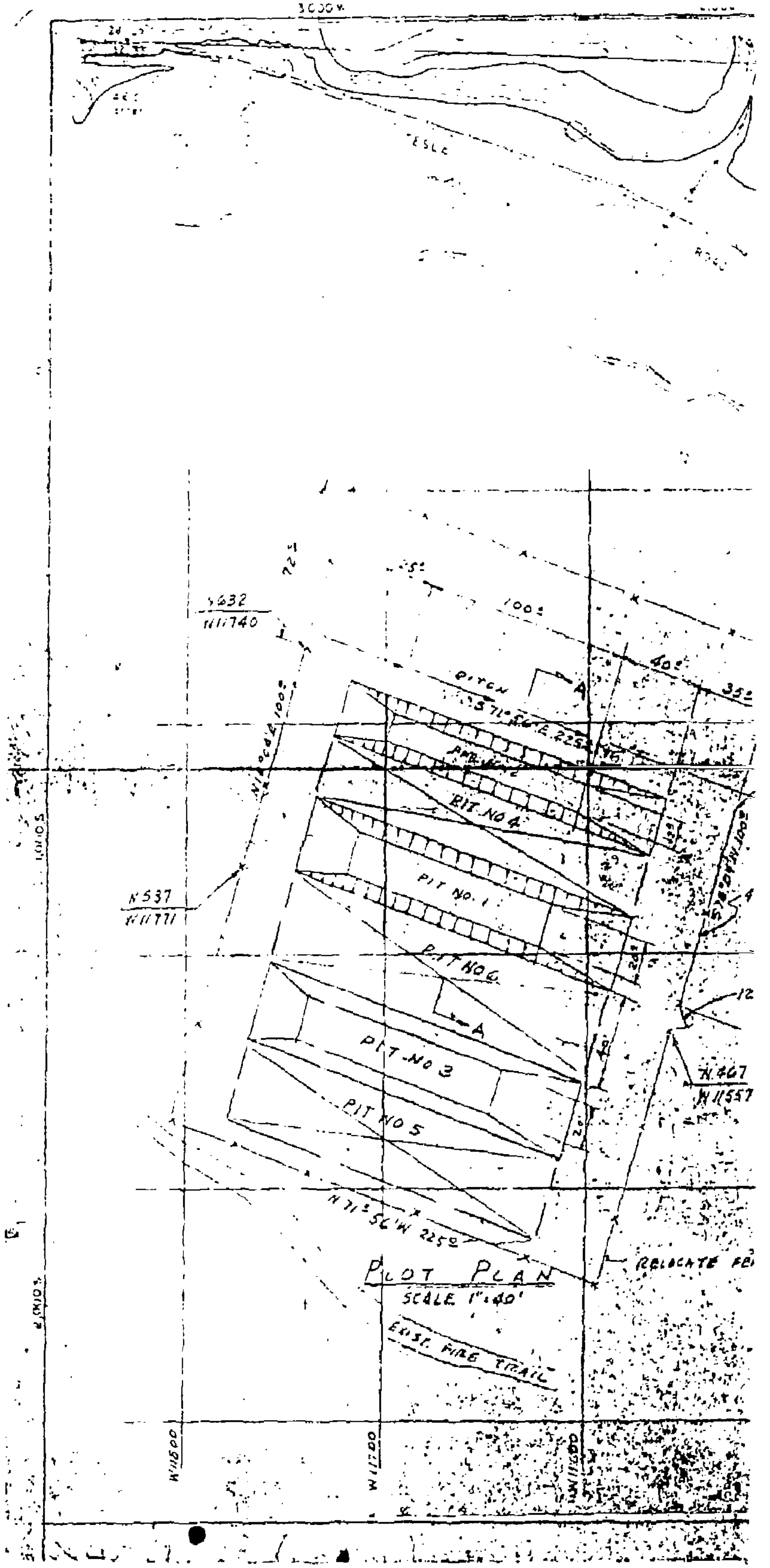
Shipment 54, 5/28/71

2 cows

Shipment 55, 2/20/73

5 cows and 1 ram


12,000 W
11,000 W
10,000 W
NEW DISPOSAL PITS
PARKING
PISTOL RANGE
CORRAL
HOLLOW
LOCATION MAP
SCALE 1"= 200'
N600
4 STRAND CATTLE FENCE
N500
12' FIELD GATE
PIT NO. 2
PIT NO. 1
PIT CROSS SECTION A-A
SCALE 1"=10'
N467
W11557
5" ROAD ROCK BASE,
N400
ROAD CROSS SECTION
RELOCATE FENCE
N300
CONTAMINATED MATERIAL BURIAL AREA
PIT NO. 1 & NO. 2
SHEET NO.
1 OF 1
SCALE AS NOTED
ACCT. NO.
UNIVERSITY OF CALIFORNIA RADIATION LABORATORY
ENGINEERING



PLOT PLAN
SCALE 1"=40'
PIT NO 4
PIT NO. 1
PIT NO 6
PIT NO 3
PIT NO 5
DITCH
N 71° 56' W 225'
S 71° 56' E 225'
EXIST. FIRE TRAIL
RELOCATE FE
TESLA
ROAD
N 632
W 11740
N 537
W 11771
N 467
W 11557
W 11800
W 11700

Soirs

ORIGINAL File with DWR

CONFIDENTIAL LOG Water Code Sec.

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

received DOE (ESQA) 10/4/84

DO NOT FILL IN

№ 70335

WATER WELL DRILLERS REPORT

State Well No.

Other Well No. 3S/4E-34E

(1) OWNER:

Name CARNAGIE CYCLE PARK
Address 238 ESTHER CT.
HAYWARD, CALIF.

(2) LOCATION OF WELL:

County SAN JOAQUIN Owner's number, if any

Township, Range, and Section T3S R4E S 33

Distance from cities, roads, railroads, etc. Corral Hollow Rd. 1 Mile East of County Line

(3) TYPE OF WORK (check):

New Well [X] Deepening [ ] Reconditioning [ ] Destroying [ ]

If destruction, describe material and procedure in Item 11

(4) PROPOSED USE (check):

Domestic [X] Industrial [ ] Municipal [ ]
Irrigation [ ] Test Well [ ] Other [ ]

(5) EQUIPMENT:

Rotary [ ]
Cable [ ]
Other [ ]

(6) CASING INSTALLED:

STEEL: OTHER:
SINGLE [X] DOUBLE [ ]

If gravel packed

From ft.	To ft.	Diam.	Gage or Wall	Diameter of Bore	From ft.	To ft.
0	503	6½	12	12		503

Size of shoe or well ring:

Size of gravel: pea

Describe joint

(7) PERFORATIONS OR SCREEN:

Type of perforation or name of screen slot

From ft.	To ft.	Perf. per row	Rows per ft.	Size in. x in.
63	503			3 x 1/8

(8) CONSTRUCTION:

Was a surface sanitary seal provided? Yes X No [ ] To what depth 50 ft.

Were any strata sealed against pollution? Yes [ ] No [ ] If yes, note depth of strata

From ft. to ft.

From ft. to ft.

Method of sealing

(9) WATER LEVELS:

Depth at which water was first found, if known ft.

Standing level before perforating, if known ft.

Standing level after perforating and developing ft.

(10) WELL TESTS:

Was pump test made? Yes [ ] No X If yes, by whom?

Yield: gal/min with ft. draw down after hrs.

Temperature of water Was a chemical analysis made? Yes [ ] No X

Was electric log made of well? Yes [ ] No X If yes, attach copy

(11) WELL LOG:

Total depth 560 ft. Depth of completed well 503 ft.

Formation: Describe by color, character, size of material, and structure

ft. to ft.	
0-8	Clay
8-12	Sand & Gravel
12-25	Shale
25-30	Clay
30-35	Shale & Gravel S
35-42	Sand Clay gray
42-170	Hard Blue Clay
170-174	Rock
174-180	Black Shale
180-230	Blue Clay
230-290	Black Sandy Shale
290-325	Hard Blue Clay & Sh
325-329	Hard White Clay
329-330	Rock
330-385	Sandy Black Hard Sh
385-420	Hard Black Shale
420-435	Black Shale to Sand
435-500	Brown to gray Shale
500-547	Blue Clay Hard
547-549	Rock
549-560	Hard Clay

Work started 2/22/72 Completed 19

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME Hennings Bros. Drilling Co., Inc.
(Person, firm, or corporation) (Typed or printed)

Address 2500 W. Rumble Rd.
Modesto, California 95350

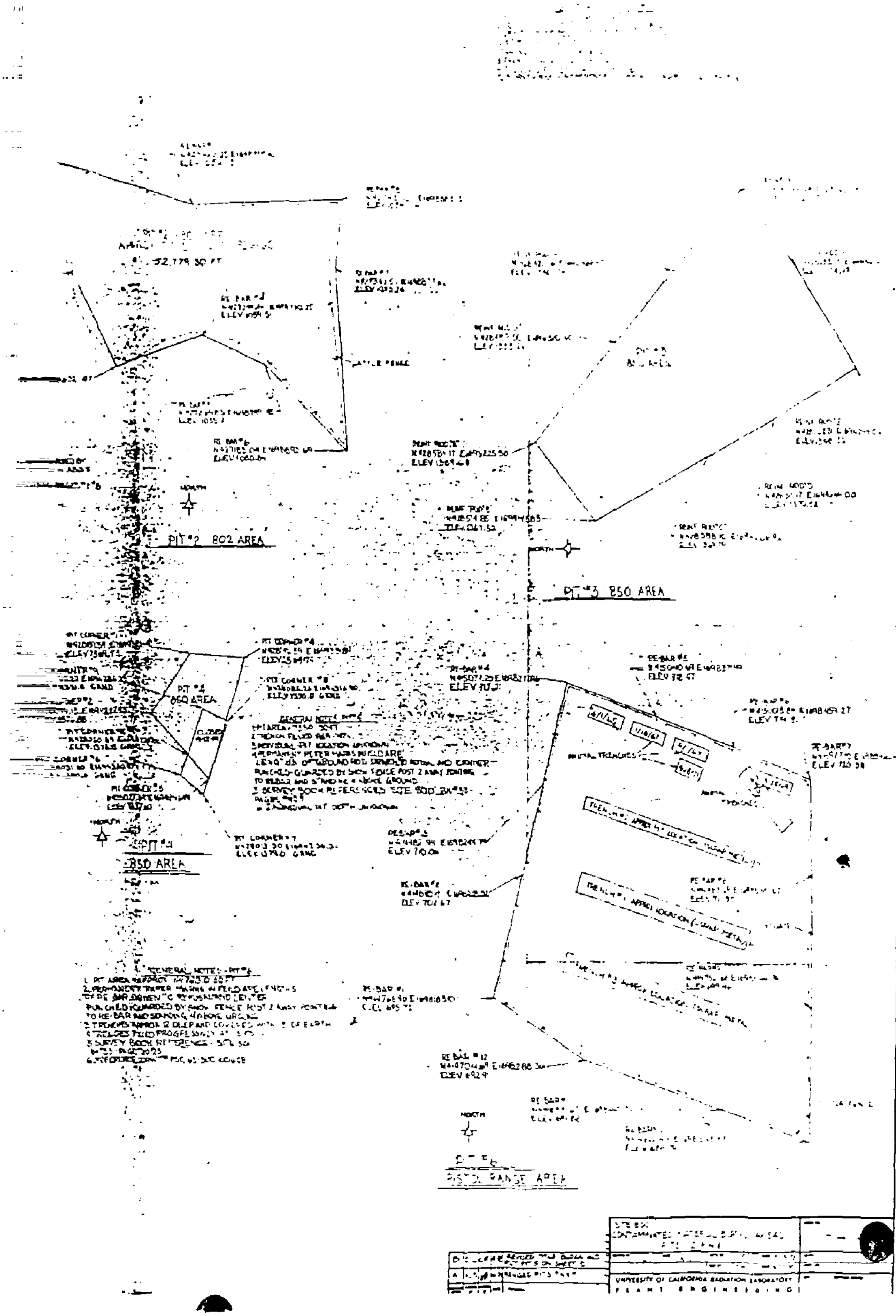
[SIGNED] (signature) (Well Driller)

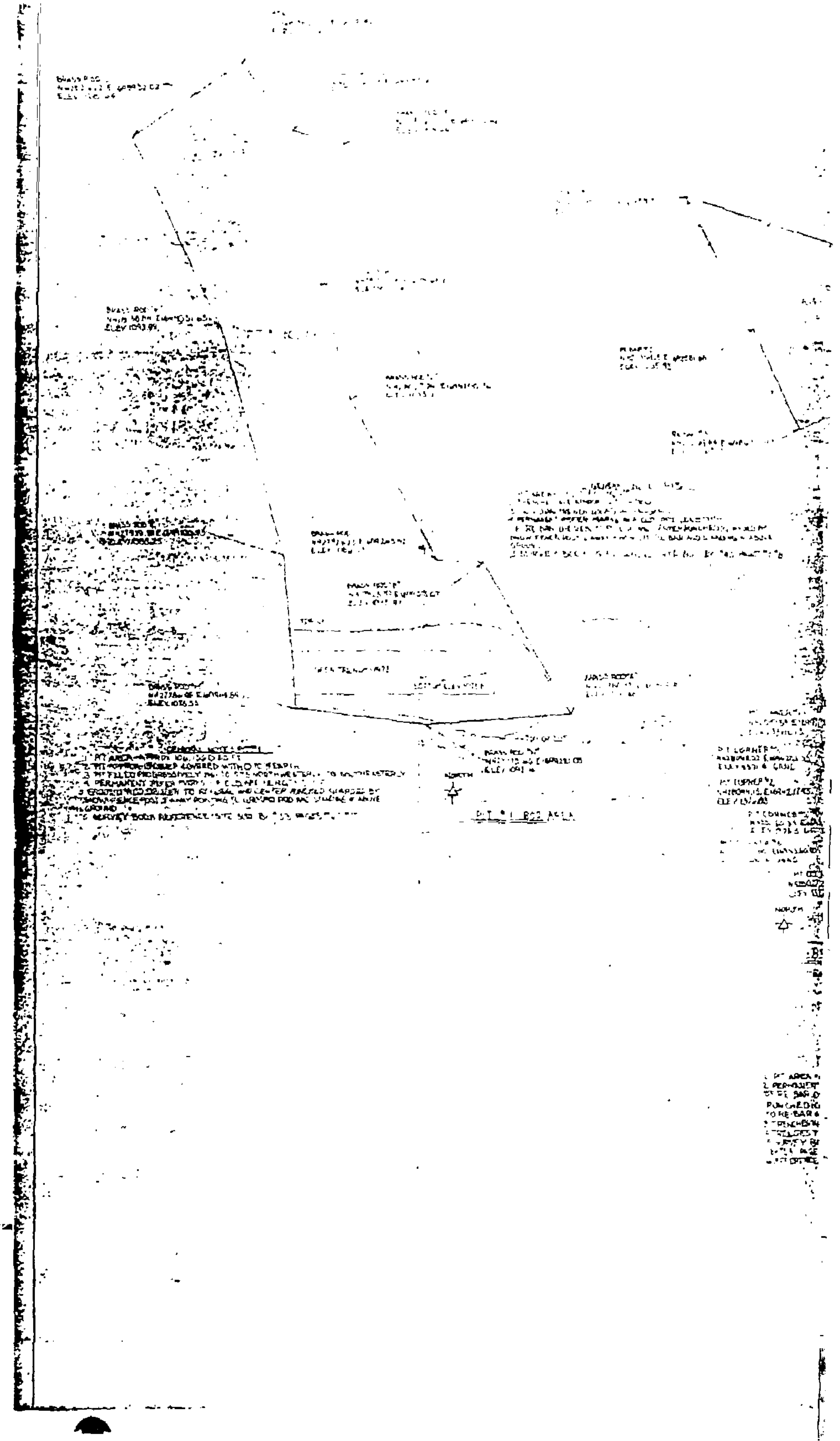
License No. 116322 Dated June 21, 1972

SKETCH LOCATION OF WELL ON REVERSE SIDE

DWR 188 (REV. 9-68)

9-R


PIT #2 802 AREA
NORTH
CATTLE FENCE
PIT #3 850 AREA
PIT #4 850 AREA
GENERAL NOTES PIT #4
GENERAL NOTES - PIT #6
PIT #6
PISTOL RANGE AREA
UNIVERSITY OF CALIFORNIA RADIATION LABORATORY
PLANT ENGINEERING


NORTH

DETECTION SCIENCES, INC.

GROUND PENETRATING RADAR AND
TERRAIN CONDUCTIVITY INVESTIGATION
LAWRENCE LIVERMORE LABORATORY
SITE 300, PIT NO. 6
LIVERMORE, CALIFORNIA

A Report Prepared for:

CH2M HILL
2200 Powell Street
Emeryville, California

by

William E. Black
Principal Geophysicist GP-843

Kenneth G. Blom
Principal Geophysicist GP-887

DETECTION SCIENCES, INC.
921 Transport Way #5
Petaluma, California 94952
Telephone (707) 763-1312

Job No. 84-106.02

November 8, 1984

DETECTION SCIENCES, INC.

TABLE OF CONTENTS

I SUMMARY

A geophysical investigation was performed at the Lawrence Livermore Laboratory, Site 300, Pit No. 6 Disposal Area to explore for buried trenches containing scrap metal and laboratory animals. We used ground penetrating radar and terrain conductivity measurements to delineate lateral variations in the electrical properties of the subsurface as a means of determining the trench locations. The terrain conductivity data indicate a high conductivity area covering a large portion of the site. A considerable number of anomalous radar returns occur in the same area. One interpretation of this anomalous area is that it represents a single large pit rather than the expected excavation configuration of several trenches. This single large pit may also be the result of more than one episode of excavation. Another interpretation is that the trenches exist in their expected configuration and that the anomalous area represents an effluent plume emanating from them. Alternatively, the terrain conductivity anomalies could be due to local variations in moisture content, clay content, or depth to groundwater. Similarily, many of the ground penetrating radar anomalies could be caused by cobbles, boulders, animal burrows, roots, etc.

II INTRODUCTION

This report presents the findings of a geophysical survey performed by Detection Sciences, Inc. at the University of California, Lawrence Livermore Laboratory, Site 300, Pit No. 6 Disposal Area near Livermore, California. The survey is part of an on-going geotechnical investigation being conducted by CH2M Hill for the University of California. The objective of the investigation is to locate three large disposal trenches and to map the aerial extent of any effluent that may have emanated from them.

The geophysical investigation was performed by Detection Sciences, Inc. Geophysicist William E. Black and Technician James L. Wilder on September 18 and 19, 1984. Mr. Mike Concannon, CH2M HILL, provided logistical support and furnished the necessary site maps. The geophysical investigation was authorized under CH2M Hill Purchase Order No. F248.

A. Site Description

Lawrence Livermore Laboratory, Site 300, is located east of the city of Livermore, California in Corral Hollow Creek Canyon approximately three miles west of Interstate 580. The area of investigation, formerly the Pit No. 6 Disposal Area, is currently being used as a rifle range. The site is situated on the north side of Corral Hollow Road, on gently sloping terrain, and at the foot of a very steep row of hills that form the north wall of the northwest trending canyon.

The site is approximately 300 feet square and is at an elevation of 700 feet. A crescent shaped row of berms approximately 10 feet high occupies the southeast corner of the site and a paved road, or walkway, extends from the berms to the northwest corner of the site (see Plate 1). The ground within the site boundaries is generally flat but is hummocky in some areas. All vegetation was removed from the site by a controlled burn prior to the start of the geophysical investigation.

Reportedly, three large trenches were excavated on the site and were used to dispose of scrap metals (Plate 1). It is our understanding that these trenches were about 200 feet long, 12 to 20 feet wide and about 12 feet deep. Supposedly, the debris in the trenches were covered with about 5 feet of fill material. In addition, reports indicate that a number of smaller trenches were excavated in the northern portion of the site and that these trenches were used to dispose of laboratory animals.

B. Purpose

The purpose of the geophysical investigation is to determine the location of the three large disposal trenches and, if possible, the small animal trenches. An additional objective of the investigation is to map the aerial extent of any effluent from the disposal area. Corroding metal in the trenches would tend to ionize the effluent making it electrically conductive and thus visible to geophysical methods that measure variations in the electrical properties of the subsurface.

It is our understanding that the findings of the geophysical investigation will be used by CH2M Hill as a guide in locating test borings and in evaluating the need for remedial measures.

C. Previous Work

Previous geophysical work performed at the site by others consists of terrain conductivity measurements obtained in February and March of 1982. In the 1982 study the terrain conductivity measurements were obtained over a larger area than the present area of investigation and with a much lower station density. However, the instrument used then allowed a greater depth of penetration than that used in the present study.

D. Scope of Work

To explore for trenches and effluent in the Pit No. 6 disposal area we measured variations in the electrical properties of the subsurface using the terrain conductivity (TC) and ground penetrating radar (GPR) methods.

We measured terrain conductivities at a total of 240 stations distributed in a grid pattern covering most of the study area as shown on Plate 1. GPR data were obtained along 14 north-south oriented traverses comprising a total coverage of 4180 lineal feet.

III DATA ACQUISITION

The theory of operation, general procedures, and instrumentation for the two geophysical methods employed in this investigation are discussed in Appendix A, Methodology. The specific procedures we followed in applying these methods to this investigation are discussed below.

A. Terrain Conductivity

TC measurements were obtained at stations distributed in a grid pattern as shown on Plate 1. Our procedure was to traverse the site along north-south profiles oriented parallel to the western boundary of the site. On each profile we took TC measurements and flagged each point at 20 foot intervals. We proceeded west to east across the site in this manner, distributing the profiles at 25 foot intervals. The only departure from this 20-by-25 foot rectangular grid system is along the southern and eastern portions of the area where the boundaries are irregular (see Plate 1). The grid marked out by the flagging was then used to guide the subsequent GPR survey.

B. Ground Penetrating Radar

The locations of the GPR traverses are shown on Plate 1. Wherever possible we traversed the same grid that we used for the TC measurements. The only departure from this was in areas where access was limited by rough ground or berms. This resulted in a total of 14 north-south traverses, distributed on 25-foot intervals and ranging in length from 255 to 340 feet.

We scanned each traverse using a 120 megahertz antenna. On the five westernmost traverses, E0+00 to E1+00, we towed the antenna behind a four-wheel drive vehicle. On the remaining traverses we towed the antenna by hand. In order to establish geodetic control, event marks were electrically inscribed on the GPR records at 20 foot intervals along each traverse. The intervals were determined by flagging that we had placed on the ground during the TC survey.

IV DATA ANALYSIS

A. Terrain Conductivity

The electromagnetic induction instrument we used to obtain TC data measures conductivity directly in units of millimhos per meter (mmho/m). The conductivity values recorded in the field were plotted versus their locations in plan view and then contoured to form the Terrain Conductivity Map shown on Plate 2.

B. Ground Penetrating Radar

Our analysis of the GPR data consisted of a close inspection of the graphical records for anomalous reflection patterns. The anomalies we identified in this manner were plotted in plan view along with the GPR tracklines as shown on Plate 3.

V RESULTS

The findings of the geophysical investigation are presented on Plates 1-4. Plate 1 is a site plan showing the locations of the TC stations, the GPR tracklines and pertinent site features such as the berms, the paved areas and the suspected trench locations (after University of California Radiation Laboratory drawing no. P5C-73-300-002EB). Plate 2 is the Terrain Conductivity Contour Map. Plate 3 shows the location of the GPR tracklines and the various anomalies we identified. Finally, Plate 4 is a sample GPR record showing some of the anomaly types depicted on Plate 3.

A. Terrain Conductivity

The terrain conductivities vary from a low of 28 to a high of 116 millimhos per meter (mmho/m). However, these are extremes as most values fall in the range of 40-80 mmho/m. Generally, values at the low end of the range occur on the berms and are the result of a topographic effect. Terrain conductivities near the upper end of the range, particularly above 90 mmho/m, occur in isolated areas and are probably due to buried metallic objects.

The TC contours shown on Plate 3 depict an area of high conductivity which occupies a large portion of the site. A conductivity value of 60 mmho/m was arbitrarily chosen as the lower limit of this anomaly because its contour depicts a more uniform shape and envelops more radar point source anomalies than higher values. A lower value contour would have covered too much of the site and could not be considered anomalous. The anomalous area, which is shaded on the contour map, extends from the north-central site boundary to the southeast corner of the site. The high conductivities in this area may be due to a higher moisture content in the soil, to a higher concentration of free ions in the saturating pore water or to a shallower depth to ground water. The crescent shaped zone of low conductivities which interrupt the high conductivity area corresponds to the berms located in the southeast quadrant of the site.

B. Ground Penetrating Radar

We identified three basic types of anomalies on the GPR records. These are described below:

Type A - Point source reflectors. These are small, typically isolated reflection patterns which usually have a hyperbolic shape. They are usually caused by buried objects such as pipelines, drums, cannisters, metallic debris, etc., however, they can also be due to natural sources such as cobbles, boulders, animal burrows, roots, etc.

Type B - Zones of irregular or discontinuous stratigraphic reflectors. These typically represent disturbed strata caused by prior excavation, such as in a pit or trench, however, this type of reflection pattern can also occur where the antenna is pulled over rough, uneven ground.

Type C - Zones of weak or "washed-out" signal from stratigraphic reflectors. These anomalies are typically due to localized areas of high conductivity which could result from increased moisture content and/or an increase in the concentration of free ions in the pore water. Alternatively, the high conductivity could indicate an increase in the clay content of the soil. Since these zones tend to be thin and of limited extent they do not show up as terrain conductivity anomalies.

Generally, the GPR records exhibit a limited depth of penetration and limited resolution of subsurface features. This is probably due to a relatively conductive and electrically homogeneous subsurface. Most of the anomalies we identified are either poorly defined or very faint. The exceptions are six type A anomalies, one type B anomaly and all of the type C anomalies. Those anomalies that are distinct are denoted by special symbols on Plate 3. In addition, an example of two distinct Type A anomalies and the only distinct Type B anomaly are shown on Plate 4.

In general, Plate 3 indicates that radar anomalies tend to be randomly distributed across the site. However, there are some crude trends that should be pointed out. For example, most of the Type A anomalies occur in the east half of the site, specifically from Profile E1+50 eastward. In addition, there is a northeast trending alignment of GPR anomalies in the southwest portion of the site. From the south end of Profile E0+00 to Profile E0+75 this zone is comprised primarily of Type C anomalies. Continuing northeast from E0+75 the zone is comprised of Type A anomalies. At E1+50 it blends into the zone of widely scattered Type A anomalies that occupy the east half of the site. There is also a poorly defined trend associated with the type B anomalies; generally they occur primarily in the west half of the site.

C. Correlation

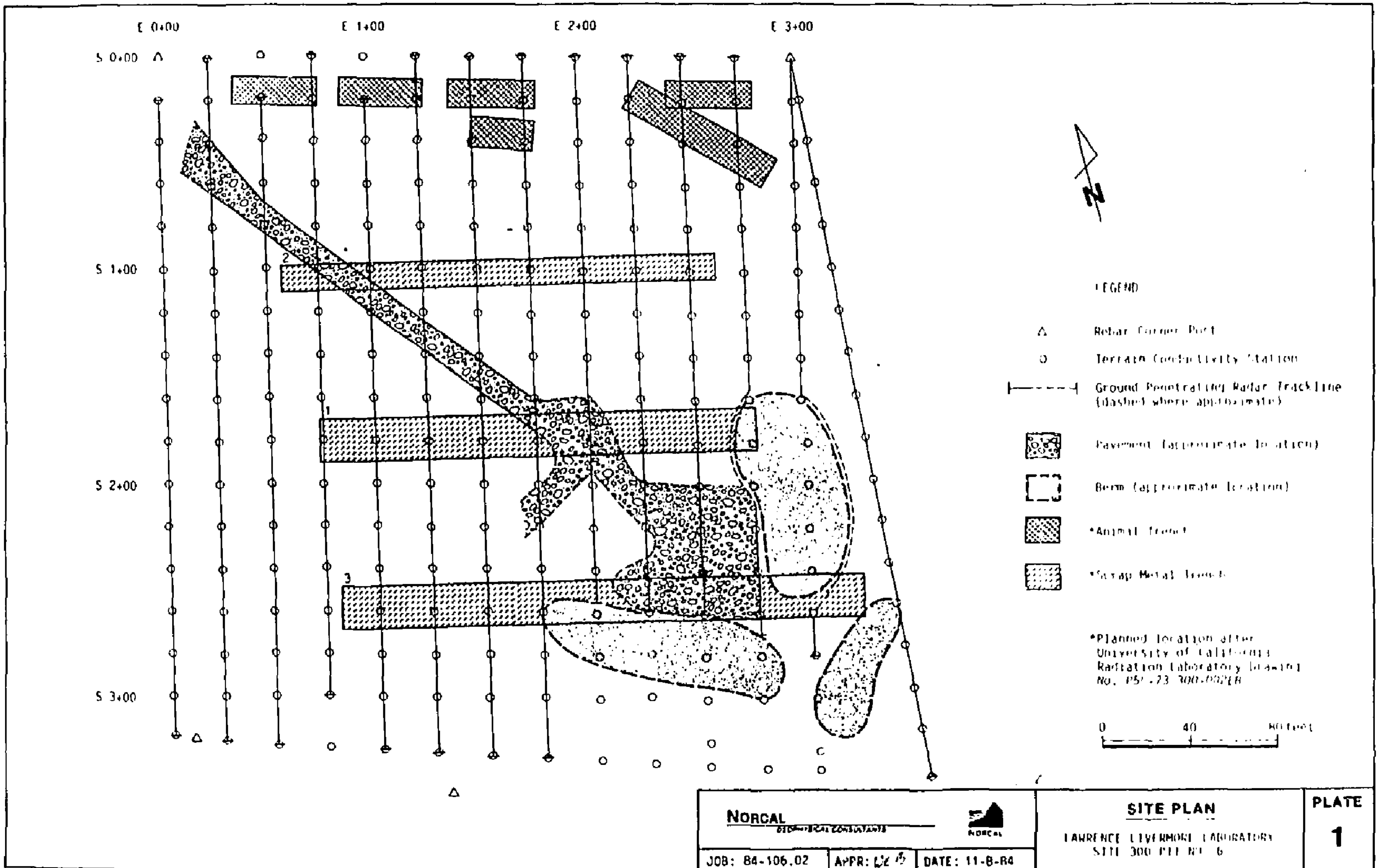
There is a rough correlation between the high conductivity area shown on Plate 2 and the zone of Type A GPR anomalies which cover much of the eastern portion of the site (Plate 3). In addition, most of the isolated conductivity anomalies (> 90 mmho/m) shown on Plate 2 coincide with, or are close to, one or more Type A GPR anomalies. However, there does not appear to be any correlation between the terrain conductivity contours and any of the Type B or C anomalies.

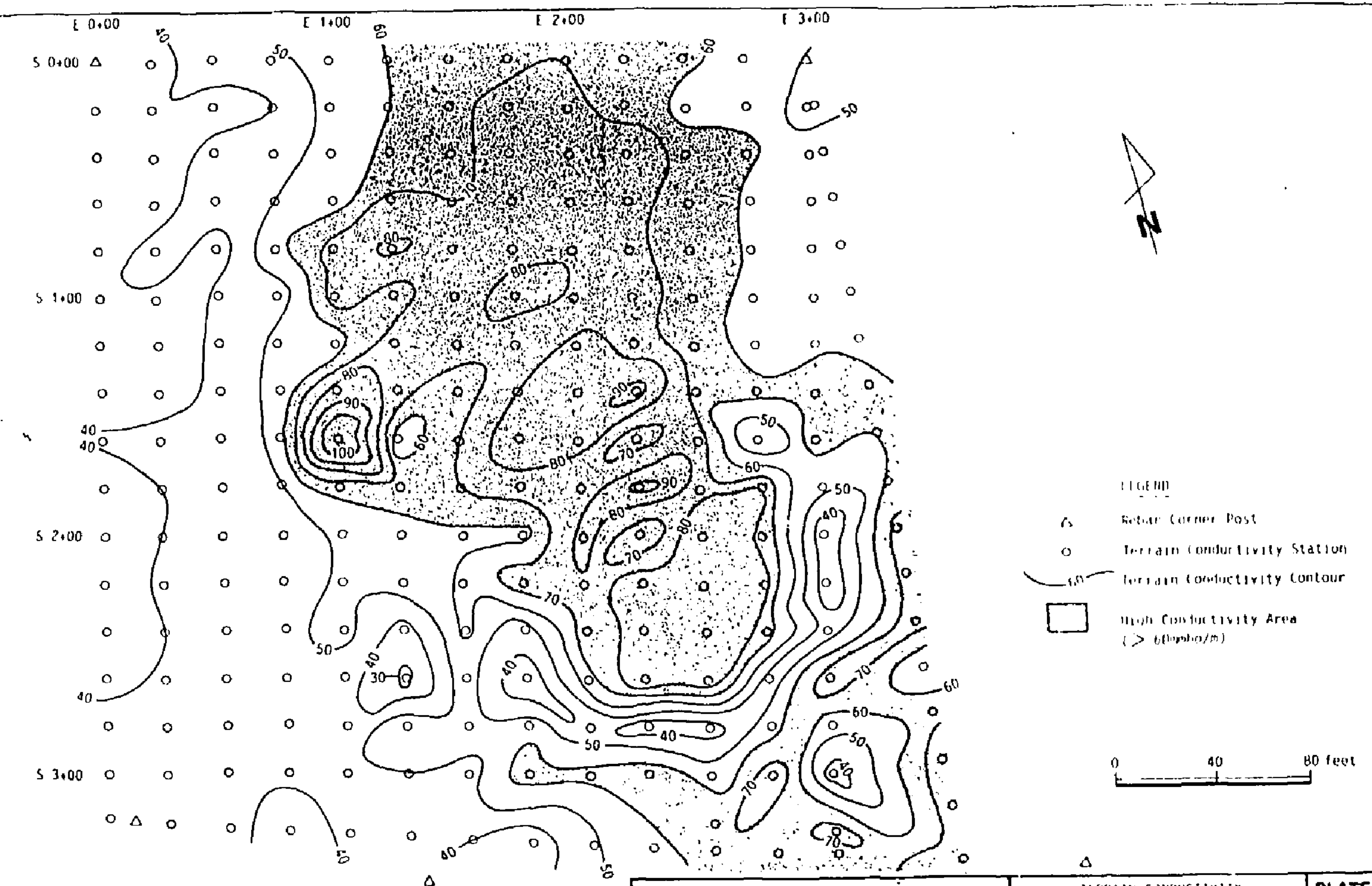
VI DISCUSSION

Surprisingly, neither the TC or GPR data give any indication of the three large scrap metal trenches or the small animal trenches that reportedly exist on the site. The TC contours do suggest, however, that there may have been a single large pit as indicated by the high conductivity area shown on Plate 2. The widespread occurance of most of the Type A GPR anomalies in the same general area may represent debris buried in this pit. In addition, there appears to be a southwestward extension of type A and type C anomalies which could represent a backfilled ramp leading into the pit from the southwest corner of the site. It is also possible that there have been several episodes of trenching and disposal to the point where buried debris (Type A anomalies) and disturbed strata (Type B and C anomalies) now occupy much of the site. Another factor that weighs against there being three separate scrap metal trenches, or at least that they are located as shown on the UCRL drawing (no. P5C-73-300-002EB), is that many of the isolated conductivity highs shown on Plate 2 and the distinct Type A GPR anomalies depicted on Plate 3, do not correspond with the trench locations shown on the drawings.

An alternative explanation for the high conductivity area shown on Plate 2 is that the trenches exist in their expected location and that the anomalous area represents conductive effluent from the scrap metal trenches. However, this interpretation does not explain the widespread occurance of Type A anomalies in the same area. Furthermore, it requires that conductive leachate also emanates from the animal trenches since the "plume" extends up-gradient from the scrap metal trenches.

VII ILLUSTRATIONS


E 0+00
E 1+00
E 2+00
E 3+00
S 0+00
S 1+00
S 2+00
S 3+00
1
2
3
N
LEGEND
Rebar Corner Post
Terrain Conductivity Station
Ground Penetrating Radar Trackline (dashed where approximate)
Pavement (approximate location)
Berm (approximate location)
*Animal Trench
*Scrap Metal Trench
*Planned location after University of California Radiation Laboratory Drawing No. 25Y-23 300-002EB
0
40
80 feet
NORCAL
GEOPHYSICAL CONSULTANTS
NORCAL
SITE PLAN
LAWRENCE LIVERMORE LABORATORY
SITE 300 PIT NO. 6
PLATE
1
JOB: 84-106.02
APPR:
DATE: 11-8-84



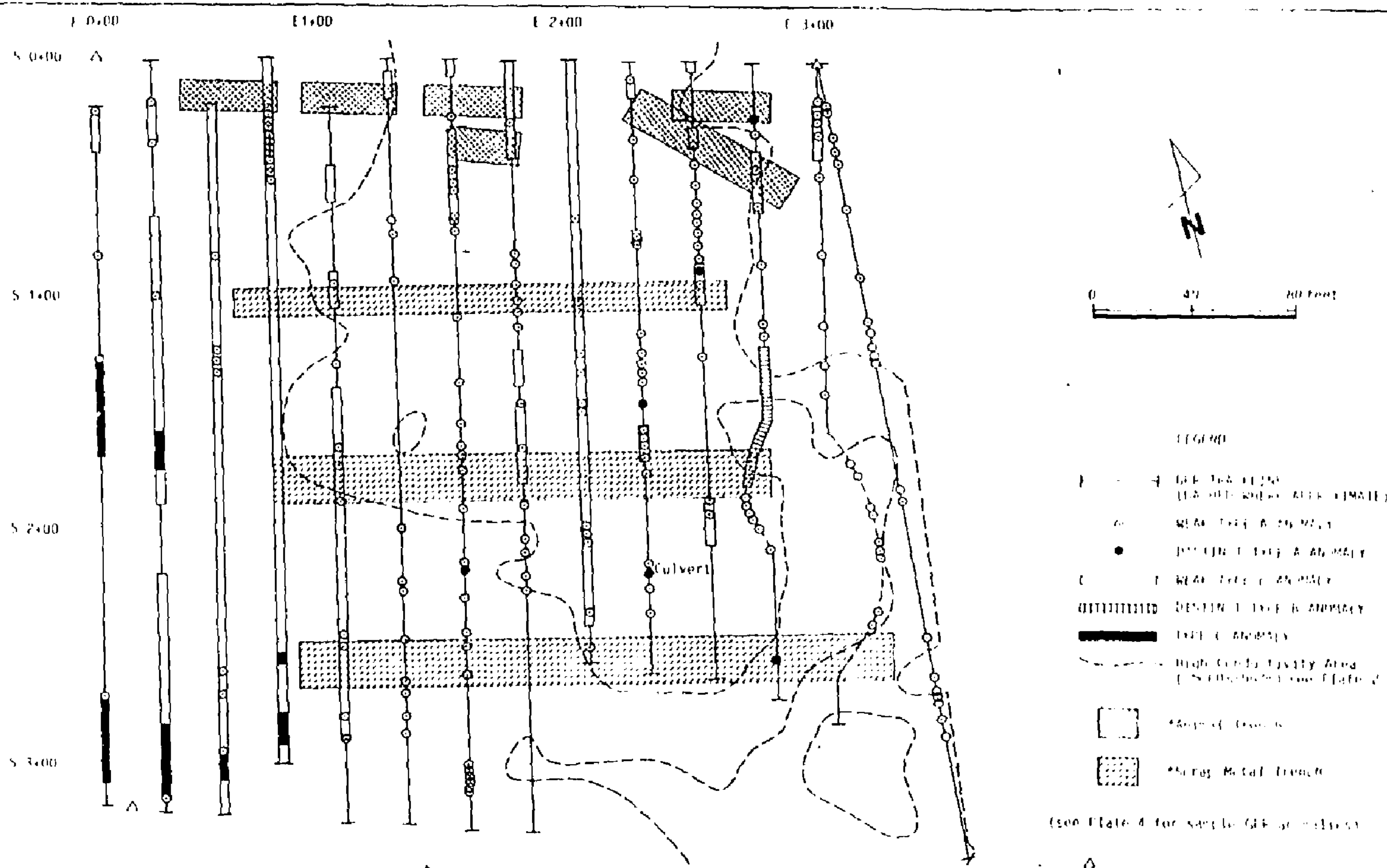
NORCAL GEOPHYSICAL CONSULTANTS

TERRAIN CONDUCTIVITY CONTOUR MAP

LAWRENCE LIVERMORE LABORATORY SITE 300, PIT NO. 6

PLATE 2

JOB: 84-106.02 | APPR: web | DATE: 11-8-84



*Planned location after
University of California
Radiation Laboratory 1a
Drawing No. PSC-73-300-002EB

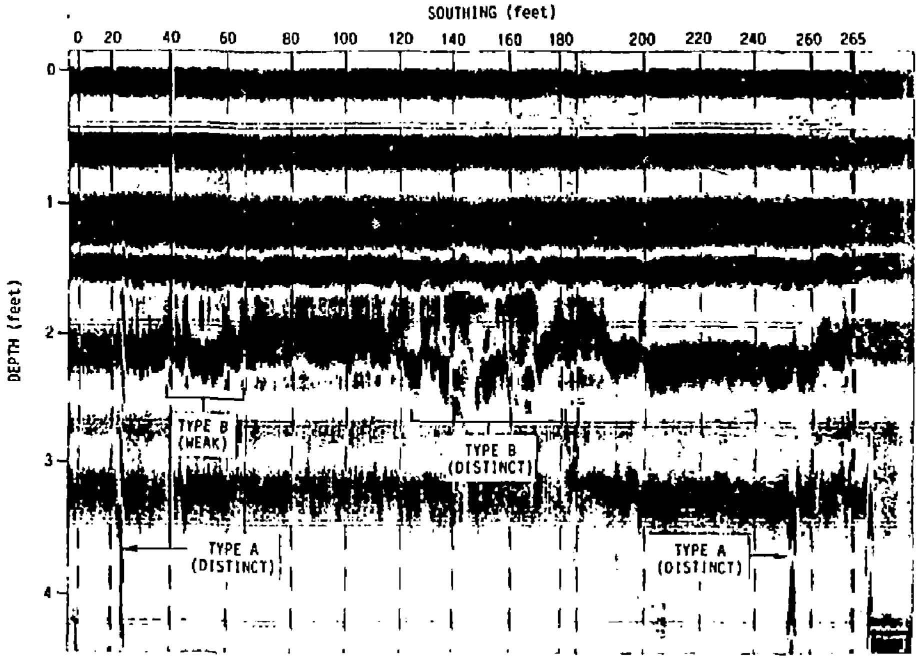
NORCAL
GEOPHYSICAL CONSULTANTS

JOB: 84-106.02 | APPR: | DATE: 11-8-84

GPR TRAVERSES AND
ANOMALY LOCATIONS

LAWRENCE LIVERMORE LABORATORY
SITE 300, PIT NO. 6

PLATE
3



NORCAL GEOPHYSICAL CONSULTANTS	SAMPLE GPR RECORD LAWRENCE LIVERMORE LABORATORY SITE 300, PIT NO. 6	PLATE 4
JOB: 84-106.02 APPR: WCB DATE: 11-8-84		

Appendix A

METHODOLOGY

METHODOLOGY

The electrical properties of earth materials vary with different conditions or material types. Also, the earth has electrical properties that can vary vertically and/or horizontally for a given area or depth in proportion to the content of water or moisture, dissolved salts or free ions, or buried conductive foreign objects. Thus, massive rock formations or dry sand are poor conductors because they contain very little moisture. Conversely, fine grained materials are relatively good conductors since they tend to hold moisture and may at times contain naturally occuring free ions. The introduction of fluids that have high free ion content or other conductive materials such as metallic debris can significantly increase the electrical conductivity of both coarse and fine grained material.

A. Terrain Conductivity

For this survey we used a Geonics Model EM-31 to measure lateral changes in terrain conductivity. The EM-31 consists of a transmitting and a receiving coil that are approximately 12 feet apart. The transmitting coil induces, at a certain frequency, a circular eddy current loop in the earth that is directly proportional to the electrical conductivity of the material it permeates. This current loop, in turn, gives rise to a magnetic field which is proportional to the amount of current flowing within the loop. The receiving coil detects this magnetic field and generates an output voltage that is proportional to its intensity. The instrument is calibrated to display this output voltage, which is linearly related to the terrain conductivity, directly in units of millimhos per meter (mmho/m).

Since the EM-31 transmits its signal into the earth through electromagnetic induction, measurements are taken without direct ground contact. Typically, the instrument is carried at hip level when used. At each station the terrain conductivity is read directly in mmho/m and recorded for later use. At many stations the instrument may be rotated about a vertical axis to check for anomalous lateral variations. In cases where the reading changes significantly as the instrument is rotated, the high and low values are observed and the average reading recorded for that particular station. The effective depth of penetration, which is a function of the instrument height (about 3 feet) and the inter-coil separation (12 feet), is approximately 18 feet.

B. Ground Penetrating Radar

Ground Penetrating Radar (GPR) is a shallow geophysical survey system that provides a continuous real-time cross section of the subsurface conditions. A radar impulse is transmitted into the ground where it is reflected back at interfaces created by changes in the subsurface materials or conditions. The time it takes the impulses to reflect back to the radar antenna corresponds to the depth of the particular interface. By recording these depth-dependant impulses on a scanning time-based graphic chart recorder, a vertical profile of the ground is generated which shows the longitudinal distribution of subsurface strata and other features over which the radar antenna has passed.

At the interface of two materials, the radar impulse typically undergoes an abrupt change in velocity causing some of the radar energy to be reflected back to the antenna on the ground surface. The amount of energy that is reflected is dependent on the contrast of the respective radar velocities of the different materials. All materials with the exception of metals are relatively transparent to the passage of radar energy. Metals reflect all of the energy striking it's surface, so that buried metal objects like pipes, rebar, or metal containers make excellent targets. Since most materials are relatively transparent, multiple reflections at various depths transmit back to the surface as the radar signal propagates downward into the ground, thus revealing various subsurface strata and/or conditions.

The penetration depth of the radar system depends on the operating frequency of the radar antenna and the electrical conductivity of the ground. Operating frequencies range from 900 Megahertz providing penetration up to a few feet for very high resolution surveys to 80 Megahertz for deeper penetration surveys that can be tens of feet. Other antenna frequencies of 600, 300, and 120 Megahertz are also available. Actual penetration capabilities of any given antenna will be dependent upon the specific site ground conductivity. As site conductivities increase, the penetration capability of a given antenna decreases. Generally, radar performance is severely limited on sites where resistivities of 20 ohm-meters or less predominate. Conversely, resistivities of several hundred ohm-meters or more allow for very good radar results.

The radar instrumentation consists of a radar impulse generator and control unit, transmitting/receiving antenna, analog graphic recorder, optional magnetic tape recorder, and electrical power converter. Surveys are conducted by moving the antenna along a surface at speeds normally about one-half to one mile per hour. Depending upon the application, speeds much slower or faster can be used with the appropriate procedures and instrument settings. The instrumentation can be stationary with a roving antenna attached by a cable 30 to 60 meters long or the instrumentation can be installed in a vehicle and the antenna towed behind.

DETECTION SCIENCES, INC.

DISTRIBUTION

5 copies to: CH2M Hill
2200 Powell Street
Emeryville, California 94608

Attn: Mr. Mike Concannon

WEB/KGB:eb

CH2M HILL PUMPING TEST DATA

WELL EP6-7
PUMPING/OBSERVATION WELL
PUMPING/RECOVERY DATA
PAGE 1 OF 2

TYPE of PUMPING TEST constant discharge
HOW Q MEASURED water meter, 5 gal bucket, stopwatch
HOW WL's MEASURED electric sounder
PUMPED WELL NO. EP6-7
RADIUS of PUMPED WELL 2" (4" diameter)
DISTANCE from PUMPED WELL —

M P for WL's top steel casing elev 706.40
DEPTH of PUMP/AIRLINE ______ wrt ______
% SUBMERGENCE : initial ______ ; pumping ______
PUMP ON : date 10/17/84 time 0900
PUMP OFF : date 10/17/84 time 1320

PERSONNEL

CLI

JOB NO. F18728.A0

TIME: Clock Time	Elapsed Time min/hrs	t sec	t' sec	t/t'	WATER LEVEL DATA: Reading	Conversions or Corrections	Water Level	S or S'		WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
2:30		150			70-1.5	stickup = 1.06'	67.44	28.19				
3:50		230			72.1		71.04	31.72				
4:30		270			75-1.85		72.09	32.77				
5:30		350			75-1.25		72.69	33.37				
8:20		500			75-1.05		72.89	33.57				
11:40		700			75-.85		73.09	33.77				
14:10		850			75-1.29		72.65	33.33				
16:40		1000			75-1.43		72.51	33.19				
20:00		1200			75-1.42		72.52	33.20				
22:00		1320			75-1.36		72.58	33.26				
25:00		1500			75-1.19		72.75	33.43				
28:20		1700			75-1.12		72.82	33.50				
31:40		1900			75-.93		73.01	33.69				
38:40		2320			75-.75		73.19	33.87				
43:20		2600			75-.46		73.48	34.16				
49:30		2970			75-.24		73.70	34.38				
54:00		3240			75-.25		73.69	34.37				
1:03:40		3820			75-.10		73.84	34.52				
1:10:10		4210			75-.13		73.81	34.49				
1:19:20		4760			75.05		73.99	34.67				
1:27:20		5240			75.24		74.18	34.86				
1:36:00		5760			75.52		74.46	35.12				
1:45:50		6350			75.67		74.61	35.29				
2:01:30		7290			76.04		74.98	35.66				
2:18:00		8280			76.19		75.13	35.81				
2:33:20		9200			76.15 (?)		75.09	35.77				
2:50:30		10230			76.46		75.40	36.08				
3:08:20		11300			76.72		75.66	36.34				
3:24:00		12240			76.91		75.15	36.53				
3:40:20		13220			77.11		76.06	36.74				
3:57:10		14230			77.11		76.06	36.74				
4:13:50		15230			77.32		76.26	36.94				
4:20:00		15600										begin recovery
4:24:40		15880	280	56.7	41.35		40.29	0.97				
4:24:50		15890	290	54.8	41.30		40.24	0.94				
4:25:10		15910	310	51.3	41.28		40.22	0.90				
4:25:20		15920	320	49.8	41.25		40.19	0.87				
4:25:40		15940	340	46.9	41.30		40.24	0.92				
4:26:10		15970	370	43.2	41.15		40.09	0.77				
4:26:20		15980	380	42.1	41.20		40.14	0.82				

CH2M HILL PUMPING TEST DATA

WELL EP6-7
PUMPING/OBSERVATION WELL (PUMPING circled)
PUMPING/RECOVERY DATA (RECOVERY circled)
PAGE 2 OF 3

TYPE of PUMPING TEST: instant discharge
HOW Q MEASURED: water meter, 5 gal bucket, stopwatch
HOW WL's MEASURED: electric sounder
PUMPED WELL NO. EP6-7
RADIUS of PUMPED WELL: 2" (4" diameter)
DISTANCE from PUMPED WELL: —

M P for WL's: top steel casing elev 706.40
DEPTH of PUMP/AIRLINE ______ wrt ______
% SUBMERGENCE: initial ______; pumping ______
PUMP ON: date 10/17/84 time 0900
PUMP OFF: date 10/17/84 time 1320

CL
JOB NO. F18173B.A0
''NL
CAT
PERSONNEL Pill S. Zac Dunlap

TIME					WATER LEVEL DATA					WATER PRODUCT.		COMMENTS
t = ____ at t' = 0					STATIC WATER LEVEL ______							
CLOCK TIME	ELAPSED TIME min/hrs	t	t'	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s'			Q	(NOTE ANY CHANGES IN OBSERVERS)
4:26:40		16000	400	40.0	41.25	Stickup 1.06	40.19	0.97				
4:27:20		16020	420	38.1	41.23		40.17	0.85				
4:27:30		16050	450	35.7	41.18		40.12	0.80				
4:27:40		16060	460	34.9	41.18		40.12	0.80				
4:28:00		16080	480	33.5	41.18		40.12	0.80				
4:28:15		16095	495	32.5	41.17		40.11	0.79				
4:28:30		16110	510	31.6	41.16		40.10	0.78				
4:29:00		16140	540	29.9	41.10		40.04	0.72				
4:29:30		16170	570	28.4	41.12		40.06	0.74				
4:29:40		16180	590	27.4	41.10		40.04	0.72				
4:30:00		16200	600	27.0	41.12		40.06	0.74				
4:30:20		16220	620	26.2	41.00		39.94	0.62				
4:30:50		16250	650	25.0	41.05		39.99	0.67				
4:31:20		16280	680	23.9	41.10		40.04	0.72				
4:31:50		16310	710	23.0	41.10		40.04	0.72				
4:32:15		16335	735	22.2	41.15		40.09	0.77				
4:32:40		16360	760	21.5	41.10		40.04	0.72				
4:33:20		16400	800	20.5	41.08		40.02	0.70				
4:33:40		16420	820	20.0	41.11		40.05	0.73				
4:34:00		16440	840	19.6	41.12		40.06	0.74				
4:34:30		16470	870	18.9	41.05		39.99	0.67				
4:35:30		16530	930	17.8	41.04		39.98	0.66				
4:37:15		16635	1035	16.1	41.05		39.99	0.67				
4:38:20		16700	1100	15.2	41.03		39.97	0.65				
4:41:20		16880	1280	13.2	41.00		39.94	0.62				
4:43:00		16980	1380	12.3	41.03		39.97	0.65				
4:44:40		17080	1480	11.5	40.98		39.92	0.60				
4:46:15		17175	1575	10.9	40.99		39.93	0.61				
4:49:00		17340	1740	10.0	40.96		39.90	0.58				
4:51:00		17460	1860	9.4	40.96		39.90	0.58				
4:53:20		17600	2000	8.8	40.95		39.89	0.57				
4:55:40		17740	2140	8.3	40.96		39.90	0.58				
5:00:00		18000	2400	7.5	40.91		39.85	0.53				
5:04:10		18250	2650	6.9	40.91		39.85	0.53				
5:08:00		18480	2880	6.4	40.90		39.84	0.52				
5:11:40		18700	3100	6.0	40.85		39.79	0.47				
5:18:20		19100	3500	5.5	40.83		39.77	0.45				
5:26:40		19600	4000	4.9	40.85		39.79	0.47				
5:35:00		20100	4500	4.5	40.81		39.75	0.43				
5:43:20		20600	5000	4.1	40.81		39.75	0.43				

CH2M HILL PUMPING TEST DATA

WELL: EP6-7
PUMPING/OBSERVATION WELL
PUMPING/RECOVERY DATA
PAGE 2 OF 3

TYPE of PUMPING TEST: constant discharge
HOW Q MEASURED: water meter, 5 gal bucket, stopwatch
MP for WL's: [illegible] elev 706.40
HOW WL's MEASURED: electric sounder
DEPTH of PUMP/AIRLINE: ______ wrt ______
PUMPED WELL NO.: EP6-7
% SUBMERGENCE: initial ______; pumping ______
RADIUS of PUMPED WELL: 2" (4" diam)
PUMP ON: date 10/17/84 time 0900
DISTANCE from PUMPED WELL: ______
PUMP OFF: date 10/17/84 time 1320

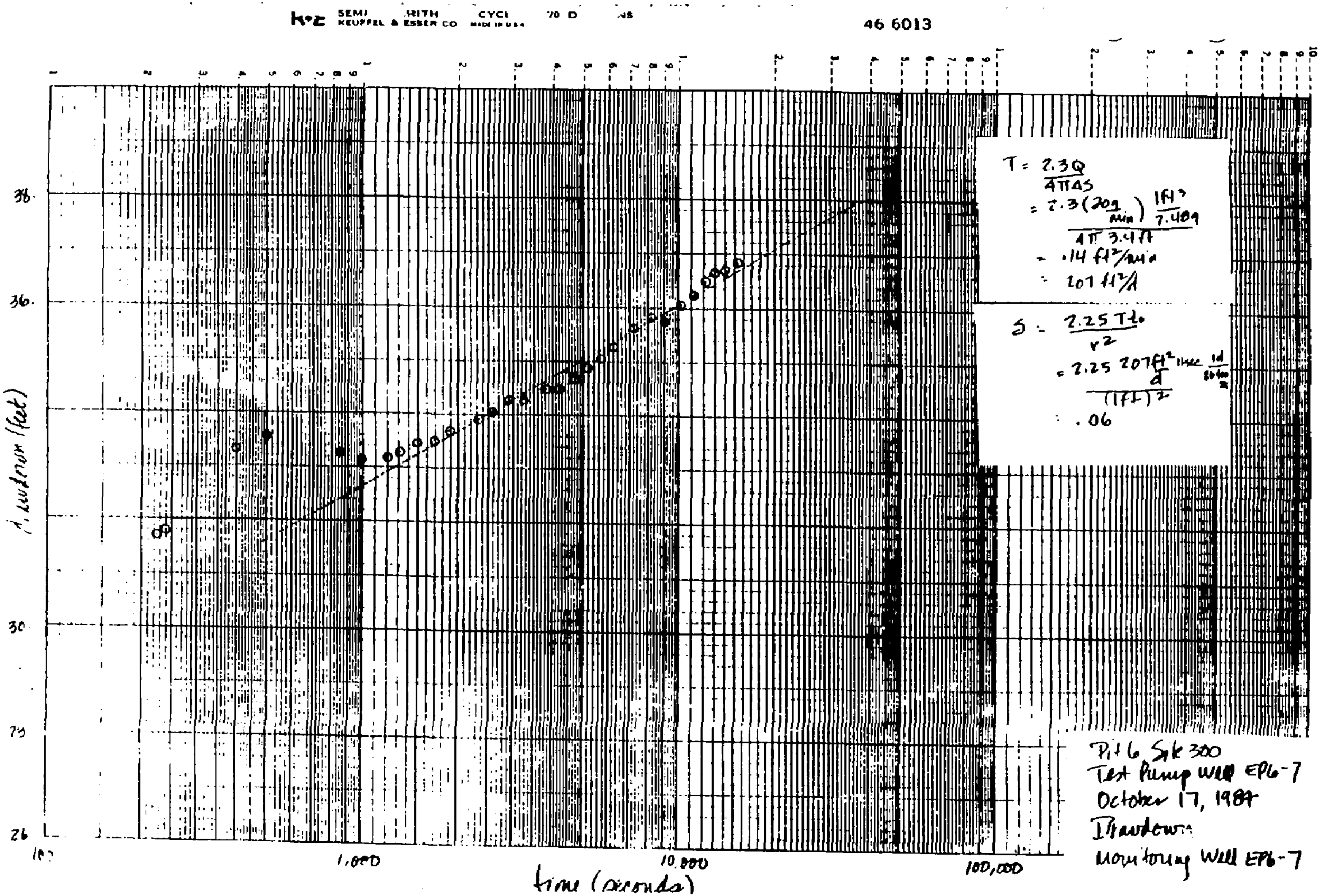
TIME (t = ___ at t' = 0)					WATER LEVEL DATA (STATIC WATER LEVEL ___)					WATER PRODUCT.		COMMENTS
CLOCK TIME	ELAPSED TIME min/hrs	t	t'	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'			Q	(NOTE ANY CHANGES IN OBSERVERS)
5:51:40		21100	5500	3.8	40.82	Stickup 1.06	39.76	0.44				
6:00:00		21600	6000	3.6	40.76	[illegible]	39.70	0.38				

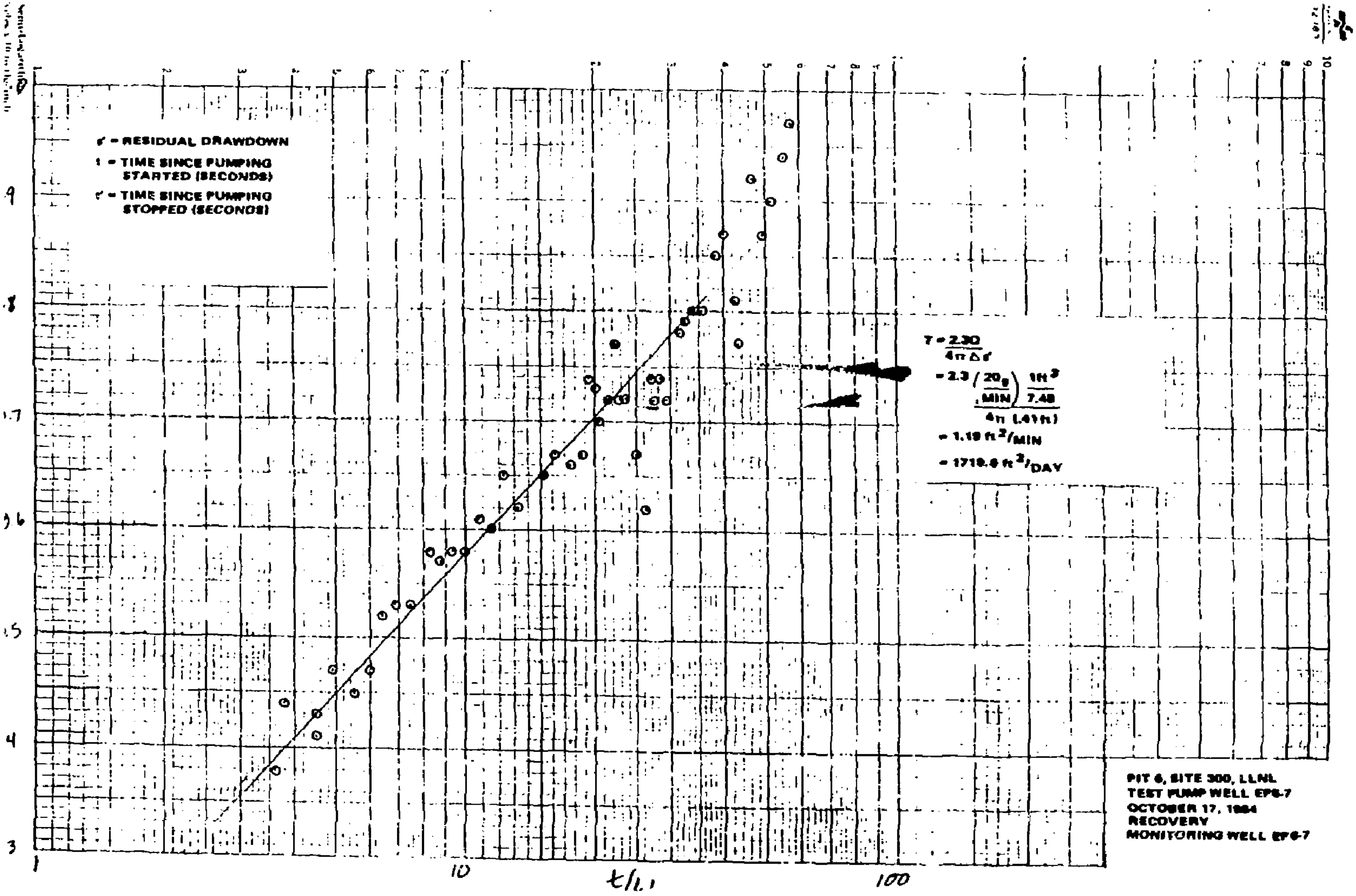
PERSONNEL ______

LOCA ______

JOB NO. ______

Form 128


K+E SEMI-LOGARITHM 5 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.
46 6013
38
36
30
28
26
100
1,000
10,000
100,000
time (seconds)
drawdown (feet)
T = 2.3Q / 4πΔS
= 2.3 (20 gal/min) (1 ft³ / 7.48 gal) / 4π 3.4 ft
= .14 ft²/min
= 207 ft²/d
S = 2.25 T t₀ / r²
= 2.25 207 ft²/d 1 sec (1 d / 86400 s) / (1 ft)²
= .06
Pit 6 Site 300
Test Pump Well EP6-7
October 17, 1984
Drawdown
Monitoring Well EP6-7



s' = RESIDUAL DRAWDOWN
t = TIME SINCE PUMPING STARTED (SECONDS)
t' = TIME SINCE PUMPING STOPPED (SECONDS)
T = 2.3Q / 4π Δs'
= 2.3 (20 g / MIN) (1 ft³ / 7.48) / 4π (.41 ft)
= 1.19 ft²/MIN
= 1719.6 ft²/DAY
PIT 6, SITE 300, LLNL
TEST PUMP WELL EP6-7
OCTOBER 17, 1984
RECOVERY
MONITORING WELL EP6-7
10
100
t/t'

CH2M HILL PUMPING TEST DATA

WELL *EP6-8*
PUMPING / OBSERVATION WELL (circled: OBSERVATION)
PUMPING / RECOVERY DATA (circled: PUMPING, RECOVERY)
PAGE *1* OF *2*

TYPE of PUMPING TEST *constant discharge*
HOW Q MEASURED *water meter, 5 gal bucket, stopwatch*
HOW WL's MEASURED *electric sounder*
PUMPED WELL NO. *EP6-7*
RADIUS of PUMPED WELL *2" (4" diameter)*
DISTANCE from PUMPED WELL *19'*

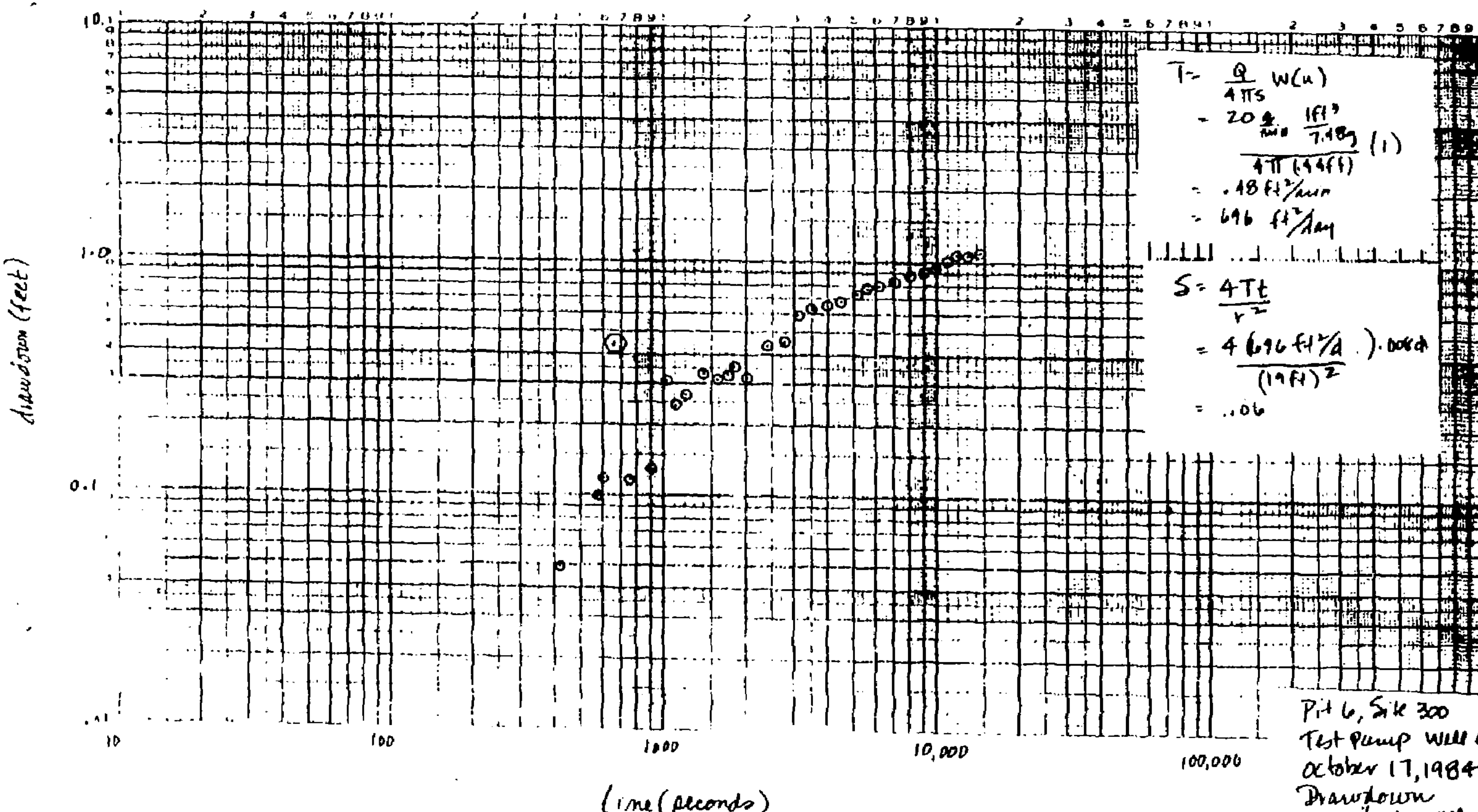
M.P. for WL's *top steel casing* elev *707.18*
DEPTH of PUMP/AIRLINE ______ wrt ______
% SUBMERGENCE : initial ______ ; pumping ______
PUMP ON : date *10/17/84* time *0900*
PUMP OFF : date *10/17/84* time *1320*

TIME: t = ______ at t' = 0
WATER LEVEL DATA — STATIC WATER LEVEL *39.64*

CLOCK TIME	ELAPSED TIME mins/hrs	t sec	t' sec	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'		WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
7:00	/	420						0.05				
9:30	/	570						0.10				
10:00	/	600						0.12				
12:30	/	750						0.12				
15:00	/	900						0.13				
17:40	/	1060						0.21				
18:20	/	1100						0.25				
21:00	/	1260						0.27				
23:20	/	1400						0.34				
26:00	/	1560						0.32				
26:40	/	1600						0.33				
30:00	/	1800						0.36				
33:20	/	2000						0.32				
40:00	/	2400						0.42				
44:30	/	2730						0.45				
50:20	/	3020						0.61				
58:20	/	3500						0.64				
1:06:40	/	4000						0.67				
1:15:20	/	4520						0.68				
1:23:50	/	5030						0.74				
1:31:40	/	5500						0.78				
1:40:00	/	6000						0.80				
1:56:40	/	7000						0.84				
2:13:20	/	8000						0.89				
2:30:00	/	9000						0.91				
2:46:40	/	10,000						0.97				
3:03:20	/	11,000						1.01				
3:20:00	/	12,000						1.08				
3:36:40	/	13,000						1.08				
3:53:20	/	14,000						1.13				
4:10:00	/	15,000						1.15				
4:20:00	/	15600										begin recovery ✓
4:31:30	/	16770	170	14.3				1.13				
4:40:30	/	16830	1230	13.7				1.03				
4:42:10	/	16930	1330	12.7				0.99				
4:43:30	/	17010	1410	12.1				1.01				
4:45:30	/	17130	1530	11.2				1.00				
4:47:40	/	17260	1660	10.4				0.98				
4:50:00	/	17400	1800	9.7				0.97				
4:52:10	/	17530	1930	9.1				0.92				

PERSONNEL *Dis...*
LOC
JOB NO. *F18728.A0*

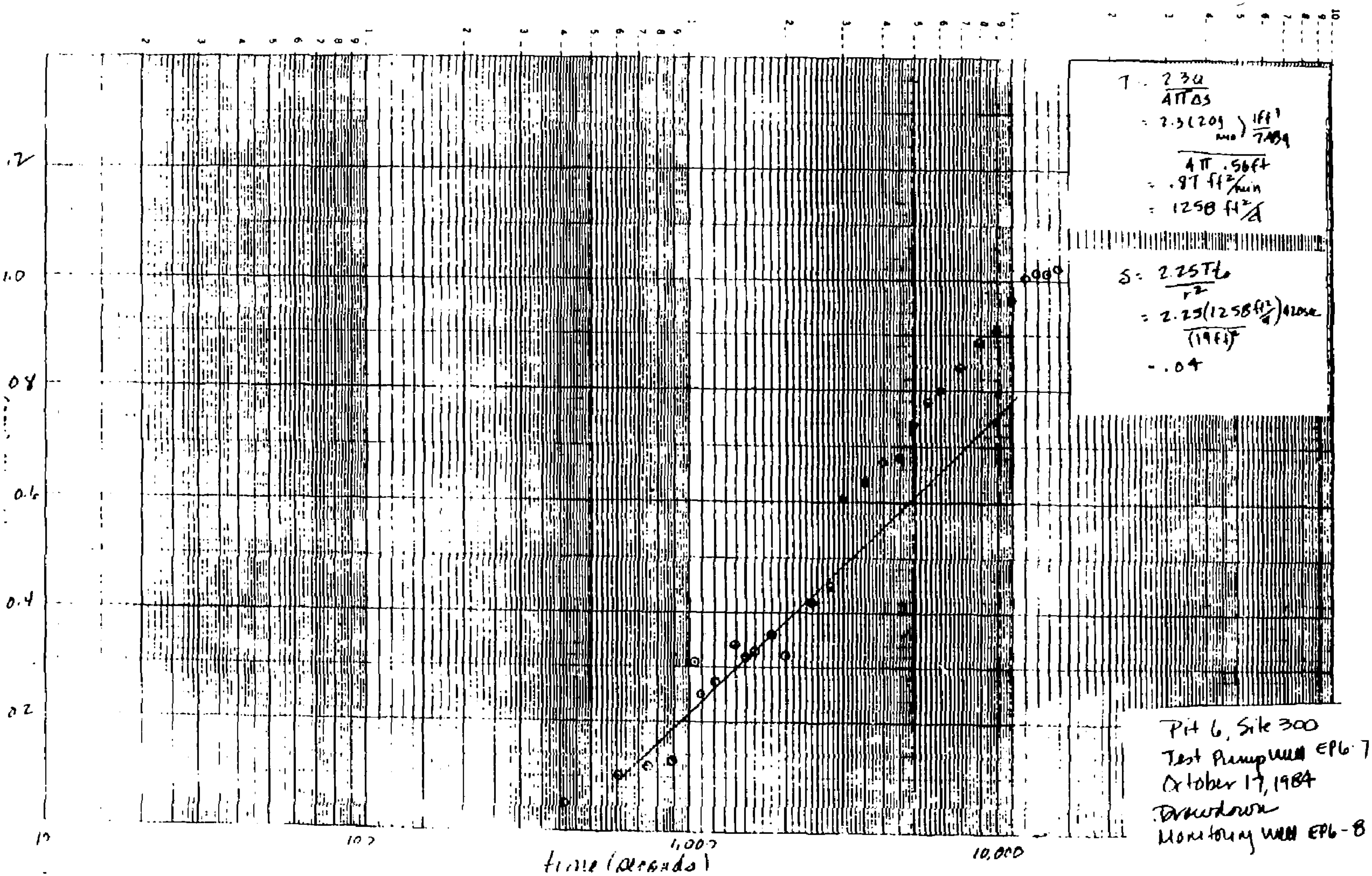
Form 128

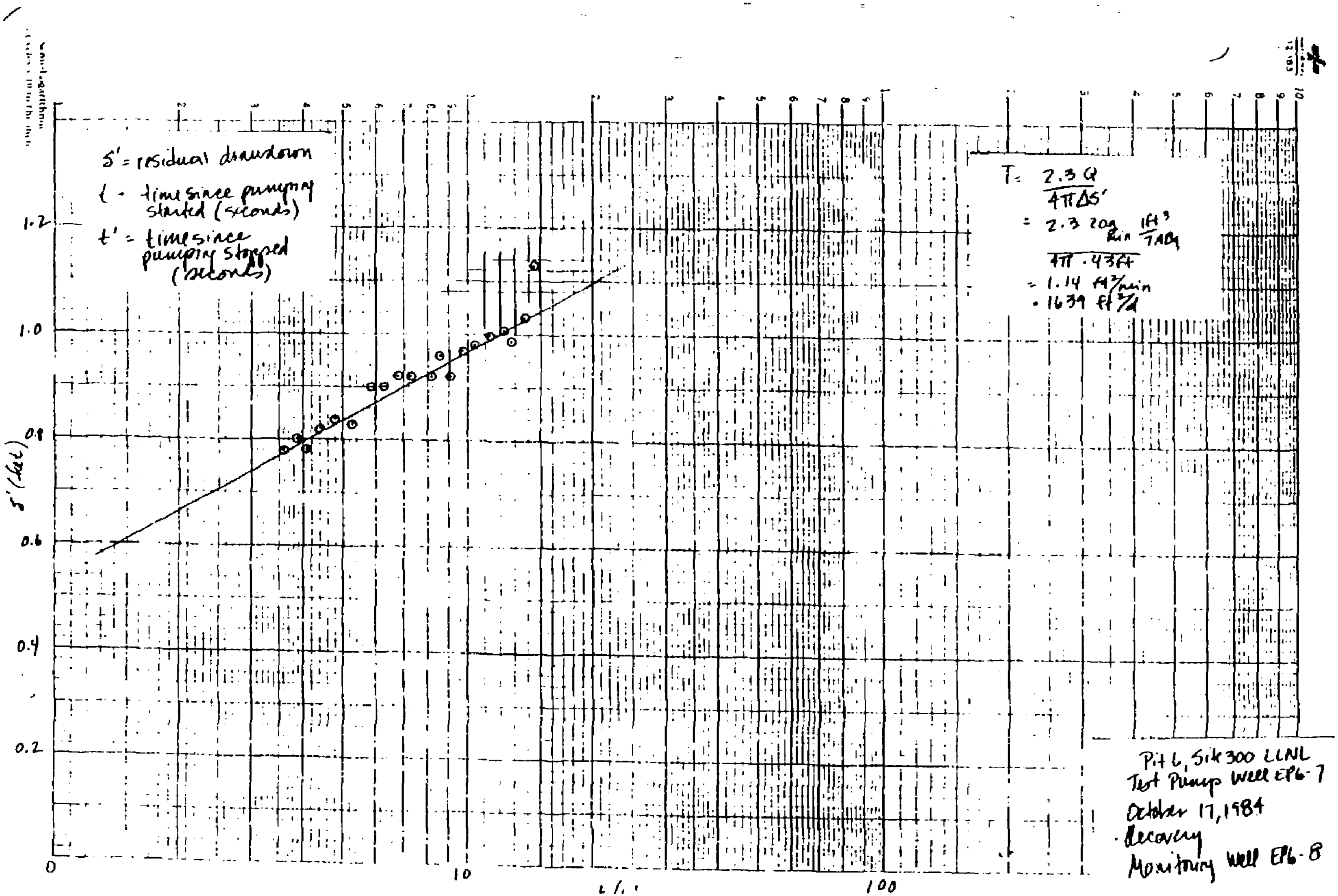


Pit 6, Site 300
Test Pump Well EPL-7
October 17, 1984
Drawdown
Monitoring Well EPL-8

K·E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 6013





s' = residual drawdown
t = time since pumping started (seconds)
t' = time since pumping stopped (seconds)
T = 2.3 Q / 4π Δs'
= 2.3 20g/min ft³/7.48g / 4π · .43 ft
= 1.14 ft²/min
= 1639 ft²/d
s' (feet)
t/t'
Pit 6, Site 300 LLNL
Test Pump Well EP6-7
October 17, 1984
Recovery
Monitoring Well EP6-8

CH2M HILL PUMPING TEST DATA

WELL K6-3
PUMPING/~~OBSERVATION~~ WELL
~~PUMPING~~/RECOVERY DATA
PAGE 1 OF 1

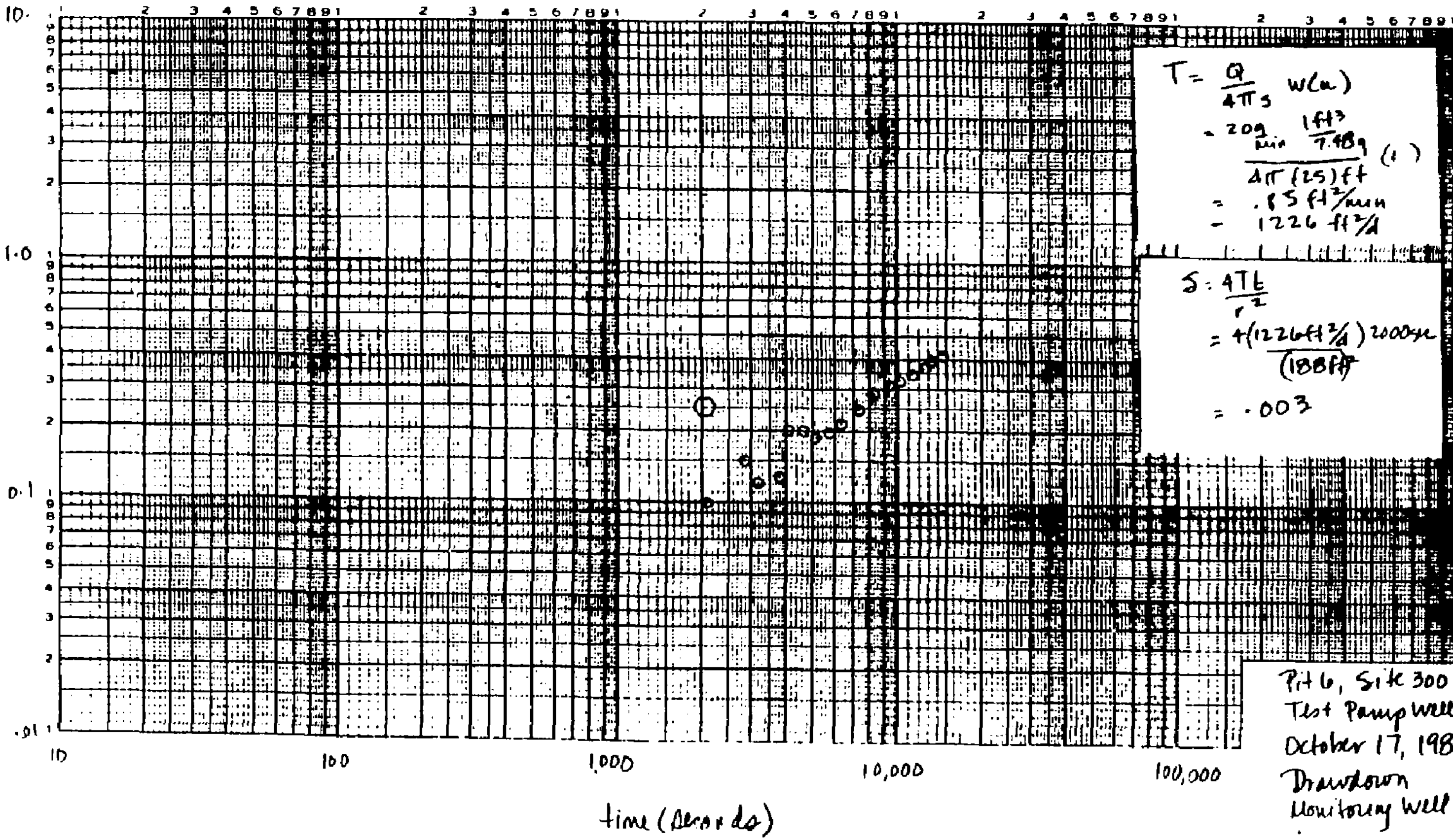
TYPE of PUMPING TEST constant discharge
HOW Q MEASURED water meter 5 gal bucket, stopwatch
HOW WL's MEASURED electric sounder
PUMPED WELL NO. EP6-7
RADIUS of PUMPED WELL 2" (4" diameter)
DISTANCE from PUMPED WELL 188'

M P for WL's top of casing elev. 724.62
DEPTH of PUMP/AIRLINE ______ wrt ______
% SUBMERGENCE : initial ______ ; pumping ______
PUMP ON : date 10/17/84 time 0900
PUMP OFF : date 10/17/84 time 1320

LOCATION [illegible] S. 300
PERSONNEL [illegible]
CLIENT NL
JOB NO. F18728.A0

TIME: t = ______ at t' = 0
WATER LEVEL DATA: STATIC WATER LEVEL ______

CLOCK TIME	ELAPSED TIME mins/hrs	t	t'	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'		WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
35:50		2150						0.10				
47.00		2820						0.15				
52:20		3140						0.12				
1:07:00		3720						0.13				
1:08:10		4090						0.20				
1:17:20		4640						0.20				
1:25:40		5140						0.19				
1:33:50		5630						0.20				
1:42:00		6120						0.22				
1:58:30		7110						0.25				
2:16:40		8200						0.29				
2:31:40		9100						0.32				
2:48:20		10,100						0.33				
3:06:30		11,190						0.35				
3:22:00		12,120						0.37				
3:38:50		13,130						090				
3:55:00		16 140						0.42				
4:12:30		15,150						0.44				
4:20:00		15600							begin recovery			
5:02:40		18160	2560	7.1				0.38				
5:06:40		18400	2800	6.6				0.38				
5:10:20		18620	3020	6.2				0.38				
5:14:20		18860	3260	5.8				0.37				
5:22:20		19340	3740	5.2				0.37				
5:29:30		19770	4170	4.7				0.37				
5:37:20		20240	4640	4.4				0.36				
5:46:20		20780	5180	4.0				0.36				
5:53:30		21210	5610	3.8				0.36				
6:02:10		21730	6130	3.5				0.35				

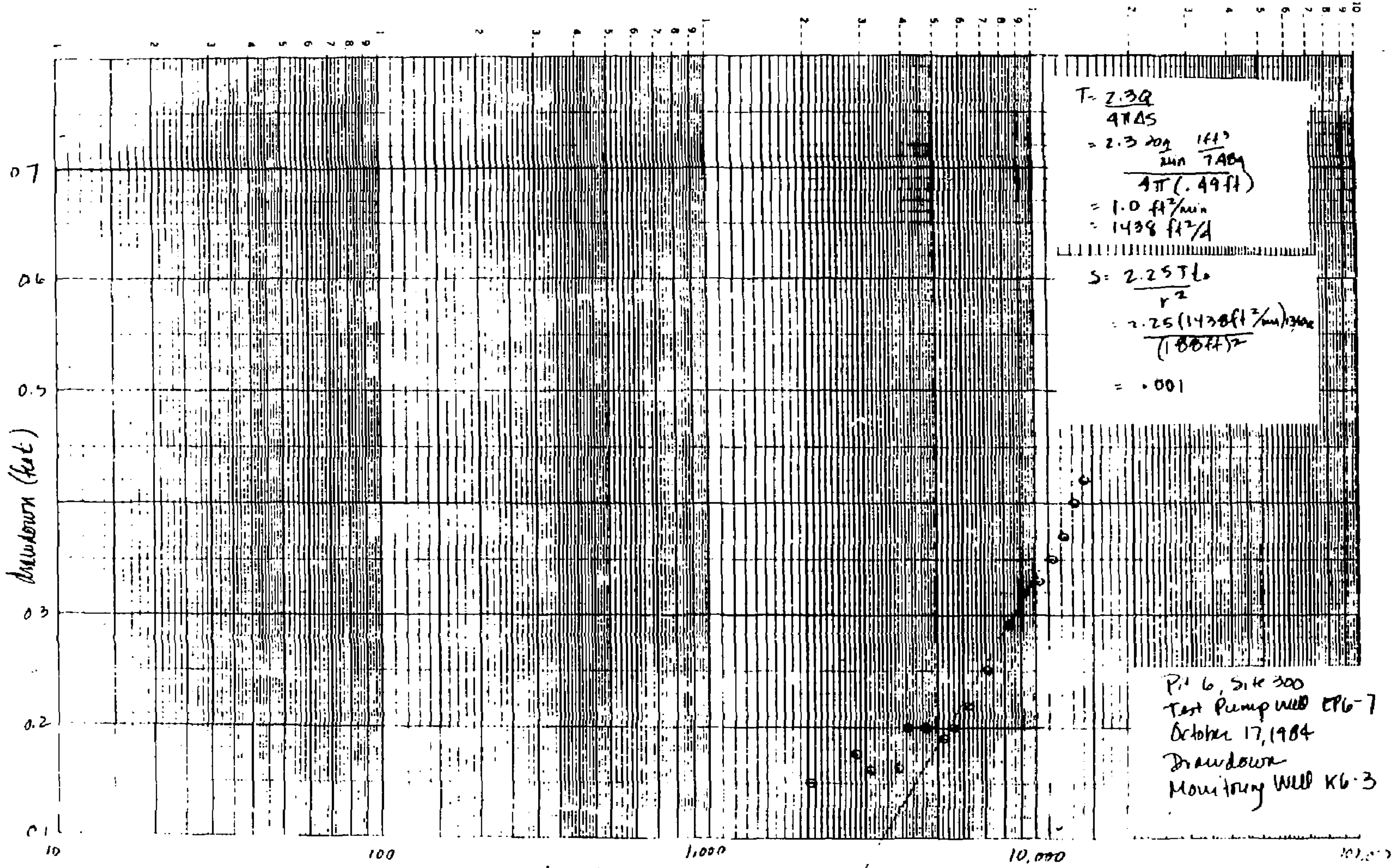


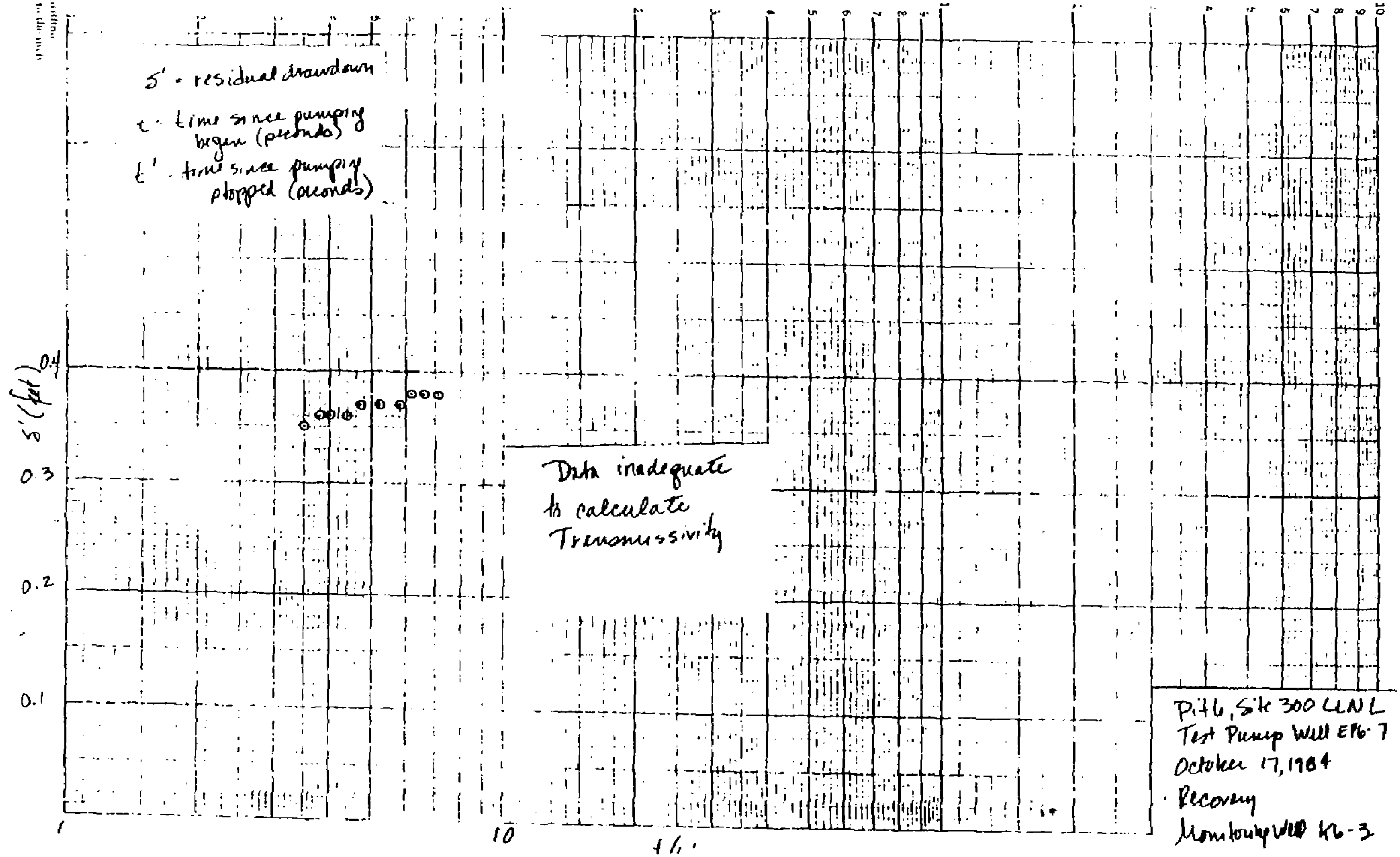
Pit 6, Site 300
Test Pump Well EP6-7
October 17, 1984
Drawdown
Monitoring Well K6-3

Logarithmic, 3 × 5

K•E SEMI-LOGARITHMIC 4 CYCLES X 70 DIVISIONS
KEUFFEL & ESSER CO.

46 6013





Semi-Logarithmic
3 Cycles x 10 to the inch

CH2M HILL PUMPING TEST DATA

WELL EP6-9
~~PUMPING~~/OBSERVATION WELL
~~PUMPING~~/RECOVERY DATA
PAGE 1 OF 1

TYPE of PUMPING TEST constant discharge
HOW Q MEASURED water meter, 5 gal bucket stopwatch
MP for WL's top steel casing elev. 693.39
HOW WL's MEASURED electric sounder
DEPTH of PUMP/AIRLINE ______ wrt ______
PUMPED WELL NO. EP6-9
% SUBMERGENCE : initial ______ ; pumping ______
RADIUS of PUMPED WELL 2" (4" diameter)
PUMP ON : date 10/19/84 time 1520 hrs
DISTANCE from PUMPED WELL —
PUMP OFF : date 10/19/84 time 1757 hrs

TIME: t = ______ at t' = 0
WATER LEVEL DATA: STATIC WATER LEVEL 27.82

CLOCK TIME	ELAPSED TIME (sec)	t	t'	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'		WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
0:30	30				40.00	Stickup .89	39.11	11.29				
1:00	60				45.00		44.11	16.29				
1:40	100				50.00		49.11	21.29				
2:30	150				54.00		53.11	25.29				
4:00	240				58.68		57.79	29.97				
4:20	260				59.12		58.23	30.41				
4:50	290				59.82		58.93	31.11				
												water level in EP6-9 did not change after 5 min since pumping began

PERSONNEL Purcell

JOB NO. F18728.A0 NL

Form 128

CH2M HILL PUMPING TEST DATA

WELL: EP6-9
PUMPING/OBSERVATION WELL (PUMPING circled)
PUMPING/RECOVERY DATA (RECOVERY DATA circled)
PAGE 1 OF 1

TYPE of PUMPING TEST: constant discharge
HOW Q MEASURED: water meter 5gal bucket, stopwatch
HOW WL's MEASURED: electric sounder
PUMPED WELL NO.: EP6-9
RADIUS of PUMPED WELL: 2" (4" diameter)
DISTANCE from PUMPED WELL: –

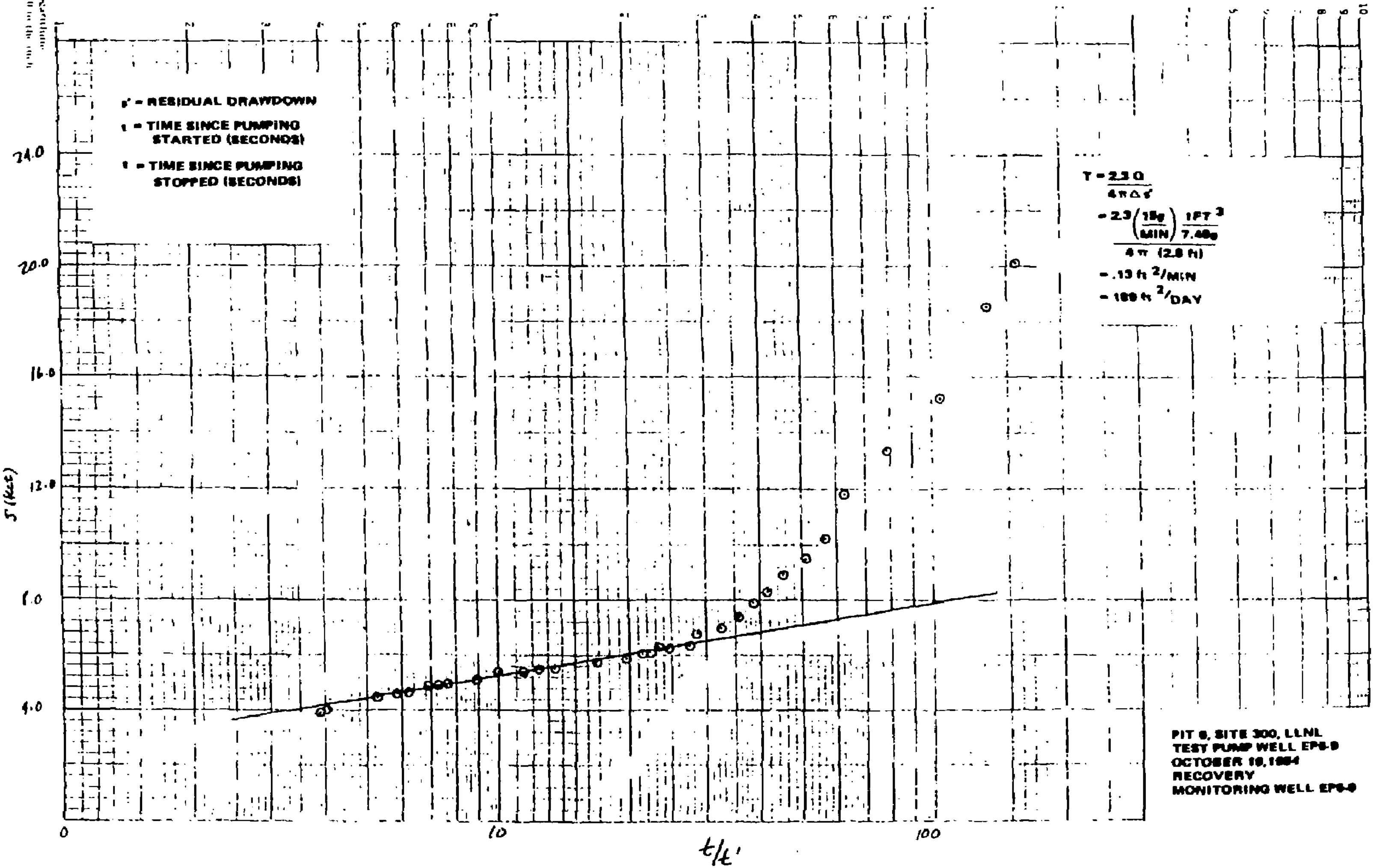
M P for WL's: top steel casing; elev 693.39
DEPTH of PUMP/AIRLINE ______ wrt ______
% SUBMERGENCE: initial ______; pumping ______
PUMP ON: date 10/19/84 time 1522?
PUMP OFF: date 10/19/84 time 1757?

JOB NO. F18728.A0

TIME: t = ______ at t' = 0

WATER LEVEL DATA — STATIC WATER LEVEL 30-1.32-.86 = 27.82

CLOCK TIME	ELAPSED TIME	t (hr)	t' (sec)	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'	WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
2:38:00		9490	60	158.0	50-1.2	stickup .86	47.94	20.12			
2:38:10		9490	70	135.6	50-3.7		45.44	17.62			
2:38:35		9515	90	105.7	45-1.1		43.04	15.22			
2:39:00		9540	120	79.5	45-2.85		41.29	13.47			
2:39:30		9570	150	63.8	45-4.6		39.54	11.72			
2:39:50		9590	170	56.4	40-.98		38.16	10.34			
2:40:10		9610	190	50.6	40-1.74		37.40	9.58			
2:40:30		9630	210	45.9	40-2.18		36.96	9.14			
2:40:50		9650	230	42.0	40-2.95		36.19	8.37			
2:41:10		9670	250	38.7	40-3.35		35.79	7.97			
2:41:30		9690	270	35.9	40-3.85		35.29	7.47			
2:42:00		9720	300	32.4	40-4.33		34.81	6.99			
2:42:30		9750	340	28.1	40-4.52		34.62	6.80			
2:43:00		9790	360	27.2	40-4.93		34.21	6.39			
2:43:40		9820	400	24.6	35-0		34.14	6.32			
2:44:00		9840	420	23.4	35-.02		34.12	6.30			
2:44:20		9860	440	22.4	35-.14		34.00	6.18			
2:44:40		9880	460	21.5	35-.25		33.89	6.07			
2:45:00		9900	480	20.6	35-.26		33.88	6.06			
2:45:20		9920	500	19.9	35-.33		33.81	5.99			
2:46:10		9970	550	18.1	35-.42		33.72	5.90			
2:47:00		10020	600	16.7	35-.52		33.62	5.80			
2:49:50		10190	770	13.2	35-.79		33.35	5.53			
2:50:30		10230	810	12.6	35-.80		33.34	5.52			
2:51:10		10270	850	12.1	35-.865		33.28	5.46			
2:52:00		10320	900	11.5	35-.90		33.24	5.42			
2:53:40		10420	1000	10.4	35-.96		33.18	5.36			
2:57:00		10620	1200	8.9	35-1.15		32.99	5.17			
3:00:20		10820	1400	7.7	35-1.32		32.82	5.00			
3:02:00		10920	1500	7.3	35-1.39		32.75	4.93			
3:03:40		11020	1600	6.9	35-1.46		32.68	4.86			
3:07:00		11220	1800	6.2	35-1.60		32.54	4.72			
3:09:00		11340	1920	5.9	35-1.66		32.48	4.66			
3:10:40		11440	2020	5.7	35-1.71	(?)	32.43	4.61			
3:13:40		11620	2200	5.3	35-1.86		32.28	4.46			
3:17:00		11820	2400	4.9	35-2.0		32.14	4.32			
3:22:40		12160	2740	4.4	35-2.14		32.00	4.18			
3:27:00		12420	3000	4.1	35-2.28		31.86	4.04			
3:30:30		12630	3210	3.9	35-2.39		31.75	3.93			



s' = RESIDUAL DRAWDOWN
t = TIME SINCE PUMPING STARTED (SECONDS)
t' = TIME SINCE PUMPING STOPPED (SECONDS)
24.0
20.0
16.0
12.0
8.0
4.0
s (feet)
0
10
100
t/t'
T = 2.3 Q / 4π Δs'
= 2.3 (15g / MIN) (1FT³ / 7.48g) / 4π (2.8 ft)
= .13 ft²/MIN
= 189 ft²/DAY
PIT 6, SITE 300, LLNL
TEST PUMP WELL EP6-9
OCTOBER 10, 1984
RECOVERY
MONITORING WELL EP6-9

CH2M HILL PUMPING TEST DATA

WELL K6-1
PUMPING/OBSERVATION WELL
PUMPING/RECOVERY DATA
PAGE 1 OF 2

TYPE of PUMPING TEST constant discharge, interference
HOW Q MEASURED water meter, 5 gal bucket
M P for WL's top pvc elev 699.26 ft, msl
HOW WL's MEASURED electric sounder
DEPTH of PUMP/AIRLINE ______ wrt ______
PUMPED WELL NO. EP6-9
% SUBMERGENCE: initial ______ ; pumping ______
RADIUS of PUMPED WELL 2" (4" diameter)
PUMP ON: date 10/19/84 time 1520 hrs
DISTANCE from PUMPED WELL 147'
PUMP OFF: date 10/19/84 time 1757 hrs

PERSONNEL [illegible]
JOB NO. F18728.A0
OCA
C T NL

TIME t= ___ at t'=0					WATER LEVEL DATA STATIC WATER LEVEL 23.92					WATER PRODUCT.		COMMENTS
CLOCK TIME	ELAPSED TIME t (secs)	t (sec)	t' (sec)	t/t'	READING (feet)	CONVERSIONS or CORRECTIONS	WATER LEVEL	s or s' (feet)			Q	(NOTE ANY CHANGES IN OBSERVERS)
6:40	400				.07			.07			15gpm	
7:00	420							.11				
7:40	460							.12				
8:00	480							.125				
8:20	500							.135				
9:10	550							.17				
10:00	600							.195				
10:50	650							.23				
11:40	700							.265				
12:30	750							.28			15	
13:20	800							.32				
14:10	850							.355				
15:00	900							.36				
16:40	1000							.41				
18:20	1100							.46				
20:00	1200							.54			15	
21:40	1300							.55				
23:20	1400							.60				
25:00	1500							.66				
26:40	1600							.69				
28:20	1700							.73				
31:40	1900							.81				
37:20	2240							.96				
40:00	2400							.99				
43:20	2600							1.08			15	
50:00	3000							1.19				
58:30	3510							1.33				
1:06:40	4000							1.47				
1:15:15	4515							1.605				
1:23:30	5010							1.69				
1:31:40	5500							1.82				
1:40:00	6000							1.91				
1:56:40	7000							2.14				
2:13:20	8000							2.29				possible decrease to ≈ 14 gpm
2:30:00	9000							2.42				
2:37:00	9420											begin recovery
2:48:00		10080	660	15.3				2.44				
2:54:50		10490	1070	9.8				2.39				
2:58:20		10700	1280	8.4				2.37				
3:04:20		11060	1670	6.6				2.32				

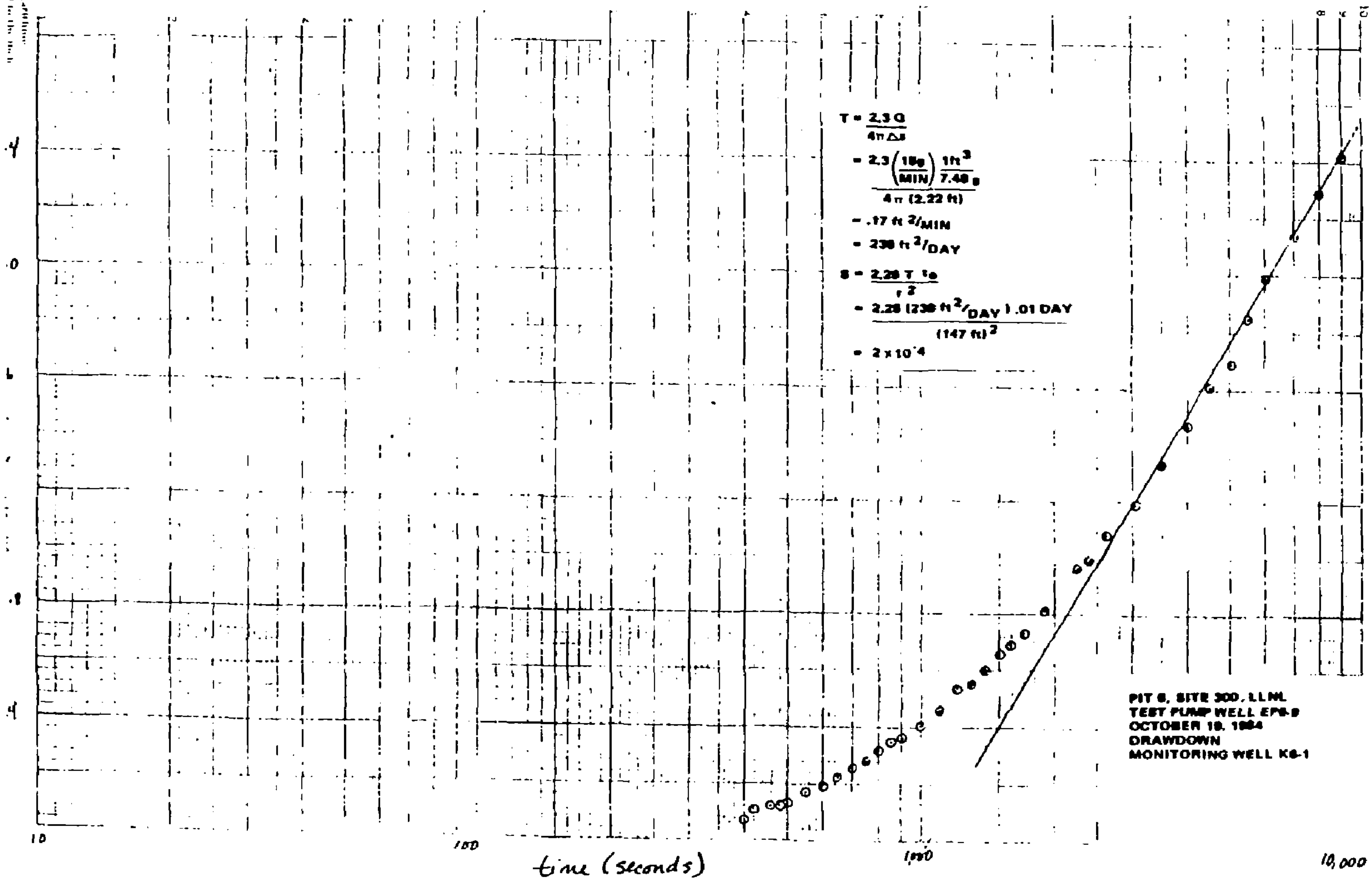
CH2M HILL PUMPING TEST DATA

WELL KG-1
PUMPING / OBSERVATION WELL
PUMPING / RECOVERY DATA
PAGE 2 OF 2

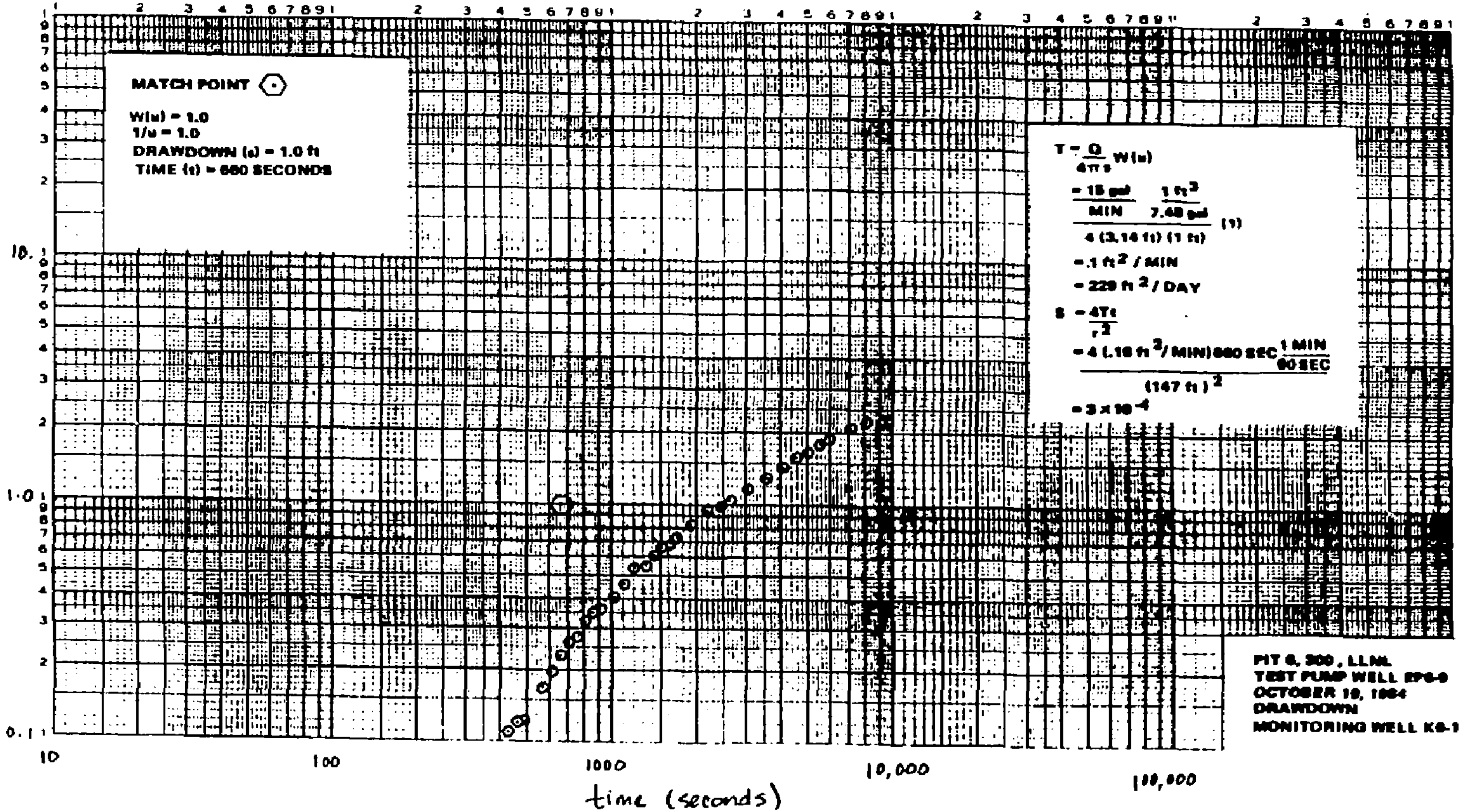
TYPE of PUMPING TEST constant discharge
HOW Q MEASURED water meter, 5 gal bucket stopwatch
M P for WL's top pvc elev 689.26 ft, MSL
HOW WL's MEASURED electric sounder
DEPTH of PUMP/AIRLINE – wrt
PUMPED WELL NO. EP6-9
% SUBMERGENCE : initial ; pumping
RADIUS of PUMPED WELL 2" (4" diameter)
PUMP ON : date 10/19/84 time 1520 hrs
DISTANCE from PUMPED WELL 147± feet
PUMP OFF : date 10/19/84 time 1757 hrs

LOCATION F... 30
PERSONNEL D Wallace
CL
JOB NO. F18728.A0

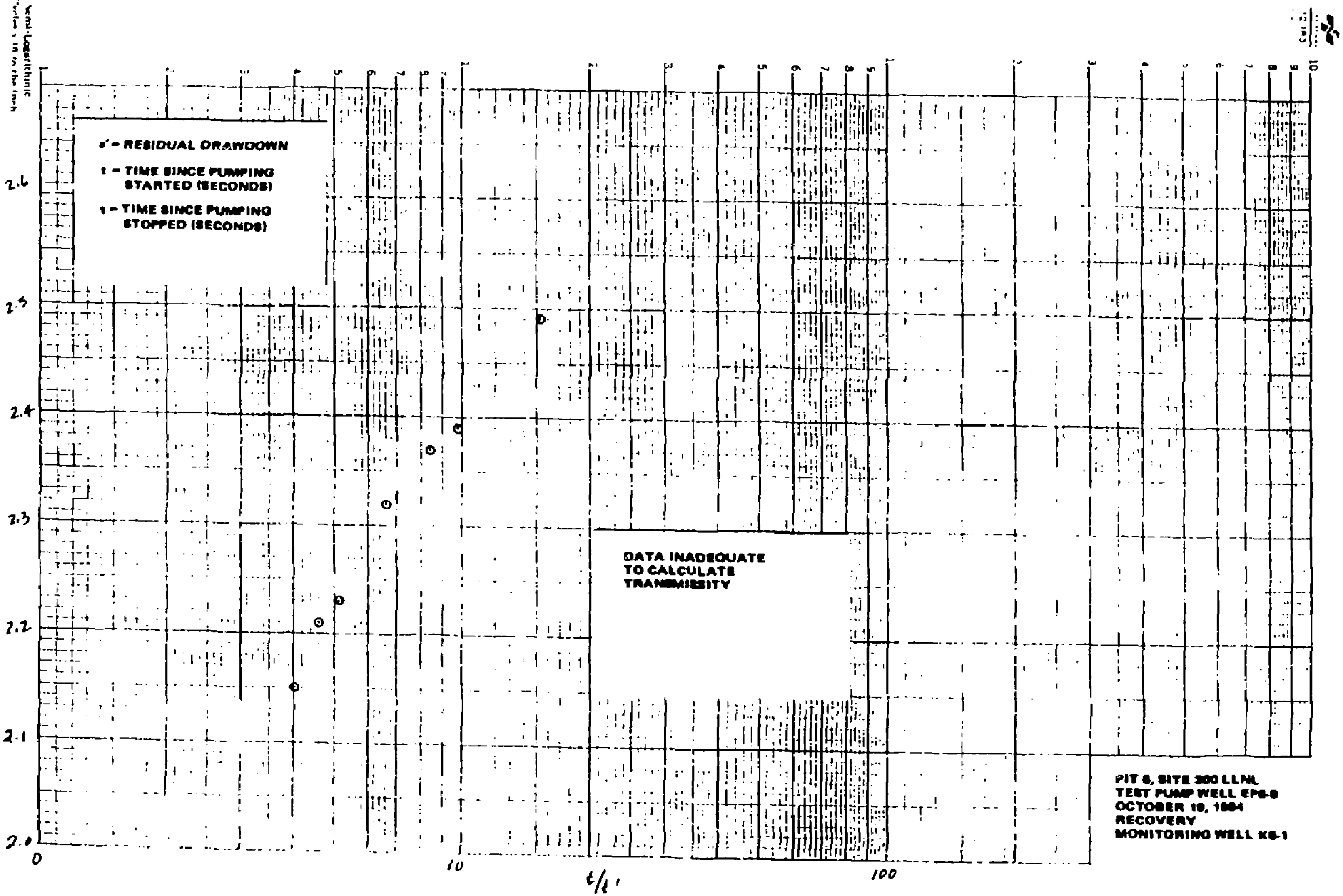
TIME (t = ___ at t' = 0)					WATER LEVEL DATA (STATIC WATER LEVEL ___)					WATER PRODUCT.		COMMENTS
CLOCK TIME	ELAPSED TIME mins/hrs	t	t'	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'			Q	(NOTE ANY CHANGES IN OBSERVERS)
3:15:10		11710	2290	5.1				2.23				
3:20:30		12030	2610	4.6				2.22				
3:28:25		12505	3085	4.0				2.15				



$T = \frac{2.3\,Q}{4\pi \Delta s}$
$= \frac{2.3\left(\frac{15\,g}{MIN}\right)\frac{1\,ft^3}{7.48\,g}}{4\pi\,(2.22\,ft)}$
$= .17\ ft^2/MIN$
$= 238\ ft^2/DAY$
$S = \frac{2.25\,T\,t_0}{r^2}$
$= \frac{2.25\,(238\ ft^2/DAY)\,.01\ DAY}{(147\ ft)^2}$
$= 2 \times 10^{-4}$
PIT 6, SITE 300, LLNL
TEST PUMP WELL EP6-9
OCTOBER 19, 1984
DRAWDOWN
MONITORING WELL K6-1
10
100
1000
10,000
time (seconds)



Full Logarithmic, 3 x 5


s' = RESIDUAL DRAWDOWN
t = TIME SINCE PUMPING STARTED (SECONDS)
t' = TIME SINCE PUMPING STOPPED (SECONDS)
DATA INADEQUATE TO CALCULATE TRANSMISSITY
PIT 6, SITE 300 LLNL
TEST PUMP WELL EP6-9
OCTOBER 19, 1984
RECOVERY
MONITORING WELL K6-1
2.0
2.1
2.2
2.3
2.4
2.5
2.6
0
10
100
t/t'
Semi-Logarithmic
3 Cycles x 10 to the Inch

CH2M HILL PUMPING TEST DATA

WELL 46-4
PUMPING / OBSERVATION WELL
PUMPING / RECOVERY DATA
PAGE 1 OF 1

TYPE of PUMPING TEST constant discharge
HOW Q MEASURED watermeter 5 gal bucket stopwatch
M P for WL's top pvc elev 706.53 ft MSL
HOW WL's MEASURED electric sounder
DEPTH of PUMP/AIRLINE ____ wrt ____
PUMPED WELL NO. EPG-9
% SUBMERGENCE : initial ____ ; pumping ____
RADIUS of PUMPED WELL 2" (4" diameter)
PUMP ON : date 10/19/84 time 1520 hrs
DISTANCE from PUMPED WELL 315?
PUMP OFF : date 10/19/84 time 1757 hrs

TIME t = ____ at t' = 0					WATER LEVEL DATA STATIC WATER LEVEL ____					WATER PRODUCT.		COMMENTS
CLOCK TIME	ELAPSED TIME mins/hrs	t	t'	t/t'	READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'			Q	(NOTE ANY CHANGES IN OBSERVERS)
36:30		2190					39 29	0				
46.11		2769					39 29	0				
1.01 17		3677					39.29	0				
1.36.15		5775					39.29	0				
2:17:05		8225					39.29	0				
												[illegible]
												measured during
												recovery period

PERSONNEL [illegible]

LOCA

JOB NO. F18728 A0

Form 128

CH2M HILL PUMPING TEST DATA

WELL EP6-8
PUMPING / OBSERVATION WELL
PUMPING / RECOVERY DATA
PAGE 1 OF 2

TYPE of PUMPING TEST Slug Test
HOW Q MEASURED —
HOW WL's MEASURED electric sounder
PUMPED WELL NO. EP6-8
RADIUS of PUMPED WELL 2" (4" diameter)
DISTANCE from PUMPED WELL —

M P for WL's top steel casing elev 767.19 ft MSL
DEPTH of PUMP/AIRLINE ______ wrt ______
% SUBMERGENCE : initial ______ ; pumping ______
PUMP ON : date 10/29/84 time 1300 hrs
PUMP OFF : date ______ time ______

LO ______ ON ______ PERSONNEL ______
JOB NO. F19728.AO "LA"

TIME (t = ___ at t' = 0) Clock Time	Elapsed Time mins/hrs	t	t'	t/t'	WATER LEVEL DATA (Static Water Level ___) Reading	Conversions or Corrections	Water Level	S or S'		WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
1:00		60			1.78							
1:10		70			1.57							
1:30		90			1.42							
1:40		100			1.27							
1:50		110			1.16							
2:00		120			1.07							
2:20		140			0.91							
2:40		160			0.79							
3:00		180			0.65							
3:10		190			0.59							
3:20		200			0.52							
3:35		215			0.44							
3:50		230			0.39							
4:10		250			0.33							
4:30		270			0.27							
4:40		280			0.19							
5:00		300			0.19							
5:30		330			0.16							
6:00		360			0.13							
6:20		380			0.12							
6:40		400			0.12							
7:00		420			0.11							
7:20		440			0.10							
7:40		460			0.10							
8:00		480			0.09							
8:20		500			0.09							
9:10		550			0.07							
10:00		600			0.07							
10:50		650			0.065							
11:50		700			0.06							
12:30		750			0.06							
13:30		800			0.05							
14:10		850			005							
15:00		900			0.04							
16:40		1000			0.035							
18:20		1100			0.035							
20:00		1200			0.035							
22:30		1350			0.03							
23:20		1400			0.03							
25:20		1520			0.025							

Form 126

CH2M HILL PUMPING TEST DATA

WELL EP6-8
PUMPING / OBSERVATION WELL
PUMPING / RECOVERY DATA
PAGE 2 OF 2

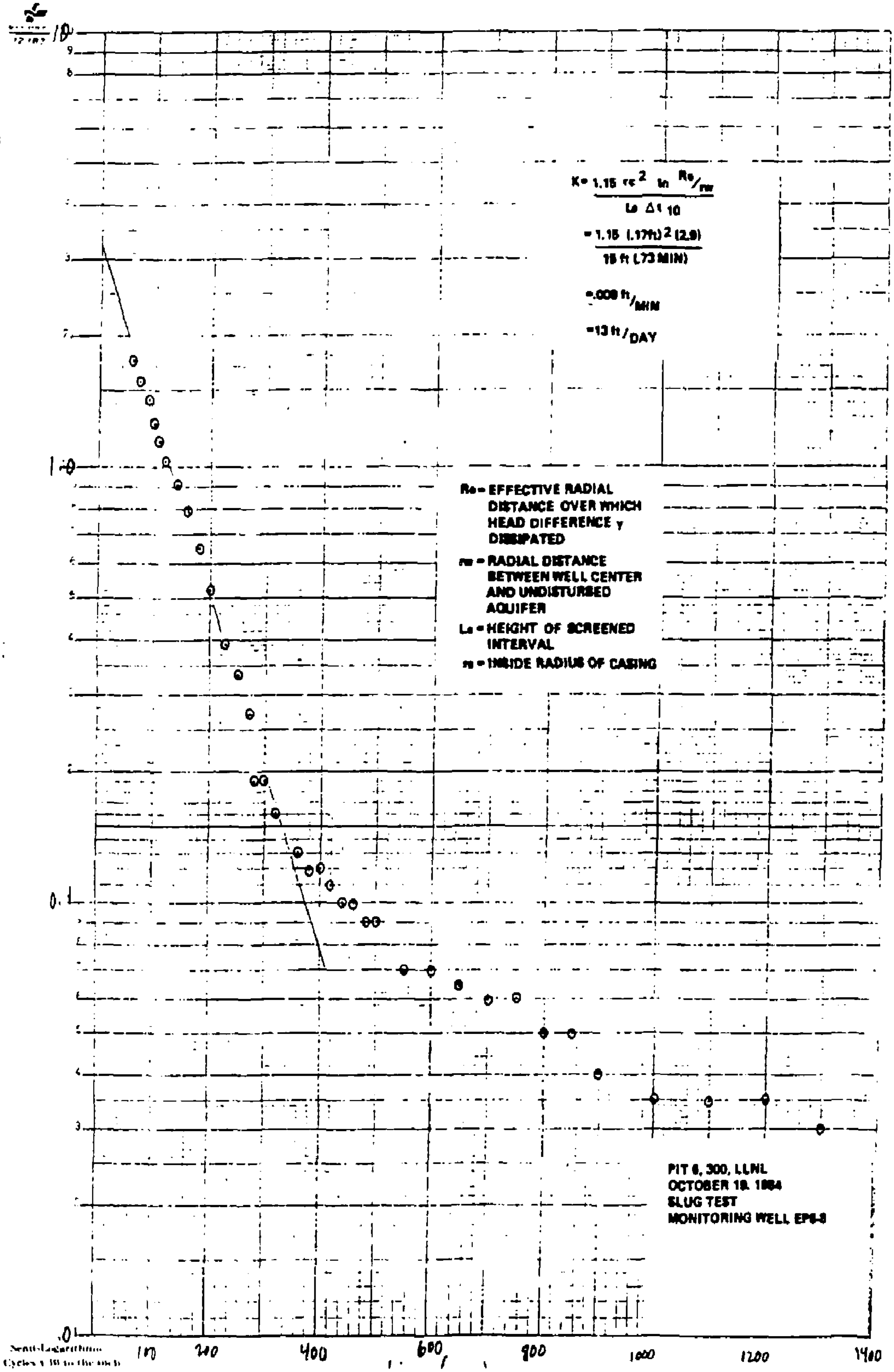
TYPE of PUMPING TEST: slug test
HOW Q MEASURED: –
HOW WL's MEASURED: electric sounder
PUMPED WELL NO.: EP6-8
RADIUS of PUMPED WELL: 2" (4" diameter)
DISTANCE from PUMPED WELL: –
M P for WL's: top steel casing elev 707.18 ft MSL
DEPTH of PUMP/AIRLINE: ______ wrt ______
% SUBMERGENCE: initial ______ ; pumping ______
PUMP ON: date 10/29/84 time 3:00 hrs
PUMP OFF: date ______ time ______

JOB NO. 118728.A0 [illegible]
PERSONNEL [illegible]

TIME: CLOCK TIME	ELAPSED TIME: min/hrs	ELAPSED TIME: t	ELAPSED TIME: t'	t/t'	WATER LEVEL DATA: READING	CONVERSIONS or CORRECTIONS	WATER LEVEL	S or S'		WATER PRODUCT.	Q	COMMENTS (NOTE ANY CHANGES IN OBSERVERS)
26:40		1600			0.025							
28:20		1700			0.02							
30:00		1800			0.02							
31:40		1900			0.02							
33:20		2000			0.02							
37:00		2220			0.02							

t = ______ at t' = 0
STATIC WATER LEVEL ______

Form 128



K= 1.15 rc 2 ln Re/rw
Le Δt 10
= 1.15 (.17ft) 2 (2.9)
15 ft (.73 MIN)
=.008 ft/MIN
=13 ft/DAY
Re = EFFECTIVE RADIAL DISTANCE OVER WHICH HEAD DIFFERENCE y DISSIPATED
rw = RADIAL DISTANCE BETWEEN WELL CENTER AND UNDISTURBED AQUIFER
Le = HEIGHT OF SCREENED INTERVAL
rc = INSIDE RADIUS OF CASING
PIT 6, 300, LLNL
OCTOBER 19, 1984
SLUG TEST
MONITORING WELL EP6-8
10
1.0
0.1
.01
200
400
600
900
1000
1200
1400

California Analytical Laboratories, Inc.
2544 Industrial Boulevard • West Sacramento, CA 95691 • (916) 372-1393

November 28, 1984
Lab No. 19549, 19562
19620

Debbie Wallace
CH2M Hill
2200 Powell Street
Emeryville, CA 94608

Dear Debbie:

Please include the following radiochemistry data with our report of November 13, 1984.

CAL I.D.	pCi/L gross-a	gross-b	radium (Ra228)
19549-1	1.4 ± 2.4	<10	<3
-2	3.5 ± 2.6	<10	<3
-3	2.9 ± 2.6	<10	<3
-4	1.4 ± 2.4	<10	<3
19562-1	3.9 ± 2.7	5.2 ± 6.4	<3
-2	2.3 ± 2.6	6.5 ± 6.5	<3
-3	<3	<10	<3
19620	<3	<10	<3

Also, I have attached the EPA Method 608 results which we forgot to include previously.

Sincerely,

Charlie

Charles J. Soderquist, PhD
Vice President

CJS:nc

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. K6-1 CAL I.D. 19549-1

OC Compound	(ug/L) (ppb) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	↓
beta-BHC	↓
heptachlor	↓
delta-BHC	↓
aldrin	↓
heptachlor epoxide	↓
endosulfan I/II	↓
p,p'-DDE	↓
dieldrin	↓
endrin	↓
p,p'-DDD	↓
p,p'-DDT	↓
endrin aldehyde	↓
endosulfan sulfate	↓
chlordane	<1
toxaphene	<10
PCB-1242	<1
PCB-1254	↓
PCB-1221	↓
PCB-1232	↓
PCB-1248	↓
PCB-1260	↓
PCB-1016	↓

PREPARED BY GS

APPROVED BY BMB

DATE 11-27-84

California Analytical Laboratories, Inc.

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. K6-7

CAL I.D. 19549-2

OC Compound	ug/L (ppb) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	↓
beta-BHC	↓
heptachlor	↓
delta-BHC	↓
aldrin	↓
heptachlor epoxide	↓
endosulfan I/II	↓
p,p'-DDE	↓
dieldrin	↓
endrin	↓
p,p'-DDD	↓
p,p'-DDT	↓
endrin aldehyde	↓
endosulfan sulfate	↓
chlordane	<1
toxaphene	<10
PCB-1242	<1
PCB-1254	↓
PCB-1221	↓
PCB-1232	↓
PCB-1248	↓
PCB-1260	↓
PCB-1016	↓

PREPARED BY [illegible]

APPROVED BY [illegible]

DATE 11-27-84

California Analytical Laboratories, Inc.

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. K6-B

CAL I.D. 19549-3

OC Compound	(ug/L) (ppb) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	↓
beta-BHC	↓
heptachlor	↓
delta-BHC	↓
aldrin	↓
heptachlor epoxide	↓
endosulfan I/II	↓
p,p'-DDE	↓
dieldrin	↓
endrin	↓
p,p'-DDD	↓
p,p'-DDT	↓
endrin aldehyde	↓
endosulfan sulfate	↓
chlordane	< 1
toxaphene	< 10
PCB-1242	< 1
PCB-1254	↓
PCB-1221	↓
PCB-1232	↓
PCB-1248	↓
PCB-1260	↓
PCB-1016	↓

PREPARED BY CS

APPROVED BY AnB

DATE 11-27-84

California Analytical Laboratories, Inc.

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. EP6-8 CAL I.D. 19549-4

OC Compound	(ug/L) (ppb) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	↓
beta-BHC	
heptachlor	
delta-BHC	
aldrin	
heptachlor epoxide	
endosulfan I/II	
p,p'-DDE	
dieldrin	
endrin	
p,p'-DDD	
p,p'-DDT	
endrin aldehyde	
endosulfan sulfate	↓
chlordane	<1
toxaphene	<10
PCB-1242	<1
PCB-1254	↓
PCB-1221	
PCB-1232	
PCB-1248	
PCB-1260	
PCB-1016	↓

PREPARED BY CS

APPROVED BY BMB

DATE 11-27-84

California Analytical Laboratories, Inc.

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. K6-3

CAL I.D. 19562-1

OC Compound	ug/L (ppb) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	
beta-BHC	
heptachlor	
delta-BHC	
aldrin	
heptachlor epoxide	
endosulfan I/II	
p,p'-DDE	
dieldrin	
endrin	
p,p'-DDD	
p,p'-DDT	
endrin aldehyde	
endosulfan sulfate	
chlordane	<1
toxaphene	<10
PCB-1242	<1
PCB-1254	
PCB-1221	
PCB-1232	
PCB-1248	
PCB-1260	
PCB-1016	

PREPARED BY [illegible]

APPROVED BY [illegible]

DATE 11-27-84

California Analytical Laboratories, Inc.

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. K6-4

CAL I.D. 19562-2

OC Compound	(ug/L) (ppb) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	↓
beta-BHC	↓
heptachlor	↓
delta-BHC	↓
aldrin	↓
heptachlor epoxide	↓
endosulfan I/II	↓
p,p'-DDE	↓
dieldrin	↓
endrin	↓
p,p'-DDD	↓
p,p'-DDT	↓
endrin aldehyde	↓
endosulfan sulfate	↓
chlordane	<1
toxaphene	<10
PCB-1242	<1
PCB-1254	↓
PCB-1221	↓
PCB-1232	↓
PCB-1248	↓
PCB-1260	↓
PCB-1016	↓

PREPARED BY CJS

APPROVED BY BMB

DATE 11-27-84

California Analytical Laboratories, Inc.

ORGANOCHLORINE PESTICIDES AND PCB'S

EPA Method 608

Sample I.D. K6-9   CAL I.D. 19562-3

OC Compound	ug/L (ppb) (circled) or ug/g (ppm)
alpha-BHC	<0.1
gamma-BHC	↓
beta-BHC	↓
heptachlor	↓
delta-BHC	↓
aldrin	↓
heptachlor epoxide	↓
endosulfan I/II	↓
p,p'-DDE	↓
dieldrin	↓
endrin	↓
p,p'-DDD	↓
p,p'-DDT	↓
endrin aldehyde	↓
endosulfan sulfate	↓
chlordane	<1
toxaphene	<10
PCB-1242	<1
PCB-1254	↓
PCB-1221	↓
PCB-1232	↓
PCB-1248	↓
PCB-1260	↓
PCB-1016	↓

PREPARED BY CS

APPROVED BY BAB

DATE 11-27-84

California Analytical Laboratories, Inc.
2544 Industrial Boulevard • West Sacramento, CA 95691 • (916) 372-1393

November 13, 1984
Lab No. 19459, 19562 & 19620
Received: 10/18, 10/20 & 10/26/84
Job #F18728.A0

Debbie Wallace
CH2M Hill
2200 Powell Street
Emeryville, CA 94608

Fourteen water samples were received in various CAL Lab containers to be analyzed as indicated below:

CAL I.D.	Sample I.D.
19549-1	K6-1
-2	K6-7
-3	K6-8
-4	EP6-8
-5	B619
-6	B6560
19562-1	K6-3
-2	K6-4
-3	K6-9
-4	B0000
-5	B4002
-6	B4008
-7	B622
19620	Ranger

Samples 19549-5, -6 and 19562-4, -5, -6 and -7 were analyzed for halogenated volatiles by EPA Method 601. All other samples were analyzed for organic Priority Pollutants by EPA Methods 608, 624 and 625; for Priority Pollutant metals by ICP and AA; for pH, EC, and chloride by standard wet chemical techniques; and for gross-alpha, gross-beta and total radium radioactivity.

RESULTS:

Results are on the attached data sheets and data table.

PRIORITY POLLUTANT METALS
(EXPANDED LIST)
Data Sheet

SAMPLE ID: K6-1 CAL ID: 19549-1

Element	Results (ppm) mg/Kg or mg/L
Antimony	0.02
Arsenic	0.018
Beryllium	<0.005
Cadmium	<0.05
Chromium	<0.01
Copper	<0.05
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	0.014
Additional Elements	
Aluminum	<0.2
Barium	<0.1
Boron	1.8
Cobalt	<0.05
Iron	0.05
Manganese	0.099
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY ____
APPROVED BY ____ DATE 11/15/82

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS
(EXPANDED LIST)
Data Sheet

SAMPLE ID: K6-3   CAL ID: 19562-1

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	0.014
Beryllium	<0.005
Cadmium	0.089
Chromium	0.017
Copper	0.078
Lead	<0.05
Mercury	<0.0005
Nickel	0.051
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	0.99
Additional Elements	
Aluminum	5.2
Barium	<0.1
Boron	1.2
Cobalt	<0.05
Iron	2.4
Manganese	0.31
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY [signature]
APPROVED BY [signature]   DATE 11/15/84

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS

(EXPANDED LIST)

Data Sheet

SAMPLE ID: K6-4 CAL ID: 19562-2

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	0.012
Beryllium	<0.005
Cadmium	0.060
Chromium	0.019
Copper	0.093
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	0.97
Additional Elements	
Aluminum	3.0
Barium	0.10
Boron	1.8
Cobalt	<0.05
Iron	4.0
Manganese	0.62
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY ____

APPROVED BY ____ DATE 11/5/84

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS

(EXPANDED LIST)

Data Sheet

SAMPLE ID: K6-7 CAL ID: 19549-2

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	0.015
Beryllium	<0.005
Cadmium	<0.05
Chromium	<0.01
Copper	<0.05
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	<0.01
Additional Elements	
Aluminum	<0.2
Barium	<0.1
Boron	1.2
Cobalt	<0.05
Iron	0.064
Manganese	0.023
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY ______

APPROVED BY ______ DATE 11/15/82

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS

(EXPANDED LIST)

Data Sheet

SAMPLE ID: K6-8 CAL ID: 19549-3

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	0.015
Beryllium	<0.005
Cadmium	<0.05
Chromium	<0.01
Copper	<0.05
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	0.016
Additional Elements	
Aluminum	<0.2
Barium	<0.1
Boron	0.93
Cobalt	<0.05
Iron	<0.05
Manganese	0.015
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY [signature]

APPROVED BY [signature] DATE 11/15/84

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS

(EXPANDED LIST)

Data Sheet

SAMPLE ID: EP6-8 CAL ID: 19549-4

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	0.013
Beryllium	<0.005
Cadmium	<0.05
Chromium	<0.01
Copper	<0.05
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	<0.01
Additional Elements	
Aluminum	<0.2
Barium	<0.1
Boron	1.1
Cobalt	<0.05
Iron	<0.05
Manganese	0.016
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY ________

APPROVED BY ________ DATE 11/15/84

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS

(EXPANDED LIST,

Data Sheet

SAMPLE ID: K6-9 CAL ID: 19562-3

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	0.011
Beryllium	<0.005
Cadmium	<0.05
Chromium	0.011
Copper	<0.05
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	0.032
Additional Elements	
Aluminum	0.26
Barium	<0.1
Boron	1.8
Cobalt	<0.05
Iron	0.35
Manganese	0.048
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY [signature]

APPROVED BY [signature] DATE 11/15/84

California Analytical Laboratories, Inc.

PRIORITY POLLUTANT METALS
(EXPANDED LIST)
Data Sheet

SAMPLE ID: Ranger CAL ID: 19620

Element	Results (ppm) mg/Kg or mg/L
Antimony	<0.02
Arsenic	<0.01
Beryllium	<0.005
Cadmium	<0.05
Chromium	<0.01
Copper	<0.05
Lead	<0.05
Mercury	<0.0005
Nickel	<0.05
Selenium	<0.005
Silver	<0.01
Thallium	<0.01
Zinc	0.036
Additional Elements	
Aluminum	<0.2
Barium	<0.1
Boron	1.9
Cobalt	<0.05
Iron	<0.05
Manganese	0.058
Vanadium	<0.2

Values for solids are based on wet weight.

PREPARED BY ________
APPROVED BY ________ DATE 11/15/82

California Analytical Laboratories, Inc.

VOLATILE HALOGENATED ORGANICS

EPA Method 601

Data Sheet

Sample I.D. B619

CAL I.D. 19549-5

	ug/L (ppb) or ug/g (ppm)
1,1-Dichloroethylene	
1,1-Dichloroethane	
trans-1,2-Dichloroethylene	
Chloroform	3.0
1,1,2-Trichloro-2,2,1-trifluoroethane	
1,2-Dichloroethane	
1,1,1-Trichloroethane	
Carbon tetrachloride	2.5
Bromodichloromethane	
1,2-Dichloropropane	
cis-1,3-Dichloropropylene	
Trichloroethylene	
trans-1,3-Dichloropropylene	
1,1,2-Trichloroethane	
Dibromochloromethane	
1,2-Dibromoethane	
Bromoform	
Tetrachloroethylene	
1,1,2,2-Tetrachloroethane	
Chlorobenzene	
DETECTION LIMIT	0.5

PREPARED BY SB

APPROVED BY BWB

DATE 11-5-84

California Analytical Laboratories, Inc.

VOLATILE HALOGENATED ORGANICS

EPA Method 601

Data Sheet

Sample I.D. B6560 CAL I.D. 1954-6

	ug/L (ppb) or ug/g (ppm)
1,1-Dichloroethylene	ND
1,1-Dichloroethane	↓
trans-1,2-Dichloroethylene	
Chloroform	
1,1,2-Trichloro-2,2,1-trifluoroethane	
1,2-Dichloroethane	
1,1,1-Trichloroethane	
Carbon tetrachloride	
Bromodichloromethane	
1,2-Dichloropropane	
cis-1,3-Dichloropropylene	
Trichloroethylene	
trans-1,3-Dichloropropylene	
1,1,2-Trichloroethane	
Dibromochloromethane	
1,2-Dibromoethane	
Bromoform	
Tetrachloroethylene	
1,1,2,2-Tetrachloroethane	
Chlorobenzene	↓
DETECTION LIMIT	0.5

PREPARED BY SB

APPROVED BY BRB

DATE 11-5-84

California Analytical Laboratories, Inc.

VOLATILE HALOGENATED ORGANICS

EPA Method 601

Data Sheet

Sample I.D. B0000 CAL I.D. 19562-4

	(ug/L) (ppb) or ug/g (ppm)
1,1-Dichloroethylene	ND
1,1-Dichloroethane	↓
trans-1,2-Dichloroethylene	↓
Chloroform	↓
1,1,2-Trichloro-2,2,1-trifluoroethane	↓
1,2-Dichloroethane	↓
1,1,1-Trichloroethane	↓
Carbon tetrachloride	↓
Bromodichloromethane	↓
1,2-Dichloropropane	↓
cis-1,3-Dichloropropylene	↓
Trichloroethylene	↓
trans-1,3-Dichloropropylene	↓
1,1,2-Trichloroethane	↓
Dibromochloromethane	↓
1,2-Dibromoethane	↓
Bromoform	↓
Tetrachloroethylene	↓
1,1,2,2-Tetrachloroethane	↓
Chlorobenzene	↓
DETECTION LIMIT	0.5

PREPARED BY SB

APPROVED BY BMB

DATE 11-5-84

California Analytical Laboratories, Inc.

VOLATILE HALOGENATED ORGANICS

EPA Method 601

Data Sheet

Sample I.D. B4002 CAL I.D. 19562-5

	ug/L (ppb) or ug/g (ppm)
1,1-Dichloroethylene	ND
1,1-Dichloroethane	↓
trans-1,2-Dichloroethylene	
Chloroform	
1,1,2-Trichloro-2,2,1-trifluoroethane	
1,2-Dichloroethane	
1,1,1-Trichloroethane	
Carbon tetrachloride	
Bromodichloromethane	
1,2-Dichloropropane	
cis-1,3-Dichloropropylene	
Trichloroethylene	
trans-1,3-Dichloropropylene	
1,1,2-Trichloroethane	
Dibromochloromethane	
1,2-Dibromoethane	
Bromoform	
Tetrachloroethylene	
1,1,2,2-Tetrachloroethane	
Chlorobenzene	
DETECTION LIMIT	0.5

PREPARED BY SB

APPROVED BY BMB DATE 11-5-84

California Analytical Laboratories, Inc.

VOLATILE HALOGENATED ORGANICS

EPA Method 601

Data Sheet

Sample I.D. B4008 CAL I.D. 19562-6

	ug/L (ppb) or ug/g (ppm)
1,1-Dichloroethylene	ND
1,1-Dichloroethane	
trans-1,2-Dichloroethylene	
Chloroform	
1,1,2-Trichloro-2,2,1-trifluoroethane	
1,2-Dichloroethane	
1,1,1-Trichloroethane	
Carbon tetrachloride	
Bromodichloromethane	
1,2-Dichloropropane	
cis-1,3-Dichloropropylene	
Trichloroethylene	
trans-1,3-Dichloropropylene	
1,1,2-Trichloroethane	
Dibromochloromethane	
1,2-Dibromoethane	
Bromoform	
Tetrachloroethylene	
1,1,2,2-Tetrachloroethane	
Chlorobenzene	
DETECTION LIMIT	0.5

PREPARED BY SB

APPROVED BY BMS

DATE 11-5-84

California Analytical Laboratories, Inc.

VOLATILE HALOGENATED ORGANICS

EPA Method 601

Data Sheet

Sample I.D. B622 CAL I.D. 19562-7

Compound	ug/L (ppb) or ug/g (ppm)
1,1-Dichloroethylene	ND
1,1-Dichloroethane	
trans-1,2-Dichloroethylene	
Chloroform	
1,1,2-Trichloro-2,2,1-trifluoroethane	
1,2-Dichloroethane	
1,1,1-Trichloroethane	
Carbon tetrachloride	
Bromodichloromethane	
1,2-Dichloropropane	
cis-1,3-Dichloropropylene	
Trichloroethylene	
trans-1,3-Dichloropropylene	
1,1,2-Trichloroethane	
Dibromochloromethane	
1,2-Dibromoethane	
Bromoform	
Tetrachloroethylene	
1,1,2,2-Tetrachloroethane	
Chlorobenzene	
DETECTION LIMIT	0.5

PREPARED BY SB

APPROVED BY BMB

DATE 11-5-84

California Analytical Laboratories, Inc.

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: K6 - 1 CAL LAB NO: 19549-1

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: [signature]

Date: 11/12/84

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: K6 - 7 CAL LAB NO: 19549-2

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: [signature]

Date: 11/12/84

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: K6 - 8   CAL LAB NO: 19549-3

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: KWM   Date: 11/12/84

California Analytical Laboratories, Inc.

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: EP6 - 8 CAL LAB NO: 19549-4

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: [signature] Date: 11/12/84

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: K6 - 4 CAL LAB NO: 19562-2

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: JB

Approved by: [signature] Date: 11/12/84

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: K6 - 3 CAL LAB NO: 19562-1

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	160
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: NBM

Date: 11/12/84

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: K6 - 9　　　CAL LAB NO: 19562-3

PP#	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: [signature]　　　Date: 11/12/84

EPA METHOD 624 (EXPANDED)
Data sheet

CLIENT ID: RANGER CAL LAB NO: 19620-1

PPW	VOLATILES	ug/L
2V	acrolein	<100
3V	acrylonitrile	<100
4V	benzene	<5
6V	carbon tetrachloride	<5
7V	chlorobenzene	<5
10V	1,2-dichloroethane	<5
11V	1,1,1-trichloroethane	<5
13V	1,1-dichloroethane	<5
14V	1,1,2-trichloroethane	<5
15V	1,1,2,2-tetrachloroethane	<10
16V	chloroethane	<10
19V	2-chloroethylvinyl ether	<10
23V	chloroform	<5
29V	1,1-dichloroethene	<5
30V	trans-1,2-dichloroethene	<5
32V	1,2-dichloropropane	<10
33V	1,3-dichloropropene	<5
38V	ethylbenzene	<5
44V	methylene chloride	<5
45V	chloromethane	<10
46V	bromomethane	<10
47V	bromoform	<10
48V	bromodichloromethane	<5
49V	fluorotrichloromethane	<10
50V	dichlorodifluoromethane	<10
51V	chlorodibromomethane	<5
85V	tetrachloroethene	<5
86V	toluene	<5
87V	trichloroethene	<5
88V	vinyl chloride	<10

NON-PRIORITY POLLUTANT HAZARDOUS SUBSTANCES LIST COMPOUNDS

CL13	acetone	<5
CL14	2-butanone	<5
CL15	carbondisulfide	<5
CL16	2-hexanone	<5
CL17	4-methyl-2-pentanone	<5
CL18	styrene	<5
CL19	vinyl acetate	<5
CL20	total xylenes	<5

The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

Prepared by: DB

Approved by: BM Date: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: K6 - 1 CAL LAB No: 19549-1

PP#	ACID COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10
22A	p-chloro-m-cresol	<10
24A	2-chlorophenol	<10
31A	2,4-dichlorophenol	<10
34A	2,4-dimethylphenol	<10
57A	2-nitrophenol	<20
58A	4-nitrophenol	<50
59A	2,4-dinitrophenol	<50
60A	4,6-dinitro-o-cresol	<20
64A	pentachlorophenol	<10
65A	phenol	<10

PP#	BASE/NEUTRAL COMPOUNDS	ug/L
1B	acenaphthene	<10
5B	benzidine	<40
8B	1,2,4-trichlorobenzene	<10
9B	hexachlorobenzene	<10
12B	hexachloroethane	<10
18B	bis(2-chloroethyl)ether	<10
20B	2-chloronaphthalene	<10
25B	1,2-dichlorobenzene	<10
26B	1,3-dichlorobenzene	<10
27B	1,4-dichlorobenzene	<10
28B	3,3'-dichlorobenzidine	<20
35B	2,4-dinitrotoluene	<20
36B	2,6-dinitrotoluene	<20
37B	1,2-diphenylhydrazine (as azobenzene)	<20
39B	fluoranthene	<10

PP#	BASE/NEUTRAL COMPOUNDS	ug/L
40B	4-chlorophenyl phenyl ether	<10
41B	4-bromophenyl phenyl ether	<10
42B	bis(2-chloroisopropyl) ether	<20
43B	bis(2-chloroethoxy) methane	<20
52B	hexachlorobutadiene	<10
53B	hexachlorocyclopentadiene	<10
54B	isophorone	<10
55B	naphthalene	<10
56B	nitrobenzene	<10
62B	N-nitrosodiphenylamine	<10
63B	N-nitrosodipropylamine	<10
66B	bis(2-ethylhexyl)phthalate	44
67B	benzyl butyl phthalate	50
68B	di-n-butyl phthalate	<10
69B	di-n-octyl phthalate	<10
70B	diethyl phthalate	<10
71B	dimethyl phthalate	<10
72B	benzo(a)anthracene	<10
73B	benzo(a)pyrene	<20
74B	benzo(b)fluoranthene	<20*
75B	benzo(k)fluoranthene	<20*
76B	chrysene	<20
77B	acenaphthylene	<10
78B	anthracene	<10
79B	benzo(ghi)perylene	<20
80B	fluorene	<10
81B	phenanthrene	<10
82B	dibenzo(a,h)anthracene	<20
83B	indeno(1,2,3-cd)pyrene	<20
84B	pyrene	<10

		ug/L
1.	aldrin	<10
2.	B-BHC	<10
3.	D-BHC	<10
4.	chlordane	<100
5.	4,4'-DDD	<10
6.	4,4'-DDE	<10
7.	4,4'-DDT	<10
8.	dieldrin	<10
9.	endosulfan sulfate	<20
10.	endrin aldehyde	<20
11.	heptachlor	<10
12.	heptachlor epoxide	<10
13.	PCB	<50
14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: [signature] DATE: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: K6 - 7 CAL LAB No: 19549-2

PP#	ACID COMPOUNDS	ug/L	PP#	BASE/NEUTRAL COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10	40B	4-chlorophenyl phenyl ether	<10
22A	p-chloro-m-cresol	<10	41B	4-bromophenyl phenyl ether	<10
24A	2-chlorophenol	<10	42B	bis(2-chloroisopropyl) ether	<20
31A	2,4-dichlorophenol	<10	43B	bis(2-chloroethoxy) methane	<20
34A	2,4-dimethylphenol	<10	52B	hexachlorobutadiene	<10
57A	2-nitrophenol	<20	53B	hexachlorocyclopentadiene	<10
58A	4-nitrophenol	<50	54B	isophorone	<10
59A	2,4-dinitrophenol	<50	55B	naphthalene	<10
60A	4,6-dinitro-o-cresol	<20	56B	nitrobenzene	<10
64A	pentachlorophenol	<10	62B	N-nitrosodiphenylamine	<10
65A	phenol	<10	63B	N-nitrosodipropylamine	<10
			66B	bis(2-ethylhexyl)phthalate	<10
	BASE/NEUTRAL COMPOUNDS		67B	benzyl butyl phthalate	<10
			68B	di-n-butyl phthalate	<10
1B	acenaphthene	<10	69B	di-n-octyl phthalate	<10
5B	benzidine	<40	70B	diethyl phthalate	<10
8B	1,2,4-trichlorobenzene	<10	71B	dimethyl phthalate	<10
9B	hexachlorobenzene	<10	72B	benzo(a)anthracene	<10
12B	hexachloroethane	<10	73B	benzo(a)pyrene	<20
18B	bis(2-chloroethyl)ether	<10	74B	benzo(b)fluoranthene	<20*
20B	2-chloronaphthalene	<10	75B	benzo(k)fluoranthene	<20*
25B	1,2-dichlorobenzene	<10	76B	chrysene	<20
26B	1,3-dichlorobenzene	<10	77B	acenaphthylene	<10
27B	1,4-dichlorobenzene	<10	78B	anthracene	<10
28B	3,3'-dichlorobenzidine	<20	79B	benzo(ghi)perylene	<20
35B	2,4-dinitrotoluene	<20	80B	fluorene	<10
36B	2,6-dinitrotoluene	<20	81B	phenanthrene	<10
37B	1,2-diphenylhydrazine		82B	dibenzo(a,h)anthracene	<20
	(as azobenzene)	<20	83B	indeno(1,2,3-cd)pyrene	<20
39B	fluoranthene	<10	84B	pyrene	<10
1.	aldrin	<10	8.	dieldrin	<10
2.	B-BHC	<10	9.	endosulfan sulfate	<20
3.	D-BHC	<10	10.	endrin aldehyde	<20
4.	chlordane	<100	11.	heptachlor	<10
5.	4,4'-DDD	<10	12.	heptachlor epoxide	<10
6.	4,4'-DDE	<10	13.	PCB	<50
7.	4,4'-DDT	<10	14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: MH DATE: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: K6 - 8 CAL LAB No: 19549-3

PP#	ACID COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10
22A	p-chloro-m-cresol	<10
24A	2-chlorophenol	<10
31A	2,4-dichlorophenol	<10
34A	2,4-dimethylphenol	<10
57A	2-nitrophenol	<20
58A	4-nitrophenol	<50
59A	2,4-dinitrophenol	<50
60A	4,6-dinitro-o-cresol	<20
64A	pentachlorophenol	<10
65A	phenol	<10

	BASE/NEUTRAL COMPOUNDS	
1B	acenaphthene	<10
5B	benzidine	<40
8B	1,2,4-trichlorobenzene	<10
9B	hexachlorobenzene	<10
12B	hexachloroethane	<10
18B	bis(2-chloroethyl)ether	<10
20B	2-chloronaphthalene	<10
25B	1,2-dichlorobenzene	<10
26B	1,3-dichlorobenzene	<10
27B	1,4-dichlorobenzene	<10
28B	3,3'-dichlorobenzidine	<20
35B	2,4-dinitrotoluene	<20
36B	2,6-dinitrotoluene	<20
37B	1,2-diphenylhydrazine (as azobenzene)	<20
39B	fluoranthene	<10

PP#	BASE/NEUTRAL COMPOUNDS	ug/L
40B	4-chlorophenyl phenyl ether	<10
41B	4-bromophenyl phenyl ether	<10
42B	bis(2-chloroisopropyl) ether	<20
43B	bis(2-chloroethoxy) methane	<20
52B	hexachlorobutadiene	<10
53B	hexachlorocyclopentadiene	<10
54B	isophorone	<10
55B	naphthalene	<10
56B	nitrobenzene	<10
62B	N-nitrosodiphenylamine	<10
63B	N-nitrosodipropylamine	<10
66B	bis(2-ethylhexyl)phthalate	<10
67B	benzyl butyl phthalate	<10
68B	di-n-butyl phthalate	<10
69B	di-n-octyl phthalate	<10
70B	diethyl phthalate	<10
71B	dimethyl phthalate	<10
72B	benzo(a)anthracene	<10
73B	benzo(a)pyrene	<20
74B	benzo(b)fluoranthene	<20*
75B	benzo(k)fluoranthene	<20*
76B	chrysene	<20
77B	acenaphthylene	<10
78B	anthracene	<10
79B	benzo(ghi)perylene	<20
80B	fluorene	<10
81B	phenanthrene	<10
82B	dibenzo(a,h)anthracene	<20
83B	indeno(1,2,3-cd)pyrene	<20
84B	pyrene	<10

1.	aldrin	<10
2.	B-BHC	<10
3.	D-BHC	<10
4.	chlordane	<100
5.	4,4'-DDD	<10
6.	4,4'-DDE	<10
7.	4,4'-DDT	<10
8.	dieldrin	<10
9.	endosulfan sulfate	<20
10.	endrin aldehyde	<20
11.	heptachlor	<10
12.	heptachlor epoxide	<10
13.	PCB	<50
14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: [signature] DATE: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: EP6 - 8 CAL LAB No: 19549-4

PP#	ACID COMPOUNDS	ug/L	PP#	BASE/NEUTRAL COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10	40B	4-chlorophenyl phenyl ether	<10
22A	p-chloro-m-cresol	<10	41B	4-bromophenyl phenyl ether	<10
24A	2-chlorophenol	<10	42B	bis(2-chloroisopropyl) ether	<20
31A	2,4-dichlorophenol	<10	43B	bis(2-chloroethoxy) methane	<20
34A	2,4-dimethylphenol	<10	52B	hexachlorobutadiene	<10
57A	2-nitrophenol	<20	53B	hexachlorocyclopentadiene	<10
58A	4-nitrophenol	<50	54B	isophorone	<10
59A	2,4-dinitrophenol	<50	55B	naphthalene	<10
60A	4,6-dinitro-o-cresol	<20	56B	nitrobenzene	<10
64A	pentachlorophenol	<10	62B	N-nitrosodiphenylamine	<10
65A	phenol	<10	63B	N-nitrosodipropylamine	<10
			66B	bis(2-ethylhexyl)phthalate	<10
	BASE/NEUTRAL COMPOUNDS		67B	benzyl butyl phthalate	<10
			68B	di-n-butyl phthalate	<10
1B	acenaphthene	<10	69B	di-n-octyl phthalate	<10
5B	benzidine	<40	70B	diethyl phthalate	<10
8B	1,2,4-trichlorobenzene	<10	71B	dimethyl phthalate	<10
9B	hexachlorobenzene	<10	72B	benzo(a)anthracene	<10
12B	hexachloroethane	<10	73B	benzo(a)pyrene	<20
18B	bis(2-chloroethyl)ether	<10	74B	benzo(b)fluoranthene	<20*
20B	2-chloronaphthalene	<10	75B	benzo(k)fluoranthene	<20*
25B	1,2-dichlorobenzene	<10	76B	chrysene	<20
26B	1,3-dichlorobenzene	<10	77B	acenaphthylene	<10
27B	1,4-dichlorobenzene	<10	78B	anthracene	<10
28B	3,3'-dichlorobenzidine	<20	79B	benzo(ghi)perylene	<20
35B	2,4-dinitrotoluene	<20	80B	fluorene	<10
36B	2,6-dinitrotoluene	<20	81B	phenanthrene	<10
37B	1,2-diphenylhydrazine		82B	dibenzo(a,h)anthracene	<20
	(as azobenzene)	<20	83B	indeno(1,2,3-cd)pyrene	<20
39B	fluoranthene	<10	84B	pyrene	<10
1.	aldrin	<10	8.	dieldrin	<10
2.	B-BHC	<10	9.	endosulfan sulfate	<20
3.	D-BHC	<10	10.	endrin aldehyde	<20
4.	chlordane	<100	11.	heptachlor	<10
5.	4,4'-DDD	<10	12.	heptachlor epoxide	<10
6.	4,4'-DDE	<10	13.	PCB	<50
7.	4,4'-DDT	<10	14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: MRU DATE: 11/12/84

California Analytical Laboratories, Inc.

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: X6 - 3 CAL LAB No: 19562-1

PP#	ACID COMPOUNDS	ug/L	PP#	BASE/NEUTRAL COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10	40B	4-chlorophenyl phenyl ether	<10
22A	p-chloro-m-cresol	<10	41B	4-bromophenyl phenyl ether	<10
24A	2-chlorophenol	<10	42B	bis(2-chloroisopropyl) ether	<20
31A	2,4-dichlorophenol	<10	43B	bis(2-chloroethoxy) methane	<20
34A	2,4-dimethylphenol	<10	52B	hexachlorobutadiene	<10
57A	2-nitrophenol	<20	53B	hexachlorocyclopentadiene	<10
58A	4-nitrophenol	<50	54B	isophorone	<10
59A	2,4-dinitrophenol	<50	55B	naphthalene	<10
60A	4,6-dinitro-o-cresol	<20	56B	nitrobenzene	<10
64A	pentachlorophenol	<10	62B	N-nitrosodiphenylamine	<10
65A	phenol	<10	63B	N-nitrosodipropylamine	<10
			66B	bis(2-ethylhexyl)phthalate	<10
	BASE/NEUTRAL COMPOUNDS		67B	benzyl butyl phthalate	<10
			68B	di-n-butyl phthalate	<10
1B	acenaphthene	<10	69B	di-n-octyl phthalate	<10
5B	benzidine	<40	70B	diethyl phthalate	<10
8B	1,2,4-trichlorobenzene	<10	71B	dimethyl phthalate	<10
9B	hexachlorobenzene	<10	72B	benzo(a)anthracene	<10
12B	hexachloroethane	<10	73B	benzo(a)pyrene	<20
18B	bis(2-chloroethyl)ether	<10	74B	benzo(b)fluoranthene	<20*
20B	2-chloronaphthalene	<10	75B	benzo(k)fluoranthene	<20*
25B	1,2-dichlorobenzene	<10	76B	chrysene	<20
26B	1,3-dichlorobenzene	<10	77B	acenaphthylene	<10
27B	1,4-dichlorobenzene	<10	78B	anthracene	<10
28B	3,3'-dichlorobenzidine	<20	79B	benzo(ghi)perylene	<20
35B	2,4-dinitrotoluene	<20	80B	fluorene	<10
36B	2,6-dinitrotoluene	<20	81B	phenanthrene	<10
37B	1,2-diphenylhydrazine (as azobenzene)	<20	82B	dibenzo(a,h)anthracene	<20
			83B	indeno(1,2,3-cd)pyrene	<20
39B	fluoranthene	<10	84B	pyrene	<10

1.	aldrin	<10	8.	dieldrin	<10
2.	B-BHC	<10	9.	endosulfan sulfate	<20
3.	D-BHC	<10	10.	endrin aldehyde	<20
4.	chlordane	<100	11.	heptachlor	<10
5.	4,4'-DDD	<10	12.	heptachlor epoxide	<10
6.	4,4'-DDE	<10	13.	PCB	<50
7.	4,4'-DDT	<10	14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: [illegible] DATE: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: K6 - 4 CAL LAB No: 19562-2

PP#	ACID COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10
22A	p-chloro-m-cresol	<10
24A	2-chlorophenol	<10
31A	2,4-dichlorophenol	<10
34A	2,4-dimethylphenol	<10
57A	2-nitrophenol	<20
58A	4-nitrophenol	<50
59A	2,4-dinitrophenol	<50
60A	4,6-dinitro-o-cresol	<20
64A	pentachlorophenol	<10
65A	phenol	<10

PP#	BASE/NEUTRAL COMPOUNDS	ug/L
1B	acenaphthene	<10
5B	benzidine	<40
8B	1,2,4-trichlorobenzene	<10
9B	hexachlorobenzene	<10
12B	hexachloroethane	<10
18B	bis(2-chloroethyl)ether	<10
20B	2-chloronaphthalene	<10
25B	1,2-dichlorobenzene	<10
26B	1,3-dichlorobenzene	<10
27B	1,4-dichlorobenzene	<10
28B	3,3'-dichlorobenzidine	<20
35B	2,4-dinitrotoluene	<20
36B	2,6-dinitrotoluene	<20
37B	1,2-diphenylhydrazine (as azobenzene)	<20
39B	fluoranthene	<10
40B	4-chlorophenyl phenyl ether	<10
41B	4-bromophenyl phenyl ether	<10
42B	bis(2-chloroisopropyl) ether	<20
43B	bis(2-chloroethoxy) methane	<20
52B	hexachlorobutadiene	<10
53B	hexachlorocyclopentadiene	<10
54B	isophorone	<10
55B	naphthalene	<10
56B	nitrobenzene	<10
62B	N-nitrosodiphenylamine	<10
63B	N-nitrosodipropylamine	<10
66B	bis(2-ethylhexyl)phthalate	7[illegible]
67B	benzyl butyl phthalate	78
68B	di-n-butyl phthalate	<10
69B	di-n-octyl phthalate	<10
70B	diethyl phthalate	<10
71B	dimethyl phthalate	<10
72B	benzo(a)anthracene	<10
73B	benzo(a)pyrene	<20
74B	benzo(b)fluoranthene	<20*
75B	benzo(k)fluoranthene	<20*
76B	chrysene	<20
77B	acenaphthylene	<10
78B	anthracene	<10
79B	benzo(ghi)perylene	<20
80B	fluorene	<10
81B	phenanthrene	<10
82B	dibenzo(a,h)anthracene	<20
83B	indeno(1,2,3-cd)pyrene	<20
84B	pyrene	<10

1.	aldrin	<10
2.	B-BHC	<10
3.	D-BHC	<10
4.	chlordane	<100
5.	4,4'-DDD	<10
6.	4,4'-DDE	<10
7.	4,4'-DDT	<10
8.	dieldrin	<10
9.	endosulfan sulfate	<20
10.	endrin aldehyde	<20
11.	heptachlor	<10
12.	heptachlor epoxide	<10
13.	PCB	<50
14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: [signature] DATE: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: K6 - 9 CAL LAB NO: 19562-3

PP#	ACID COMPOUNDS	ug/L	PP#	BASE/NEUTRAL COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10	40B	4-chlorophenyl phenyl ether	<10
22A	p-chloro-m-cresol	<10	41B	4-bromophenyl phenyl ether	<10
24A	2-chlorophenol	<10	42B	bis(2-chloroisopropyl) ether	<20
31A	2,4-dichlorophenol	<10	43B	bis(2-chloroethoxy) methane	<20
34A	2,4-dimethylphenol	<10	52B	hexachlorobutadiene	<10
57A	2-nitrophenol	<20	53B	hexachlorocyclopentadiene	<10
58A	4-nitrophenol	<50	54B	isophorone	<10
59A	2,4-dinitrophenol	<50	55B	naphthalene	<10
60A	4,6-dinitro-o-cresol	<20	56B	nitrobenzene	<10
64A	pentachlorophenol	<10	62B	N-nitrosodiphenylamine	<10
65A	phenol	<10	63B	N-nitrosodipropylamine	<10
			66B	bis(2-ethylhexyl)phthalate	<10
	BASE/NEUTRAL COMPOUNDS		67B	benzyl butyl phthalate	<10
			68B	di-n-butyl phthalate	<10
1B	acenaphthene	<10	69B	di-n-octyl phthalate	<10
5B	benzidine	<40	70B	diethyl phthalate	<10
8B	1,2,4-trichlorobenzene	<10	71B	dimethyl phthalate	<10
9B	hexachlorobenzene	<10	72B	benzo(a)anthracene	<10
12B	hexachloroethane	<10	73B	benzo(a)pyrene	<20
18B	bis(2-chloroethyl)ether	<10	74B	benzo(b)fluoranthene	<20*
20B	2-chloronaphthalene	<10	75B	benzo(k)fluoranthene	<20*
25B	1,2-dichlorobenzene	<10	76B	chrysene	<20
26B	1,3-dichlorobenzene	<10	77B	acenaphthylene	<10
27B	1,4-dichlorobenzene	<10	78B	anthracene	<10
28B	3,3'-dichlorobenzidine	<20	79B	benzo(ghi)perylene	<20
35B	2,4-dinitrotoluene	<20	80B	fluorene	<10
36B	2,6-dinitrotoluene	<20	81B	phenanthrene	<10
37B	1,2-diphenylhydrazine (as azobenzene)	<20	82B	dibenzo(a,h)anthracene	<20
			83B	indeno(1,2,3-cd)pyrene	<20
39B	fluoranthene	<10	84B	pyrene	<10
1.	aldrin	<10	8.	dieldrin	<10
2.	B-BHC	<10	9.	endosulfan sulfate	<20
3.	D-BHC	<10	10.	endrin aldehyde	<20
4.	chlordane	<100	11.	heptachlor	<10
5.	4,4'-DDD	<10	12.	heptachlor epoxide	<10
6.	4,4'-DDE	<10	13.	PCB	<50
7.	4,4'-DDT	<10	14.	toxaphene	<500

* - compounds co-elute - analysed as a single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: [illegible] DATE: 11/12/84

EPA METHOD 625 PRIORITY POLLUTANTS
Data Sheet

CLIENT ID: RANGER CAL LAB No: 19620-1

PP#	ACID COMPOUNDS	ug/L	PP#	BASE/NEUTRAL COMPOUNDS	ug/L
21A	2,4,6-trichlorophenol	<10	40B	4-chlorophenyl phenyl ether	<10
22A	p-chloro-m-cresol	<10	41B	4-bromophenyl phenyl ether	<10
24A	2-chlorophenol	<10	42B	bis(2-chloroisopropyl) ether	<20
31A	2,4-dichlorophenol	<10	43B	bis(2-chloroethoxy) methane	<20
34A	2,4-dimethylphenol	<10	52B	hexachlorobutadiene	<10
57A	2-nitrophenol	<20	53B	hexachlorocyclopentadiene	<10
58A	4-nitrophenol	<50	54B	isophorone	<10
59A	2,4-dinitrophenol	<50	55B	naphthalene	<10
60A	4,6-dinitro-o-cresol	<20	56B	nitrobenzene	<10
64A	pentachlorophenol	<10	62B	N-nitrosodiphenylamine	<10
65A	phenol	<10	63B	N-nitrosodipropylamine	<10
			66B	bis(2-ethylhexyl)phthalate	<10
	BASE/NEUTRAL COMPOUNDS		67B	benzyl butyl phthalate	<10
			68B	di-n-butyl phthalate	<10
1B	acenaphthene	<10	69B	di-n-octyl phthalate	<10
5B	benzidine	<40	70B	diethyl phthalate	<10
8B	1,2,4-trichlorobenzene	<10	71B	dimethyl phthalate	<10
9B	hexachlorobenzene	<10	72B	benzo(a)anthracene	<10
12B	hexachloroethane	<10	73B	benzo(a)pyrene	<20
18B	bis(2-chloroethyl)ether	<10	74B	benzo(b)fluoranthene	<20*
20B	2-chloronaphthalene	<10	75B	benzo(k)fluoranthene	<20*
25B	1,2-dichlorobenzene	<10	76B	chrysene	<20
26B	1,3-dichlorobenzene	<10	77B	acenaphthylene	<10
27B	1,4-dichlorobenzene	<10	78B	anthracene	<10
28B	3,3'-dichlorobenzidine	<20	79B	benzo(ghi)perylene	<20
35B	2,4-dinitrotoluene	<20	80B	fluorene	<10
36B	2,6-dinitrotoluene	<20	81B	phenanthrene	<10
37B	1,2-diphenylhydrazine		82B	dibenzo(a,h)anthracene	<20
	(as azobenzene)	<20	83B	indeno(1,2,3-cd)pyrene	<20
39B	fluoranthene	<10	84B	pyrene	<10

1.	aldrin	<10	8.	dieldrin	<10
2.	B-BHC	<10	9.	endosulfan sulfate	<20
3.	D-BHC	<10	10.	endrin aldehyde	<20
4.	chlordane	<100	11.	heptachlor	<10
5.	4,4'-DDD	<10	12.	heptachlor epoxide	<10
6.	4,4'-DDE	<10	13.	PCB	<50
7.	4,4'-DDT	<10	14.	toxaphene	<500

* - compounds co-elute - analysed as single compound
The less-than (<) symbol means "not present at or above the indicated value (detection limit)".

PREPARED BY: DB

APPROVED BY: [illegible] DATE: 11/12/84