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NAVAL AIR STATION, ALAMEDA
ALAMEDA, CALIFORNIA

DATA SUMMARY REPORT
RI/FS PHASES 2B AND 3
VOLUME 2 of 2
APPENDICES A through G
FINAL

October 27, 1992

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FINAL
DATA SUMMARY REPORT
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PHASES 2B AND 3

DATED 27 OCTOBER 1992

THIS RECORD CONTAINS MULTIPLE VOLUMES
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NAS ALAMEDA - RI/FS PHASES 2B AND 3
DATA SUMMARY REPORT

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APPENDIX A

FIELD METHODS

1.0 SOIL GAS SURVEYS

Soil gas surveys were conducted at Sites 7A and 14 to provide plume definition and to aid in locating monitoring wells. Surveys were performed by Hydro-Geo-Chem of Tucson, Arizona. Its report of the surveys is included as Appendix I to this report. Methods used in performing the surveys are described in the Hydro-Geo-Chem report.

The original sampling grid at Site 7A consisted of 63 sampling points on approximately 50-foot centers. Seven sample points were added during the survey, bringing the total number of points to 70. The sampling grid at Site 14 consisted of 44 sampling points on varying centers due to the irregular shape of the area. After the soil gas survey was completed, a California-licensed surveyor surveyed the sample points. Horizontal control was provided by the California State Plane Coordinates (Zone 3, NAD 27). The surveyor did not compute elevations for the soil gas points.

2.0 GEOPHYSICS

JMM geophysicists surveyed all of the proposed borehole locations prior to drilling to determine the presence of buried utilities or other subterranean hazards. Locations were surveyed with a Geonics EM31 Conductivity Meter and a GeoMetrics 856 Magnetometer using a continuous instrument-sweep approach. Field data were not recorded and permanent acquisition stations were not established. The survey sweep approach consisted of repetitive back-and-forth profiling over each proposed borehole location. When the instruments gave no anomalous readings over the proposed location, the geophysicist approved it for drilling. When the instruments showed anomalies beneath a proposed borehole the geophysicist moved the borehole to a nearby location that was clear.

3.0 BOREHOLE DRILLING AND SOIL SAMPLE COLLECTION

Between June 18 and July 26, 1991, 81 soil borings were drilled at Alameda NAS. Groundwater quality monitoring wells were constructed in 37 of the borings. Exploration Geoservices, Inc. of San Jose, California, was the drilling subcontractor.

Each boring was approximately 15 feet deep. Borings were drilled with a Mobile B-61 hollow stem auger drill rig equipped with both 7-7/8-inch outside diameter (OD) and 8-1/4 inch OD augers. The smaller augers were used to drill the soil borings. JMM specified the larger ID augers for the monitoring well borings to allow easier construction and filter pack installation.

Regardless of the auger size, the borings were sampled continuously to depth using 1.5-foot long, 2.5-inch ID steel split spoon samplers. Samplers were advanced with a 140 pound hammer with a 30 inch drop.

Once retrieved, the split spoons were opened on clean aluminum foil. The sediment was described on a borehole log using the United Soil Classification System. A small portion of the sample in a plastic "Zip-lock" bag for photoionization detector (PID) field screening. The bag was labeled with depth and time and placed in the sun for 15 minutes. After 15 minutes, the bag was punctured with a PID probe and the reading recorded on the boring log.

Four samples from each boring were retained for chemical analysis. After the PID screening sample was removed from the split spoon, and two 8-oz. clear glass jars and two 500-ml amber glass jars were filled with soil. The 8-oz. jars are for volatile compounds so they were filled as quickly as possible and with zero head space to inhibit volatilization. JMM collected samples from the surface, the vadose zone, the depth of the industrial sewer or midway in the boring when there was no industrial sewer nearby, and the bottom of the boring. This system was altered when discolored soil and/or soil with odors indicating obvious contamination was encountered. In these cases, the obviously contaminated soil was sampled regardless of the depth. Duplicates of approximately 10 percent of the samples were collected. Wherever possible, the duplicates and field samples were taken from the same split spoon. If there was not sufficient sample recovery the remainder of the duplicate was taken from the next split spoon.

Three to six geotechnical samples were retained from each boring. To collect a geotechnical sample, the split spoon sampler was lined with three 6-inch long brass sleeves. The sleeves were capped with tightly fitting plastic caps and labelled the sample with site, boring, and depth. JMM collected geotechnical samples from both saturated and unsaturated soil and all major lithologies that were encountered at each site.

Borings in which monitoring wells were not constructed were grouted at the completion of drilling. Grout consisted of neat cement with approximately three percent bentonite powder. The grout was installed through tremie pipe inside the augers to ensure that all water in the boring was displaced and that the boring did not collapse. The drillers withdrew the augers only after the grout had reached the surface.

Proper decontamination is important to ensure that chemical samples are representative and that there is no cross contamination. Prior to each day of work, the drill rig, augers, drill tools, and samplers were steam cleaned with the base's approved source water. The rig and equipment were also steam cleaned if the crew changed sites during the day. Before each day's drilling, the JMM geologist inspected the rig for oil, fuel, and hydraulic fluid leaks that could contaminate the samples or site.

During drilling, the drillers cleaned the split spoons in a four bucket decontamination system between samples. The first bucket contained pre-rinse water from the approved source. The second bucket contained water from the approved source and Liquinox detergent. The third and fourth buckets contained deionized water. JMM personnel collected equipment blanks every other day to monitor the quality of the decontamination system. Blanks were collected by pouring deionized water through a cleaned split spoon sampler into appropriate water sampler containers.

Besides field screening the soil samples, the PID was used for health and safety monitoring. Readings were collected from the worker's breathing zone every 5 to 10 minutes and recorded in the field log book. Simultaneously, readings were collected from an oxygen meter, a combustible gas indicator, a hydrogen sulfide monitor, a total particulate monitor and a noise dosimeter. All instruments were calibrated in accordance to manufacturer's instructions at the beginning and end of each day. Calibration information was recorded in a separate logbook for each instrument.

Field documentation consisted of labels and chains of custody for the chemical samples, boring logs, a field log book, and a sample register. The laboratory preprinted the sample labels and chains of custody forms. Field personnel recorded the date, time, sampler's initials, and depth of the sample on the labels and chains of custody as the samples were taken. Start and stop times, health and safety screening results, problems, and other events of the day were recorded in the field notebook. All chemical samples, duplicates, and blanks were recorded in the sample register.

All soil, water, and waste generated during borehole drilling was transported to a central location on the base. Soil was placed in storage bins and water was placed in a single, large Baker Tank pending laboratory results. The waste soil and water will be disposed of properly when laboratory results are obtained. Other waste materials (personal protective equipment, plastic, etc.) were placed in labelled 55-gallon drums.

4 0 WELL CONSTRUCITON AND DEVELOPMENT

Groundwater monitoring wells were constructed in 37 of the 81 borings drilled at Alameda NAS. Wells were designed to intercept the first water bearing zone while not extending into the second zone. To accomplish this, the wells are constructed with 10 feet of screen extending downward from approximately 1 foot above the water table. When aquitards were encountered, shorter screens were used (extending from 1 foot above the water table to the depth of the aquitard). For purposes of this field program the geologist considered clay layers greater than 1-foot-thick to be aquitards.

Wells were constructed inside the hollow stem augers with 2-inch diameter Schedule 40 PVC casing and screen. The screen slot size was 0.010-inch. A threaded shoe was placed on the bottom of wells where the screen was a full 10 feet long and a slip cap with at least three stainless steel retaining screws was placed on wells with screens shorter than 10 feet. All joints were flush threaded and watertight. The drillers used no solvent or glue on the casing joints. As discussed above, the drillers installed screens that are shorter than 10 feet long in some wells in order to not penetrate aquitards. In these wells, boreholes were backfilled with bentonite chips to the appropriate depth prior to installing casing. When flowing sands were encountered, water from the base's approved source was added to the borehole prior to installing the casing. The water provided hydraulic head to keep the sand from flowing into the augers during well construction.

A filter pack of #2/16 Monterey sand was poured around the slotted interval of the casing. As the filter pack level rose in the annular space, the augers were incrementally removed. The sand level in the auger was monitored with a weighted tag line to ensure that a small amount of sand remained in the augers at all times to prevent borehole sloughing. The filter pack typically extended from the bottom of the well to one foot above the screened interval.

After filter pack installation, a sanitary seal of bentonite pellets was installed using the same technique. Typical sanitary seal thickness was 1 to 2 feet depending on well depth. Because there was some concern about the hydrating properties of the brackish groundwater encountered at NAS Alameda, a small cup of pellets was hydrated with the same water used in the well simultaneously with the seal. The seal was considered complete when the pellets in the cup were hydrated. After the seal was hydrated, the well was grouted to the surface with a mixture of neat cement and approximately three percent bentonite powder. The grout was installed in annular space between the well casing and the augers in the same manner as the filter pack and bentonite seal.

After the grout had cured, the wells were finished with a surface completion consisting of a locking steel stove pipe and flush-mounted Christie Box. The concrete was sloped slightly away from the Christie Box so water will not pond on the box lid. A State of California licensed surveyor then surveyed the well casing relative to the State Plane Coordinate System (Zone 3, NAD 27) for horizontal control, and Mean Low Low Tide markers for vertical control.

Well development techniques included bailing, swabbing, and pumping. Approximately 10 gallons of water were bailed from the well which was then swabbed for 30 minutes. After swabbing, an additional 5 gallons of water was then bailed from the well. A bladder pump was used to remove the remainder of the water. A total of three well borehole volumes was removed. A new hose was placed on the bladder pump for each well and all bailers and bailer parts were steam cleaned between wells. JMM personnel measured and recorded conductivity, temperature, pH, and turbidity at the beginning of development and every 5 gallons afterward.

Field documentation for monitoring well construction and development consisted of boring logs, field notebooks, well construction logs, and development logs. The screened interval, blank casing interval, sand pack, seal, grout interval, and amount and type of well materials was recorded on both the boring log and the well construction log. Start and stop times, daily events, and problems were recorded in the field notebooks. Calculations, removed volumes, and parameter measurements were recorded on the well development logs.

All water generated during the well construction and development process was collected and transported it to a central location on the base for storage in a Baker Tank pending laboratory results. The water will be properly disposed when JMM receives laboratory results.

5.0 GROUNDWATER SAMPLE COLLECTION

Groundwater samples were collected from the 37 groundwater quality monitoring wells installed for this project. Sample analytes varied by site and are listed in Section 4.0 of this report. In order to compute groundwater gradients, the water levels in of all the wells at a site were measured prior to any sampling. Measurements were made relative to the top of the well casing.

Groundwater sampling followed a five-step procedure. First, the water level was measured and the volume of the submerged well boring (well casing plus filter pack) computed. Second, the well was purged of three well bore volumes with a Teflon bailer. If the well purged dry, it was sampled after recovering to 80 percent of its original water level. During purging, the conductivity, temperature, pH, and salinity of

the water was measured and recorded after every 5 gallons. Third, after purging was completed, a sample was collected with the same bailer used for purging. In order to obtain representative samples, all samples were collected from the middle of the screened interval. Duplicate samples were collected from approximately 10 percent of the wells. Fourth, the samples for dissolved metals samples were filtered through disposable 0.45 micron filters and preserved with appropriate acids and bases as specified by the laboratory. Finally, samples were packed in ice for shipping. All of the day's VOC samples were shipped together with a trip blank. The laboratory analyzes trip blanks to determine if volatile compounds leaked from any of the sample containers and possibly cross contaminated the samples during shipment.

All bailers, bailer parts, and water level probes were steam cleaned at the beginning of each day using the base's approved water supply. A sufficient number of bailers were on site to do a complete days sampling without having to steam clean again. During the day, water level probes were cleaned with Liquinox soap and deionized water between wells. A new nylon cord was used for each bailer; nylon cord was never reused. Equipment blanks were collected every other day to monitor the quality of decontamination. The blanks were taken by pouring deionized water into a cleaned bailer and then pouring the water from the bailer into appropriate water sample containers. The laboratory analyzed the equipment blanks for the site specific analytes.

Field documentation for groundwater sampling consisted of labels and chains of custody for the water samples, water sample logs, a field log book, and a sample register. The laboratory preprinted the sample labels and chains of custody forms. Field personnel added the date, time, sampler's initials, and the pH and conductivity of the water to the labels and chains of custody as the samples were taken. Recorded information included the amount of purged water, the conductivity, pH, temperature, and salinity of the water. The field log book was used to record start and stop times, problems, and other events of the day. All samples, duplicates, and blanks were recorded in the sample register.

All purged water was collected in 55-gallon drums and transported to a central location on base, where it was transferred to a single large Baker Tank. The water in the Baker Tank will be analyzed and disposed of properly.

6.0 SLUG TESTING

Rising head slug tests were performed in each monitoring well to determine the in-situ permeabilities of the aquifers. The slugs were constructed of 5-foot lengths of 1-inch diameter PVC pipe. The pipe was filled with clean sand and both ends were sealed watertight. Slugs were cleaned with Liquinox soap and deionized water prior to use in each well. A new nylon cord was also used for each well.

Data were recorded with a Hermit 1000B data logger and a 10 psi transducer. The transducer was lowered to near the bottom of the well and secured with duct tape to prevent it from moving. The slug was then placed in the well and the water level allowed to recover. The water level was allowed to stabilize and the data logger programmed. For the rising head test, the slug was quickly withdrawn from the well while simultaneously starting the data logger. The water level was allowed to recover to at least 80 percent of its original level before the test was stopped.

Data from the data logger data transferred to a micro computer with a computer interface cable and a manufacturer-supplied software package. Data were plotted and analyzed using the commercial software package (AQTESOLV Aquifer Test Solver ver 1.00). This package uses the Bouwer and Rice method for partially penetrating unconfined aquifers.

APPENDIX B
NAS ALAMEDA - SITE 4
SURFACE SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B04-01	B04-02	B04-03	B04-04	B04-05	B04-06	B04-07	B04-08	B04-09
Date Sampled	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED									
PHYSICAL PARAMETERS-LAB									
MOISTURE (% wet wt.)	7.5	8.6	7.6	6.6	7.8	7.7	6.1	6.4	7.6
TOTAL ORGANIC CARBON (% dry wt.)									
TOC as CARBON (OC/1.724)*	0.174	0.174	1.91	0.058	< 0.058	0.348	0.232	0.174	0.348
ORG. CONTENT (OC), Total @440 C	0.3	0.3	3.3	0.1	< 0.1	0.6	0.4	0.3	0.6
ANIONS (mg/kg-dry)									
CYANIDE	1	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	16

Sample Number	B04-10	B04-11	Duplicate B04-11	B04-12	B04-13	B04-14	B04-15	B04-16	B04-17
Date Sampled	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91	09/05/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED									
PHYSICAL PARAMETERS-LAB									
MOISTURE (% wet wt.)	8.8	8.4	6.1	13.5	9.3	12.8	11.7	10.7	9.2
TOTAL ORGANIC CARBON (% dry wt.)									
TOC as CARBON (OC/1.724)*	0.406	0.174	0.754	0.116	< 0.058	0.812	0.638	1.16	1.28
ORG. CONTENT (OC), Total @440 C	0.7	0.3	1.3	0.2	< 0.1	1.4	1.1	2.0	2.2
ANIONS (mg/kg-dry)									
CYANIDE	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1	1	19	2

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 4
SURFACE SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B04-18	B04-19	B04-20	W04-01	W04-02
Date Sampled	09/05/91	09/05/91	09/05/91	09/06/91	09/06/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED					
PHYSICAL PARAMETERS-LAB					
MOISTURE (% wet wt.)	11.1	12.7	7.2	7.4	6.3
TOTAL ORGANIC CARBON (% dry wt.)					
TOC as CARBON (OC/1.724)*	0.696	0.580	0.522	NA	NA
ORG. CONTENT (OC), Total @440 C	1.2	1.0	0.9	NA	NA
ANIONS (mg/kg-dry)					
CYANIDE	1	3	< 0.5	9	7870

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-01-000	B05-01-003	Duplicate B05-01-003	B05-01-010	Duplicate B05-01-010	B05-01-014	B05-02-000	Duplicate B05-02-000
Date Sampled	07/16/91	07/16/91	10/15/91	07/16/91	07/16/91	07/16/91	07/16/91	07/16/91
Depth of Sample	0.0 ft	3.0 ft	3.0 ft	10.0 ft	10.0 ft	14.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	5.5	4.4	6.3	21.9	20.0	30.9	5.5	5.8
pH, SED (Std.Units)	NA	NA	NA	NA	NA	8.7	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	NA	NA	0.116	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	NA	NA	0.2	NA	NA
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NA	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.5	< 0.5	NA	< 0.6	< 0.6	< 0.7	< 0.5	< 0.5

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-02-003	B05-02-010	B05-02-015	B05-03-000	B05-03-004	B05-03-010	B05-03-014	B05-04-000
Date Sampled	07/16/91	07/16/91	07/16/91	07/24/91	07/24/91	07/24/91	07/24/91	07/23/91
Depth of Sample	3.0 ft	10.0 ft	15.0 ft	0.0 ft	3.5 ft	9.5 ft	14.0 ft	2.3 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	4.5	15.5	33.5	7.8	6.2	18.4	32.5	3.1
pH, SED (Std.Units)	NA	8.4	NA	NA	7.9	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.290	NA	NA	0.232	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.5	NA	NA	0.4	NA	NA	NA
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.5	< 0.5	< 0.7	< 0.5	< 0.5	< 0.6	< 0.7	< 0.5

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-04-002	B05-04-008	B05-04-014	Duplicate B05-04-014	B05-05-000	B05-05-003	B05-05-008	B05-05-014
Date Sampled	07/23/91	07/23/91	07/23/91	07/23/91	07/17/91	07/17/91	07/17/91	07/17/91
Depth of Sample	2.0 ft	8.0 ft	14.0 ft	14.0 ft	0.0 ft	3.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	5.1	17.6	19.7	32.1	8.9	7.9	17.0	22.5
pH, SED (Std.Units)	NA	9.0	NA	NA	NA	NA	NA	9.1
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.174	NA	NA	NA	NA	NA	0.174
ORG. CONTENT (OC), Total @440 C	NA	0.3	NA	NA	NA	NA	NA	0.3
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.5	< 0.5	< 0.5	< 0.7	< 0.5	< 0.5	< 0.5	< 0.6

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-06-000	B05-06-002	B05-06-010	Duplicate B05-06-010	B05-06-014	B05-07-000	B05-07-002	B05-07-010
Date Sampled	07/12/91	07/12/91	07/12/91	07/12/91	07/12/91	07/12/91	07/12/91	07/12/91
Depth of Sample	0.0 ft	2.0 ft	9.5 ft	9.5 ft	14.0 ft	0.0 ft	2.0 ft	9.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	5.5	6.9	16.6	18.0	23.5	8.8	7.6	17.7
pH, SED (Std.Units)	NA	NA	9.5	9.5	NA	NA	NA	9.4
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	< 0.058	0.348	NA	NA	NA	0.174
ORG. CONTENT (OC), Total @440 C	NA	NA	< 0.1	0.6	NA	NA	NA	0.3
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.5	< 0.5	< 0.6	< 0.6	< 0.6	< 0.5	< 0.5	< 0.6

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-07-014	B05-08-000	B05-08-002	B05-08-008	B05-08-014	B05-09-000	B05-09-002	B05-09-010
Date Sampled	07/12/91	08/08/91	08/08/91	08/08/91	08/08/91	07/12/91	07/12/91	07/12/91
Depth of Sample	14.0 ft	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	9.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	19.9	7.6	7.8	17.3	35.0	10.6	6.3	17.5
pH, SED (Std.Units)	9.0	8.1	7.2	6.5	8.9	NA	NA	9.3
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	< 0.058	0.406	0.464	0.116	0.580	NA	NA	0.406
ORG. CONTENT (OC), Total @440 C	< 0.1	0.7	0.8	0.2	1.0	NA	NA	0.7
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.6	< 0.5	< 0.5	< 0.6	< 0.7	< 0.5	< 0.5	< 0.6

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-09-014	B05-10-000	B05-10-003	B05-10-007	B05-10-008	B05-10-014	B05-11-000	B05-11-004
Date Sampled	07/12/91	07/16/91	07/16/91	07/16/91	07/16/91	07/16/91	07/17/91	07/17/91
Depth of Sample	14.0 ft	0.0 ft	3.0 ft	7.0 ft	8.0 ft	14.0 ft	0.0 ft	4.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	20.5	8.9	6.7	10.3	15.8	18.8	9.1	8.1
pH, SED (Std.Units)	NA	NA	NA	NA	NA	9.0	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	NA	NA	< 0.058	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	NA	NA	< 0.1	NA	NA
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.6	< 0.5	< 0.5	< 0.5	< 0.6	< 0.6	< 0.5	< 0.5

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 5
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B05-12-000	B05-12-002	B05-12-008	B05-12-014	B05-13-000	B05-13-002	B05-13-008	B05-13-014
Date Sampled	07/11/91	07/11/91	07/11/91	07/11/91	07/11/91	07/11/91	07/11/91	07/11/91
Depth of Sample	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	8.9	8.0	21.2	21.7	10.3	6.4	17.4	24.1
pH, SED (Std.Units)	NA	NA	NA	9.0	NA	NA	NA	9.3
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	0.406	NA	NA	NA	0.290
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	0.7	NA	NA	NA	0.5
ASBESTOS (%)								
ASBESTOS, TOTAL	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD	NFAD
ANIONS (mg/kg-dry)								
CYANIDE	< 0.5	< 0.5	< 0.6	< 0.6	< 0.6	< 0.5	< 0.6	< 0.6

Notes: NA = Not analyzed
NAFD = No Asbestos Fibers Detected
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 6
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B06-01-000	B06-01-002	B06-01-008	B06-01-014	B06-02-000	B06-02-002	B06-02-007	B06-02-014
Date Sampled	07/01/91	07/01/91	07/01/91	07/01/91	07/01/91	07/01/91	07/01/91	07/01/91
Depth of Sample	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	6.5 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	6.7	8.1	19.6	27.4	24.7	7.9	15.5	49.1
pH, SED (Std.Units)	NA	9.0	8.9	NA	NA	NA	9.4	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.232	0.174	NA	NA	NA	0.232	NA
ORG. CONTENT (OC), Total @440 C	NA	0.4	0.3	NA	NA	NA	0.4	NA

Sample Number	B06-03-000	B06-03-002	B06-03-008	B06-03-014	B06-04-000	B06-04-002	B06-04-007	B06-04-014
Date Sampled	07/09/91	07/09/91	07/09/91	07/09/91	07/02/91	07/02/91	07/02/91	07/02/91
Depth of Sample	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	6.5 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	6.7	5.0	17.7	22.8	6.4	8.8	10.2	19.6
pH, SED (Std.Units)	NA	NA	9.3	NA	NA	NA	8.8	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	0.174	NA	NA	NA	0.406	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	0.3	NA	NA	NA	0.7	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 6
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B06-05-000	B06-05-000	B06-05-002	B06-05-005	B06-05-011	B06-06-000	B06-06-000	B06-06-005
Date Sampled	07/02/91	07/02/91	07/02/91	07/02/91	07/02/91	08/05/91	08/05/91	08/05/91
Depth of Sample	0.0 ft	0.0 ft	2.0 ft	5.0 ft	11.0 ft	0.0 ft	0.0 ft	5.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	7.6	7.3	7.9	18.2	40.5	4.3	4.2	16.9
pH, SED (Std.Units)	NA	NA	NA	9.4	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	0.116	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	0.2	NA	NA	NA	NA

Sample Number	B06-06-011	B06-06-014	B06-07-000	B06-07-002	B06-07-008	B06-07-014	B06-08-000	B06-08-002
Date Sampled	08/05/91	08/05/91	07/09/91	07/09/91	07/09/91	07/09/91	07/08/91	07/08/91
Depth of Sample	11.0 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	40.0	23.1	5.6	5.5	19.8	20.4	8.1	8.4
pH, SED (Std.Units)	NA	8.6	NA	NA	9.3	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.290	NA	NA	0.638	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.5	NA	NA	1.1	NA	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 6
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B06-08-007	B06-08-014	B06-09-000	B06-09-002	B06-09-008	B06-09-014	B06-10-000	B06-10-002
Date Sampled	07/08/91	07/08/91	07/08/91	07/08/91	07/08/91	07/08/91	07/08/91	07/08/91
Depth of Sample	6.5 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	20.5	29.5	10.2	6.7	44.3	38.3	6.2	19.5
pH, SED (Std.Units)	9.1	NA	NA	NA	8.7	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	0.174	NA	NA	NA	0.464	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	0.3	NA	NA	NA	0.8	NA	NA	NA

Sample Number	B06-10-008	B06-10-008	B06-10-014	B06-11-000	B06-11-002	B06-11-007	B06-11-014	B06-11-014
Date Sampled	07/08/91	07/08/91	07/08/91	07/02/91	07/02/91	07/02/91	07/02/91	07/02/91
Depth of Sample	8.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	6.5 ft	14.0 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	32.5	39.2	25.3	6.9	6.9	4.9	21.5	21.5
pH, SED (Std.Units)	8.8	9.1	NA	NA	NA	8.0	9.0	8.8
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	0.464	0.464	NA	NA	NA	0.116	0.290	0.290
ORG. CONTENT (OC), Total @440 C	0.8	0.8	NA	NA	NA	0.2	0.5	0.5

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 6
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B06-12-000	B06-12-002	B06-12-008	B06-12-014	B06-12-014	B06-13-000	B06-13-002	B06-13-008
Date Sampled	07/10/91	07/10/91	07/10/91	07/10/91	07/10/91	06/28/91	06/28/91	06/28/91
Depth of Sample	0.0 ft	2.0 ft	8.0 ft	14.0 ft	14.0 ft	0.0 ft	1.0 ft	8.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	3.8	7.7	20.2	24.5	26.2	17.9	5.2	46.4
pH, SED (Std.Units)	NA	NA	9.2	NA	NA	NA	NA	9.3
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	0.232	NA	NA	NA	NA	3.65
ORG. CONTENT (OC), Total @440 C	NA	NA	0.4	NA	NA	NA	NA	6.3

Sample Number	B06-13-014	B06-14-000	B06-14-004	B06-14-008	B06-14-014	B06-15-000	B06-15-002	B06-15-005
Date Sampled	06/28/91	06/27/91	06/27/91	06/27/91	06/27/91	06/27/91	06/27/91	06/27/91
Depth of Sample	14.0 ft	0.0 ft	3.5 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	5.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	35.7	7.1	10.9	19.2	22.6	5.3	5.8	17.4
pH, SED (Std.Units)	NA	NA	9.0	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	0.812	NA	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	1.4	NA	NA	NA	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 6
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B06-15-014	B06-16-000	B06-16-004	B06-16-008	B06-16-008	B06-16-014	B06-17-000	B06-17-002
Date Sampled	06/27/91	06/27/91	06/27/91	06/27/91	06/27/91	06/27/91	07/09/91	07/09/91
Depth of Sample	14.0 ft	0.0 ft	3.5 ft	8.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	25.2	7.8	6.4	16.8	19.9	26.0	10.0	6.8
pH, SED (Std.Units)	NA	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	NA	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	NA	NA	NA	NA	NA

Sample Number	B06-17-002	B06-17-008	B06-17-014	B06-18-000	B06-18-002	B06-18-007	B06-18-014	B06-19-000
Date Sampled	07/09/91	07/09/91	07/09/91	07/01/91	07/01/91	07/01/91	07/01/91	06/28/91
Depth of Sample	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	6.5 ft	14.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	8.0	18.6	27.7	7.3	4.4	17.9	18.1	9.0
pH, SED (Std.Units)	NA	9.4	NA	NA	NA	9.1	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.232	NA	NA	NA	0.638	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.4	NA	NA	NA	1.1	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 6
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B06-19-002	B06-19-007	B06-19-007	B06-19-014
Date Sampled	06/28/91	06/28/91	06/28/91	06/28/91
Depth of Sample	1.0 ft	6.5 ft	6.5 ft	14.0 ft
PARAMETER REPORTED				
PHYSICAL PARAMETERS-LAB				
MOISTURE (% wet wt.)	5.4	19.2	18.7	22.9
pH, SED (Std.Units)	NA	NA	NA	9.0
TOTAL ORGANIC CARBON (% dry wt)				
TOC as CARBON (OC/1.724)*	NA	NA	NA	0.812
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	1.4

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 7A
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B07A-01-000	B07A-01-001	B07A-01-007	B07A-01-012	Duplicate B07A-01-012	B07A-02-000	B07A-02-002
Date Sampled	06/19/91	06/19/91	06/19/91	06/19/91	06/19/91	06/21/91	06/21/91
Depth of Sample	0.0 ft	1.0 ft	6.5 ft	11.5 ft	11.5 ft	0.0 ft	2.0 ft
PARAMETER REPORTED							
PHYSICAL PARAMETERS-LAB							
MOISTURE (% wet wt.)	6.6	9.8	20.5	49.1	48.1	5.2	27.8
pH, SED (Std.Units)	NA	NA	8.8		9.3	NA	NA
				NA			
TOTAL ORGANIC CARBON (% dry wt)							
TOC as CARBON (OC/1.724)*	NA	NA	< 0.058	NA	4.06	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	< 0.1	NA	7.0	NA	NA

Sample Number	B07A-02-007	B07A-02-013	B07A-03-000	B07A-03-001	B07A-03-003	B07A-03-012	B07A-04-000
Date Sampled	06/21/91	06/21/91	06/18/91	06/18/91	06/18/91	06/18/91	06/21/91
Depth of Sample	7.0 ft	13.0 ft	0.0 ft	0.5 ft	3.5 ft	12.0 ft	0.0 ft
PARAMETER REPORTED							
PHYSICAL PARAMETERS-LAB							
MOISTURE (% wet wt.)	48.1	51.2	5.3	13.7	42.9	52.8	3.4
pH, SED (Std.Units)		8.6	NA	NA	NA	8.5	NA
	NA						
TOTAL ORGANIC CARBON (% dry wt)							
TOC as CARBON (OC/1.724)*	NA	0.580	NA	NA	NA	0.986	NA
ORG. CONTENT (OC), Total @440 C	NA	1.0	NA	NA	NA	1.7	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 7A
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B07A-04-001	Duplicate B07A-04-001	B07A-04-005	B07A-04-013	B07A-05-000	B07A-05-002	B07A-05-007
Date Sampled	06/21/91	06/21/91	06/21/91	06/21/91	06/20/91	06/20/91	06/20/91
Depth of Sample	1.0 ft	1.0 ft	5.0 ft	13.0 ft	0.0 ft	2.0 ft	0.5 ft
PARAMETER REPORTED							
PHYSICAL PARAMETERS-LAB							
MOISTURE (% wet wt.)	26.4	12.8	16.5	48.2	6.4	12.8	47.0
pH, SED (Std.Units)	8.5	NA	NA	NA	NA	9.0	NA
TOTAL ORGANIC CARBON (% dry wt)							
TOC as CARBON (OC/1.724)*	< 0.058	NA	NA	NA	NA	0.116	NA
ORG. CONTENT (OC), Total @440 C	< 0.1	NA	NA	NA	NA	0.2	NA

Sample Number	B07A-05-013	B07A-06-000	Duplicate B07A-06-000	B07A-06-002	B07A-06-010	B07A-06-017	B07A-07-000
Date Sampled	06/20/91	06/19/91	06/19/91	06/19/91	06/19/91	06/19/91	06/19/91
Depth of Sample	12.5 ft	0.0 ft	0.0 ft	2.0 ft	9.5 ft	17.0 ft	0.0 ft
PARAMETER REPORTED							
PHYSICAL PARAMETERS-LAB							
MOISTURE (% wet wt.)	49.2	7.3	6.9	12.8	52.1	43.5	7.4
pH, SED (Std.Units)	NA	NA	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)							
TOC as CARBON (OC/1.724)*	NA	NA	NA	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	NA	NA	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 7A
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B07A-07-001	B07A-07-005	B07A-07-013
Date Sampled	06/19/91	06/19/91	06/19/91
Depth of Sample	1.0 ft	5.0 ft	13.0 ft
PARAMETER REPORTED			
PHYSICAL PARAMETERS-LAB			
MOISTURE (% wet wt.)	6.1	35.1	49.1
pH, SED (Std.Units)	NA	NA	8.3
TOTAL ORGANIC CARBON (% dry wt)			
TOC as CARBON (OC/1.724)*	NA	NA	0.812
ORG. CONTENT (OC), Total @440 C	NA	NA	1.4

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 7B
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B07B-01-000	B07B-01-004	B07B-01-008	B07B-01-014	B07B-02-000	B07B-02-004	B07B-02-011
Date Sampled	06/24/91	06/24/91	06/24/91	06/24/91	06/24/91	06/24/91	06/24/91
Depth of Sample	0.0 ft	4.0 ft	8.0 ft	14.0 ft	0.0 ft	4.0 ft	11.0 ft
PARAMETER REPORTED							
PHYSICAL PARAMETERS-LAB							
MOISTURE (% wet wt.)	10.3	6.8	36.4	17.5	6.5	14.3	28.5
pH, SED (Std.Units)	NA	9.4	9.1	NA	NA	9.2	9.6
TOTAL ORGANIC CARBON (% dry wt)							
TOC as CARBON (OC/1.724)*	NA	0.116	4.00	NA	NA	< 0.058	0.232
ORG. CONTENT (OC), Total @440 C	NA	0.2	6.9	NA	NA	< 0.1	0.4

Sample Number	Duplicate B07B-02-011D	B07B-02-014	B07B-03-000	B07B-03-002	B07B-03-011	B07B-03-016
Date Sampled	06/24/91	06/24/91	06/21/91	06/21/91	06/21/91	06/21/91
Depth of Sample	11.0 ft	14.0 ft	0.0 ft	2.0 ft	11.0 ft	16.0 ft
PARAMETER REPORTED						
PHYSICAL PARAMETERS-LAB						
MOISTURE (% wet wt.)	37.9	17.3	8.2	4.1	14.5	16.3
pH, SED (Std.Units)	9.4	9.5	NA	NA	8.9	NA
TOTAL ORGANIC CARBON (% dry wt)						
TOC as CARBON (OC/1.724)*	0.058	0.638	NA	NA	0.116	NA
ORG. CONTENT (OC), Total @440 C	0.1	1.1	NA	NA	0.2	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 8
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B08-01-000	Duplicate B08-01-000	B08-01-004	B08-01-010	B08-01-014	B08-02-000	B08-02-002	B08-02-008
Date Sampled	07/30/91	07/30/91	07/30/91	07/30/91	07/30/91	08/06/91	08/06/91	08/06/91
Depth of Sample	0.0 ft	0.0 ft	3.5 ft	9.5 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	2.4	2.4	11.0	20.4	19.0	3.5	3.5	15.3
pH, SED (Std.Units)	NA	NA	NA	9.0	8.3	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	0.290	0.174	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	0.5	0.3	NA	NA	NA

Sample Number	B08-02-014	B08-03-000	B08-03-002	B08-03-008	B08-03-014	B08-04-000	B08-04-002	B08-04-008
Date Sampled	08/06/91	07/29/91	07/29/91	07/29/91	07/29/91	07/29/91	07/29/91	07/29/91
Depth of Sample	14.0 ft	0.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	24.8	5.4	7.8	20.6	24.3	4.6	6.5	22.1
pH, SED (Std.Units)	9.2	NA	NA	NA	NA	NA	NA	8.4
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	0.580	NA	NA	NA	NA	NA	NA	0.290
ORG. CONTENT (OC), Total @440 C	1.0	NA	NA	NA	NA	NA	NA	0.5

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 8
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	Duplicate B08-04-008	B08-04-014	B08-05-000	B08-05-002	Duplicate B08-05-008	B08-05-008	B08-05-014	B08-06-000
Date Sampled	10/15/91	07/29/91	07/30/91	07/30/91	07/30/91	07/30/91	07/30/91	08/07/91
Depth of Sample	8.0 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft	8.0 ft	14.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	19.7	40.1	6.9	4.9	19.0	16.8	16.2	6.4
pH, SED (Std.Units)	NA	NA	NA	NA	NA	8.4	8.3	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	NA	NA	0.174	0.406	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	NA	NA	0.3	0.7	NA

Sample Number	B08-06-004	B08-06-008	B08-06-014	B08-07-000	B08-07-002	B08-07-005	Duplicate B08-07-013	B08-07-013
Date Sampled	08/07/91	08/07/91	08/07/91	08/13/91	08/13/91	08/13/91	08/13/91	08/13/91
Depth of Sample	3.5 ft	8.0 ft	14.0 ft	0.0 ft	2.0 ft	5.0 ft	14.0 ft	12.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	9.1	31.2	16.5	8.7	4.5	17.2	15.5	17.0
pH, SED (Std.Units)	NA	9.0	8.8	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.870	0.348	NA	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	1.5	0.6	NA	NA	NA	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 8
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B08-08-000	B08-08-002	B08-08-008	B08-08-014	Duplicate B08-08-014	B08-09-000	B08-09-005	B08-09-008
Date Sampled	08/06/91	08/06/91	08/06/91	08/06/91	08/06/91	08/07/91	08/07/91	08/07/91
Depth of Sample	0.0 ft	2.0 ft	8.0 ft	14.0 ft	14.0 ft	0.0 ft	5.0 ft	8.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	3.1	6.7	18.2	37.2	33.1	5.1	10.2	15.6
pH, SED (Std.Units)	NA	NA	NA	8.6	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	1.62	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	2.8	NA	NA	NA	NA

Sample Number	B08-09-014	Duplicate B08-09-014	B08-10-000	B08-10-005	B08-10-008	B08-10-014	B08-11-000	B08-11-004
Date Sampled	08/07/91	08/07/91	08/07/91	08/07/91	08/07/91	08/07/91	07/30/91	07/30/91
Depth of Sample	14.0 ft	14.0 ft	0.0 ft	5.0 ft	8.0 ft	14.0 ft	0.0 ft	4.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	16.5	28.6	4.6	11.2	14.3	17.1	6.5	8.4
pH, SED (Std.Units)	NA	8.5	NA	NA	NA	8.3	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.986	NA	NA	NA	0.290	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	1.7	NA	NA	NA	0.5	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 8
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B08-11-010	B08-11-014	B08-12-000	B08-12-005	B08-12-008	B08-12-014
Date Sampled	07/30/91	07/30/91	08/13/91	08/13/91	08/13/91	08/13/91
Depth of Sample	9.5 ft	14.0 ft	0.0 ft	5.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED						
PHYSICAL PARAMETERS-LAB						
MOISTURE (% wet wt.)	21.4	19.8	7.8	8.0	16.2	17.5
pH, SED (Std.Units)	NA	8.5	NA	9.5	NA	NA
TOTAL ORGANIC CARBON (% dry wt)						
TOC as CARBON (OC/1.724)*	NA	0.232	NA	0.638	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.4	NA	1.1	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 10A
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B10-01-000	B10-01-005	B10-01-008	B10-01-014	B10-02-000	B10-02-005	B10-02-008	B10-02-014
Date Sampled	08/05/91	08/05/91	08/05/91	08/05/91	08/02/91	08/02/91	08/02/91	08/02/91
Depth of Sample	0.0 ft	5.0 ft	8.0 ft	14.0 ft	0.0 ft	5.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	9.4	17.8	16.8	20.3	5.9	18.6	32.2	19.8
pH, SED (Std.Units)	NA	NA	NA	NA	NA	NA	NA	9.3
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	NA	NA	NA	NA	NA	0.290
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	NA	NA	NA	NA	0.5

Sample Number	B10-03-000	B10-03-002	B10-03-010	B10-03-014	B10-04-000	B10-04-005	B10-04-010	Duplicate B10-04-010
Date Sampled	08/01/91	08/01/91	08/01/91	08/01/91	08/02/91	08/02/91	08/02/91	08/02/91
Depth of Sample	0.0 ft	2.0 ft	9.5 ft	14.0 ft	0.0 ft	5.0 ft	9.5 ft	9.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	5.5	6.4	18.4	18.7	3.3	16.6	18.1	20.9
pH, SED (Std.Units)	NA	NA	9.0	NA	NA	NA	NA	8.3
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	0.348	NA	NA	NA	NA	0.232
ORG. CONTENT (OC), Total @440 C	NA	NA	0.6	NA	NA	NA	NA	0.4

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 10A
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	**B10-04-014**
Date Sampled	**08/02/91**
Depth of Sample	**14.0 ft**
PARAMETER REPORTED	
PHYSICAL PARAMETERS-LAB	
MOISTURE (% wet wt.)	29.6
pH, SED (Std.Units)	NA
TOTAL ORGANIC CARBON (% dry wt)	
TOC as CARBON (OC/1.724)*	NA
ORG. CONTENT (OC), Total @440 C	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 11
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B11-01-000	B11-01-002	B11-01-005	B11-01-014	B11-02-000	B11-02-005	B11-02-010	B11-02-014
Date Sampled	06/26/91	06/26/91	06/26/91	06/26/91	06/26/91	06/26/91	06/26/91	06/26/91
Depth of Sample	0.0 ft	2.0 ft	5.0 ft	14.0 ft	0.0 ft	5.0 ft	10.0 ft	14.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	5.8	5.3	6.3	17.2	6.7	16.0	43.0	18.5
pH, SED (Std.Units)	NA	NA	8.8	NA	NA	NA	NA	9.1
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	1.10	NA	NA	NA	NA	0.464
ORG. CONTENT (OC), Total @440 C	NA	NA	1.9	NA	NA	NA	NA	0.8

Sample Number	B11-03-000	B11-03-004	B11-03-008	B11-03-014	B11-04-000	Duplicate B11-04-000	B11-04-004	B11-04-010
Date Sampled	06/25/91	06/25/91	06/25/91	06/25/91	06/25/91	06/25/91	06/25/91	06/25/91
Depth of Sample	0.0 ft	3.5 ft	8.0 ft	14.0 ft	0.0 ft	0.0 ft	3.5 ft	9.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	5.6	4.6	16.8	14.2	3.6	4.0	6.4	23.6
pH, SED (Std.Units)	NA	9.3	NA	NA	NA	NA	9.3	9.0
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	1.80	NA	NA	NA	NA	0.058	1.10
ORG. CONTENT (OC), Total @440 C	NA	3.1	NA	NA	NA	NA	0.1	1.9

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 11
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B11-04-014	B11-05-000	B11-05-004	Duplicate B11-05-004	B11-05-005	B11-05-014	B11-06-000	B11-06-004
Date Sampled	06/25/91	06/26/91	06/26/91	06/26/91	06/26/91	06/26/91	06/25/91	06/25/91
Depth of Sample	14.0 ft	0.0 ft	3.5 ft	3.5 ft	5.0 ft	14.0 ft	0.0 ft	3.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	14.9	6.9	5.1	4.6	13.9	13.7	5.1	6.7
pH, SED (Std.Units)	9.2	NA	NA	NA	9.3	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	1.04	NA	NA	NA	1.74	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	1.8	NA	NA	NA	3.0	NA	NA	NA

Sample Number	B11-06-008	Duplicate B11-06-008	B11-06-014	B11-07-000	B11-07-001	B11-07-008	B11-07-014
Date Sampled	06/25/91	06/25/91	06/25/91	06/24/91	06/24/91	06/24/91	06/24/91
Depth of Sample	8.0 ft	8.0 ft	14.0 ft	0.0 ft	1.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED							
PHYSICAL PARAMETERS-LAB							
MOISTURE (% wet wt.)	33.0	25.8	15.6	6.2	8.7	19.5	16.7
pH, SED (Std.Units)	9.2	9.5	NA	NA	NA	NA	9.0
TOTAL ORGANIC CARBON (% dry wt)							
TOC as CARBON (OC/1.724)*	1.39	0.116	NA	NA	NA	NA	< 0.058
ORG. CONTENT (OC), Total @440 C	2.4	0.2	NA	NA	NA	NA	< 0.1

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 12
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B12-01-000	B12-01-004	B12-01-010	B12-01-014	Duplicate B12-01-014	B12-02-000	B12-02-004	B12-02-010
Date Sampled	07/25/91	07/25/91	07/25/91	07/25/91	07/25/91	07/25/91	07/25/91	07/25/91
Depth of Sample	0.0 ft	3.5 ft	9.5 ft	14.0 ft	14.0 ft	0.0 ft	3.5 ft	9.5 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	4.4	4.3	18.7	20.3	19.9	3.4	5.7	34.3
pH, SED (Std.Units)	NA	9.3	NA	8.9	8.9	NA	NA	9.6
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.290	NA	0.174	0.406	NA	NA	0.522
ORG. CONTENT (OC), Total @440 C	NA	0.5	NA	0.3	0.7	NA	NA	0.9

Sample Number	B12-02-014	B12-03-000	B12-03-004	B12-03-011	Duplicate B12-03-011	B12-03-014	B12-04-000	B12-04-004
Date Sampled	07/25/91	07/26/91	07/26/91	07/26/91	07/26/91	07/26/91	07/26/91	07/26/91
Depth of Sample	14.0 ft	0.0 ft	3.5 ft	11.0 ft	11.0 ft	14.0 ft	0.0 ft	4.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	21.3	3.0	4.7	43.9	42.7	19.3	3.2	7.1
pH, SED (Std.Units)	9.6	NA	NA	9.1	9.3	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	0.406	NA	NA	0.232	0.522	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	0.7	NA	NA	0.4	0.9	NA	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 12
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B12-04-010	B12-04-013	B12-05-000	B12-05-005	B12-05-008	B12-05-014	B12-06-000	B12-06-005
Date Sampled	07/26/91	07/26/91	08/12/91	08/12/91	08/12/91	08/12/91	08/12/91	08/12/91
Depth of Sample	9.5 ft	12.5 ft	0.0 ft	5.0 ft	8.0 ft	14.0 ft	0.0 ft	5.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	40.2	20.7	4.4	5.8	18.6	17.8	5.5	4.5
pH, SED (Std.Units)	NA	9.2	NA	8.3	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.406	NA	0.638	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.7	NA	1.1	NA	NA	NA	NA

Sample Number	B12-06-008	Duplicate B12-06-008	B12-06-014	B12-07-000	B12-07-004	B12-07-010	B12-07-014	B12-08-000
Date Sampled	08/12/91	08/12/91	08/12/91	07/25/91	07/25/91	07/25/91	07/25/91	07/24/91
Depth of Sample	8.0 ft	8.0 ft	14.0 ft	0.0 ft	3.5 ft	9.5 ft	14.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	17.9	17.9	18.4	4.0	6.0	24.1	17.2	2.5
pH, SED (Std.Units)	NA	8.7	NA	NA	NA	9.4	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.116	NA	NA	NA	0.174	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.2	NA	NA	NA	0.3	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 12
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B12-08-004	B12-08-012	B12-08-014	B12-09-000	B12-09-004	B12-09-010	B12-09-014	B12-10-000
Date Sampled	07/24/91	07/24/91	07/24/91	07/24/91	07/24/91	07/24/91	07/24/91	08/05/91
Depth of Sample	3.5 ft	9.5 ft	14.0 ft	0.0 ft	3.5 ft	9.5 ft	14.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	6.5	19.2	18.2	3.0	9.5	19.5	21.7	3.3
pH, SED (Std.Units)	NA	10.2	NA	NA	NA	NA	9.0	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.522	NA	NA	NA	NA	0.348	NA
ORG. CONTENT (OC), Total @440 C	NA	0.9	NA	NA	NA	NA	0.6	NA

Sample Number	Duplicate B12-10-000	B12-10-002	B12-10-008	B12-10-014
Date Sampled	08/05/91	08/05/91	08/05/91	08/05/91
Depth of Sample	0.0 ft	2.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED				
PHYSICAL PARAMETERS-LAB				
MOISTURE (% wet wt.)	3.1	2.9	19.8	22.3
pH, SED (Std.Units)	NA	NA	NA	9.5
TOTAL ORGANIC CARBON (% dry wt)				
TOC as CARBON (OC/1.724)*	NA	NA	NA	0.232
ORG. CONTENT (OC), Total @440 C	NA	NA	NA	0.4

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 14
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B14-01-000	B14-01-002	B14-01-005	B14-01-014	B14-01-014	B14-02-000	B14-02-002	B14-02-008
Date Sampled	07/11/91	07/11/91	07/11/91	07/11/91	07/11/91	07/10/91	07/10/91	07/10/91
Depth of Sample	0.0 ft	2.0 ft	5.0 ft	14.0 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	2.4	6.7	47.2	17.6	18.5	1.8	20.5	29.6
pH, SED (Std.Units)	NA	NA	8.6	NA	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	NA	0.290	NA	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	NA	0.5	NA	NA	NA	NA	NA

Sample Number	B14-02-014	B14-03-000	B14-03-004	B14-03-008	B14-03-014
Date Sampled	07/10/91	07/10/91	07/10/91	07/10/91	07/10/91
Depth of Sample	14.0 ft	0.0 ft	3.5 ft	8.0 ft	14.0 ft
PARAMETER REPORTED					
PHYSICAL PARAMETERS-LAB					
MOISTURE (% wet wt.)	17.2	6.1	6.2	22.0	23.3
pH, SED (Std.Units)	NA	NA	NA	8.4	NA
TOTAL ORGANIC CARBON (% dry wt)					
TOC as CARBON (OC/1.724)*	0.290	NA	NA	0.232	NA
ORG. CONTENT (OC), Total @440 C	0.5	NA	NA	0.4	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 15
SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	B15-01-000	B15-01-002	Duplicate B15-01-002	B15-01-008	B15-01-014	B15-02-000	Duplicate B15-02-000	B15-02-002
Date Sampled	08/01/91	08/01/91	08/01/91	08/01/91	08/01/91	07/31/91	10/15/91	07/31/91
Depth of Sample	0.0 ft	2.0 ft	2.0 ft	8.0 ft	14.0 ft	0.0 ft	0.0 ft	2.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	3.3	16.6	16.9	18.1	19.4	0.8	1.0	11.5
pH, SED (Std.Units)	NA	9.3	NA	8.6	NA	NA	NA	NA
TOTAL ORGANIC CARBON (% dry wt)								
TOC as CARBON (OC/1.724)*	NA	0.406	NA	0.348	NA	NA	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.7	NA	0.6	NA	NA	NA	NA

Sample Number	B15-02-008	B15-02-014	B15-03-000	B15-03-002	B15-03-008	B15-03-014
Date Sampled	07/31/91	07/31/91	07/31/91	07/31/91	07/31/91	07/31/91
Depth of Sample	8.0 ft	14.0 ft	0.0 ft	2.0 ft	8.0 ft	14.0 ft
PARAMETER REPORTED						
PHYSICAL PARAMETERS-LAB						
MOISTURE (% wet wt.)	18.8	26.1	5.2	5.8	16.5	22.2
pH, SED (Std.Units)	NA	8.9	NA	8.7	NA	NA
TOTAL ORGANIC CARBON (% dry wt)						
TOC as CARBON (OC/1.724)*	NA	0.174	NA	0.174	NA	NA
ORG. CONTENT (OC), Total @440 C	NA	0.3	NA	0.3	NA	NA

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 15
SURFACE SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	S15-01	Duplicate S15-01	S15-02	S15-03	S15-04	S15-05	S15-06	S15-07
Date Sampled	07/23/91	07/23/91	07/23/91	07/23/91	07/23/91	07/23/91	07/23/91	07/22/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.4	0.4	0.5	0.3	1.4	2.3	1.1	0.5

Sample Number	S15-08	S15-09	S15-10	S15-11	Duplicate S15-11	S15-12	S15-13	S15-14
Date Sampled	07/23/91	07/23/91	07/22/91	07/22/91	07/22/91	07/22/91	07/22/91	07/22/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.4	0.9	0.8	0.9	1.1	1.0	0.5	0.5

Sample Number	S15-15	S15-16	S15-17	Duplicate S15-17	S15-18	S15-19	S15-20	S15-21
Date Sampled	07/23/91	07/24/91	07/24/91	07/24/91	07/23/91	07/23/91	07/22/91	07/22/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.7	3.4	1.7	3.2	0.6	0.5	0.4	0.6

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 15
SURFACE SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	S15-22	S15-23	S15-24	S15-25	S15-26	S15-27	S15-28	S15-29
Date Sampled	07/22/91	07/22/91	07/23/91	07/24/91	07/23/91	07/24/91	07/24/91	07/22/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.8	0.5	0.8	4.4	0.2	4.7	0.4	0.5

Sample Number	S15-30	S15-31	S15-32	S15-33	S15-34	S15-35	S15-36	S15-37
Date Sampled	07/22/91	07/22/91	07/22/91	07/23/91	07/24/91	07/24/91	07/24/91	07/24/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.9	1.0	0.5	0.8	1.4	4.0	4.5	1.6

Sample Number	S15-38	S15-39	S15-40	S15-41	S15-42	S15-43	S15-44	S15-45
Date Sampled	07/22/91	07/22/91	07/22/91	07/22/91	07/23/91	07/24/91	07/24/91	07/24/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.6	1.2	0.9	0.4	0.4	3.9	3.9	4.0

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX B
NAS ALAMEDA - SITE 15
SURFACE SOIL ANALYTICAL RESULTS FOR GENERAL CHEMICALS

Sample Number	S15-46	S15-47	S15-48	S15-49	Duplicate S15-49	S15-50	S15-51	Duplicate S15-51
Date Sampled	07/24/91	07/22/91	07/22/91	07/22/91	07/22/91	07/22/91	07/23/91	07/23/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED								
PHYSICAL PARAMETERS-LAB								
MOISTURE (% wet wt.)	0.5	0.6	0.8	0.4	0.7	0.4	1.6	1.4

Sample Number	S15-52	S15-53	S15-54	Duplicate S15-54	S15-55
Date Sampled	07/24/91	07/23/91	07/23/91	07/23/91	07/24/91
Depth of Sample	0.0 ft	0.0 ft	0.0 ft	0.0 ft	0.0 ft
PARAMETER REPORTED					
PHYSICAL PARAMETERS-LAB					
MOISTURE (% wet wt.)	1.2	0.5	0.5	0.4	0.8

Notes: NA = Not analyzed
< = Analyte reported below detection limit
* = conversion to TOC (Black, 1965)

APPENDIX C

BOREHOLE LOGS

DATED 27 OCTOBER 1992

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

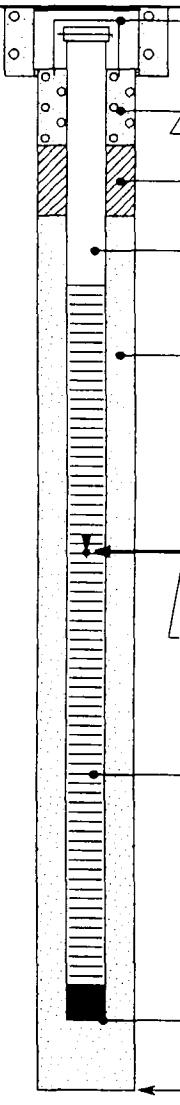
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-05-01
DATE STARTED 7/16/91 COMPLETED 7/16/91
REF. ELEVATION 12.03 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
				0.5		CN	CONCRETE
	■	CHEM	50/3"			SP	SAND (SP), light olive brown (2.5Y 5/3), lense, moist, 5 to 10% fines, fine sand, high estimated K, roots present
				0.2		SW	
2	■	CHEM	37			SP	sandy GRAVEL (SW), light olive brown, very dense, moist, 5 to 10% fines, 30 to 40% fine sand, fine to coarse gravel, moderate estimated K
			50/5"	0.2			
			24				SAND (SP), light olive brown, very dense, moist, 5 to 10% fines, fine sand, high estimated K
4	■	GEO-TECH	50				
			42	0.2			@ 4 feet-as above, moist to damp
	☒		25			SW	gravelly SAND (SW), yellowish brown (10YR 5/6), very dense, moist, 20 to 30% fines, sand, 20 to 30% gravel
			35			SP	
6			36	0			
	☒		17				SAND (SP), as above, abundant shell fragments, high estimated K
			20				
			22				@ 7.5 feet-as above, color change to olive gray (5Y 4/2)
	■	CHEM	2			SM	silty SAND (SM), olive (5Y 4/3), loose, wet, 30 to 35% fines, fine sand, moderate estimated K, some shells
			2				
			11	0			
	☒		4				
10	■	GEO-TECH	6				
	☒		14	0.5			
	☒		6				
			9				
12			6				
	☒		1				
	■	GEO-TECH	6				
			11	0		CL	silty CLAY (CL), black (2.5Y N2/), stiff, wet, 100% fines, low to moderate estimated K
14	■	CHEM	2				
			4				@ 14.5 feet-silty CLAY (CL), as above, alternating with silty sand (with few small shells)
			6	0			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14.5 FEET

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

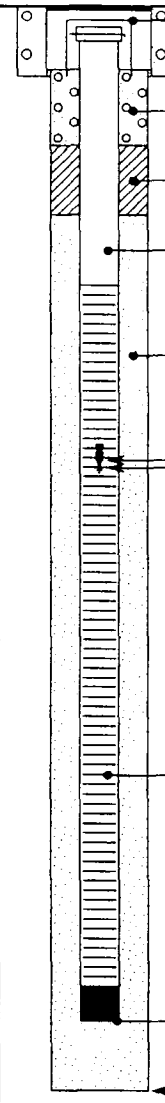
BORING/WELL NUMBER *MW-05-02* CLIENT *PRC/US NAVY*

DATE STARTED *7/16/91* COMPLETED *7/16/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*

REF. ELEVATION *11.80 FEET, TOP OF CASING* GEOLOGIST *KAREN KRAMER*

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
				0.5		CN	CONCRETE
		CHEM	27			SP	SAND (SP), yellowish brown (10YR 5/6), very dense, moist, 5% fines, fine sand, trace gravel, high estimated K
			47				
2			50	0.5			@ 1.5 feet-as above, dense, no gravel
		CHEM	32				
			47	0.5			
			19				@ 3.5 feet-as above, with shells
4		GEO-TECH	37				
			40	0.5			
			10				@ 5 feet-as above, 2 inch clay layer, dense, wet (in clay layer)
			27				
6			30	0.5			
			18				SAND (SP), olive brown (2.5Y 4/4), medium dense, wet, 20 to 25% fines, fine sand, high estimated K
			27				
			34	0.5			
		GEO-TECH	14				
			28				
			47	0.5			
		CHEM	14				
10			27				
			42	0.5			
			13				@ 11 feet-as above, 25 to 30% fines, wet
			14				
12			16	0.5			
			6				
		GEO-TECH	6			CL	sandy CLAY (CL), olive brown (2.5Y 4/4), medium dense, wet, 65% fines, fine sand, moderate estimated K
			20				
14			8	0.5		SM	silty SAND (SM), black (2.5Y N2/), medium dense, wet, 20 to 30% fines, fine sand, high estimated K
		CHEM	5			CL	silty CLAY (CL), black (2.5Y N2/), stiff, moist, 100% fines, low estimated K, pockets of silty sand
			5				
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./D. RYAN*

HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*

TOTAL DEPTH OF BORING *15.5 FEET* WELL COMPLETION DEPTH *14.5 FEET*

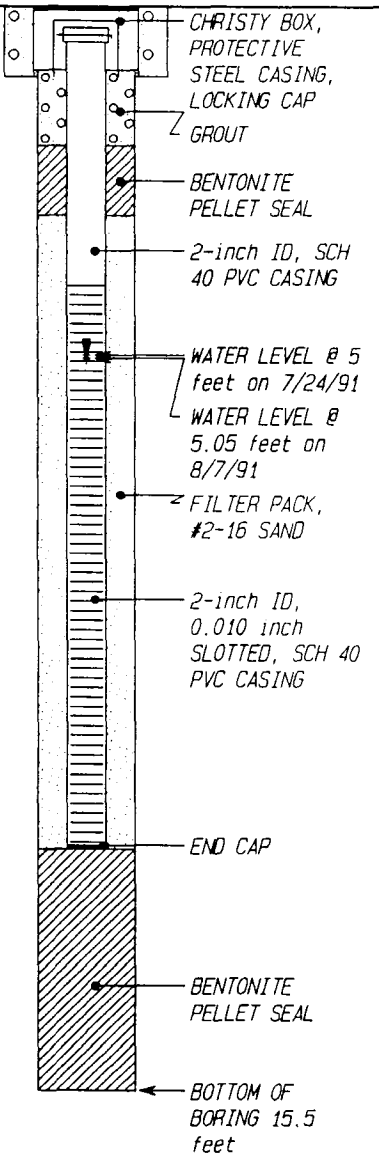
JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-05-03
DATE STARTED 7/24/91 COMPLETED 7/24/91
REF. ELEVATION 11.12 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	29	100		SC	clayey SAND (SC), olive brown (2.5Y 4/3), moist, 15 to 20% fines, fine sand, trace gravel, moderate to high estimated K, hydrocarbon odor
2			30	505			
			32			SP	SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 10 to 15% fines, fine sand, high estimated K, hydrocarbon odor
		GEO-TECH	46				
			50	727			
		CHEM	17				@ 3.5 feet-as above, color change to olive (5Y 4/3), strong odor (smells like pesticide)
4			30				
			40	742			
			12				@ 5 feet-as above, wet/moist, some clay layers
			15				
6			20	47			
			9				@ 6.5 feet-as above, color change to dark olive (5Y 3/3), wet, pesticide odor
			16				
			18	80			
			9				
		GEO-TECH	14				
			21	150			
		CHEM	4				@ 9.5 feet-as above, odor diminishing
10			16				
			19	87			
			9				
			12				
12			15	6.7		SC	clayey SAND (SC), olive (5Y 4/4), medium dense, moist, 30 to 40% fines, fine sand, low to moderate estimated K
			4				
		GEO-TECH	6				
			9	8.7		CL SC	sandy CLAY (CL) and clayey SAND (SC), black to olive (5Y 4/3), stiff, moist, 40 to 60% fines, fine sand, low estimated K
14		CHEM	4				
			6				
			12	6.7			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 12 FEET

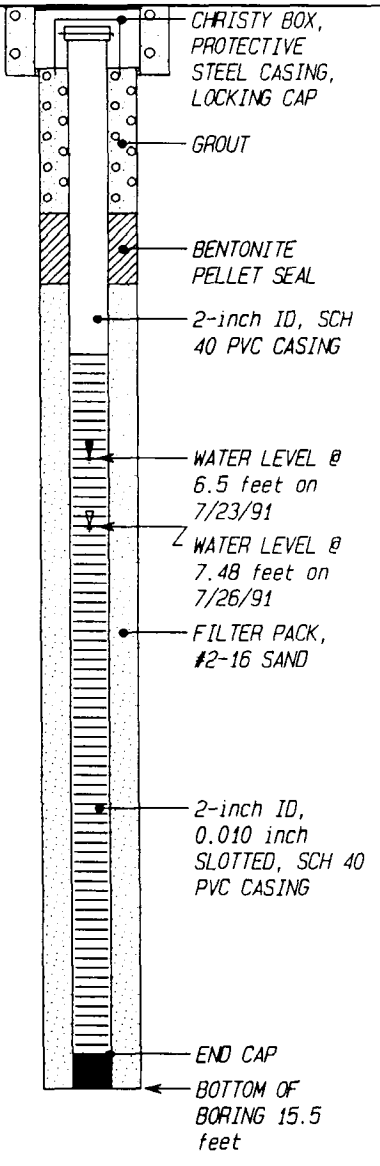
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-05-04
DATE STARTED 7/23/91 COMPLETED 7/23/91
REF. ELEVATION 11.83 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						AS	ASPHALT
		CHEM	50/2"	2.3		SW	gravelly SAND (SW), orange brown (10YR 5/6), dense, moist, 10% fines, fine to medium sand, 25 to 30% fine gravel, moderate estimated K
				11.9		SP	SAND (SP), brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, moderate estimated K
2		CHEM	33				
			42				
			50	4.7			
			31				
4		GEO-TECH	50				
			50/5"	7.1			
			12				
			22				
6			26	4.7			
			11				
			11			SM	silty SAND (SM), grayish green, (5Y 5/4), medium dense, wet, 15 to 20% fines, very fine to fine sand, moderate estimated K
			11	11.9			
8		CHEM	3				
			3				@ 8.5 feet-as above, grayish green (5Y 4/2)
			14	14.3			
			4				
10		GEO-TECH	6				@ 10 feet-as above, grayish green (5Y 5/4), 10 to 15% fines, fine to medium sand
			13	7.1			
			40				
			10				
12			10				
			10			SC	clayey SAND (SC), black (2.YR N2/), loose, wet, 35 to 40% fines, very fine to fine sand, low estimated K, highly organic, abundant shell fragments
		GEO-TECH	4				
			2	4.7			
14		CHEM	7				
			8				@ 14.5 feet-as above, 20 to 25% fines, very fine to fine sand
			10				
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 15.5 FEET

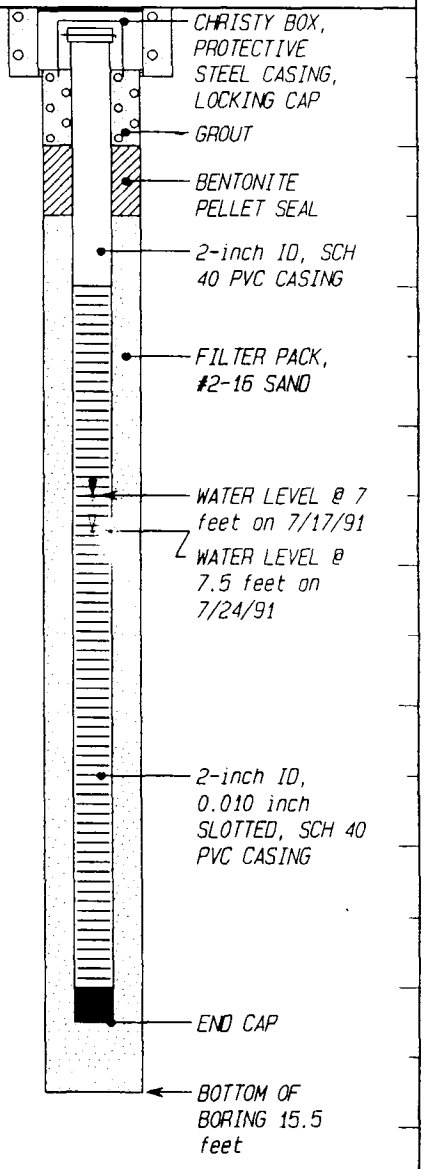
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-05-05
DATE STARTED 7/17/91 COMPLETED 7/17/91
REF. ELEVATION 10.98 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	25			SW	gravelly SAND (SW), olive brown (2.5Y 4/3), dense, moist, 10 to 15% fines, fine sand, 15 to 20% gravel, moderate to high estimated K
2			32	0.5		SP	
		CHEM	14				SAND (SP), olive brown (2.5Y 4/3), medium dense, moist, 5 to 10% fines, fine sand, trace gravel, high estimated K, trace shell fragments
			13	0.5			
			11				
			27				
4		GEO-TECH	30				
			27	0.5			
			12				
			13				
6			15	0.5			@ 6 feet-as above, except 15 to 20% fines, few clay fragments with discoloration to olive gray (5Y 4/2), at 6 to 7 feet
			17				
			17				SAND (SP), olive brown (2.5Y 4/3), medium dense, wet, 15 to 20% fines, fine sand, trace shell fragments
			22	0.5			
8		CHEM	6				
			6				
			5				
			5				@ 9.5 feet-as above, gradual color change to olive (5Y 4/3)
10		GEO-TECH	6				
			6	0.5		SP	SAND (SP), 11% fines
			5			SM	@ 11 feet-15 to 20% fines, areas of clayey sand, abundant shell fragments
			10				
12			20	0.5			
			1				
		GEO-TECH	11				
			20	0.5		SC	clayey SAND (SC), dark olive (5Y 3/3), medium dense, moist to wet, 40 to 50% fines, fine sand, moderate estimated K
14		CHEM	6				
			8				
			10	0.5			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14.5 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-06 CLIENT PRC/US NAVY
DATE STARTED 7/12/91 COMPLETED 7/12/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.36 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				2.1		CN	CONCRETE	
		CHEM	30			SM SC	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 15 to 20% fines, fine sand, trace gravel, high estimated K	
2			27	2.1				
		CHEM	24					
			25					
			19	2.1				
4		GEO-TECH	8					
			6					
			6	2.1				
			4			SP	SAND (SP), yellowish brown (10YR 5/4), loose, wet, 10 to 20% fines, fine sand, high estimated K	! DEPTH TO WATER=5 feet
			1					
6			4	0.7				
			3					
			6					
			15	0.7				
8			11				@ 8 feet-as above, wet, trace shell fragments	
		GEO-TECH	26					
			25	2.1				
		CHEM	1				@ 9.5 feet-as above, olive (5Y 4/4), abundant shell fragments	
10			4					
			14	0.7				
			15			SC	@ 11 feet-as above, 20 to 30% fines	
			32					
12			35	0.7				
			8					
		GEO-TECH	6			CL	CLAY (CL), [some clayey SAND (SC)], olive (5Y 3/4), stiff, moist, 50 to 100% fines, fine sand, low to moderate estimated K	
			7	5.0				
14		CHEM	1					
			3					
			6	0.7				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-07 CLIENT PRC/US NAVY
DATE STARTED 7/12/91 COMPLETED 7/12/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.34 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				2.1		CN	CONCRETE	
		CHEM	18			SP	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 10 to 15% fines, fine sand, trace gravel, high estimated K	
2			45	2.1				
		CHEM	17				@ 1.5 feet-as above, dense	
			21					
			22	5.0				
			12			SM SC	@ 3.5 feet- as above, 15 to 25% fines	
4		GEO-TECH	22					
			32	5.0				
			22				@ 5 feet-as above, wet	▼ DEPTH TO WATER=5 feet
			33					
6			34	3.6				
			30				@ 6.5 feet-as above, gradual color change to olive (5Y 4/4), clay stringers, some small shells	
			34					
			50	5.0				
8			28				@ 8 feet-as above, dense, wet, abundant small shells	
		GEO-TECH	45					
			50/5"	5.0				
		CHEM	38					
10				6.4				
			28					
			50					
12			45	7.9		SM	@ 12 feet-grades into a silty SAND (SM), olive (5Y 4/4), dense, wet, 30 to 40% fines, fine sand, moderate estimated K	
			11					
		GEO-TECH	10					
			12	7.9				
14		CHEM	1			CL	@ 13.8 feet-layer of black sand	
			3				CLAY (CL), olive to dark olive, stiff, wet, fines, 0 to 40% fine sand, moderate estimated K	
			9	3.6				
16							@ 15 feet-alternates with black silty sand containing shells, strong H2S odor	
							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-08 CLIENT PRC/US NAVY
DATE STARTED 8/8/91 COMPLETED 8/8/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.86 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	9	124		SP	SAND (SP), olive gray (5Y 4/2), medium dense, moist, 10 to 15% fines, fine sand, high estimated K, hydrocarbon odor	
2			12					
			12				@ 1.5 feet-as above, very moist, hydrocarbon odor	
		CHEM	17					
			15	632				
			13					
4		GEO-TECH	12				@ 4.2 feet-thin clay layer, hydrocarbon odor	
			14	146				
			14			CL	sandy CLAY (CL), olive (5Y 4/3), very stiff, moist, fines, 10 to 20% sand, low estimated K, hydrocarbon odor	
			14			SP		
6			14	257				
			7				SAND (SP), olive gray (5Y 4/2), medium dense, moist, 5 to 10% fines, fine sand, high estimated K, hydrocarbon odor	! DEPTH TO WATER=6.5 feet
			8					
			11	7.7			SAND (SP), dark olive gray (5Y 3/2), medium dense, wet, 10 to 15% fines, fine sand, high estimated K, hydrocarbon odor	
		CHEM	7					
			8					
			8	12.7				
			8					
10		GEO-TECH	12					
			14	20.2				
			3				@ 11 feet-as above, black, hydrocarbon odor	
			4			CL	silty CLAY (CL), olive (5Y 4/3), medium stiff, moist, 100% fines, low estimated K, hydrocarbon odor	
12			5	58				
			2			SP CL	SAND (SP) and sandy CLAY (CL) (as above), hydrocarbon odor	
		GEO-TECH	2					
			3	45				
14		CHEM	1			CL	sandy CLAY (CL), dark olive gray, very soft, moist, fines, 10 to 20% sand, low estimated K, mild H2S and fuel odor	
			1					
			0	10				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE YAEGER

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-09 CLIENT PRC/US NAVY
DATE STARTED 7/12/91 COMPLETED 7/12/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.22 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				3.6		CN	CONCRETE	
		CHEM	42			SW	gravelly SAND (SW), yellowish brown (10YR 5/6), very dense, moist, 20 to 25% fines, fine sand, 20 to 30% gravel, moderate estimated K	
2			40	2.1		SP		
		CHEM	47				SAND (SP), yellowish brown (10 YR 5/6), very dense, moist, 10 to 15% fines, very fine to fine sand, moderate to high estimated K	
			50			SP		
			50	2.1				
			36				SAND (SP), yellowish brown (10YR 5/6), very dense, moist, 5% fines, very fine to fine sand, moderate to high estimated K	
4		GEO-TECH	34					
			50	0.7				
			17				@ 5 feet-as above, wet, 30 to 40% fines	
			25					
6			25	2.1				! DEPTH TO WATER=6 feet
			15				@ 6.5 feet-as above, color change to olive (5Y 4/3) 20 to 30% fines	
			22					
			25	8.0				
8		GEO-TECH	12					
			13					
			14	3.6				
		CHEM	5					
10			25				@ 10 feet-as above	
			32	5.0				
			9					
			22					
12			23	3.6				
			5			SC	clayey SAND (SC), dark olive (5Y 3/3), medium dense, wet, 30 to 40% fines, very fine to fine sand, moderate estimated K, some small shells	
		GEO-TECH	11					
			13	7.9		CL	silty CLAY (CL), olive (5Y 4/3), stiff, wet, 100% fines, some clayey sand in pockets, moderate estimated K	
14		CHEM	1					
			3					
			4	0.7				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-10 CLIENT PRC/US NAVY
DATE STARTED 7/16/91 COMPLETED 7/16/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.88 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	20			SW	gravelly SAND (SW), light olive brown (2.5Y 5/4), very dense, moist, 20 to 25% fines, fine sand, 10 to 25% gravel, moderate estimated K	
2			43	0.5				
		CHEM	20			SP	@ 1.5 feet- as above, color change to dark yellowish brown (10YR 4/6)	
			30					
			30	0.5			SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, trace gravel, high estimated K	
			23					
4		GEO-TECH	23					
			23	0.5				
			12				@ 5 feet-as above, 10 to 15% fines	
			16					
6			17	0.5				
		CHEM	12					
			13				@ 7 feet-as above, color change to olive (5Y 4/4), damp/wet, hydrocarbon odor	
			13	0.5				
8		CHEM	17				@ 8 feet-wet, strong hydrocarbon odor	! DEPTH TO WATER=8 feet
			19					
		CHEM	24	0.5			@ 9 feet-as above, color change to light olive brown (2.5Y 5/4), wet	
			18					
10		GEO-TECH	19					
			28	0.5				
			19					
			23					
12			25	0.5				
		GEO-TECH	48				SAND (SP), olive (5Y 4/3), dense, wet, 10 to 15% fines, fine sand, high estimated K	
			50					
			50/4"	0.5				
14		CHEM	2			CL SC	silty CLAY (CL), olive (5Y 4/3), medium stiff, wet, 100% fines, low to moderate estimated K, slight hydrocarbon odor, with clayey SAND (SC) interbeds	
			3					
			4	0.5				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-11 CLIENT PRC/US NAVY
DATE STARTED 7/17/91 COMPLETED 7/17/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.66 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				0.5		CN	CONCRETE	
		CHEM	25			SW	gravelly SAND (SW), olive brown (2.5Y 4/3), dense, moist, 10 to 15% fines, fine sand, 15 to 20% gravel, moderate estimated K	
2			30	0.5				
			50			SW/GC	@ 2 feet-as above, mottled with olive gray in areas, very moist, gravel is fine to coarse grained, in some areas sandy GRAVEL (GC), probable fill material	
				1.5				
		CHEM	50/4"	1.5				
4								
			38			SP	SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 10 to 15% fines, very fine to fine sand, high estimated K	
			50					
6			50/5"	0				
			24					
			50					
			50/4"	0.5			@ 7.5 feet-sand as above with several clay stringers	
8		CHEM	27					
			36				SAND (SP), light olive brown (2.5Y 5/4), dense, wet, 5 to 10% fines, fine sand, high estimated K	! DEPTH TO WATER=8.5 feet
			25	0				
			16				@ 9.5 feet-as above, color change to olive (5Y 4/3), wet	
10		GEO-TECH	16					
			20	1.0				
			27				@ 11 feet-as above, black in areas	
			40					
12			50/5"	1.0			@ 12 feet-getting flowing sands up in auger	
			16					
		GEO-TECH	26					
			42	1.0				
14		CHEM	50/3"	1.0		SM	silty SAND (SM), olive 5Y 4/3), very dense, wet, 20 to 30% fines, very fine to fine sand, high estimated K, hydrocarbon odor	
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-12 CLIENT PRC/US NAVY
DATE STARTED 7/11/91 COMPLETED 7/11/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.80 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				9.0		CN	CONCRETE	
		CHEM	26	4.8		SP	SAND (SP), dark yellowish brown (10YR 3/6), medium dense, moist, 10 to 15% fines, fine sand, trace gravel, high est K	
2			50/4"			SW	gravelly SAND (SW), dark yellowish brown (10YR 3/6), dense, moist, 30 to 40% fines, fine sand, 30 to 45% gravel, moderate est K	
		CHEM	50					
			43					
			36	4.8				
			48			SP	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 15 to 20% fines, fine sand, trace gravel, high est K	
4		GEO-TECH	50/3"	7.6				
			36			CL	@ 5.25 feet-CLAY layer, (CL) olive, moist, stiff	
			45			SW	gravelly SAND (SW), yellowish brown (10YR 5/4), dense, moist, 30 to 40% fines, sand, 30 to 40% gravel	
6			48	7.6		SP		! DEPTH TO WATER=6.5 feet
			31				SAND (SP), yellowish brown (10YR 5/4), dense, wet, 15 to 20% fines, fine sand, high est K	
			47					
			50/4"	6.2				
8		CHEM	21				SAND (SP), olive (5Y 5/3), dense, wet, 15 to 20% fines, fine sand, high est K	
			28					
			24	6.2				
10		GEO-TECH	8			SC	clayey SAND (SC), olive (5Y 5/3, loose, wet, 40 to 50% fines, fine sand, high to moderate est K	
			9					
			11	11.8				
			3					
12			3			CL	silty CLAY, (CL), dark olive, medium stiff, moist, 100% fines, low to moderate est K	
			3	9.0				
			5			CL SC	@ 12.5 feet-as above, CLAY (CL), with areas of clayey SAND (SC)	
		GEO-TECH	8					
			11	9.0				
14		CHEM	1				@ 14 feet-as above (CL) and (SC), alternating layers, dark olive, soft, wet	
			1					
			3	9.0				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-05-13
DATE STARTED 7/11/91 COMPLETED 7/11/91
ELEVATION 11.28 FEET

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
	■	CHEM	50/5"	2.0		SP	SAND (SP), dark yellowish brown (10YR 4/6), dense moist, 10 to 15% fines, fine sand, 5to 10% gravel, moderate to high est K	
				9.3		SM		
2	■	CHEM	50/5"			SW	silty SAND (SM), dark yellowish brown (10YR 4/6), very dense, moist, 30 to 35% fines, fine sand, 10 to 15% fine to coarse gravel, high est K	
			40	3.0				
	⊠		30			SP	@ 2 feet-3 inches of asphalt	
4	■	GEO-TECH	50/5"				gravelly SAND (SW), dark yellowish brown (10 YR 4/6), very dense, moist, 20 to 30% fines, fine sand, 30 to 40% fine to coarse gravel, moderate est K	▼ DEPTH TO WATER=5 feet
				0.6				
	⊠		15					
			15	2.0				
6			37				SAND (SP), yellowish brown (10YR 5/4), dense, moist, 10 to 15% fines, fine sand, high est K	
	⊠		15			SW		
						SP	@ 6 feet-wet, 20 to 30% fines, some clay stringers	
			35					
			50	11.8				
8	■	CHEM	16				gravelly SAND (SW), yellowish brown, dense, wet, 20 to 30% fines, fine to coarse sand, 40 to 50% gravel, high est K	
			25			SC		
			37	3.4		SM	SAND (SP), yellowish brown (10YR 5/4), dense, wet, 10 to 15% fines, fine sand, moderate to high est K, some clay fragments	
			19					
10	■	GEO-TECH	21					
			26	3.4			clayey SAND (SC), olive (5Y 3/3)	
	⊠		3			CL	silty SAND (SM), olive (5Y 4/4), dense, wet, 30 to 40% fines, fine sand, high est K	
			5					
12			5	4.8		CL SC	silty CLAY (CL) olive (5Y 4/4), medium stiff, moist, 100% fines, moderate est K	
	⊠		1					
	■	GEO-TECH	6				silty CLAY (CL) and clayey SAND (SC), as above, sandy in areas	
			20					
14	■	CHEM	5			SC	clayey SAND (SC), olive (5Y 4/3), stiff, wet, 40 to 50% fines, fine sand, moderate to low est K	
			6					
			5	7.6				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

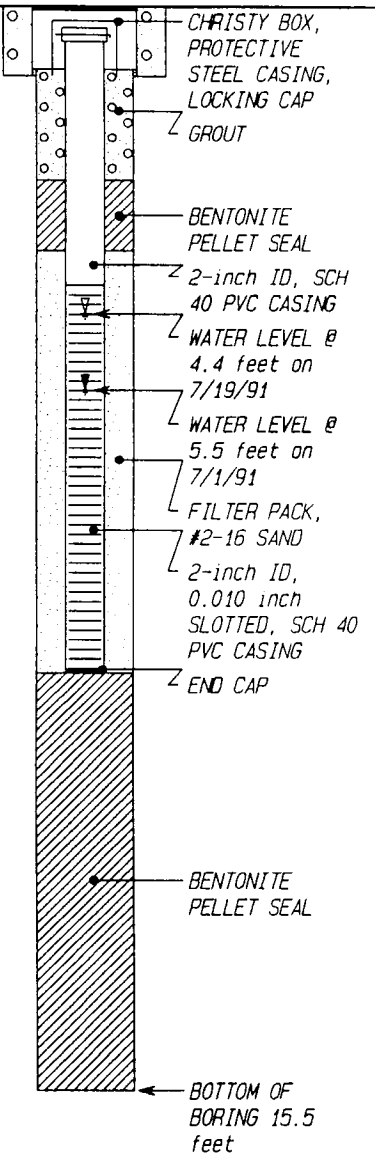
DRILLING CONTRACTOR EXPLORATION GEOSERVICES
BIT TYPE HOLLOW STEM AUGER
DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-06-01 CLIENT PRC/US NAVY
DATE STARTED 7/1/91 COMPLETED 7/1/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
REF. ELEVATION 10.60 FEET, TOP OF CASING GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	27	4.0		SP	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 5 to 10% fines, fine to medium sand, 5 to 10% gravel, moderate high estimated K
			50/4"				
				1.3			
2		CHEM	37				
			50/5"				
				1.3			
			28				
4		GEO-TECH	30				
			35	14.9			SAND (SP), greenish gray (5Y 4/2), medium dense, moist, 10 to 15% fines, fine sand, low to moderate estimated K, some shell fragments, and 1/2 inch clay fragments.
			14				
			15				
6			19	9.8			@ 5.5 feet-as above, wet
			6				
			14				@ 7 feet-as above, wet, 5 to 10% fines, fine to medium sand
			23	12.2			
8		CHEM	5				
			5				
			6	12.2		CL	CLAY (CL), dark gray (2.5Y N3/), medium, stiff, moist, fines, low estimated K
			1				
10		GEO-TECH	4				
			4				
			4	12.2			
			10				
12			12			SC	clayey SAND (SC), black (2.5Y N2/), loose, moist, 20 to 25% fines, fine to medium sand, low estimated K, abundant shell fragments
			5	6.8			
		GEO-TECH	6				@ 13 feet-as above, with occasional 1/2 inch clay layers
			6				
14		CHEM	1	14.9			@ 14 feet-as above, strong H2S odor
			5				
			6				
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET WELL COMPLETION DEPTH 9.5 FEET

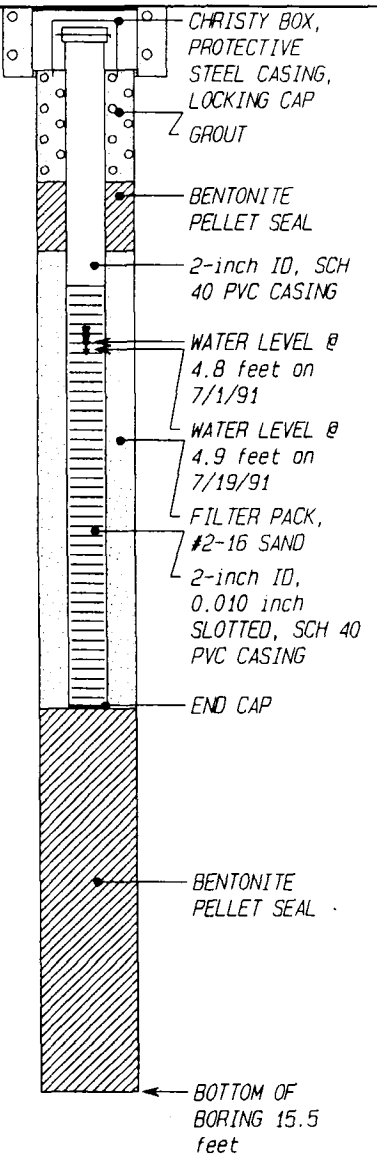
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-06-02
DATE STARTED 7/1/91 COMPLETED 7/1/91
REF. ELEVATION 10.88 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	14	14.9		SP	SAND (SP), brown (2.5Y 6/4), medium dense, moist, 5 to 10% fines, very fine to fine sand, trace clay fragments (1/2 inch to 3 inches), moderate estimated K
2			19	12.2			
		CHEM	24				
			24				
			36	12.2			
			20				
4		GEO-TECH	26				
			23	9.8		SM	silty SAND (SM), greenish gray (5Y 4/1), medium dense, wet, 20 to 25% fines, fine sand, low to moderate estimated K
			24				
			20				
6			18	6.8			
		CHEM	13				@ 6.5 feet-as above, trace clay fragments (1/2 inch to 1 inch)
			17				
			16	6.8			
8			6				
		GEO-TECH	10				
			4	20.8			
			1			CL	CLAY (CL), dark gray (2.5Y N3/), soft, wet, fines, low estimated K, some plant debris
10			0				
			3	23.1			
			1				
			6			SC	clayey SAND (SC), black (2.5Y N3/), dense, wet, 25 to 30% fines, very fine to fine sand, low to moderate estimated K, abundant shell fragments, 1/2 to 1 inch clay layers
12			7	0.8			
			3				
		GEO-TECH	6				
			6				
14		CHEM	1	12.2			@ 14 feet-as above, 1 to 2 inch clay layers, strong H2S odor, decaying plant matter
			4				
			5				
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

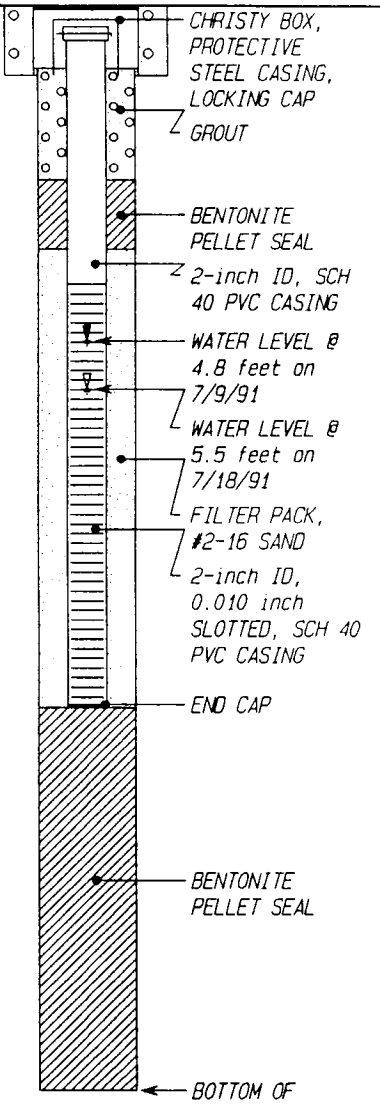
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 10 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-06-03
DATE STARTED 7/9/91 COMPLETED 7/9/91
REF. ELEVATION 11.38 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						AS	ASPHALT
		CHEM	38	15.1		SM	silty SAND (SM), dark yellowish brown (10YR 4/4), dense, moist, 25 to 30% fines, very fine to medium sand, 10 to 15% fine to coarse gravel, low to moderate est K, oxidized, probable fill
			50/4"				
2		CHEM	14	12.4		SP	SAND (SP), brown (10YR 5/3), dense, moist, 15 to 20% fines, very fine to fine sand, low to moderate est K, some 1/2 to 1 inch clay fragments
			38				
			50				
			17	12.4			
4		GEO-TECH	24				
			24	12.4			
			10				@ 5 feet-as above, wet
			12				
6			12	12.4			
			6				
			13				@ 7 feet-as above, olive (5Y 4/3)
			19	12.4			
8		CHEM	2				
			3				
			5	12.4			
			1			CL	CLAY (CL), very dark grey (2.5YR N3/), very soft, moist, fines, low est K
10		GEO-TECH	1				
			0	15.1			
			1				
			0				
12			6	12.4			@ 12 feet-as above, 5 to 10% very fine sand
			5				
		GEO-TECH	6				
			10	12.4			sandy CLAY (CL), very dark grey (2.5YR N3/), stiff, wet, fines, 30 to 35% very fine to fine sand, low est K
14		CHEM	5				
			6			SC	clayey SAND (SC), very dark grey (2.5YR N3/), stiff, wet, 40 to 45% fines, very fine to fine sand, low est K, slight H2S odor
			6	15.1			
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

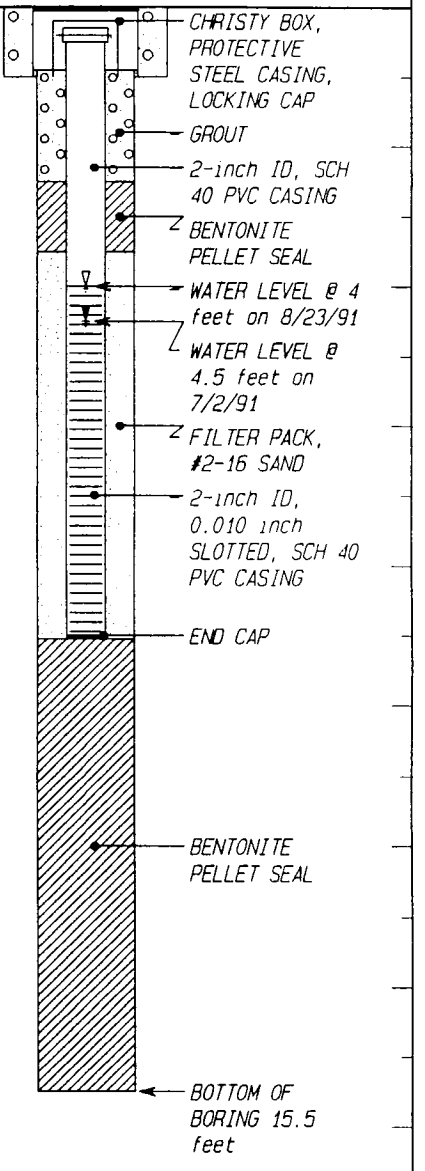
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 10 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-06-04 CLIENT PRC/US NAVY
DATE STARTED 7/2/91 COMPLETED 7/2/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
REF. ELEVATION 10.77 FEET, TOP OF CASING GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
				0.6		CN	CONCRETE
		CHEM	10			SP/SM	SAND (SP) and silty SAND (SM), yellowish brown (10YR 5/4), medium dense, moist, 20 to 25% fines, fine sand, 5 to 10% gravel, moderate est K
2			19	0.6			
		CHEM	10				@ 2.5 feet-as above, medium dense, 25 to 30% fines, trace gravel.
			14				
			20				
		GEO-TECH	6	0.6			
4			12				
			12				@ 4.5 feet-as above, olive (5Y 4/3).
			9	0.4			
			12			GW	GRAVEL (GW), fine gravel
6			28			SP	SAND (SP), as above
		CHEM	15	0.4		GW	GRAVEL (GW), olive gray (5Y 4/3), medium dense, moist to wet, 25 to 35% fines, fine gravel, high est K
			28				
			16			SP	
8			1	1.0			SAND (SP), as above
		GEO-TECH	1			CL	CLAY (CL), dark olive (5Y 3/3), soft, moist, fines, low est K
			2				
			1	0.6			
10			1				@ 10 feet-as above, trace sand filled burrows
			3				
			3	0.6			
			16				
12			14			SP	SAND (SP), dark olive to black, medium dense, moist, 30 to 35% fines, fine sand, high est K, abundant shell fragments
			8			CL/SP	
		GEO-TECH	5				CLAY (CL) and SAND (SP), alternating layers with shell fragments
			5				
14		CHEM	1	1.2		CL/SC	CLAY (CL) and clayey SAND (SC)
			2				
			4				
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET WELL COMPLETION DEPTH 9 FEET

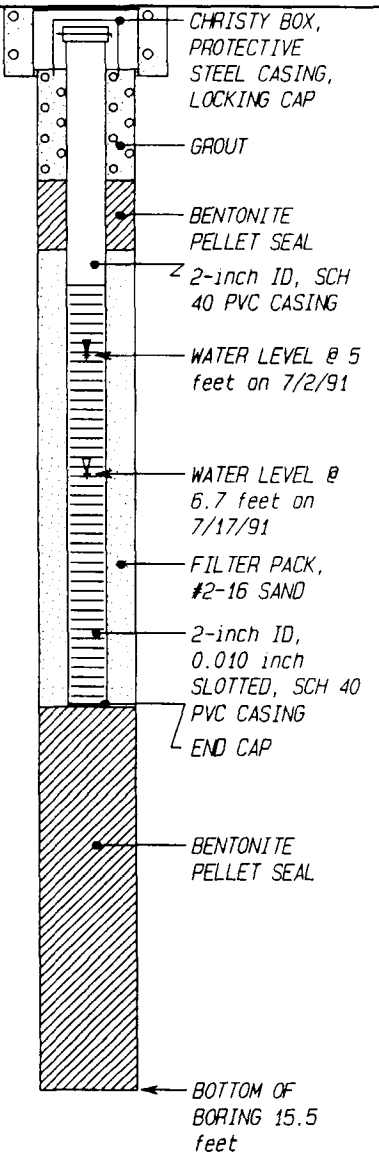
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-06-05
DATE STARTED 7/2/91 COMPLETED 7/2/91
REF. ELEVATION 11.09 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
				0.5		SP	SAND (SP), dark brown (10YR 3/3), medium dense, moist, 25 to 30% fines, fine sand, 5 to 10% gravel, high est K
		CHEM	18	0.6			
			30				
2		CHEM	4	0.6			@ 1.5 feet-as above, medium dense, some shell fragments
			19				
			21				
		GEO-TECH	8	0.6			
4			8				
			8				@ 4.5 feet-as above, moist to wet.
		CHEM	8	0.6			@ 5 feet-as above, olive (5Y 4/3), some shell fragments
			9				
6			11				
		GEO-TECH	7	0.6			@ 6.5 feet-as above, wet.
			8				
			10				
8			8			SW	gravelly SAND (SW), dark olive (5Y 3/3), medium dense, moist to wet, 25 to 30% fines, fine to medium sand, 35 to 40% fine gravel, moderate est K
			16				
			3				
			1	0.6		SP	@ 9.5 feet-SAND (SP)
10			1			CL	CLAY (CL), dark olive (5Y 3/3), soft, moist, fines, low est K, silty partings throughout (thinly bedded)
			1				
		CHEM	1	0.6			
			3				
12			3			SC	clayey SAND (SC), dark olive to black, loose, wet, 30 to 35% fines, fine sand, some shell fragments
			11	0.6			
			12				
			9				
14			3				
			4				
			4				
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 10 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-06 CLIENT PRC/US NAVY
DATE STARTED 8/5/91 COMPLETED 8/5/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.54 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
			HAND AUGER to 5'			CN	CONCRETE	
	■	CHEM				SP	SAND (SP), yellowish brown (10YR 5/6), medium dense, moist, 10 to 15% fines, fine sand, trace fine gravel, moderate est K	
2								
4								
	■	CHEM	34	5.6			SAND (SP), dark grayish brown (10YR 4/2), dense, wet, 10 to 15% fines, fine sand, 5 to 10% fine gravel, moderate est K, trace 1" clay fragments	▼ DEPTH TO WATER=5 feet
6			50					
			50/4"	7.7				
			5					
			4					
			9	8.2				
8			11					
	■	GEO-TECH	11					
			11	5.4		CL	CLAY (CL), black (7.5YR N2/), stiff, moist, fines, low est K	
			3					
10	■	GEO-TECH	3					
			11	6.6			sandy CLAY (CL), black (7.5YR N2/), soft, moist, fines, 15 to 20% very fine to fine sand, low est K	
		CHEM	7					
			7					
12			9	8.8				
			0				@ 12.5 feet-as above, wet, slight H2S odor	
	■	GEO-TECH	0					
			2	7.1				
14	■	CHEM	1			SC	clayey SAND (SC), black (7.5YR N2/), very loose, wet, 30 to 35% fines, very fine to medium sand, moderate est K, strong H2S odor	
			2					
			4	6.2				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-07
DATE STARTED 7/9/91 COMPLETED 7/9/91
ELEVATION 7.46 FEET

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
		CHEM	11	12.4		SM	silty SAND (SM), dark yellowish brown, (10YR 4/4), medium dense, moist, 15 to 20% fines, fine sand, 5 to 10% fine to coarse gravel, moderate est K	
			18					
			26	12.1		SP	SAND (SP), brown (10YR 5/3), medium dense, moist, 10 to 15% fines, very fine to fine sand, low to moderate est K	
2		CHEM	24					
			30					
			50/4"	0.0				
			30					
4		GEO-TECH	29					
			50/4"	0.0				! DEPTH TO WATER=5 feet
			20					
			21			SM	silty SAND (SM), olive (5Y 4/3), medium dense, wet, 15 to 20% fines, fine to medium sand, moderate est K	
6			24	0.0				
			5					
			8					
			10	0.0				
8		CHEM	5					
			6					
			6	0.0				
		GEO-TECH	5				@ 9.5 feet-as above, 20 to 25% fines	
10			5			CL	CLAY (CL), very dark gray (2.5YR N3/), medium stiff, moist, fines, low est K	
			4	0.0				
			3					
			8					
12			12	0.0		SC	clayey SAND (SC), very dark gray (2.5YR N3/), medium dense, wet, 20 to 25% fines, fine to medium sand, low to moderate est K, abundant shell fragments	
			5					
			4					
		GEO-TECH CHEM	3	0.0				
14			1					
			0					
			2	0.0				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR EXPLORATION GEOSERVICES
BIT TYPE HOLLOW STEM AUGER
DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-08 CLIENT PRC/US NAVY
DATE STARTED 7/8/91 COMPLETED 7/8/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.36 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	21	7.4		SP	SAND (SP), brown (10YR 5/3), dense, moist, 5 to 10% fines, fine sand, trace fine gravel, high est K, slightly oxidized, roughly bedded	
			50/5"	7.4				
2		CHEM	27	7.4				
			50/4"				@ 2.5 feet-as above, irregular 1/4 to 1 inch clay fragments	
			20					
4		GEO-TECH	35					
			48	7.4			SAND (SP), olive gray (5Y 5/2), dense, moist, 15 to 20% fines, very fine to fine sand, moderate est K	
			49					
			50/5"	4.9		SM	silty SAND (SM), olive gray (5Y 5/2), medium dense, wet, 30 to 35% fines, very fine to fine sand, low to moderate est K	! DEPTH TO WATER=5.5 feet
6		CHEM	15					
			16					
			18	7.4				
8			1				@ 8 feet-as above, very dark gray (2.5YR N3/), some shell fragments	
		GEO-TECH	1			CL	CLAY (CL), dark gray (2.5YR N4/), soft, damp, fines, low est K	
			3	9.9				
			1					
10			0				@ 10 feet-as above, abundant shell fragments in horizontal layers	
			2	9.9				
			8			SC	clayey SAND (SC), very dark gray (2.5YR N3/), medium dense, wet, 30% fines, fine sand, low est K, some shell fragments, slight H2S odor	
			11					
12			13					
			8					
		GEO-TECH	8					
			8	9.9		CL	CLAY (CL), dark gray (2.5YR N4/), stiff, moist, fines with abundant plant debris, strong H2S odor	
14		CHEM	4			SC	clayey SAND (SC), very dark gray (2.5YR N3/), medium dense, wet, 30 to 35% fines, fine sand, low to moderate est K, 1 to 2 inch peat layers	
			5	7.4				
			16					
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-09
DATE STARTED 7/8/91 COMPLETED 7/8/91
ELEVATION 11.20 FEET

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	15	4.9		SP	SAND (SP), brown (10YR 5/3), medium dense, moist, 10 to 15% fines, fine sand, trace fine gravel, moderate est K, some 3/4 inch clay fragments	
2			33	7.4				
		CHEM	23				@ 2.5 feet-as above, no clay fragments below 2.5 feet	
			22					
			50/5"	7.4				
			16					
4		GEO-TECH	44					
			50	7.4				
			26				SAND (SP), olive gray (5Y 5/2), dense, wet, 15 to 20% fines, fine to medium sand, moderate est K	! DEPTH TO WATER=5 feet
			48					
6			30	9.9				
			9				@ 6.5 feet-as above, some shell fragments	
			4					
			6	7.4		CL	CLAY (CL), very dark gray (2.5YR N3/), medium stiff, moist, fines, low est K, some very fine 1/4 inch thick sand layers	
8		CHEM	2					
			1					
			1	4.9				
			1					
10		GEO-TECH	0					
			4	7.4		SC	clayey SAND (SC), very dark gray (2.5YR N3/), very loose, wet, 30 to 35% fines, very fine to fine sand, low to moderate est K, slight hydrocarbon odor	
			2					
			3					
12			5	7.4				
			9					
		GEO-TECH	8					
			1	9.9				
14		CHEM	1				@ 14 feet-as above, 40 to 45% fines, very fine to fine sand, some shell fragments	
			3					
			4	12.3				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR EXPLORATION GEOSERVICES
BIT TYPE HOLLOW STEM AUGER
DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-10 CLIENT PRC/US NAVY
DATE STARTED 7/8/91 COMPLETED 7/8/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.32 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	24	4.6		SP	SAND (SP), brown (10YR 5/3), dense, moist, 10 to 15% fines, fine sand, moderate est K	
			49	4.9				
2		CHEM	13					
			14					
			18	4.9				
			3				@ 3.5 feet-as above, 1 to 3 inch clay fragments, some oxidized soil	
4		GEO-TECH	8					
			44					
			39	2.4				DEPTH TO WATER=5 feet
			50/5"				SAND (SP), olive gray (5Y 5/2), medium dense, wet, 15 to 20% fines, fine to medium sand, moderate est K	
6				2.4				
			8					
			7					
			5	2.4		CL	CLAY (CL), very dark gray (2.5YR N3/), medium stiff, wet, fines, low est K	
8		CHEM	9			SC	clayey SAND (SC), very dark gray (2.5YR N3/), loose, wet, 30 to 40% fines, fines to medium sand, low est K, some shell fragments	
			6					
			6	2.4		CL	CLAY (CL), very dark gray (2.5YR N3/), soft, moist, fines	
			1					
10		GEO-TECH	1					
			1	2.4				
			3			SC	clayey SAND (SC), very dark gray (2.5YR N3/), loose, moist, 40 to 45% fines, fine to medium sand, some shell fragments, low est K	
			10					
12			11	2.4				
			1					
			0					
			4					
14		CHEM	2					
			3					
			6	2.4			TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-11 CLIENT PRC/US NAVY
DATE STARTED 7/2/91 COMPLETED 7/2/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.19 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
				0.6		SP	SAND (SP), yellowish brown (10YR 5/4), medium dense, moist, 25 to 30% fines, fine sand, trace gravel, moderate est K	
		CHEM	8	0.6				
			22					
2		CHEM	9	0.6			@ 1.5 feet-as above, medium dense, no gravel	
			12					
			24					
			9	0.6				
4		GEO-TECH	14					
			22					
			9	0.6			@ 5 feet-as above, color change to olive (5Y 4/3)	DEPTH TO WATER=5 feet
			22			GW	GRAVEL (GW), olive (5Y 4/3), medium dense, wet, fines, interbedded with 30 to 35% silty sand	
6			31					
		CHEM	19	0.6			GRAVEL (GW), olive (5Y 4/3), medium dense, wet, 20 to 25% fines, 5 to 10% fine sand, fine gravel, high est K	
			26					
			24					
8			8	0.6		CL	CLAY (CL) and clayey SAND (SC), dark olive (5Y 3/3), alternating layers	
		GEO-TECH	11			SC		
			5			CL	CLAY (CL), dark olive (5Y 3/3), stiff, moist, fines, low to moderate est K	
			1					
10			0					
			0	0.6				
			1					
			2					
12			2					
		GEO-TECH	9	0.6			@ 12.5 feet-as above	
			8				@ 13 feet-alternating clay and sandy clay layers	
			5					
14		CHEM	3	0.6		SC	clayey SAND (SC), dark olive (5Y 3/3), loose, moist, 30 to 40% fines, fine sand, moderate est K, abundant shell fragments	
			5					
			6					
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-12 CLIENT PRC/US NAVY
DATE STARTED 7/10/91 COMPLETED 7/10/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.93 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	8	0		SP	SAND (SP), yellowish brown (10YR 5/6), medium dense, dry to damp, 10 to 15% fines, fine to medium sand, high est K	
			19					
2		CHEM	20	0			@ 1.5 feet-as above, medium dense, moist	
			20					
			22	0				
			20	0				
4		GEO-TECH	30				@ 4 feet-as above, dark yellowish brown (10YR 4/6), 20 to 25% fines	DEPTH TO WATER=4.5 feet
			31					
			18	0			SAND (SP), dark yellowish brown (10YR 4/6), medium dense, moist to wet, 20 to 25% fines, fine to medium sand, moderate to high est K	
			25					
6			36					
			15	0				
			22					
			25				SAND (SP), olive (5Y 4/3), medium dense, moist to wet, 20 to 25% fines, fine to medium sand, high est K, trace shell fragments	
8		CHEM	12	0				
			4					
			5			CL	CLAY (CL), dark olive (5Y 3/3), medium stiff, moist, fines, moderate est K	
			1	0				
10		GEO-TECH	0				@ 10 feet-as above, sandy partings	
			1					
			0	0			@ 11 feet-as above, 1/2 inch sandy partings, small shells	
			0					
12			5					
			6	0		SC CL	clayey SAND (SC) and sandy CLAY (CL), dark olive (5Y 3/3), medium stiff, wet, 50% fines, 50% sand, high est K, sand layers up to 6 inches thick	
		GEO-TECH	5					
			3					
14		CHEM	0	0		CL	sandy CLAY (CL), dark olive (5Y 3/3), medium stiff, moist, fines, 40 to 50% fine sand, moderate to low est K, abundant shell fragments	
			3					
			4					
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-13
DATE STARTED 6/28/91 COMPLETED 6/28/91
ELEVATION 11.48 FEET

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	28	26.9		SP	SAND (SP), brown (10YR 5/3), very dense, moist, trace fines, fine sand, moderate est K, trace one inch clay fragments, trace shell fragments	
2			72	2.2				
		CHEM	21					
			50/5"	2.2				
			24					
4		GEO-TECH	31					
			34	2.2			SAND (SP), olive gray (5Y 4/2), dense, wet, trace fines, fine to medium sand, moderate to high est K	▼ DEPTH TO WATER=4.75 feet
			18					
			28					
6			32	6.7				
			14				@ 6.5 feet-as above, 10 to 15% fines, fine sand, moderate est K	
			16					
			12	4.4		CL	@ 7 feet-as above, 25 to 30% fines, fine sand low to moderate est K	
8		CHEM	4					
			4				CLAY (CL), very dark gray (5Y 3/1), soft, wet, fines, low est K	
			4	8.9				
		GEO-TECH	7					
10			12				@ 10 feet-1/4" fine sand layers	
			14	8.9				
			7			SC CL	clayey SAND (SC) and CLAY (CL); CL as above; (SC), very dark gray (5Y 3/1), loose, moist to wet, 30 to 35% fines, fine sand, low est K, some shell fragments, CL beds 0.75 to 1.5 inch, SC beds 2 to 3 inches.	
			7					
12			9	11.2				
		GEO-TECH	4					
			6					
			7	6.7				
14		CHEM	6					
			9				@ 14.5 feet-some sand beds with fine to medium sand	
			11	6.7				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR EXPLORATION GEOSERVICES
BIT TYPE HOLLOW STEM AUGER
DRILLER ELDON KENNEDY

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-14 CLIENT PRC/US NAVY
DATE STARTED 6/27/91 COMPLETED 6/27/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.50 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				3.4		CN	CONCRETE	
		CHEM	26 50/5"	3.4		SP	SAND (SP), dark yellowish brown (10YR 4/4), dense, moist, 10 to 15% fines, fine to medium sand, trace gravel, high est K	
2		GEO-TECH	30 50/5"	3.4			@ 1.5 feet-as above, some shell fragments and large clay fragments	
							@ 2.5 feet-as above, 20 to 25% fines	
4		CHEM	53 46 50/5"	5.1			@ 3.5 feet-as above, moist to wet, 30 to 40% fines, abundant shell fragments	
			24 28 23	5.1			SAND (SP), dark yellowish brown (10YR 4/4), dense, wet, 20 to 25% fines, fine to medium sand, high est K, abundant shell fragments	DEPTH TO WATER=5 feet
6		GEO-TECH	2 5 13				@ 6.5 feet-as above, olive (5Y 5/4)	
8		CHEM	2 9 10	3.4			@ 8 feet-as above, olive (5Y 4/3)	
10			1 0 0 1 2 7	3.4		CL	CLAY (CL), dark olive (5Y 3/3), soft, moist, fines, low est K, some sandy partings	
							@ 11 feet-as above, some burrows	
12			2 2 4	3.4			@ 12.5 feet-as above, dark olive to black	
14		GEO-TECH CHEM	2 3 7	3.4		CL SC	CLAY (CL) and clayey SAND (SC), dark olive (5Y 3/3), moist, 50 to 100% fines, low est K, some shell fragments	
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-15 CLIENT PRC/US NAVY
DATE STARTED 6/27/91 COMPLETED 6/27/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.59 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				6.8		CN	CONCRETE	
		CHEM	15	3.4		SP	SAND (SP), dark yellowish brown (10YR 4/6), dense, moist, 20 to 25% fines, fine to medium sand, 5 to 10% gravel, high est K	
2			44					
		CHEM	22	5.1			@ 2 feet-as above, 5 to 10% fines, no gravel, moderate to well sorted	
			50/5"				@ 3 feet-as above, dense, moist to wet	
		GEO-TECH	23					
4			34					
		CHEM	29					
			19	5.1			@ 5 feet-as above, wet, abundant shell fragments	! DEPTH TO WATER=5 feet
			29					
6			37					
			8	5.1				
		GEO-TECH	11					
			20					
			1	5.1				
			4			CL	@ 8.5 feet-as above, black sand, shell fragments along bedding planes	
			5					
			1				CLAY (CL), dark olive (5Y 3/3), medium stiff, moist, fines, low est K	
10			1					
			1					
			1					
			0					
12			3					
		GEO-TECH	4	5.1		CL SC	CLAY (CL) and clayey SAND (SC), dark olive (5Y 3/3), medium stiff, moist, 50 to 60% fines	
			6					
			11					
14		CHEM	1					
			3					
			7					
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-16 CLIENT PRC/US NAVY
DATE STARTED 6/27/91 COMPLETED 6/27/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.52 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				1.7		CN	CONCRETE	
		CHEM	9			SP	SAND (SP), yellowish brown (10YR 5/6), dense, moist, 15 to 20% fines, fine to medium sand, 5 to 10% fine gravel, high est K	
			50/6"					
2			26	3.4			@ 1.5 feet-as above, no gravel from 1.5 to 2 feet	
		GEO-TECH	50/5"					
		CHEM	41	3.4				
4			50/5"					
			34	0			@ 5 feet-as above, layers of shell fragments, dense, wet, sand is well sorted and medium grained	! DEPTH TO WATER=5 feet
			50/5"					
6								
			15	0			SAND (SP), yellowish brown (10YR 5/6), dense, wet, 15 to 20% fines, fine to medium sand, high est K	
		GEO-TECH	30					
			23					
8			9	0			SAND (SP), olive (5Y 4/3), medium dense, wet, 15 to 20% fines, fine to medium sand, high est K, shell fragments throughout	
			12					
			10					
			1	0		CL	CLAY (CL), dark olive (5Y 3/3), very soft, moist, fines, low est K, some partings of silt and sand, burrows lined with sand	
10			0					
			1					
			1	0				
			0				@ 11.5 feet-as above, layer of sand and shells, wood fragments	
12			1					
			3	0		CL/SC	CLAY (CL) and clayey SAND (SC), dark olive (5Y 3/3), medium stiff, wet, 20 to 25% silt and fine sand, high est K, abundant roots, H2S odor	
		GEO-TECH	4					
			4					
14		CHEM	3	0				
			4					
			6					
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-17 CLIENT PRC/US NAVY
DATE STARTED 7/9/91 COMPLETED 7/9/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.58 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	10	12.4		SP	SAND (SP), brown (10YR 5/3), medium dense, moist, 10 to 15% fines, very fine to fine sand, trace fine gravel, moderate est K, some 1/4 to 1/2 inch clay fragments	
2			10	12.4				
		CHEM	7					
			8					
			8	15.1				
			15					
4		GEO-TECH	24					
			28	15.1			@ 4.7 feet-as above, wet	! DEPTH TO WATER=4.7 feet
			22					
			34			SM	silty SAND (SM), olive gray (5Y 4/2), dense, wet, 15 to 20% fines, fine to medium sand, moderate est K	
6			33	15.1				
			6					
			12				@ 7 feet-as above, some 1/2 to 1 inch clay fragments	
			17	17.9				
8		CHEM	6					
			5				@ 8.5 feet-as above, abundant shell fragments	
			8	17.9				
		GEO-TECH	4			CL	CLAY (CL), very dark gray (2.5YR N3/), medium stiff, wet, fines, low est K	
10			1					
			1	17.9				
			1					
			0					
12			1	17.9			sandy CLAY (CL), very dark gray (2.5YR N3/), stiff, wet, fines, 15 to 20% very fine sand, low est K	
		GEO-TECH	9					
			10					
			9	17.9			@ 13.5 feet-as above, 30 to 35% very fine sand	
14		CHEM	1					
			3					
			4	17.9				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-18 CLIENT PRC/US NAVY
DATE STARTED 7/1/91 COMPLETED 7/1/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.08 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	26	4.0		SP	SAND (SP), brown (2.5Y 6/4), dense, moist, 5 to 10% fines, fine to medium sand, moderate estimated K	
			50/5"	1.3				
2		CHEM	31					
			48					
			50	1.3				
			25					
4		GEO-TECH	48					
			41	1.3		SM	silty SAND (SM), olive gray (5Y 4/1), dense, wet, 20 to 25% fines, very fine to fine sand, low to moderate estimated K	! DEPTH TO WATER=5 feet
			15					
			18					
6			26	4.0			@ 6 feet-as above, 15 to 20% fines, fine sand, some shell fragments	
		CHEM	6					
			18					
			20	6.5				
8			7				@ 8 feet-as above, very loose	
		GEO-TECH	8					
			6	4.0				
			1			CL	CLAY (CL), dark gray (2.5Y N3/), medium stiff, moist, fines, low estimated K, organic stringers on horizontal bedding surfaces	
10			2					
			4	4.0				
			1					
			3					
12			5	4.0				
			1			SC	clayey SAND (SC), dark gray (2.5Y N3/), loose, wet, 25 to 30% fines, very fine to fine sand, moderate to low estimated K	
		GEO-TECH	5					
			7	1.3				
14		CHEM	3					
			8				@ 14.5 feet-as above, abundant shell fragments	
			7	1.3		CL	CLAY (CL), dark gray (2.5Y N3/), medium stiff, moist, fines, low estimated K	
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-06-19 CLIENT PRC/US NAVY
DATE STARTED 6/28/91 COMPLETED 6/28/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.12 FEET GEOLOGIST RICH HALKET

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	20	4.4		SP	SAND (SP), brown (10YR 5/3), medium dense, moist, 5 to 10% fines, fine sand, trace fine gravel, moderate to high est K, some 1/2 to 1 inch clay nodules and shell fragments	
			30/5"	6.7				
2		CHEM	25					
			34					
			54	6.9				
			44					
4		GEO-TECH	30					
			24	2.2				! DEPTH TO WATER=5 feet
			20					
			25				@ 5.5 feet-as above, olive (5Y 4/3), wet	
6			27	6.7				
		CHEM	12					
			16					
			17	8.9			@ 7.5 feet-as above, 15 to 20% fines, very fine to fine sand	
8			5					
		GEO-TECH	5					
			18	8.9				
			4					
10			5					
			9	8.9		CL	CLAY (CL), very dark gray (2.5Y N3/), stiff, damp, fines, low est K	
			4					
			5					
12			7	6.7				
			5			SC	clayey SAND (SC), green (5Y 4/4), loose, wet, 25 to 30% fines, fine sand, low to moderate est K, some shell fragments, H2S odor	
		GEO-TECH	5					
			4					
14		CHEM	4	8.9				
			5					
			7					
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER ELDON KENNEDY

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

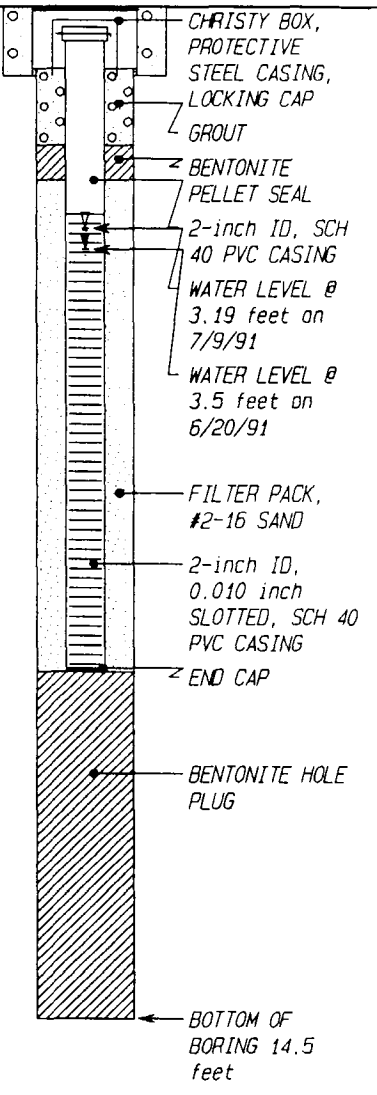
BORING/WELL NUMBER *MW-7A-01* CLIENT *PRC/US NAVY*

DATE STARTED *6/19/91* COMPLETED *6/19/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*

REF. ELEVATION *10.49 FEET, TOP OF CASING* GEOLOGIST *KAREN KARMER*

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
				5.3		AS	ASPHALT
		CHEM	18			SW	gravelly SAND (SW), reddish brown, dense, damp, 10-20% fines, sand, 20-30% gravel, moderate est K, probable fill material
			23	10.2			
			30				
2		GEO-TECH	35	3.4			
			43				
			10/3"				
		GEO-TECH	15	9.2		SP	
4			9				SAND (SP), dark olive gray, wet, medium dense, 5-10% fines, sand, high est K, probable fill material
			14				
			43				
			25				
6			20				
		CHEM	11	8.7			SAND (SP), dark olive gray, medium dense, wet, 5-10% fines, 90-95% sand, 1-5% fine to coarse gravel, high est K
			13				
			12				
			23	6.3			SAND (SP), @ 8.0 feet-as above, dense, wet, wood and cement fragments, hydrocarbon odor
		GEO-TECH	30				
			50/2"				
10			4	3.0		CL	CLAY (CL), dark olive gray, stiff, moist to wet, fines, low est K, abundant roots and other organic material, strong H2S smell
			4				
			7				
		CHEM	1				
12			2	4.3			
			4				
		GEO-TECH	3				
			3				
14			3				
							TOTAL DEPTH 14.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./J. COLLINS*

HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*

TOTAL DEPTH OF BORING *14.5 FEET* WELL COMPLETION DEPTH *9.5 FEET*

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

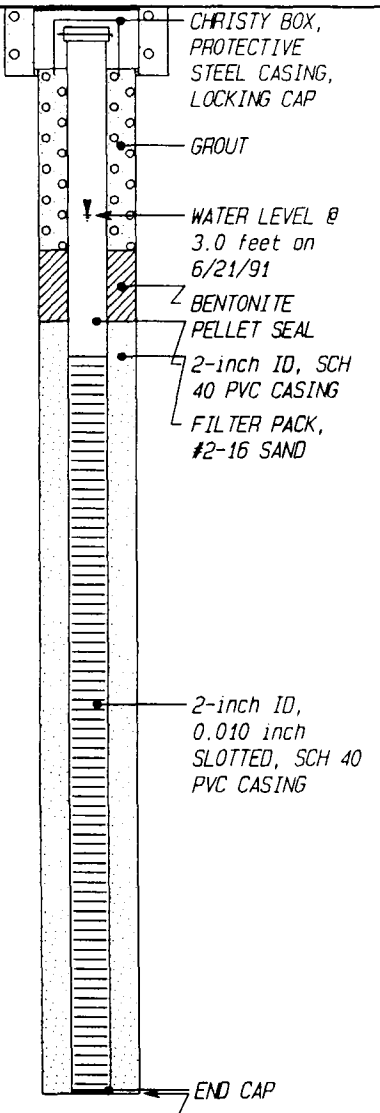
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-7A-02
DATE STARTED 6/21/91 COMPLETED 6/21/91
REF. ELEVATION 10.21 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						AS	ASPHALT
		CHEM	44	0.5		SW	gravelly SAND (SW), brown (7.5YR 5/3), loose, moist 0-5% fines, fine to medium sand, 10-15% fine gravel, moderate to high est K
			50/4"				
		GEO-TECH	9			SM	
2			24	1.1			silty SAND (SM), black (2.5Y 2/10), medium stiff moist, fines, 15-20% fine sand, 0-5% fine gravel, low to moderate est K
		CHEM	24				
			17			CL	
			14				CLAY (CL), black (2.5YR N/3), stiff, damp, fines, 0-5% coarse sand, low est K
			4	1.1			
4			6				
			7	1.7			
		GEO-TECH	2				@ 5 feet-as above, black organic matter along horizantal bedding planes
			6	16.4			
6			6				
		CHEM	4				CLAY (CL), black (2.5YR N/3), medium stiff, wet, low est K, vertical parting allowing some water movement, some plant matter (partially decayed), slight H2S odor
			3	20.2			
			2				
8			1				
			1				@ 8.5 feet-as above, damp
			2				
			1				@ 9.5 feet-as above, wet
10			2				
			4				@ 10.5 feet-as above, damp, horizontally oriented plant material (partially decayed), strong H2S odor
			2				
			2				
12			2	46.9			
		CHEM	1				
			1				
			2				
14			1				
		GEO-TECH	3				
			3				
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

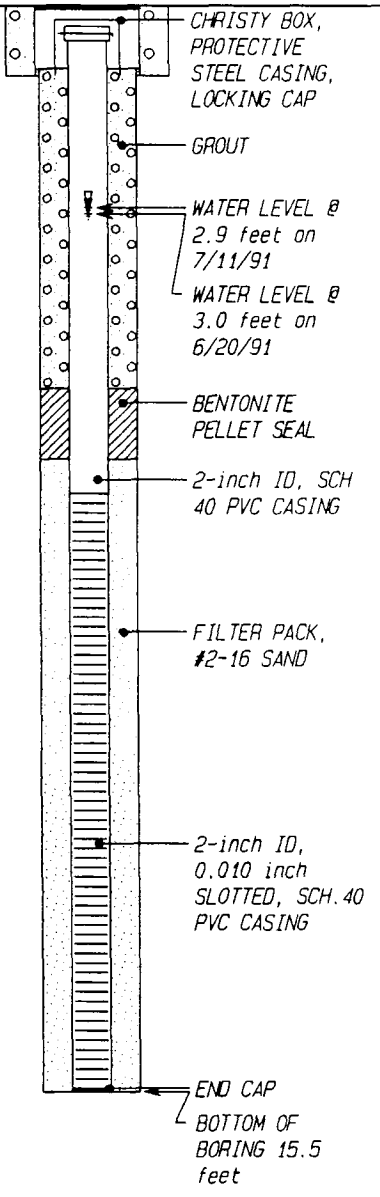
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 15.5 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-7A-03
DATE STARTED 6/18/91 COMPLETED 6/18/91
REF. ELEVATION 10.18 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST DAN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						AS	ASPHALT 2" thick
		CHEM	24	77-81		SM	gravelly silt (SM), grayish brown (2.5Y 5/2), loose, moist, fines, 5% medium to coarse sand, 20% plus gravel-pebbles 1-2 inch in sizes, moderate to high est K
		CHEM	30			SC	
			23				
2		GEO-TECH	20				
			13				
			11			CL ML	clayey SAND (SC), olive (5Y 5/4), damp, 25-30% fines, medium to coarse sand, 5% gravel-pebbles strong hydrocarbon odor (possible diesel)
			3				
4		CHEM	3	29			
			6				CLAY/silty CLAY (CL/ML), dark gray (7.5R N3), moist, <1% sand, low est K, trace of plant debris-strem/root, approx 1/16 inch diameter
			6				
6		GEO-TECH	9	6.6			
			9				@ 4.5 feet-as above, clay stiffens to clayey silt, 5% very fine sand, organic material and viscous black oil throughout
			4				
			6				
			9				@ 5.0 feet-as above, silt, dark grey (7.5YR N 3/0), dry, medium stiff to stiff, low est K thin stringers of black organic matter evenly spread throughout, possible mud cracks on suface of beds, low est K
8			2				
			2				
			2				
			4				CLAY/SILT (CL/ML), dark grey, (2.5Y N4/0), very soft, damp to moist, 95% fines, 5% very fine sand
10			4				
			5	10.4			@ 9 feet-as above, moderate to high amounts of plant material, roots/leaves and black mottling
		FEAS-STUDY	4				
			4	3.2			
12			5				
		CHEM	2				
			3	10.2			
			4				
14		GEO-TECH	2				
			3				@ 14.5 feet-as above, organic material more decomposed than above
			3				TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 15.5 FEET

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

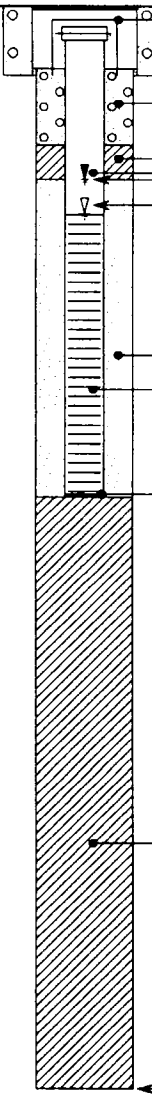
BORING/WELL NUMBER *MW-07A-04* CLIENT *PRC/US NAVY*

DATE STARTED *6/21/91* COMPLETED *6/21/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*

REF. ELEVATION *8.99 FEET, TOP OF CASING* GEOLOGIST *RICH HALKET*

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		0.0		SW	gravely SAND (SW), brown (7.5YR 5/3), medium dense, 10 to 15% fines, very fine to fine sand, 15-20% gravel, moderate est K
			6				
			8	5.8			
			28				@ 1 foot-as above, 5-10% fines, very fine to fine sand, 10-15% fine gravel low to moderate est K
2		CHEM	15				
			17			SP	SAND (SP), green (5Y 5/2), medium dense, wet, 0-5%, fines, fine to medium sand, moderate est K
			16	6.4			
			15				
4		GEO-TECH	16				
			20	5.2			
		CHEM	4				SAND (SP), green (5Y 5/2), as above, 10-15% fines, fine to medium sand, low to moderate est K
			8				
6			7	9.3			
			2			CL	CLAY (CL), dark grey (5Y 3/1), medium stiff, damp fines, low est K
			2	1.1			
			1				
8			3				
		GEO-TECH	4				
			1				
			4	4.1			@ 9.5 feet-as above, moist, horizontally bedded organic matter, strong H2S odor
10			1				
			2				
			1				
			1				
12			3	19.3			
		CHEM	2				
			2				
			2	7.0			
14			2				
		GEO-TECH	2				
			2	7.6			
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./J. COLLINS*

HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*

TOTAL DEPTH OF BORING *15.5 FEET* WELL COMPLETION DEPTH *7 FEET*

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-7A-05 CLIENT PRC/US NAVY
DATE STARTED 6/20/91 COMPLETED 6/20/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 9.69 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
		CHEM	28	3.4		SW	gravelly SAND (SW), yellowish brown (10YR 5/4), loose, dry, 15-25% fines, fine sand, 20-30% fine gravel, moderate est K	
		GEO TECH	42 27	6.3				
2		CHEM	20 21	4.1			@ 1.5 feet-as above, color change to dark yellowish brown (10YR 3/4), moist, medium dense	
			18 5			SP	SAND (SP), dark olive gray (5Y 3/3), medium dense, wet, 15-20% fines, fine sand, 5-10% gravel	! DEPTH TO WATER=3 feet
4			2	0.5				
			2 1			CL	CLAY (CL), dark olive gray, soft, moist, fines, some black organic material	
6		GEO-TECH	1 1	12.6			@ 5.0 feet-as above, very soft, moist	
		CHEM	1 0 1	4.0			@ 6.5 feet-as above, dark olive gray	
8			1 1	6.3			@ 8.0 feet-as above, some organic root and stalk fragment, strong H2S odor	
10			1 1 1	32			@ 9.5 feet-as above, less abundant organic fragments, strong H2S odor	
			1 1	9			@ 11.0 feet-as above, very soft, moist, organic fragments common, small bits of wood	
12		CHEM	0 0 1 1	16			@ 13.0 feet-as above, organic fragments are present but no stalks or roots	
14			1	36			@ 14.0 feet-as above, stalks and roots present	
		GEO-TECH	2 2 4	0.5			TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER J. COLLINS

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-7A-06 CLIENT PRC/US NAVY
DATE STARTED 6/19/91 COMPLETED 6/19/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 9.85 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
		CHEM	26	12		AS	ASPHALT	
			43	268		SW / SP	gravelly SAND (SW), dark brown (10YR 3/3), loose, damp, 10-15% fines, fine to medium sand, 30-35% gravel, high est K, hydrocarbon odor	
			31					
2		CHEM	15	436			SAND (SP), dark brown, dense, damp, 5-10% fines, fine sand, 10-20% gravel, high est K, strong hydrocarbon odor	
			20					
			16			CL		
			10	104			@ 2.0 feet-as above, brown and dark olive gray, medium dense, wet	
4		GEO-TECH	13			CL / SP	SAND (SP), as above, with layers of wet, dark olive gray, CLAY (CL)	! DEPTH TO WATER= 4.5 feet
			6					
			2	10		CL	CLAY (CL), dark olive gray, soft, moist, fines organic rich, H2S odor	
			2					
6			3					
			1	10			@ 6.5 feet-as above, abundant stalks	
			1					
			1					
8		GEO-TECH	1					
			6					
			6					
		CHEM	1	8.2				
10			2					
			3					
			1	8.2				
			1					
12			2					
			1					
			1	36.5				
			1					
14			1	35			@ 14.0 feet-as above, with oyster shell fragments	
			3					
			3					
			1	17				
16		GEO-TECH	2					
			2					
		CHEM	1					
			1					
18			2					
							TOTAL DEPTH 18.5 feet	

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 18.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-7A-07 CLIENT PRC/US NAVY
DATE STARTED 6/19/91 COMPLETED 6/19/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.46 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				106		AS	ASPHALT	
		CHEM	38			SW	gravelly SAND (SW), brownish gray, loose, dry to damp, 10-20% fines, sand, 20-30% gravel, high est K, hydrocarbon odor	
			50/2"	557				
2		GEO-TECH	23	370		SP	@ 1.5 feet-as above, dark brown (7.5YR 3/3), hydrocarbon odor	
			24					
			14				SAND (SP), light olive brown (2.5Y 5/3), medium dense, damp, 5-10% fines, sand, well sorted, high est K, hydrocarbon odor	! DEPTH TO WATER= 3.5 feet
4			3			CL		
			3					
			6				CLAY (CL), dark olive gray, (5Y 3/3), stiff, wet, fines, low est K, some organic matter present	
		CHEM	3	28				
			7				@ 5.0 feet-as above, mottled, light and dark olive gray, wet	
6			7	37				
			3				@ 6.5 feet-as above, dark olive gray, moderate H2S odor	
		GEO-TECH	4					
			6	106				
8			1				@ 8.0 feet-as above, dark olive gray, soft, black abundant organic material, H2S odor	
			1					
			3	44				
			1					
10			1				@ 10 feet-CLAY (CL), as above, abundant roots and stalks, H2S odor	
			3					
			2	158				
			1					
12			2					
		CHEM	1	83			@ 12.5 feet-as above	
			1					
			2					
14			1				@ 14.0 feet-as above	
		GEO-TECH	1					
			3					
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

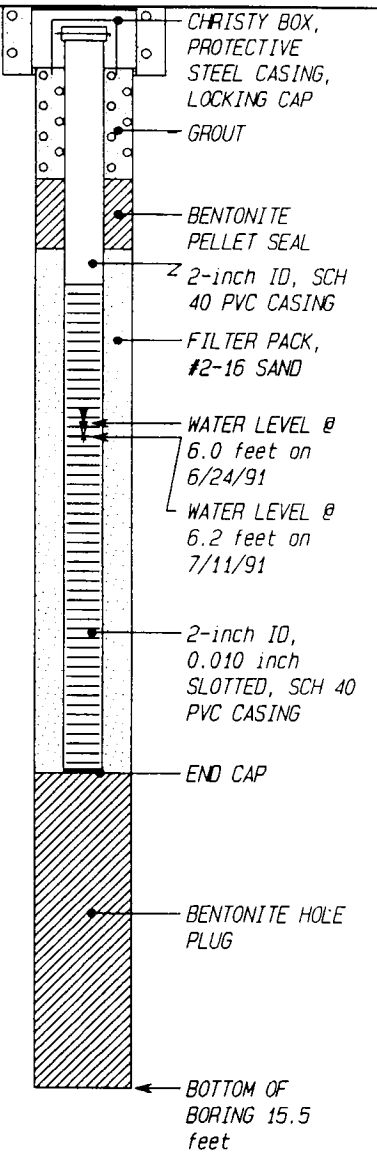
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-07B-01
DATE STARTED 6/24/91 COMPLETED 6/24/91
REF. ELEVATION 11.45 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	42	4.1		SC	clayey SAND (SC), brown (2.5Y 5/3), very dense, moist, 15-20% fines, fine to medium sand, 0-5% fine gravel, low est K
2			45				
			25				
		GEO-TECH	34			SP	SAND (SP), brown (2.5Y 5/4), dense, moist, 0-5% fines, very fine to fine sand, moderate est K
			42	7.4			
		CHEM	11				@ 3.5 feet-as above, some shell fragments at 3 feet
4			21				
			26	7.4		CL	gravelly CLAY (CL), brown, (2.5Y 5/3), hard, wet, 10-20% fines, 15-20% gravel, low est K
			20				
			36				
6			35	4.1			Interbedded SAND (SP), gravelly CLAY (CL)
			14			SM	
		GEO-TECH	13				silty SAND (SM), olive (2.5Y 5/3), medium dense, wet, 15-20% fines, very fine sand, 0-5% fine gravel, moderate est K
			15	7.4			
8		CHEM	4			GC	clayey GRAVELY (GC), grey, loose, wet, 15-20% fines, fine gravel, moderate est K
			2	5.7			
			6			CL	CLAY (CL), grey (2.5Y 5/3), medium stiff, wet, fines, low est K
10			1				
			6				@ 10.3 feet-as above, fine gravel interbed with clay
			2	9.0			
			4			SC	clayey SAND (SC), black (2.5Y 5/4), dense, moist, 20% fines, very fine to fine sand, low est K, some shell fragments
			21				
12			50/5	7.4			
			18				@ 12 feet-as above, mottled grey/brown (2.5Y N4/) and (2.5Y 5/4)
		GEO-TECH	29				
			45				
14		CHEM	16				@ 14 feet-as above, clay layer 14.4 to 14.8
			35	5.7			
			40				
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 11 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-7B-02 CLIENT PRC/US NAVY
DATE STARTED 6/24/91 COMPLETED 6/24/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.60 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
				7.4		CN	CONCRETE	
		CHEM	15			SM	silty SAND (SM), brown (2.5Y 5/4), medium dense, moist, 15-20% fines, very fine to medium sand, 1-15% fine gravel, moderate est K	
			36			SP		
			44	2.4				
2			16				SAND (SP), brown (2.5Y 5/4), dense, moist, 0-5% fines, fine sand, moderate est K, 0-5% shell fragments	
		GEO-TECH	22			SP		
			30	7.4		CL		
		CHEM	11				SAND (SP), brown (2.5Y 5/4), medium dense, moist, 7% fines, fine gravel, low est K	
4			15					
			18	4.1			gravelly CLAY (CL), brown (2.5Y 5/4), very stiff, moist, fines, 20-25% fine gravel, low est K	
			9					
			10			GC	clayey GRAVELLY (GC), olive (2.5Y N3/), wet, 15-20% fines, 10-15% coarse sand, fine gravel, moderate est K, some shell fragments	! DEPTH TO WATER= 5.5 feet
6			17	195.6				
			12			CL		
			7				CLAY (CL), black (2.5Y N2/), stiff, wet, fines, low est K	
			7	33.8				
			1				@ 8.0 feet-as above, interbedded with 5" gravel layer	
			0					
			0	23.9				
			1					
10		GEO-TECH	1					
			2	10.7				
		CHEM	8			SC	clayey SAND (SC), black (2.5Y N3/), moist, medium dense, 15-20% fines, very fine to fine sand, low est K	
			11					
12			13					
		GEO-TECH	10	7.4				
			27				clayey SAND (SC), mottled brown and gray (2.5Y-4/3 & 2.5Y N5/), very dense, moist, 20-25% fines, very fine to fine sand, low est K, some root material	
			40					
14		CHEM	25					
			50/5"	7.4				
							TOTAL DEPTH 15.0 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-7B-03 CLIENT PRC/US NAVY
DATE STARTED 6/21/91 COMPLETED 6/21/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.71 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	22	0.0		SP	SAND (SP), brown (2.5Y 4/2), medium dense, damp, 0-5% fines, very fine to fine sand, moderate est K, root and plant debris	
		GEO-TECH	23	0.0				
			28					
2		CHEM	16					
			12	1.1			@ 2.5 feet-as above, some 0.5 x 0.5 inch clay fragments, oyster shell fragments, and fine gravel, probable fill material	
			5					
			6					
4			11					
			11	6.4				
		GEO-TECH	14				@ 5 feet-as above, some root debris	! DEPTH TO WATER=5 feet
			13					
6			23					
			11					
			4			CL	CLAY (CL), black (2.5Y N4/), medium stiff, wet, fines, 1-5% very fine sand, low est K	
			2	4.1				
8			3					
			3				@ 8.5 feet-as above, 10-15% very fine to fine sand on horizontal bedding planes	
			4					
			1				@ 9.5 feet-as above, 5-10% very fine to fine sand, some shell fragments	
10			1					
			3	6.4				
		CHEM	11			SC	clayey SAND (SC), gray (2.5Y N3/), medium dense, wet, 20-25% fines, very fine to fine sand, low to moderate est K, some shell fragments	
			8					
12			9	3.5			@ 12.0 feet-as above, olive (2.5Y 5/4)	
			5					
			14				@ 13.0 feet-as above, mottled olive and gray (2.5Y 5/6 and 2.5Y N3/), moist, some plant debris	
			21	6.4				
14			20					
		GEO-TECH	36					
			31					
		CHEM	31					
16			40					
							TOTAL DEPTH 16.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
JTW
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 16.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

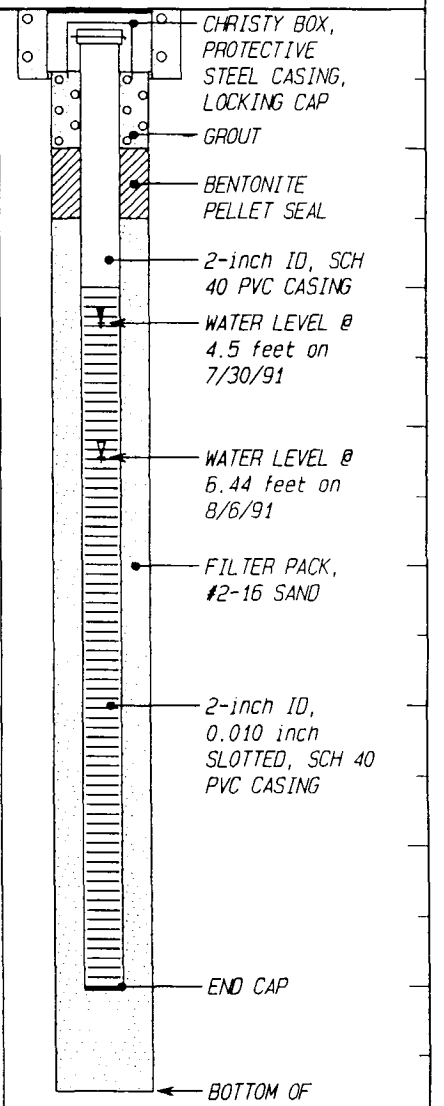
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-08-01
DATE STARTED 7/30/91 COMPLETED 7/30/91
REF. ELEVATION 11.35 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						AS	ASPHALT
		CHEM	50			GM	sandy GRAVEL (GM), olive (5Y 4/4), very dense, dry, 10 to 20% fines, fine to medium sand, 20 to 30% fine to coarse gravel, moderate est K
			36				
			46			SC	
2			36			SP	clayey SAND (SC), yellowish brown (10YR 5/6), dense, moist, 20 to 30% fines, fine sand, moderate est K
		GEO-TECH	50				
			50				
		CHEM	10				SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, high est K
4			16				
			16			SC	clayey SAND (SC) and CLAY (CL)
			16			CL	clayey GRAVEL (GC), light olive brown (2.5Y 5/4), medium dense, moist to wet, 30 to 40% fines, fine gravel, moderate est K
			26			GC	
6			36			SP SM	SAND (SP) and silty SAND (SM), olive (5Y 4/3), medium dense, wet, 5 to 10% fines, fine sand, high est K
			11				
			9				
			14				@ 6.5 feet-as above, wet, 10 to 15% fines, shell fragments abundant
			1				
		GEO-TECH	1				
			10				
10		CHEM	13				
			18				
			19				
			3				@ 11 feet-as above, olive (5Y 4/3) to dark olive (5Y 3/4)
			4				
12			7				
			6				
		GEO-TECH	18				
			20				
14		CHEM	8				
			16				
			20				
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

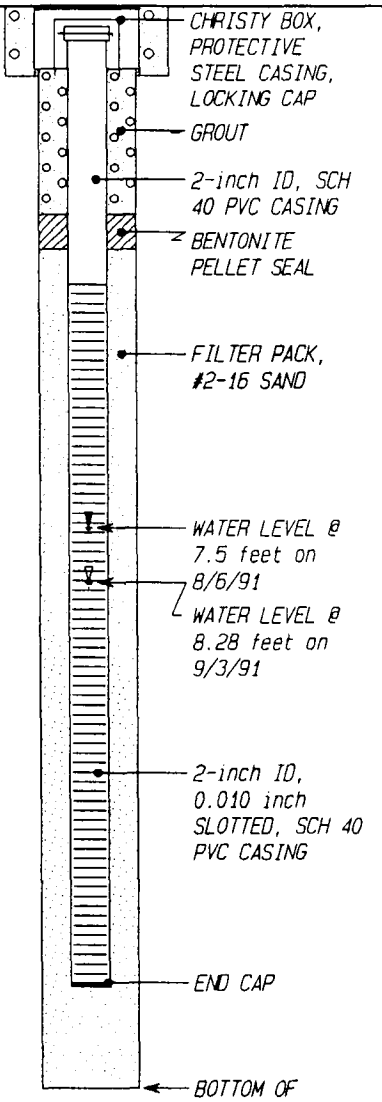
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-08-02
DATE STARTED 8/6/91 COMPLETED 8/6/91
REF. ELEVATION 12.95 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	HAND AUGER to 2'			SM	silty SAND (SM), dark brown (10YR 3/3), medium dense, moist, 20 to 30% fines, fine sand, moderate to high est K, abundant roots and grass
2		CHEM	13			SP	SAND (SP), light olive brown (2.5Y 5/4), dense, very moist, 5 to 10% fines, fine sand, high est K
			30				
			50/5"	8.3			
			20				@ 3.5 feet-as above, moist
4		GEO-TECH	50				
			50/5"	9.4			
			40				
			50			SW	gravelly SAND (SW), yellowish brown (10YR 5/6), very dense, moist, 30 to 35% fines, fine to medium sand, 30 to 40% gravel, moderate est K
6			50/4"	8.9		SP	SAND (SP), light olive brown (2.5Y 5/4), dense, wet, 10 to 15% fines, fine sand, high est K
			30				
			45				
			50	8.9			
8		CHEM	39				@ 8 feet-as above, olive brown (2.5Y 4/3), wet, abundant shell fragments
			25				
			19	9.9			
			7			SC	clayey SAND (SC), olive gray (5Y 4/2), loose, moist to wet, 30 to 50% fines, very fine to fine sand, low to moderate est K, faint layering visible
10			5				
			6	8.9			
			8				
			10				
12			10	6.8			
		GEO-TECH	9			SP	SAND (SP), olive gray (5Y 4/2), medium dense, wet, 10 to 15% fines, very fine to fine sand, high est K
			15				
			19	8.9			
14		CHEM	10			SP/SC	SAND (SP) and clayey SAND (SC), olive gray (5Y 4/2), medium dense, wet, 10 to 15% fines, very fine to fine sand, high est K, product odor (mothballs)
			11				
			8	9.4			
16							TOTAL DEPTH 15.5 feet
18							



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

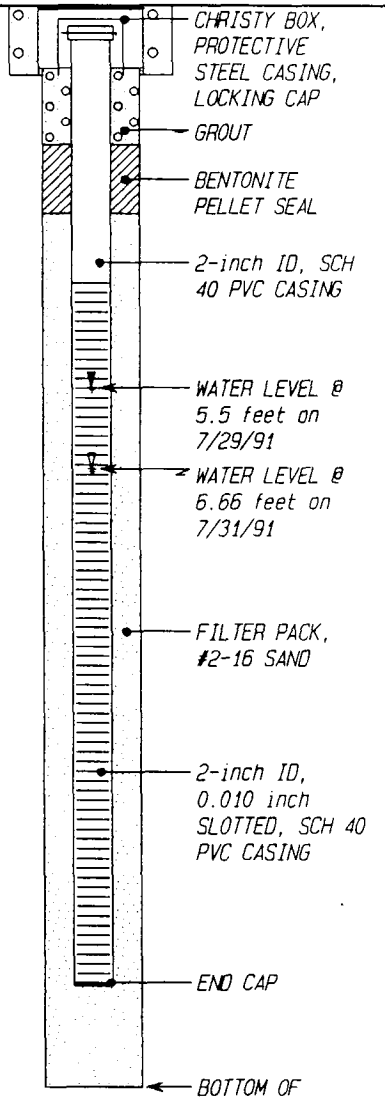
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-08-03
DATE STARTED 7/29/91 COMPLETED 7/29/91
REF. ELEVATION 11.48 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
				12.7		AS	ASPHALT
		CHEM	10			SP	SAND (SP), yellowish brown (10YR 5/6), loose, moist, 5 to 10% fines, fine to medium sand, high est K
			17				
			29	16.2			
2		CHEM	17				@ 1.5 feet-as above, medium dense, trace fines, fine sand
			20				
			21	19.6			@ 2.5 feet-as above, trace fine gravel
			16				@ 3.5 feet-as above, trace clay fragments
4		GEO-TECH	33				
			37	12.2			
			20				@ 5 feet-as above, wet, 10 to 15% fines
			22				
6			22	9.3			
			8			SM	silty SAND (SM), olive (5Y 4/4), loose, wet, 30 to 40% fines, very fine to fine sand, moderate est K
			5				
			4	15.7			
8		CHEM	5			CL	sandy CLAY (CL), olive (5Y 4/4), stiff, wet, fines, 30 to 40% sand, moderate est K
			12				
			20	19.6		SP	SAND (SP), dark olive (5Y 3/3), medium dense, wet, 5 to 10% fines, fine sand, high est K, abundant shell fragments
			8				
10		GEO-TECH	19				
			22	14.7			
			14				
			16				
12			21	13.7			
			7				
		GEO-TECH	8			CL	silty CLAY (CL) dark olive (5Y 3/3), stiff, wet, 100% fines, moderate est K
			9				
14		CHEM	1			SP CL	SAND (SP) and silty CLAY (CL), meduim stiff, moist, 50 to 100% fines, fine sand, moderate est K
			2				
			4	13.2			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

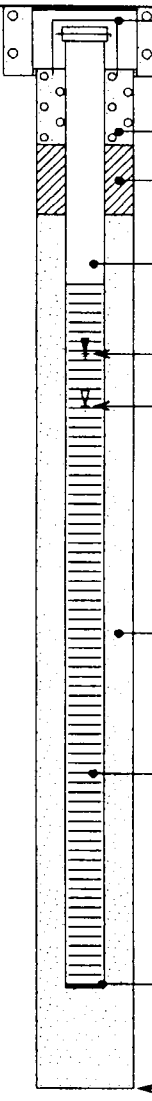
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-08-04
DATE STARTED 7/29/91 COMPLETED 7/29/91
REF. ELEVATION 10.26 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		1.4		SM	silty SAND (SM), dark yellowish brown (10YR 4/6), loose, dry, 30 to 35% fines, fine sand, moderate est K
			16			SP	
			18				
			20	2.9			SAND (SP), dark yellowish brown (10YR 4/6), medium dense, moist, 10 to 15% fines, fine sand, high est K
2		CHEM	12				
			12				
			9	2.9			@ 2 feet-as above, some clay fragments
			6				
4		GEO-TECH	8				
			10	6.8			
			5				SAND (SP), dark yellowish brown (10YR 4/6), medium dense, wet, 10 to 15% fines, fine sand, high est K
			7				
6			7	10.3			
			3				@ 6.5 feet-as above, olive (5Y 4/4), wet, some shell fragments
			3				
			2	6.8			
8		CHEM	1				
			3				
			5	4.4			
			5				@ 9.5 feet-as above, olive gray (5Y 3/3), trace clay fragments
10		GEO-TECH	6				
			6	4.4			
			10			SC CL	clayey SAND (SC) and sandy CLAY (CL), olive gray (5Y 3/3), medium dense, wet, 15 to 80% fines, fine sand, moderate est K, abundant shell fragments in layers
			5				
12			8	5.4			
			2				@ 12.5 feet-as above, wet, increase in amount of clay, shell fragments abundant
		GEO-TECH	2				
			3	1.4			
14		CHEM	3				
			3				
			3	1.9			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



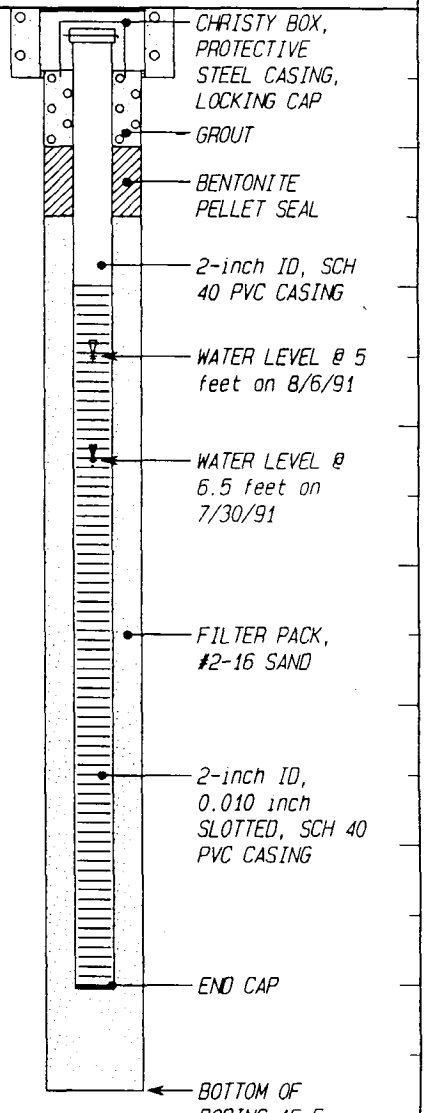
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-08-05
DATE STARTED 7/30/91 COMPLETED 7/30/91
REF. ELEVATION 10.04 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			DRILL AHEAD			AS	ASPHALT
		CHEM	47			SW	gravelly SAND (SW), dark yellowish brown (10YR 4/6), 10 to 15% fines, fine to medium sand, 30 to 35% fine gravel (asphalt mixed in), moderate to high est K
2		CHEM	50/4" 46			SP	SAND (SP), yellowish brown (10YR 5/6), dense, moist, trace fines, fine sand, trace gravel, high est K
			50				
			43				
4		GEO-TECH	8 16				@ 4 feet-as above, 10 to 15% fines, very moist
			20				
			22				SAND (SP), yellowish brown (10YR 5/6), wet, 5 to 10% fines, fine sand, high est K
6			50 50/4"				
			12				
			32				
			43				
8		CHEM	7				@ 8 feet-as above, olive (5Y 4/3)
			14				
			20			SC CL	clayey SAND (SC) and silty CLAY (CL), dark olive (5Y 3/4), dense, wet, 30 to 100% fines, fine sand, moderate est K
10		GEO-TECH	8				
			43				
			17			SC SP	clayey SAND (SC) and SAND (SP), dark olive (5Y 3/4), dense, wet, 10 to 30% fines, fine sand, moderate est K
12			34 50/4"				
			17			SP	SAND (SP), dark olive (5Y 3/4), dense, wet, 0 to 10% fines, fine sand, high est K
		GEO-TECH	23 50/2"				
14		CHEM	28				@ 14 feet-as above, product odor (mothballs)
			30				
			30				TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-06 CLIENT PRC/US NAVY
DATE STARTED 8/7/91 COMPLETED 8/7/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.62 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
		CHEM	20			GP	sandy GRAVEL (GP), olive brown (2.5Y 4/3), dense, moist, 10 to 15% fines, 20 to 30% sand, fine gravel and asphalt, high est K	
			40			GC		
			45	1.3		SP		
2			26				clayey GRAVEL (GC), light olive brown (2.5Y 5/4), very dense, moist, 20 to 30% fines, 10 to 15% sand, fine gravel, moderate to low est K	
		GEO-TECH	40					
			36	1.7				
		CHEM	14				SAND (SP), light olive brown (2.5Y 5/3), dense, moist, 5 to 10% fines, fine sand, high est K	
4			26			SP		
			40	3.5		GP	SAND (SP) and sandy GRAVEL (GP), light olive brown (2.5Y 5/3), very dense, moist to wet, 10 to 30% fines, fine sand, fine gravel, moderate est K	
			40			SP		
			50				SAND (SP), light olive brown (2.5Y 5/3), very dense, moist to wet, 10 to 15% fines, fine sand, high est K	
6			50/2"					! DEPTH TO WATER=6.5 feet
			26					
			30				@ 6.5 feet-wet, some shell fragments	
			36					
8		CHEM	8			SC	clayey SAND (SC), olive gray (5Y 4/2), dense, wet, 20 to 30% fines, fine sand, moderate est K	
			8					
			8	3.5		CL	sandy CLAY (CL), olive gray (5Y 4/2), very stiff, moist, fines, 10 to 20% sand, low est K	
			15					
10		GEO-TECH	25			SP	SAND (SP), dark olive gray (5Y 3/2), dense, wet, 10 to 15% fines, fine sand, high est K	
			39					
			5					
			10					
12			20					
			20					
		GEO-TECH	30					
			40					
14		CHEM	20					
			30				@ 14.5 feet-as above, strong odor (mothballs)	
			36	0				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-07 CLIENT PRC/US NAVY
DATE STARTED 8/13/91 COMPLETED 8/13/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.92 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
	■	CHEM	HAND AUGER to 2'	5.0 / 3.1		SM	silty SAND (SM), brown (5YR 3/3), very dense, moist, 25-30% fines, very fine to medium sand, trace gravel, moderate estimated K	
2	■	CHEM	50 / 50/4	6.3		SP	SAND (SP), light brown (2.5Y 5/3), dense, moist, 5-10% fines, fine to medium sand, high est K	
4	⊠ ■ ⊠	GEO-TECH	25 / 50 / 50/6	8.8			@ 4.3 to 4.5 feet-as above, gravel layer	
	■	CHEM	30 / 40				@ 5 feet-as above, wet	! DEPTH TO WATER=5 feet
6			50/5	8.2				
	⊠ ■ ⊠	GEO-TECH	12 / 42 / 50	6.9				
			12 / 28 / 22	8.2			@ 8 feet-as above, 10 to 15% fines, very fine to fine sand, slight mothball odor	
10			4 / 2 / 2	7.5				
			12 / 30 / 44	6.3		CL	CLAY (CL), very dark gray (5Y 3/1), medium stiff, wet, fines, 10 to 15% very fine sand, low est K	
12	■	CHEM	15 / 22 / 33	7.5		SC	clayey SAND (SC), dark gray (2.5Y N4/), dense, wet, 20 to 25% fines, fine to medium sand, moderate est K	
14	⊠ ■ ⊠	GEO-TECH	20 / 20 / 20	5.2				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-08 CLIENT PRC/US NAVY
DATE STARTED 8/06/91 COMPLETED 8/06/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.71 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
	■	CHEM	HAND AUGER to 2'	72		SW	gravelly SAND (SW), dark brown (10YR 3/3), very dense, moist, 10 to 15% fines, fine to medium sand, 30 to 40% fine gravel, moderate est K, hydrocarbon odor	
2	■	CHEM	50/3" 50	94			@ 2 feet-as above, change in color to dark yellowish brown (10YR 4/4), 20 to 25% fines, hydrocarbon odor	
				5.2		SP	SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, high est K	
4	⊠	GEO-TECH	50/3" 16 36 26	6.8			@ 4.7 feet-as above, some clay fragments	! DEPTH TO WATER=5 feet
6	⊠		48 50	6.8			SAND (SP), olive brown (2.5Y 4/3), dense, wet, 10 to 15% fines, very fine to fine sand, high est K	
	⊠		14 26 21	6.8			@ 7 feet-as above, abundant shell fragments	
8	■	CHEM	7 7 6	9.9			@ 8 feet-as above, olive (5Y 4/4)	
10	⊠		2 2				@ 9.5 feet-as above, olive gray (5Y 4/2)	
	■	GEO-TECH	10 10 18	8.3		SM	silty SAND (SM), 30 to 40% fines	
12	⊠		20 5	9.9			@ 11.5 to 11.8 feet-clay layer	
	⊠	GEO-TECH	14 15	7.8		SP SC	SAND (SP), as above, mixed with clayey SAND (SC), olive gray (5Y 4/2), medium dense, wet, 10 to 40% fines, fine sand, moderate est K	
14	■	CHEM	4 3 4	6.2		CL	sandy CLAY (CL), dark gray (5Y 4/1), medium stiff, moist, 80 to 100% fines, fine sand, low est K	
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-09 CLIENT PRC/US NAVY
DATE STARTED 8/07/91 COMPLETED 8/07/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.72 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
		CHEM	HAND AUGER to 3.5'	56		SW	gravelly SAND (SW), dark yellowish brown (10YR 4/4), dense, moist, 20 to 30% fines, fine to medium sand, 30 to 40% gravel, moderate est K	
2						SP	SAND (SP), light olive brown (2.5Y 5/4), loose, moist, 10 to 15% fines, fine sand, high est K	
			21					
4		GEO-TECH	36					
			47	7.9		SC	clayey SAND (SC), olive (5Y 4/3), very dense, moist, 30 to 40% fines, fine to medium sand, 20 to 30%, gravel, moderate est K, pieces of red brick	
		CHEM	36					
			20					
			40			SP		
6			50	9			SAND (SP), olive gray (5Y 4/2), dense, wet, 10 to 15% fines, fine sand, high est K	! DEPTH TO WATER=6.5 feet
			25					
			50				@ 7 feet-as above, light olive brown (2.5Y 5/4), wet	
			50	13.4				
8		CHEM	18					
			29					
			17	14				
			3					
10		GEO-TECH	4					
			19	13.4		SC	clayey SAND (SC), olive (5Y 4/4), medium stiff, wet, 30 to 40% fines, fine sand, moderate to low est K, some layers of sandy clay	
			6					
			8					
12			30	15		SP	SAND (SP), dark olive (5Y 3/3), medium dense, wet, 10 to 20% fines, fine sand, high est K	
			17					
		GEO-TECH	28					
			30	15.5			@ 13.5 feet-as above, some layers of clay	
14		CHEM	7				@ 14 feet-as above, hydrocarbon odor	
			8					
			9	12.3		CL	sandy CLAY (CL), dark olive (5Y 3/3), stiff, moist to wet, fines, 20 to 30% fine sand, low est K	
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-10 CLIENT PRC/US NAVY
DATE STARTED 8/7/91 COMPLETED 8/7/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.99 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
	■	CHEM	HAND AUGER to 3.5'	309		SW	gravelly SAND (SW), light olive brown (2.5Y 5/4), dense, moist, 10 to 25% fines, fine to medium sand, 20 to 30% gravel, moderate est K	
2						SP	SAND (SP), light olive brown (2.5Y 5/4), very dense, moist, 10 to 15% fines, fine sand, high est K	
				6.2				
	⊠		40					
4	■	GEO-TECH	50					
	⊠		50					
	■	CHEM	8					
			20			SW	gravelly SAND (SW), olive (5Y 4/3), dense, moist 20-30% fines, fine to medium sand, 30-35% gravel, moderate est K	
6			39	4.6				! DEPTH TO WATER=6.5 feet
	⊠		40			SP	SAND (SP), olive gray (5Y 4/2) at the top, light olive brown (2.5Y 5/4) with depth, very dense wet, 10 to 15% fines, fine sand, high est K, clay fragments at the top, some shell fragments	
			50					
			50/5	10.2				
8	■	CHEM	15					
			20					
			25	6.8				
			9					
10	⊠	GEO-TECH	6					
	■		5	6.8		CL	sandy CLAY (CL), olive (5Y 4/3), stiff, wet, fines, 10-20% sand, low est K	
			16			SM	silty SAND (SM), olive (5Y 4/3), stiff, wet, fines, 10-20% sand, low est K	
			17					
12	⊠		16	10.6				
			6			SC	clayey SAND (SC), dark olive (5Y 3/3), medium dense, moist to wet, 20-25% fines, fine sand, moderate to low est K	
	■	GEO-TECH	11					
	⊠		15					
14	■	CHEM	16			SP	SAND (SP), dark olive (5Y 3/3), medium dense, wet, 10-15% fines, fine sand, high est K, product odor	
			13					
			9	9.5		CL	sandy CLAY (CL), dark olive (5Y 3/3), stiff, wet, fines, 20-25% sand, low est K	
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-11 CLIENT PRC/US NAVY
DATE STARTED 7/30/91 COMPLETED 7/30/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.25 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
		CHEM	HAND AUGER to 5'			SM	silty SAND (SM), dark yellowish brown (10YR 3/6), loose, moist, 30 to 40% fines, fine sand, moderate est K, abundant roots	
						SW		
						SP	as above, with gravel	
2							SAND (SP), light olive brown (2.5Y 5/4), medium dense, moist, 5-10% fines, fine sand, high est K	
4		CHEM						
			6				SAND (SP), light olive brown (2.5Y 5/4), loose, wet, 10-15% fines, fine sand, high est K, some clay fragments	! DEPTH TO WATER=5.0 feet
6			7					
			8					
			5					
			6				as above, without the clay fragments, wet	
			11					
8			5					
		GEO-TECH	10					
			7					
		CHEM	7					
10			7			SC	clayey SAND (SC), olive (5Y 4/3), medium dense, wet, 20-30% fines, fine sand, moderate est K	
			3					
			5			CL	CLAY, olive (5Y 4/4), soft, wet, 100% fines, low est K	
			7			SP		
12			9			SC	SAND (SP), and clayey sand (SC), olive (5Y 4/3), medium dense, wet, 10-30% fines, fine sand, moderate to high est K	
		GEO-TECH	8					
			12					
			18					
14		CHEM	7			SC	clayey SAND (SC), dark olive, 30-40% fines, fine sand	
			11			SP		
			21				SAND (SP), dark olive (5Y 3/4), medium dense, moist to wet, 5-10% fines, fine sand, high est K, carbon and wood fragments, non-descriptive product odor	
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-08-12 CLIENT PRC/US NAVY
DATE STARTED 8/13/91 COMPLETED 8/13/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.84 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
			HAND AUGER to 5'			AS	ASPHALT	
		CHEM				SP	SAND (SP), yellowish brown (10YR 5/4), medium dense, 10-15% fines, fine sand, moderate est K	
2								
						CL	sandy CLAY, (CL), brown (10YR 5/3), medium dense, damp, fines, 25-30% fine sand, low est K	
4						SC	clayey SAND (SC), brown (10YR 5/3), medium dense, damp, 20-25% fines, very fine to fine sand, low est K	
		CHEM	16					
			47				@ 5.5 feet-as above, orange-brown, very dense	
6			50	6.3		SP	SAND (SP), light olive brown (2.5Y 5/3), medium dense, damp, 10-15% fines, fine to medium sand, moderate est K	
			24					
			27					
			40	4.4				
8		CHEM	20					
			26					
			30	7.5				! DEPTH TO WATER=9.0 feet
			20					
10		GEO-TECH	14			SC	clayey SAND (SC), olive gray (5Y 5/2), medium dense, wet, 20-25% fines, fine sand, low to moderate est K	
			44	12.6				
			6					
			6					
12			6	6.6		CL	CLAY (CL), olive (5Y 5/3), hard, wet, fines, low est K	
			20			SM		
		GEO-TECH	25				silty SAND (SM), olive (5Y 5/3), medium dense, wet, 20-25% fines, fine to medium sand, low to moderate est K	
			25	4.8				
14		CHEM	25					
			25					
			25	5.6			as above, odor, (moth balls)	
							TOTAL DEPTH =15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

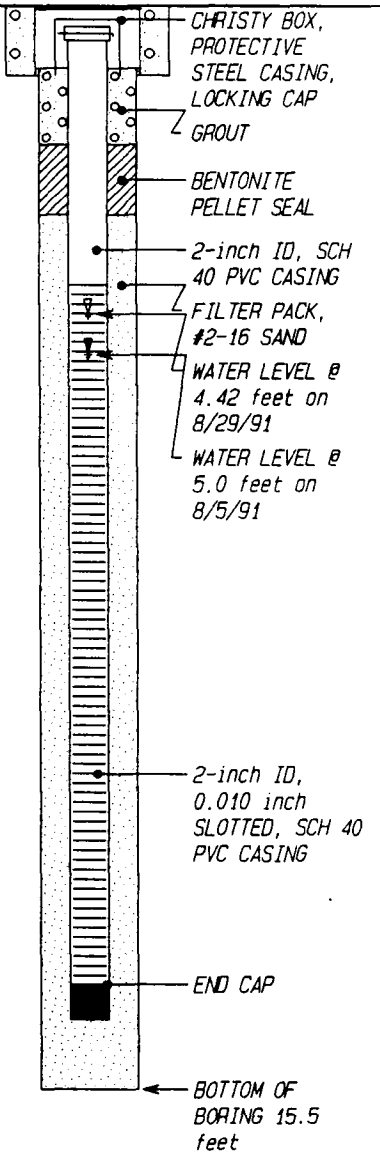
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-10-01 CLIENT PRC/US NAVY
DATE STARTED 8/5/91 COMPLETED 8/5/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 10.62 FEET, TOP OF CASING GEOLOGIST RICH HALKET

feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
	■	CHEM	HAND AUGER to 5'			CN	CONCRETE
						SW	gravelly SAND (SW), very dark grayish brown (10YR 3/2), dense, moist, 1-5% fines, fine to medium sand, 10-15% fine to coarse gravel, 1-3% cobbles/ boulders, moderate est K, some metal debris
2						SP	SAND (SP), yellowish brown (10YR 5/6), medium dense, moist, 10-15% fines, fine to medium sand, moderate est K
4							
	■	CHEM	19				@ 5 feet-as above, olive (5Y 4/4), wet
			37				
6	⊠		41	2.2			
	⊠		19				
	■	GEO-TECH	24				@ 7 feet-as above, olive, (5Y 5/3)
	⊠		28	4.4			
8	■	CHEM	19				
			24				
			27	4.4			
	⊠		9				
10	■	GEO-TECH	13				@ 10 feet-as above
	⊠		14	5.5			
			1				
			1			CL	CLAY (CL), olive (5Y 5/3), soft, wet, fines, low est K
12			11	2.2			
	⊠		1			SP	SAND (SP), olive (5Y 5/3), loose, wet, 10-15% fines, fine sand, high est K
	■	GEO-TECH	2				
	⊠		3	3.8		CL	CLAY (CL), black (7.5YR N2/), soft, moist, fines, low est K
14	■	CHEM	4				
			11			SC	clayey SAND (SC), black (7.5YR N2/), medium dense, wet, 15-20% fines, fine to medium sand, moderate est K, abundant shell fragments
	⊠		17	3.3			
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



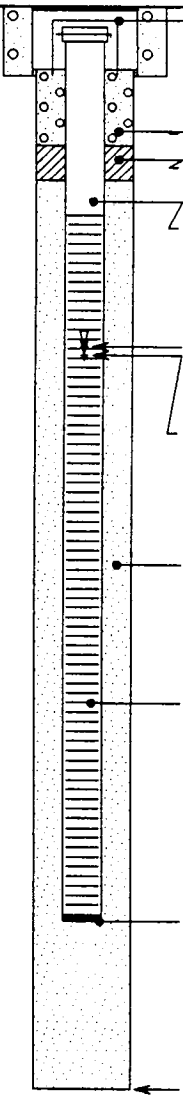
REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET WELL COMPLETION DEPTH 14.0 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

ING/WELL NUMBER MW-10-02 CLIENT PRC/US NAVY
E STARTED 8/2/91 COMPLETED 8/2/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.00 FEET, TOP OF CASING GEOLOGIST KAREN KRAMER

feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
			HAND AUGER to 5'			CN	CONCRETE
	■	CHEM		0.2		SP	SAND (SP), light olive brown (2.5Y 5/4), loose, moist, 5 to 10% fines, fine sand, high est K
2							SAND (SP), as above, loose
4							
	■	CHEM	10				SAND (SP), olive brown (2.5Y 4/4), medium dense wet, 10-20% fines, fine sand, high est K
			18				
6			21	0			
	⊠		9				@ 6.5 feet-as above, color change to olive (5Y 4/4)
	■	GEO-TECH	13				
			21	0.8			
8	■	CHEM	10				
			20				
			40	1.3			
			7				
10	⊠	GEO-TECH	16				
	■		30	2.4			
			9				
			16				@ 11.5 feet-as above, with some shell fragments
12	⊠		23	2.9		SC	clayey SAND (SC), olive (5Y 4/3), medium dense, wet to moist, 20-30% fines, fine to very fine sand, moderate est K
			21				
	⊠	GEO-TECH	21				
			11	2.4		SP	SAND (SP), olive (5Y 4/3), medium dense, wet, 10-15% fines, fine sand, high est K
14	■	CHEM	12				
			12				
			10	4.5		SM	silty SAND (SM), dark olive (5Y 3/3), abundant shell fragments
16							TOTAL DEPTH 15.5 feet
18							



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET WELL COMPLETION DEPTH 13 FEET

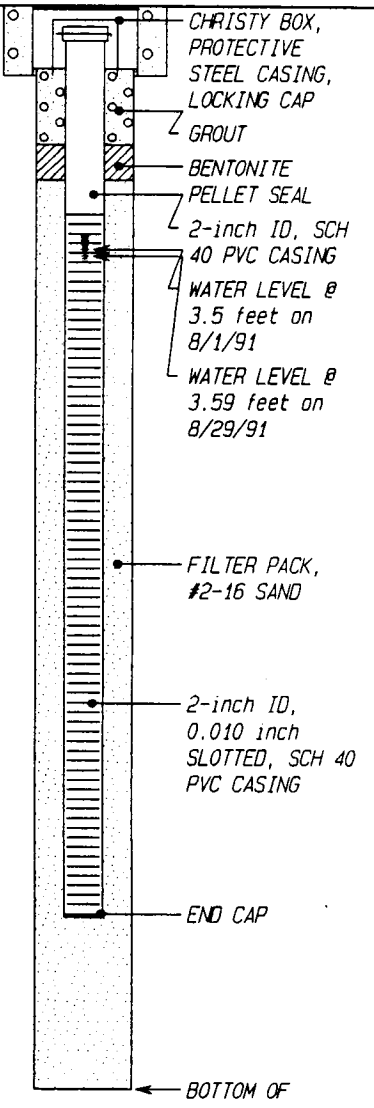
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

ING/WELL NUMBER *MW-10-03* CLIENT *PRC/US NAVY*
STARTED *8/1/91* COMPLETED *8/1/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*
ELEVATION *10.16 FEET, TOP OF CASING* GEOLOGIST *KAREN KRAMER*

feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM		7.6		SP	
			7				SAND (SP), light olive brown (2.5Y 5/4), loose moist, 0 to 5% fines, fine to very fine sand, high est K
			9	5.7			
2		CHEM	6				
			7				SAND (SP), @ 1.5 feet-as above, some pieces of black glassy material
			8	11.9			
			8				SAND (SP), wet, color change to olive brown (2.5Y 4/4), 10-15% fines
4		GEO-TECH	18				
			24	6.1			
			20				@ 5 feet-as above, trace pieces of black glassy material
			20				
6			30	6.1			
			8				SAND (SP), as above, color change to olive (5Y 4/4)
			13				
			24	8.1			
8			6				
		GEO-TECH	11				
			11	9.0			
10		CHEM	8				
			20				
			39	6.1			
			10				
			19				
12			19	7.1			
			18				
		GEO-TECH	23				@ 13 feet-as above, color change to dark olive (5Y 3/3), abundant small shells
			28	8.1			
14		CHEM	23				@ 14 feet-as above, wet, abundant small shells, slight H2S odor
			30				
			26	10.4			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./D. RYAN*
HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*
TOTAL DEPTH OF BORING *15.5 FEET* WELL COMPLETION DEPTH *13.0 FEET*

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

ING/WELL NUMBER B-10-04 CLIENT PRC/US NAVY
E STARTED 8/2/91 COMPLETED 8/2/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
VATION 11.03 FEET GEOLOGIST KAREN KRAMER

feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
			HAND AUGER to 5'	4.0		CN		
		CHEM				SP	SAND (SP), light olive brown (2.5Y 5/6), moist, 5-10% fines, fine sand, high est K	
2								
4								
								! DEPTH TO WATER=4.7 feet
		CHEM	8				@ 5.0 feet-as above, 10-15% fines, wet	
			27					
6			45	4.5				
			16					
			25					
			26	6.6			@ 7.5 feet-as above, color change to olive (5Y 4/4), (SP)	
8			6					
		GEO-TECH	16					
			21	5.6				
		CHEM	8			SM	silty SAND (SM), olive (5Y 4/4), medium dense wet, 20-30% fines, fine sand, moderate est K	
10			12					
			20	5.0				
			3					
			1					
12			2			CL	CLAY (CL), olive (5Y 4/4), soft, moist, 100% fines, low est K	
			3					
		GEO-TECH	4				@ 13 feet-as above, with sandy clay and shells	
			5	5.0				
14		CHEM	11					
			19			SP	SAND (SP), olive gray (5Y 4/2), medium dense, wet, 10-15% fines, fines sand, high est K, abundant small shells	
			22	6.1				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

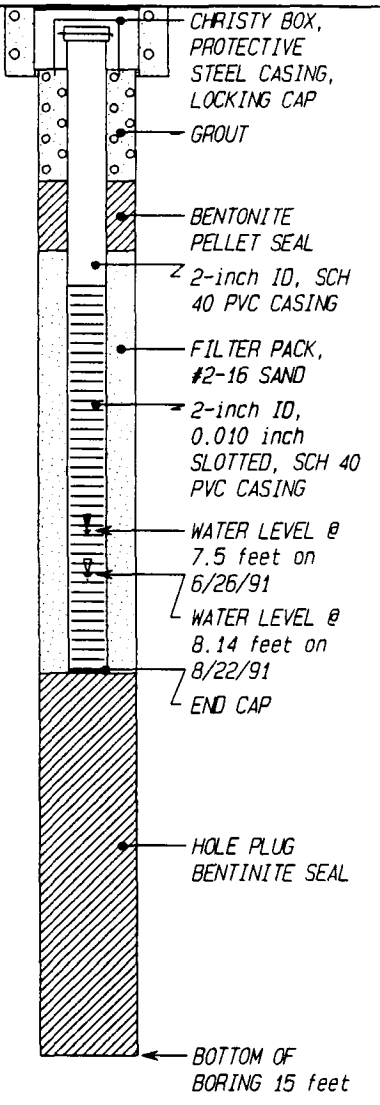
JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER *MW-11-01* CLIENT *PRC/US NAVY*
DATE STARTED *6/26/91* COMPLETED *6/26/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*
ELEVATION *12.35 FEET, TOP OF CASING* GEOLOGIST *KAREN KRAMER*

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	8	1.0		SC	clayey SAND (SC), dark yellowish brown (10YR 4/4) medium dense, moist, 30-40% fines, fine to medium sand, 5-10% gravel, low to moderate est K, abundant 2" clay fragments
			14				
2		CHEM	23	3.1		SP	SAND (SP), dark yellowish brown (10Y 4/4), moist, 5 to 10% fines, high est K
			25				
			37				
			24	1.0			
4		GEO-TECH	30				
			41				
		CHEM	29	0			@ 5.0 feet-as above, moist
			30				
6			34	0		CL	CLAY (CL), pale olive (5Y 6/3), dense, moist, fines, low est K, shell fragments and gravel at uppermost contact
			29				
		GEO-TECH	34	0		SC	clayey SAND (SC), dark yellowish brown, medium dense, moist to wet, 30-50% fines, 5-10% gravels fine to medium sand, low to moderate est K, some shell fragments
			13				
8			10	0			
			9				
			7				clayey SAND (SC), dark olive (5Y 3/3), wet, 30-40% fines, fine to coarse sand, 10-15% gravel, high est K, some shell fragments
10			1	0		CL	
			0				
			0				CLAY (CL), dark olive (5Y 3/3), soft, moist, fines, low est K, bedding planes separated by silts and fine sand
			1	0			
			6				
12			8				@ 12.0 feet-as above, burrows present associated with sand
		GEO-TECH	15			SC	clayey SAND (SC), dark olive (5Y 3/3), dense, moist, 25-30% fines, fine to medium sand, moderate est K, shell fragments along bedding planes
			50/6"				
14		CHEM	21	1.0			
			50/4"				clayey SAND (SC), light olive brown (2.5Y 5/6), dense, moist to wet, 30-40% fines, fine to medium sand, moderate est K
16							TOTAL DEPTH 15 feet
18							

WELL DIAGRAM



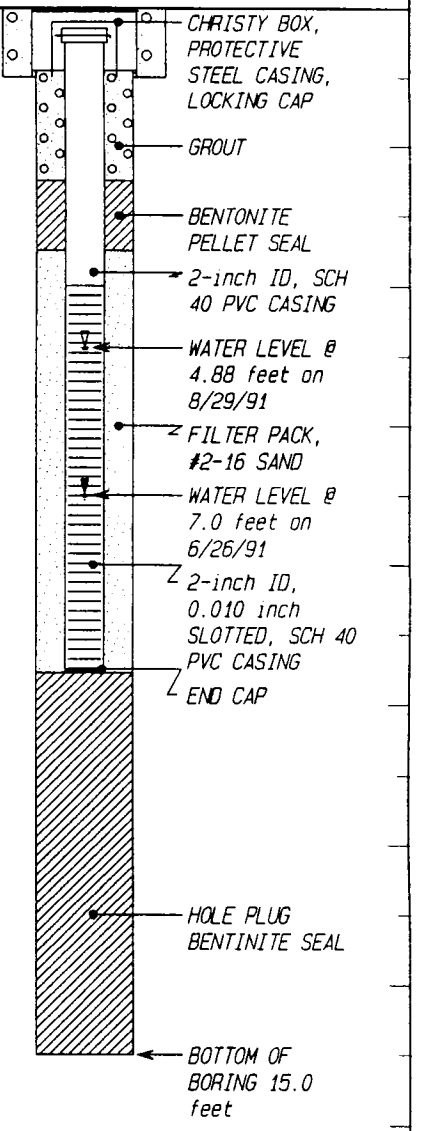
REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./J. COLLINS*
HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*
TOTAL DEPTH OF BORING *15 FEET* WELL COMPLETION DEPTH *9.5 FEET*

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-11-02 CLIENT PRC/US NAVY
DATE STARTED 6/26/91 COMPLETED 6/26/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
REF. ELEVATION 12.03 FEET, TOP OF CASING GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
						CN	CONCRETE
		CHEM	48	3.1		SP	SAND (SP), yellowish brown (10YR 5/4), loose, moist, 5-10% fines, fine to medium sand, 5-10% fine gravel, high est K, some shell fragments
			50/6"				
2			47	5.2		SW	
			50/6"			SP	@ 1.5 feet-as above, except no gravel, moist
			20	1.0			gravelly SAND (SW), dense, moist, 30-35% fines, fine to medium sand, 20-25% fine gravel, moderate est K
4		GEO-TECH	27				
			28				SAND (SP), yellowish brown (10YR 5/4), moderate est K
		CHEM	19	1.0			
			28			SW/SC	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 5-10% fines, fine to medium sand, high est K
6			30				
			19	1.0		SP	
			9	0		SW	gravelly SAND (SW) and clayey SAND (SC), yellowish brown, dense, moist, 20-40% fines, fine to coarse sand, 0-40% gravels, moderate est K
			8			CL	
8		GEO-TECH	5	0			
			5			SC	@ 6.5 feet-as above, SAND (SP) & gravelly SAND (SW)
			6			CL	
10		CHEM	1	5.2			gravelly SAND (SW), dark olive (5Y 3/4), medium dense, wet, 30-35% fines, 30-35% gravels
			2				
			4				CLAY (CL), dark olive (5Y 3/4), soft, wet, fines, moderate est K, thin sand interbeds
			11	5.2			
12			50/5"			SP/SC	CLAY (CL), @ 8 feet-as above, moist, no sands
							clayey SAND (SC), @ 8.5 feet-as above
		GEO-TECH	40				
			50/5"	3.1		SC	CLAY (CL), @ 9.5 feet-as above, some sand and sands and shells
14		CHEM	39	3.1			@ 11.5 feet-as above, black sand with shells
			50/4"				clayey SAND (SC), mottled yellowish brown (10YR 5/7), dense, moist, 30-40% fines, fine to medium sand, moderate est K
16							TOTAL DEPTH 15 feet
18							



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15 FEET WELL COMPLETION DEPTH 9.5 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

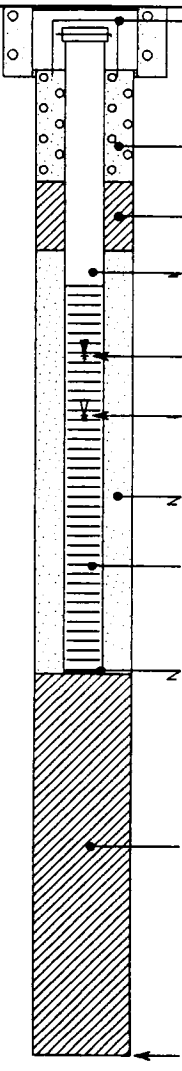
BORING/WELL NUMBER *MW-11-03* CLIENT *PRC/US NAVY*

DATE STARTED *6/25/91* COMPLETED *6/25/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*

ELEVATION *11.41 FEET, TOP OF CASING* GEOLOGIST *KAREN KRAMER*

Feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		0.9		AS	ASPHALT
			35	0.9		SW	gravelly SAND (SW), light olive brown (2.5Y 5/3), dense, moist, 20 to 25% fines, fine to medium sand, 25 to 30% fine to coarse gravel, moderate est K
			50/5"			SP	
2			19				
		GEO-TECH	37				SAND (SP), light olive brown (2.5Y 5/3), very dense, moist, 5 to 10% fines, fine to medium sand, 0 to 5% fine gravel, high est K
			50/5"				
		CHEM	36	2.0			
4			33				@ 3.5 feet-as above, very moist
			35				
			7	0.9			@ 5 feet-as above, olive brown (2.5Y 4/4), wet
			25				
6			30				
		GEO-TECH	7	0.9			
			15				@ 7 feet-as above, trace shell fragments
			20				
8		CHEM	6				@ 8 feet-as above, dark olive gray (5Y 3/2), wet, 25 to 30% fines
			5				
			4				
			1	4.7		SC	@ 9.5 feet-2 inches of clayey SAND (SC), dark olive gray (5Y 3/2), moist to wet, 30 to 40% fines, fine to medium sand, low to moderate est K
10			0			CL	
			1				CLAY (CL), dark olive gray (5Y 3/2), soft, moist, fines, low est K, silty partings
			8				
			24			SP	SAND (SP), black, dense, moist, some shell fragments
12			50/4"	0.9		SC	
		GEO-TECH	27				clayey SAND (SC), olive (5Y 5/4), very dense, moist, 30 to 35% fines, fine to medium sand, moderate est K
			50/5"	6.6			
14		CHEM	25	2.8			clayey SAND (SC), olive brown (2.5Y 4/4), with light gray mottling, 30 to 40% fines, fine to medium sand, low to moderate est K, mottling associated with root material
			50				
16							TOTAL DEPTH 15 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./J. COLLINS*

HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*

TOTAL DEPTH OF BORING *15 FEET* WELL COMPLETION DEPTH *9.5 FEET*

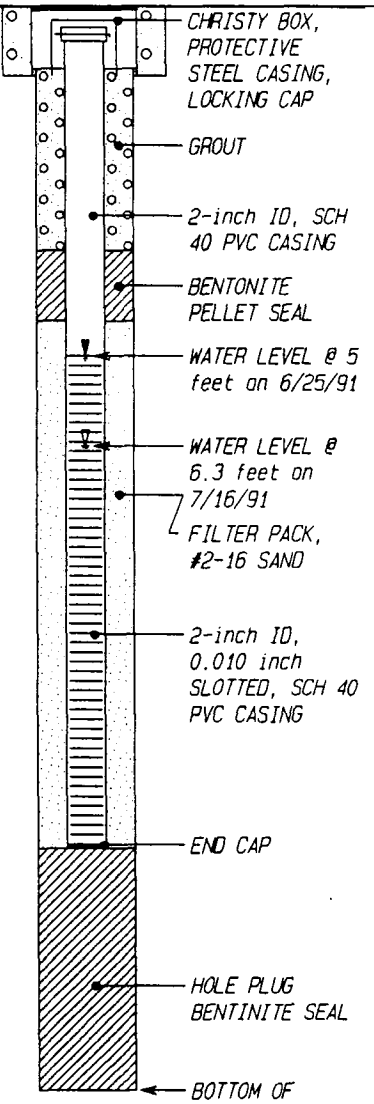
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-11-04
DATE STARTED 6/25/91 COMPLETED 6/25/91
ELEVATION 11.97 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

Feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	48	0.9		AS	ASPHALT
			50/5"			SW	gravelly SAND (SW), dark olive (5Y 2.5/3), medium dense, 20 to 30% fines, fine to coarse sand, 30 to 50% gravel, low to moderate est K
2		GEO-TECH	50/2"	0.9			@ 0.5 feet-as above, yellowish brown (10YR 5/4)
							@ 1.5 feet-as above, 10 to 20% gravel
4		CHEM	18	0.9			
			50/6"			SP	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 5 to 10% fines, fine to medium sand
			13	0.9			
6			24				
			28				
			15	0.9			
			27				SAND (SP), dark olive (5Y 3/1), dense, wet, 20 to 30% fines, sand, 5 to 10% fine gravel in layers, layers, moderate est K, shell fragments in gravel layers
			36				
8			6	0.9			
		GEO-TECH	12				
			15				
10		CHEM	1				
			1				
			1			CL	CLAY (CL), dark gray (5Y N4/4), soft, moist to wet, fines, low est K, gradational contact over approximately 6 inches with overlying sand
			7	2.8			
			14				
12			48			SP	SAND (SP), black, dense, moist, 5 to 10% fines, abundant shell fragments
			20	0.9			
		GEO-TECH	44				SAND (SP), yellowish brown (10YR 5/6), dense, moist, 5 to 10% fines, fine to medium sand, moderate est K
			44				
14		CHEM	35	0.9			
			34				
			52				
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 12 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

ING/WELL NUMBER B-11-05 CLIENT PRC/US NAVY
E STARTED 6/26/91 COMPLETED 6/26/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
/ATION 11.35 FEET GEOLOGIST KAREN KRAMER

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	13	0		SP	SAND (SP), dark yellowish brown (10YR 4/6), loose, moist, 20 to 25% fines, fine to medium sand, 10 to 15% fine gravel, moderate est K, probable fill	
			16	52				
			16					
2		GEO-TECH	14	0				
			28					
			37					
		CHEM	17				@ 3.5 feet-as above, dense, 5 to 10% fines, no gravel, moderate est K	
4			38					
			40					
		CHEM	9	0			@ 5 feet-as above, dark olive gray (5Y 3/2), wet	! DEPTH TO WATER=5 feet
			16					
6			25					
			8	0			@ 6.5 feet-as above, some shell fragments, oily sheen on water from the hole	
		GEO-TECH	20					
			21					
8			2	1			@ 8 feet-2 inch clay layer with shell fragments	
			11	40				
			2			CL	CLAY (CL), dark olive gray (5Y 3/2), soft, moist, fines, low est K	
			1					
10			1				NO RECOVERY - 9.5 to 11 feet	
			2					
			18	3.1		SC	clayey SAND (SC), black, dense, moist, 30 to 40% fines, fine to medium sand, moderate est K, mottled with light gray clay	
			21					
12			50				@ 11.5 feet-as above, light gray	
		GEO TECH	23					
			50					
14		CHEM	32					
			50/5"					
							TOTAL DEPTH 15 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-11-06 CLIENT PRC/US NAVY
DATE STARTED 6/25/91 COMPLETED 6/25/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.61 FEET GEOLOGIST KAREN KRAMER

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
		CHEM	15	0.9		SW	gravelly SAND (SW), yellowish brown (10YR 5/4), dense, moist, 20 to 25% fines, fine to medium sand, 20 to 30% gravel, moderate est K	
			37	2.8				
			44			SP		
2			27	0.9			@ .5 to 1.5 feet-as above, yellowish red (5YR 5/8)	
		GEO-TECH	43					
			41				SAND (SP), yellowish brown (10YR 5/4), dense, moist, 5-10% fines, fine to medium sand, high est K	
4		CHEM	16	2.8				
			38					
			40					
			12	2.8			@ 5.0 feet-as above, wet, faint laminations	
			28					DEPTH TO WATER=5.5 feet
6			32					
			7				SAND (SP), dense, wet, 10-15% fines, fine to medium sand, high est K, gravelly at base, trace shells	
		GEO-TECH	12	2.8				
			20					
8		CHEM	4	2.8			silty SAND (SP), dark gray, abundant shell fragments	
			12					
			7			CL	CLAY (CL), dark gray, medium dense, wet, fines, low est K	
			1	4.7				
10			0				@ 10.0 feet-as above, some partings of silty sand	
			1					
			3					
			7			SC	clayey SAND (SC), black, medium dense, moist, 30-40% fines, medium sand	
12			30					
			23	2.8			@ 12.0 feet-as above, dark yellowish brown to olive, dense, wet, 30-40% fines, fine to medium sand	
		GEO-TECH	35					
			33				clayey SAND (SC), dark yellowish brown (10YR 4/4), dense, wet, 30-40% fines, fine to medium sand, moderate est K	
14		CHEM	10	4.7				
			28					
			31					
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-11-07 CLIENT PRC/US NAVY
DATE STARTED 6/24/91 COMPLETED 6/24/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 12.66 FEET GEOLOGIST RICH HALKET

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						CN	CONCRETE	
		CHEM	45			SM	silty SAND (SM), light olive brown (2.5Y 5/4), dense, moist, 15 to 20% fines, very fine to fine sand, moderate est K, possible petroleum odor	
			50/4"	1564				
2			42			ML	gravelly SILT (ML), light olive brown (2.5Y 5/4), hard, dry, fines, 5 to 10% sand, 15 to 20% fine gravel	
			50	57				
			15			SP	SAND (SP), light olive brown (2.5Y 5/4), medium dense, moist, 0 to 5% fines, fine sand, moderate est K	
			14					
4			20					
			14	98.2		CL GW	gravelly CLAY (CL) and GRAVEL (GW), dark gray (2.5Y N4/), CL, stiff, moist, fines, 5 to 10% sand, 10 to 15% fine gravel, low est K; GW, dense, wet, 15% to 20% fine to coarse sand, fine gravel, moderate to high est K, some shell fragments, gravel interbeds are 2"-6" thick	DEPTH TO WATER= 5.5 feet
			27					
			32					
6			4	7.4				
		GEO-TECH	13					
			14					
		CHEM	3					
			0					
			10	5.7				
		GEO-TECH	4			CL GW	@ 9.0 feet-as above, with sand (SP), gray (2.5Y N4/), dense, wet, very fine to fine sand, moderate est K, sand interbeds are 2"-3" thick	
			3					
10			4	7.4				
			4					
			8			SC	clayey SAND (SC), mottled brown/grey (2.5Y 4/4-2.5Y N5/), very dense, moist, 25-30% very fine to fine sand, low est K, trace plant debris	
			19					
12			8					
		GEO-TECH	27					
			48	4.1			@ 13 feet-as above	
		CHEM	20					
14			38					
			50/5"					
							TOTAL DEPTH 15 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

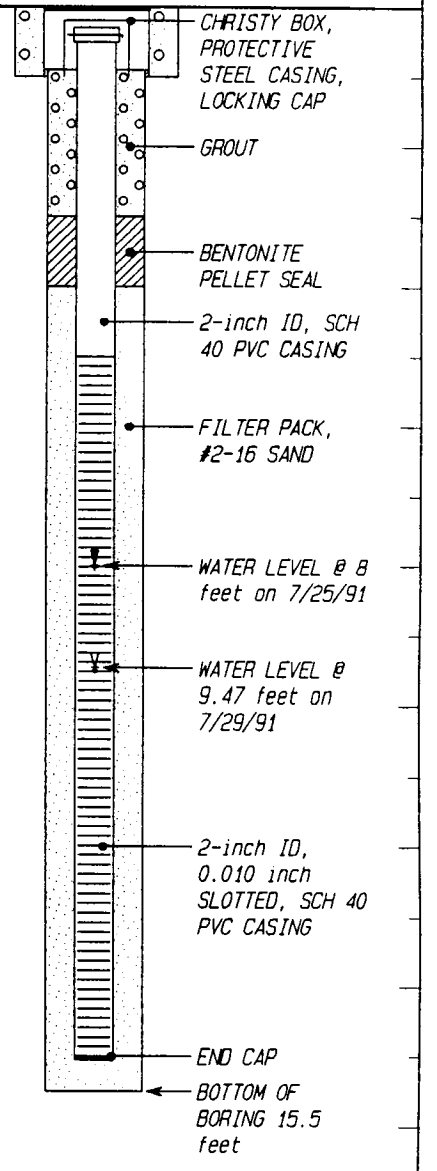
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.0 FEET DRILLER JOHN COLLINS

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-12-01
DATE STARTED 7/25/91 COMPLETED 7/25/91
REF. ELEVATION 11.56 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		9.5		AS	ASPHALT
			5/4"			SW	gravelly SAND (SW), brown (10YR 4/3), medium dense, moist, 10 to 15% fines, fine to coarse sand, 20 to 25% fine gravel
				8.3			
2			46			SP	SAND (SP), light olive brown (2.5Y 5/4), medium dense, moist, 5 to 10% fines, fine sand, moderate to high est K
		GEO-TECH	40				
			50	11.2			
		CHEM	14				
4			36				
			37	15.9			
			14				
			20	11.7			
6			30				
			12				
			16				
			22	12.6			
8			12				SAND (SP), olive (5Y 4/4), dense, wet, 5 to 10% fines, fine sand, high est K
		GEO-TECH	17				
			21	17.6			
		CHEM	8			SM	silty SAND (SM), dark olive gray (5Y 3/2), dense, wet, 15 to 20% fines, fine to medium sand, moderate est K
10			8				
			12	10.4			
			2			CL	CLAY (CL), black (5Y 2.5/1), soft, moist, fines, 5 to 10% fine sand, low est K, shell hash in sandy areas
12			2				
			4				
			3			SC	clayey SAND (SC), dark gray (5Y 4/1), dense, wet, 25 to 30% fines, very fine to fine sand, moderate est K
		GEO-TECH	6				
14			16	14.4			
		CHEM	5				
			10				
			9	15.8			
16							TOTAL DEPTH 15.5 feet
18							



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

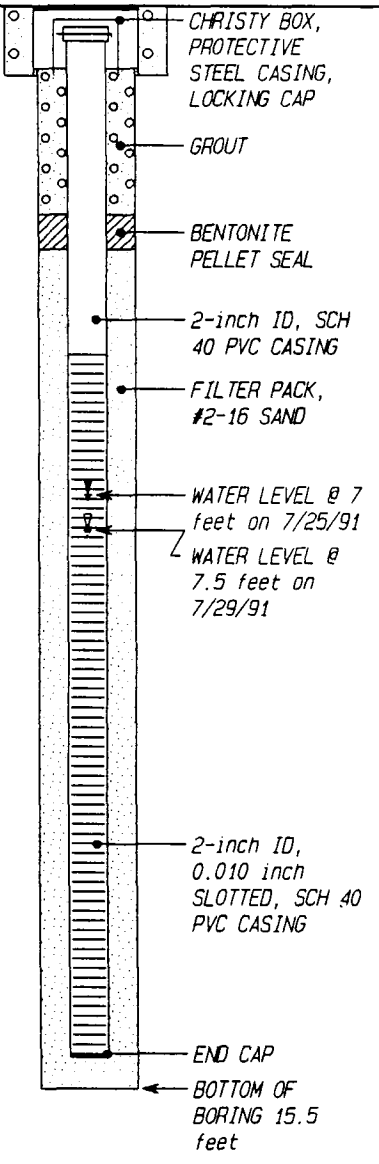
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 15 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-12-02
DATE STARTED 7/25/91 COMPLETED 7/25/91
REF. ELEVATION 10.94 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		13.1		AS	ASPHALT
			46			SW	gravelly SAND (SW), dark brown (10YR 3/3), medium dense, moist, 10 to 15% fines, fine to medium sand, 20 to 25% fine gravel, moderate est K
			40				
			40	15.8		SP	SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, high est K
2			40				
			47				
			50	11.3			@ 3.5 feet-as above, some shell hash, some 1/2 to 1 inch clay fragments
4		CHEM	27				
			20				
			30	14.4			
			19				
		GEO-TECH	25				
6			26	15.3			
			14				
			20	19.0			SAND (SP), olive gray (5Y 4/2), medium dense, wet, 5 to 10% fines, fine to medium sand, moderate to high est K
			21				
			9				
		GEO-TECH	10				
			15	14.0			@ 9 feet-as above, 10 to 15% fines, fine sand, some 1/2 inch clay fragments
		CHEM	1			SM	CLAY (CL), black (5Y 2.5/1), soft, moist, fines, 5 to 10% very fine sand, low est K
10			5				
			13	19.0			
			5			CL	
			5				
12			9	14.9		SC	clayey SAND (SC), dark gray (5Y 4/1), loose, wet, 25 to 30% fines, fine sand, low to moderate est K, abundant shell fragments
			5				
		GEO-TECH	11				
14			11	12.2			
		CHEM	3				
			4				
			7	14.0			
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 15 FEET

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

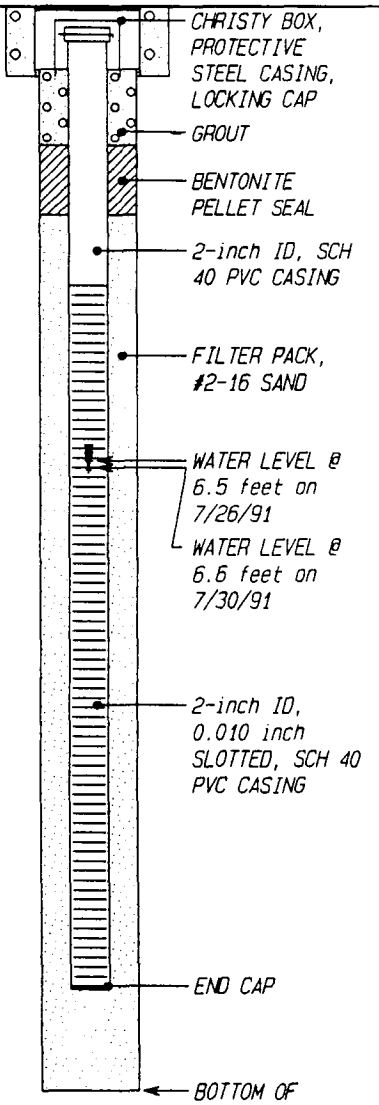
BORING/WELL NUMBER *MW-12-03* CLIENT *PRC/US NAVY*

DATE STARTED *7/26/91* COMPLETED *7/26/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*

REF. ELEVATION *10.72 FEET, TOP OF CASING* GEOLOGIST *RICH HALKET*

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		12.1		AS	ASPHALT
			22			GM	sandy GRAVEL (GM), dark brown (10YR 3/3), loose, moist, 15 to 20% fines, 25 to 30% fine to medium sand, fine gravel, moderate est K
			23			SP	
			26	15.2			
2			23				SAND (SP), light olive brown (2.5Y 5/3), dense, moist, 10 to 15% fines, fine sand, moderate to high est K
			29				
			43	11.1			
		CHEM	23				
4			34				
			34	15.7			
			24				
		GEO-TECH	24				
6			23	12.5			
			13				@ 6.5 feet-as above, wet
			17	6.9			
			18				
8			7				
		GEO-TECH	8				@ 8.5 feet-as above, very fine sand
			9	12.5			
			1				@ 9.5 feet-as above, possible flowing sand, very loose
10			0				
			0			SC	clayey SAND (SC), very dark gray (5Y 3/1), loose, wet, 25 to 30% fines, very fine to fine sand, moderate est K, abundant shell fragments
		CHEM	4				
			4			CL	CLAY (CL), very dark gray (5Y 3/1), soft, moist, fines, 5 to 10% very fine sand, low est K
12			4	14.3			
			1				
		GEO-TECH	9			SC	clayey SAND (SC), dark gray (5Y 4/1), very loose, wet, 15 to 20% fines, very fine to fine sand, moderate est K, abundant shell fragments
			13	9.2			
14		CHEM	2				
			5				
			3	12.7			
							TOTAL DEPTH 15.5 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./D. RYAN*

HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*

TOTAL DEPTH OF BORING *15.5 FEET* WELL COMPLETION DEPTH *15 FEET*

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

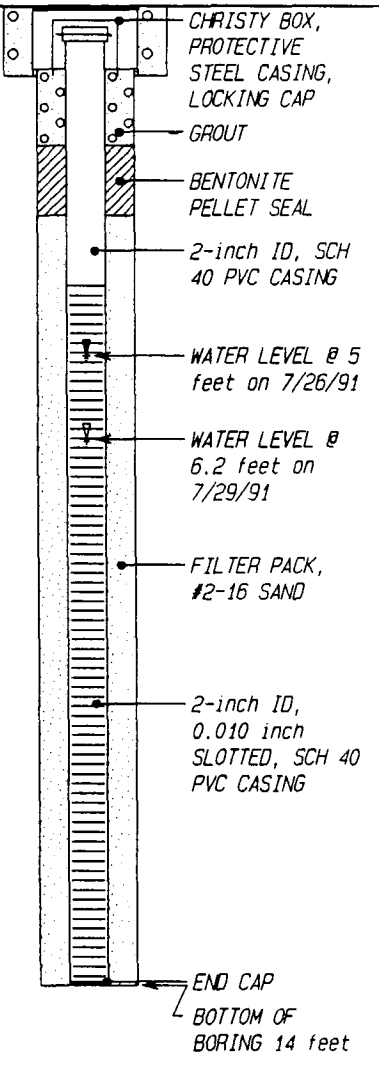
BORING/WELL NUMBER *MW-12-04* CLIENT *PRC/US NAVY*

DATE STARTED *7/26/91* COMPLETED *7/26/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*

REF. ELEVATION *10.60 FEET, TOP OF CASING* GEOLOGIST *KAREN KRAMER*

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	HAND AUGER to 4'	10.6		AS	ASPHALT
						GW	sandy GRAVEL (GW), very dark gray (10YR 3/1), medium dense, moist, 10 to 15% fines, 25 to 30% fine to medium sand, fine gravel, moderate est K
2						SW	gravelly SAND (SW), yellowish brown (10YR 5/4), medium dense, moist, 5 to 10% fines, fine to medium sand, 25 to 30% fine gravel, moderate est K
				6.9		SP	SAND (SP), light olive brown (2.5Y 5/3), medium dense, moist, 5 to 10% fines, fine gravel, high est K
4		CHEM	12				
			15	20.3			
			16				
		GEO-TECH	16			SW	SAND (SW), light olive brown (2.5Y 5/3), medium dense, wet, 10% fines, 22% gravel, high est K
6			16	9.5			
			8				
			13				@ 7 feet-as above, trace clay fragments
			20	13.4			
8			8				
		GEO-TECH	12				@ 8.5 feet-as above, 10 to 15% fines, very fine to fine sand
			15	19.4			
		CHEM	1				
10			1			CL	CLAY (CL), very dark gray (5Y 3/1), soft, moist, fines, low est K
			2	16.9			
			6				
		GEO-TECH	4			SC	clayey SAND (SC), very dark gray (5Y 3/1), loose, wet, 15 to 20% fines, fine sand, moderate est K, some shell fragments
12			4	18.0			
		CHEM	3				
			5				
			6	21.3			
14							TOTAL DEPTH 14 feet
16							
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./D. RYAN*

HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*

TOTAL DEPTH OF BORING *14 FEET* WELL COMPLETION DEPTH *14 FEET*

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-12-05 CLIENT PRC/US NAVY
DATE STARTED 8/12/91 COMPLETED 8/12/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.22 FEET GEOLOGIST KAREN KRAMER

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
	■	CHEM	HAND AUGER to 5'	6.2		SW	gravelly SAND (SW), light olive brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, 10 to 15% gravel, high est K	
2				3.3		SP	SAND (SP), light olive brown (2.5Y 5/4), loose, medium dense, moist, 5 to 10% fines, fine sand, high est K	
4								
	■	CHEM	30					
			44					
6			50	1.6				
	☒		20					
	■	GEO-TECH	27					
	☒		31	2.2			@ 7.5 feet-color change to olive (5Y 4/3)	
	■	CHEM	8			SM	silty SAND (SM), dark olive gray (5Y 3/2), medium dense, wet, 20 to 25% fines, very fine to fine sand, moderate est K	▼ DEPTH TO WATER=8 feet
			21					
			17	3.3				
	☒		2					
10	■	GEO-TECH	4			CL/SC	CLAY (CL) and clayey SAND (SC), dark olive gray (5Y 3/2), stiff, wet, fines, 20 to 30% fine sand, low est K	
	☒		6	3.3				
	☒		1			CL	CLAY (CL), dark olive gray (5Y 3/2), stiff, wet, low est K	
			4					
12			6			SP	SAND (SP), dark olive gray (5Y 3/2), stiff, moist, 10 to 15% fines, fine sand, high est K, abundant small shells	
	☒		4			CL/SC		
			6					
	■	GEO-TECH	19	3.3			CLAY (CL) and clayey SAND (SC)	
14	■	CHEM	6			SP	SAND (SP), dark olive gray (5Y 3/2), medium dense, wet, 10 to 15% fines, fine sand, high est K, abundant small shells	
			17					
			22	3.3				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-12-06 CLIENT PRC/US NAVY
DATE STARTED 8/12/91 COMPLETED 8/12/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.18 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
		CHEM	HAND AUGER to 4.5'			AS	ASPHALT	
						SM	silty SAND (SM)	
2								
						SP	SAND (SP), light olive brown (2.5Y 5/4), dense, moist, 5 to 10% fines, fine sand, high est K	
4								
			50					
		CHEM	50					
			50					
6			50	2.2				
			25				@ 6.5 feet-color change olive gray (5Y 4/2), wet, 10 to 15% fines, very fine to fine sand	! DEPTH TO WATER=7 feet
			37					
		GEO-TECH	37	7.3				
8		CHEM	25			SM	silty SAND (SM), olive gray (5Y 4/2), dense, wet, 20 to 25% fines, very fine to fine sand, moderate est K	
			37					
			35	4.5				
			6					
10			6					
			15	5.6		CL	CLAY (CL) and sandy CLAY (CL), dark olive gray (5Y 3/2), medium stiff, moist, fines, 10 to 30% fine sand, low est K, abundant sand layers and silt partings	
			2					
			2					
12			7	5.0				
			5			SC	clayey SAND (SC), dark olive gray (5Y 3/2), medium dense, wet, 20 to 25% fines, fine sand, moderate est K, abundant small shells	
		GEO-TECH	15					
			17	6.7				
14		CHEM	5					
			10					
			15	5.0				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-12-07 CLIENT PRC/US NAVY
DATE STARTED 7/25/91 COMPLETED 7/25/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.70 FEET GEOLOGIST RICH HALKET

Depth feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
		CHEM		10.4		AS	ASPHALT	
			50			SW	gravelly SAND (SW), brown (10YR 3/3), medium dense, moist, 5 to 10% fines, fine to medium sand, 20 to 25% fine gravel, moderate estimated K	
			34					
			27	4.9		SP	SAND (SP), brown (2.5Y 5/4), medium dense, moist, 5 to 10% fines, fine sand, moderate estimated K	
2			18					
			20					
			22	15.3				
		CHEM	20					
4			22					
			26	5.8				
			7					
		GEO-TECH	11					
6			25	14.0				
			11					
			21				@ 7 feet-as above, wet	! DEPTH TO WATER=7 feet
			12	18.5				
8			12					
		GEO-TECH	14				@ 8.5 feet-as above, gray green (5Y 4/2)	
			18	11.2		CL	CLAY (CL), green (5Y 3/2), stiff, wet, fines, low estimated K	
		CHEM	10					
10			11			SC	clayey SAND (SC), black (2.5Y N2/), loose, wet, 15 to 20% fines, very fine to fine sand, moderate estimated K, abundant shell fragments	
			12	13.1				
			3					
			4					
12			6	11.7		CL	sandy CLAY (CL), black (2.5Y N2/), soft, wet, fines, 35 to 40% very fine to fine sand, low estimated K, abundant shell fragments	
			10					
		GEO-TECH	7			SC	clayey SAND (SC), black (2.5Y N2/), soft, wet, 30 to 35% fines, very fine to fine sand, moderate estimated K, abundant shell fragments	
			16	13.5				
14		CHEM	5					
			7					
			18	12.2			TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-12-08 CLIENT PRC/US NAVY
DATE STARTED 7/24/91 COMPLETED 7/24/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.90 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
		CHEM	40	1.8		GW	sandy GRAVEL (SW), yellowish brown (10YR 5/4), moist, 5 to 10% fines, 20 to 25% fine sand, fine gravel, moderate to high est K	
			50			SW		
			50	7.7				
2			35			SP	gravelly SAND (SW), yellowish brown (10YR 5/4), very dense, moist, 5 to 10% fines, fine sand, 30 to 35% gravel, moderate est K	
			29					
		GEO-TECH	36	7.0				
		CHEM	19				SAND (SP), yellowish brown (10YR 5/4), dense, moist, 10 to 15% fines, fine sand, high est K	
4			23					
			19	1.4				
			13				@ 5 feet-as above, color change to light olive brown (2.5Y 5/4)	
			11					
6			11	3.7				
			3				@ 6.5 feet-as above, clay layer from 6.5 to 7 feet, dark olive (5Y 3/4), wet	DEPTH TO WATER=6.5 feet
			7					
			10	2.4				
			10					
		GEO-TECH	12					
			14	4.1				
		CHEM	4					
10			2					
			6	1.8				
			2			CL	silty CLAY (CL), with sandy partings, dark olive (5Y 3/4), fines, 0 to 10% very fine sand, low est K, clay is thinly bedded	
			3					
12			7	5.4				
			3			SC CL	clayey SAND (SC) and CLAY (CL), dark olive	
		GEO-TECH	6					
			11	4.7				
14		CHEM	8			SC	clayey SAND (SC), dark olive (5Y 3/4), medium dense, wet, 20 to 30% fines, fine sand, high est K, small shells abundant	
			9					
			10	4.4				
							TOTAL DEPTH 15.5 feet	
16								
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-12-09 CLIENT PRC/US NAVY
DATE STARTED 7/24/91 COMPLETED 7/24/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.96 FEET GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
						AS	ASPHALT	
		CHEM	22	10.3		SW	gravelly SAND (SW), with asphalt, yellowish brown (10YR 5/4), very dense, moist, 10 to 15% fines, fine to medium sand, 30 to 40% fine to coarse gravel, moderate estimated K	
			40			GW		
			40	10.3				
2			28			SP	sandy GRAVEL (GW), brown (7.5YR 4/6), very dense, moist, 20 to 30% fines, 30 to 40% sand, fine to coarse gravel, low to moderate K	
		GEO-TECH	39					
			37	10.6				
		CHEM	10				SAND (SP), light olive brown (2.5Y 5/4), medium dense, moist, 10 to 15% fines, fine sand, high estimated K	
4			19					
			21	16.0				
			10					
			12					
6			10	14.0				
			14					
			24					
			24	10.0				
			17				@ 8 feet-as above, color change to olive (5Y 4/3), wet	! DEPTH TO WATER=8 feet
		GEO-TECH	18					
			19	20.0				
		CHEM	9					
10			12					
			6	9.7		CL	silty CLAY (CL), olive (5Y 4/3), stiff, moist, fines, low estimated K	
			4					
			3				@ 11.5 feet-as above, sandy partings and 4 inch sand layer, dark olive (5Y 3/3)	
12			3	7.0				
			4			CL/SC	@ 12 feet-as above, clay is thinly bedded	
		GEO-TECH	5				sandy CLAY (CL) and clayey SAND (SC), dark olive (5Y 3/3), stiff, moist to wet, 50 to 60% fines, 30 to 40% sand, moderate estimated K, sandy areas have small shells	
			6	6.0				
14		CHEM	10			SP/SC		
			12				SAND (SP) and clayey SAND (SC), dark olive (5Y 3/3), medium dense, moist to wet, 15 to 30% fines, fine sand, moderate estimated K, abundant small shells	
			14	10.0				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER B-12-10 CLIENT PRC/US NAVY
DATE STARTED 8/5/91 COMPLETED 8/5/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
ELEVATION 11.34 FEET GEOLOGIST RICH HALKET

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION	COMMENTS
		CHEM	HAND AUGER to 2'	12.1		AS	ASPHALT	
						SM	silty SAND (SM), yellowish red (5YR 5/6), very hard, dry, 25 to 30% fines, fine to medium sand, 5 to 10% fine gravel, low est K	
2		CHEM	27			SP	SAND (SP), yellowish brown (10YR 5/6), dense, moist, 10 to 15% fines, fine to medium sand, moderate est K	
			50					
			50/5"	2.7				
			27					
4			37					
			40	4.4				
			16					
			18					
6			22	4.9			@ 6 feet-as above, wet	! DEPTH TO WATER=6 feet
			5					
		GEO-TECH	7			SM	silty SAND (SM), olive (5Y 5/3), medium dense, wet, 20 to 25% fines, fine sand, low to moderate est K	
			8	4.2				
8		CHEM	12					
			13					
			18	4.4		CL	CLAY (CL), black (5YR 2.5/1), medium stiff, wet, fines, 25 to 30% fine to medium sand, low est K, some shell fragments	
			1					
10			3					
			12	4.4				
			3			SC	clayey SAND (SC), black (5YR 2.5/1), medium dense, wet, 30 to 35% fines, fine to medium sand, low est K, some shell fragments	
			3					
12			5	4.8				
			6					
			11					
			15	4.4				
14		CHEM	3					
			3					
			2	4.4				
16							TOTAL DEPTH 15.5 feet	
18								

REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

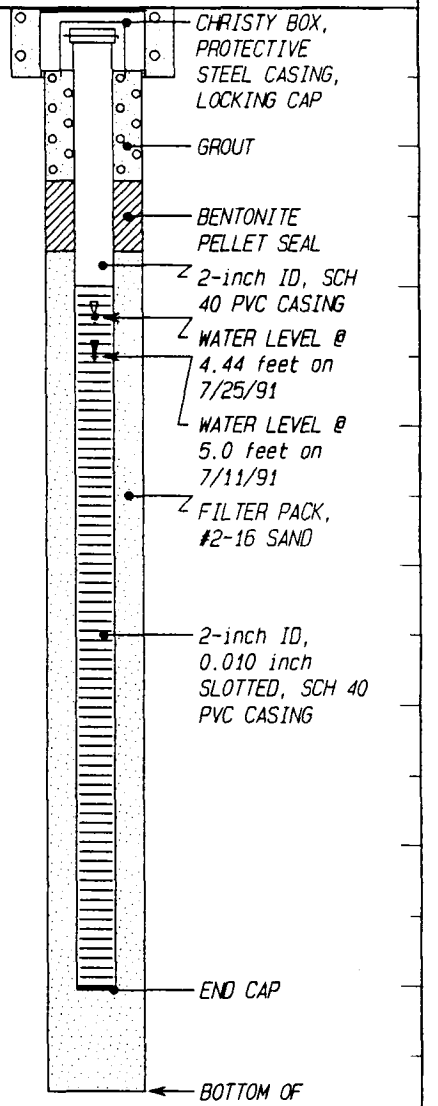
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR EXPLORATION GEOSERVICES
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET DRILLER DAVE RYAN

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-14-01
DATE STARTED 7/11/91 COMPLETED 7/11/91
REF. ELEVATION 9.73 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	20 28 40	2.0		SM	silty SAND (SM), dark yellowish brown (10YR 4/6), dense, dry, 30 to 40% fines, fine sand, moderate to high est K, abundant grass and roots
2		CHEM	36 24	0.6			@ 1.5 feet-as above, 20-25% gravel, roots still abundant, dense, moist
			36 14	18.3			
4		GEO-TECH	11 13	218		SM SC	silty SAND and clayey SAND (SM/SC), medium dense, wet, 30-40% fines, fine sand, 20-30% gravel, moderate est K, strong hydrocarbon odor
		CHEM	11 5			CL	CLAY (CL), dark olive (5Y 3/3), medium stiff, wet, 100% fines, moderate est K, strong hydrocarbon odor
6			5 1	53			CLAY (CL), olive (5Y 4/3), wet, medium stiff, 100% fines, moderate est K, gravelly asphalt at 8 feet
			6 15	2.0			
8			1 1			SP	SAND (SP), dark olive (5Y 3/3), loose, wet, 5-30% fines, fine sand, high est K, trace small shell fragments
			11 14	2.0			
10		GEO-TECH	12 13	2.0			
			12 19				
12			25 20	2.0			@ 12.5 feet-as above, abundant shells
		GEO-TECH	20 22	2.0			
14		CHEM	16 22				
			22	2.0			
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

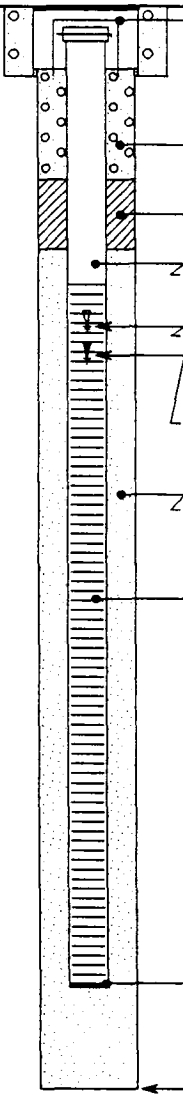
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14.0 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-14-02
DATE STARTED 7/10/91 COMPLETED 7/10/91
REF. ELEVATION 11.15 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	50			SM	silty SAND (SM), dark yellowish brown (10YR 7/6), dry, 25-30% fines, fine sand, 20-30% fine to coarse gravel, high est K
			50/3"			GM	sandy GRAVEL (GM), dark yellowish brown, very dense, moist, 25-30% fines, 25-30% fine sand, fine to coarse gravel, moderate est K
2		CHEM	5			CL	sandy CLAY (CL), grayish brown (10YR 5/2), medium stiff, moist, fines, 20-30% sand, low est K
			15				
			20			SP	SAND, (SP), dark yellowish brown, medium dense, moist, 10-15% fines, fine sand, moderate est K
		GEO-TECH	17				
4			17				
			11				
			2				@ 4.5 feet-as above, with some clay areas
			0			CL	CLAY (CL), dark olive (5Y 3/3), soft, moist, 100% fines, low est K
6			2				
			1				
			0				
			0				@ 7.5 feet-as above, color change to olive (5Y 5/4)
		CHEM	1				
			2				@ 8.0 feet-as above, moist to wet
			10			ML	clayey SILT (ML), dark olive (5Y 3/3), stiff, moist to wet, fines, 10% fine sand, low est K
			5				
10		GEO-TECH	15			SM	silty SAND (SM), dark olive (5Y 3/3), medium dense, wet, 30-35% fines, fine sand, moderate est K
			33				
			10				
			24			SP	SAND (SP), dark olive (5Y 3/3), medium dense, wet, 20-25% fines, fine sand, high est K
12			29				
			9				
		GEO-TECH	11				
			14				
14		CHEM	14				
			24				
			37				
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

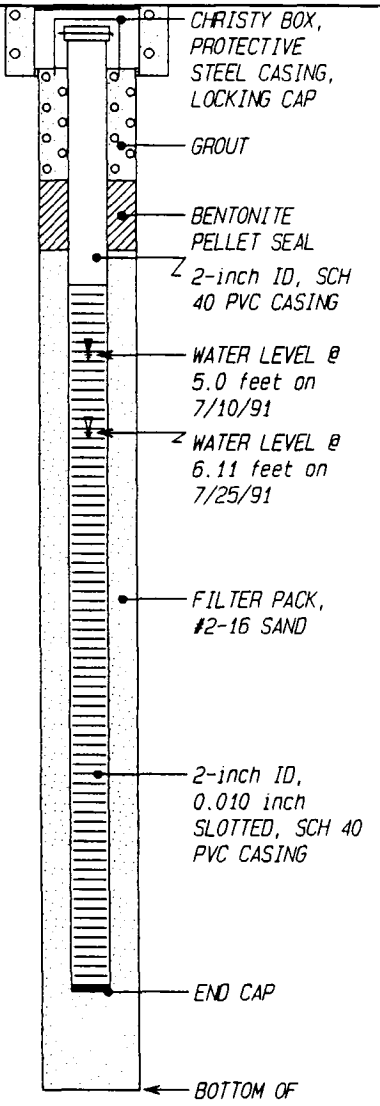
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./J. COLLINS
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14.0 FEET

JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-14-03
DATE STARTED 7/10/91 COMPLETED 7/10/91
REF. ELEVATION 10.15 FEET, TOP OF CASING
CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	11			SM	silty SAND (SM), dark yellowish brown (10YR 2/5), dry, 25-30% fines, fine sand, 25-30% gravel moderate est K
			45				
2			21				@ 1.5 feet-as above, gravel is fine to coarse grained, dense
			21				
			21				
			21				
4		CHEM	40			SP	SAND (SP), yellowish brown (10YR 5/4), dense, moist, 0-5% fines, fine sand, 5-10% gravel, high est K
			42				
			36				
			18				@ 5 feet-as above, olive (5Y 4/4), dense, moist to wet, 5-10% fines, high est K
6		GEO-TECH	23				
			19				
			6				
			5				
			8			CL	CLAY (CL), dark olive (5Y 3/3), stiff, moist, 100% fines, low est K
		CHEM	3				
			2			SC	CLAY and clayey SAND (CL/SC), olive (5Y 4/3), soft, moist, 40-50% fines, fine sand, low to moderate est K
			2				
			6				
10		GEO-TECH	16			SC CL	clayey SAND (SC), olive (5Y 4/3), medium dense, wet, 40-50% fines, fine sand, low to moderate est K
			11				
			4				
12			3				
			30				
			14			SP	SAND (SP), olive (5Y 4/3), medium dense, wet, 10-15% fines, fine to medium sand, high est K
		GEO-TECH	18				
			18				
14		CHEM	5				@ 14 feet-as above, 20-30% fines
			6				
			9				
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

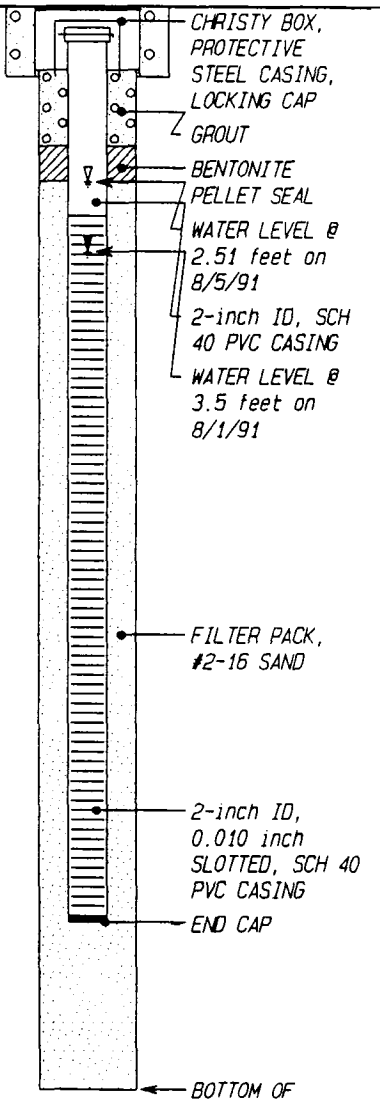
DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET
DRILLING CONTRACTOR/DRILLER EXP. GEOSER./D. RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 14 FEET

JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER *MW-15-01* CLIENT *PRC/US NAVY*
DATE STARTED *8/1/91* COMPLETED *8/1/91* PROJECT/JMM PROJECT NO. *NAS ALAMEDA/2738.0256*
REF. ELEVATION *6.70 FEET, TOP OF CASING* GEOLOGIST *KAREN KRAMER*

DEPTH feet	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	SOIL CLASS	GEOLOGIC DESCRIPTION
	CHEM	50/3"	0.4	SW	silty SAND (SW), light olive brown (2.5 Y 5/3), dry, 20-30% fines, fine sand, 30-35% gravel, moderate est K
		31			
2	CHEM	40	2.89	SP	SAND (SP), dark olive brown (2.5Y 3/3), very dense, moist, 10-15% fines, fine sand, 5-10% fine gravel, high est K, some shell fragments
		21			
		31			
		32			SAND (SP), as above, change to light olive brown (2.5Y 5/3), moist to wet, clayey sand area with shells from 2.5' to 3', abundant shell fragments
		17			
4	GEO-TECH	23			
		23	2.8		
		14			SAND (SP), as above, faint layers visible, wet, trace clay lenses
		26			
6		29	1.4		
		12			SAND (SP), light olive brown (2.5Y 5/3), dense, wet, 10-15% fines, fine sand, high est K, abundant shell fragments, trace clay lenses, some pieces of red brick
		20			
		30	7.1		
	CHEM	7			
		12			
		21	5.2	SC	clayey SAND (SC), light olive gray (5Y 5/2), medium dense, wet, 30-40% fines, fine sand, moderate est K, 2 inches of flowing sand in auger
10	GEO-TECH	37			
		2			
		9	7.6	SP	SAND (SP), olive (5Y 5/4), very dense, wet, 10-15% fines, fine sand, high est K, abundant shell fragments
		6			
		13			
12		14	7.1		
		6			clayey SAND (SC), olive gray (5Y 5/2), medium dense, wet, 30-35% fines, fine sand, moderate est K, abundant shell fragments
	GEO-TECH	7		CL	
		6	7.6		
14	CHEM	2			sandy CLAY (CL), olive gray (5Y 5/2), stiff, moist, fines, 10-15% very fine sand, low est K, abundant shell fragments
		3			
		3	7.6		
16					TOTAL DEPTH 15.5 feet
18					



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE *AUGER/MOBILE B-40* DRILLING CONTRACTOR/DRILLER *EXP. GEOSER./D. RYAN*
HOLE DIAMETER *8.35 INCHES* BIT TYPE *HOLLOW STEM AUGER*
TOTAL DEPTH OF BORING *15.5 FEET* WELL COMPLETION DEPTH *13.0 FEET*

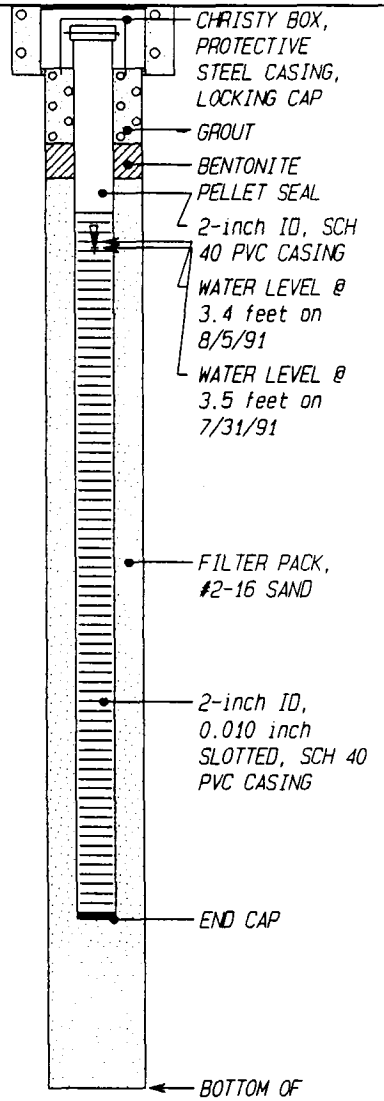
JAMES M. MONTGOMERY
CONSULTING ENGINEERS, INC.
365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-15-02
DATE STARTED 7/31/91 COMPLETED 7/31/91
REF. ELEVATION 6.89 FEET, TOP OF CASING

CLIENT PRC/US NAVY
PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM		4.7		SM	silty SAND (SM), light olive brown (2.5Y 5/4), loose, dry, 30-35% fines, fine to medium sand, moderate est K
			20			SP	
			30				
			40	8.9		GC	SAND (SP), light brown (2.5Y 5/4), dense, moist 5-10% fines, fine sand, high est K
2		CHEM	17			SP	
			18				clayey GRAVEL (GC), light olive brown (2.5Y 5/6), dense, 30-40% fines, fine gravel, low est K
			16	4.7			
			8				SAND (SP), light olive brown (2.5Y 5/4), medium dense, moist, 0 to 5% fines, fine sand, high est K
4		GEO-TECH	4			CL	
			8	10.5			CLAY (CL), olive gray (5Y 4/2), stiff, wet, 100% fines, low est K
			11			SP	
			19				SAND (SP), olive gray (5Y 3/2), dense, wet, 5-10% fines, fine sand, high est K
6			15	6.3			
			1				
			1			CL	silty CLAY (CL), olive (5Y 4/3), soft, wet, 100% fines, moderate est K, some black thin silty partings
			9	7.9			
8		CHEM	11			SP	SAND (SP), olive gray (5Y 5/2), medium dense, wet, 10-15% fines, fine sand, high est K
			13				
			25	9.4			
			7				
10		GEO-TECH	8			SC CL	clayey SAND (SC) and sandy CLAY (CL), olive gray (5Y 4/3), stiff, wet, 30-60% fines, fine sand, moderate est K
			9	8.4			
			11			SP	SAND (SP), olive gray (5Y 5/2), medium dense, wet, 10-15% fines, fine sand, high est K, shell fragments abundunt
			11				
12			12	7.9			
			4				@ 12.5 feet-as above, sand (SP), wet
		GEO-TECH	6			SC	clayey SAND (SC), olive gray (5Y 4/2), medium dense, moist to wet, 30-40% fines, fine sand, abundant shell fragments, moderate est K
			8	10.0			
14		CHEM	1				
			4			CL	silty CLAY (CL), olive gray (5Y 4/2), stiff, moist to wet, 100% fines, fine sand, abundant shell fragments, low to moderate est K
			5	14.2			
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST
JERRY T. WICKHAM
3766
STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40
HOLE DIAMETER 8.35 INCHES
TOTAL DEPTH OF BORING 15.5 FEET

DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
BIT TYPE HOLLOW STEM AUGER
WELL COMPLETION DEPTH 13 FEET

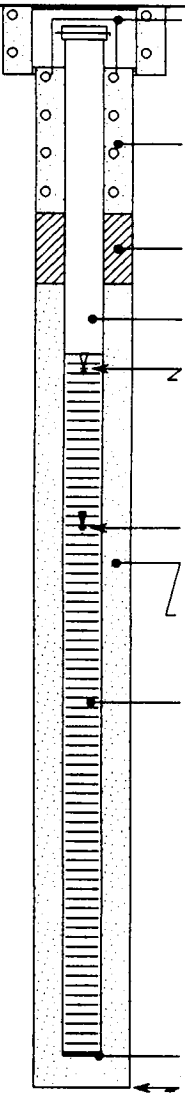
JAMES M. MONTGOMERY CONSULTING ENGINEERS, INC.

365 LENNON LANE, WALNUT CREEK, CALIFORNIA, 94598 / (415) 975-3400

BORING/WELL NUMBER MW-15-03 CLIENT PRC/US NAVY
DATE STARTED 7/31/91 COMPLETED 7/31/91 PROJECT/JMM PROJECT NO. NAS ALAMEDA/2738.0256
REF. ELEVATION 8.67 FEET, TOP OF CASING GEOLOGIST KAREN KRAMER

DEPTH feet	SAMPLE	SAMP. NO.	BLOWS/6 IN	HNU-PID meter units	GRAPHIC LOG	SOIL CLASS	GEOLOGIC DESCRIPTION
		CHEM	43	9.4		SW	gravelly SAND (SW), dark olive brown (2.5Y 3/3), dense, mosit, 15-25% fines, fine sand, 30-35% gravel, moderate est K, some asphalt
			50				
			50/3"	7.3			
2		CHEM	42				
			48			SP	SAND (SP), light olive brown (2.5Y 5/3), very dense, moist, 5-15% fines, fine sand, high est K
			50	11.5			
			12				
4		GEO-TECH	9			SC CL	clayey SAND (SC) and sandy CLAY (CL), light olive brown (2.5Y 5/4), dense, moist, 30-70% fines, fine sand, low est K
			12	4.2			
			4			CL	sandy CLAY (CL), light olive brown, (2.5Y 5/4), stiff, moist to wet, fines, 20-30% sand, low est K
			6				
6			8	5.2			
			6				
			8				@ 7 feet-as above, sandy CLAY (CL)
			9	5.2			
8		CHEM	6			SC CL	@ 8 feet-as above, with SAND (SP), light olive brown, wet, 10-15% fines, fine sand, high est K, abundant shells
			12				
			22	2.6			
			11			SC	clayey SAND (SC), light olive brown (2.5Y 5/4), very stiff, wet, 20-35% fines, fine sand, moderate est K
10		GEO-TECH	12				
			14	3.6			
			7				
			12				@ 11.5 feet-as above, 30-40% fines, very stiff, wet
12			18	6.3			
			16				
		GEO-TECH	17			SC CL	clayey SAND as above, with some sandy CLAY (CL), very hard, wet
			12	2.6			
14		CHEM	12			SC	@ 14 feet-as above, clayey SAND
			15				
			16	3.6		CL	CLAY (CL), olive gray (2.5Y 4/2), stiff, moist, 100% fines, low est K
16							TOTAL DEPTH 15.5 feet
18							

WELL DIAGRAM



REGISTERED GEOLOGIST JERRY T. WICKHAM 3766 STATE OF CALIFORNIA

DRILLING METHOD/RIG TYPE AUGER/MOBILE B-40 DRILLING CONTRACTOR/DRILLER EXP. GEOSER./DAVE RYAN
HOLE DIAMETER 8.35 INCHES BIT TYPE HOLLOW STEM AUGER
TOTAL DEPTH OF BORING 15.5 FEET WELL COMPLETION DEPTH 15 FEET

Environmental Resources Management **Drilling Log**

Project USN ALAMEDA Owner US NAVY

Location ALAMEDA GAS STA ~~W.O.~~ Job Number 40011

Well Number W1 Total Depth 10 Diameter 2"

Surface Elevation ____ Water Level: Initial ____ 24-hrs ____

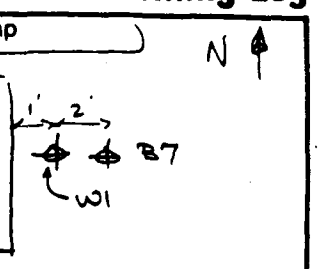
Screen: Dia. 2" Length 8.0' Slot Size ____

Casing: Dia. 2" Length 2.0' Type PVC SCH. 40

Drilling Company KLEINFELDER Drilling Method HOLLOW STEM

Driller DOUG / JERRY Log By BLB Date Drilled 2/3/89

Sketch Map



Notes

CFB ASSIST

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
				START: 11:00 A COMPLETE: 12:00 P
1				ASPHALT 2" COARSE GRAVEL, WITH SAND & SILT, SOME CLAY. PUSHED 30" SHELBY TUBE, REC: 0 PETROL. ODOR. HNU: 170 ppm
				TWICE LOST SAMPLE.
2				ON TUBE: SAND + CLAY, WET. PETROL. ODOR
				PUSHED 30" SHELBY. REC:
3				SAND - GREY. WITH SILT. WET. STRONG ODOR. HNU: 500 ppm
				← CONTACT SAND/CLAY
4				CLAY, AS BELOW.
5			11:15 4.5-5.0	CLAY, GREY, ORGANIC, SOFT, SMOOTH. NO ODOR
6				
7				CLAY, GREY, ORGANIC. SOME PLANT PARTS. SMOOTH. SOFT. STICKY. MILD ODOR H_2S
8				
9				
10				TBOH 10.0'

WL: HELD 2.00, WET 0.71, WL 1.29 — 12:45 P 2/3

(25 lbs) SAND (2 BAGS) 10' → 2'
BENTONITE 2' → 1.5'
CEMENT 1.5' → 0.5'

WELL TOP SET IN CONCRETE CHRISTY BOX (AT GRADE)

Page 1 of 1

Environmental Resources Management

Drilling Log

Project USN ALAMEDA Owner US NAVY

Location ALAMEDA GAS STA W.O. Number 40011

Well Number W 2 Total Depth 10 Diameter 6 3/4"

Surface Elevation _____ Water Level: Initial _____ 24-hrs. _____

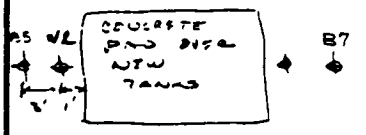
Screen: Dia. _____ Length 8' Slot Size _____

Casing: Dia. _____ Length 2' Type _____

Drilling Company KLEINFELDER Drilling Method HOLLOWSTEM

Driller DOUG/TERRY Log By BLB Date Drilled 2/3/87

Sketch Map



Notes

CFB ASSIST

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
				BEGIN 1:20 P — COMPLETE 2:15P
1				ASPHALT 2" , COARSE GRAVEL TO ~ 1 FOOT
				PUSHED 30" SHELBY, REC 18"
				SAND
2			1:30	
			2.0-2.5	SAND, MED TO FINE GR WET, PETROL ODOR HNU 130 ppm
				GREY - BROWN
3				
4				SAND, GREY. MED TO FINE GR. WET. PETROL. ODOR.
5				PUSHED 30" SHELBY REC 30"
6				← SAND/CLAY CONTACT
7			1:45	
			7.0-7.5	CLAY. ORGANIC, WET, GREY. SLIGHT ODOR H_2S
8				
9				CLAY
10				EOH 10.0'
11				SAND 2 BAGS 10' - 2'
				BENTONITE (25 lbs) 2' - 1.5
12				CEMENT 1.5' - 0.5'

Page 1 of 1

Environmental Resources Management

Drilling Log

Project USN ALAMEDA Owner US NAVY

Location ALAMEDA GASSTA ~~W.O.~~ Job Number 40011

Well Number W3 Total Depth 10' Diameter 6 3/4

Surface Elevation _____ Water Level: Initial _____ 24-hrs _____

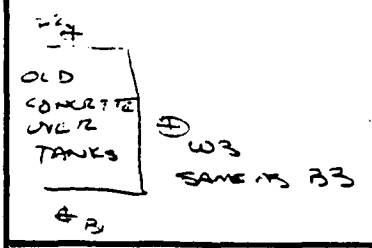
Screen: Dia. 2" Length 8' Slot Size _____

Casing: Dia. 2" Length 2' Type PVC SCHED 40

Drilling Company KLEINFELDER Drilling Method HOLLOWSTEM

Driller DOUG / JERRY Log By BOB Date Drilled 2/3/87

Sketch Map



Notes
WELL INTO BORING B3
NO SAMPLES TAKEN 2/3

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
				SUNNY, WARM START 12:30 P COMPLETE: 1:15 P
1		BENT CEMENT		FOR COMPLETE BORING LOG REFER TO LOG OF B3, 1/29/87
2		SAND CASING BENT CEMENT		
3		2" CASING		
4				
5		2 BAGS SAND		
6				
7		PVC SCH 40		
8		SLOTTED		2 BAGS SAND 10' → 2' BENTONITE 2' – 1.5' CEMENT 1.5' – 0.5'
9				
10				

Environmental Resources Management **Drilling Log**

Project USN ALAMEDA Owner USNAVY

Location ALAMEDA ~~W.O.~~ Number 40011

~~Well~~ BORING Number B3 Total Depth 17.5 Diameter 6 3/4"

Surface Elevation _____ Water Level: Initial _____ 24-hrs. _____

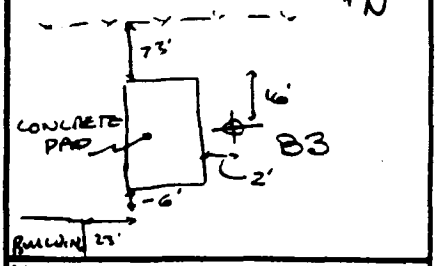
Screen: Dia. _____ Length _____ Slot Size _____

Casing: Dia. _____ Length _____ Type _____

Drilling Company KLEINFELDER Drilling Method HOLLOWSTEM

Driller DOUG / JERRY Log By BWB Date Drilled 1/29/87

Sketch Map



Notes

CFB ASSIST

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
				FIRST THREE ATTEMPTS HIT PIPES. ASPHALT AT SURFACE
1				CONCRETE PAD AT 6"
				CUTTINGS: COARSE SAND & GRAVEL MOIST W/ PRODUCT
2				STRONG ODOR. HNU 100 ppm IN CUTTINGS
				TO FIVE FEET
3				
4				
5				
6	PUSHED 30" SHELBY 30" REC, REC 18"		3:00	
**			6.0-6.5	SAND, WELL SORTED, MED GRAINED. MINOR SILT, GREY
7				WET. SOFT. NO ODOR. HNU 20± ppm
8				
9				CUTTINGS - SLOPPY SILT W/ CLAY. SOME SAND
10				
11	PUSHED 30" SHELBY 30" REC, REC 30"			
12			3:10 P	
			12.0-12.5	CLAY, ORGANIC. SOFT, STICKY, SMOOTH, CLEAN. NO ODOR OF
13				PETROLEUM. SLIGHT ODOR H_2S

Environmental Resources Management **Drilling Log**

Project USN ALAMEDA Owner USNAVY

Location ALAMEDA G-15 STA ~~WO~~ JOB Number 40011

Well Number B3 Total Depth 17.5 Diameter 6 3/4

Surface Elevation ____ Water Level: Initial ____ 24-hrs. ____

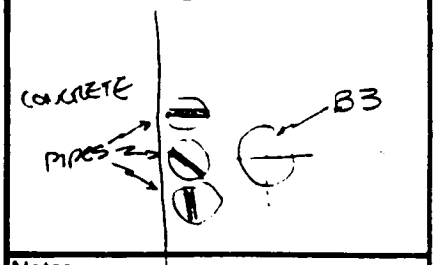
Screen: Dia. ____ Length ____ Slot Size ____

Casing: Dia. ____ Length ____ Type ____

Drilling Company KLEINFELDER Drilling Method HOLLOW STEM

Driller DOUG/SEIZAY Log By PBLB Date Drilled 1/29/87

Sketch Map DETAIL



Notes

Depth (Feet)	Graphic Log	Well Construction	Sample Number	Description/Soil Classification (Color, Texture, Structures)
14				AUGERED TO 15 FEET CUTTINGS: MUCKY CLAYEY FINE SAND. DKGREY SLIGHT ODOR PETROLEUM.
15	PUSHED 30" SHELBY			
16				SILTY CLAY AS BELOW
17			3:30 17.0-17.5	SILTY CLAY, ORGANIC, WET. DKGREY. STICKY STRONG ODOR H_2S, NO ODOR PETROLEUM
18				BOH. 17.5 FEET AFTER 2 HRS, WATER AT ~2.5 FEET FLOATING HYDROCARBONS PRESENT HOLE CAVED TO ~5', COVERED HOLE AND COMPLETED AS A WELL ON 2/3/87.

BORING LOCATION AREA 97, North of Building 162 (40ft westward from NE Corner)			GROUND EL.
DEPTH/ELEV. WATER 12 ft	DRILL CONTRACTOR EXCELTECH - RPM		TOTAL DEPTH 15.0'
DRILL RIG Mobile B-34	BORING DIA. 8" ϕ HA	DATE DRILLED 3/12/85	LOGGED BY CL

SOIL CLASS.	DESCRIPTION	DEPTH	SAMPLE NO.	PR / RQD	REC.	MODE	REMARKS
	0.0'-1.5' Topsoil, brown, moist	0					
SP	1.5'-2.0' Fine to medium SAND, trace gravel, brown, moist						
SP	2.0'-7.0' Fine to medium SAND, trace gravel, light brown, trace shells	5					No noticeable odor
SP	7.0'-8.0' Fine to medium SAND, trace silt, gray, wet						Minor odor at ~7ft. 6% LEL
SC	8.0'-12.0' clayey SAND and SILT, dark gray, wet	10					No noticeable odor
CL	12.0'-15.0' Silty CLAY, trace sand, bluesh gray. very soft, wet						No noticeable odor
	Hole terminated at 15 ft	15					Installed 2" ϕ sch. 4 PVC pipes. After installing the pipe the hole caved in to 5 feet below ground surface while the augers were being pulled out. The hole was redrilled and the PVC pipes reinstalled (0-5.0': blank, 5.0'-15.0': slotted), Sand was poured in from inside of auger stem, and was flushed with water while the auger was pulled out slowly.

DATA ON THIS LOG ARE AN APPROXIMATION OF THE GEOLOGIC AND SUBSURFACE CONDITIONS BECAUSE THE INFORMATION WAS OBTAINED FROM INDIRECT, DISCONTINUOUS, AND POSSIBLY DISTURBED SAMPLING NECESSITATED BY USE OF SMALL-DIAMETER HOLES. ROTARY AND WASH BORING HOLES HAVE FURTHER COMPLICATIONS IN THIS REGARD BECAUSE OF THE NEED TO USE DRILLING FLUID AND/OR CASING IN ADVANCING HOLES.

THIS LOG INDICATES CONDITIONS IN THIS HOLE ONLY ON THE DATE INDICATED AND MAY NOT REPRESENT CONDITIONS AT OTHER LOCATIONS AND ON OTHER DATES. ANY WATER LEVELS SHOWN ARE SUBJECT TO VARIATION.

THIS HOLE WAS LOGGED IN SUCH A WAY AS TO PROVIDE DATA PRIMARILY FOR DESIGN PURPOSES AND NOT NECESSARILY FOR THE PURPOSES OF SPECIFIC CONTRACTORS.

THE STRATIFICATION LINES OR DEPTH INTERVALS REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN MATERIAL TYPES, AND THE TRANSITIONS MAY BE GRADUAL.

SOIL CLASSIFICATIONS SHOWN ON LOGS ARE FIELD CLASSIFICATIONS BASED ON THE UNIFIED SOILS CLASSIFICATION SYSTEM.

Wahler Associates	CONFIRMATION STUDY NAS-ALAMEDA	EXPLORATION BORING LOG		BORING NO.
		PROJECT NO. NFV112A	SHEET NO. 1 OF 1	NA-8

APPENDIX D

GEOTECHNICAL LABORATORY REPORTS

DATED 27 OCTOBER 1992

The Earth Technology Corporation

18411 Gothard Street Unit F Huntington Beach, California 92648
Telephone: (714) 842-7011 Telecopy (714) 842-3735

Transmittal

To James M. Montgomery
365 Lennon Lane
Walnut Creek,
CA 94598

Date Nov. 19, 1991

☐ Mail
☐ Airmail
☐ Messenger
☒ Federal Express

Attention Ms. Donna Courington

Project No. 2738.0258 / NAS-Alameda

Submitted Herewith are Laboratory test results of NAS - Alameda Project.
Enclosed please find partially results on Table 3,4,and 5 and 20 Grain Size Distribution Curves as indicated on the list attached. If there is any question please call me at (714) 842-7011.

Copy To Keam Tan

By S. Sayawatana
Somboon Sayawatana

F1016

TABLE 3

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: NAS-Alameda

TETC NO: 92-371-07001

PROJECT NUMBER: 2738.0258

CLIENT: James M. Montgomery

DATE: Nov. 18, 1991

SUMMARIZED BY: S. Sayawatana

SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	DRY DENSITY ASTM D2937 (pcf)	SPECIFIC GRAVITY ASTM D854	CEC EPA 9080 (meq/100g)	TOC WALKLEY BLACK (% w/w)
B-11-03	13-13.5				29.1	ND
B-11-02	8.5-9				14.6	ND
B-11-05	7-7.5				2.2	-
B-11-01	4-4.5				-	ND
B-11-04	13.5-14				-	ND
B-11-07	9-9.5				-	-
B-11-06	7-7.5				-	-
B-07A-06	8-8.5				39.2	0.9
B-07A-04	9-9.5				34.4	-
B-07A-03	14.5-15				15.3	0.8
B-07A-02	6-6.5				-	-
B-07A-06	16-16.5				-	1.1
B-07A-04	4.5-5				-	ND
B-07A-06	4.5-5				-	ND
B-07A-07	7-7.5				-	0.9
B-07A-02	1.5-2				-	-
B-07B-01	7.5-8				3.6	ND
B-07B-02	10-10.5				35.5	0.6
B-07B-03	15-15.5				37.2	ND
B-07B-02	2.5-3				-	-
B-07B-02	3-3.5				-	ND
B-07B-01	3-3.5				-	ND
B-07B-01	13.5-14				-	ND

ND = Not detected

Detection Limit: CEC = 0.3 meq/100g,
TOC = 0.1 % w/w

TABLE 4

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: NAS-Alameda

TETC NO: 92-371-07001

PROJECT NUMBER: 2738.0258

CLIENT: James M. Montgomery

DATE: Nov. 18, 1991

SUMMARIZED BY: S. Sayawatana

SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	DRY DENSITY ASTM D2937 (pcf)	SPECIFIC GRAVITY ASTM D854	CEC EPA 9080 (meq/100g)	TOC WALKLEY BLACK (% w/w)
B-05-01	13.5-14				-	-
B-05-06	13.5-14				-	0.6
B-05-09	14.5-15				-	-
B-05-12	13.5-14			2.74	-	ND
B-05-02	13.5-14				31.2	-
B-05-04	13.5-14				-	-
B-05-05	10.5-11				17.4	-
B-05-08	4-4.5				9.8	ND
B-05-06	3.5-4				-	ND
B-05-09	8.5-9	22.5	104.0		-	-
B-05-02	8-8.5				-	ND
B-05-02	8.5-9			2.73	-	-
B-05-03	8.5-9	18.5	110.0	2.72	-	ND
B-15-01	13-13.5				-	0.4
B-15-02	10-10.5				-	-
B-15-03	13-13.5				-	-
B-15-02	13.5-14				-	-
B-15-02	4-4.5				16.6	0.9
B-15-03	10.5-11	18.0	113.0	2.71	37.4	ND
B-15-01	4-4.5	19.5	104.5		3.8	-
B-15-01	10-10.5				-	-
B-10-01	7-7.5	17.0	110.5		3.8	-
B-10-02	7-7.5	20.0	103.5	2.72	14.7	ND
B-10-03	13-13.5				18.8	-
B-10-01	13-13.5				-	ND
B-10-03	4-4.5				-	ND
B-14-03	10-10.5				-	-
B-14-03	5.5-6	18.5	101.0		1.6	ND
B-14-01	10-10.5	20.0	105.0		14.3	ND
B-14-02	10-10.5	32.0	96.0	2.6	9.8	-
B-14-02	3.5-4				-	ND

TABLE 5

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: NAS-Alameda

TETC NO: 92-371-07001

PROJECT NUMBER: 2738.0258

CLIENT: James M. Montgomery

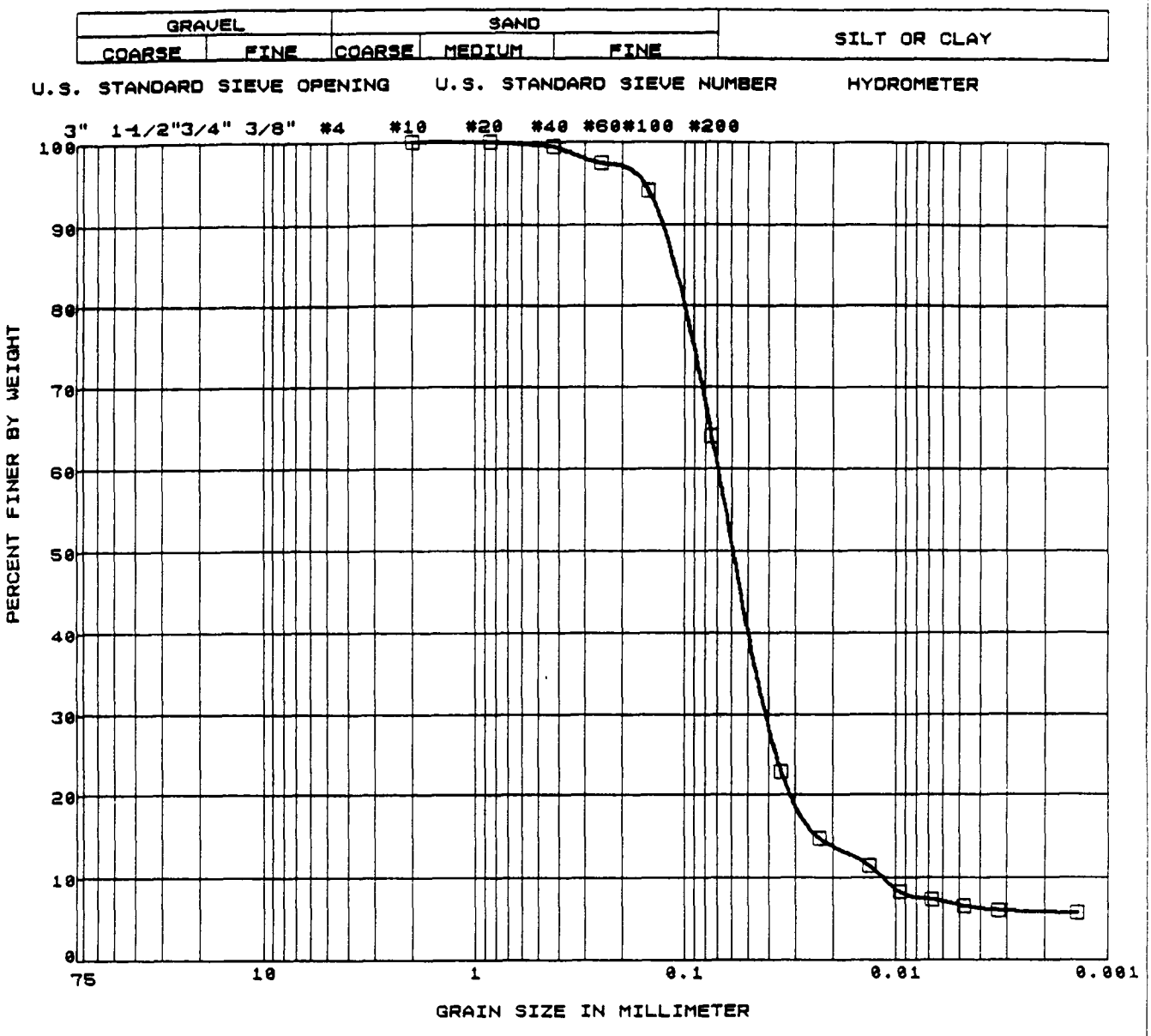
DATE: Nov. 18, 1991

SUMMARIZED BY: S. Sayawatana

SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	DRY DENSITY ASTM D2937 (pcf)	SPECIFIC GRAVITY ASTM D854	CEC EPA 9080 (meq/100g)	TOC WALKLEY BLACK (% w/w)
B-05-04	10-10.5			2.68	-	-
B-05-05	13-13.5				-	-
B-05-06	8.5-9	17.5	110.5		-	-
B-08-01	8.5-9	28.5	95.0		10.2	ND
B-08-04	10-10.5	20.5	102.0	2.69	2.9	-
B-08-03	13-13.5				-	-
B-08-08	10.5-11				18.4	-
B-08-03	4.5-5				-	-
B-08-04	13.5-14				-	-
B-08-09	10-10.5				-	-
B-08-07	4-4.5				-	ND
B-08-02	12-13				-	ND
B-06-03	10-10.5				-	-
B-06-13	10-10.5				-	-
B-06-12	10.5-11				-	-
B-06-02	4.5-5	20.5	100.5		3.6	-
B-06-05	6.5-7	17.0	111.0	2.73	4.8	-
B-06-08	4.5-5	21.0	100.5		5.1	-
B-06-01	13.5-14				-	0.4
B-06-04	4-4.5				-	-
B-06-05	3.5-4				-	-
B-06-14	7-7.5				-	-
B-06-18	8.5-9				-	ND
B-06-14	2.5-3				-	ND
B-12-01	8.5-9	20.0	102.5		8.0	-
B-12-02	8.5-9	22.0	96.0	2.73	15.7	ND
B-12-03	8.5-9				16.4	-
B-12-02	13-13.5				-	-
B-12-04	5.5-6				-	-
B-12-05	13.5-14				-	0.8
B-12-08	8.5-9				-	-
B-12-06	7.5-8	19.5	99.0		-	-
B-12-03	13-13.5				-	-
B-12-03	5.5-6				-	ND

Grain Size distribution curves of the following samples:

1. B-05-02 depth 13-13.5
2. B-05-05 10.5-11
3. B-05-09 8.5-9
4. B-05-02 8-8.5
5. B-15-02 10-10.5
6. B-15-01 10-10.5
7. B-10-02 7-7.5
8. B-14-01 10-10.5
9. B-14-02 3.5-4
10. B-08-01 8.5-9
11. B-08-04 10-10.5
12. B-08-08 10.5-11
13. B-08-03 4.5-5
14. B-08-04 13.5-14
15. B-06-08 4.5-5
16. B-06-01 13.5-14
17. B-06-04 4-4.5
18. B-12-02 13-13.5
19. B-12-04 5.5-6
20. B-12-05 13.5-14



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-05-02	13-13.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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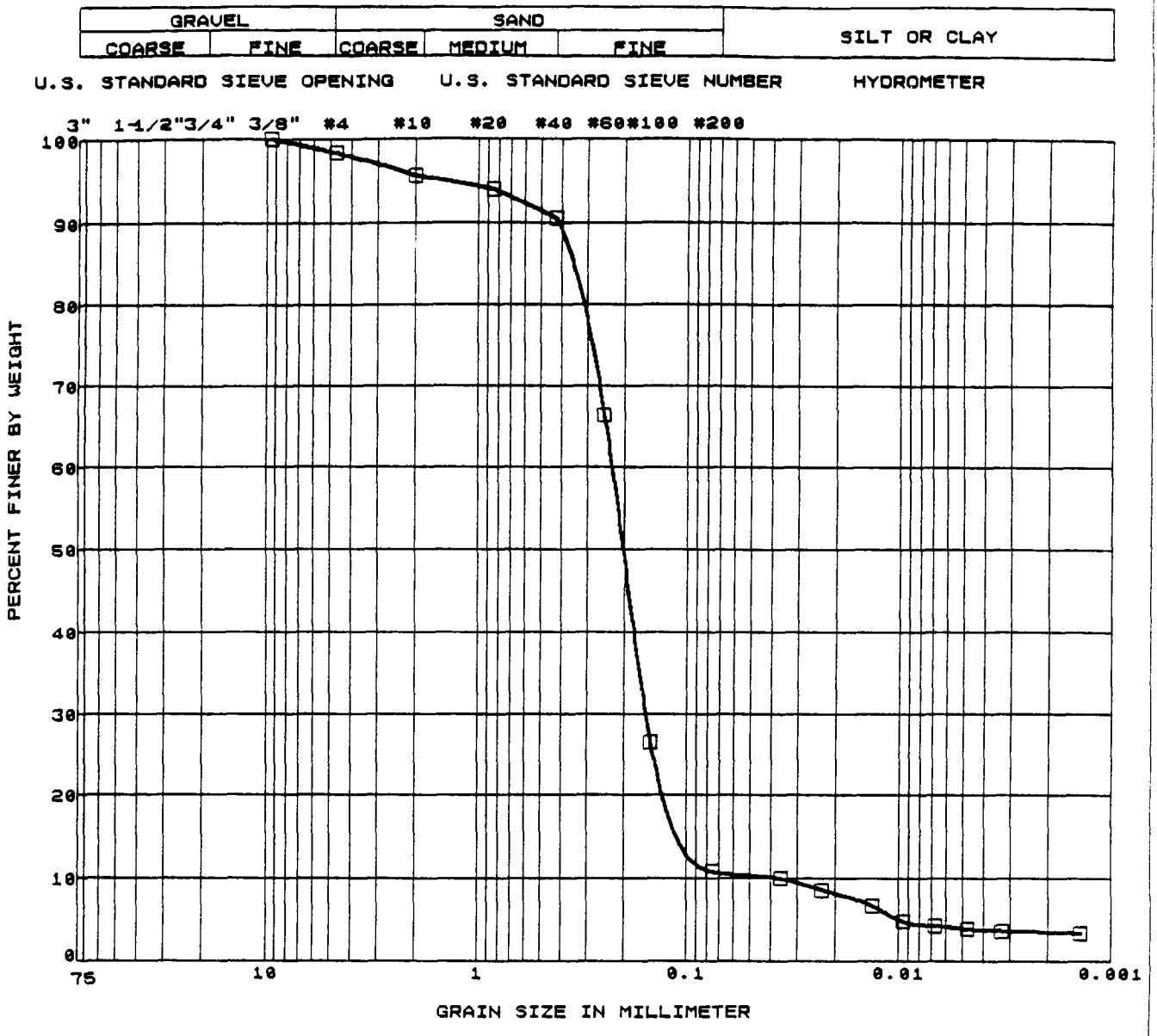
FIGURE 67



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-05-05	10.5-11	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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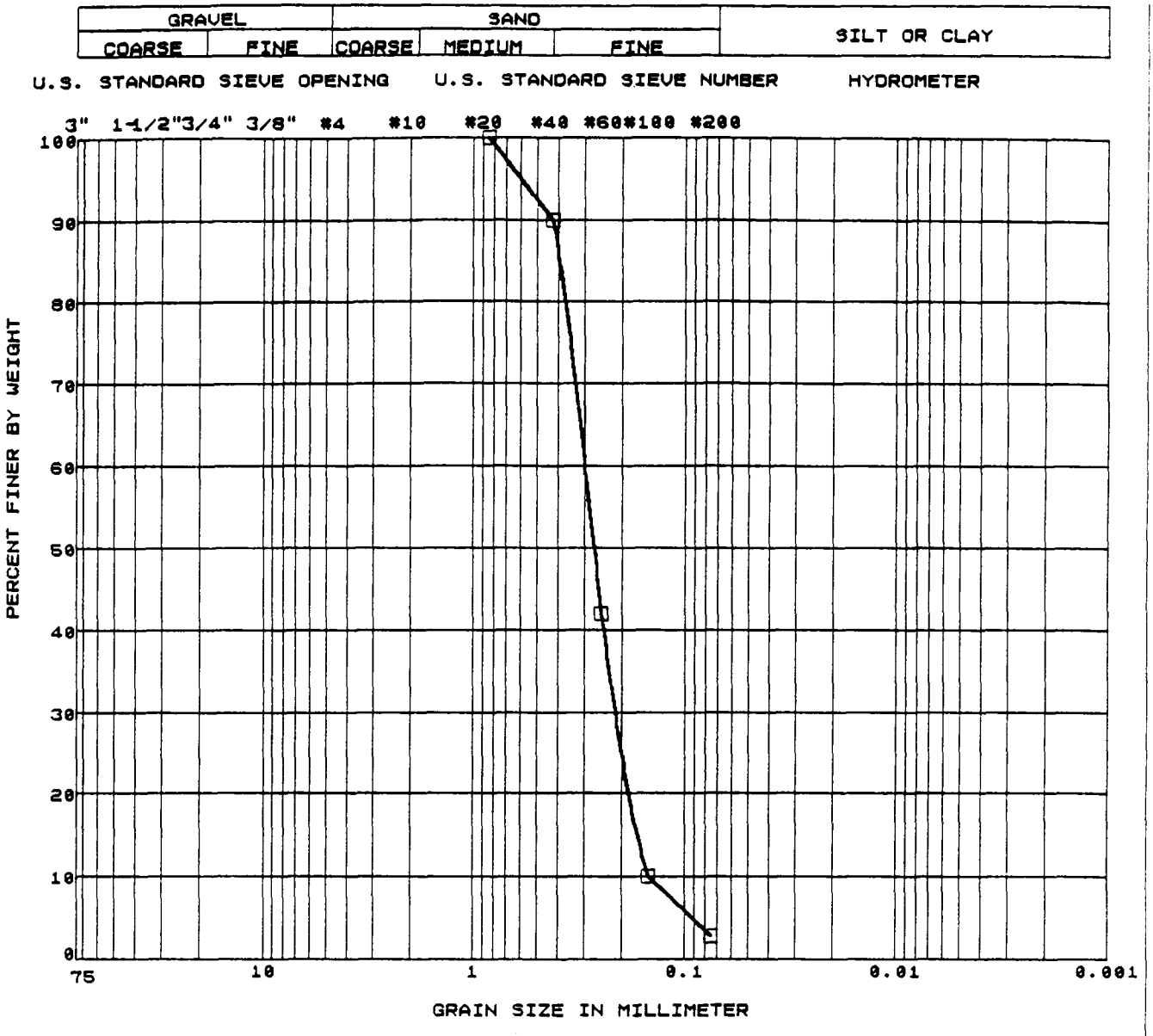
FIGURE 68



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-05-09	8.5-9	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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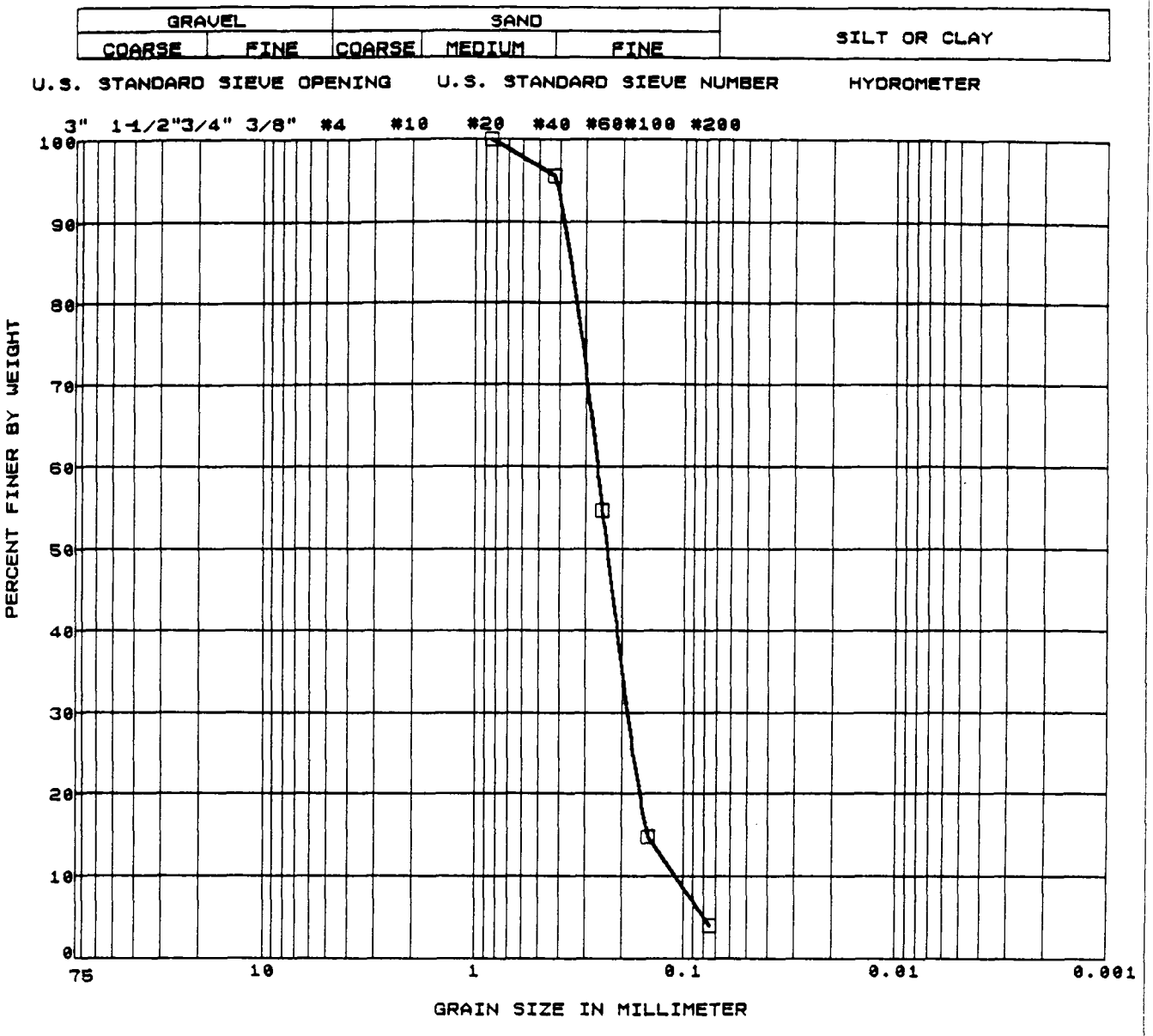
FIGURE 70



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-05-02	8-8.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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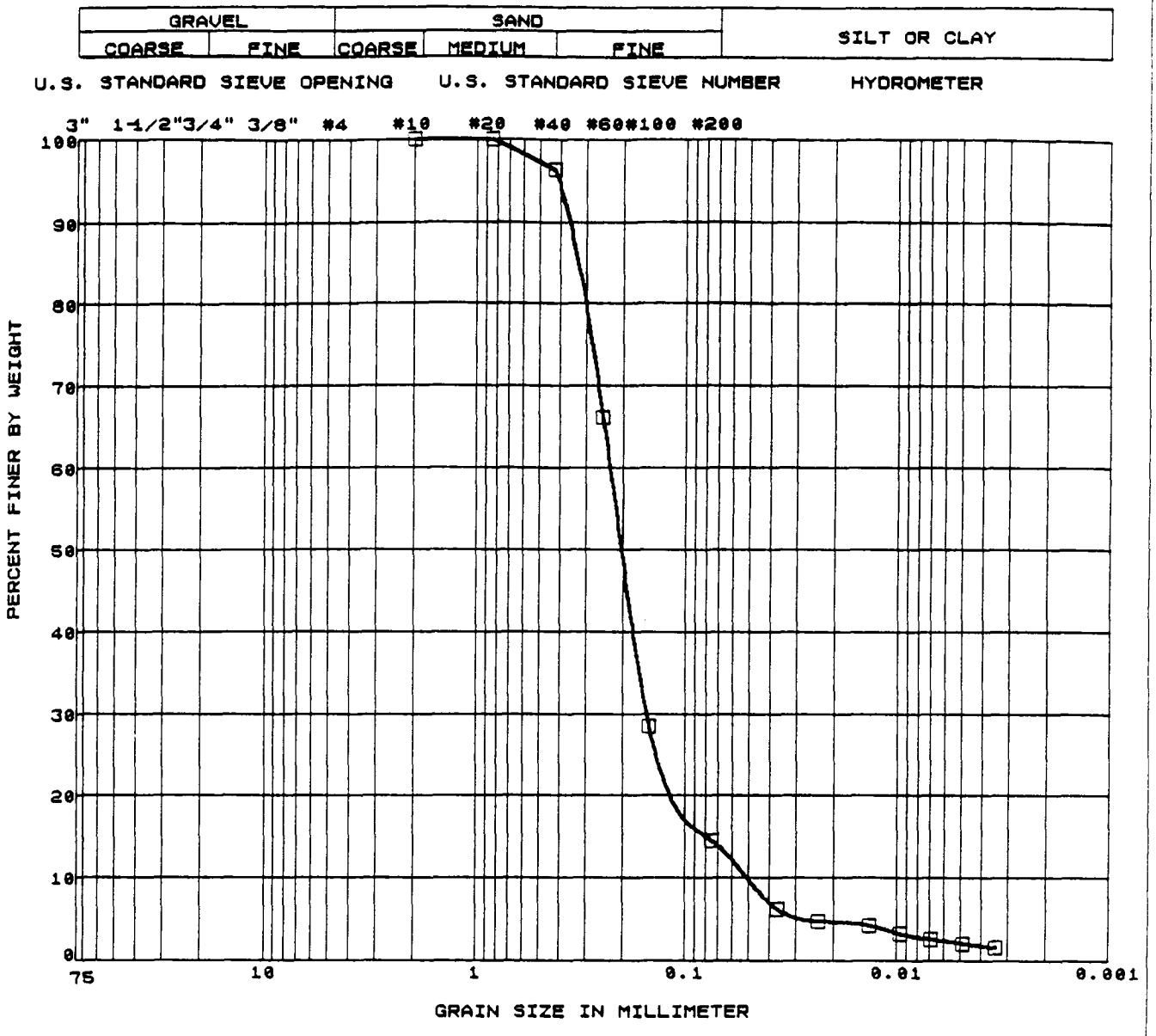
FIGURE 71



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-15-02	10-10.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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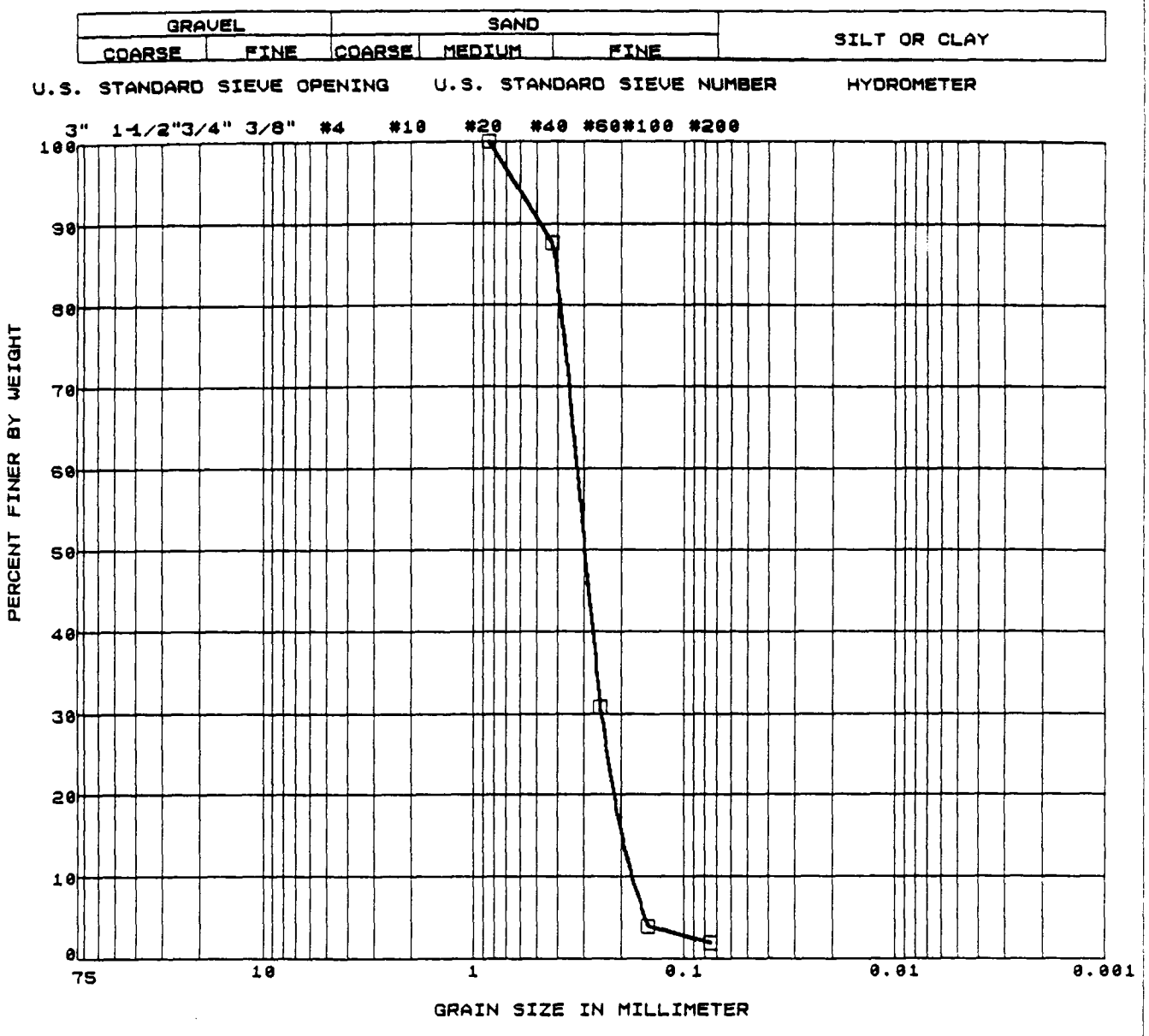
FIGURE 72



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-15-01	10-10.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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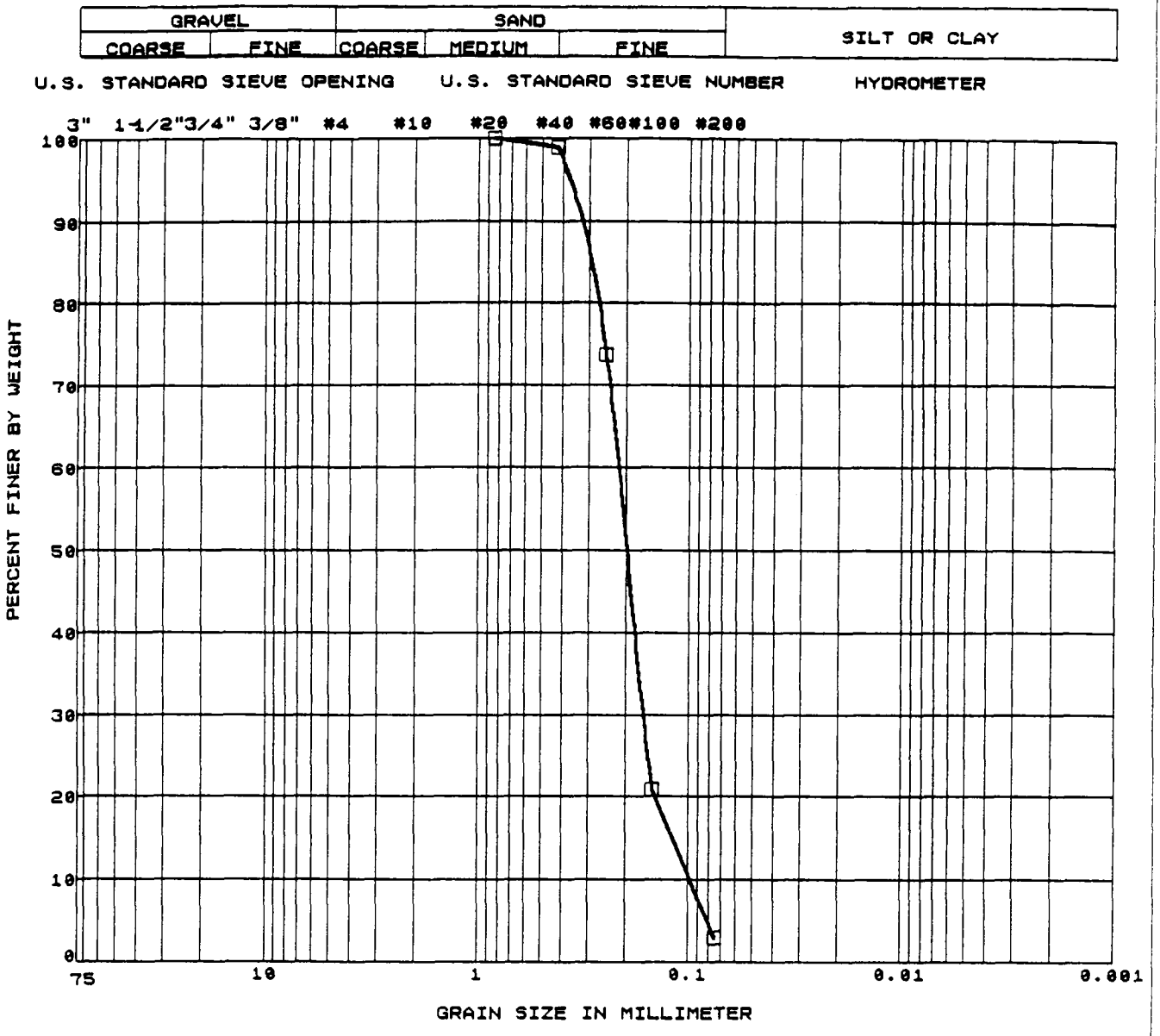
FIGURE 73



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-10-02	7-7.5	TUBE			

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GRAIN SIZE DISTRIBUTION CURVE

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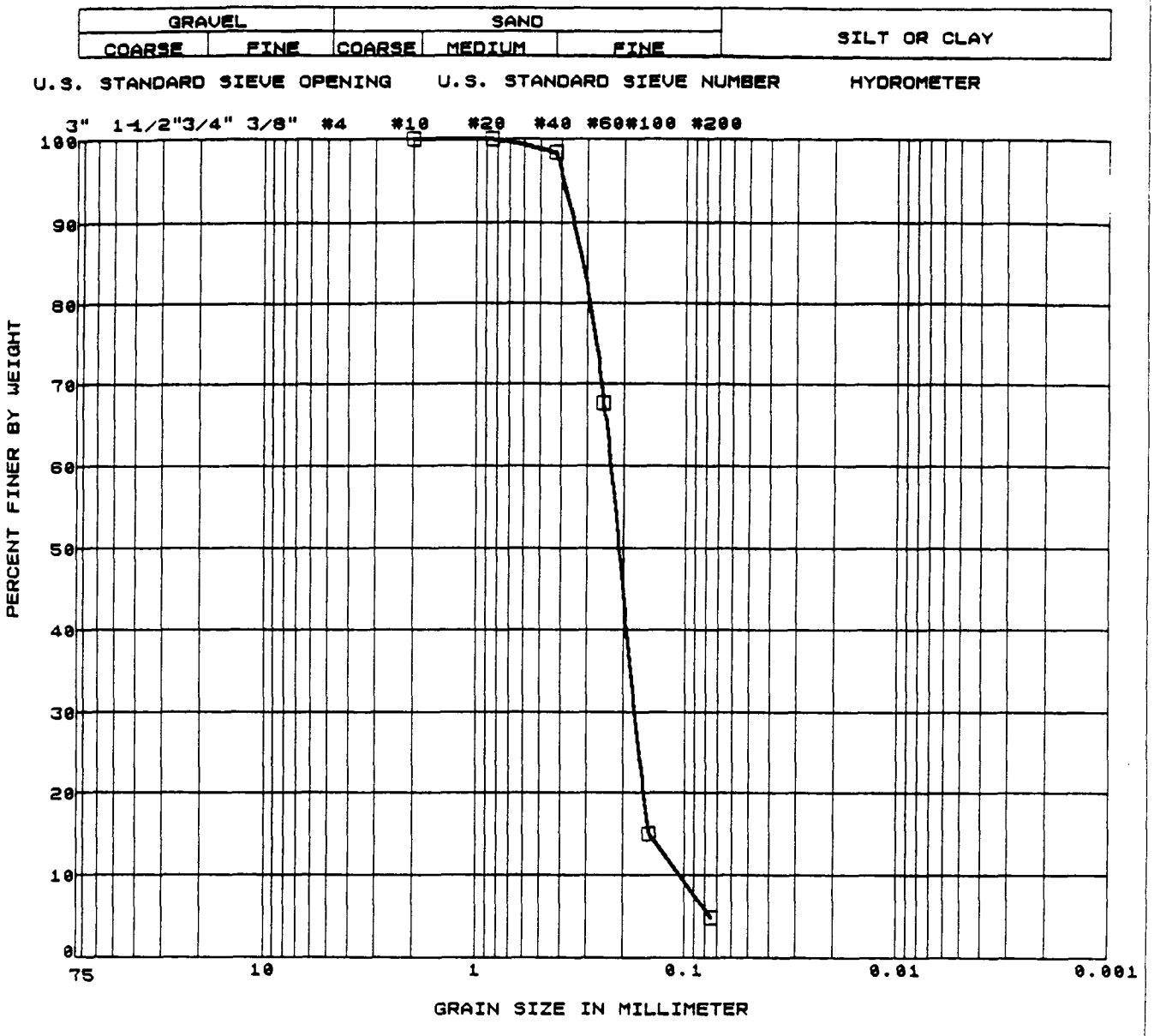
FIGURE 74



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-14-01	10-10.5	TUBE			

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GRAIN SIZE DISTRIBUTION CURVE

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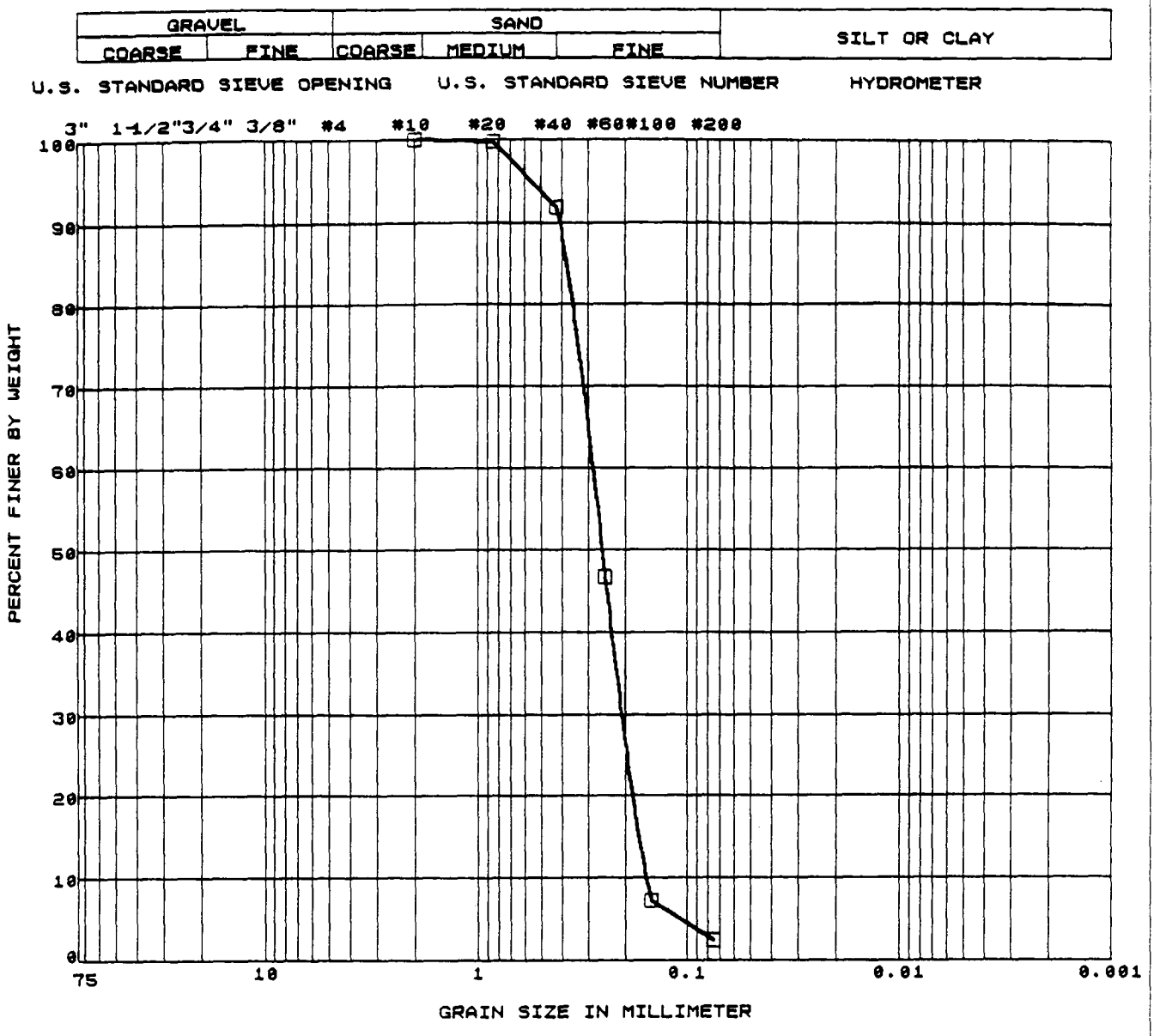
FIGURE 75



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-14-02	3.5-4	TUBE			

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GRAIN SIZE DISTRIBUTION CURVE

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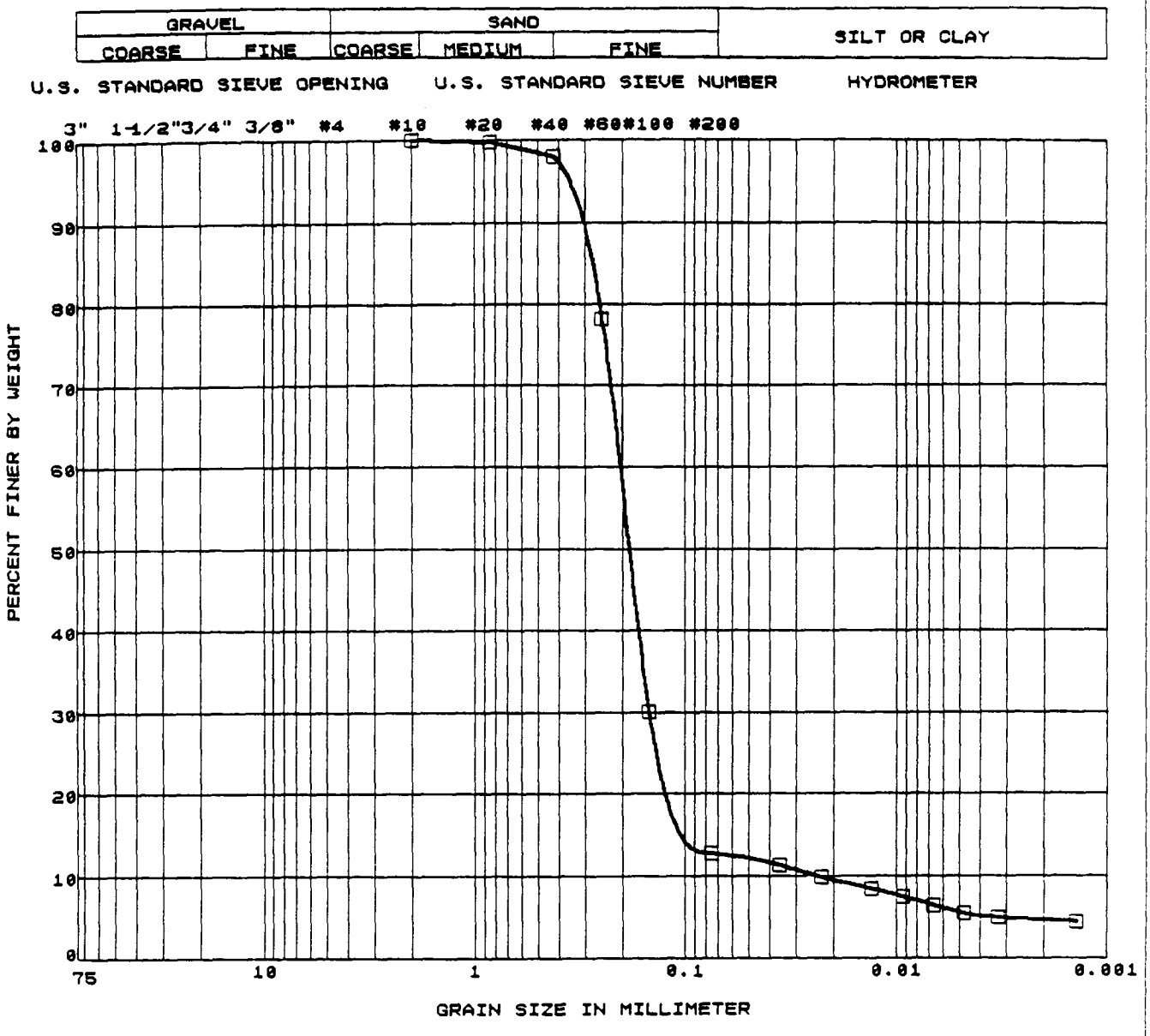
FIGURE 76



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-08-01	8.5-9	TUBE			

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GRAIN SIZE DISTRIBUTION CURVE

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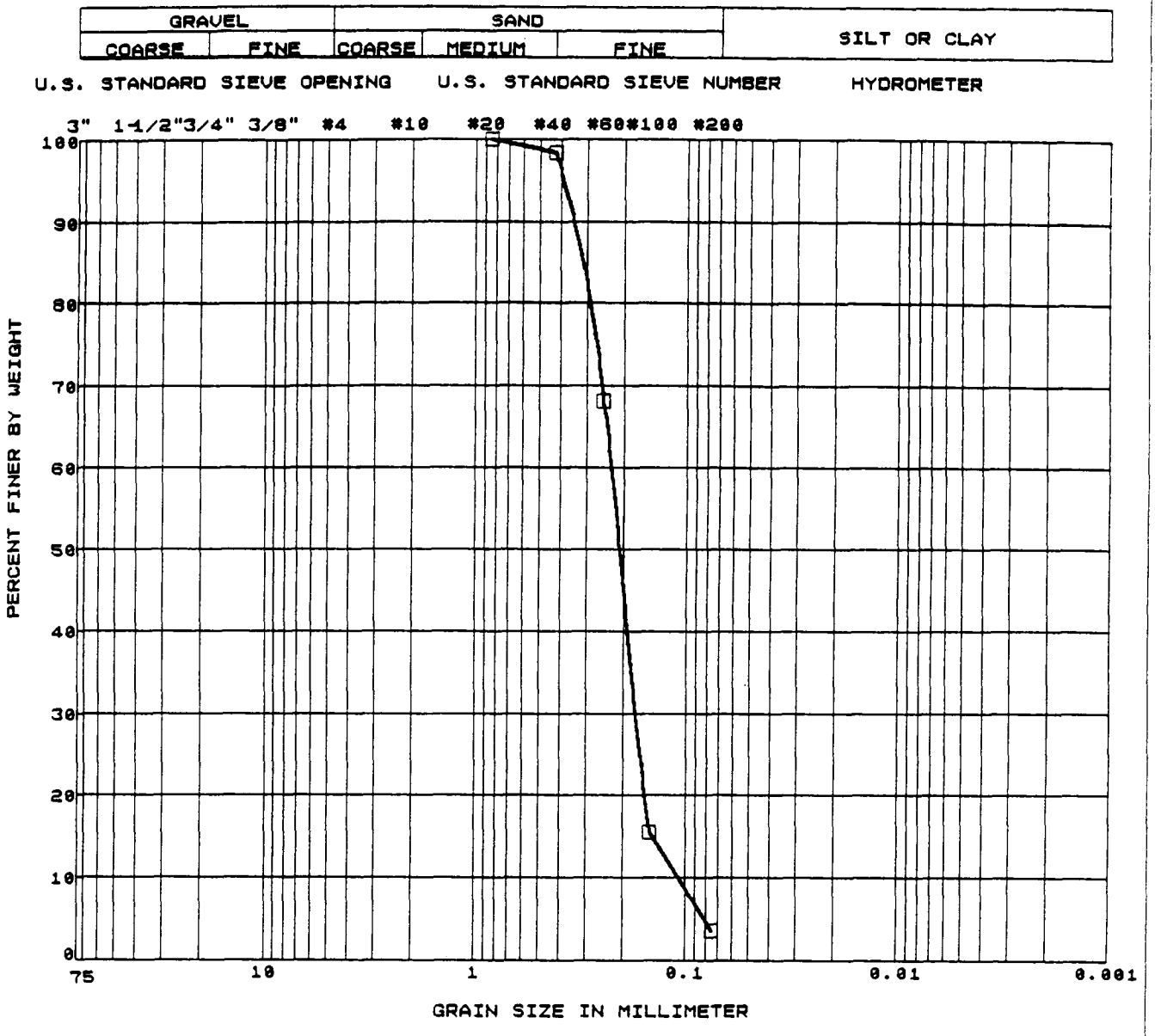
FIGURE 77



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-08-04	10-10.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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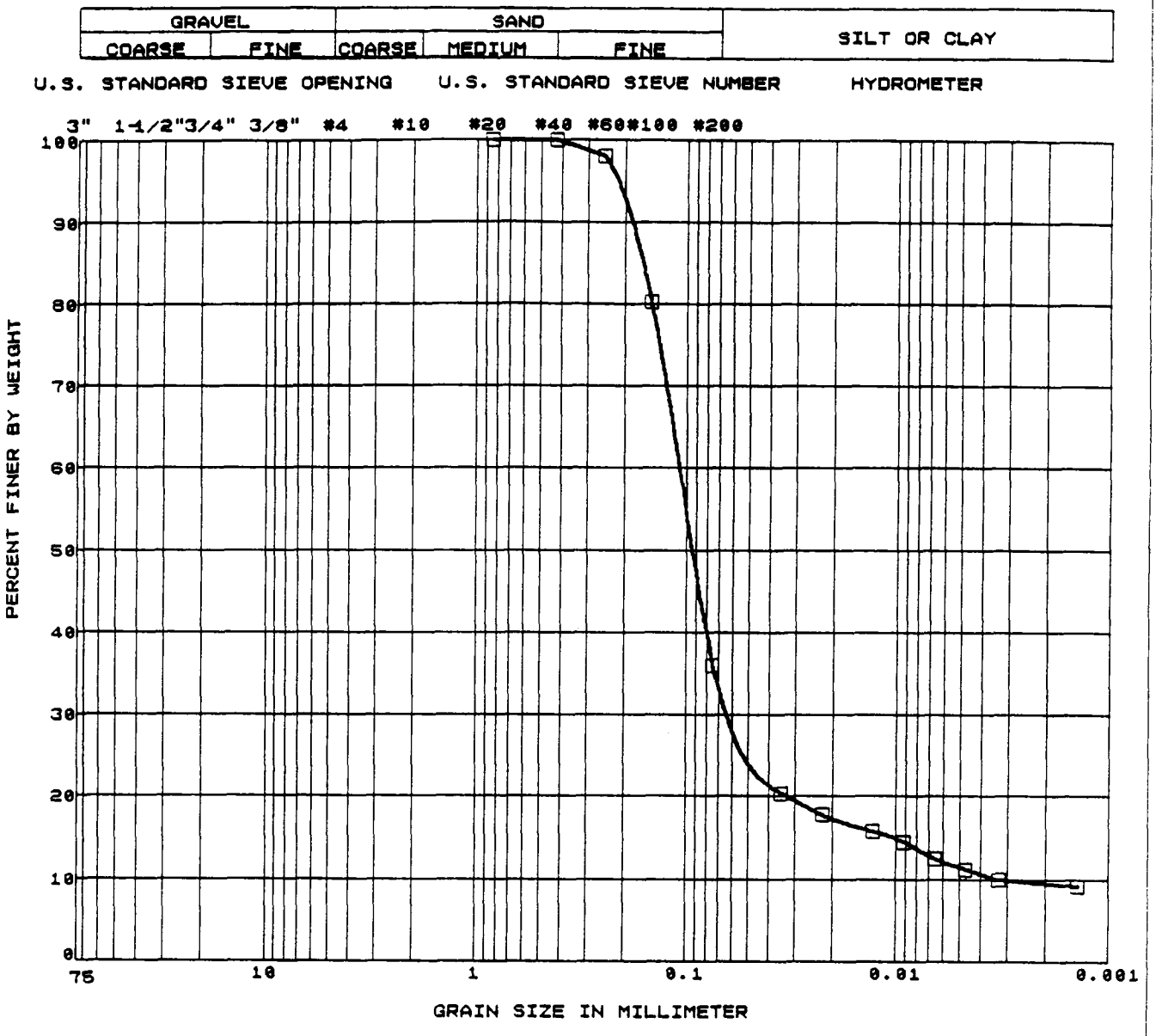
FIGURE 7B



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-08-08	10.5-11	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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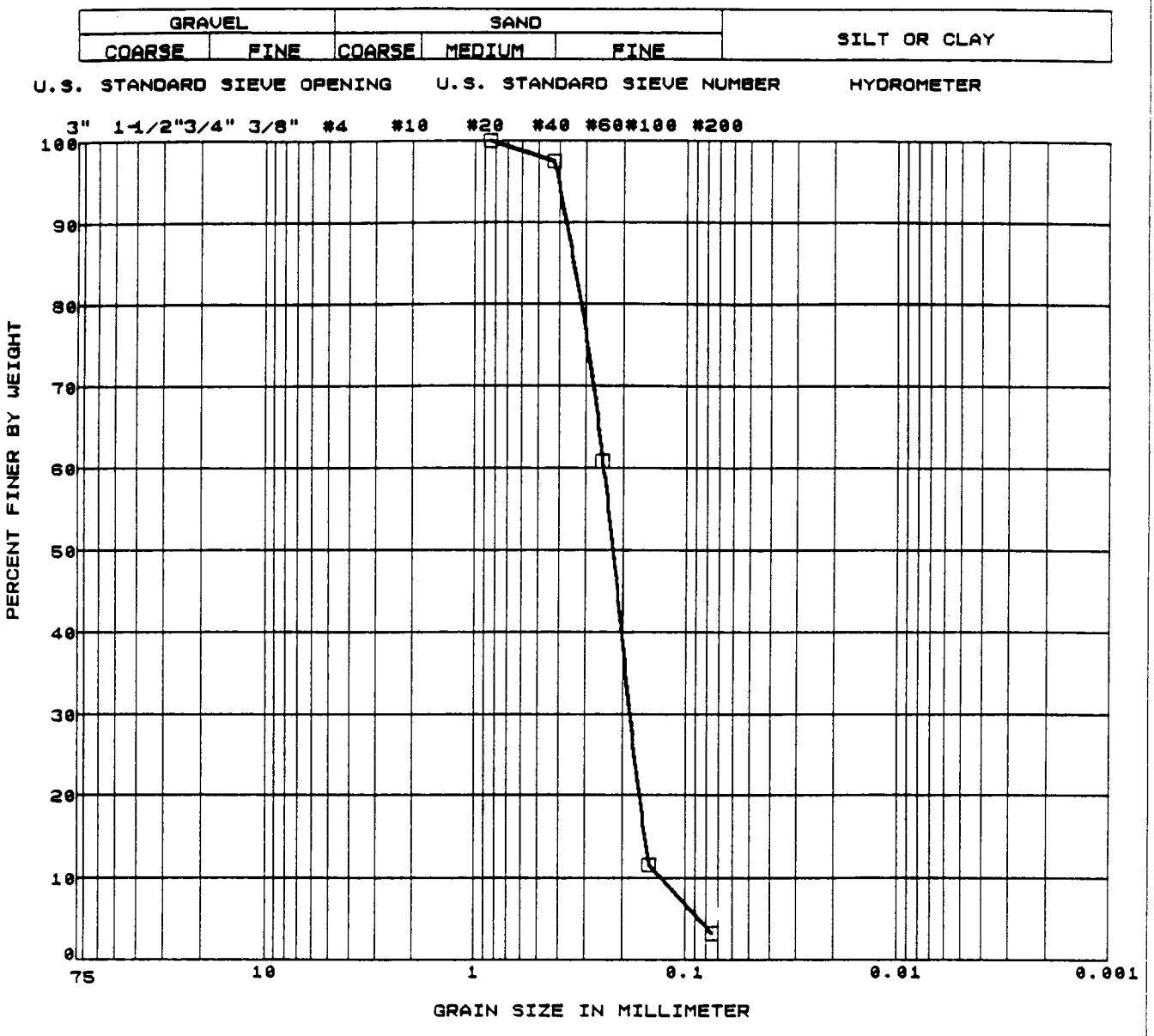
FIGURE 79



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-08-03	4.5-5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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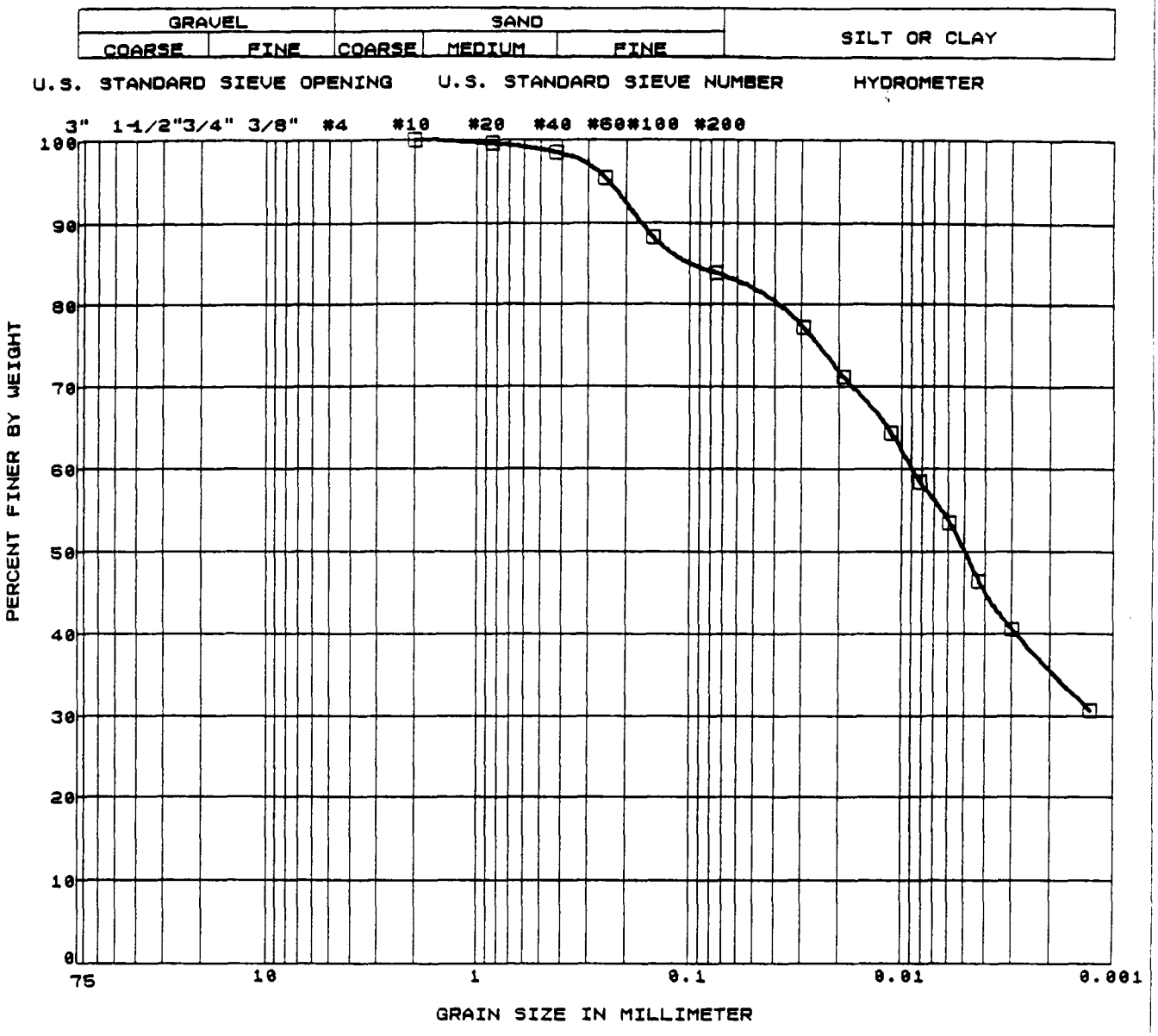
FIGURE 80



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-08-04	13.5-14	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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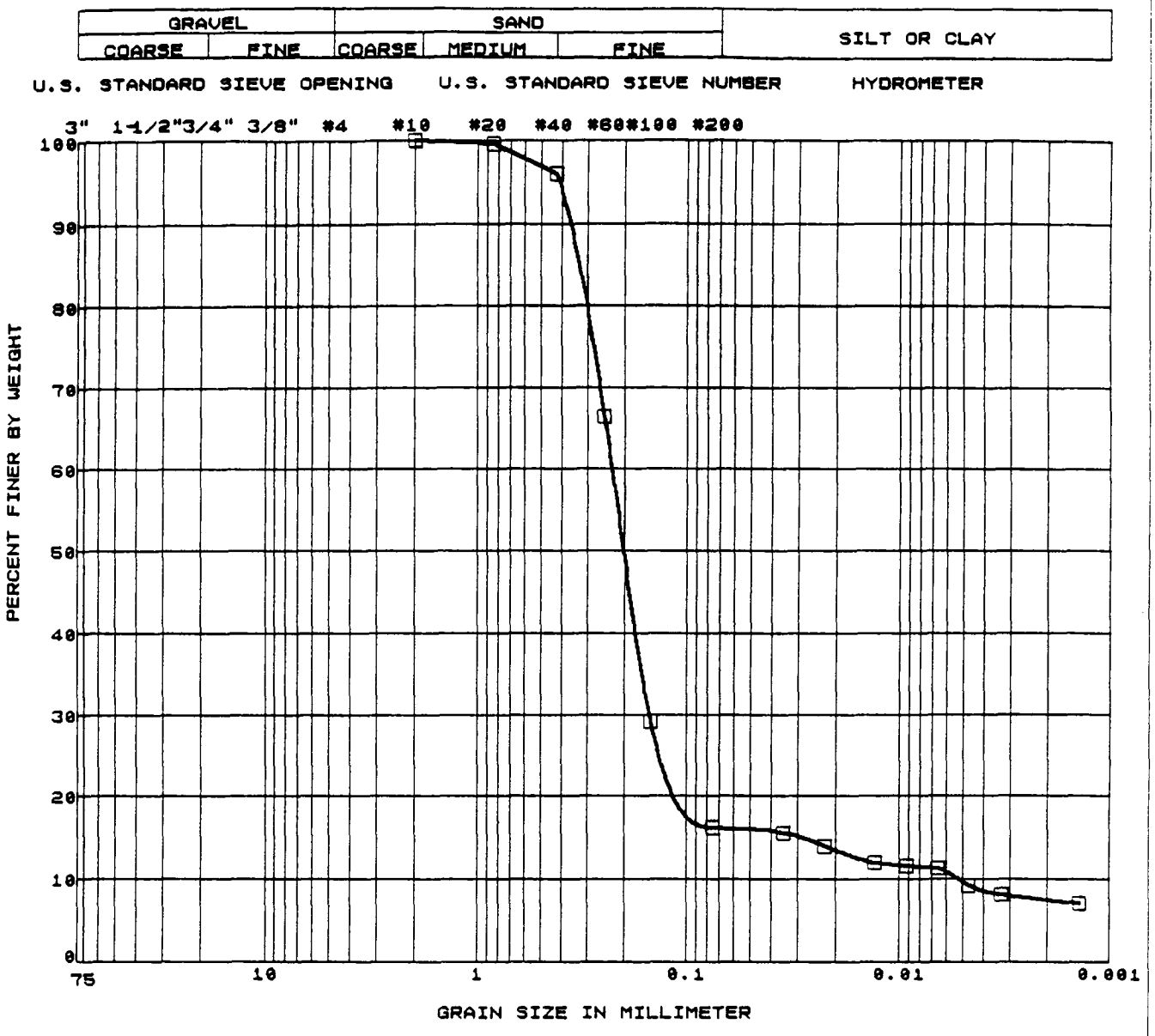
FIGURE B1



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-06-08	4.5-5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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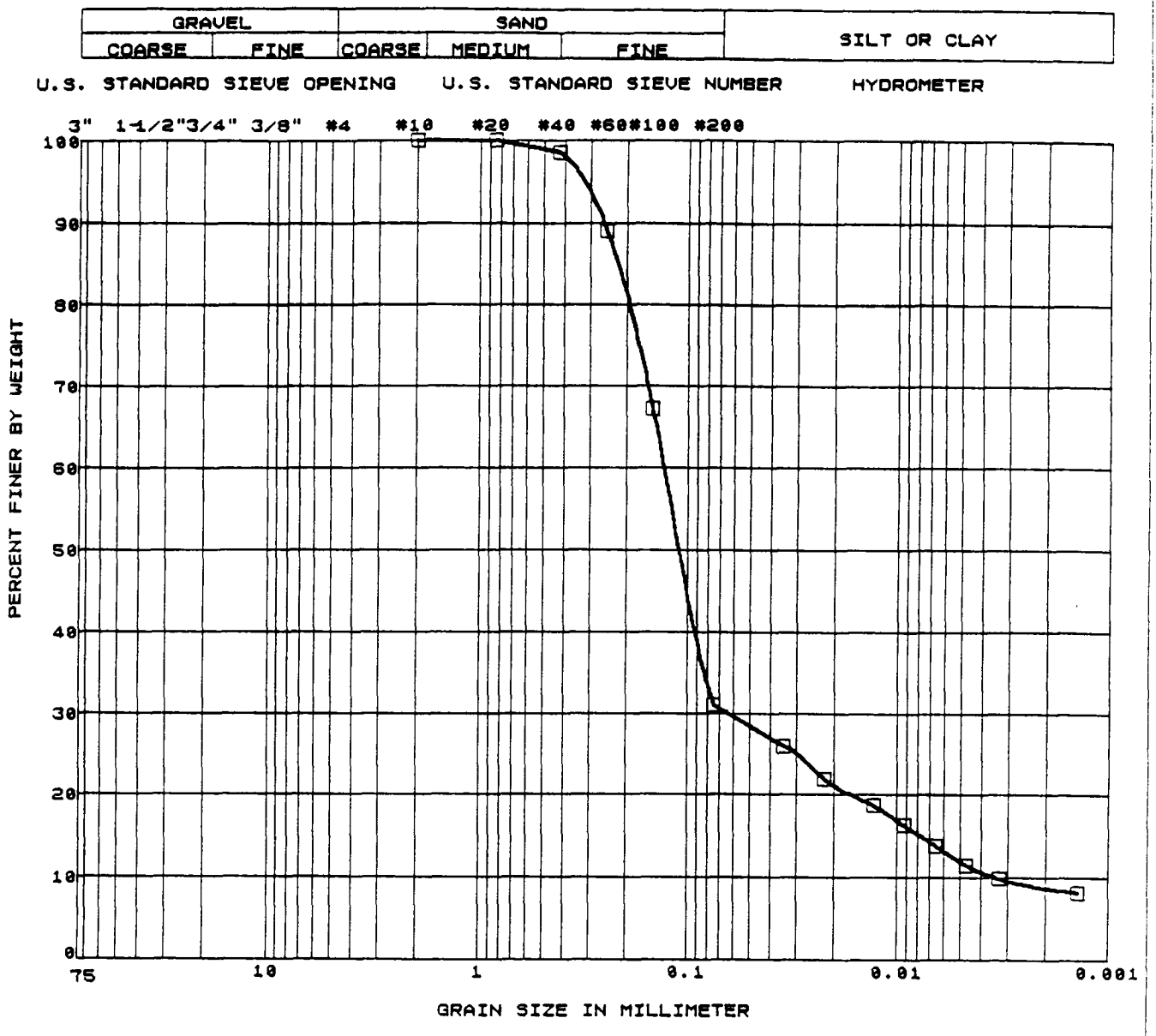
FIGURE B2



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-06-01	13.5-14	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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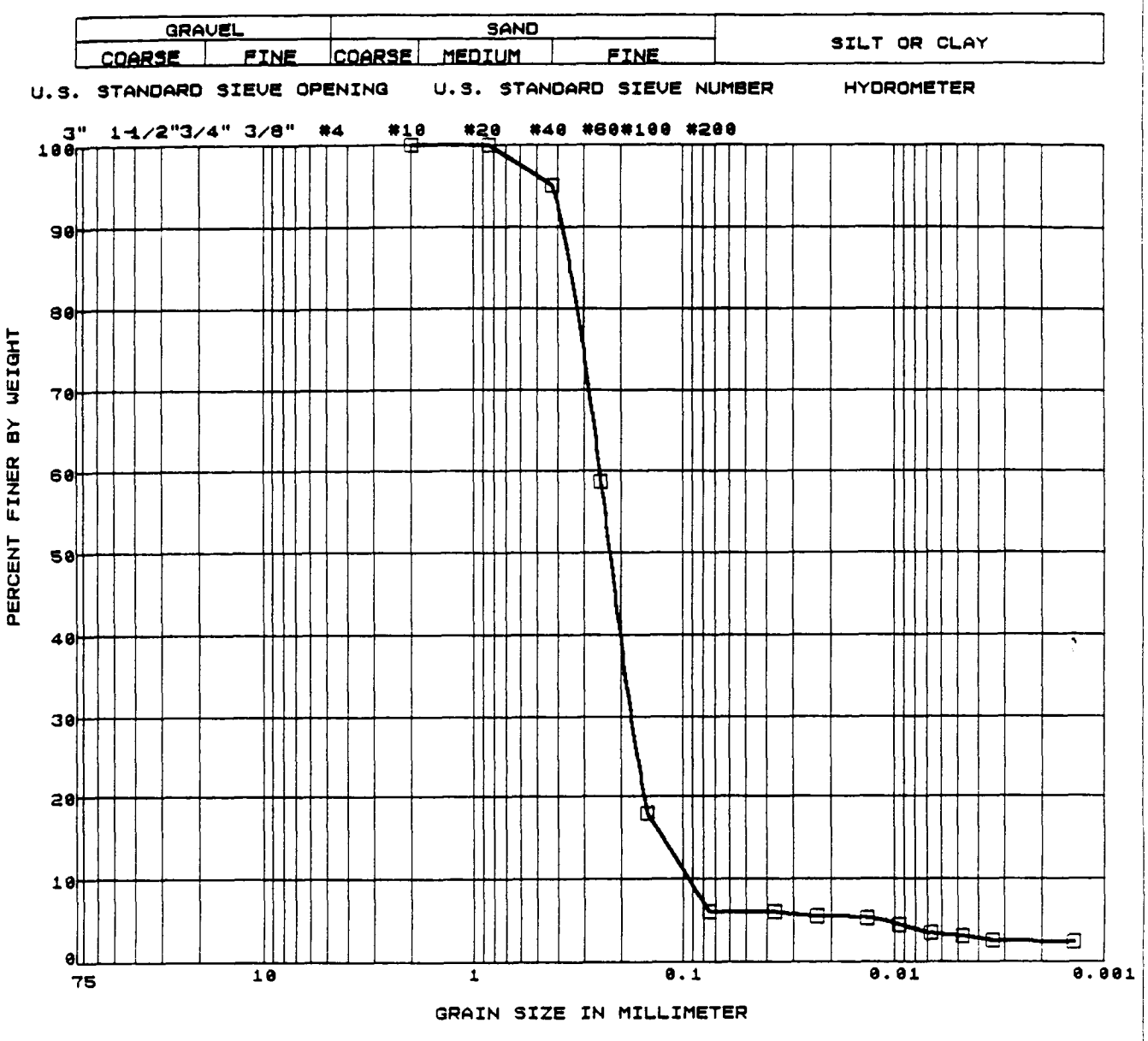
FIGURE 83



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-06-04	4-4.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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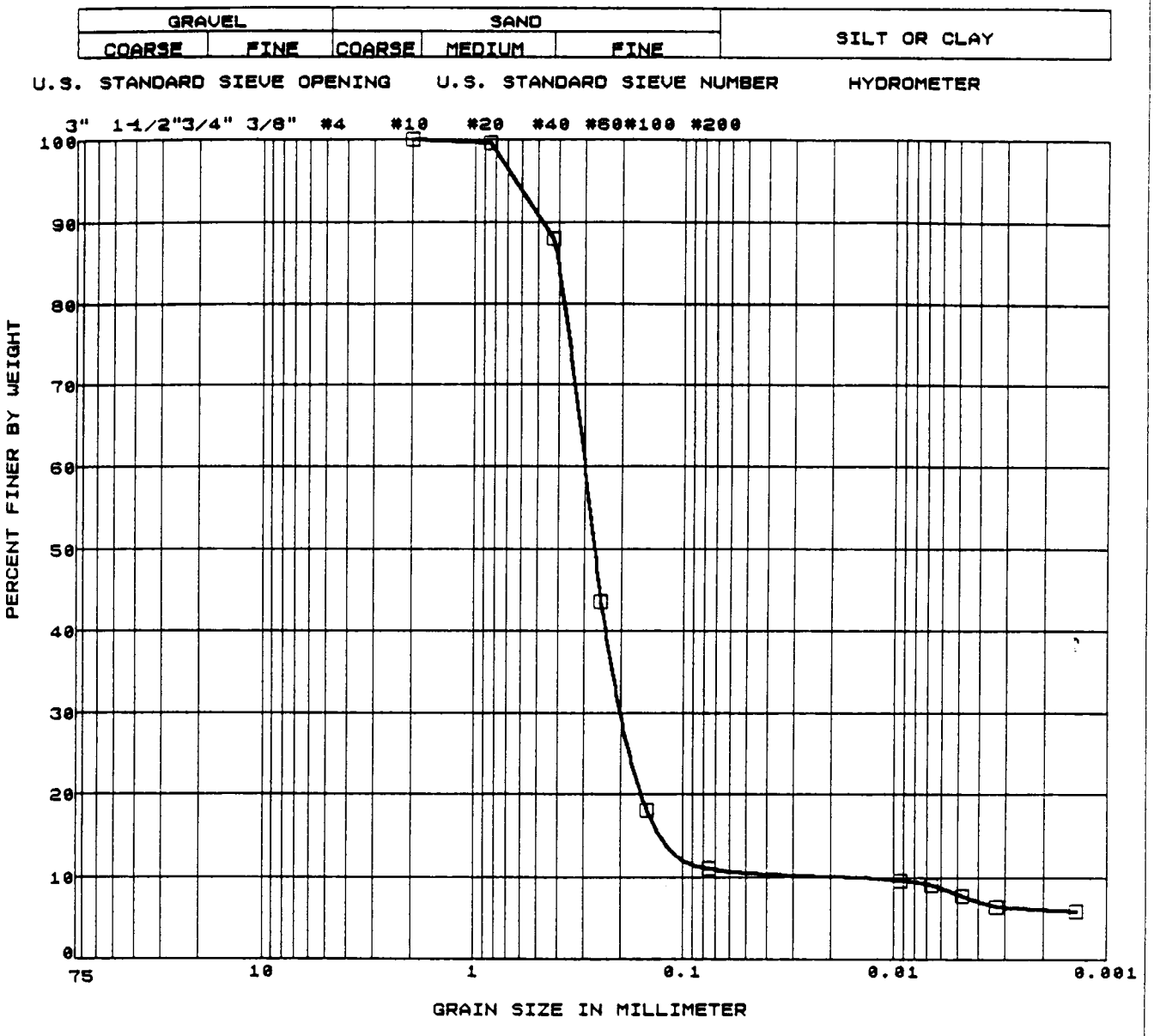
FIGURE 84



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-12-02	13-13.5	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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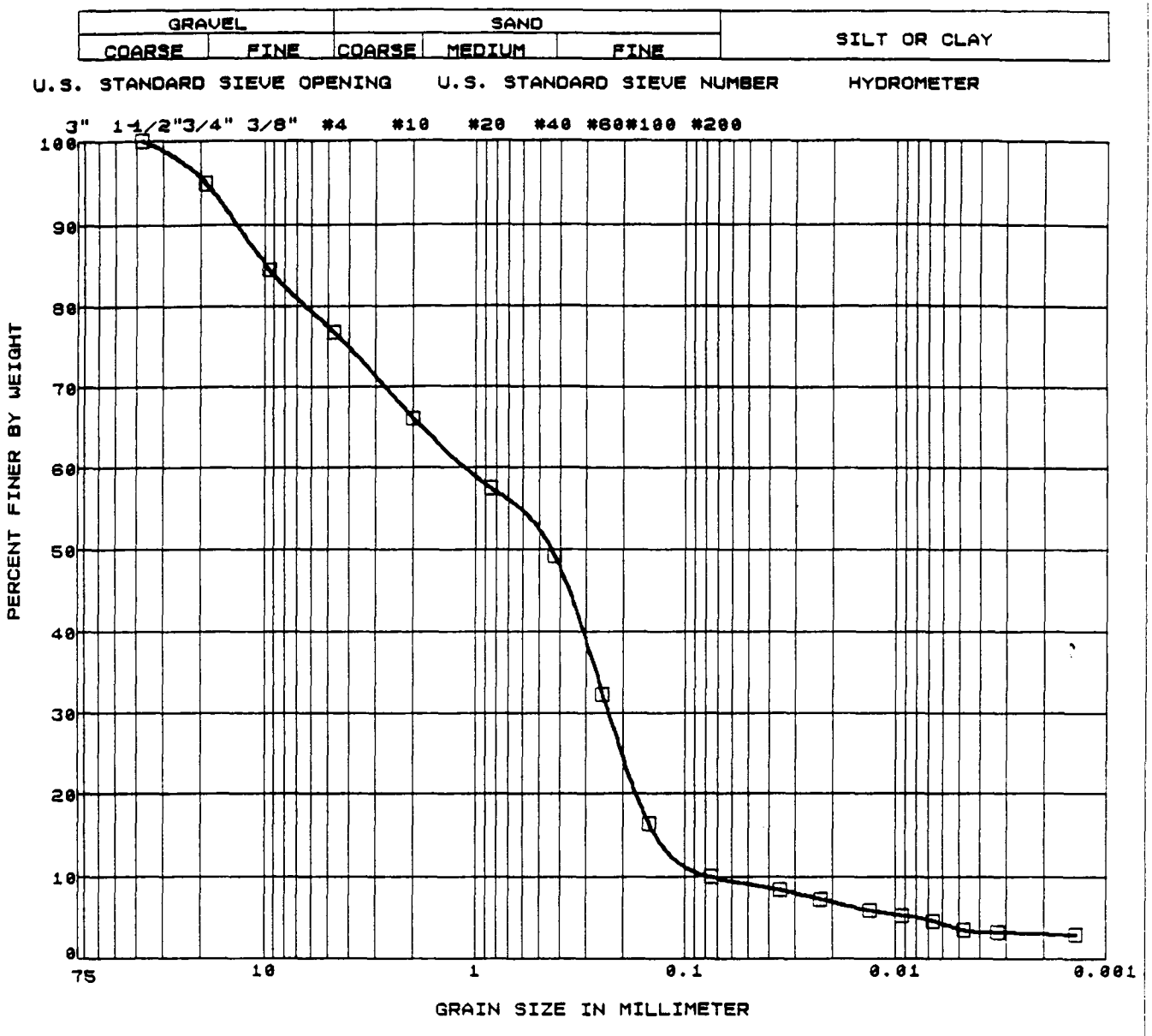
FIGURE 85



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		B-12-04	5.5-6	TUBE			

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GRAIN SIZE DISTRIBUTION CURVE

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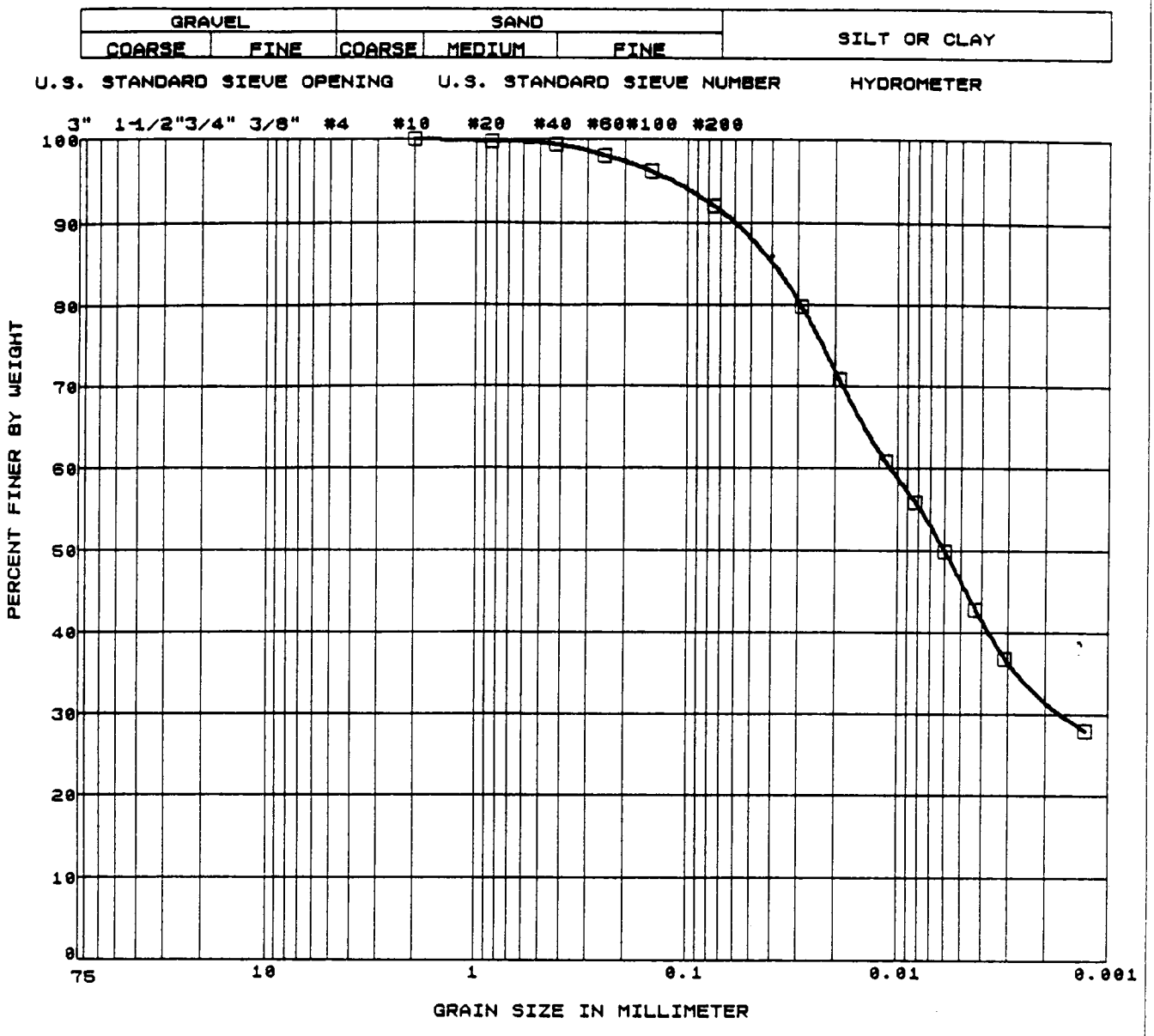
FIGURE 86



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□		8-12-05	13.5-14	TUBE			

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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FIGURE 87

The Earth Technology Corporation

18411 Gothard Street Unit F Huntington Beach, California 92648
Telephone: (714) 842-7011 Telecopy (714) 842-3735

Transmittal

To: James M. Montgomery
365 Lennon Lane
Walnut Creek,
CA 94598

Attention: Ms. Donna Courington

Project No. 2738.0258

Date: Dec. 4, 1991

☐ Mail
☐ Airmail
☐ Messenger
☒ UPS Overnite

Submitted Herewith: are partially Laboratory test results of NAS-Alameda Project.
The test results included Moisture & Density, Permeability as shown on
Table 6 and 7 Grain Size distribution Curves.
The rest of the test results will be reported shortly.

Copy To: Kean Tan

By: S. Sayawatana
Somboon Sayawatana

F1016

TABLE 6

SUMMARY OF LABORATORY TEST RESULTS

PROJECT NAME: NAS-Alameda

TETC NO: 92-371-07001

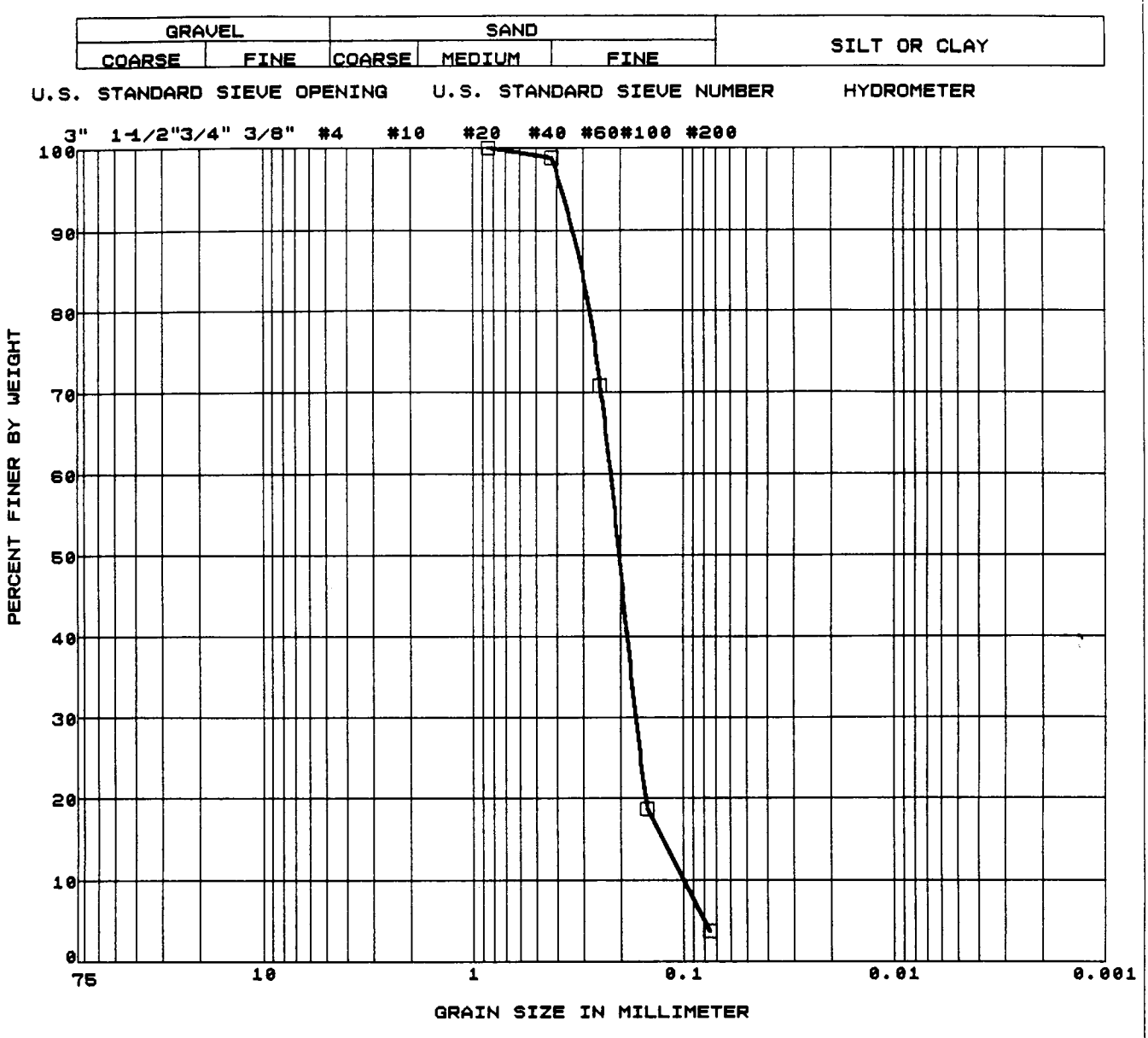
PROJECT NUMBER: 2738.0258

CLIENT: James M. Montgomery

DATE: Dec. 2, 1991

SUMMARIZED BY: S. Sayawatana

SAMPLE NO.	DEPTH (ft)	MOISTURE CONTENT ASTM D2216 (%)	DRY DENSITY ASTM D2937 (pcf)	PERMEABILITY	
				EFFECTIVE STRESSES (psi)	HYDRAULIC CONDUCTIVITY (EPA 9100) (cm/s)
B-011A-03	13-13.5	20.0	111.0	8	2.84E-07
B-011A-02	8.5-9	23.0	99.0	5	9.91E-05
B-011A-05	7-7.5	21.5	104.0	4	3.61E-06
B-011A-04	13.5-14	17.5	115.0	9	9.19E-09
B-011A-06	7-7.5	19.0	105.0	4	4.65E-04
B-07A-04	9-9.5	47.0	70.0	5	1.00E-07
B-07A-03	14.5-15	70.0	56.5	7	3.79E-08
B-07A-04	4.5-5	15.5	111.5	3	4.01E-04
B-07A-06	4.5-5	14.0	111.0	3	1.85E-04
B-07A-07	7-7.5	72.5	56.5	3	5.48E-08
B-07B-01	7.5-8	15.0	111.5	5	1.05E-05
B-07B-03	15-15.5	18.5	109.0	9	5.29E-07
B-07B-02	3-3.5	11.0	93.5	3	6.48E-04
B-05-06	13.5-14				
B-05-12	13.5-14	24.0	99.5	8	3.90E-05
B-05-04	13.5-14	71.0	57.5	6	3.81E-08
B-05-06	3.5-4	8.0	94.5	3	7.81E-04
B-05-02	8-8.5	14.0	109.0	5	5.73E-04
B-05-03	8.5-9	14.5	110.0	5	2.06E-04
B-15-01	13-13.5				
B-15-02	4-4.5				
B-15-03	10.5-11	17.0	111.5	7	1.14E-05
B-10-01	7-7.5	16.0	109.0	4	6.81E-04
B-10-01	13-13.5	43.0	81.0	7	2.82E-07
B-14-03	10-10.5	21.0	100.5	6	3.53E-04
B-14-01	10-10.5	20.0	104.0	6	8.90E-04
B-14-02	10-10.5	22.0	97.0	6	4.87E-05
B-08-03	13-13.5	40.0	81.5	7	7.13E-08
B-08-09	10-10.5	34.5	93.0	6	2.71E-06
B-06-12	10.5-11	86.0	50.0	5	4.95E-08
B-06-05	3.5-4	8.0	96.0	3	6.19E-04
B-06-14	7-7.5	25.0	99.0	4	9.88E-05
B-12-02	8.5-9	22.0	96.5	5	2.33E-04
B-12-08	8.5-9	18.5	98.0	5	2.52E-04
B-12-03	13-13.5				



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-011-01		4-4.5				

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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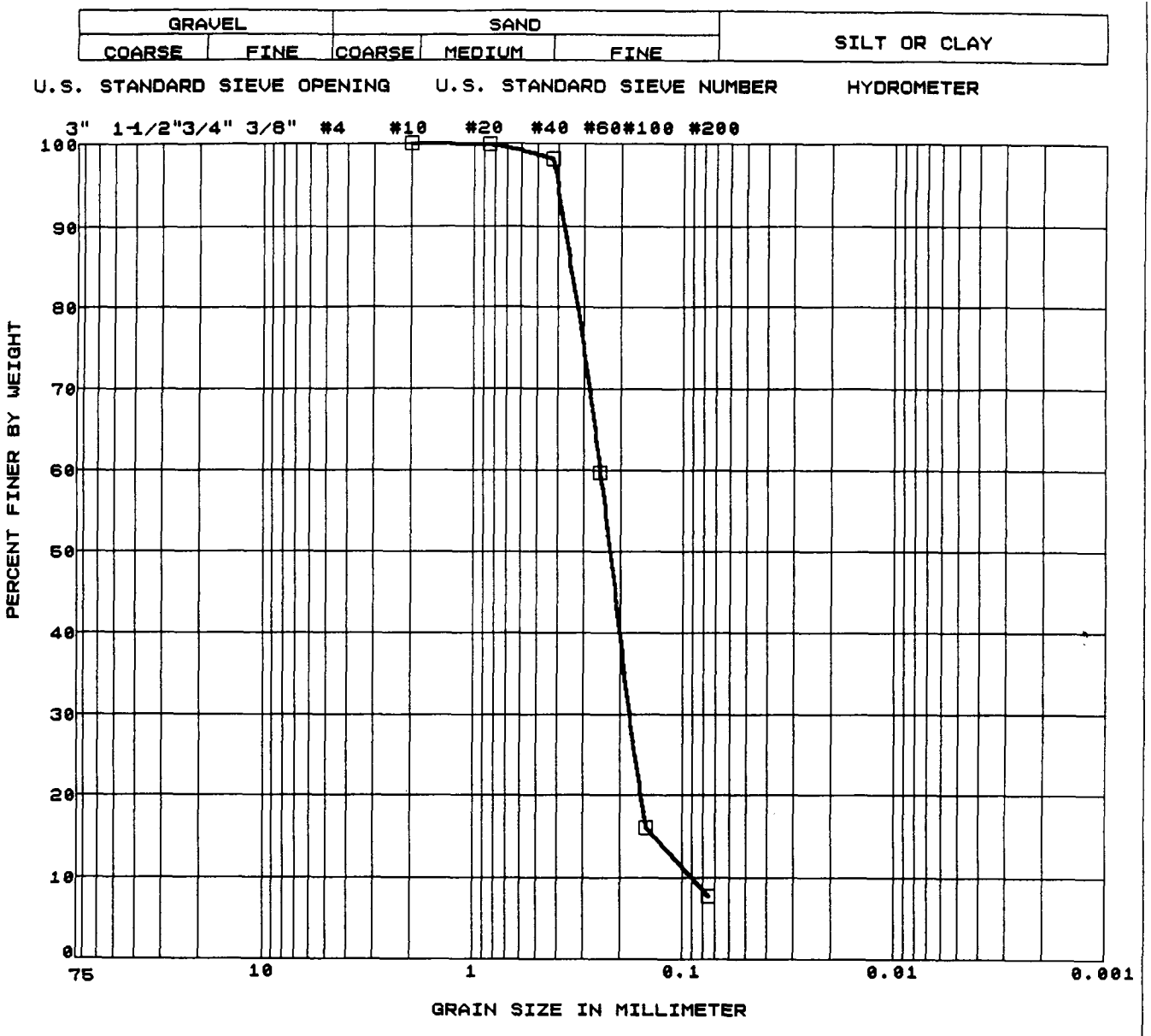
FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-011-02		8.5-9				

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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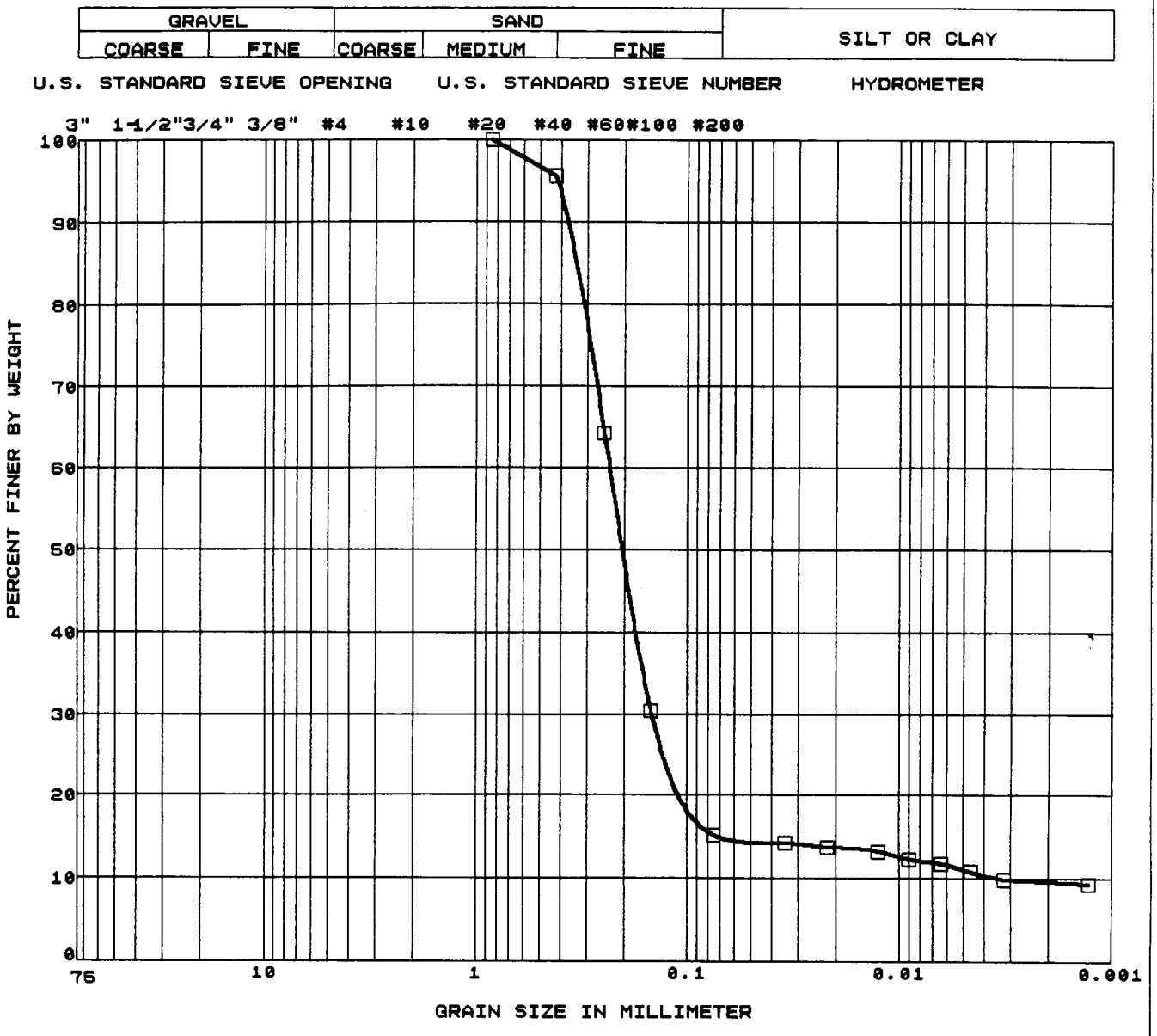
FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-011-03		13-13.5				

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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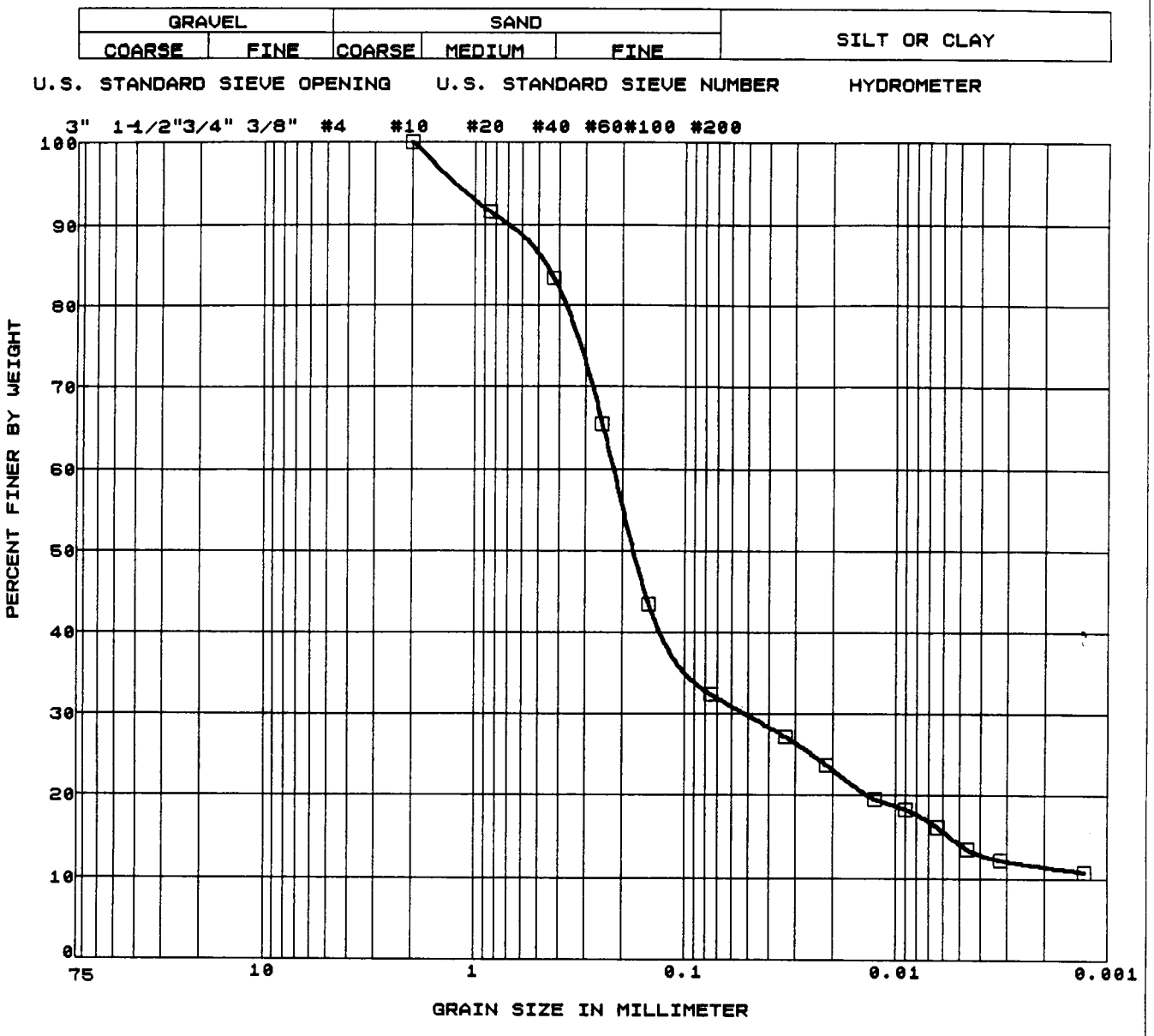
FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-07A-02		1.5-2				

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

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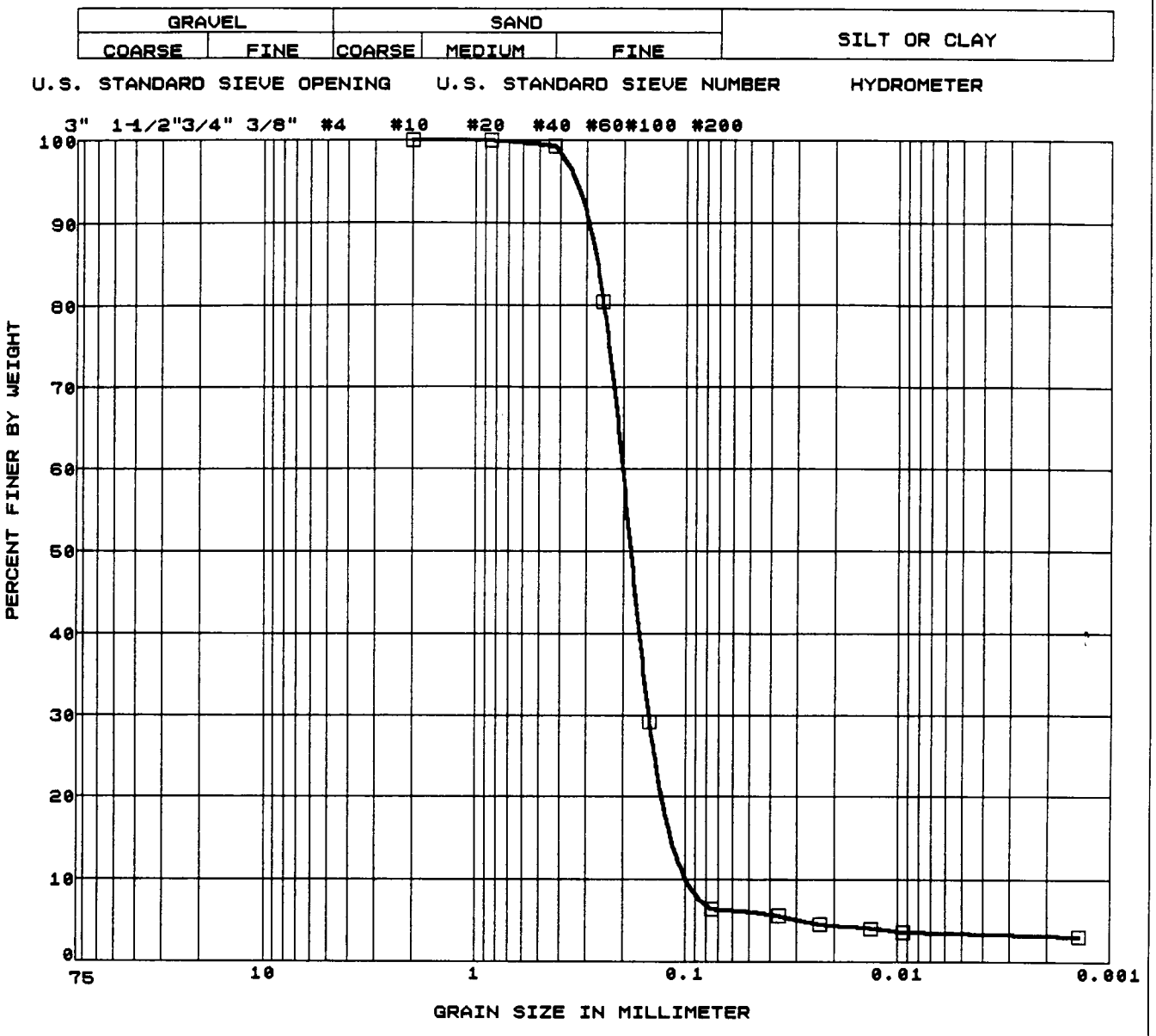
FIGURE



SYMBOL	BORING NO.	SAMPLE NO.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-07B-02		2.5-3				

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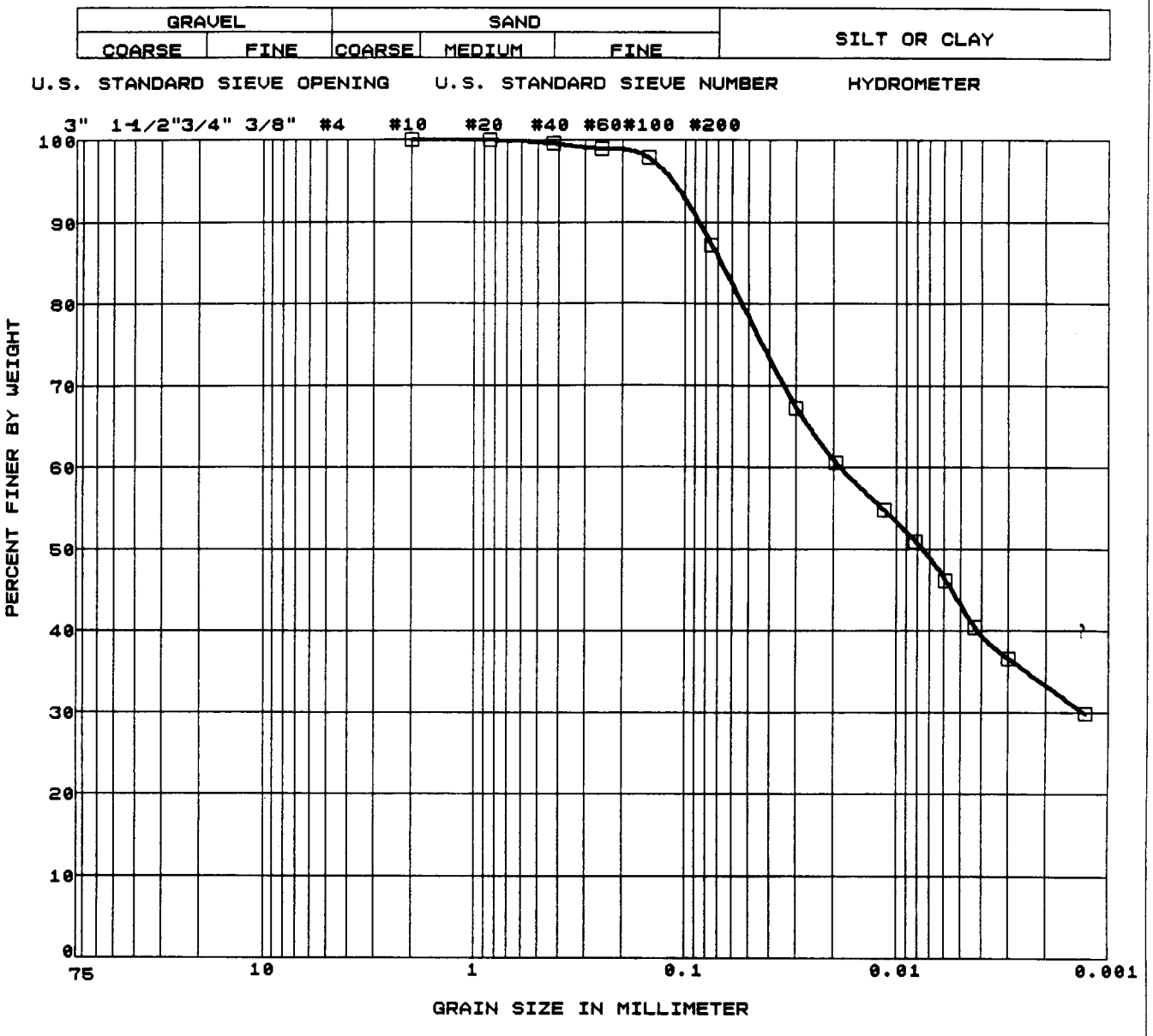
PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

12/91

FIGURE



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□	B-07B-02	10-10.5					

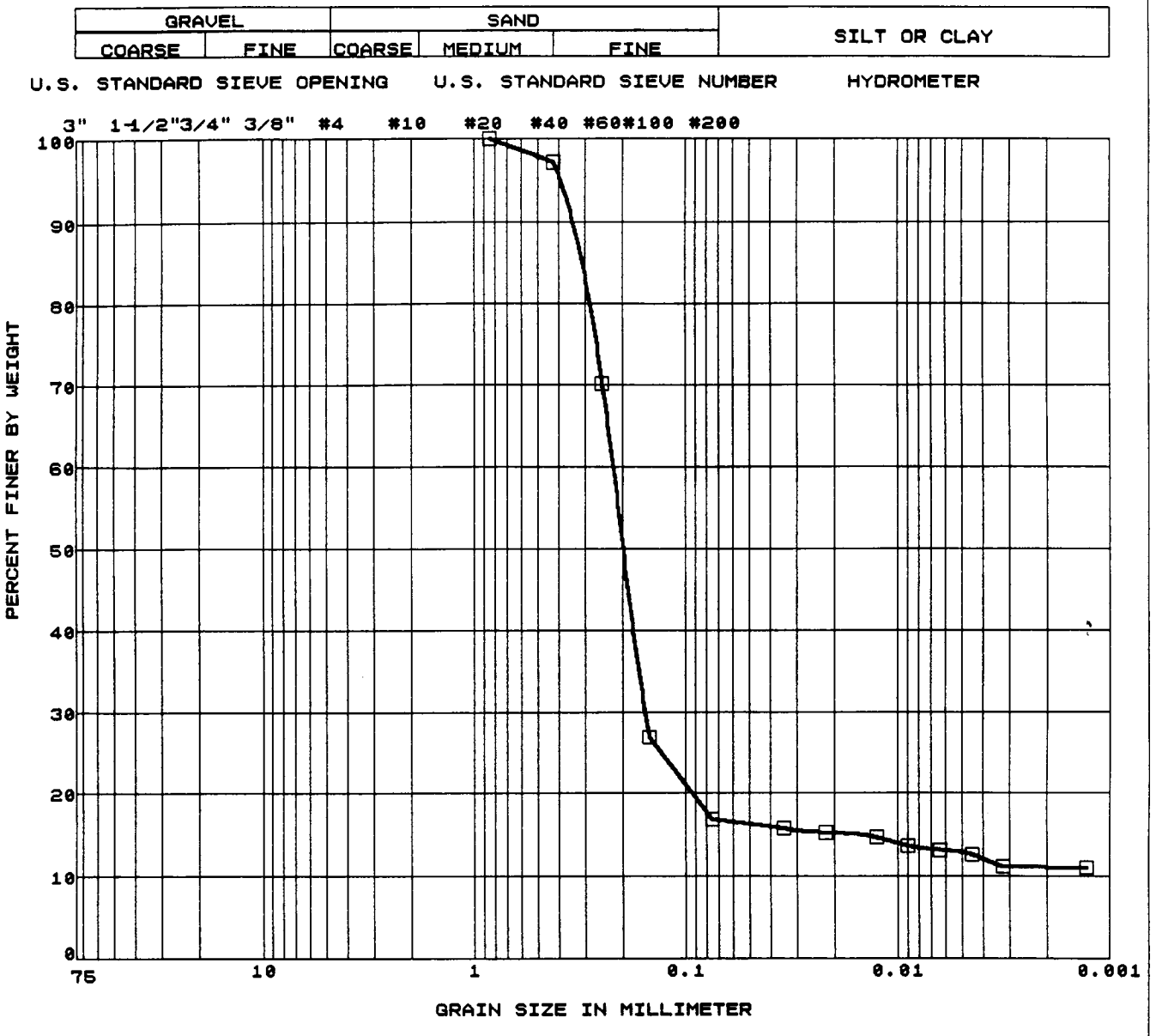
The Earth Technology Corporation

PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

12/91

FIGURE



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□	B-07B-03		15-15.5				

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PROJECT NAME: NAS-Alameda

GRAIN SIZE DISTRIBUTION CURVE

12/91

FIGURE

The Earth Technology Corporation

16411 Beach Boulevard, Suite F
Huntington Beach, California 92648
Telephone (714) 842-7011 Fax (714) 842-3735

April 6, 1992

James M. Montgomery
365 Lennon Lane
Walnut Creek, CA 94598

Attention: Ms. Donna Courington

Subject: Report/Laboratory Testing Results
Project Name: NAS Alameda
Project No.: 2738.0258
TETC Project No.: 92-371-07002

Dear Ms. Courington:

Enclosed are results of the laboratory testing program conducted on the samples from the NAS Alameda project. The testing performed for this program was conducted in general accordance with ASTM, USEPA testing procedures as follows:

TYPE OF TEST	TEST PROCEDURE
Grain Size Analysis	ASTM D422
Cation Exchange Capacity	EPA 9081
Total Organic Carbon	ASA-SSSA, Ch 29

Test results are presented in Table 1 and Figure of Grain Size distribution curves.

ASTM: American Society for Testing and Materials, Annual Book of ASTM Standards, Section 4, Vloume 04.08, Soil and Rock: Dimension Stone: Geosynthetics, 1991.

USEPA: United States Environmental Protection Agency, Test Methods for Evaluating Solid Waste, SW 846 Volume 1C, Labortory Manual Physical/Chemical Methods, November 1986.

ASA-SSSA: American Society of Agronomy, Inc. and Soil Science Society of America, Inc. Part 2, Chapter 29, 1982.

We appreciate the opportunity to provide testing services to JMM. If you have any questions regarding the test results, please contact us.

Very truly yours,

THE EARTH TECHNOLOGY CORPORATION (Commercial)

S. Sayawatana

Somboon Sayawatana
Staff Engineer

Kean Tan
Manager,
Geomechanics Laboratories

Enclosure

The Earth Technology Corporation

18411 Gothard Street, Unit F
Huntington Beach, California 92648
Telephone (714) 842-7311 Fax (714) 842-3735

PROJECT NAME: NAS Alameda
PROJECT NO.: 2738.0258
CLIENT: JMM Consulting

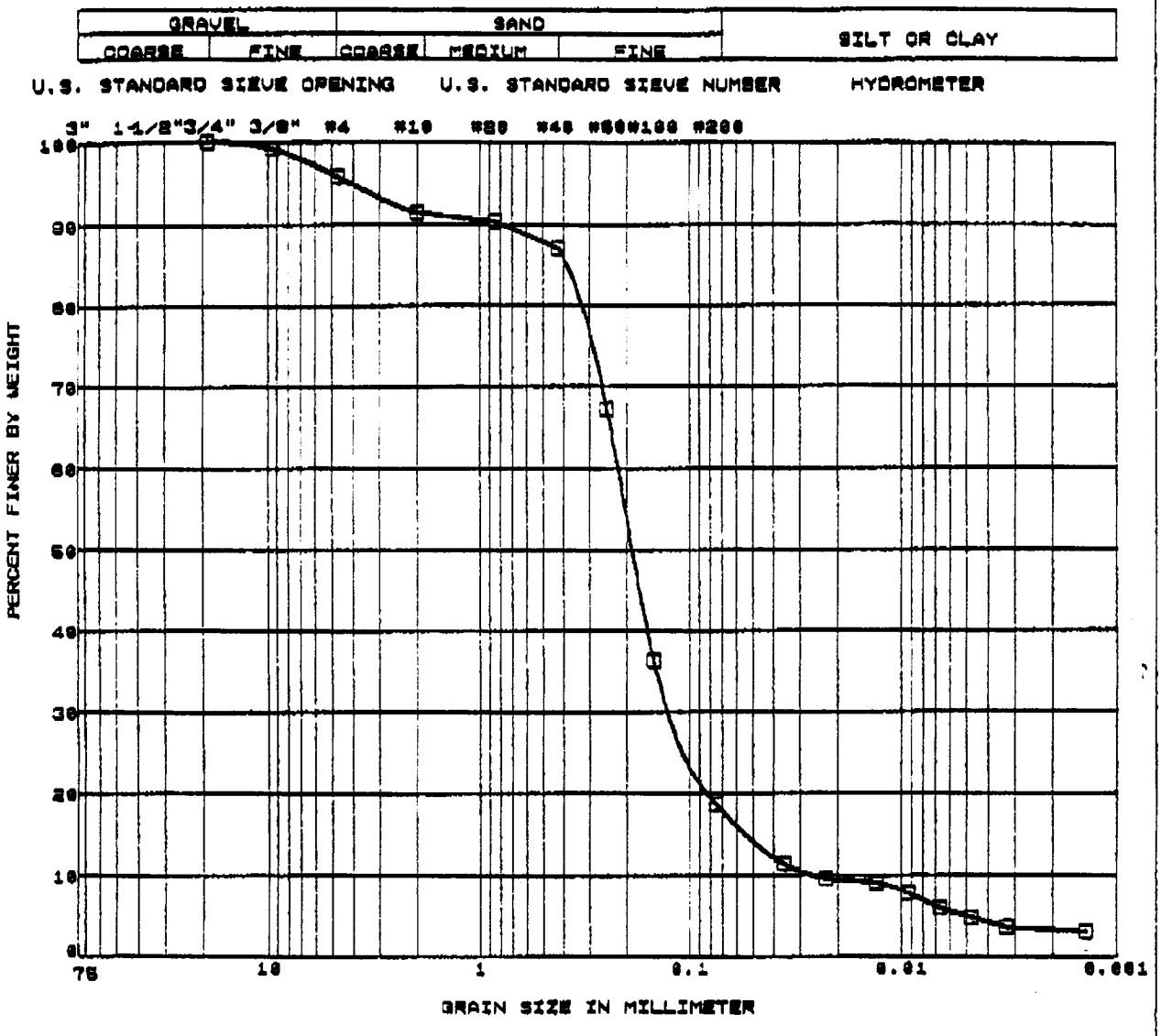
TETC NO.: 92-371-07002
DATE: April 6, 1992

TABLE 1

SUMMARY OF TEST RESULTS

SAMPLE ID	CEC (9081) meq/100g
B-04-01	7.4
B-04-04	8.2
B-04-05	7.7
B-04-09	4.9
B-04-10	7.0
B-04-13	6.8
B-04-18	9.8
B-04-02-008	7.8
Detection Limit	0.3

SAMPLE ID	TOC (Walkley Black) %
B-04-02-008	0.2
Dectection Limit	0.1



SYMBOL	SAMPLE ID.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-04-02		TUBE			

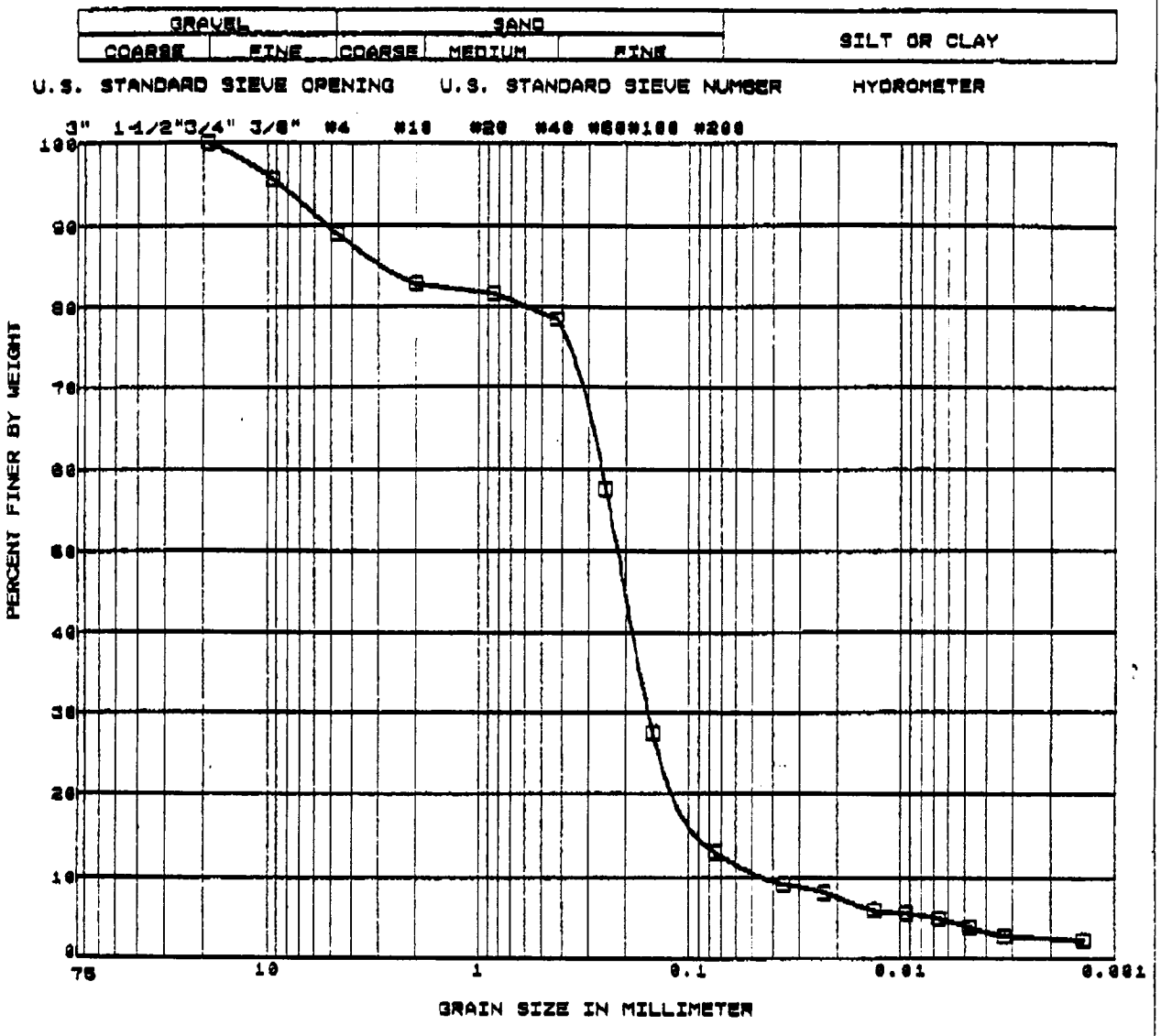
The Earth Technology Corporation

PROJECT NAME: NAS Alameda

GRAIN SIZE DISTRIBUTION CURVE

4/92

FIGURE



SYMBOL	SAMPLE ID.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-04-03		TUBE			

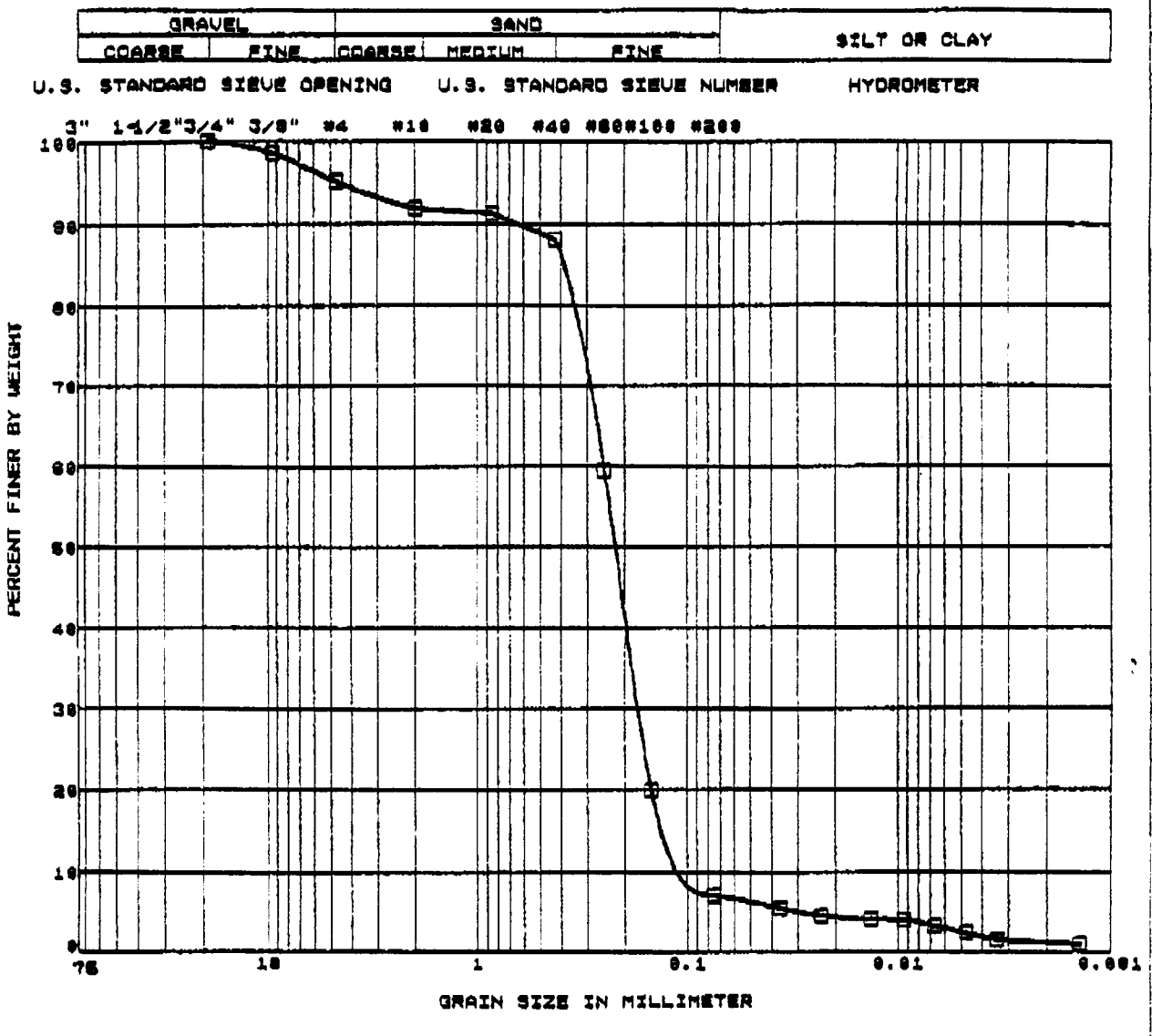
The Earth Technology Corporation

PROJECT NAME: NAS Alameda

GRAIN SIZE DISTRIBUTION CURVE

4/92

FIGURE



SYMBOL	SAMPLE ID.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	E-04-07		TUBE			

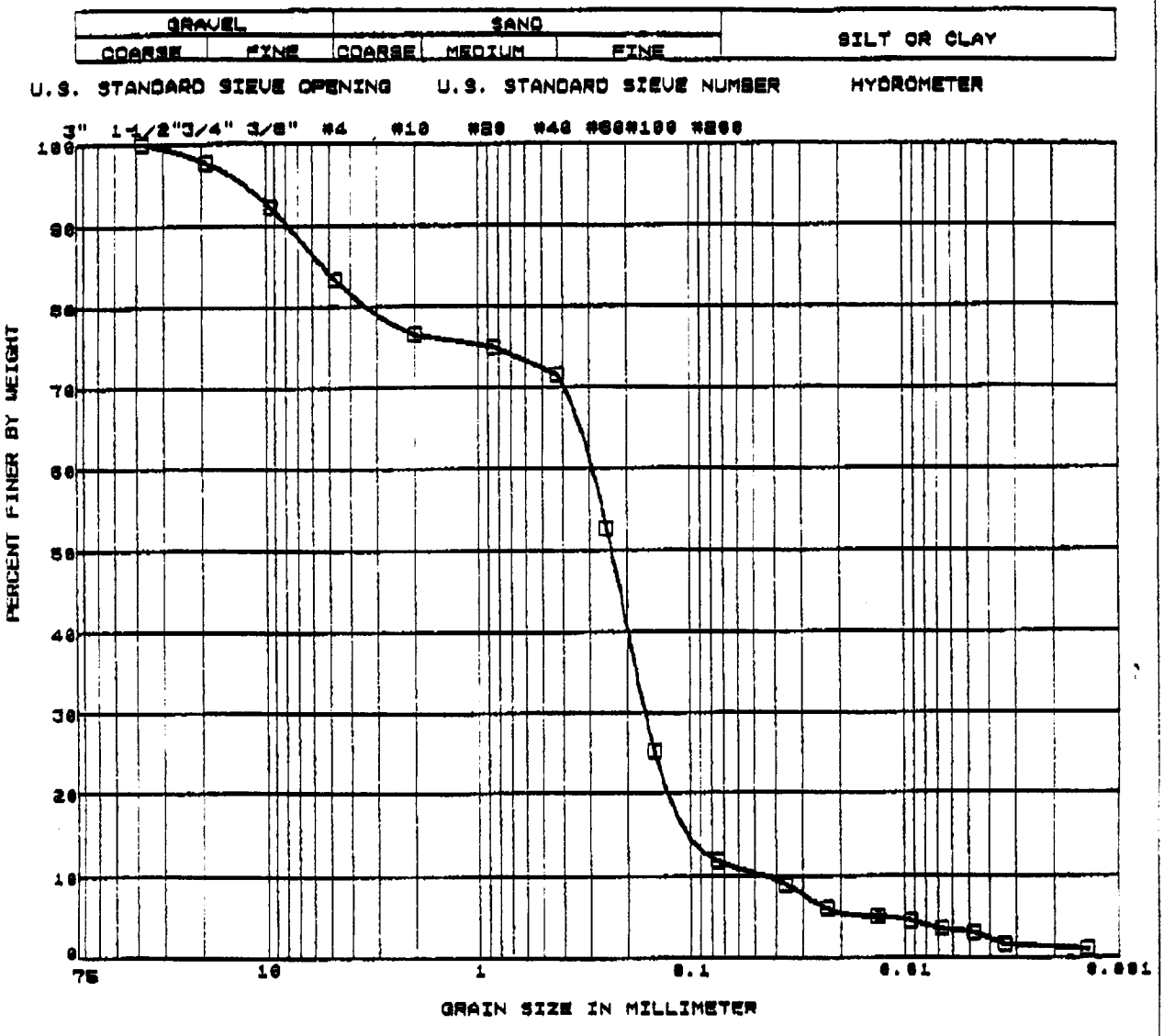
The Earth Technology Corporation

PROJECT NAME: NAS Alameda

GRAIN SIZE DISTRIBUTION CURVE

4/92

FIGURE



SYMBOL	SAMPLE ID.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-04-11		TUBE			

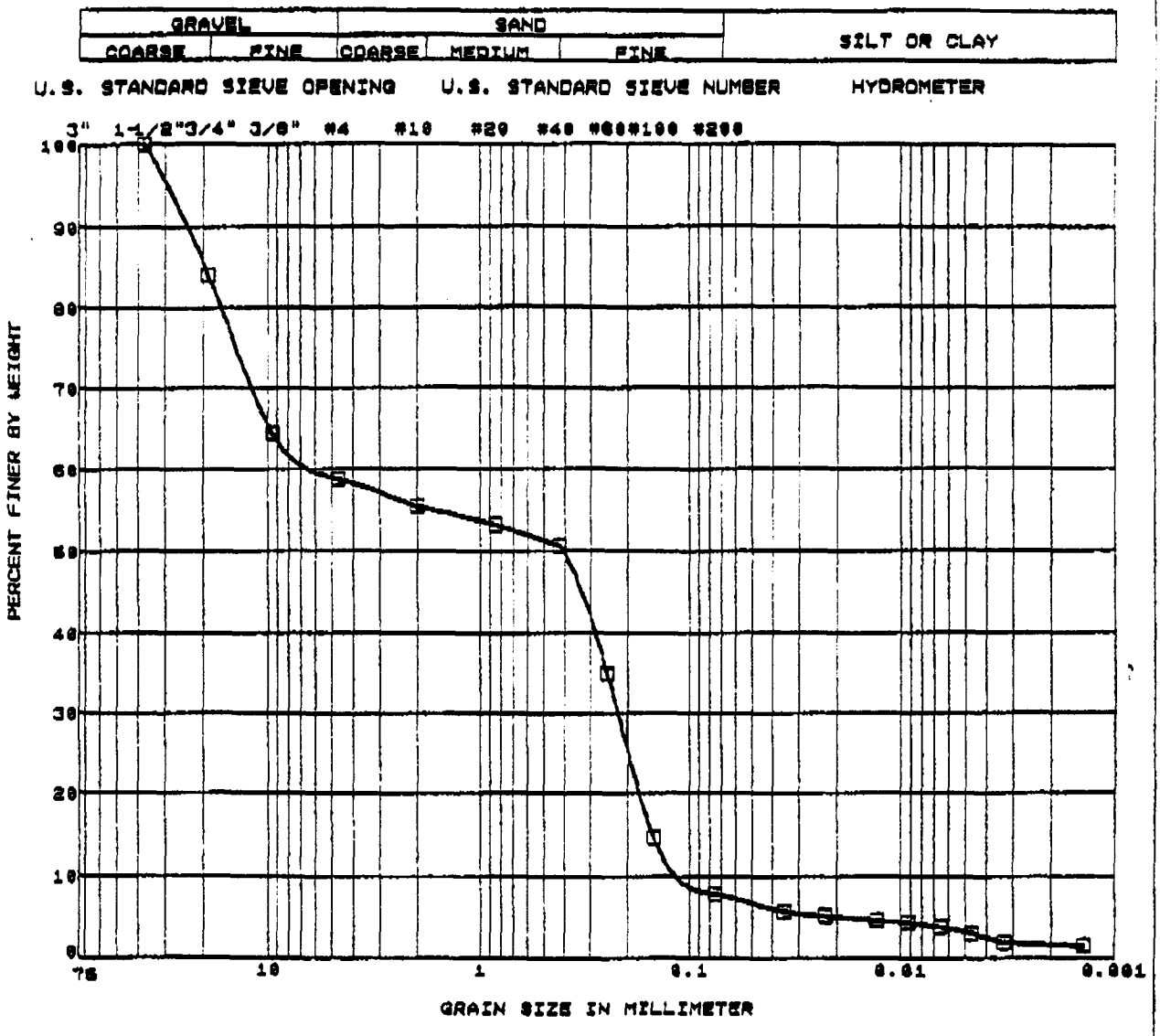
The Earth Technology Corporation

PROJECT NAME: NAS Alameda

GRAIN SIZE DISTRIBUTION CURVE

4/92

FIGURE



SYMBOL	SAMPLE ID.	DEPTH (FT)	SAMPLE TYPE	SOIL TYPE	LIQUID LIMIT	PLASTI-CITY INDEX
□	B-04-19		TUBE			

The Earth Technology Corporation

PROJECT NAME: NAS Alameda

GRAIN SIZE DISTRIBUTION CURVE

4/92

FIGURE

APPENDIX E

AQUIFER TESTING PROGRAM

1.0 INTRODUCTION

There are several acceptable methods for determining aquifer hydraulic properties. Determination of the hydraulic properties of an aquifer is commonly referred to as evaluating the "mechanics" of the aquifer. Developing an understanding of the aquifer mechanics is an important component of the site characterization. These data provide a means of quantifying aquifer properties, and therefore may be used subsequently for evaluation of the environmental fate and transport mechanisms for potential contaminants of concern. The three most common aquifer testing methods are:

- slug testing
- step-drawdown testing
- pumping tests

These methods are considered "in-situ" methods as each method involves determining the hydraulic characteristics of the aquifer by applying a "stress" to the aquifer and recording the response to that stress through time. Because the methods involve testing a relatively representative portion of the aquifer, they are generally considered more accurate than "ex-situ" (laboratory) soil permeability testing.

The hydraulic properties of interest include:

- Hydraulic conductivity - this property is a constant of proportionality that describes fluid flow through a porous media. Hydraulic conductivity ("K" by convention) is a function of the permeability of the media and of the physical properties of the fluid. In a groundwater setting, the physical properties of the water are considered relatively constant, and therefore hydraulic conductivity can be considered a function of the porous media. For this reason, the terms permeability and hydraulic conductivity are commonly used interchangeably for groundwater settings. It is important to note that hydraulic conductivity varies over 13 orders of magnitude for earth materials. For this reason, order-of-magnitude approximations are generally considered appropriate for evaluation of aquifer mechanics.

  The Darcy flow velocity of groundwater is directly proportional to the hydraulic conductivity of the aquifer and of the hydraulic gradient. Quantification of the hydraulic conductivity is therefore significant in terms of evaluating solute transport mechanisms associated with advection.

- Transmissivity - this term ("T" by convention) is simply the product of the hydraulic conductivity and the aquifer thickness ("b" by convention). Transmissivity typically varies

significantly due to spatial variations in both the thickness and conductivity of the aquifer.

- Storativity - this term represents the volume of water that an aquifer can release from storage per unit of aquifer storage area to a unit change in head ("S" by convention). Typically used for confined aquifer settings.

The three aquifer testing methods, slug testing, step-drawdown testing, and pumping tests have different applications and limitations. In general, step-drawdown tests and pumping tests are most feasible for relatively high transmissivity zones, such as sand and gravel aquifers. In these types of aquifers, the pumping test is the most accurate means of evaluating aquifer mechanics. With transmissive zones, groundwater can be removed at a rate that will stress the aquifer, and therefore water level changes will be noted in observation wells. Pumping tests are less effective for lower transmissivity zones because of difficulties in removing sufficient groundwater to stress the aquifer and measure a response in observation wells without dewatering the pumping well. These tests are typically infeasible or impractical for low yield aquifers. For low to moderately transmissive zones, a more viable aquifer test method is slug testing, described below.

2.0 SLUG TESTING

The slug withdrawal test requires the removal of a known volume from a well. A slug withdrawal test is commonly referred to as a "rising head" test. Water levels are monitored during recovery, and the rate at which a well recovers is a function of the hydraulic properties of the water-bearing stratum and of the well itself.

Because of the relatively small stress applied to the water-bearing zone, slug tests are best suited for low to moderately conductive aquifers. Slug tests are representative of the aquifer material in the area relatively close to the well. However, the tests provide a cost-effective means of determining "point" transmissivities over a large area such as the NAS Alameda facility.

3.0 SLUG TESTING METHODS

Rising head slug tests were conducted in 37 monitoring wells at the NAS Alameda facility to evaluate in-situ permeabilities of the uppermost water-bearing zone. These wells partially penetrate this zone.

This slug test data were analyzed using the methods of Bouwer and Rice for unconfined aquifers. The commercially available software program "AQTESOLV" was used for data reduction.

The rising head field data, result output, and graphs are included in this Appendix. Field procedures to obtain slug test data from the monitoring wells on the NAS Alameda facility are discussed in Appendix A of this report.

4.0 UNCONFINED SLUG TEST METHODOLOGY

The Bouwer and Rice equation was used for the unconfined aquifer slug tests. Monitoring wells whose screen intervals straddle the water table require a well borehole radius adjustment to compensate for water storage in the filter pack (Bouwer, 1989; Kruseman & deRidder, 1990; Schafer, 1992). The Bouwer and Rice article and Bouwer's update article are attached for reference. The equation used to adjust for the borehole radius is:

$$r_{w\,adj} = [(1-n)r_c^2 + nr_w^2]^{1\backslash 2}$$

where:

n	=	porosity
r_c	=	radius of well casing
r_w	=	radius of well (including filter pack)
$r_{w\,adj}$	=	adjusted radius of well (including filter pack)

A porosity of 0.3 was used in this study and is within the range for sands and silts (Freeze & Cherry, 1979).

For evaluation of slug tests in unconfined aquifers, the following conditions and assumptions are applied (Bouwer & Rice, 1976; Kruseman & deRidder, 1990):

- The aquifer is unconfined and has an apparent infinite areal extent;
- The aquifer if homogeneous, isotropic, and of uniform thickness over the area influenced by the slug test;
- Prior to the test, the water table is (nearly) horizontal over the area that will be influenced by the test;
- The head in the well is lowered instantaneously at $t_o = 0$; the drawdown in the water table around the well is negligible; there is no flow above the water table;
- The inertia of the water column in the well and the linear and non-linear well losses are negligible;
- The well either partially or fully penetrates the saturated thickness of the aquifer;
- The well diameter is finite; hence storage in the well cannot be neglected;

- The flow to the well is in a steady state.

Data are plotted on a time versus drawdown graph. The x- and y- axis intersections from a late time, flat slope line are used to calculate the hydraulic conductivity (K) value in wells which the screen or open intervals are fully submerged (Figure E-1). However, in wells which the screen or open interval straddle the water-table, a double flat slope line effect is typically observed (Figure E-2). The first steep slope (early time) line shows the filter pack or developed zone drainage. The second flat slope (late time) line is representative of flow from the undisturbed saturated screened aquifer zone (Bouwer, 1989; Schafer, 1992). The second slope line is used to calculate the K value.

The knowns and constants listed in the result output, as shown on Figure E-3, correspond to the Bouwer and Rice equation. Field data were measured in feet and minutes. The hydraulic conductivity results were converted to SI units of centimeters per second. The y_o on the result output refers to the drawdown value where the slope line intersects the y axis.

5.0 DISCUSSION

Several limitations are inherent to slug testing methods. These limitations include:

- Slug tests only provide aquifer characteristics over a relatively small area of investigation. Uncertainty between data points (wells) may be significant in heterogeneous hydrogeologic setting.

- Aquifer storage coefficients for unconfined aquifers cannot be determined using slug tests. Storativity values determined for confined aquifers are only approximate values and should not be used for estimating long-term steady state conditions (Cooper et al, 1967).

- Slug tests are incapable of providing data required to evaluate the pumping characteristics of the well, and therefore cannot determine specific capacity or well efficiency. Well efficiency may be compromised by construction details, well development, and borehole skin effects.

6.0 SLUG TEST DATA INFORMATION SUMMARY

This section summarizes and clarifies information found in the following rising head field data, result output, and graphs. The previous sections discuss the following information in greater detail.

Rising Head Field Data	Measurement Units/Comments
Value (Head)	feet (ft)
Elapsed time*	minutes (min)

* Some values are negative numbers as is a result of the datalogger recording procedures. Based upon initial head readings, the appropriate change in head values were calculated.

Result Output - Bouwer and Rice Method	Measurement Units/Comments
Knowns and Constants:	
Radius of well casing	ft
Radius of well (borehole)**	ft
Aquifer saturated thickness	ft
Well screen length	ft
Static height of water in well	ft
$Log(R_e/R_w)$	Program printout error, should be $\ln(R_e/R_w)$
A,B,C	Dimensionless parameter as a function of L_e/R_w for the calculation of $\ln(R_e/R_w)$ (see Bouwer and Rice, 1989). These parameters are calculated by the program.
R_e	Equivalent radius over which head loss occurs
R_w	Radius of well (including gravel pack)

** This value may have an borehole radius adjustment (see Bouwer and Rice, 1989).

Results from Visual Curve Matching:	
K (hydraulic conductivity)	ft/min (cm/sec)***
y_0	ft; intersection of the slope on the y axis
Visual match parameter estimates	The program statistics provide an incorrect K estimation.
Type Curve Data	Correct estimated K produced by visual/manual curve matching. The time and drawdown data following the K and y_0 results are residual program statistics information. This information is not immediately relevant to the calculated K value.

*** This hydraulic conductivity value was converted to SI units of centimeters and seconds.

Result Output Graph:

Figures E-1 and E-2 discussed in the aquifer testing program description illustrate the appropriate slopes on a time versus drawdown graph. Note that on these graphs, the y-axis has been labelled as H/H_0 and should be labelled as drawdown.

7.0 REFERENCES

Bouwer, H., 1989. The Bouwer and Rice Slug Test - An Update. Groundwater, Vol. 27, No. 3, pp. 304-309.

Bouwer, H. and R.C. Rice, 1976. A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells. Water Resources Research, Vol. 12, No. 3, pp. 423-428.

Cooper, H.H., J.D. Bredehoeft, and S.S. Papadopulos, 1967. Response of a Finite-Diameter Well to an Instantaneous Charge of Water. Water Resources Research, Vol. 3, No. 1, pp. 263-269.

Driscoll, F.G., 1986. Groundwater and Wells, 2nd Edition. Johnson Filtration Systems Inc., St. Paul, Minnesota, pp. 59-85, 205-267, 534-579.

Duffield, G.M., J.O. Rumbaugh, III, 1991. AQTESOLV, Aquifer Test Solver, Version 1.10. Geraghty and Miller Modeling Group, Reston, VA.

Freeze, R.A. and J.A. Cherry, 1979. Groundwater. Prentice-Hall Inc., Englewood Cliff, NJ, pp. 29, 37, 339-342.

Kruseman, G.P. and N.A. deRidder, 1990. Analysis and Evaluation of Pumping Test Data, 2nd Edition. ILRI publication 47, pp. 237-247.

Schafer, D.A., 1992. Slug Tests. Unpublished article in "Testing and Modeling Low Yield Aquifers" short course, June 1992, Groundwater Resource Association of California, Pleasant Hill, CA.

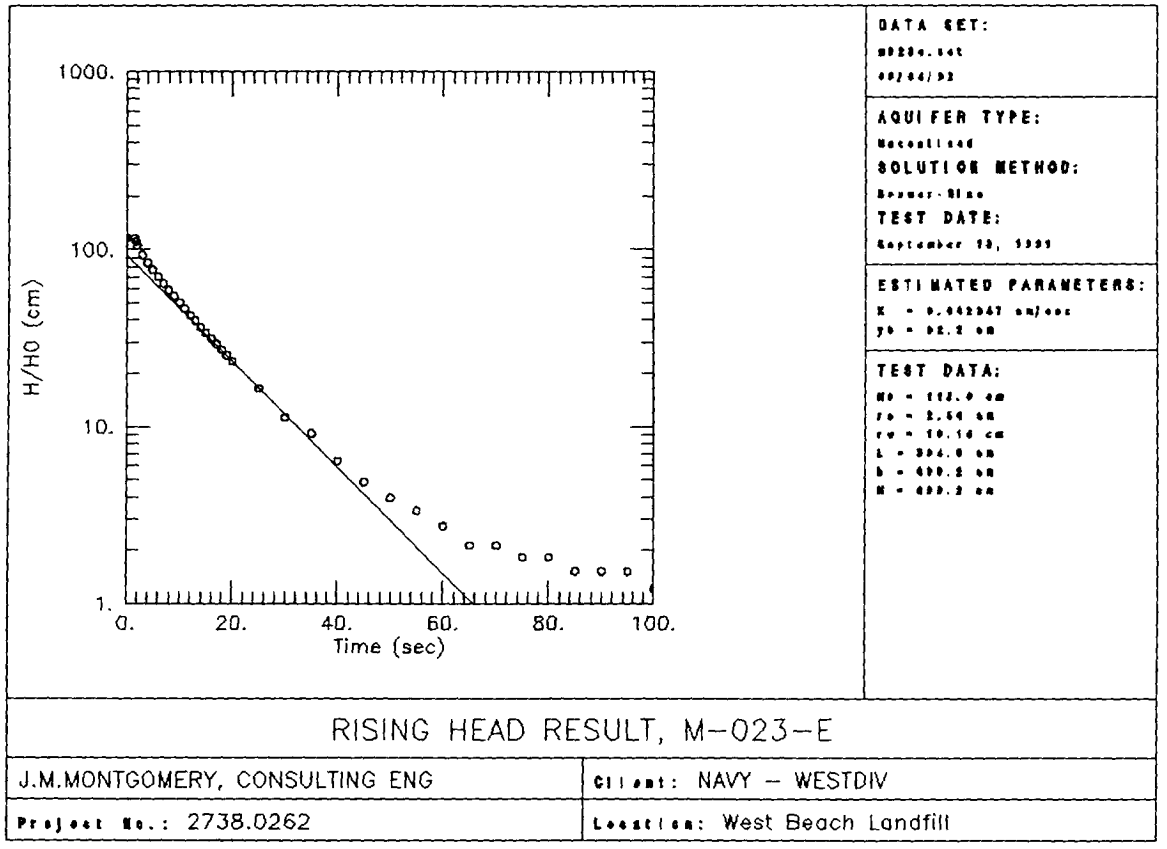


Figure E-1
Example of a typical time versus drawdown graph for unconfined conditions.

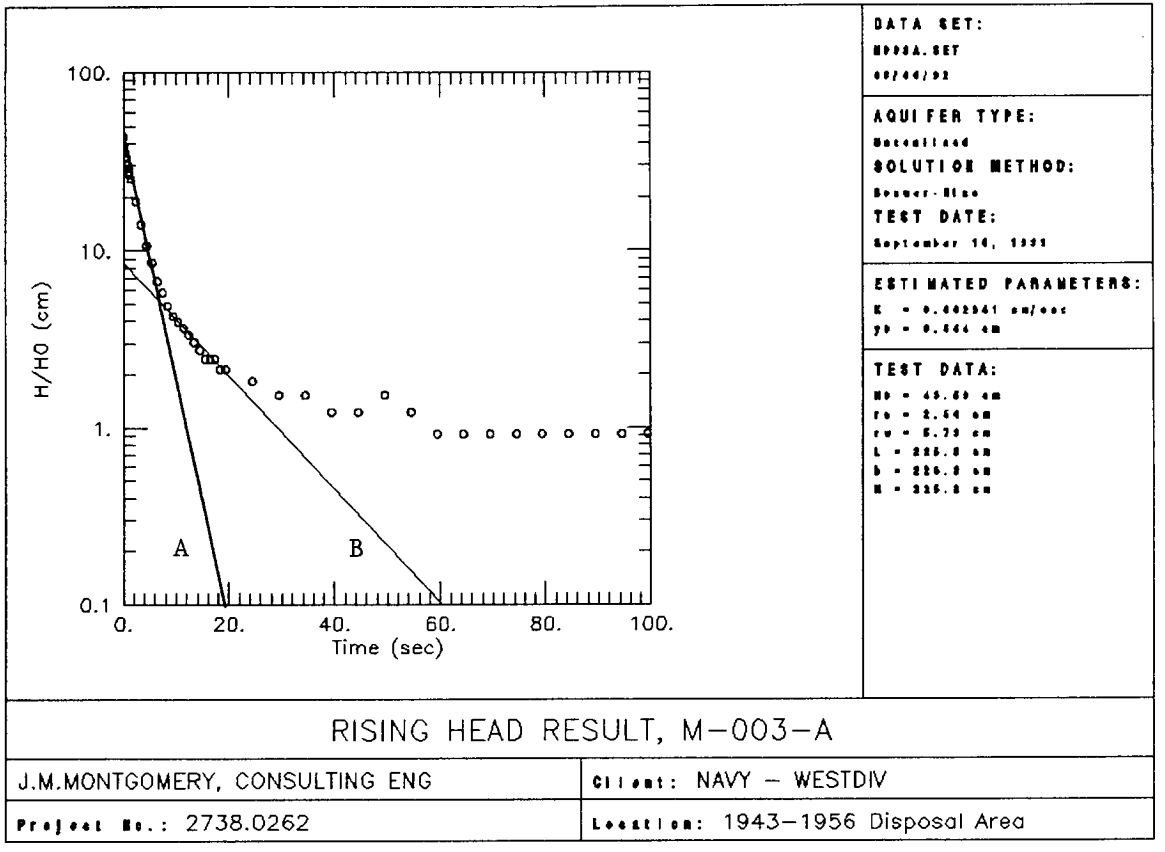


Figure E-2

Example of a time versus drawdown graph illustrating a steep slope, A (early time) and a flat slope, B (late time) for unconfined conditions in which the screen or open interval straddles the water table.

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A Q T E S O L V   R E S U L T S

Version 1.10

02/24/92 15:30:30

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TEST DESCRIPTION

Data set........... m001a.set
Data set title..... RISING HEAD RESULT, M-001-A
Company............ JAMES M. MONTGOMERY
Project............ 2738.0262
Client............. NAVY - WESTDIV
Location........... 1943-1956 Disposal Area
Test date.......... July 26, 1991

Knowns and Constants:
No. of data points.................. 35
Radius of well casing............... 2.54
Radius of well...................... 5.79
Aquifer saturated thickness......... 274.3
Well screen length.................. 274.3
Static height of water in well...... 274.3
Log(Re/Rw).......................... 2.951
A, B, C............................. 0.000, 0.000, 2.549

= =

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

= =

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 1.8613E-003 (Incorrect hydraulic conductivity estimation)
y0 = -1.3253E+100

< < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < < <

TYPE CURVE DATA

K = 2.21280E-003 (Correct estimated hydraulic conductivity)
y0 = 7.16778E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	7.168E+000	8.000E+001	4.361E-002		

Figure E-3
Example of a result output file using the Bouwer and Rice method.

A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers With Completely or Partially Penetrating Wells

HERMAN BOUWER AND R. C. RICE

U.S. Water Conservation Laboratory, Agricultural Research Service, U.S. Department of Agriculture, Phoenix, Arizona 85040

A procedure is presented for calculating the hydraulic conductivity of an aquifer near a well from the rate of rise of the water level in the well after a certain volume of water is suddenly removed. The calculation is based on the Thiem equation of steady state flow to a well. The effective radius R_e over which the head difference between the equilibrium water table in the aquifer and the water level in the well is dissipated was evaluated with a resistance network analog for a wide range of system geometries. An empirical equation relating R_e to the geometry of the well and aquifer was derived. The technique is applicable to completely or partially penetrating wells in unconfined aquifers. It can also be used for confined aquifers that receive water from the upper confining layer. The method's results are compatible with those obtained by other techniques for overlapping geometries.

With the slug test the hydraulic conductivity or transmissibility of an aquifer is determined from the rate of rise of the water level in a well after a certain volume or 'slug' of water is suddenly removed from the well. The slug test is simpler and quicker than the Theis pumping test because observation wells and pumping the well are not needed. With the slug test the portion of the aquifer 'sampled' for hydraulic conductivity is smaller than that for the pumping test even though with the latter, most of the head loss also occurs within a relatively small distance of the pumped well and the resulting transmissibility primarily reflects the aquifer conditions near the pumped well.

Essentially instantaneous lowering of the water level in a well can be achieved by quickly removing water with a bailer or by partially or completely submerging an object in the water, letting the water level reach equilibrium, and then quickly removing the object. If the aquifer is very permeable, the water level in the well may rise very rapidly. Such rapid rises can be measured with sensitive pressure transducers and fast-response strip chart recorders or x-y plotters. Also it may be possible to isolate portions of the perforated or screened section of the well with special packers for the slug test. This not only reduces the inflow and hence the rate of rise of the water level in the well, but it also makes it possible to determine the vertical distribution of the hydraulic conductivity. Special packer techniques may have to be developed to obtain a good seal, especially for rough casings or perforations. Effective sealing may be achieved with relatively long sections of inflatable stoppers or tubing. The use of long sections of these materials would also reduce leakage flow from the rest of the well to the isolated section between packers. This flow can occur through gravel envelopes or other permeable zones surrounding the casing. Sections of inflatable tubing may have to be long enough to block off the entire part of the well not used for the slug test. High inflation pressures should be used to minimize volume changes in the tubing due to changing water pressures in the isolated section when the head is lowered.

So far, solutions for the slug test have been developed only for completely penetrating wells in confined aquifers. *Cooper et al.* [1967] derived an equation for the rise or fall of the water level in a well after sudden lowering or raising, respectively. Their equation was based on nonsteady flow to a pumped, completely penetrating well, and the solution was expressed as a series of 'type curves' against which observed rates of water level rises were matched. Values for the transmissibility and storage coefficient were then evaluated from the curve parameter and horizontal-scale position of the type curve showing the best fit with the experimental data. *Skibitzke* [1958] developed an equation for calculating transmissibility from the recovery of the water level in a well that was repeatedly bailed. The technique is limited to wells in confined aquifers with sufficiently shallow water levels to permit short time intervals between bailing cycles [*Lohman*, 1972].

To use the slug test for partially penetrating or partially perforated wells in confined or unconfined aquifers, some solutions developed for the auger hole and piezometer techniques to measure soil hydraulic conductivity [*Bouwer and Jackson*, 1974] may be employed. However, the geometry of most groundwater wells is outside the range in geometry covered by the existing equations or tables for the auger hole or piezometer methods. For this reason, theory and equations are presented in this paper for slug tests on partially or completely penetrating wells in unconfined aquifers for a wide range of geometry conditions. The wells may be partially or completely perforated, screened, or otherwise open along their periphery. While the solutions are developed for unconfined aquifers, they may also be used for slug tests on wells in confined aquifers if water enters the aquifer from the upper confining layer through compression or leakage.

THEORY

Geometry and symbols of a well in an unconfined aquifer are shown in Figure 1. For the slug test the water level in the well is suddenly lowered, and the rate of rise of the water level is measured. The flow into the well at a particular value of y can be calculated by modifying the Thiem equation to

$$Q = 2\pi KL \frac{y}{\ln (R_e/r_w)} \tag{1}$$

where Q is the flow into the well (length³/time), K is the hydraulic conductivity of the aquifer (length/time), L is the height of the portion of well through which water enters (height of screen or perforated zone or of uncased portion of well), y is the vertical distance between water level in well and equilibrium water table in aquifer, R_e is the effective radius over which y is dissipated, and r_w is the horizontal distance

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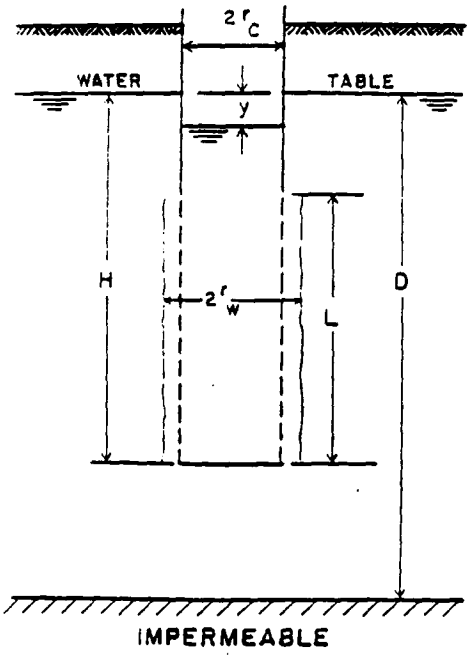

Fig. 1. Geometry and symbols of a partially penetrating, partially perforated well in unconfined aquifer with gravel pack or developed zone around perforated section.

from well center to original aquifer (well radius or radius of casing plus thickness of gravel envelope or developed zone).

The terms L, y, R_e, and r_w are all expressed in units of length. The effective radius R_e is the equivalent radial distance over which the head loss y is dissipated in the flow system. The value of R_e depends on the geometry of the flow system, and it was determined for different values of H, L, D, and r_w (Figure 1) with a resistance network analog, as will be discussed in the next section. Equation (1) is based on the assumptions that (1) drawdown of the water table around the well is negligible, (2) flow above the water table (in the capillary fringe) can be ignored, (3) head losses as water enters the well (well losses) are negligible, and (4) the aquifer is homogeneous and isotropic. These are the usual assumptions in the development of equations for pumped hole techniques [*Bouwer and Jackson*, 1974, and references therein].

The value of r_w in (1) represents the radial distance between the undisturbed aquifer and the well center. Thus r_w should include gravel envelopes or 'developed' zones if they are much more permeable than the aquifer itself (Figure 1).

The rate of rise, dy/dt, of the water level in the well after suddenly removing a slug of water can be related to the inflow Q by the equation

$$dy/dt = -Q/\pi r_c^2 \tag{2}$$

where πr_c^2 is the cross-sectional area of the well where the water level is rising. The minus sign in (2) is introduced because y decreases as t increases.

The term r_c is the inside radius of the casing if the water level is above the perforated or otherwise open portion of the well. If the water level is rising in the perforated section of the well, allowance should be made for the porosity outside the well casing if the hydraulic conductivity of the gravel envelope or developed zone is much higher than that of the aquifer. In that case the (open) porosity in the permeable zone must be included in the cross-sectional area of the well. For example, if the radius of the perforated casing is 20 cm and the casing is surrounded by a 10-cm permeable gravel envelope with a porosity of 30%, r_c should be taken as $[20^2 + 0.30(30^2 - 20^2)]^{1/2} = 23.5$ cm to obtain the cross-sectional area of the well that relates Q to dy/dt. The value of r_w for this well section is 30 cm.

Combining (1) and (2) yields

$$\frac{1}{y}\,dy = -\frac{2KL}{r_c^2 \ln (R_e/r_w)}\,dt \tag{3}$$

which can be integrated to

$$\ln y = -\frac{2KLt}{r_c^2 \ln (R_e/r_w)} + \text{constant} \tag{4}$$

Applying this equation between limits y_0 at $t = 0$ and y_t at t and solving for K yield

$$K = \frac{r_c^2 \ln (R_e/r_w)}{2L}\,\frac{1}{t}\,\ln\frac{y_0}{y_t} \tag{5}$$

This equation enables K to be calculated from the rise of the water level in the well after suddenly removing a slug of water from the well. Since K, r_c, r_w, R_e, and L in (5) are constants, $(1/t)\ln y_0/y_t$ must also be constant. Thus field data should yield a straight line when they are plotted as $\ln y_t$ versus t. The term $(1/t)\ln y_0/y_t$ in (5) is then obtained from the best-fitting straight line in a plot of $\ln y$ versus t (see the example). The value of $\ln R_e/r_w$ is dependent on H, D, L, and r_w and can be evaluated from the analog results presented in the next section. The transmissibility T of the aquifer is calculated by multiplying (5) by the thickness D of the aquifer or

$$T = \frac{Dr_c^2 \ln (R_e/r_w)}{2L}\,\frac{1}{t}\,\ln\frac{y_0}{y_t} \tag{6}$$

This equation is based on the assumption that the aquifer is uniform with depth.

Equations (5) and (6) are dimensionally correct. Thus K and T are expressed in the same units as the length and time parameters in the equations.

EVALUATION OF R_e

Values of R_e, expressed as $\ln R_e/r_w$, were determined with an electrical resistance network analog for different values of r_w, L, H, and D (Figure 1), using the same assumptions as those for (1). An axisymmetric sector of 1 rad was simulated by a network of electrical resistors. The vertical distance between the nodes was constant, but the radial distance between nodes increased with increasing distance from the center line (Figure 2). This yielded a network with the highest node density near the well, where the head loss was greatest, and a decreasing node density toward the outer reaches of the system. For a more detailed discussion of graded networks for representing axisymmetric flow systems, see *Liebmann* [1950] and *Bouwer* [1960].

The radial extent of the medium represented on the analog was more than 60,000 times the largest r_w value used in the analyses. Thus the radial extent of the analog system was essentially infinite, as evidenced by the fact that a reduction in radial extent by several nodes did not have a measurable effect on the observed value of R_e.

The value of R_e for an infinitely deep aquifer ($D = \infty$) was determined by simulating an impermeable and then an infinitely permeable layer at a certain value of D. If this value of D is taken to be sufficiently large, the flow in the system when the layer at D is taken as being impermeable is only slightly

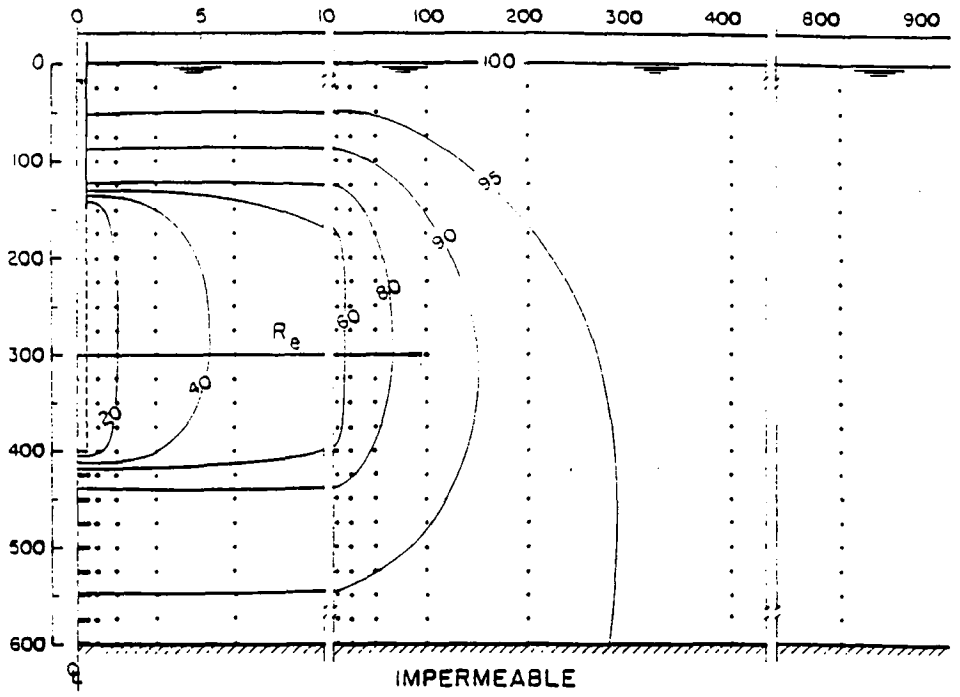

Fig. 2. Node arrangement (dots) for resistance network analog and potential distribution (indicated as percentages on equipotentials) for system with $L/r_w = 625$, $H/r_w = 1000$, and $D/r_w = 1500$. The numbers on the left and at the top of the figure are arbitrary length units (note breaks in horizontal scale).

less than the flow when the layer is taken as being infinitely permeable. The average of the two flows can then be taken as a good estimate of the flow that would occur if the aquifer were represented on the analog as being uniform to infinite depth [*Bouwer*, 1967]. This average flow was used to calculate R_e for $D = \infty$.

The analog analyses were performed by simulating a system with certain values of r_w, H, and D. The electrical current entering the 'well' was then measured for different values of L, ranging from near H to near 0. This was repeated for other values of r_w, H, and D. The condition where $L = H$ could not be simulated on the analog because it would mean a short between the water table as the source and the well as the sink. The electrical current flow in the analog was converted to volume per day, and $\ln R_e/r_w$ was evaluated with (1) for each combination of r_w, H, L, and D used in the analog.

For a given geometry described by r_w, H, and D, the current flow Q_l into the simulated well varied essentially linearly with L and could be described by the equation

$$Q_l = mL + n \tag{7}$$

Because of the linearity between Q_l and L the results of the analyses could be extrapolated to the condition $L = H$. The values of m in (7) appeared to vary inversely with $\ln H/r_w$. The values of n varied approximately linearly with $\ln [(D - H)/r_w]$, the slope A and intercept B in these relations being a function of L/r_w. This enabled the derivation of the following empirical equation relating $\ln R_e/r_w$ to the geometry of the system:

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln (H/r_w)} + \frac{A + B \ln [(D - H)/r_w]}{L/r_w}\right]^{-1} \tag{8}$$

In this equation, A and B are dimensionless coefficients that are functions of L/r_w, as shown in Figure 3. If $D >> H$, an increase in D has no measurable effect on $\ln R_e/r_w$. The analog results indicated that the effective upper limit of $\ln [(D - H)/r_w]$ is 6. Thus if D is considered infinity or $(D - H)/r_w$ is so large that $\ln [(D - H)/r_w]$ is greater than 6, a value of 6 should still be used for the term $\ln [(D - H)/r_w]$ in (8).

If $D = H$, the term $\ln [(D - H)/r_w]$ in (8) cannot be used. The analog results indicated that for this condition, which is the case of a fully penetrating well, (8) should be modified to

$$\ln R_e/r_w = \left(\frac{1.1}{\ln (H/r_w)} + \frac{C}{L/r_w}\right)^{-1} \tag{9}$$

where C is a dimensionless parameter that is a function of L/r_w as shown in Figure 3.

Equations (8) and (9) yield values of $\ln R_e/r_w$ that are within 10% of the actual value as evaluated by analog if $L > 0.4H$ and within 25% if $L << H$ (for example, $L = 0.1H$).

The analog analyses were performed for wells that were closed at the bottom. Occasionally, however, wells with open bottoms were also simulated. The flow through the bottom appeared to be negligible for all values of r_w and L used in the analyses. If L is not much greater than r_w (for example, $L/r_w << 4$), the system geometry approaches that of a piezometer cavity [*Bouwer and Jackson*, 1974], in which case the bottom flow can be significant. Equations (8) and (9) can also be used to evaluate $\ln R_e/r_w$ if a portion of the perforated or otherwise open part of the well is isolated with packers for the slug test.

Equipotentials for the flow system around a partially penetrating, partially perforated well in an unconfined aquifer after lowering the water level in the well are shown in Figure 2. The numbers along the symmetry axis and the water table represent arbitrary length units. The numbers on the equipotentials indicate the potential as a percentage of the total head difference between the water table (100%) and the open portion of the well (0%) shown as a dashed line.

The value of R_e for the case in Figure 2 is 96.7 length units. As shown in the figure, this corresponds approximately to the

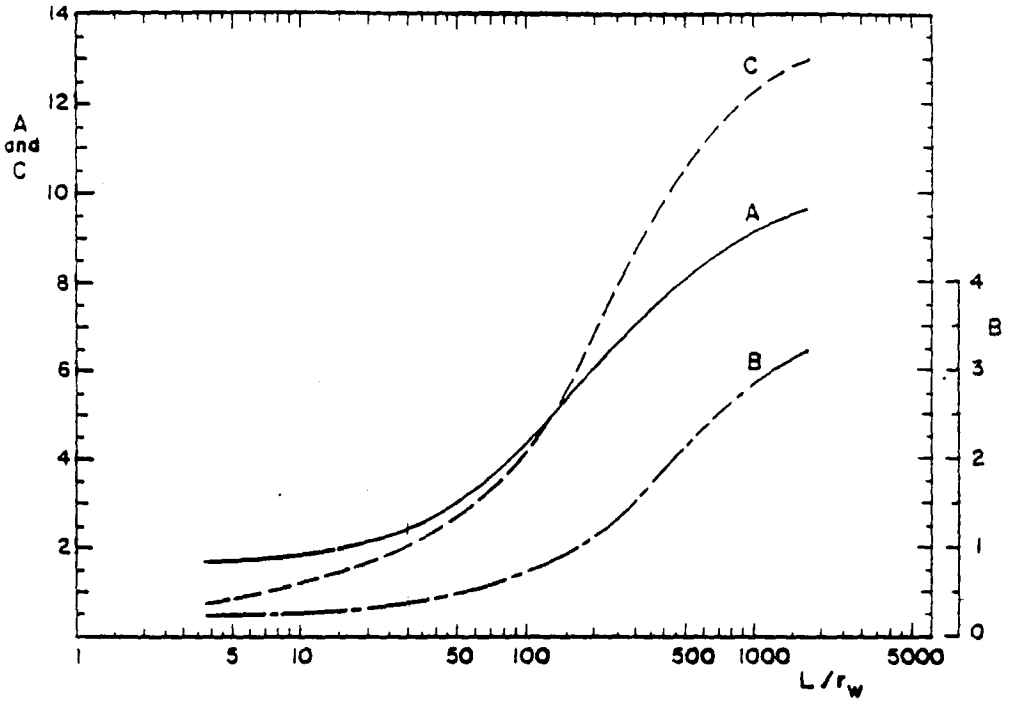

Fig. 3. Curves relating coefficients A, B, and C to L/r_w.

85% equipotential when R_e is laterally extended from the center of the open portion of the well. Thus most of the head loss in the flow system occurs in a cylinder with radius R_e, which is indicative of the horizontal extent of the portion of the aquifer sampled for K or T. The vertical extent is somewhat greater than L, as indicated by, for example, the 80% equipotential in Figure 2.

To estimate the rate of rise of the water level in a well after it is suddenly lowered, (5) can be written as

$$t = \frac{r_c^2}{2KL} \ln \frac{R_e}{r_w} \ln \frac{y_0}{y_t} \tag{10}$$

By taking $y_t = 0.9y_0$, (10) reduces to

$$t_{90\%} = 0.0527 \frac{r_c^2}{KL} \ln \frac{R_e}{r_w} \tag{11}$$

where $t_{90\%}$ is the time that it takes for the water level to rise 90% of the distance to the equilibrium level. By assuming a permeable aquifer with $K = 30$ m/day, a well with $r_c = 0.2$ m and $L = 10$ m, and $\ln (R_e/r_w) = 3$, (11) yields $t_{90\%} = 1.82$ s. Thus if y_0 is taken as 30 cm, it takes 1.8 s for the water level to rise 27 cm, another 1.8 s for the next 2.7 cm (90% of the remaining 3 cm), and another 1.8 s for the next 0.27 cm, or a total of 5.4 s for a rise of 29.97 cm. Measurement of this fast rise requires a sensitive and accurate transducer and a fast-response recorder. The rate of rise can be reduced by allowing groundwater to enter through only a portion of the open section of the well, as can be accomplished with packers.

For a moderately permeable aquifer with, for example, $K = 1$ m/day, a well with $r_c = 0.1$ m and $L = 20$ m, and $\ln (R_e/r_w) = 5$, (11) yields $t = 11.4$ s. In this case, it would take the water level 22.8 s to rise from 30 cm to 0.3 cm below static level.

EXAMPLE

A slug test was performed on a cased well in the alluvial deposits of the Salt River bed west of Phoenix, Arizona. The well, known as the east well, is located about 20 m east of six rapid infiltration basins for groundwater recharge with sewage effluent [*Bouwer*, 1970]. The static water table was at a depth of 3m, $D = 80$ m, $H = 5.5$ m, $L = 4.56$ m, $r_c = 0.076$ m, and r_w was taken as 0.12 m to allow for development of the aquifer around the perforated portion of the casing. A Statham PM131TC pressure transducer was suspended about 1 m below the static water level in the well (when trade names and company names are included, they are for the convenience of the reader and do not imply preferential endorsement of a particular product or company over others by the U.S. Department of Agriculture). A solid cylinder with a volume equivalent to a 0.32-m change in water level in the well was also placed below the water level. When the water level had returned to equilibrium, the cylinder was quickly removed. The transducer output, recorded on a Sargent millivolt recorder, yielded the y-t relationship shown in Figure 4 with y plotted on a logarithmic scale. The straight-line portion is the valid part of the readings. The actual y_0 value of 0.29 m indicated by the straight line is close to the theoretical value of 0.32 m calculated from the displacement of the submerged cylinder.

Extending the straight line in Figure 4 shows that for the arbitrarily selected t value of 20 s, $y = 0.0025$ m. Thus $(1/t) \ln y_0/y_t = 0.238$ s^{-1}. The value of $L/r_w = 38$, for which Figure 3 yields $A = 2.6$ and $B = 0.42$. Substituting these values into (8) and using the maximum value of 6 for $\ln [(D - H)/r_w]$ (since $\ln [(D - H)/r_w]$ for the well exceeds 6) yield $\ln (R_e/r_w) = 2.37$. Equation (5) then gives $K = 0.00036$ m/s $= 31$ m/day. This value agrees with K values of 10 and 53 m/day obtained previously with the tube method on two nearby observation wells [*Bouwer*, 1970]. These K values were essentially point measurements on the aquifer immediately around the well bottoms, which were at depths of 9.1 and 6.1 m, respectively.

COMPARISONS

Piezometer method. The geometry to which (8) and (9) and the coefficients in Figure 3 apply overlaps the geometry of the

piezometer method at the lower values of L/r_w. With the piezometer method a cavity is augered out in the soil below a piezometer tube. The water level in the tube is abruptly lowered, and K of the soil around the cavity is calculated from the rate of rise of the water level in the tube [*Bouwer and Jackson*, 1974]. The equation for K is

$$K = \frac{\pi r_c^2}{A_V} \frac{1}{t} \ln \frac{y_0}{y_t} \tag{12}$$

where A_V is a geometry factor with dimension of length. Values of A_V were evaluated with an electrolytic tank analog by *Youngs* [1968], whose results were expressed in tabular form as A_V/r_w for different values of L/r_w (ranging between 0 and 8), $(H - L)/r_w$, and $(D - H)/r_w$.

Taking a hypothetical case where $L/r_w = 8$, $H/r_w = 12$, and $D/r_w = 16$, K calculated with (5) is 18% below K calculated with (12). This is more than the 10% error normally expected with (8) and (9) for the L/H value of 0.67 in this case. The larger discrepancy may be due to the difference in methodology, or to the fact that the L/r_w value is close to the lower limit of the range covered on the resistance network analog.

An approximate equation for calculating K with the piezometer method was presented by *Hvorslev* [1951]. The equation, which is based on the assumptions of an ellipsoidal cavity or well screen and infinite vertical extent (upward and downward) of the flow system, contains a term $[1 + (L/2r_w)^2]^{1/2}$. For most well-slug-test geometries, $L/2r_w$ will be sufficiently large to permit replacement of this term by $L/2r_w$. In that case, however, Hvorslev's equation for Q yields $R_e = L$, which is not true. In reality, R_e is considerably less than L. For example, if $L = 40$ m, $r_w = 0.4$ m, $H = 80$ m, and $D = \infty$, (8) shows that $R_e = 11.9$ m, which is much less than the value of 40 m indicated by Hvorslev's equation. However, since the calculation of K is based on $\ln (R_e/r_w)$ as shown by (5), the error in K is less than the error in R_e (i.e., 36 and 236%, respectively, in this case).

If, for the above example, the top of the well screen or cavity had been taken at the same level as the water table ($H = 40$ m), R_e would have been 8.6 m and Hvorslev's equation would have yielded a K value that is 50% higher than K given by (5). The larger error is probably due to Hvorslev's assumption of infinite vertical (upward) extent of the flow system, which is not met when the cavity is immediately below the water table. Using Hvorslev's equation for cavities immediately below a confining layer would increase the error to 73%, but this, of course, is due to the fact that a water table is not a solid boundary. Hvorslev's equation for the confining layer case can be shown to yield $R_e = 2L$.

Auger hole method. The analog analyses for (8) and (9) and Figure 3 were performed for $L < H$, because short circuiting between the water table and the well prevented simulation of the case where $L = H$. If the analog results are extrapolated to $L = H$, however, the geometry of the system in Figure 1 becomes similar to that of the auger hole technique, for which a number of equations and graphs have been developed to calculate K from the rise of the water level in the well [*Bouwer and Jackson*, 1974]. *Boast and Kirkham* [1971], for example, developed the equation

$$K = C_{BK} \frac{\Delta y}{\Delta t} \tag{13}$$

where C_{BK} was determined mathematically and expressed in tabular form for various values of L/r_w, $(D - H)/r_w$, and y_0/H. Since the rate of rise of the water level in the hole after

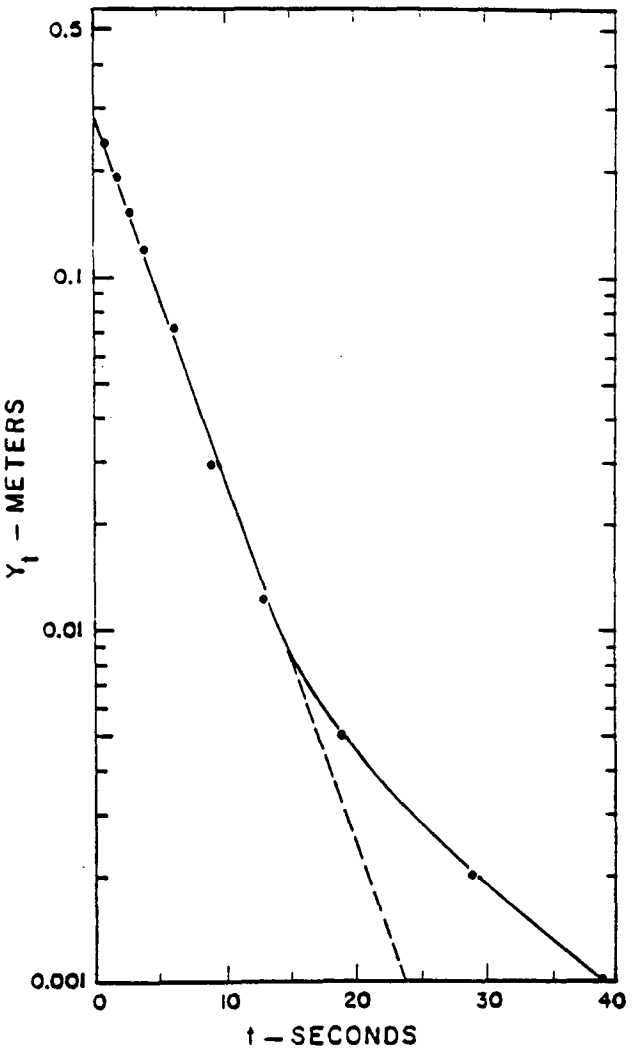

Fig. 4. Plot of y versus t for slug test on east well.

the removal of a slug of water decreases with decreasing y, $\Delta y/\Delta t$ is not a constant and the value of K obtained with this procedure depends on the magnitude of Δy used in the field measurements. The general rule is that Δy should be relatively small.

Taking a hypothetical case where $y_0 = 2.5$ m, $y_t = 2.4$ m, $\Delta t = 10$ s, $L = H = 5$ m, $D = 6$ m, and $r_w = 0.1$ m, (5) yields a K value that is 36% lower than K calculated with (13). However, if y_t is taken as 0.5 m, which should give $\Delta t = 394$ s according to the theory that $(1/t) \ln y_0/y_t$ is constant, the K value yielded by (5) is 26% higher than K obtained with (13). If y_t is taken as 0.9 m, (5) and (13) give identical results.

Slug test on wells in confined aquifers. The confined aquifer for which the slug test by *Cooper et al.* [1967] was developed is an aquifer with an internal water source, for example, recharge through aquitards or compression of confining layers or other material. This situation is similar to that of the unconfined aquifer presented in this paper because the water table is considered horizontal, like the upper boundary of a confined aquifer, and the water table is a plane source. Thus K or T calculated with (5) or (6) should be of the same order as K calculated with the procedure of *Cooper et al.* [1967], which involves plotting the rise of the water level in the well and finding the best fit on a family of type curves. *Cooper et al.* [1967] presented an example of the calculation of T for a well

with $r_c = r_w = 0.076$ m and $L = 98$ m. The resulting value of T was 45.8 m²/day. Values of D and H for this well were not given. However, since the well was 122 m deep and completely penetrating (at least theoretically), D and H must have been between 98 and 122 m. Assuming that both D and H were 100 m, (6) yields $T = 62.8$ m²/day, which is compatible with T obtained by Cooper et al.

CONCLUSIONS

The hydraulic conductivity of an aquifer near a well can be calculated from the rise of the water level in the well after a slug of water is suddenly removed. The calculation is based on the Thiem equation, using an effective radius R_e for the distance over which the head difference between the equilibrium water table in the aquifer and the water level in the well is dissipated. Values of R_e were evaluated by electrical resistance network analog. An empirical equation was then developed to relate R_e to the geometry of the system. This equation is accurate to within 10–25%, depending on how much of the well below the water table is perforated or otherwise open. The technique is applicable to partially or completely penetrating wells in unconfined aquifers. It can also be used to estimate the hydraulic conductivity of confined aquifers that receive water from the upper confining layer through recharge or compression.

The vertical distance between the rising water level in the well and the equilibrium water table in the aquifer must yield a straight line when it is plotted on a logarithmic scale against time. This can be used to check the validity of field measurements and to obtain the best-fitting line for calculating the hydraulic conductivity. Permeable aquifers produce rapidly rising water levels that can be measured with fast-response pressure transducers and strip chart recorders or x-y plotters. The portion of the aquifer sampled for hydraulic conductivity with the slug test is approximately a cylinder with radius R_e and a height somewhat larger than the perforated or otherwise open section of the well.

Hydraulic conductivity values obtained with the propos slug test are compatible with those yielded by the auger h and piezometer techniques where the geometries of the syste overlap, and by a slug test for completely penetrating wells in confined aquifers.

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The Bouwer and Rice Slug Test — An Update[a]

by Herman Bouwer[b]

ABSTRACT

The Bouwer and Rice slug test was developed to measure aquifer hydraulic conductivity around boreholes (production, monitoring, or test wells). The wells can be partially penetrating and partially screened, perforated, or otherwise open. The slug test can be based on quickly withdrawing a volume of water from the well and measuring the subsequent rate of rise of the water level in the well, or by adding a slug of water and measuring the subsequent rate of fall of the water level in the well. While originally developed for unconfined aquifers, the method can also be used for confined or stratified aquifers if the top of the screen or perforated section is some distance below the upper confining layer. Anomalies ("double straight line effect") sometimes observed in the measured rate of rise of the water level in the well are attributed to drainage of a gravel pack or developed zone around the well following lowering of the water level. The effect of this drainage can be eliminated by ignoring the early data points and using the second straight line portion in the data plot for calculation of hydraulic conductivity. The method is applicable to any diameter and depth of the borehole, provided that the dimensions of the system are covered by the ranges for which the geometry factor R_e has been worked out. The smaller the diameter of the hole, however, the more vulnerable the results will be to aquifer heterogeneities and to inaccuracies in estimating effective well diameters. Computer programs for rapid processing of the field data have been developed.

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INTRODUCTION

The slug test developed by Bouwer and Rice (1976) permits the measurement of saturated hydraulic conductivity (K) of aquifer materials with a single well. The method consists of quickly lowering or raising the water level in a well or borehole from equilibrium and measuring its subsequent rate of rise or fall, respectively. The method was designed to measure K of the aquifer around the screen or otherwise open portion of the well for fully or partially penetrating wells in unconfined aquifers. Because of its simplicity, the Bouwer and Rice slug test has become a frequently used tool in ground-water investigations. This paper addresses some of the experiences obtained with the method, including the validity of falling level tests, use of the method in confined aquifers, effect of draining gravel packs on the rise of the water level, effect of hole diameter, and computer processing of field data.

METHODOLOGY

Geometry and symbols of a slug-tested well are shown in Figure 1. The rate of flow of ground water into the well when the water level in the well is a distance y lower than the static ground-water table around the well is calculated with the Thiem equation as

$$Q = 2\pi K L_e \frac{y}{\ln(R_e/r_w)} \qquad (1)$$

where Q = volume rate of flow into well; K = hydraulic conductivity of aquifer around well; L_e = length of screened, perforated, or otherwise open section of well; y = vertical difference between water level inside well and static water table outside

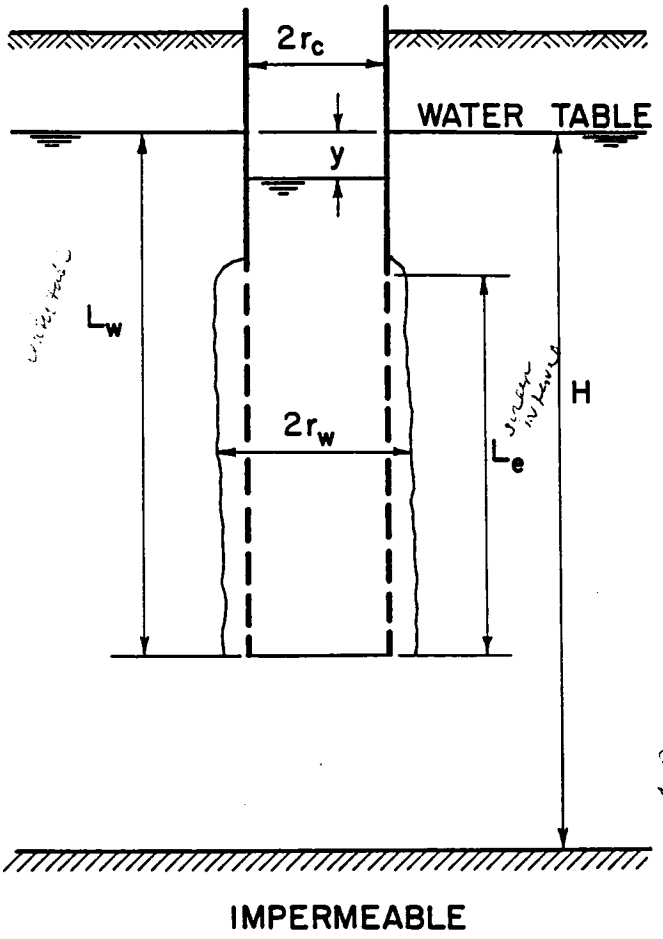

Fig. 1. Geometry and symbols for slug test on partially penetrating, partially screened well in unconfined aquifer with gravel pack and/or developed zone around screen.

well; R_e = effective radial distance over which y is dissipated; and r_w = radial distance of undisturbed portion of aquifer from centerline.

Values of R_e were determined with an electrical resistance network analog for different values of r_w, L_e, L_w, and H (see Figure 1 for meaning of geometry symbols). The value of r_w is the radius of the screened or open section of the well plus the thickness of a sand or gravel pack and/or of the developed zone around the well. Thus, r_w is the radial distance from the center of the well to normal K of the aquifer. Because the thickness of the developed zone is almost never known, the tendency is to ignore it and take only gravel or sand packs into account.

The rate of rise dy/dt of the water level in the well after the water level has been quickly lowered some distance is

$$\frac{dy}{dt} = -\frac{Q}{\pi r_c^2} \qquad (2)$$

where r_c is the radius of the casing or other section of the well where the rise of the water level is measured. If the water level rises in the screened or open section of the well with a gravel pack around it, the thickness and porosity of the gravel envelope should be taken into account when calculating the equivalent value of r_c for the rising water level. This calculation is based on the total free-water surface area in the well and sand or gravel pack, calculated as $\pi r_c^2 + \pi(r_w^2 - r_c^2)n$, where n is the porosity, and $r_w - r_c$ is the thickness of the envelope. The equivalent radius of a circle giving this total area is then calculated as $[(1-n)r_c^2 + nr_w^2]^{1/2}$. For example, if the radius of the screen or perforated casing is 20 cm and there is 8 cm gravel pack with a porosity of 30 percent, r_c should be taken as 25.9 cm, while r_w is 28 cm.

Solving equation (2) for Q, equating the resulting expression to equation (1), integrating, and solving for K yields

$$K = \frac{r_c^2 \ln(R_e/r_w)}{2L_e} \frac{1}{t} \ln \frac{y_0}{y_t} \qquad (3)$$

where y_0 = y at time zero; and y_t = y at time t.

The results of the analog analyses to evaluate R_e for various system geometries were expressed in terms of the dimensionless ratio $\ln(R_e/r_w)$. The data could be fitted into two equations, one for the case where $L_w < H$, and one where $L_w = H$. The resulting equations were, respectively,

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{A + B\ln[(H-L_w)/r_w]}{L_e/r_w}\right]^{-1} \qquad (4)$$

and

$$\ln \frac{R_e}{r_w} = \left[\frac{1.1}{\ln(L_w/r_w)} + \frac{C}{L_e/r_w}\right]^{-1} \qquad (5)$$

where A, B, and C are dimensionless numbers plotted in Figure 2 as a function of L_e/r_w.

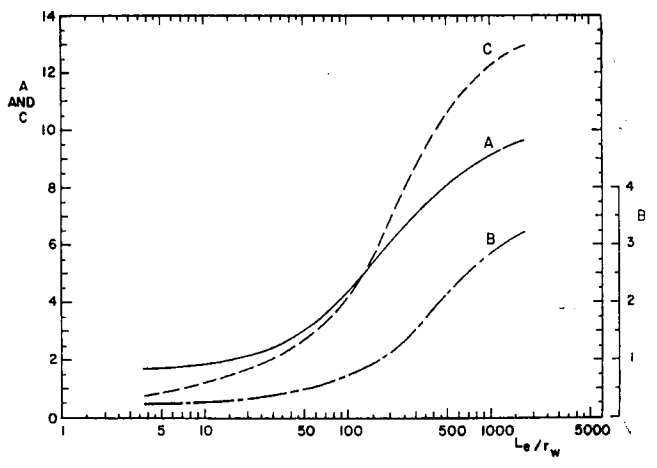

Fig. 2. Dimensionless parameters A, B, and C as a function of L_e/r_w for calculation of $\ln(R_e/r_w)$.

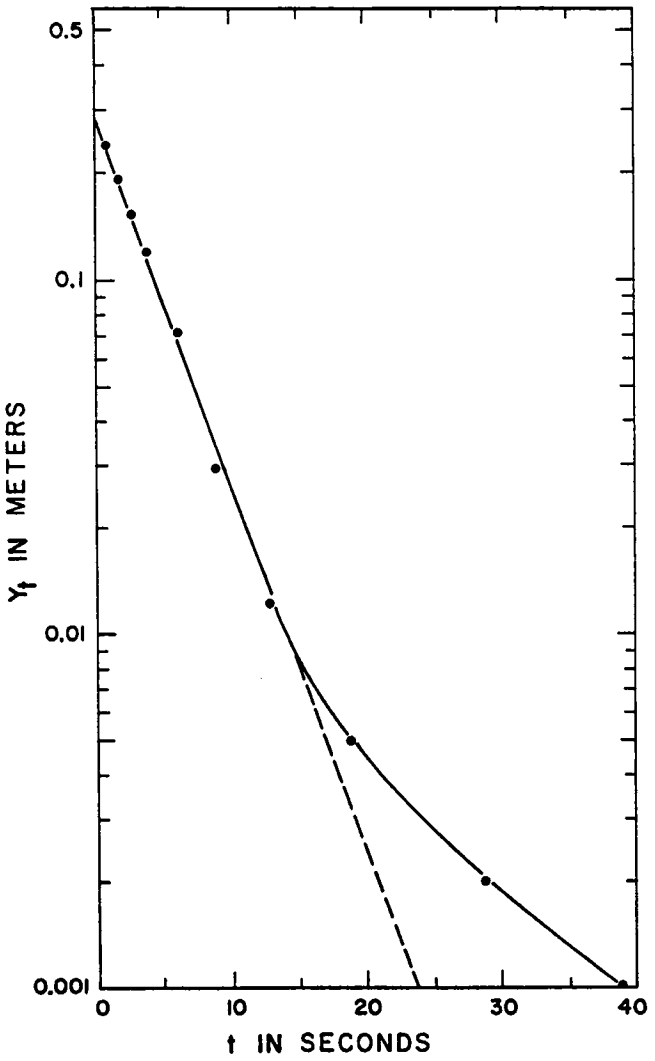

Fig. 3. Graph of log y_t versus t for slug test on well in Salt River Bed, 27th Avenue, Phoenix, Arizona.

Because y and t are the only variables in equation (3), a plot of ln y_t versus t must show a straight line. Thus, instead of calculating K on the basis of two measurements of y and t (y_0 at t = 0 and y_t at t), a number of y and t measurements can be taken and $[\ln(y_0/y_t)]/t$ determined as the slope of the best-fitting line through the y versus t points on semilogarithmic paper (Figure 3). The straight line through the data points can also be used to select two values of y, namely, y_0 and y_t, along with the time interval t between them for substitution into equation (3). Because drawdown of the ground-water table around the well becomes increasingly significant as the test progresses, the points as in Figure 3 begin to deviate from the straight line for large t and small y. Thus, only the straight line portion of the data points should be used to evaluate $[\ln(y_0/y_t)]/t$ for calculation of K with equation (3).

The slug test can be used on production wells, test wells, observation wells, and monitoring wells. Objectives for the measurements include characterization of aquifer hydraulic conductivity for modeling, ground-water recharge studies, and ground-water pollution studies. The method is particularly useful in ground-water contamination studies because the slug test can be carried out on the same wells used for ground-water quality monitoring. Also, combining the resulting values of hydraulic conductivity with the porosity of the aquifer and slopes of the ground-water table or piezometric surface permits the prediction of pore-water velocities and, hence, the rate of movement of pollution plumes and transport of contaminants. The slug test can also be useful in determining vertical distribution of hydraulic conductivities in an aquifer system and other spatial variability of hydraulic conductivity in studies of macrodispersion and movement of contaminants.

Over the years, a number of questions and comments about the slug test have been received. These questions and comments are addressed in the following sections.

DOUBLE STRAIGHT LINE EFFECT

Users of the slug test have observed that when plotting log y_t versus t as in Figure 3, they sometimes get a double straight line as shown schematically in Figure 4. The first part (AB) is straight and steep, whereas the next part (BC) is straight and less steep. Then, at point C, the points begin their expected deviation from the straight line as

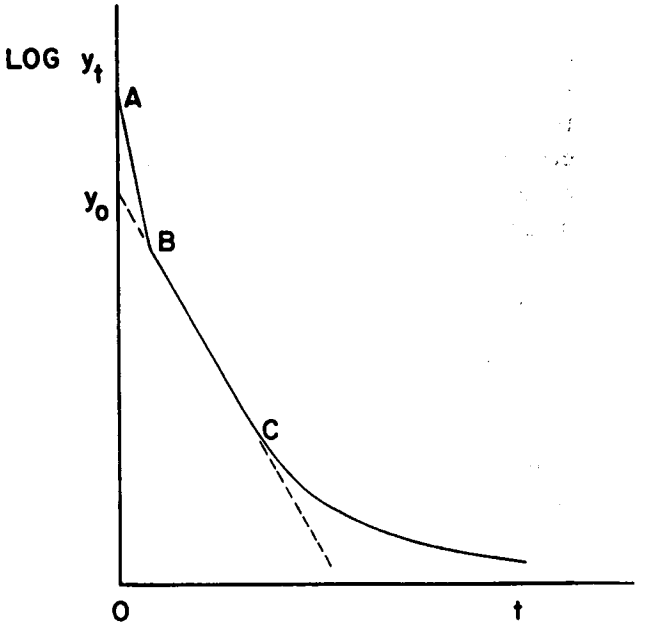

Fig. 4. Schematic of double straight line effect.

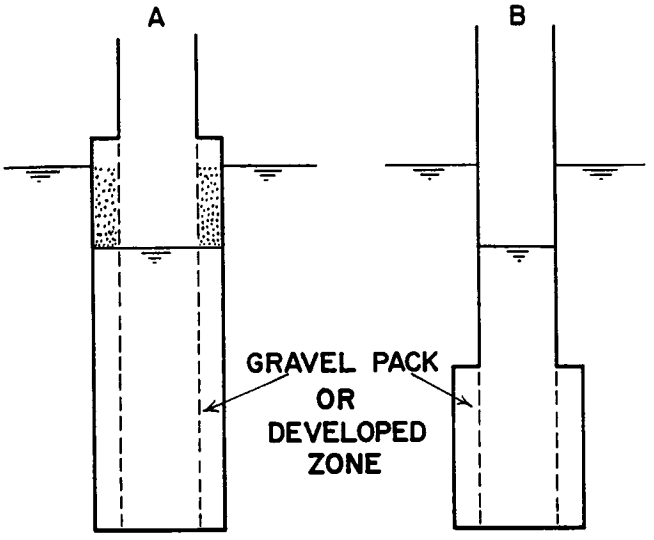

Fig. 5. Slug test for borehole with ground-water level below (A), and above (B) top of screen or perforated section.

the drawdown around the hole becomes significant relative to y_t. The first straight line portion in Figure 4 is probably due to a highly permeable zone around the well (gravel pack or developed zone), which quickly sends water into the well immediately after the water level in the well has been lowered (Figure 5A). Then, when the water level in the permeable zone around the well has drained to the water level in the well itself, the flow into the well slows down and the points begin to form a second, less steep, straight line (BC in Figure 4). This second straight line is more indicative of the flow from the undisturbed aquifer into the well. Hence, segment BC should be used in calculating K of the aquifer with equation (3). In the original 1976 article, gravel envelopes or developed zones were assumed to drain at the same rate as the water level in the borehole when it is lowered for the slug test, i.e., essentially instantaneously. However, some gravel packs or developed zones apparently are not permeable enough to give such instantaneous drainage.

If the ground-water table is above the screened or open section of the borehole, and the water level in the hole is not lowered so far that it drops below the top of the open section (Figure 5B), the gravel envelope or developed zone around the open section cannot drain. The inflow into the hole then is immediately controlled by the aquifer, and the double straight line effect should not occur. If it still occurs, it could indicate leakage around the casing or grouting above the gravel pack.

Where the double straight line is due to a gravel pack around the well, the effective well radius r_w should be taken as the radial distance from the center of the well to the outer surface of the gravel pack. Where the double straight line is due to a naturally developed zone around the well r_w is harder to evaluate and an "intelligent" estimate must be made. It may also be possible to estimate r_w from the value of y at point B in Figure 4. Considering the volume of water in the well between y_A and y_B in Figure 4 to be due to the drainage of the gravel pack or developed zone, and knowing or estimating the drainable porosity of the gravel pack or developed zone, the radial extent of this zone can be calculated for evaluation of r_w. Capillary fringe effects do not have to be considered, since the capillary fringe was also present in the pack or in the developed zone before the water level was lowered. Because the rising water level in the hole during the slug test will also fill up the drained pore space of the gravel pack or developed zone, the value of r_c in the equation for calculation of K should be adjusted to take this effect into account, as discussed earlier in this article.

Conceivably, a well could have a gravel pack surrounded by a less permeable developed zone before the original aquifer material is reached. This could lead to a triple straight line effect, with an intermediate straight line portion at point B, or a curved transition zone at B if the hydraulic conductivity of the developed zone gradually decreases until K of the original aquifer material is reached. By the same token, portion AB in Figure 4 could also be curved if the hydraulic conductivity of the gravel pack or developed zone immediately around the well decreases with radial distance from the well.

FALLING WATER LEVEL TEST

The slug test was developed for a rising water level in the borehole, as obtained by quick removal of a certain volume or slug of water. This can be achieved by bailing, (quick) pumping, or by immersing a section of pipe filled with sand or other ballast and closed with caps on both ends, or other submersible object, in the borehole, letting the water level in the borehole return to equilibrium, and quickly removing the submerged object. The question is often raised: can the method also be used when a volume of water is quickly added to the hole and the subsequent rate of fall of the water level in the hole is measured for calculatio of K? The answer is yes, provided that the equilibrium water level is above the screened or open section of the borehole (Figures 1 and 5B). In this

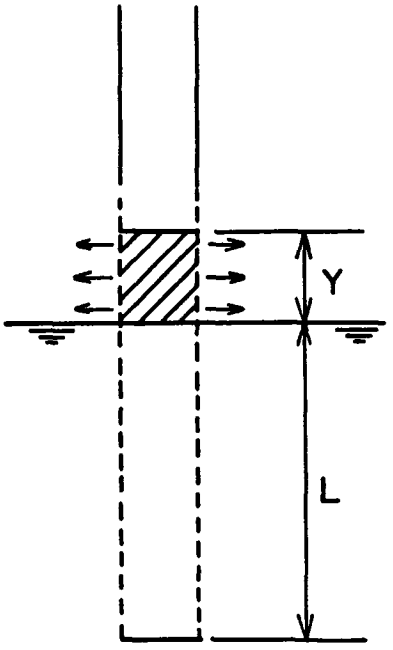

Fig. 6. Schematic of addition of water (hatched section) to borehole with equilibrium water level below top of screen or perforated section, with outflow of water into vadose zone (horizontal arrows).

case, the outflow from the well due to the falling water level occurs only through the screened or open section of the well, and the flow system in the aquifer is a true reverse of the flow system for the rising water level after a slug of water has been removed (ignoring, of course, eventual rises and drawdowns of the ground-water table immediately around the borehole if the aquifer is unconfined). Thus, equations (3), (4), and (5) are also applicable to the addition of a slug of water and measuring the subsequent rate of fall of the water level in the borehole for calculation of K of the aquifer around the hole.

If the equilibrium water level in the borehole is below the top of the screen or open section (Figure 6), and water is added (hatched section in Figure 6), the subsequent flow of water into the aquifer due to the falling water level not only takes place through the screen or perforations below the original water table, but also through the vadose zone above the original water table (arrows in Figure 6). This increases the rate of fall of the water level in the borehole beyond that caused by inflow into the aquifer and leads to an overestimation of K. The greater the ratio of y/L (Figure 6) in this case, the more the slug test will overestimate K if the measurement is based on adding water to the hole and measuring the subsequent rate of fall of the water level.

APPLICATION OF SLUG TEST TO CONFINED AQUIFERS

Theoretically, the slug test (Bouwer and Rice, 1976) applies to aquifers where the upper boundary is a plane source (rising water-level test) or sink (falling water-level test), as in an unconfined aquifer. However, because most of the head difference y between the static water table and the water level in the well is dissipated in the vicinity of the well around the screen or perforated section, the method should also be applicable to situations where the upper boundary of the aquifer is an impermeable or semipermeable plane, i.e., an impermeable or semipermeable upper confining layer. Thus the slug test should also give reasonable values for K in confined, semiconfined, or stratified aquifers. Theoretically, the larger the distance between the top of the screened or open section of the well and the upper confining layer (like $L_w - L_e$ in Figure 1), the more accurate the resulting values of K will be. In actuality, however, source boundaries of ground water flowing into the well in response to lowering the water level are hard to define because of elastic deformation of aquifer material and confining and interbedded fine-textured layers, and because of leakage through semiconfining layers.

EFFECT OF WELL DIAMETER

Theoretically, the Bouwer and Rice slug test applies to any diameter of the borehole. Practically, the hole dimensions should be selected so that the geometry parameters are covered by Figure 2. The larger r_w and L_e (Figure 1), the larger the portion of the aquifer on which K is determined. For layered aquifers, smaller values of L_e may sometimes be preferable because they give more resolution and more information about the vertical distribution of K when the slug test is carried out at different depths. Very small hole diameters (for example 2 in. or 5 cm) should still give accurate values for K, but the values apply to only a small region around the well and, hence, are more sensitive to spatial variability. Also, inaccuracies in the estimates of the thickness of gravel envelopes and developed zones have a greater effect on the calculated values of K where r_c is small than where r_c is large.

PROCESSING OF y VERSUS t MEASUREMENTS

To calculate $1/t \ln(y_0/y_t)$ for the appropriate straight line portion of curves as in Figure 3 or 4, two values of y on the straight line and their

corresponding values of t are read from the graph. The natural logarithm of the ratio y_0/y_t is then taken and divided by the difference between the two values of t. For example, Figure 3 shows that at y is 0.28 m and 0.001 m, t is 0 and 24 seconds, respectively. This yields
$1/t \ln(y_0/y_t) = 1/24 \ln(0.28/0.001) = 0.23$ m/sec.
If $1/t \ln(y_0/y_t)$ is calculated from the slope of the curve, the number of log cycles on the vertical scale between the two points is divided by the time increment and multiplied by 2.3 to convert to natural logarithm. For example, Figure 3 shows that the straight line from $y_0 = 0.28$ m to $y_t = 0.001$ m covers 2.4 log cycles. The time increment between the two points is again 24 seconds, yielding $1/t \ln(y_0/y_t) = 2.3 \times 2.4/24 = 0.23$ m/sec, which is the same as calculated earlier. Because of different coordinate scales in plots of log y versus t, the value of $1/t \ln(y_0/y_t)$ cannot be taken as the actual slope of the straight line portion!

ESTIMATING RATE OF RISE OR FALL OF WATER LEVEL IN WELL

If the water level in a slug-tested well rises or falls at a relatively slow rate, simple water-level measuring devices and a stop watch may be all that is needed to do the test. Fast-moving water levels, however, require the use of a pressure transducer and a fast-acting x-y plotter. To get some idea about the rate of water-level movement that can be expected in a slug-tested well and what equipment to use, equation (3) can be solved for t and $\ln(y_0/y_t)$ can be taken as ln 10 to calculate the time $t_{90\%}$ required for the water level in the well to rise or fall 90% of the initial lowering or raising, respectively, of the water level in the well. This yields the equation

$$t_{90\%} = 1.15 \frac{r_c^2}{KL_e} \ln \frac{R_e}{r_w} \qquad (6)$$

where K must be taken as the estimated or expected value of K of the aquifer. Equation (6) yields values of t that are 22 times greater than the t values calculated by the $t_{90\%}$ equation in the original article (Bouwer and Rice, 1976), where $\ln(y_0/y_t)$ was erroneously taken as ln 0.9, thus yielding the time required for only 10% of the water-level rise or fall to occur.

COMPUTER PROGRAMS

Where the Bouwer and Rice slug test is routinely used, time for calculating K with equation (3) is saved by developing a computer program in which values of L_e/r_w are stored for direct calculation of $\ln(R_e/r_w)$ and K from the field data. Such programs have been developed by several users (see, for example, Pandit and Miner, 1986; and Kemblowski and Klein, 1988). Also, a number of users have designed forms for easy and systematic recording of field data.

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Response of a Finite-Diameter Well to an Instantaneous Charge of Water[1]

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Abstract. A solution is presented for the change in water level in a well of finite diameter after a known volume of water is suddenly injected or withdrawn. A set of type curves computed from this solution permits a determination of the transmissibility of the aquifer. (Key words: Aquifer tests; groundwater; hydraulics; permeability)

INTRODUCTION

Ferris and Knowles [1954] introduced a method for determining the transmissibility of an aquifer from observations of the water level in a well after a known volume of water is suddenly injected into the well. (See also *Ferris et al.* [1962]). They reasoned that for practical purposes the well may be approximated by an instantaneous line source in the infinite region, for which the residual head differences due to the injection are described by

$$h = (V/4\pi Tt)e^{-r^2S/4Tt} \qquad (1)$$

where

- h = change in head at distance r and time t due to the injection;
- r = distance from the line source or center of well;
- t = time since instantaneous injection;
- V = volume of water injected;
- T = transmissibility of aquifer;
- S = coefficient of storage of aquifer.

They reasoned further that the head H in the injected well would be described closely by (1) when r is set equal to the effective radius r_e [*Jacob*, 1947, p. 1049] of the screen or open hole. Then, since r_e is small, the exponential approaches unity quickly, so that the equation approaches $H = V/4\pi Tt$, which can be written

$$T = V(1/t)/4\pi H \qquad (2)$$

To the extent that the equation is valid for a well of finite diameter, a determination of the transmissibility can be obtained from the slope of a plot of head H versus the reciprocal of time $(1/t)$.

Since the volume of water injected into the well is $\pi r_c^2 H_0$, where r_c is the radius of the casing in the interval over which the water level fluctuates and H_0 is the initial head increase in the well, equation 1 can be written

$$h/H_0 = (r_c^2/4Tt)e^{-r^2S/4Tt} \qquad (3)$$

and equation 2 can be written

$$H/H_0 = r_c^2/4Tt \qquad (4)$$

Recently *Bredehoeft et al.* [1966] demonstrated by means of an electrical analog model of a well-aquifer system that equation 3 gives a satisfactory approximation of the head in an injected well only after the time t is large enough for the ratio H/H_0 to be very small (see Figure 1). The observed discrepancy appears to arise from the assumption that the injected well can be approximated by a line source.

We present here an exact solution for the head in and around a well of finite diameter after the well is instantaneously charged with a known volume of water.

ANALYSIS

Consider a nonflowing well cased to the top of a homogeneous isotropic artesian aquifer of uniform thickness, and screened (or open) throughout the thickness of the aquifer (Figure 2). Suppose that the well is instantaneously charged with a volume V of water. (We will consider

[1] Publication authorized by the Director, U. S. Geological Survey.

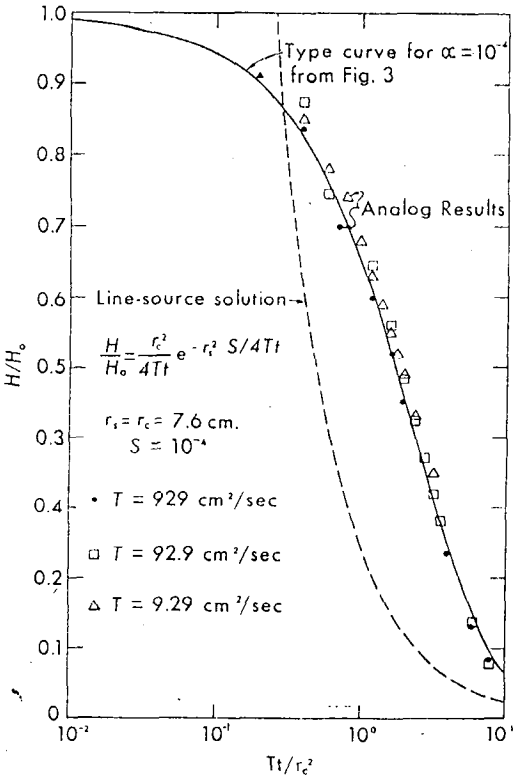

Fig. 1. Comparison of analog results with curve representing line-source solution.

an injection as a positive charge and a withdrawal as a negative one.) The water level in the well instantaneously moves to the height $H_0 = V/\pi r_c^2$ above or below its initial level and immediately begins to return to its initial level according to some function of time $H(t)$. Meanwhile the head in the surrounding aquifer varies according to $h(r, t)$. Our objective is to find a solution for $h(r, t)$ and $H(t)$. The inertia of the column of water in the well will be neglected. (See, in this connection, *Bredehoeft et al.* [1966]). Since the solution to be obtained can be superposed on any initial condition, we can simplify the problem without loss of generality by assuming that the head is initially uniform and constant.

The problem is described mathematically by

$$\partial^2 h/\partial r^2 + 1/r(\partial h/\partial r) = S/T(\partial h/\partial t) \qquad (r > r_s) \qquad (5)$$

$$h(r_s + 0, t) = H(t) \qquad (t > 0) \qquad (5a)$$

$$h(\infty, t) = 0 \qquad (t > 0) \qquad (5b)$$

$$2\pi r_s T[\partial h(r_s + 0, t)]/\partial r = \pi r_c^2(\partial H(t)/\partial t) \qquad (t > 0) \qquad (5c)$$

$$h(r, 0) = 0 \qquad (r > r_s) \qquad (5d)$$

$$H(0) = H_0 = V/\pi r_c^2 \qquad (5e)$$

Equation 5 is the differential equation governing nonsteady radial flow of confined groundwater. (See, for example, *Jacob*, 1950, p. 333.) Boundary condition 5*a* states that after the first instant the head in the aquifer at the face of the well is equal to that in the well. Boundary condition 5*b* states that as r approaches infinity the change in head approaches zero. Equation 5*c* expresses the fact that the rate of flow of water into (or out of) the aquifer is equal to the rate of decrease (or increase) in volume of water within the well. The conditions 5*d* and 5*e* state that initially the change in head is zero everywhere outside the well and equal to H_0 inside the well.

By applying the Laplace transform with respect to time the problem is reduced to

$$\partial^2\bar{h}/\partial r^2 + 1/r\,(\partial\bar{h}/\partial r) = (S/T)\,(p\bar{h}) \qquad (6)$$

$$\bar{h}(\infty, p) = 0 \qquad (6a)$$

$$[\partial\bar{h}(r_s + 0, p)]/\partial r = (r_c^2/2r_sT)[p\bar{h}(r_s + 0, p) - H_0] \qquad (6b)$$

for which the solution is

$$\bar{h}(r, p) = \frac{r_s S H_0 K_0(rq)}{Tq[r_s q K_0(r_s q) + 2\alpha K_0(r_s q)]} \qquad (7)$$

where $q = (pS/T)^{\frac{1}{2}}$, and $\alpha = r_s^2 S/r_c^2$. The solution $h(r, t)$ is the inverse transform, which is available from the analogous problem in heat flow [*Carslaw and Jaeger*, 1959, p. 342].

$$h = \frac{2H_0}{\pi}\int_0^\infty e^{-\beta u^2/\alpha}\{J_0(ur/r_s) \cdot [uY_0(u) - 2\alpha Y_1(u)] - Y_0(ur/r_s) \cdot [uJ_0(u) - 2\alpha J_1(u)]\}\frac{du}{\Delta(u)} \qquad (8)$$

where $\beta = Tt/r_c^2$ and

$$\Delta(u) = [uJ_0(u) - 2\alpha J_1(u)]^2 + [uY_0(u) - 2\alpha Y_1(u)]^2$$

Fig. 2. Idealized

The head $H(t)$ inside
stituting $r = r_s$ in equ

$$H = (8H_0\alpha/\pi^2)\int_0^\infty$$

Values of H/H_0 con
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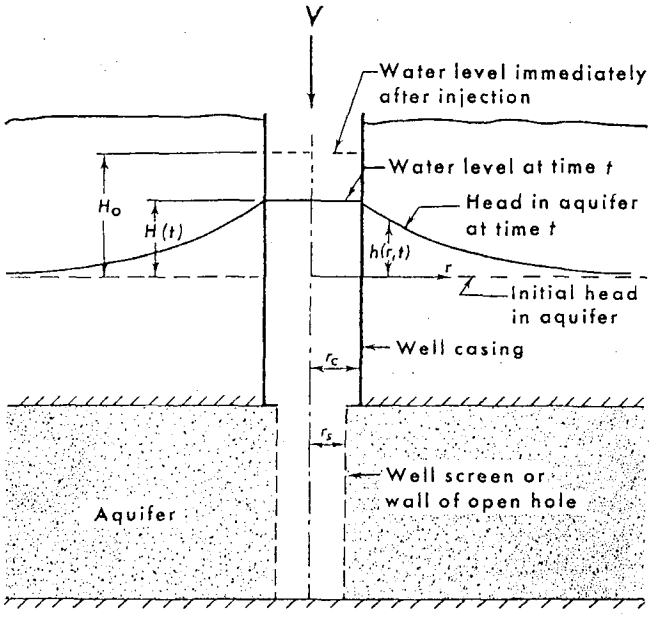

Fig. 2. Idealized representation of a well into which a volume V of water is suddenly injected.

The head $H(t)$ inside the well, obtained by substituting $r = r_s$ in equation 8, is

$$H = (8H_0\alpha/\pi^2) \int_0^\infty e^{-\beta u^2/\alpha}\, du/(u\, \Delta(u)) \qquad (9)$$

Values of H/H_0 computed by numerically integrating equation 9 are given in Table 1. Values computed from the line-source solutions, equations 3 and 4, are given in Table 2. In Figure 3 the values from Table 1 are represented as a family of five curves of H/H_0 versus the dimensionless time parameter $\beta = Tt/r_c^2$, one curve for each of five values of the parameter $\alpha = r_s^2S/r_c^2$. Also represented, by a dashed curve, are the values computed from equation 4.

It is apparent from Tables 1 and 2 and from Figure 3 that the line-source solutions 3 and 4 proposed by *Ferris and Knowles* [1954] give a close approximation of the finite-source solution 9 only for large values of the time parameter Tt/r_c^2. The approximation seems to be acceptable for Tt/r_c^2 greater than 100 (or, equivalently, for H/H_0 less than about 0.0025). (In the test at Speedway City, Indiana, used by Ferris and Knowles to exemplify their method, H/H_0 ranged from 0.01 to 0.001, and the value of transmissibility determined from these data agreed fairly well with one obtained by another method.)

A family of type curves plotted on semilogarithmic paper, as in Figure 3, permits a determination of the transmissibility. The method is similar to the Theis graphical method [*Wenzel*, 1942]. A test on a well near Dawsonville, Georgia, will be used to demonstrate the method. This well is cased to 24 m with 15.2-cm (6-inch) casing and drilled as a 15.2-cm open hole to a depth of 122 m. Figure 4 is a reproduction of a chart showing the hydrograph of the well after the sudden withdrawal of a long weighted float from the well. The weight of the float was 10.16 kilograms, and hence by the principle of Archimedes it had displaced a volume of 0.01016 m^3 of water when floating in the well. Its withdrawal was therefore equivalent to a negative charge of $V = 0.01016$ m^3. From the relation $H_0 = V/\pi r_c^2$ the initial head change is found to be $H_0 = 0.560$ m.

The hydrograph in Figure 4 was recorded electrically from a pressure transducer, which was suspended below the water surface in the well. Table 3 lists data from this chart. To determine the aquifer constants the data are

TABLE 1. Values of H/H_0 for a Well of Finite Diameter (computed from equation 9)

Tt/r_c^2	H/H_0				
	$\alpha = 10^{-1}$	$\alpha = 10^{-2}$	$\alpha = 10^{-3}$	$\alpha = 10^{-4}$	$\alpha = 10^{-5}$
1.00×10^{-3}	0.9771	0.9920	0.9969	0.9985	0.9992
2.15×10^{-3}	0.9658	0.9876	0.9949	0.9974	0.9985
4.64×10^{-3}	0.9490	0.9807	0.9914	0.9954	0.9970
1.00×10^{-2}	0.9238	0.9693	0.9853	0.9915	0.9942
2.15×10^{-2}	0.8860	0.9505	0.9744	0.9841	0.9888
4.64×10^{-2}	0.8293	0.9187	0.9545	0.9701	0.9781
1.00×10^{-1}	0.7460	0.8655	0.9183	0.9434	0.9572
2.15×10^{-1}	0.6289	0.7782	0.8538	0.8935	0.9167
4.64×10^{-1}	0.4782	0.6436	0.7436	0.8031	0.8410
1.00×10^{0}	0.3117	0.4598	0.5729	0.6520	0.7080
2.15×10^{0}	0.1665	0.2597	0.3543	0.4364	0.5038
4.64×10^{0}	0.07415	0.1086	0.1554	0.2082	0.2620
7.00×10^{0}	0.04625	0.06204	0.08519	0.1161	0.1521
1.00×10^{1}	0.03065	0.03780	0.04821	0.06355	0.08378
1.40×10^{1}	0.02092	0.02414	0.02844	0.03492	0.04426
2.15×10^{1}	0.01297	0.01414	0.01545	0.01723	0.01999
3.00×10^{1}	0.009070	0.009615	0.01016	0.01083	0.01169
4.64×10^{1}	0.005711	0.005919	0.006111	0.006319	0.006554
7.00×10^{1}	0.003722	0.003809	0.003884	0.003962	0.004046
1.00×10^{2}	0.002577	0.002618	0.002653	0.002688	0.002725
2.15×10^{2}	0.001179	0.001187	0.001194	0.001201	0.001208

plotted on semilogarithmic paper of the same scale as that of the type curves in Figure 3, and this plot is superposed on the type curves. With the arithmetic axes coincident, the data plot is translated horizontally to a position where the data best fit the type curves, as

TABLE 2. Values of H/H_0 for Line-source Approximation of a Well

Tt/r_c^2	H/H_0 from equation 3					H/H_0 from eq. 4
	$\alpha = 10^{-1}$	$\alpha = 10^{-2}$	$\alpha = 10^{-3}$	$\alpha = 10^{-4}$	$\alpha = 10^{-5}$	
1.00×10^{-3}	0.000000	20.52	194.7	243.8	249.4	250.0
2.15×10^{-3}	0.001035	36.35	103.5	115.0	116.2	116.3
4.64×10^{-3}	0.2463	31.44	51.05	53.59	53.85	53.88
1.00×10^{-2}	2.052	19.47	24.38	24.94	24.99	25.00
2.15×10^{-2}	3.635	10.35	11.50	11.62	11.63	11.63
4.64×10^{-2}	3.144	5.105	5.359	5.385	5.388	5.388
1.00×10^{-1}	1.947	2.438	2.494	2.499	2.500	2.500
2.15×10^{-1}	1.035	1.150	1.162	1.163		1.163
4.64×10^{-1}	0.5105	0.5359	0.5385	0.5388		0.5388
1.00×10^{0}	0.2438	0.2494	0.2499	0.2500		0.2500
2.15×10^{0}	0.1150	0.1162	0.1163			0.1163
4.64×10^{0}	0.05359	0.05385	0.05388			0.05388
7.00×10^{0}	0.03558	0.03570	0.03571			0.03571
1.00×10^{1}	0.02494	0.02499	0.02500			0.02500
1.40×10^{1}	0.01783	0.01786				0.01786
2.15×10^{1}	0.01162	0.01163				0.01163
3.00×10^{1}	0.008326	0.008333				0.008333
4.64×10^{1}	0.005385	0.005388				0.005388
7.00×10^{1}	0.003570	0.003571				0.003571
1.00×10^{2}	0.002499	0.002500				0.002500
2.15×10^{2}	0.001163					0.001163

shown in F
$t = 11$ sec
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coordinates.
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$$T = \frac{1.0r}{t}$$

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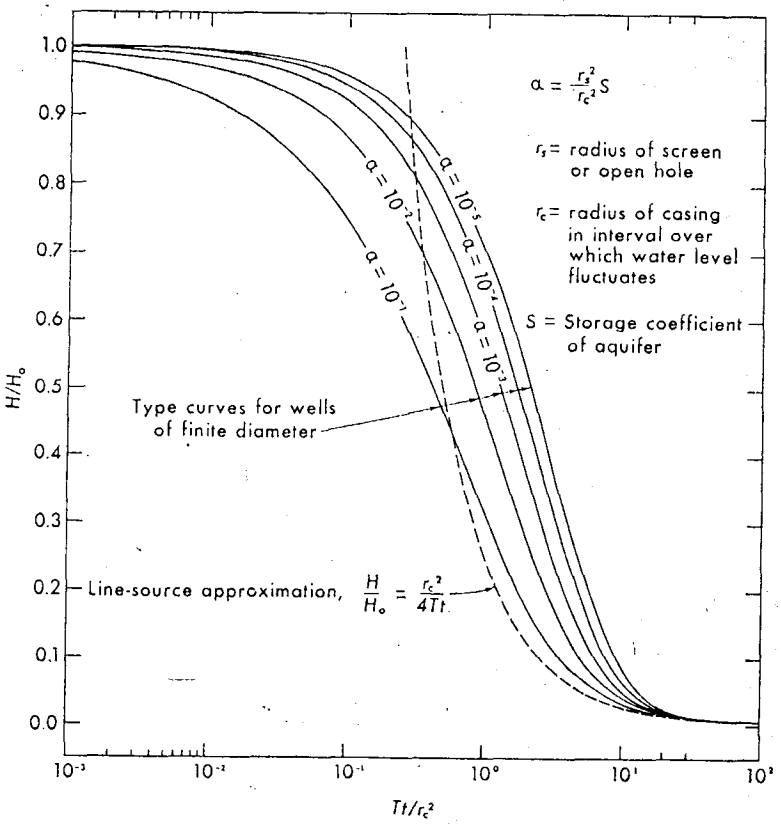

Fig. 3. Type curves for instantaneous charge in well of finite diameter.

shown in Figure 5. In this position the time $t = 11$ sec on the data coordinates is found to overlie the value $Tt/r_c^2 = 1.0$ on the type-curve coordinates. Hence the transmissibility is computed to be

$$T = \frac{1.0 r_c^2}{t} = \frac{(1.0)(7.6)^2}{(11)} = 5.3 \text{ cm}^2/\text{sec}$$

In principle the coefficient of storage can be determined by interpolating from its values for the curves that lie on either side of the data plot in the matched position. Thus, in the example just described, the coefficient of storage would be $S = 10^{-3}$, since for this well $r_c = r_s$, so that $\alpha = S$, and the points fall on the curve for $\alpha = 10^{-3}$. However, because the matching of data plot to the type curves depends upon the shapes of the type curves, which differ only slightly when α differs by an order of magnitude, a determination of S by this method has questionable reliability.

The determination of T is not so sensitive to the choice of the curves to be matched. Whereas the determined value of S will change by an

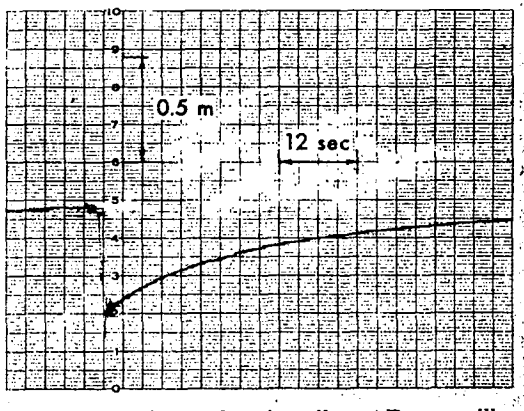

Fig. 4. Hydrograph of well at Dawsonville, Georgia, showing response of water level to the sudden withdrawal of a weighted float.

TABLE 3. Rise of Water Level in Dawsonville Well after Instantaneous Withdrawal of Weighted Float

t (sec)	$1/t$	Head (m)	H (m)	H/H_0
−1		0.896		
0		0.336	0.560	1.000
3	0.333	0.439	0.457	0.816
6	0.167	0.504	0.392	0.700
9	0.111	0.551	0.345	0.616
12	0.0833	0.588	0.308	0.550
15	0.0667	0.616	0.280	0.500
18	0.0556	0.644	0.252	0.450
21	0.0476	0.672	0.224	0.400
24	0.0417	0.691	0.205	0.366
27	0.0370	0.709	0.187	0.334
30	0.0333	0.728	0.168	0.300
33	0.0303	0.747	0.149	0.266
36	0.0278	0.756	0.140	0.250
39	0.0256	0.765	0.131	0.234
42	0.0238	0.784	0.112	0.200
45	0.0222	0.788	0.108	0.193
48	0.0208	0.803	0.093	0.166
51	0.0196	0.807	0.089	0.159
54	0.0185	0.814	0.082	0.146
57	0.0175	0.821	0.075	0.134
60	0.0167	0.825	0.071	0.127
63	0.0159	0.831	0.065	0.116

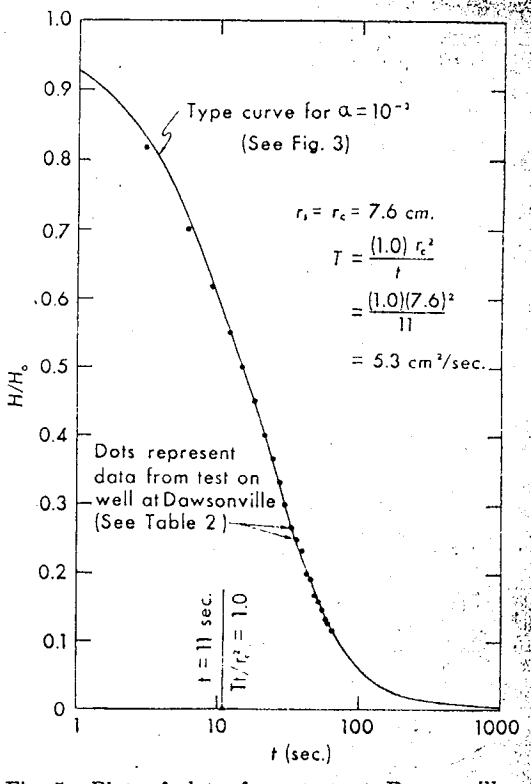

Fig. 5. Plot of data from test at Dawsonville, Georgia, superposed on type curve.

order of magnitude when the data plot is moved from one type curve to another, that of T will change much less. From a knowledge of the geologic conditions and other considerations one can ordinarily estimate S within an order of magnitude and thereby eliminate some of the doubt as to what value of α is to be used for matching the data plot.

Figure 6 shows the data from the test on the Dawsonville well plotted according to the Ferris-Knowles method. The points do not fall along a straight line as postulated in this method but, instead, fall along the trace of the type curve for $\alpha = 10^{-3}$, which has been transferred from Figure 5. Also shown is a straight line through the origin whose slope, when used according to the Ferris-Knowles method, will yield the transmissibility of 5.3 cm²/sec obtained by matching the data to the type curves.

CONCLUSION

The judgment of an experienced hydrologist is needed to decide the significance, if any, of a determination of T by the method of instantaneous charge. As *Ferris et al.* [1962] properly warned

> the duration of a 'slug' test is very short, hence the estimated transmissibility determined from the test will be representative only of the water-bearing material close to the well. Serious errors will be introduced unless the . . . well is fully developed and completely penetrates the aquifer.

Few wells completely penetrate an aquifer, but it is nevertheless possible under some circumstances for a hydrologist to derive useful information from a test on a partially penetrating well. Since the vertical permeabilities of most stratified aquifers are only small fractions of the horizontal permeabilities, the induced flow within the small radius of the cone that develops during the short period of observation is likely to be essentially 2-dimensional. Therefore, the determined value of T would represent approximately the transmissibility of that part

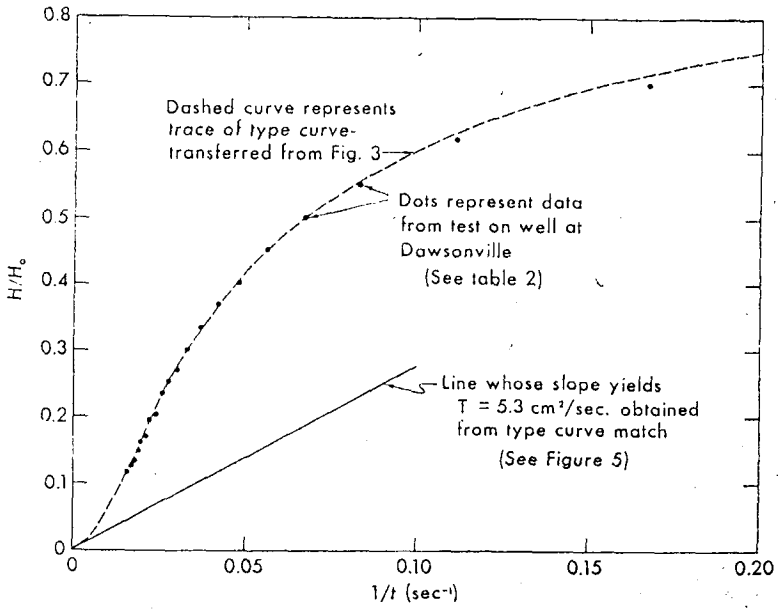

Fig. 6. Data from test on well of Dawsonville, Georgia, plotted according to the Ferris-Knowles method.

of the aquifer in which the well is screened or open, provided that the aquifer is reasonably homogeneous and isotropic in planes parallel to the bedding and provided that the effective radius r_e can be estimated closely.

REFERENCES

Bredehoeft, J. D., H. H. Cooper, Jr., and I. S. Papadopulos, Inertial and storage effects in well-aquifer systems: An analog investigation, *Water Resources Res.*, *2*(4), 697–707, 1966.

Carslaw, H. S., and J. C. Jaeger, *Conduction of Heat in Solids*, 510 pp., Oxford University Press, London, 1959.

Ferris, J. G., and D. B. Knowles, The slub test for estimating transmissibility, *U. S. Geol. Surv. Ground Water Note 26*, 1954.

Ferris, J. G., D. B. Knowles, R. H. Brown, and R. W. Stallman, Theory of aquifer tests, *U. S. Geol. Surv. Water-Supply Paper 1536-E*, 1962.

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(Manuscript received May 12, 1966.)

M-05-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/20 17:23

Unit# 00515 Test# 3

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/20 09:50

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.13
0.0066	7.40
0.0099	-3.02
0.0133	3.33
0.0166	1.90
0.0200	1.73
0.0233	1.76
0.0266	1.68
0.0300	1.69
0.0333	1.64
0.0500	1.47
0.0666	1.32
0.0833	1.18
0.1000	1.06
0.1166	0.95
0.1333	0.85
0.1500	0.77
0.1666	0.70
0.1833	0.64
0.2000	0.58
0.2166	0.54
0.2333	0.51
0.2500	0.48
0.2666	0.46
0.2833	0.44
0.3000	0.42
0.3166	0.41
0.3333	0.39
0.4167	0.34
0.5000	0.31
0.5833	0.29

M-05-01

Elapsed Time	Value
0.6667	0.27
0.7500	0.25
0.8333	0.24
0.9167	0.23
1.0000	0.22
1.0833	0.21
1.1667	0.20
1.2500	0.19
1.3333	0.18
1.4166	0.17
1.5000	0.17
1.5833	0.16
1.6667	0.15
1.7500	0.15
1.8333	0.14
1.9167	0.14
2.0000	0.14
2.5000	0.11
3.0000	0.09
3.5000	0.08
4.0000	0.07
4.5000	0.06
5.0000	0.06
5.5000	0.05
6.0000	0.05
6.5000	0.05
7.0000	0.05
7.5000	0.05
8.0000	0.05

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A Q T E S O L V   R E S U L T S

Version 1.10

01/08/92 12:11:49

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TEST DESCRIPTION

Data set........... m0501z.set
Data set title..... RISING HEAD RESULT, M-05-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 5
Test date.......... September 20, 1991

Knowns and Constants:

No. of data points..................	55
Radius of well casing...............	0.083
Radius of well......................	0.19
Aquifer saturated thickness.........	5.9
Well screen length..................	5.9
Static height of water in well......	5.9
Log(Re/Rw)..........................	2.6
A, B, C.............................	0.000, 0.000, 2.002

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	6.5137E-004 ft/min = 3.3×10^{-4} cm/sec
y0 =	-6.5343E+019

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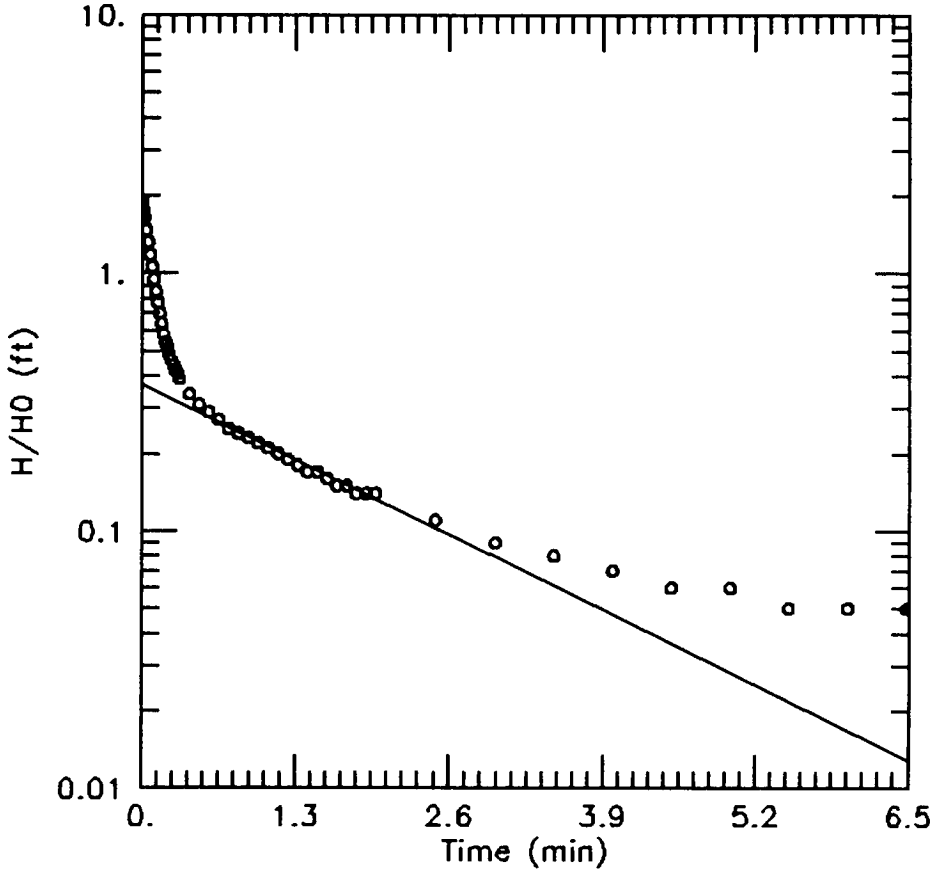
TYPE CURVE DATA

K = 7.71630E-004
y0 = 3.68201E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.682E-001	8.000E+000	6.306E-003		



DATA SET:
m0501z.out
01/09/92

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.0007083 ft/min
y0 = 0.371 ft

TEST DATA:
H0 = 1.0 ft
rc = 0.083 ft
rw = 0.13 ft
L = 6.0 ft
b = 6.0 ft
B = 6.0 ft

RISING HEAD RESULT, M-05-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 5

M-05-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/20 17:21

Unit# 00515 Test# 1

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/20 09:11

Elapsed Time (min)	Value (ft)
0.0000	0.02
0.0033	-0.05
0.0066	4.58
0.0099	4.31
0.0133	0.31
0.0166	2.34
0.0200	2.80
0.0233	2.30
0.0266	1.66
0.0300	1.51
0.0333	1.43
0.0500	1.17
0.0666	0.95
0.0833	0.77
0.1000	0.63
0.1166	0.50
0.1333	0.42
0.1500	0.35
0.1666	0.30
0.1833	0.27
0.2000	0.24
0.2166	0.21
0.2333	0.20
0.2500	0.18
0.2666	0.17
0.2833	0.16
0.3000	0.15
0.3166	0.14
0.3333	0.13
0.4167	0.10
0.5000	0.08
0.5833	0.07

M-05-02

Elapsed Time	Value
0.6667	0.06
0.7500	0.05
0.8333	0.04
0.9167	0.03
1.0000	0.03
1.0833	0.02
1.1667	0.02
1.2500	0.02
1.3333	0.02
1.4166	0.01
1.5000	0.02
1.5833	0.00
1.6667	0.01
1.7500	0.01
1.8333	0.01
1.9167	0.01
2.0000	0.00
2.5000	0.00
3.0000	0.01

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A Q T E S O L V   R E S U L T S
Version 1.10

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TEST DESCRIPTION

Data set........... m0502z.set
Data set title..... RISING HEAD RESULT, M-05-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 5
Test date.......... September 20, 1991

Knowns and Constants:
No. of data points.................. 38
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 7
Well screen length.................. 7
Static height of water in well...... 7
Log(Re/Rw).......................... 2.744
A, B, C............................. 0.000, 0.000, 2.191

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.3273E-003 ft/min = 1.7 * 10^{-3} cm/sec
y0 =	7.6140E-001

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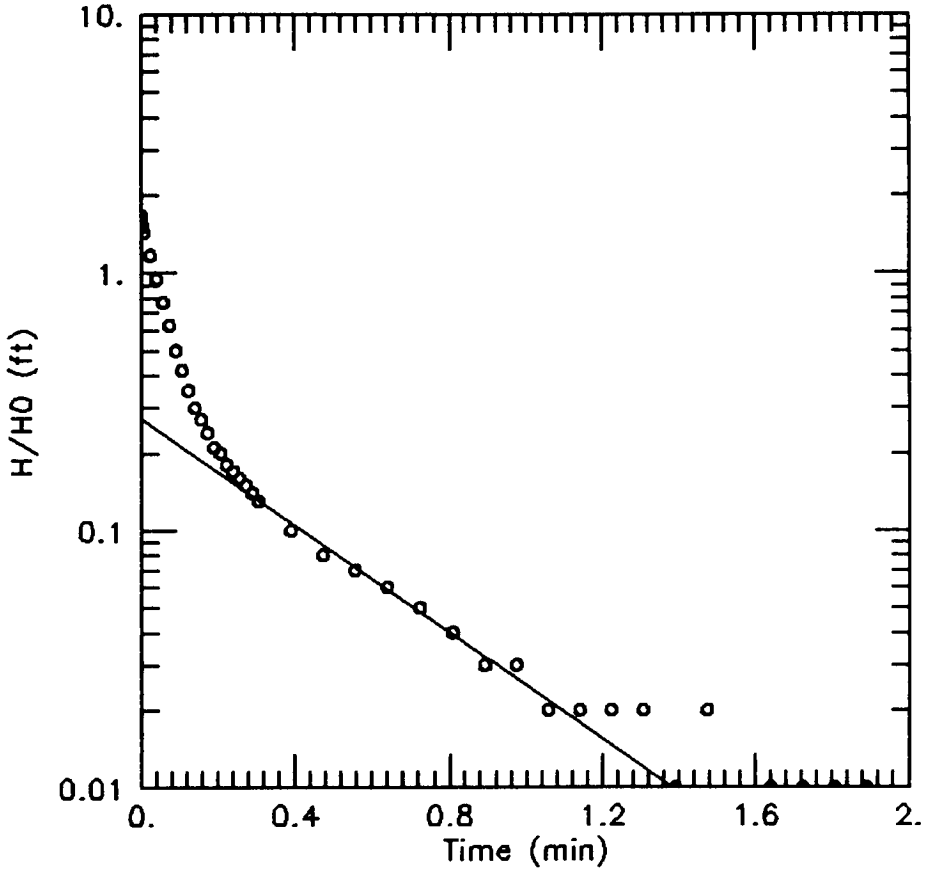
TYPE CURVE DATA

K = 3.29676E-003
y0 = 2.77779E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.778E-001	2.000E+000	2.103E-003		



DATA SET:
m0502z.001
01/16/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.00329 ft/min
y0 = 0.2703 ft

TEST DATA:
H0 = 1.66 ft
rc = 0.083 ft
rw = 0.18 ft
L = 7. ft
b = 7. ft
B = 7. ft

RISING HEAD RESULT, M-05-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 5

M-05-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/20 17:32

Unit# 00515 Test# 9

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/20 12:25

Elapsed Time (min)	Value (ft)
0.0000	0.01
0.0033	4.37
0.0066	5.03
0.0099	-0.86
0.0133	1.68
0.0166	1.52
0.0200	1.51
0.0233	1.48
0.0266	1.43
0.0300	1.39
0.0333	1.35
0.0500	1.21
0.0666	1.08
0.0833	0.98
0.1000	0.89
0.1166	0.81
0.1333	0.74
0.1500	0.69
0.1666	0.63
0.1833	0.58
0.2000	0.54
0.2166	0.50
0.2333	0.47
0.2500	0.44
0.2666	0.41
0.2833	0.39
0.3000	0.36
0.3166	0.34
0.3333	0.32
0.4167	0.25
0.5000	0.20
0.5833	0.17

M-05-03

Elapsed Time	Value
0.6667	0.15
0.7500	0.13
0.8333	0.11
0.9167	0.09
1.0000	0.08
1.0833	0.07
1.1667	0.06
1.2500	0.06
1.3333	0.06
1.4166	0.05
1.5000	0.05
1.5833	0.04
1.6667	0.04
1.7500	0.04
1.8333	0.04
1.9167	0.04
2.0000	0.03

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A Q T E S O L V   R E S U L T S

Version 1.10

[illegible]/08/92 12:56:53

TEST DESCRIPTION

Data set........... m0503z.set
Data set title..... RISING HEAD RESULT, M-05-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 5
Test date.......... September 20, 1991

Knowns and Constants:
No. of data points.................. 44
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 6.74
Well screen length.................. 6.74
Static height of water in well...... 6.74
Log(Re/Rw).......................... 2.712
A, B, C............................. 0.000, 0.000, 2.146

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

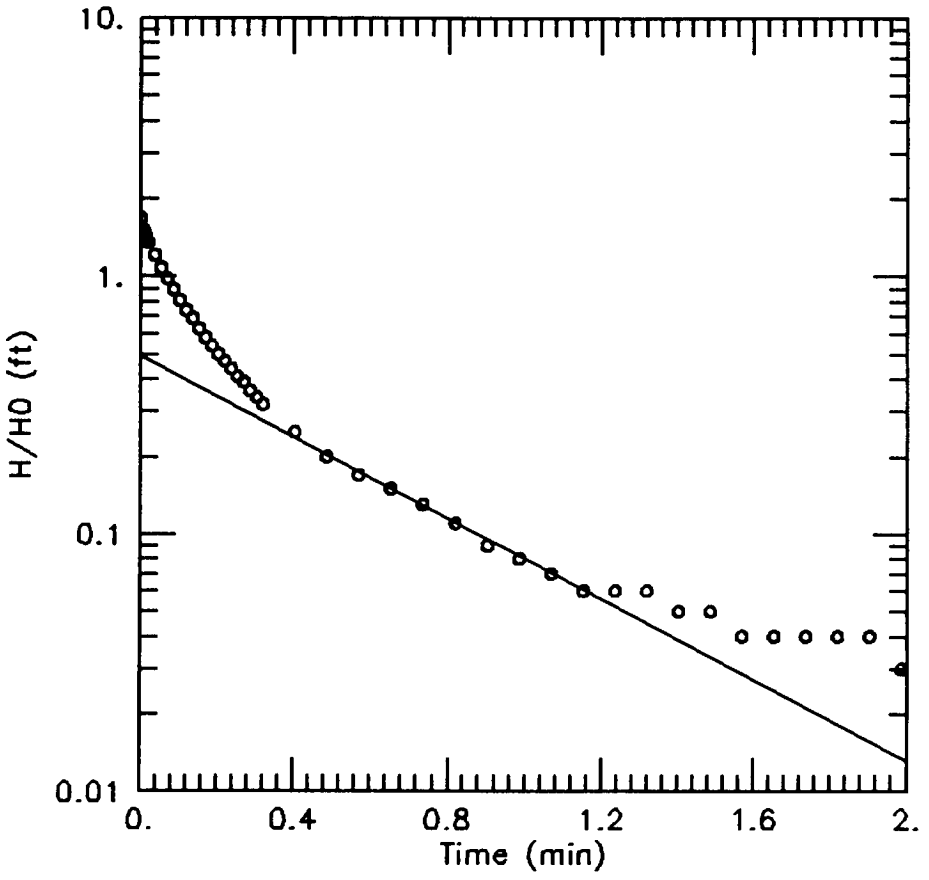
	Estimate
K =	2.7294E-003 ft/min = $1.4*10^{-3}$ cm/sec
y0 =	7.6140E-001

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 2.58910E-003
y0 = 5.04242E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	5.042E-001	2.000E+000	1.203E-002		



DATA SET:
m05032.001
01/14/92

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.002514 ft/min
y0 = 0.4001 ft

TEST DATA:
H0 = 1.63 ft
rc = 0.083 ft
rw = 0.18 ft
L = 0.74 ft
b = 0.74 ft
H = 0.74 ft

RISING HEAD RESULT, M-05-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY – WESTDIV
Project No.: 2738.0257	Location: SITE 5

M-05-04
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/20 17:30

Unit# 00515 Test# 7

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/20 11:29

Elapsed Time (min)	Value (ft)
0.0000	-0.03
0.0033	0.00
0.0066	1.26
0.0099	6.84
0.0133	6.79
0.0166	1.58
0.0200	1.44
0.0233	2.18
0.0266	1.47
0.0300	1.92
0.0333	1.69
0.0500	1.60
0.0666	1.49
0.0833	1.40
0.1000	1.30
0.1166	1.22
0.1333	1.14
0.1500	1.07
0.1666	1.00
0.1833	0.93
0.2000	0.87
0.2166	0.82
0.2333	0.76
0.2500	0.72
0.2666	0.68
0.2833	0.64
0.3000	0.61
0.3166	0.57
0.3333	0.55
0.4167	0.45
0.5000	0.40
0.5833	0.36

M-05-04

Elapsed Time	Value
0.6667	0.32
0.7500	0.30
0.8333	0.28
0.9167	0.27
1.0000	0.26
1.0833	0.25
1.1667	0.23
1.2500	0.23
1.3333	0.21
1.4166	0.21
1.5000	0.20
1.5833	0.19
1.6667	0.19
1.7500	0.18
1.8333	0.17
1.9167	0.15
2.0000	0.16
2.5000	0.13
3.0000	0.11
3.5000	0.10
4.0000	0.09
4.5000	0.08
5.0000	0.08
5.5000	0.07
6.0000	0.07
6.5000	0.07
7.0000	0.06
7.5000	0.05
8.0000	0.05
8.5000	0.04

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A Q T E S O L V   R E S U L T S
Version 1.10

,08/92 13:14:44

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TEST DESCRIPTION

Data set........... m0504z.set
Data set title..... RISING HEAD RESULT, M-05-04
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 5
Test date.......... September 20, 1991

Knowns and Constants:
No. of data points.................. 52
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 7.25
Well screen length.................. 7.25
Static height of water in well...... 7.25
Log(Re/Rw).......................... 2.773
A, B, C............................. 0.000, 0.000, 2.235

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

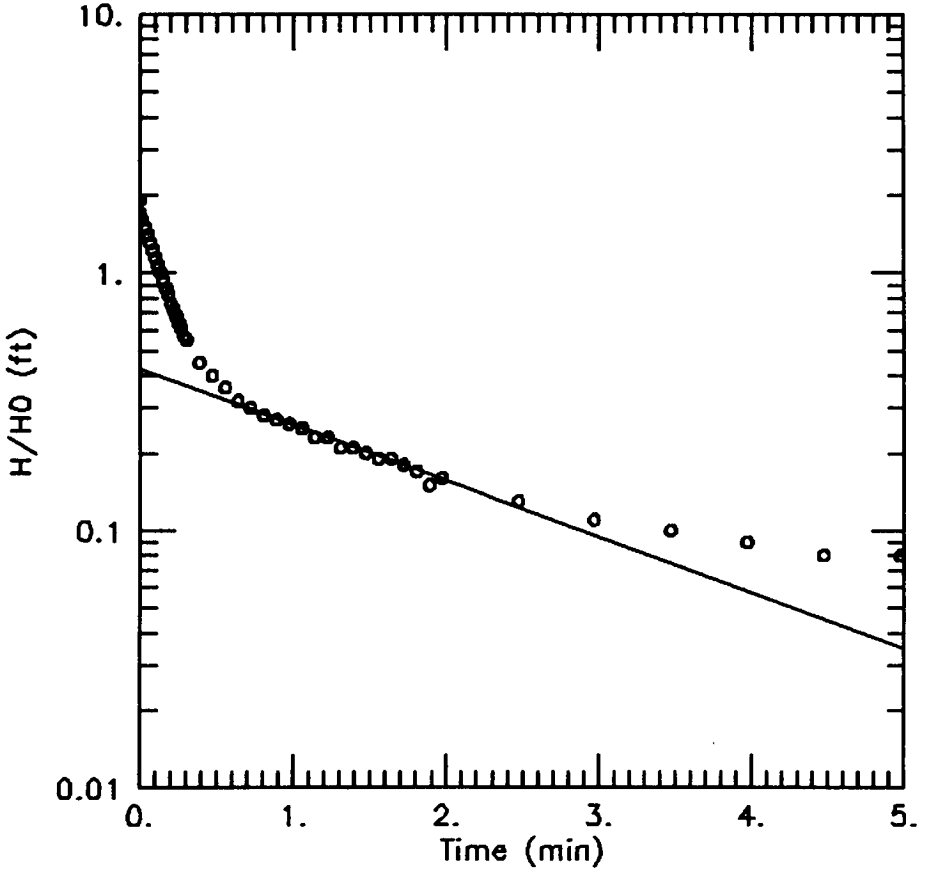
Estimate
K = 5.1637E-004 ft/min = 2.6×10^{-4} cm/sec
y0 = -3.0094E+020

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 6.55152E-004
y0 = 4.23128E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.231E-001	9.000E+000	4.817E-003		



DATA SET:
m0504z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.0000011 ft/min
y0 = 0.4240 ft

TEST DATA:
H0 = 1.02 ft
rc = 0.083 ft
rw = 0.18 ft
L = 7.26 ft
b = 7.26 ft
B = 7.26 ft

RISING HEAD RESULT, M-05-04

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 5

M-05-05
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/20 17:47

Unit#est# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/20 10:43

Elapsed Time (min)	Value (ft)
0.0000	0.52
0.0033	2.52
0.0066	5.86
0.0099	4.94
0.0133	1.90
0.0166	1.94
0.0200	1.91
0.0266	1.84
0.0300	1.81
0.0333	1.78
0.0666	1.52
0.0833	1.40
0.1000	1.29
0.1166	1.18
0.1333	1.08
0.1500	0.99
0.1666	0.90
0.2000	0.76
0.2166	0.70
0.2500	0.59
0.2666	0.55
0.2833	0.51
0.3166	0.46
0.3333	0.44
0.5000	0.33
0.5833	0.29
0.6667	0.27
0.8333	0.24
0.9167	0.22
1.0000	0.21
1.1667	0.19
1.2500	0.18

M-05-05

Elapsed Time	Value
1.4166	0.17
1.5000	0.15
1.5833	0.14
1.7500	0.14
1.8333	0.13
1.9100	0.13
2.0000	0.12
2.5000	0.10
3.0000	0.08
3.5000	0.07
4.0000	0.06
4.5000	0.05
5.0000	0.05
6.0000	0.05

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 13:38:57

TEST DESCRIPTION

Data set........... m0505z.set
Data set title..... RISING HEAD RESULT, M-05-05
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 5
Test date.......... September 20, 1991

Knowns and Constants:
No. of data points.................. 39
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 6.2
Well screen length.................. 6.2
Static height of water in well...... 6.2
Log(Re/Rw).......................... 2.642
A, B, C............................. 0.000, 0.000, 2.053

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

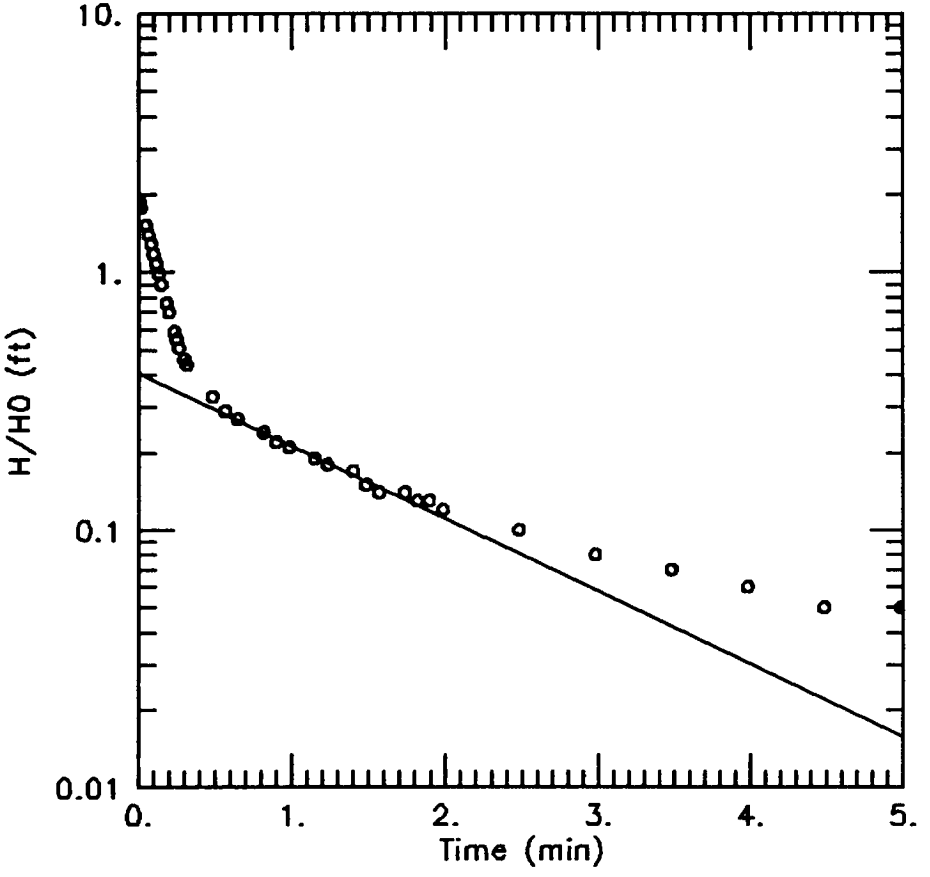
Estimate
K = 9.4307E-004 ft/min = $4.8 * 10^{-4}$ cm/sec
y0 = -3.0094E+020

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 9.77018E-004
y0 = 4.21785E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.218E-001	6.000E+000	7.771E-003		



DATA SET:
m0505z.dat
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.0000536 ft/min
y0 = 0.4054 ft

TEST DATA:
H0 = 1.01 ft
rc = 0.083 ft
rw = 0.18 ft
L = 0.2 ft
b = 0.2 ft
B = 0.2 ft

RISING HEAD RESULT, M-05-05

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY – WESTDIV
Project No.: 2738.0257	Location: SITE 5

M-06-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/26 18:46

Unit# 00515 Test# 1

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/26 09:37

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	2.75
0.0066	2.68
0.0099	2.00
0.0133	2.02
0.0166	2.01
0.0200	1.99
0.0233	1.95
0.0266	1.93
0.0300	1.91
0.0333	1.89
0.0500	1.81
0.0666	1.74
0.0833	1.67
0.1000	1.60
0.1166	1.54
0.1333	1.48
0.1500	1.42
0.1666	1.36
0.1833	1.31
0.2000	1.26
0.2166	1.21
0.2333	1.16
0.2500	1.08
0.2666	1.04
0.2833	1.00
0.3000	0.95
0.3166	0.91
0.3333	0.87
0.4167	0.70
0.5000	0.55
0.5833	0.44
0.6667	0.36
0.7500	0.31
0.8333	0.30
0.9167	0.27
1.0000	0.25
1.0833	0.24
1.1667	0.22
1.2500	0.21
1.3333	0.20
1.4166	0.20
1.5000	0.19
1.5833	0.18
1.6667	0.18
1.7500	0.17
1.8333	0.17
1.9167	0.16
2.0000	0.16
2.5000	0.14
3.0000	0.12
3.5000	0.11
4.0000	0.10
4.5000	0.09
5.0000	0.08

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 14:04:47

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TEST DESCRIPTION

Data set........... m0601z.set
Data set title..... RISING HEAD RESULT, M-06-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 6
Test date.......... September 26, 1991

Knowns and Constants:
No. of data points.................. 43
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 4.85
Well screen length.................. 4.85
Static height of water in well...... 4.85
Log(Re/Rw).......................... 2.432
A, B, C............................. 0.000, 0.000, 1.829

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 1.1704E-003 ft/min = 6.1*10^-4 cm/sec
y0 = -3.0094E+020

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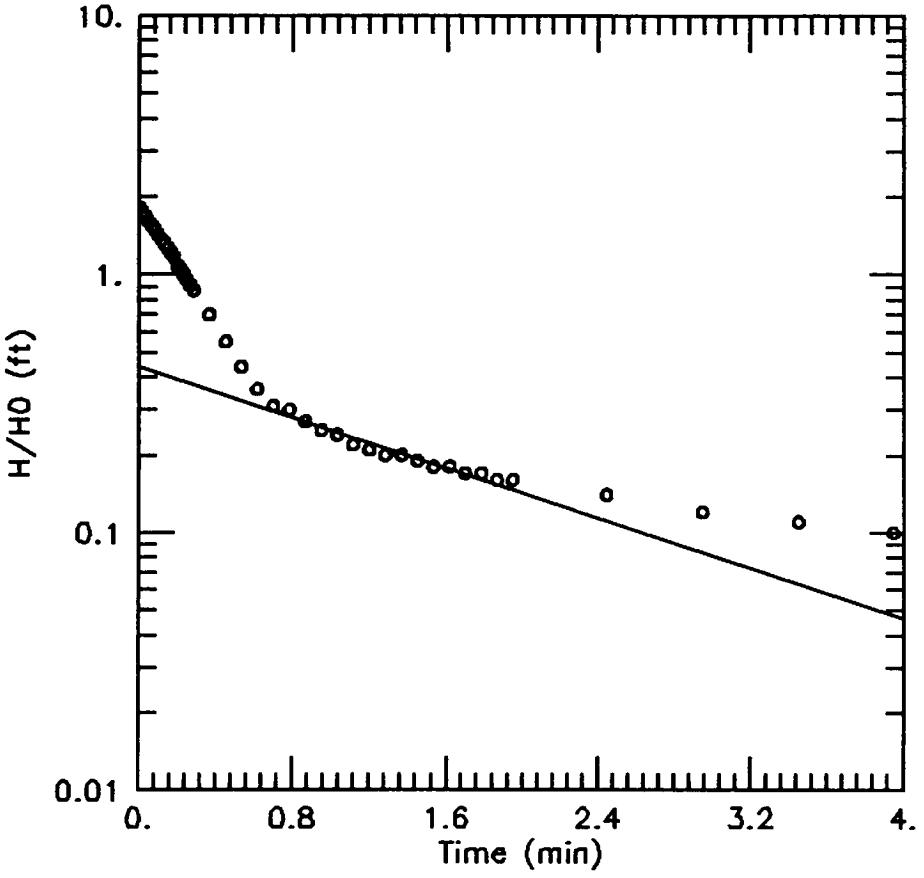
TYPE CURVE DATA

K = 7.95517E-004
y0 = 3.73680E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.737E-001	4.000E+000	5.920E-002		



DATA SET:
m0601z.001
01/16/92

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 26, 1991

ESTIMATED PARAMETERS:
K = 0.0009087 ft/min
y0 = 0.4382 ft

TEST DATA:
H0 = 1.01 ft
rc = 0.083 ft
rw = 0.18 ft
L = 4.05 ft
b = 4.05 ft
B = 4.05 ft

RISING HEAD RESULT, M-06-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY – WESTDIV
Project No.: 2738.0257	Location: SITE 6

M-06-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/27 17:34

Unit# 00515 Test# 0

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/27 08:51

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.00
0.0066	5.45
0.0099	-4.23
0.0133	1.66
0.0166	1.94
0.0200	1.83
0.0233	1.81
0.0266	1.79
0.0300	1.77
0.0333	1.75
0.0500	1.66
0.0666	1.57
0.0833	1.48
0.1000	1.40
0.1166	1.32
0.1333	1.25
0.1500	1.18
0.1666	1.11
0.1833	1.05
0.2000	0.99
0.2166	0.93
0.2333	0.87
0.2500	0.82
0.2666	0.77
0.2833	0.73
0.3000	0.69
0.3166	0.65
0.3333	0.62
0.4167	0.50
0.5000	0.43
0.5833	0.39
0.6667	0.35
0.7500	0.33
0.8333	0.31
0.9167	0.29
1.0000	0.28
1.0833	0.26
1.1667	0.24
1.2500	0.24
1.3333	0.22
1.4166	0.21
1.5000	0.21
1.5833	0.20
1.6667	0.19
1.7500	0.18
1.8333	0.17
1.9167	0.17
2.0000	0.16
2.5000	0.13
3.0000	0.11
3.5000	0.10
4.0000	0.08
4.5000	0.07

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A Q T E S O L V   R E S U L T S
Version 1.10

[illegible]/08/92 14:10:49

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TEST DESCRIPTION

Data set........... m0602z.set
Data set title..... RISING HEAD RESULT, M-06-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 6
Test date.......... September 27, 1991

Knowns and Constants:
No. of data points.................. 47
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 4.82
Well screen length.................. 4.82
Static height of water in well...... 4.82
Log(Re/Rw).......................... 2.427
A, B, C............................. 0.000, 0.000, 1.825

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

Estimate
K = 1.3648E-003 ft/min = 7.1 * 10^{-4} cm/sec
y0 = -3.0094E+020

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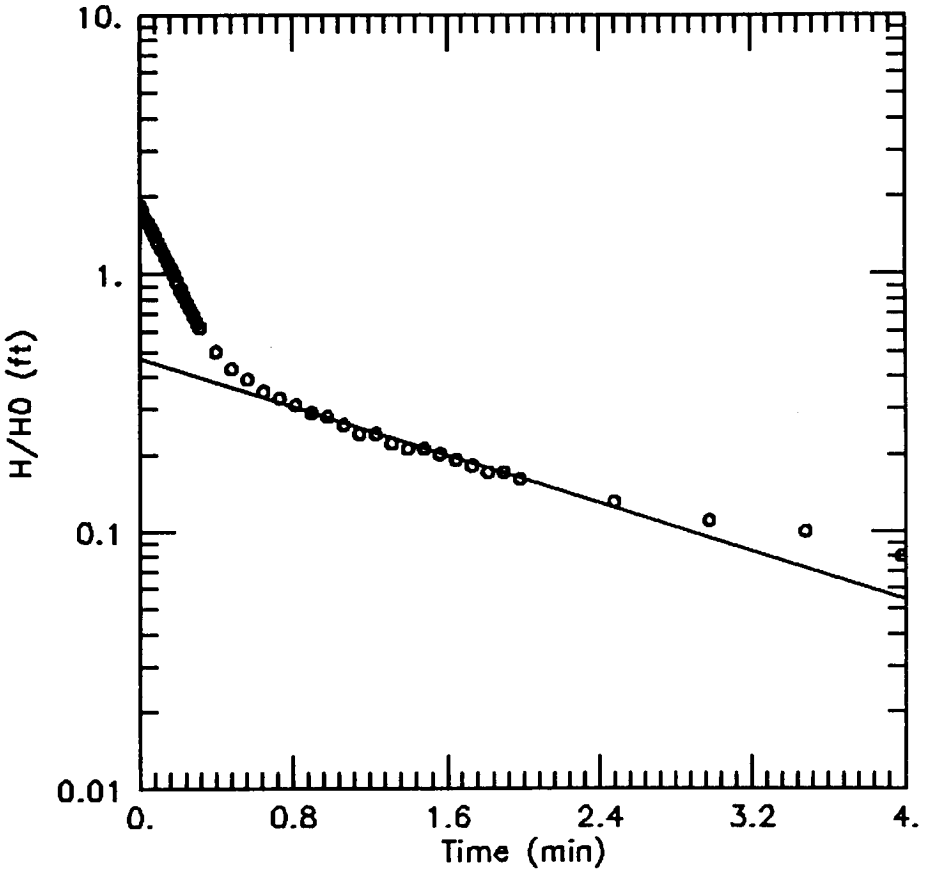
TYPE CURVE DATA

K = 9.48253E-004
y0 = 4.72037E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.720E-001	5.000E+000	3.066E-002		



DATA SET:
m06022.est
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 27, 1991

ESTIMATED PARAMETERS:
K = 0.0009365 ft/min
y0 = 0.4693 ft

TEST DATA:
H0 = 1.03 ft
rc = 0.083 ft
rw = 0.16 ft
L = 4.02 ft
b = 4.02 ft
B = 4.02 ft

RISING HEAD RESULT, M-06-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY – WESTDIV
Project No.: 2738.0257	Location: SITE 6

M-06-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/26 18:45

Unit# 00515 Test# 0

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/26 08:51

Elapsed Time (min)	Value (ft)
0.0000	1.79
0.0033	1.77
0.0066	1.76
0.0099	1.74
0.0133	1.73
0.0166	1.72
0.0200	1.70
0.0233	1.69
0.0266	1.67
0.0300	1.66
0.0333	1.65
0.0500	1.58
0.0666	1.53
0.0833	1.47
0.1000	1.42
0.1166	1.37
0.1333	1.33
0.1500	1.28
0.1666	1.24
0.1833	1.20
0.2000	1.15
0.2166	1.12
0.2333	1.08
0.2500	1.05
0.2666	1.01
0.2833	0.98
0.3000	0.95
0.3166	0.92
0.3333	0.87
0.4167	0.75
0.5000	0.67
0.5833	0.58

Elapsed Time	Value
0.6667	0.51
0.7500	0.45
0.8333	0.41
0.9167	0.37
1.0000	0.33
1.0833	0.30
1.1667	0.28
1.2500	0.26
1.3333	0.24
1.4166	0.22
1.5000	0.21
1.5833	0.20
1.6667	0.18
1.7500	0.17
1.8333	0.16
1.9167	0.15
2.0000	0.14
2.5000	0.11
3.0000	0.07
3.5000	0.07
4.0000	0.06
4.5000	0.06

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A Q T E S O L V   R E S U L T S
Version 1.10

,28/91 18:41:15

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TEST DESCRIPTION

Data set........... M0603Z.SET
Data set title..... RISING HEAD RESULT, M-06-03

Knowns and Constants:
- No. of data points................. 53
- Radius of well casing.............. 0.083
- Radius of well..................... 0.19
- Aquifer saturated thickness......... 4.26
- Well screen length.................. 4.26
- Static height of water in well...... 4.26
- Log(Re/Rw).......................... 2.32
- A, B, C.............................. 0.000, 0.000, 1.735

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.7964E-003 ft/min = $1.9 * 10^{-3}$ cm/sec
y0 =	6.9315E+234

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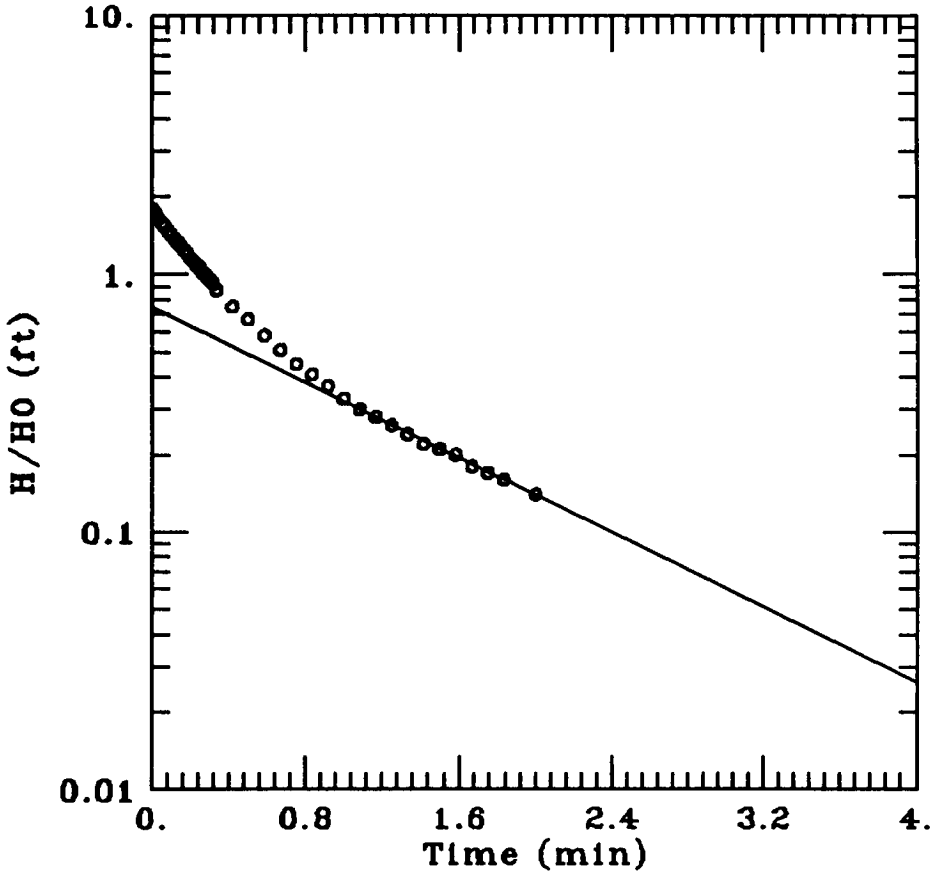
TYPE CURVE DATA

K = 1.57263E-003
y0 = 7.43952E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	7.440E-001	4.000E+000	2.601E-002		



DATA SET:
M0603Z.SET
10/20/01

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.001573 ft/min
y0 = 0.744 ft

TEST DATA:
H0 = 1.78 ft
rc = 0.083 ft
rw = 0.18 ft
L = 4.26 ft
b = 4.20 ft
B = 4.26 ft

RISING HEAD RESULT, M-06-03

M-06-04
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/24 18:30

Unit# 00515 Test# 1

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/24 09:53

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	2.71
0.0066	2.24
0.0099	3.34
0.0133	1.68
0.0166	1.67
0.0200	1.65
0.0233	1.60
0.0266	1.56
0.0300	1.52
0.0333	1.48
0.0500	1.32
0.0666	1.17
0.0833	1.04
0.1000	0.93
0.1166	0.82
0.1333	0.73
0.1500	0.66
0.1666	0.59
0.1833	0.53
0.2000	0.48
0.2166	0.44
0.2333	0.41
0.2500	0.38
0.2666	0.35
0.2833	0.33
0.3000	0.31
0.3166	0.30
0.3333	0.28
0.4167	0.23
0.5000	0.20

M-06-04

Elapsed Time	Value
0.5833	0.18
0.6667	0.16
0.7500	0.15
0.8333	0.14
0.9167	0.13
1.0000	0.12
1.0833	0.11
1.1667	0.10
1.2500	0.10
1.3333	0.09
1.4166	0.08
1.5000	0.08
1.5833	0.07
1.6667	0.07
1.7500	0.06
1.8333	0.06
1.9167	0.06
2.0000	0.05
2.5000	0.04
3.0000	0.04
3.5000	0.04
4.0000	0.02
4.5000	0.00
5.0000	0.00
5.5000	0.01

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 15:14:43

TEST DESCRIPTION

Data set........... m0604z.set
Data set title..... RISING HEAD RESULT, M-06-04
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 6
Test date.......... September 24, 1991

Knowns and Constants:
No. of data points.................. 49
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 4.46
Well screen length.................. 4.46
Static height of water in well...... 4.46
Log(Re/Rw).......................... 2.36
A, B, C............................. 0.000, 0.000, 1.767

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

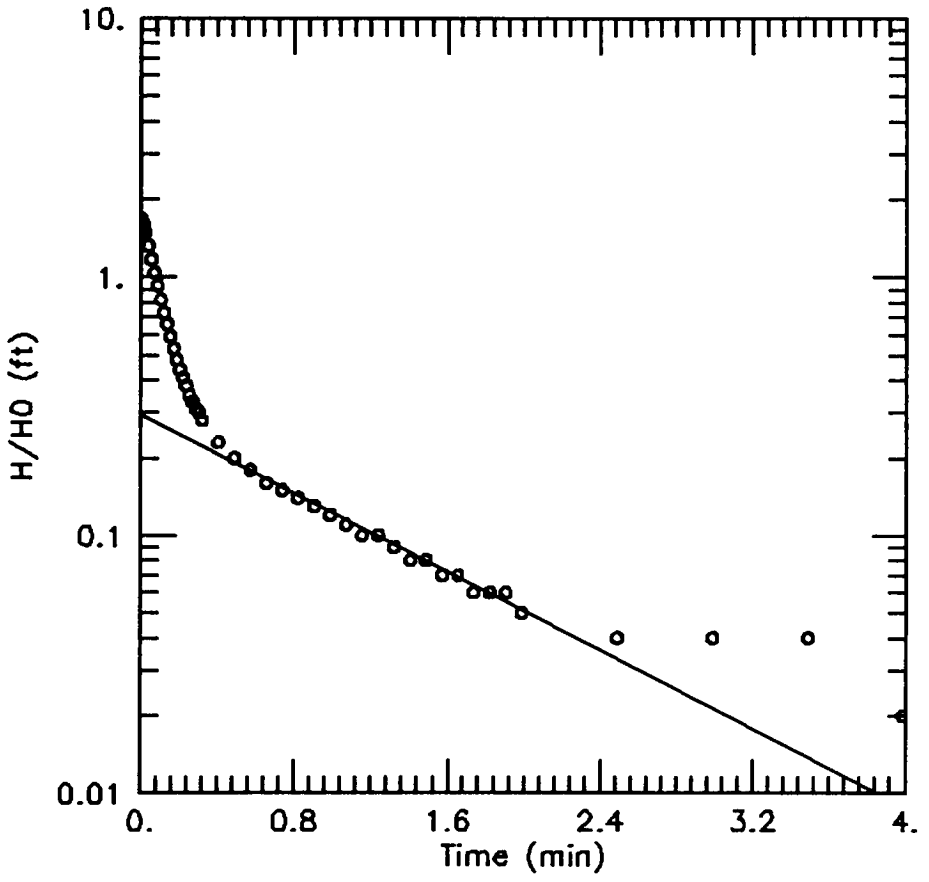
	Estimate
K =	1.8042E-003 ft/min = 9.1×10^{-4} cm/sec
y0 =	-6.5343E+019

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.60237E-003
y0 = 2.97447E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.974E-001	4.000E+000	8.828E-003		



DATA SET:
m0604z.est
01/10/02

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 24, 1991

ESTIMATED PARAMETERS:
K = 0.001608 ft/min
y0 = 0.2844 ft

TEST DATA:
H0 = 1.68 ft
rc = 0.083 ft
rw = 0.18 ft
L = 4.46 ft
b = 4.46 ft
B = 4.46 ft

RISING HEAD RESULT, M-06-04

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY – WESTDIV
Project No.: 2738.0257	Location: SITE 6

M-06-05
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/24 18:29

Unit# 00515 Test# 0

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/24 09:17

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.00
0.0066	0.00
0.0099	4.66
0.0133	-1.74
0.0166	1.17
0.0200	1.61
0.0233	1.64
0.0266	1.62
0.0300	1.58
0.0333	1.54
0.0500	1.39
0.0666	1.26
0.0833	1.14
0.1000	1.03
0.1166	0.93
0.1333	0.85
0.1500	0.77
0.1666	0.70
0.1833	0.64
0.2000	0.58
0.2166	0.54
0.2333	0.50
0.2500	0.46
0.2666	0.44
0.2833	0.42
0.3000	0.40
0.3166	0.38
0.3333	0.37
0.4167	0.31
0.5000	0.28
0.5833	0.25

M-06-05

Elapsed Time	Value
0.6667	0.24
0.7500	0.22
0.8333	0.21
0.9167	0.20
1.0000	0.18
1.0833	0.17
1.1667	0.17
1.2500	0.16
1.3333	0.15
1.4166	0.14
1.5000	0.14
1.5833	0.13
1.6667	0.12
1.7500	0.12
1.8333	0.11
1.9167	0.11
2.0000	0.10
2.5000	0.08
3.0000	0.07
3.5000	0.06
4.0000	0.05
4.5000	0.04
5.0000	0.03
5.5000	0.03
6.0000	0.03
6.5000	0.03

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 15:21:33

TEST DESCRIPTION

Data set........... m0605z.set
Data set title..... RISING HEAD RESULT, M-06-05
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 6
Test date.......... September 24, 1991

Knowns and Constants:
No. of data points.................. 50
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 4.52
Well screen length.................. 4.52
Static height of water in well...... 4.52
Log(Re/Rw).......................... 2.371
A, B, C............................. 0.000, 0.000, 1.776

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

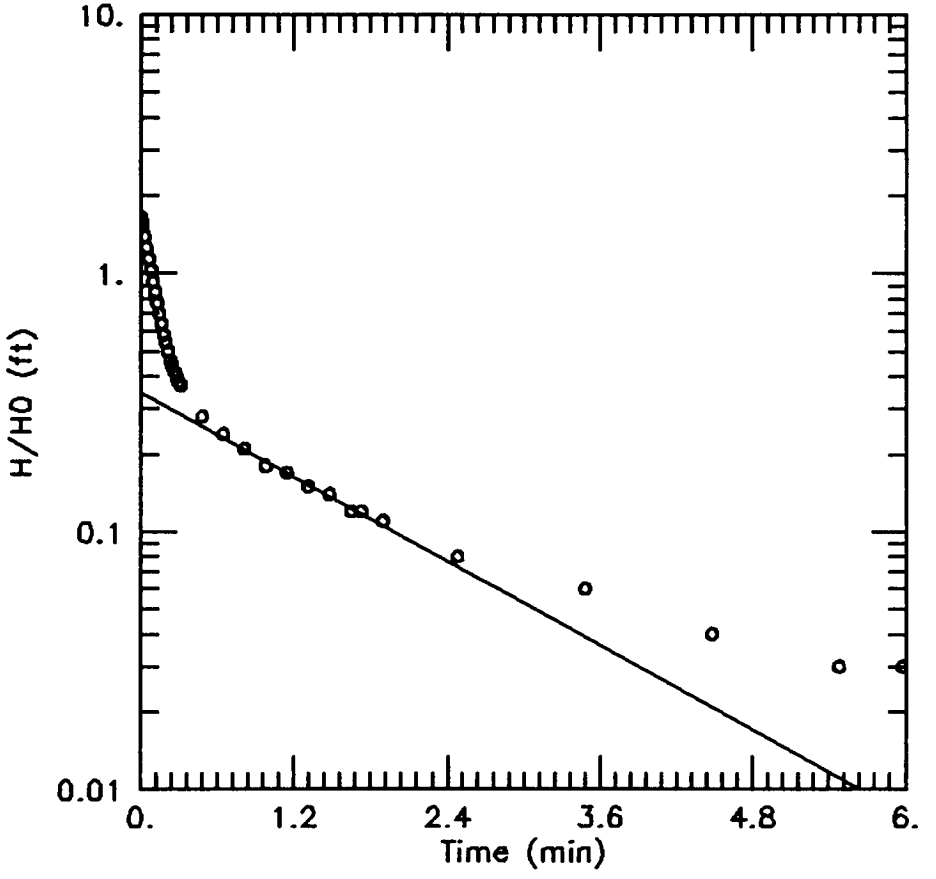
Estimate
K = 1.0880E-003 ft/min = 5.6* 10^{-4} cm/sec
y0 = -6.5343E+019

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.16515E-003
y0 = 3.59646E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.596E-001	4.500E+000	1.975E-002		



DATA SET:
m0605z.001
01/16/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 24, 1991

ESTIMATED PARAMETERS:
K = 0.001193 ft/min
y0 = 0.343 ft

TEST DATA:
H0 = 1.64 ft
rc = 0.083 ft
rw = 0.18 ft
L = 4.52 ft
b = 4.52 ft
B = 4.52 ft

RISING HEAD RESULT, M-06-05

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 6

M-07A-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/17 17:00

Unit# 00515 Test# 3

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/17 10:55

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.33
0.0066	3.32
0.0099	5.51
0.0133	-0.18
0.0166	1.33
0.0200	2.80
0.0233	1.24
0.0266	1.72
0.0300	1.98
0.0333	1.52
0.0500	1.64
0.0666	1.54
0.0833	1.47
0.1000	1.42
0.1166	1.37
0.1333	1.32
0.1500	1.28
0.1666	1.23
0.1833	1.19
0.2000	1.14
0.2166	1.10
0.2333	1.06
0.2500	1.02
0.2666	0.99
0.2833	0.95
0.3000	0.92
0.3166	0.90
0.3333	0.87
0.4167	0.76
0.5000	0.68
0.5833	0.64

M-07A-01

Elapsed Time	Value
0.6667	0.60
0.7500	0.58
0.8333	0.57
0.9167	0.55
1.0000	0.54
1.0833	0.53
1.1667	0.52
1.2500	0.51
1.3333	0.50
1.4166	0.50
1.5000	0.49
1.5833	0.48
1.6667	0.48
1.7500	0.47
1.8333	0.46
1.9167	0.46
2.0000	0.45
2.5000	0.43
3.0000	0.39
3.5000	0.38
4.0000	0.37
4.5000	0.36
5.0000	0.35
5.5000	0.33
6.0000	0.33
6.5000	0.31
7.0000	0.30
7.5000	0.29
8.0000	0.29
8.5000	0.28
9.0000	0.27
9.5000	0.26
10.0000	0.25
12.0000	0.22
14.0000	0.20
16.0000	0.19
18.0000	0.16
20.0000	0.16

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 15:47:37

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TEST DESCRIPTION

Data set........... m07a01z.set
Data set title..... RISING HEAD RESULT, M-07A-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 7A
Test date.......... September 17, 1991

Knowns and Constants:
- No. of data points.................. 58
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 5.81
- Well screen length.................. 5.81
- Static height of water in well...... 5.81
- Log(Re/Rw).......................... 2.587
- A, B, C............................. 0.000, 0.000, 1.987

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

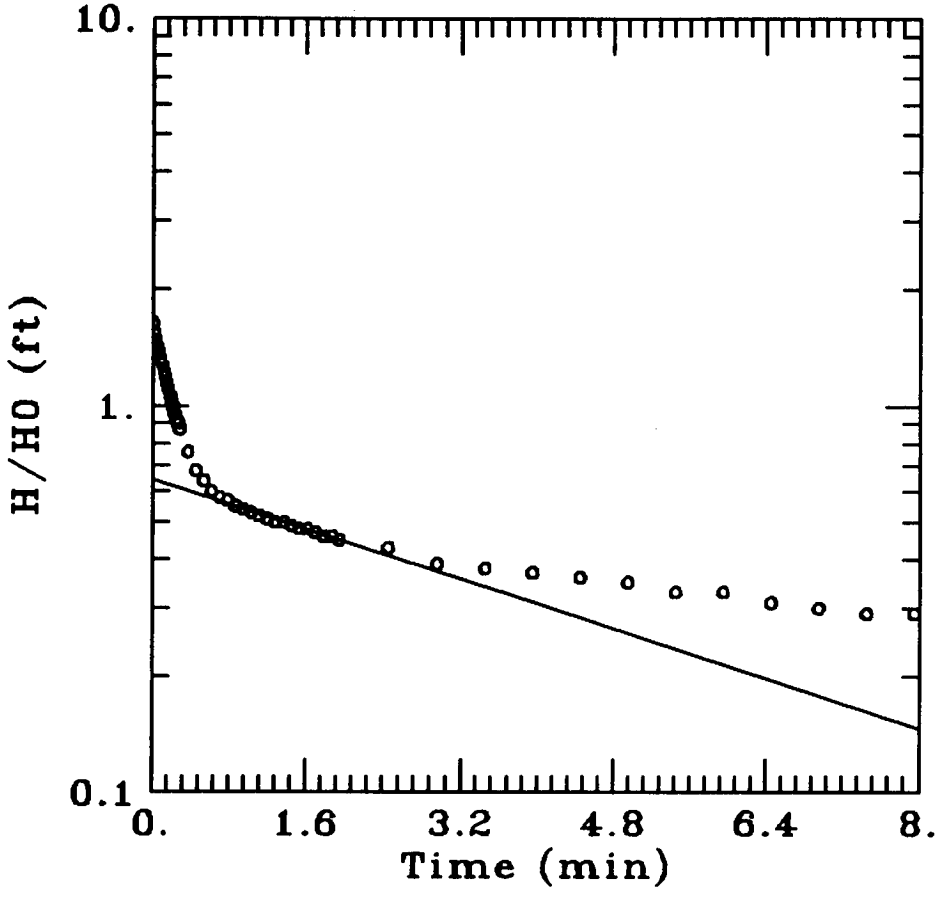
	Estimate
K =	1.6286E-004 ft/min = 8.1×10^{-5} cm/sec
y0 =	4.1388E+149

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 2.44865E-004
y0 = 6.21584E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	6.216E-001	5.000E+000	2.798E-001		



DATA SET:
m07a01z.dat
01/16/92

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 17, 1991

ESTIMATED PARAMETERS:
K = 0.0002047 ft/min
y0 = 0.6457 ft

TEST DATA:
H0 = 1.64 ft
rc = 0.083 ft
rw = 0.18 ft
L = 6.01 ft
b = 6.01 ft
B = 6.01 ft

RISING HEAD RESULT, M-07A-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 7A

M-07A-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/17 17:03

Unit# 00515 Test# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/17 13:14

Elapsed Time (min)	Value (ft)
0.0000	0.75
0.0033	4.00
0.0066	5.96
0.0099	6.86
0.0133	7.09
0.0166	4.59
0.0200	-0.96
0.0233	0.72
0.0266	3.49
0.0300	5.31
0.0333	4.53
0.0500	4.18
0.0666	3.54
0.0833	2.95
0.1000	2.59
0.1166	2.49
0.1333	2.52
0.1500	2.59
0.1666	2.65
0.1833	2.67
0.2000	2.66
0.2166	2.64
0.2333	2.62
0.2500	2.60
0.2666	2.59
0.2833	2.58
0.3000	2.58
0.3166	2.57
0.3333	2.57
0.4167	2.54
0.5000	2.53
0.5833	2.51

M-07A-02

Elapsed Time	Value
0.6667	2.50
0.7500	2.49
0.8333	2.48
0.9167	2.47
1.0000	2.46
1.0833	2.44
1.1667	2.44
1.2500	2.43
1.3333	2.42
1.4166	2.42
1.5000	2.41
1.5833	2.40
1.6667	2.39
1.7500	2.39
1.8333	2.38
1.9167	2.37
2.0000	2.37
2.5000	2.33
3.0000	2.30
3.5000	2.26
4.0000	2.23
4.5000	2.21
5.0000	2.19
5.5000	2.18
6.0000	2.16
6.5000	2.14
7.0000	2.12
7.5000	2.08
8.0000	2.07
8.5000	2.05
9.0000	2.04
9.5000	2.03
10.0000	2.02
12.0000	1.98
14.0000	1.94
16.0000	1.90
18.0000	1.87
20.0000	1.84
22.0000	1.81
24.0000	1.79
26.0000	1.77
28.0000	1.75
30.0000	1.72
32.0000	1.70
34.0000	1.66
36.0000	1.66
38.0000	1.66
40.0000	1.65
42.0000	1.63
44.0000	1.63
46.0000	1.63
48.0000	1.62
50.0000	1.60

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/10/92 15:06:17

TEST DESCRIPTION

Data set........... m07a02z.set
Data set title..... RISING HEAD RESULT, M-07A-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 7A
Test date.......... September 17, 1991

Knowns and Constants:
No. of data points.................. 72
Radius of well casing............... 0.083
Radius of well...................... 0.33
Aquifer saturated thickness......... 11.16
Well screen length.................. 10
Static height of water in well...... 11.16
Log(Re/Rw).......................... 2.648
A, B, C............................. 0.000, 0.000, 1.979

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

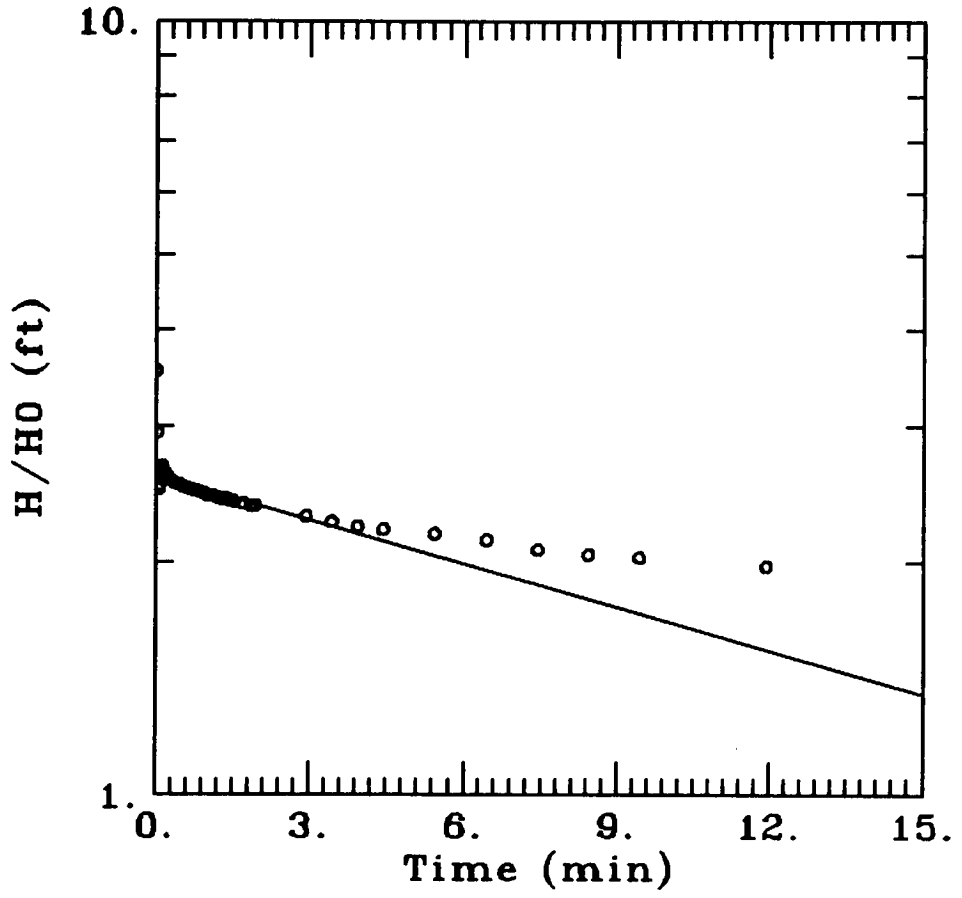
Estimate
K = 9.6640E-006 ft/min = $4.9 * 10^{-6}$ cm/sec
y0 = -4.6180E+207

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 3.95340E-005
y0 = 2.58261E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.583E+000	1.500E+001	1.348E+000		



DATA SET:
m07a02z.sot
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 17, 1991

ESTIMATED PARAMETERS:
K = 3.9834E-05 ft/min
y0 = 2.583 ft

TEST DATA:
H0 = 3.64 ft
rc = 0.083 ft
rw = 0.33 ft
L = 10. ft
b = 11.16 ft
B = 11.16 ft

RISING HEAD RESULT, M-07A-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 7A

M-07A-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/19 18:44

Unit# 00515 Test# 1

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/19 11:38

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.01
0.0066	0.75
0.0099	2.81
0.0133	6.57
0.0166	7.30
0.0200	2.05
0.0233	0.16
0.0266	-1.48
0.0300	-1.48
0.0333	1.24
0.0500	0.45
0.0666	3.20
0.0833	0.82
0.1000	1.56
0.1166	2.15
0.1333	1.22
0.1500	1.70
0.1666	1.79
0.1833	1.44
0.2000	1.66
0.2166	1.68
0.2333	1.53
0.2500	1.63
0.2666	1.63
0.2833	1.57
0.3000	1.62
0.3166	1.61
0.3333	1.58
0.4167	1.60
0.5000	1.59
0.5833	1.58
0.6667	1.58
0.7500	1.58
0.8333	1.57
0.9167	1.57
1.0000	1.57
1.0833	1.56
1.1667	1.56
1.2500	1.55
1.3333	1.55
1.4166	1.54
1.5000	1.54
1.5833	1.52
1.6667	1.52
1.7500	1.52
1.8333	1.52
1.9167	1.52
2.0000	1.52
2.5000	1.51
3.0000	1.49
3.5000	1.47
4.0000	1.46
4.5000	1.46
5.0000	1.44
5.5000	1.43
6.0000	1.43
6.5000	1.42
7.0000	1.41
7.5000	1.41
8.0000	1.41
8.5000	1.41
9.0000	1.40
9.5000	1.40
10.0000	1.39
12.0000	1.39
14.0000	1.38
16.0000	1.37
18.0000	1.36
20.0000	1.35
22.0000	1.36
24.0000	1.34
26.0000	1.34
28.0000	1.34
30.0000	1.33
32.0000	1.32
34.0000	1.32
36.0000	1.31
38.0000	1.31
40.0000	1.32
42.0000	1.30
44.0000	1.30
46.0000	1.31
48.0000	1.31
50.0000	1.30
52.0000	1.29
54.0000	1.28
56.0000	1.27
58.0000	1.28
60.0000	1.28

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/10/92 15:14:10

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TEST DESCRIPTION

```
Data set........... m07a03z.set
Data set title..... RISING HEAD RESULT, M-07A-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 7A
Test date.......... September 19, 1991

Knowns and Constants:
   No. of data points.................. 71
   Radius of well casing............... 0.083
   Radius of well...................... 0.33
   Aquifer saturated thickness......... 14.4
   Well screen length.................. 8
   Static height of water in well...... 14.4
   Log(Re/Rw).......................... 2.738
   A, B, C.............................  0.000,  0.000,  1.790
```

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ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

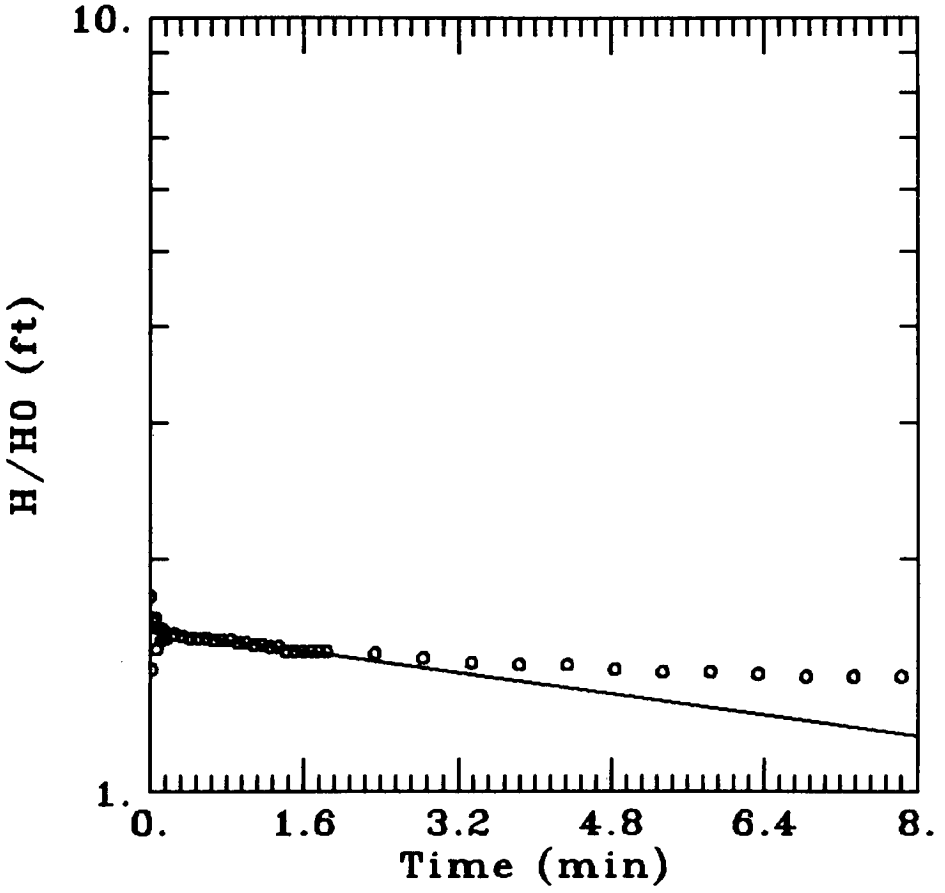
```
          Estimate
   K  =   4.4801E-006 ft/min ≅ 2.3 * 10^-6 cm/sec
   y0 =  -4.6180E+207
```

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

```
     K  = 4.64485E-005
     y0 = 1.61899E+000
```

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.619E+000	8.000E+000	1.181E+000		



DATA SET:
m07a03z.set
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 19, 1991

ESTIMATED PARAMETERS:
K = 4.0449E-05 ft/min
y0 = 1.610 ft

TEST DATA:
H0 = 1.79 ft
rc = 0.083 ft
rw = 0.33 ft
L = 0. ft
b = 14.4 ft
H = 14.4 ft

RISING HEAD RESULT, M-07A-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 7A

M-07A-04
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/17 16:56

Unit# 00515 Test# 1

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/17 10:05

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	2.60
0.0066	2.91
0.0099	2.37
0.0133	1.42
0.0166	1.39
0.0200	1.34
0.0233	1.33
0.0266	1.31
0.0300	1.29
0.0333	1.28
0.0500	1.21
0.0666	1.14
0.0833	1.08
0.1000	1.02
0.1166	0.97
0.1333	0.92
0.1500	0.87
0.1666	0.83
0.1833	0.79
0.2000	0.75
0.2166	0.71
0.2333	0.68
0.2500	0.65
0.2666	0.62
0.2833	0.59
0.3000	0.57
0.3166	0.55
0.3333	0.52
0.4167	0.44
0.5000	0.38
0.5833	0.34
0.6667	0.31
0.7500	0.29
0.8333	0.27
0.9167	0.25
1.0000	0.24
1.0833	0.23
1.1667	0.22
1.2500	0.21
1.3333	0.20
1.4166	0.20
1.5000	0.19
1.5833	0.19
1.6667	0.18
1.7500	0.18
1.8333	0.17
1.9167	0.17
2.0000	0.16
2.5000	0.14
3.0000	0.13
3.5000	0.12
4.0000	0.11
4.5000	0.10
5.0000	0.11
5.5000	0.08
6.0000	0.06
6.5000	0.07
7.0000	0.07
7.5000	0.07
8.0000	0.07
8.5000	0.06
9.0000	0.05
9.5000	0.06
10.0000	0.05
12.0000	0.04
14.0000	0.03
16.0000	0.02
18.0000	0.03
20.0000	0.03

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 17:15:25

TEST DESCRIPTION

Data set........... M07A04Z.SET
Data set title..... RISING HEAD RESULT, M-07A-04
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... SITE 7A
Test date.......... September 17, 1991

Knowns and Constants:
- No. of data points.................. 59
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 4
- Well screen length.................. 4
- Static height of water in well...... 3.5
- Log(Re/Rw).......................... 2.013
- A, B, C............................. 2.179, 0.344, 0.000

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

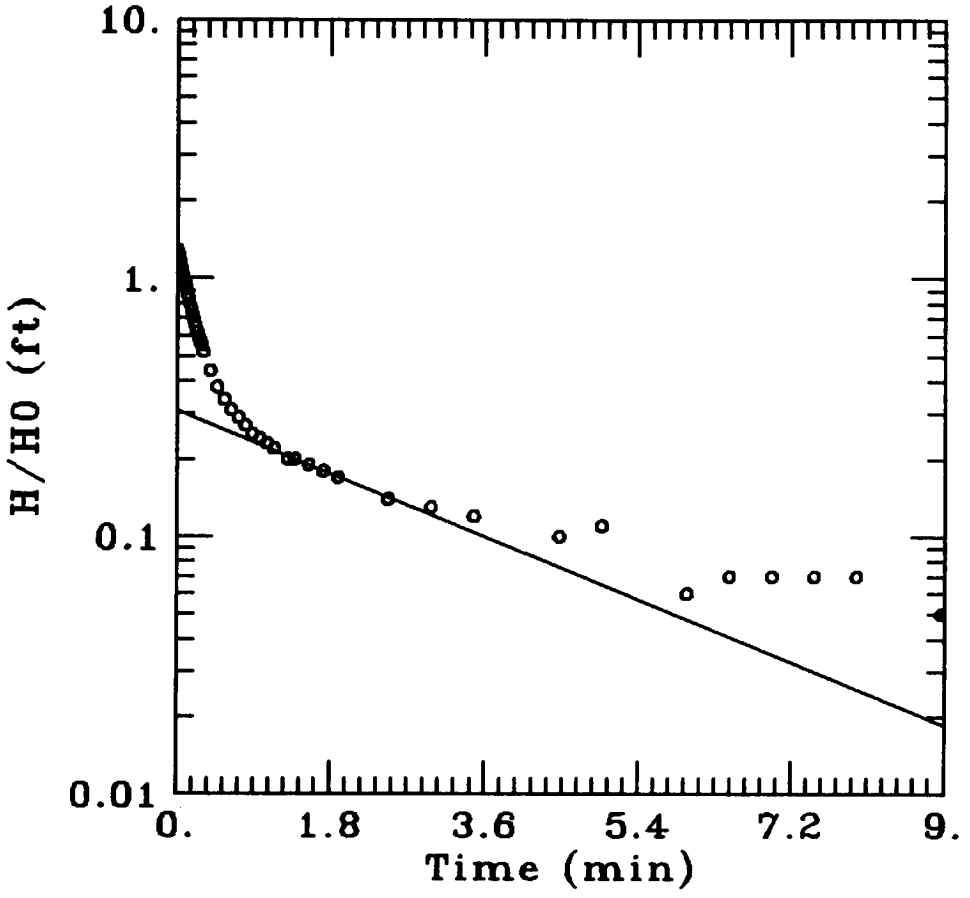
Estimate
K = 3.4238E-004 ft/min = 1.7 * 10^{-4} cm/sec
y0 = -6.5343E+019

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.07766E-003
y0 = 4.47649E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.476E-001	5.000E+000	1.998E-002		



DATA SET:
m07a04z.sot
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 17, 1991

ESTIMATED PARAMETERS:
K = 0.0005417 ft/min
y0 = 0.3061 ft

TEST DATA:
H0 = 1.28 ft
rc = 0.083 ft
rw = 0.18 ft
L = 4. ft
b = 4. ft
B = 3.5 ft

RISING HEAD RESULT, M-07A-04

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: SITE 7A

M-07B-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:36

Unit# 00515 Test# 1

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 08:42

Elapsed Time (min)	Value (ft)
0.0000	-0.02
0.0033	0.29
0.0066	7.54
0.0099	7.54
0.0133	-1.72
0.0166	2.68
0.0200	1.24
0.0233	1.52
0.0266	1.61
0.0300	1.37
0.0333	1.45
0.0500	1.25
0.0666	1.10
0.0833	0.96
0.1000	0.84
0.1166	0.74
0.1333	0.65
0.1500	0.57
0.1666	0.52
0.1833	0.47
0.2000	0.43
0.2166	0.41
0.2333	0.38
0.2500	0.37
0.2666	0.35
0.2833	0.33
0.3000	0.32
0.3166	0.31
0.3333	0.30
0.4167	0.27
0.5000	0.22
0.5833	0.21
0.6667	0.20
0.7500	0.18
0.8333	0.16
0.9167	0.14
1.0000	0.13
1.0833	0.12
1.1667	0.11
1.2500	0.10
1.3333	0.08
1.4166	0.08
1.5000	0.08
1.5833	0.07
1.6667	0.07
1.7500	0.06
1.8333	0.06
1.9167	0.05
2.0000	0.05
2.5000	0.03
3.0000	0.02

M-07B-01

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 17:37:58

TEST DESCRIPTION

Data set........... m07b01z.set
Data set title..... RISING HEAD RESULT, M-07B-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 7B, Building 162
Test date.......... September 18, 1991

Knowns and Constants:
- No. of data points.................. 42
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 6.3
- Well screen length.................. 6.3
- Static height of water in well...... 6.3
- Log(Re/Rw).......................... 2.655
- A, B, C............................. 0.000, 0.000, 2.070

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

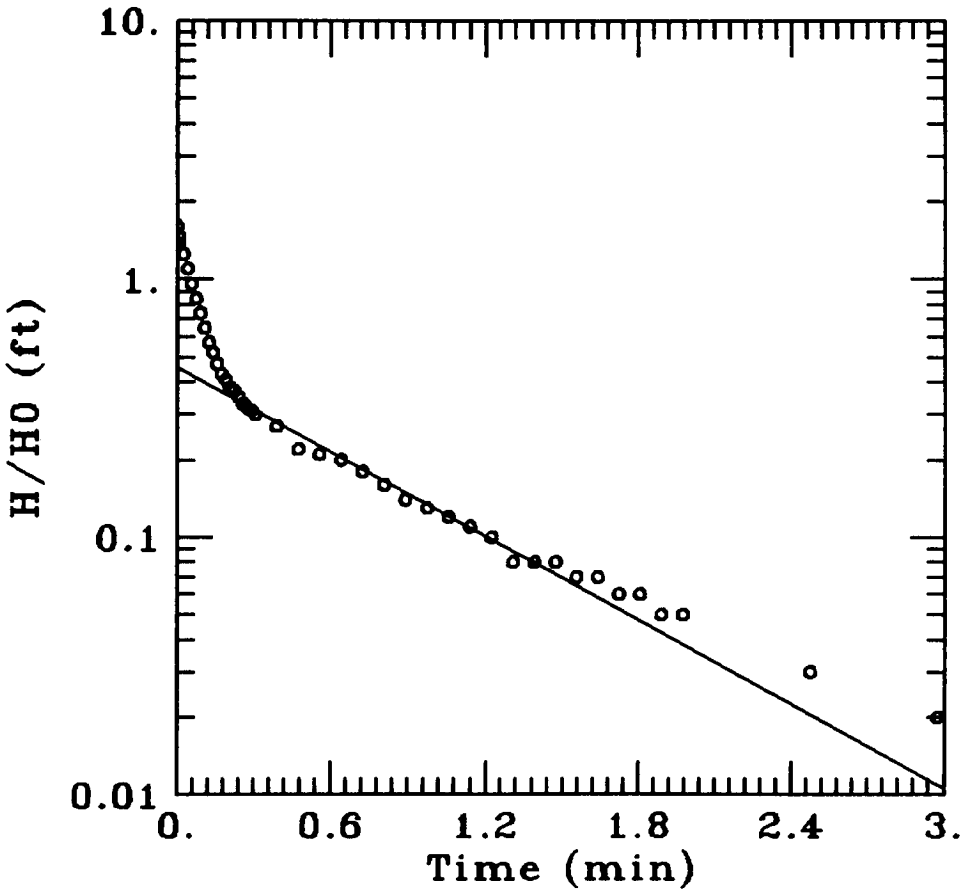
	Estimate
K =	1.9796E-003 ft/min = $1.0 * 10^{-3}$ cm/sec
y0 =	4.3937E-098

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>

TYPE CURVE DATA

K = 1.52609E-003
y0 = 3.81130E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.811E-001	3.000E+000	1.627E-002		



DATA SET:
m07b01z.sot
01/10/92

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.001020 ft/min
y0 = 0.455 ft

TEST DATA:
H0 = 1.61 ft
rc = 0.083 ft
rw = 0.15 ft
L = 6.3 ft
b = 6.3 ft
B = 6.3 ft

RISING HEAD RESULT, M-07B-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 7B, Building 162

M-08-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/19 18:56

Unit# 00515 Test# 9

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/19 15:05

Elapsed Time (min)	Value (ft)
0.0000	0.41
0.0033	5.81
0.0066	3.48
0.0099	2.95
0.0133	1.83
0.0166	1.75
0.0200	1.68
0.0233	1.62
0.0266	1.58
0.0300	1.55
0.0333	1.50
0.0500	1.31
0.0666	1.15
0.0833	1.00
0.1000	0.87
0.1166	0.76
0.1333	0.66
0.1500	0.58
0.1666	0.51
0.1833	0.45
0.2000	0.41
0.2166	0.37
0.2333	0.34
0.2500	0.32
0.2666	0.30
0.2833	0.28
0.3000	0.27
0.3166	0.25
0.3333	0.24
0.4167	0.20
0.5000	0.18
0.5833	0.16

Elapsed Time	Value
0.6667	0.14
0.7500	0.13
0.8333	0.12
0.9167	0.11
1.0000	0.10
1.0833	0.09
1.1667	0.09
1.2500	0.07
1.3333	0.07
1.4166	0.06
1.5000	0.06
1.5833	0.06
1.6667	0.06
1.7500	0.05
1.8333	0.05
1.9167	0.05
2.0000	0.04
2.5000	0.03
3.0000	0.02
3.5000	0.02
4.0000	0.03
4.5000	0.02
5.0000	0.01

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 18:10:32

==

TEST DESCRIPTION

Data set........... m0801z.set
Data set title..... RISING HEAD RESULT, M-08-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 8
Test date.......... September 19, 1991

Knowns and Constants:
- No. of data points.................. 50
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 7.4
- Well screen length.................. 7.4
- Static height of water in well...... 7.4
- Log(Re/Rw)......................... 2.79
- A, B, C............................. 0.000, 0.000, 2.261

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

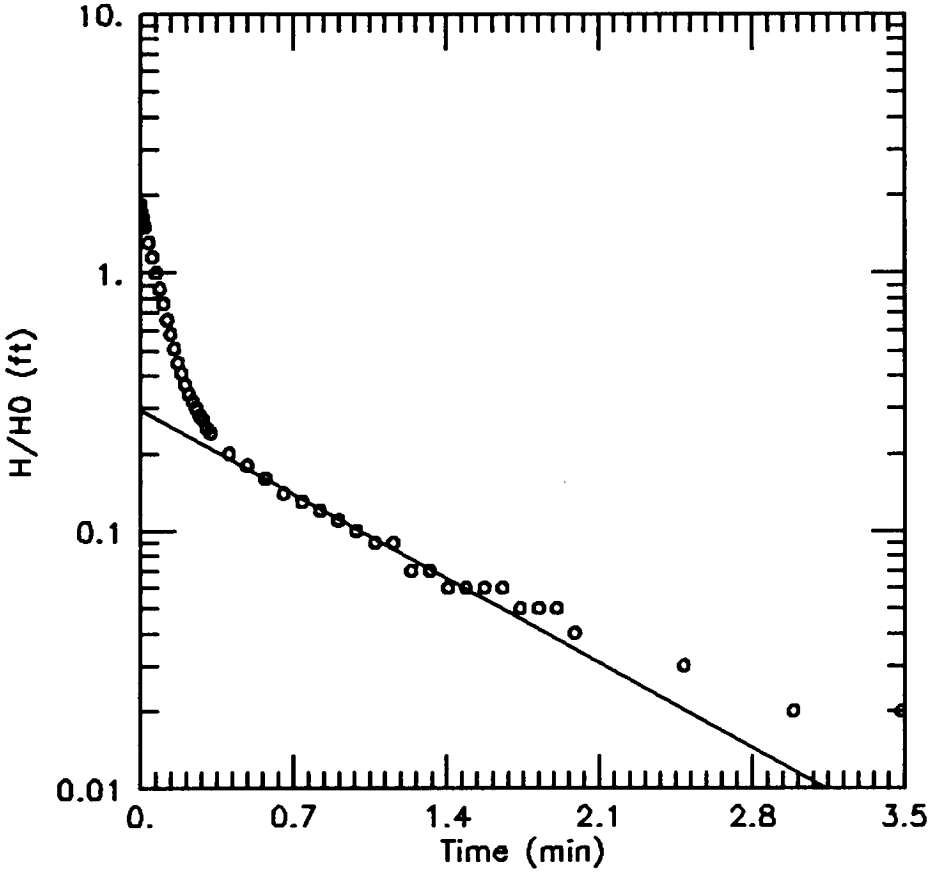
	Estimate
K =	1.2970E-003 ft/min = $6.6 * 10^{-4}$ cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>

TYPE CURVE DATA

K = 1.53442E-003
y0 = 3.20130E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.201E-001	2.000E+000	3.013E-002		



DATA SET:
m0801z.out
01/16/92

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 19, 1991

ESTIMATED PARAMETERS:
K = 0.001401 ft/min
y0 = 0.864 ft

TEST DATA:
H0 = 1.05 ft
rc = 0.083 ft
rw = 0.18 ft
L = 7.4 ft
b = 7.4 ft
H = 7.4 ft

RISING HEAD RESULT, M-08-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 8

M-08-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/23 19:08

Unit# 00515 Test# 7

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/23 11:07

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.00
0.0066	1.78
0.0099	3.57
0.0133	-0.27
0.0166	2.39
0.0200	1.99
0.0233	1.92
0.0266	1.87
0.0300	1.84
0.0333	1.81
0.0500	1.65
0.0666	1.51
0.0833	1.38
0.1000	1.26
0.1166	1.15
0.1333	1.04
0.1500	0.94
0.1666	0.85
0.1833	0.77
0.2000	0.70
0.2166	0.64
0.2333	0.59
0.2500	0.55
0.2666	0.51
0.2833	0.49
0.3000	0.47
0.3166	0.45
0.3333	0.44
0.4167	0.39
0.5000	0.36
0.5833	0.34
0.6667	0.32
0.7500	0.31
0.8333	0.29
0.9167	0.28
1.0000	0.27
1.0833	0.26
1.1667	0.25
1.2500	0.25
1.3333	0.24
1.4166	0.22
1.5000	0.22
1.5833	0.22
1.6667	0.21
1.7500	0.21
1.8333	0.20
1.9167	0.20
2.0000	0.19
2.5000	0.17
3.0000	0.14
3.5000	0.13
4.0000	0.12
4.5000	0.11
5.0000	0.10
5.5000	0.09
6.0000	0.08
6.5000	0.08
7.0000	0.08
7.5000	0.08

M-08-02

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 18:16:44

TEST DESCRIPTION

Data set........... m0802z.set
Data set title..... RISING HEAD RESULT, M-08-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 8
Test date.......... September 23, 1991

Knowns and Constants:
No. of data points.................. 53
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 5.5
Well screen length.................. 5.5
Static height of water in well...... 5.5
Log(Re/Rw).......................... 2.54
A, B, C............................. 0.000, 0.000, 1.936

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

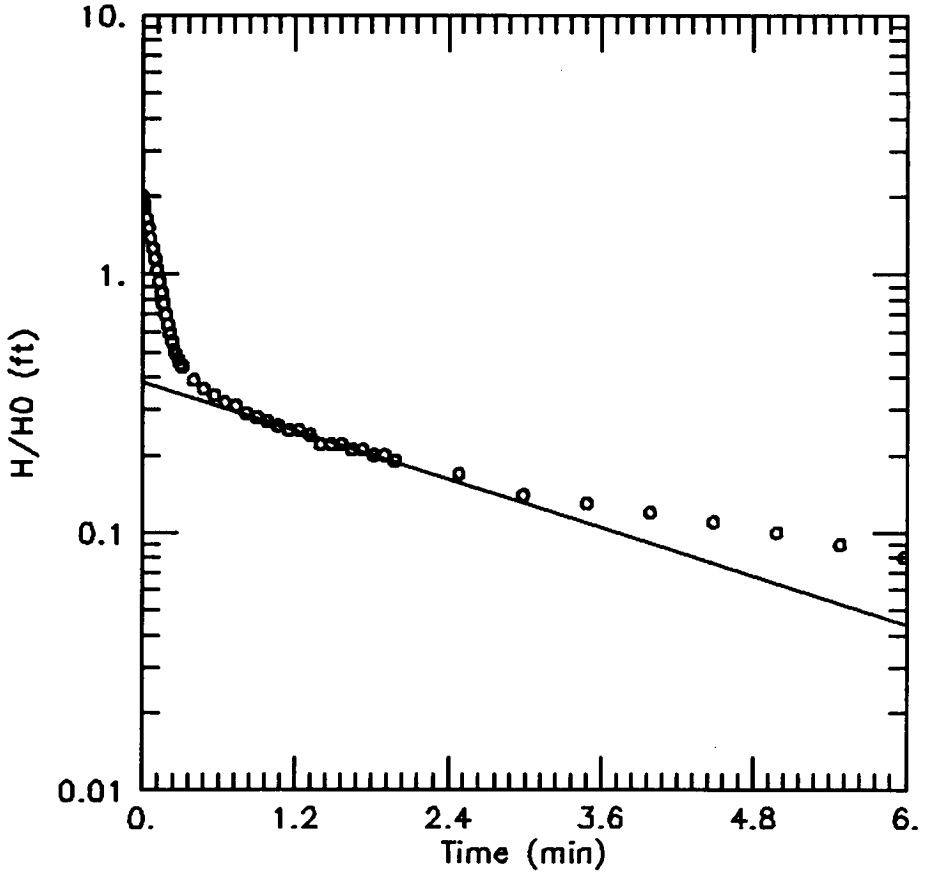
	Estimate
K =	6.2428E-004 ft/min = $3.1 * 10^{-4}$ cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 6.46952E-004
y0 = 4.12008E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.120E-001	5.000E+000	5.392E-002		



DATA SET:
m0002z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.0005765 ft/min
y0 = 0.3835 ft

TEST DATA:
H0 = 1.00 ft
rc = 0.083 ft
rw = 0.18 ft
L = 6.5 ft
b = 6.5 ft
E = 6.5 ft

RISING HEAD RESULT, M-08-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 8

M-08-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/19 18:48

Unit# 00515 Test# 3

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/19 13:28

Elapsed Time (min)	Value (ft)
0.0000	-0.05
0.0033	0.19
0.0066	2.53
0.0099	6.75
0.0133	2.85
0.0166	-0.96
0.0200	2.98
0.0233	1.54
0.0266	0.98
0.0300	1.86
0.0333	1.31
0.0500	1.27
0.0666	1.10
0.0833	0.97
0.1000	0.86
0.1166	0.77
0.1333	0.69
0.1500	0.62
0.1666	0.56
0.1833	0.51
0.2000	0.47
0.2166	0.43
0.2333	0.40
0.2500	0.38
0.2666	0.36
0.2833	0.35
0.3000	0.33
0.3166	0.32
0.3333	0.31
0.4167	0.26
0.5000	0.23
0.5833	0.21

M-08-03

Elapsed Time	Value
0.6667	0.19
0.7500	0.17
0.8333	0.16
0.9167	0.15
1.0000	0.14
1.0833	0.14
1.1667	0.13
1.2500	0.12
1.3333	0.11
1.4166	0.11
1.5000	0.10
1.5833	0.10
1.6667	0.09
1.7500	0.09
1.8333	0.09
1.9167	0.08
2.0000	0.08
2.5000	0.06
3.0000	0.05
3.5000	0.03
4.0000	0.03
4.5000	0.01
5.0000	0.00
5.5000	0.00
6.0000	0.01
6.5000	0.01
7.0000	0.01
7.5000	0.01

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S

Version 1.10

01/08/92 18:22:25

TEST DESCRIPTION

Data set........... m0803z.set
Data set title..... RISING HEAD RESULT, M-08-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 8
Test date.......... September 19, 1991

Knowns and Constants:
- No. of data points.................. 48
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 6.9
- Well screen length.................. 6.9
- Static height of water in well...... 6.9
- Log(Re/Rw)......................... 2.732
- A, B, C............................ 0.000, 0.000, 2.174

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

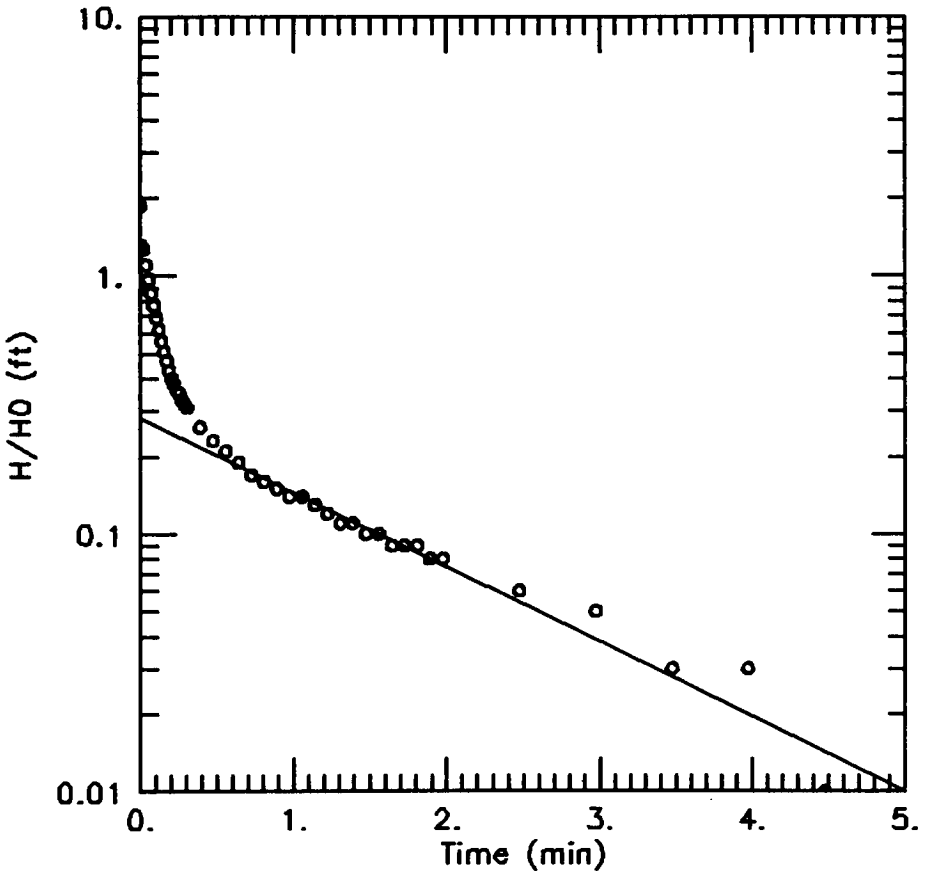
	Estimate
K =	9.3883E-004 ft/min = 4.8* 10^{-4} cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.57238E-003
y0 = 4.10835E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.108E-001	3.000E+000	1.292E-002		



DATA SET:
m0803z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.0000007 ft/min
y0 = 0.2700 ft

TEST DATA:
H0 = 1.06 ft
rc = 0.083 ft
rw = 0.13 ft
L = 0.0 ft
b = 0.0 ft
B = 0.0 ft

RISING HEAD RESULT, M-08-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 8

M-08-04
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/19 18:51

Unit# 00515 Test# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/19 14:04

Elapsed Time (min)	Value (ft)
0.0000	0.32
0.0033	2.01
0.0066	7.76
0.0099	1.28
0.0133	0.64
0.0166	2.38
0.0200	1.53
0.0233	1.70
0.0266	1.70
0.0300	1.62
0.0333	1.62
0.0500	1.49
0.0666	1.37
0.0833	1.26
0.1000	1.16
0.1166	1.07
0.1333	0.98
0.1500	0.90
0.1666	0.82
0.1833	0.75
0.2000	0.69
0.2166	0.64
0.2333	0.59
0.2500	0.56
0.2666	0.52
0.2833	0.50
0.3000	0.47
0.3166	0.45
0.3333	0.43
0.4167	0.36
0.5000	0.32
0.5833	0.29

M-08-04

Elapsed Time	Value
0.6667	0.27
0.7500	0.25
0.8333	0.23
0.9167	0.22
1.0000	0.21
1.0833	0.20
1.1667	0.19
1.2500	0.18
1.3333	0.17
1.4166	0.16
1.5000	0.15
1.5833	0.14
1.6667	0.14
1.7500	0.13
1.8333	0.12
1.9167	0.11
2.0000	0.11
2.5000	0.08
3.0000	0.07
3.5000	0.06
4.0000	0.05
4.5000	0.03
5.0000	0.03
5.5000	0.04
6.0000	0.04
6.5000	0.03
7.0000	0.03
7.5000	0.02
8.0000	0.02
8.5000	0.03
9.0000	0.02
9.5000	0.02
10.0000	0.02

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S

Version 1.10

/08/92 18:30:09

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TEST DESCRIPTION

Data set........... m0804z.set
Data set title..... RISING HEAD RESULT, M-08-04
Company............ J.M.Montgomery, Consulting Eng
Project............ 2738.0257
Client............. NAVY CLEAN
Location........... Alameda Naval Air Station
Test date.......... September 19, 1991

Knowns and Constants:
No. of data points.................. 56
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 8.15
Well screen length.................. 8.15
Static height of water in well...... 8.15
Log(Re/Rw).......................... 2.87
A, B, C............................. 0.000, 0.000, 2.395

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

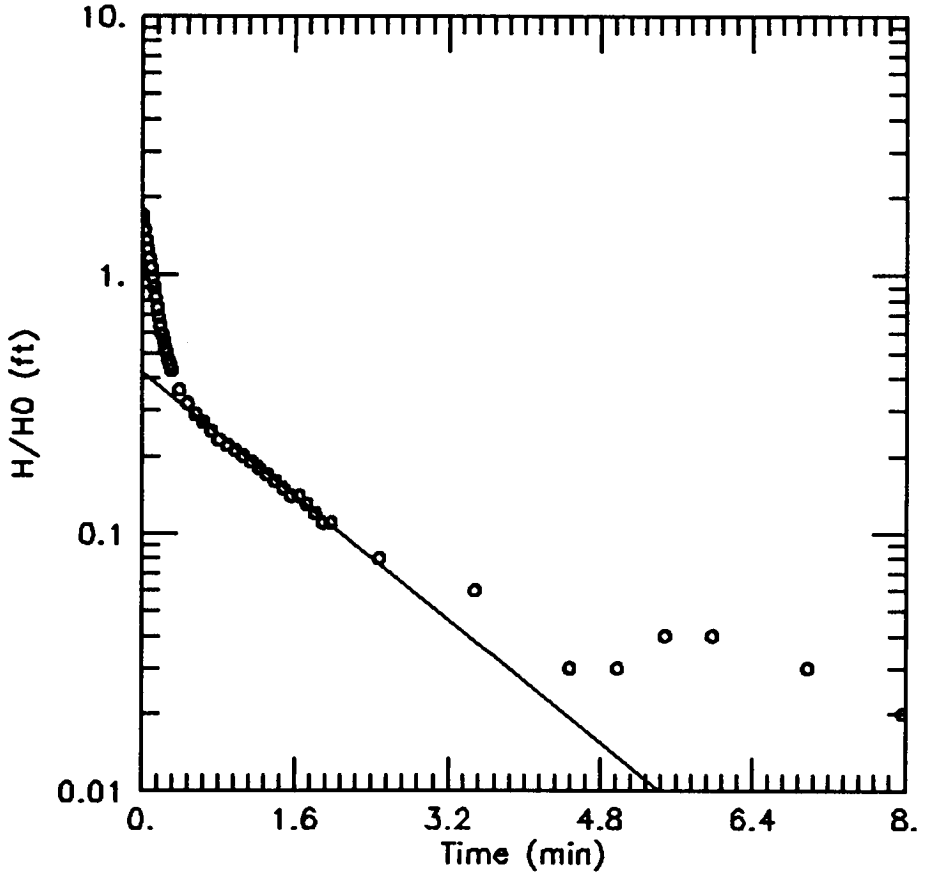
	Estimate
K =	5.1008E-004 ft/min = 2.6×10^{-4} cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 8.37916E-004
y0 = 4.20485E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.205E-001	4.000E+000	2.652E-002		



DATA SET:
m0804z.001
01/16/92

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 19, 1991

ESTIMATED PARAMETERS:
K = 0.0000379 ft/min
y0 = 0.4187 ft

TEST DATA:
H0 = 1.7 ft
rc = 0.083 ft
rw = 0.18 ft
L = 3.15 ft
b = 3.15 ft
H = 3.15 ft

RISING HEAD RESULT, M-08-04

J.M.Montgomery, Consulting Eng	Client: NAVY CLEAN
Project No.: 2738.0257	Location: Alameda Naval Air Station

M-08-05
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/19 18:54

Unit# 00515 Test# 7

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/19 14:31

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.19
0.0066	6.24
0.0099	10.14
0.0133	-1.29
0.0166	2.94
0.0200	1.43
0.0233	1.50
0.0266	1.41
0.0300	1.30
0.0333	1.27
0.0500	1.07
0.0666	0.90
0.0833	0.76
0.1000	0.63
0.1166	0.53
0.1333	0.45
0.1500	0.38
0.1666	0.33
0.1833	0.29
0.2000	0.25
0.2166	0.23
0.2333	0.21
0.2500	0.19
0.2666	0.17
0.2833	0.16
0.3000	0.15
0.3166	0.14
0.3333	0.14
0.4167	0.11
0.5000	0.09
0.5833	0.08

Elapsed Time	Value
0.6667	0.07
0.7500	0.06
0.8333	0.05
0.9167	0.05
1.0000	0.04
1.0833	0.03
1.1667	0.03
1.2500	0.02
1.3333	0.02
1.4166	0.02
1.5000	0.01
1.5833	0.01
1.6667	0.01
1.7500	0.01
1.8333	0.01
1.9167	0.00
2.0000	0.00
2.5000	0.00
3.0000	0.01
3.5000	0.00
4.0000	-0.00
4.5000	0.00
5.0000	0.00

A Q T E S O L V   R E S U L T S
Version 1.10

0[illegible]/08/92 18:37:53

TEST DESCRIPTION

Data set........... m0805z.set
Data set title..... RISING HEAD RESULT, M-08-05
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 8, Building 114
Test date.......... September 19, 1991

Knowns and Constants:
- No. of data points................... 40
- Radius of well casing................ 0.083
- Radius of well....................... 0.19
- Aquifer saturated thickness.......... 8.8
- Well screen length................... 8.8
- Static height of water in well....... 8.8
- Log(Re/Rw)........................... 2.932
- A, B, C.............................. 0.000, 0.000, 2.512

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

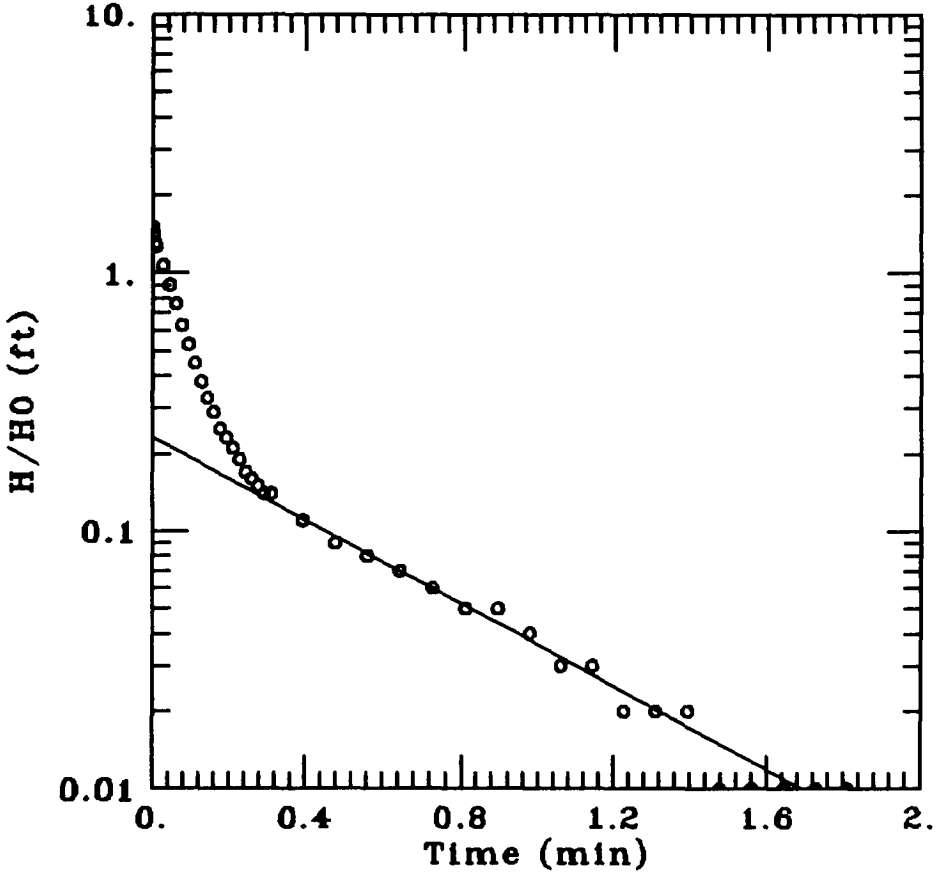
VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	2.3889E-003 ft/min = $1.2 * 10^{-3}$ cm/sec
y0 =	2.2626E+304

TYPE CURVE DATA

K = 2.18747E-003
y0 = 2.42830E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.428E-001	1.500E+000	1.392E-002		



DATA SET:
M0505Z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.002191 ft/min
y0 = 0.2301 ft

TEST DATA:
H0 = 1.5 ft
rc = 0.083 ft
rw = 0.18 ft
L = 8.0 ft
B = 3.0 ft
H = 3.0 ft

RISING HEAD RESULT, M-08-05

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 8, Building 114

M-10-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/23 19:06

Unit# 00515 Test# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/23 10:14

Elapsed Time (min)	Value (ft)
0.0000	-0.10
0.0033	0.19
0.0066	3.62
0.0099	3.95
0.0133	2.09
0.0166	-0.35
0.0200	1.11
0.0233	1.73
0.0266	1.74
0.0300	1.65
0.0333	1.59
0.0500	1.37
0.0666	1.19
0.0833	1.02
0.1000	0.87
0.1166	0.74
0.1333	0.63
0.1500	0.54
0.1666	0.46
0.1833	0.40
0.2000	0.35
0.2166	0.31
0.2333	0.28
0.2500	0.26
0.2666	0.24
0.2833	0.22
0.3000	0.21
0.3166	0.19
0.3333	0.19
0.4167	0.15
0.5000	0.13
0.5833	0.11
0.6667	0.10
0.7500	0.08
0.8333	0.07
0.9167	0.07
1.0000	0.06
1.0833	0.06
1.1667	0.04
1.2500	0.04
1.3333	0.04
1.4166	0.03
1.5000	0.03
1.5833	0.03
1.6667	0.02
1.7500	0.02
1.8333	0.02
1.9167	0.02
2.0000	0.02
2.5000	0.01
3.0000	0.00
3.5000	0.00
4.0000	0.00
4.5000	0.00
5.0000	0.00
5.5000	0.00
6.0000	0.00
6.5000	0.02

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 18:55:58

TEST DESCRIPTION

Data set........... m1001z.set
Data set title..... RISING HEAD RESULT, M-10-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 10, Building 400
Test date.......... September 23, 1991

Knowns and Constants:
- No. of data points.................. 41
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 9.6
- Well screen length.................. 9.6
- Static height of water in well...... 9.6
- Log(Re/Rw).......................... 3.003
- A, B, C............................. 0.000, 0.000, 2.659

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

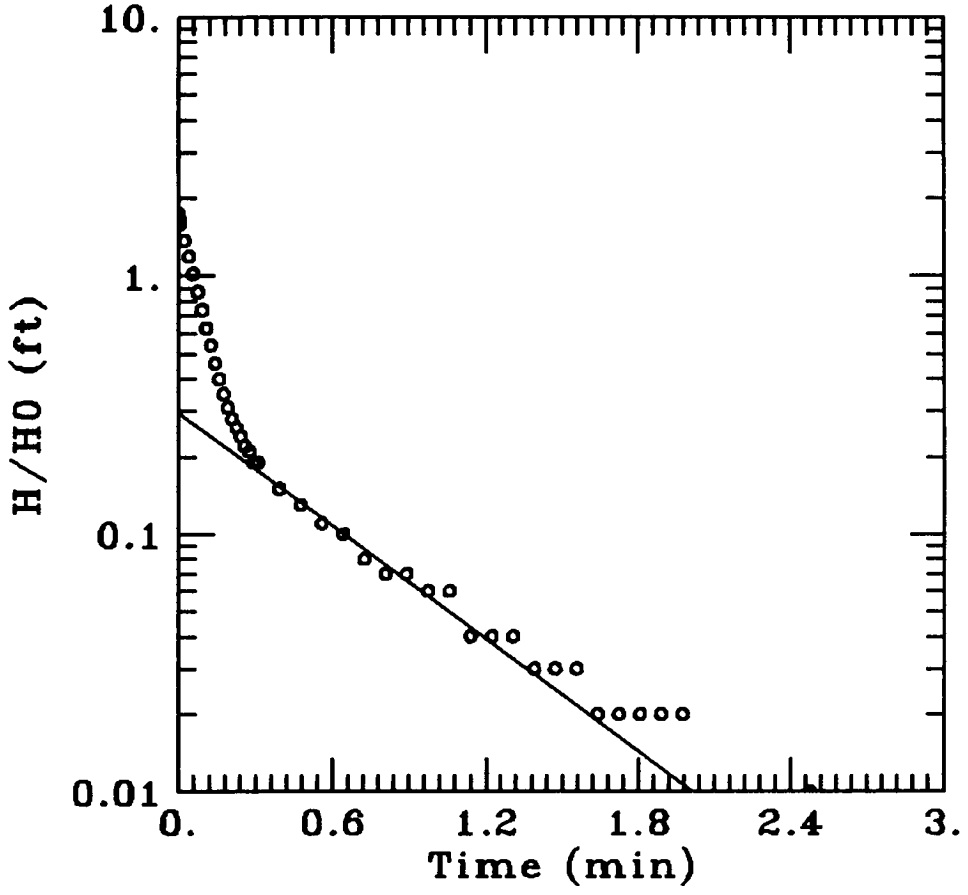
	Estimate
K =	2.1837E-003 ft/min = 1.1 * 10^{-3} cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.64021E-003
y0 = 2.63216E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.632E-001	2.500E+000	5.852E-003		



DATA SET:
m1001z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 20, 1991

ESTIMATED PARAMETERS:
K = 0.001011 ft/min
y0 = 0.2642 ft

TEST DATA:
H0 = 1.74 ft
rc = 0.083 ft
rw = 0.18 ft
L = 0.6 ft
b = 0.6 ft
H = 0.6 ft

RISING HEAD RESULT, M-10-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 10, Building 400

M-10-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/23 19:04

Unit# 00515 Test# 2

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/23 09:33

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	2.41
0.0066	6.01
0.0099	1.56
0.0133	1.03
0.0166	1.49
0.0200	1.53
0.0233	1.48
0.0266	1.40
0.0300	1.33
0.0333	1.27
0.0500	0.99
0.0666	0.77
0.0833	0.59
0.1000	0.46
0.1166	0.35
0.1333	0.28
0.1500	0.22
0.1666	0.19
0.1833	0.16
0.2000	0.14
0.2166	0.12
0.2333	0.11
0.2500	0.10
0.2666	0.09
0.2833	0.08
0.3000	0.08
0.3166	0.07
0.3333	0.07
0.4167	0.06
0.5000	0.05
0.5833	0.03

M-10-02

Elapsed Time	Value
0.6667	0.04
0.7500	0.03
0.8333	0.03
0.9167	0.03
1.0000	0.03
1.0833	0.02
1.1667	0.02
1.2500	0.02
1.3333	0.02
1.4166	0.02
1.5000	0.02
1.5833	0.02
1.6667	0.02
1.7500	0.02
1.8333	0.02
1.9167	0.02
2.0000	0.02
2.5000	0.02

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 19:02:28

==

TEST DESCRIPTION

Data set........... m1002z.set
Data set title..... RISING HEAD RESULT, M-10-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 10, Building 400
Test date.......... September 23, 1991

Knowns and Constants:
No. of data points.................. 43
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 7.5
Well screen length.................. 7.5
Static height of water in well...... 7.5
Log(Re/Rw).......................... 2.801
A, B, C............................. 0.000, 0.000, 2.279

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

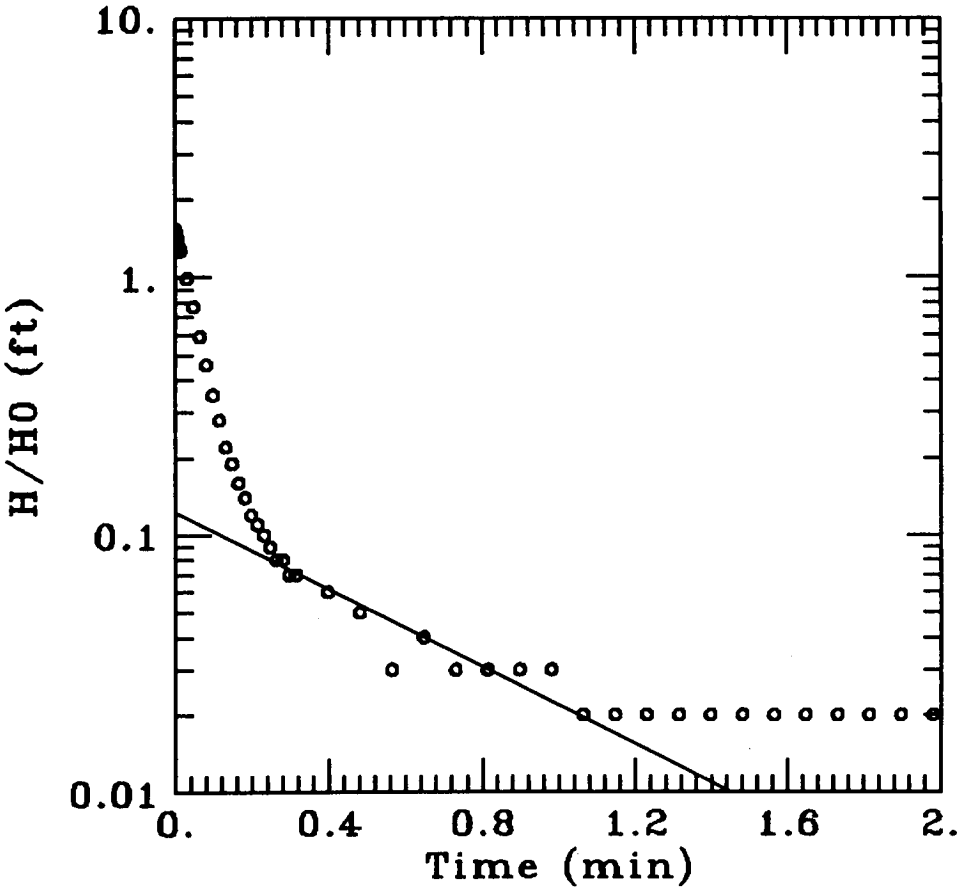
	Estimate
K =	2.1955E-003 ft/min = 1.1×10^{-3} cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.89257E-003
y0 = 1.04008E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.040E-001	2.500E+000	2.629E-003		



DATA SET:
M1002z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 28, 1991

ESTIMATED PARAMETERS:
K = 0.002237 ft/min
y0 = 0.1327 ft

TEST DATA:
H0 = 1.53 ft
rc = 0.083 ft
rw = 0.10 ft
L = 7.5 ft
b = 7.5 ft
H = 7.5 ft

RISING HEAD RESULT, M-10-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 10, Building 400

M-10-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/23 18:54

Unit# 00515 Test# 0

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/23 08:56

Elapsed Time (min)	Value (ft)
0.0000	0.07
0.0033	0.60
0.0066	5.84
0.0099	3.15
0.0133	-0.23
0.0166	1.83
0.0200	1.44
0.0233	1.41
0.0266	1.34
0.0300	1.27
0.0333	1.21
0.0500	0.93
0.0666	0.72
0.0833	0.56
0.1000	0.44
0.1166	0.35
0.1333	0.29
0.1500	0.24
0.1666	0.21
0.1833	0.18
0.2000	0.16
0.2166	0.14
0.2333	0.14
0.2500	0.13
0.2666	0.12
0.2833	0.11
0.3000	0.10
0.3166	0.10
0.3333	0.09
0.4167	0.07
0.5000	0.06
0.5833	0.05

M-10-03

Elapsed Time	Value
0.6667	0.04
0.7500	0.04
0.8333	0.03
0.9167	0.03
1.0000	0.03
1.0833	0.02
1.1667	0.02
1.2500	0.01
1.3333	0.02
1.4166	0.02
1.5000	0.02
1.5833	0.02
1.6667	0.02
1.7500	0.02
1.8333	0.02
1.9167	0.02
2.0000	0.02
2.5000	0.02
3.0000	0.01
3.5000	0.01
4.0000	0.01
4.5000	0.01
5.0000	0.01

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 19:07:24

==

TEST DESCRIPTION

Data set........... m1003z.set
Data set title..... RISING HEAD RESULT, M-10-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 10, Building 400
Test date.......... September 23, 1991

Knowns and Constants:
- No. of data points.................. 49
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 8.98
- Well screen length.................. 8.98
- Static height of water in well...... 8.98
- Log(Re/Rw).......................... 2.949
- A, B, C............................. 0.000, 0.000, 2.545

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

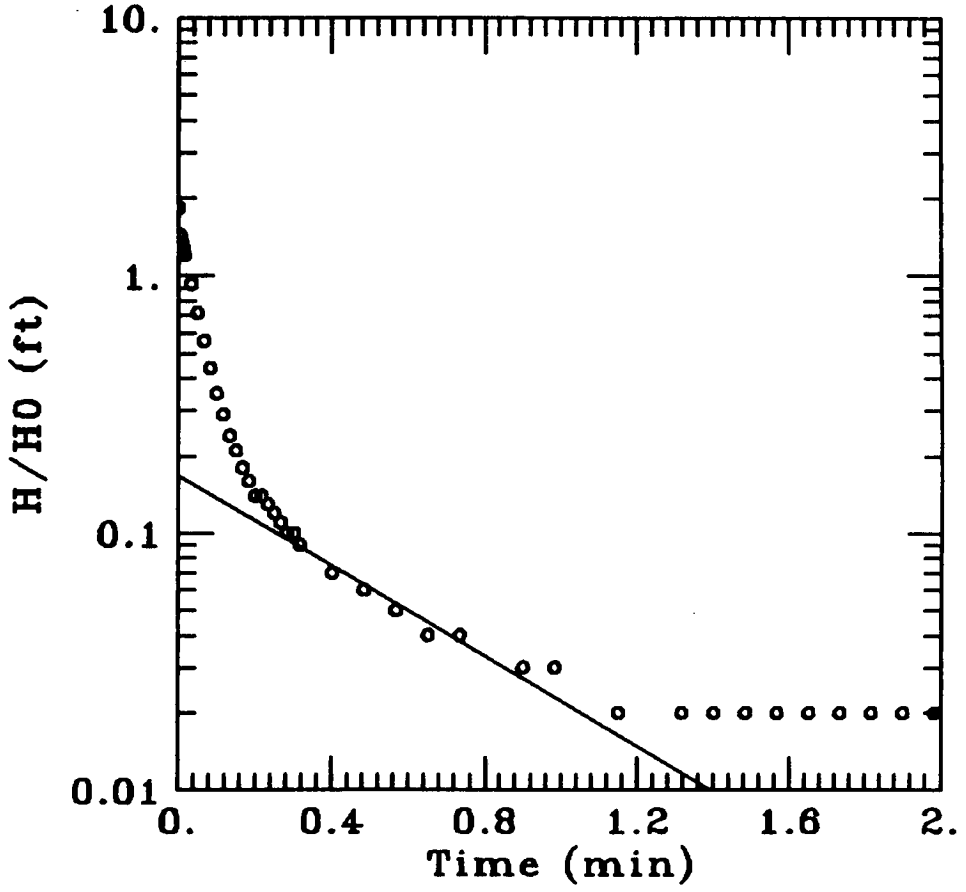
	Estimate
K =	1.1053E-003 ft/min = $5.6 * 10^{-4}$ cm/sec
y0 =	2.2626E+304

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 2.12546E-003
y0 = 1.49761E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.498E-001	3.000E+000	5.333E-004		



DATA SET:
m1003z.dat
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 28, 1991

ESTIMATED PARAMETERS:
K = 0.002287 ft/min
y0 = 0.1063 ft

TEST DATA:
H0 = 1.03 ft
rc = 0.083 ft
rw = 0.18 ft
L = 0.00 ft
D = 0.00 ft
B = 0.00 ft

RISING HEAD RESULT, M-10-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 10, Building 400

M-11-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:38

Unit# 00515 Test# 2

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 08:59

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.00
0.0066	0.04
0.0099	0.62
0.0133	0.62
0.0166	0.58
0.0200	0.55
0.0233	0.51
0.0266	0.50
0.0300	0.48
0.0333	0.46
0.0500	0.38
0.0666	0.32
0.0833	0.27
0.1000	0.23
0.1166	0.21
0.1333	0.20
0.1500	0.19
0.1666	0.18
0.1833	0.17
0.2000	0.17
0.2166	0.17
0.2333	0.16
0.2500	0.16
0.2666	0.16
0.2833	0.15
0.3000	0.15
0.3166	0.15
0.3333	0.15
0.4167	0.14
0.5000	0.14
0.5833	0.14
0.6667	0.14
0.7500	0.14
0.8333	0.14
0.9167	0.14
1.0000	0.13
1.0833	0.13
1.1667	0.13
1.2500	0.13
1.3333	0.13
1.4166	0.12
1.5000	0.13
1.5833	0.12
1.6667	0.12
1.7500	0.12
1.8333	0.12
1.9167	0.14
2.0000	0.14
2.5000	0.13
3.0000	0.12
3.5000	0.12
4.0000	0.11
4.5000	0.11
5.0000	0.11
5.5000	0.11
6.0000	0.11
6.5000	0.11
7.0000	0.10
7.5000	0.08

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A Q T E S O L V   R E S U L T S
Version 1.10

10/29/91 16:13:51

==

TEST DESCRIPTION

```
Data set........... M1101Z.SET
Data set title..... RISING HEAD RESULT, M-11-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 11, Building 14
Test date.......... September 18, 1991

Knowns and Constants:
   No. of data points.................. 56
   Radius of well casing............... 0.083
   Radius of well...................... 0.19
   Aquifer saturated thickness......... 1.1
   Well screen length.................. 1.1
   Static height of water in well...... 1.1
   Log(Re/Rw).......................... 1.262
   A, B, C.............................  0.000,  0.000,  0.961
```

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

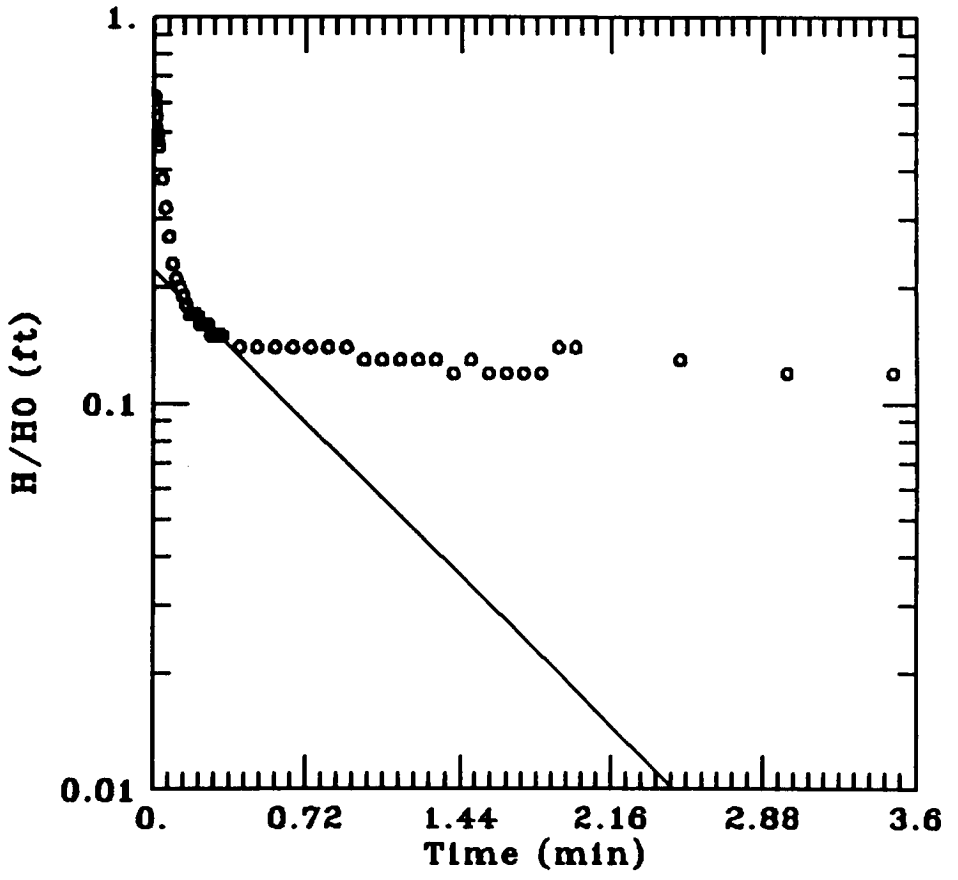
```
         Estimate
   K  =  5.9497E-004  ft/min = 3.0 × 10^-4 cm/sec
   y0 =  6.9315E+234
```

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

```
     K  = 4.98721E-003
     y0 = 2.20874E-001
```

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.209E-001	3.600E+000	2.351E-003		



DATA SET:
M1101Z.SET
10/20/01

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.004907 ft/min
y0 = 0.2500 ft

TEST DATA:
H0 = 0.42 ft
rc = 0.083 ft
rw = 0.16 ft
L = 1.1 ft
b = 1.1 ft
H = 1.1 ft

RISING HEAD RESULT, M-11-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY – WESTDIV
Project No.: 2738.0257	Location: Site 11, Building 14

M-11-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:39

Unit# 00515 Test# 3

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 09:29

Elapsed Time (min)	Value (ft)
0.0000	1.46
0.0033	0.75
0.0066	1.17
0.0099	0.99
0.0133	0.93
0.0166	0.89
0.0200	0.86
0.0233	0.82
0.0266	0.79
0.0300	0.76
0.0333	0.73
0.0500	0.60
0.0666	0.51
0.0833	0.44
0.1000	0.39
0.1166	0.35
0.1333	0.32
0.1500	0.30
0.1666	0.28
0.1833	0.27
0.2000	0.26
0.2166	0.26
0.2333	0.25
0.2500	0.24
0.2666	0.24
0.2833	0.23
0.3000	0.23
0.3166	0.22
0.3333	0.22
0.4167	0.21
0.5000	0.20

Elapsed Time	Value
0.5833	0.19
0.6667	0.18
0.7500	0.17
0.8333	0.17
0.9167	0.17
1.0000	0.17
1.0833	0.16
1.1667	0.16
1.2500	0.16
1.3333	0.16
1.4166	0.15
1.5000	0.15
1.5833	0.15
1.6667	0.15
1.7500	0.14
1.8333	0.14
1.9167	0.14
2.0000	0.14
2.5000	0.13
3.0000	0.13
3.5000	0.12
4.0000	0.11
4.5000	0.11
5.0000	0.11
5.5000	0.10
6.0000	0.10
6.5000	0.10
7.0000	0.10
7.5000	0.09
8.0000	0.09
8.5000	0.08
9.0000	0.08
9.5000	0.08
10.0000	0.08

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A Q T E S O L V   R E S U L T S

Version 1.10

01/08/92 19:28:44

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TEST DESCRIPTION

Data set........... m1102z.set
Data set title..... RISING HEAD RESULT, M-11-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 11, Building 14
Test date.......... September 18, 1991

Knowns and Constants:
No. of data points.................. 61
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 2.6
Well screen length.................. 2.6
Static height of water in well...... 2.6
Log(Re/Rw).......................... 1.9
A, B, C............................. 0.000, 0.000, 1.450

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

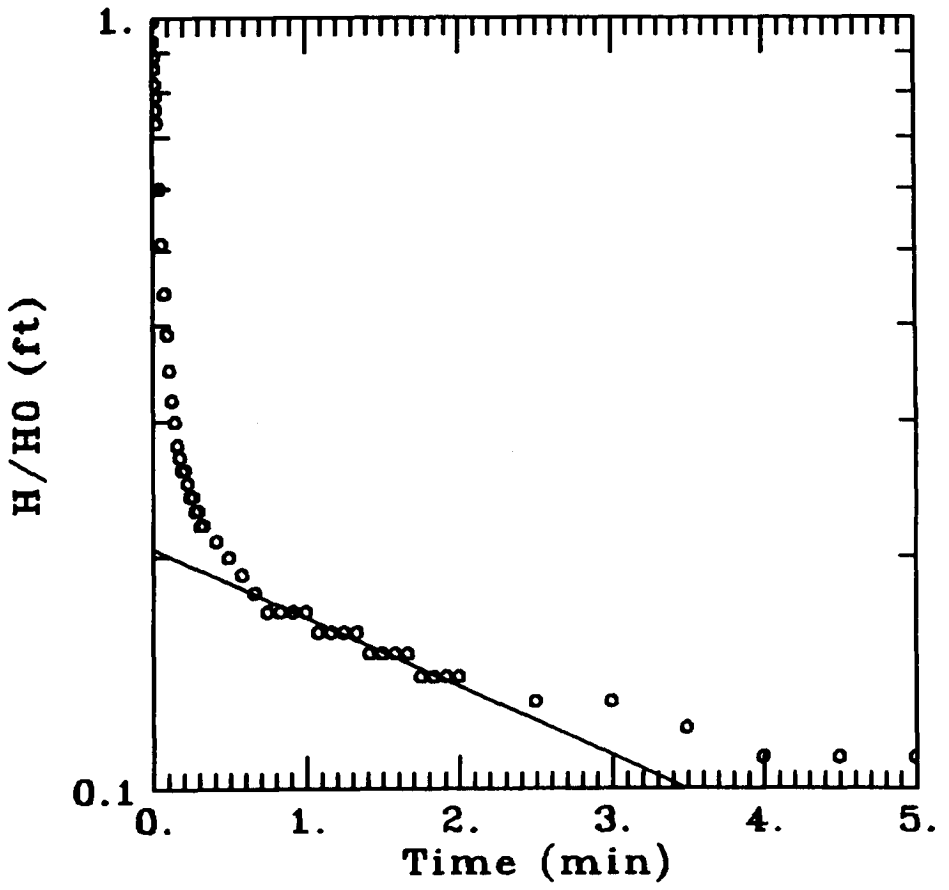
	Estimate
K =	4.5031E-004 ft/min = 2.3 * 10^-4 cm/sec
y0 =	-8.9151E-287

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 5.30861E-004
y0 = 2.07558E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.076E-001	4.000E+000	8.927E-002		



DATA SET:
m1102z.001
01/10/02

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.0008103 ft/min
y0 = 0.2040 ft

TEST DATA:
H0 = 0.98 ft
rc = 0.083 ft
rw = 0.18 ft
L = 2.6 ft
b = 2.6 ft
H = 2.6 ft

RISING HEAD RESULT, M-11-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 11, Building 14

M-11-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:41

Unit# 00515 Test# 4

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 10:31

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.01
0.0066	2.95
0.0099	1.56
0.0133	1.29
0.0166	1.09
0.0200	1.12
0.0233	1.09
0.0266	1.07
0.0300	1.04
0.0333	1.01
0.0500	0.89
0.0666	0.79
0.0833	0.69
0.1000	0.60
0.1166	0.53
0.1333	0.46
0.1500	0.41
0.1666	0.36
0.1833	0.32
0.2000	0.28
0.2166	0.25
0.2333	0.23
0.2500	0.21
0.2666	0.19
0.2833	0.18
0.3000	0.17
0.3166	0.16
0.3333	0.15
0.4167	0.11
0.5000	0.09
0.5833	0.08
0.6667	0.07
0.7500	0.06
0.8333	0.03

Elapsed Time	Value
0.9167	0.04
1.0000	0.04
1.0833	0.04
1.1667	0.04
1.2500	0.04
1.3333	0.04
1.4166	0.03
1.5000	0.03
1.5833	0.03
1.6667	0.03
1.7500	0.03
1.8333	0.03
1.9167	0.03
2.0000	0.03

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 19:33:42

==

TEST DESCRIPTION

Data set........... m1103z.set
Data set title..... RISING HEAD RESULT, M-11-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 11, Building 14
Test date.......... September 18, 1991

Knowns and Constants:
- No. of data points.................. 42
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 2.8
- Well screen length.................. 2.8
- Static height of water in well...... 2.8
- Log(Re/Rw).......................... 1.961
- A, B, C............................. 0.000, 0.000, 1.489

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

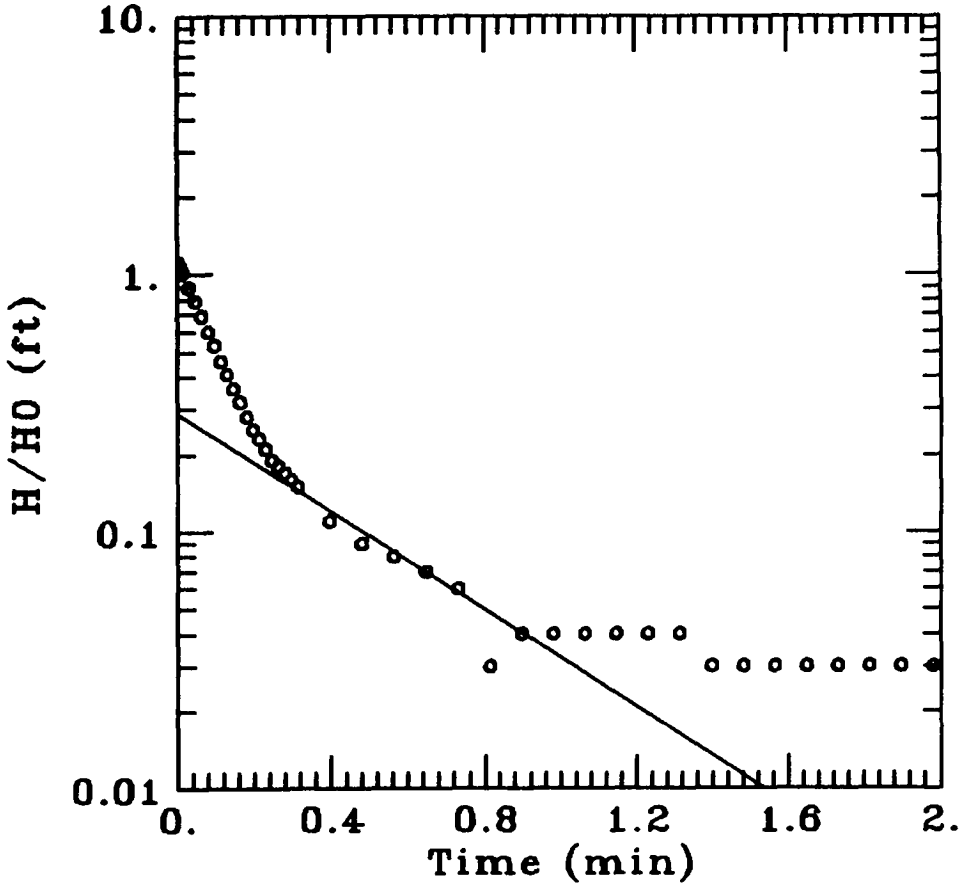
	Estimate
K =	4.3843E-003 ft/min = 2.2 * 10^-3 cm/sec
y0 =	-8.9151E-287

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 5.26024E-003
y0 = 2.74544E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.745E-001	2.000E+000	3.506E-003		



DATA SET:
m1103z.est
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bower-Rice

TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.005205 ft/min
y0 = 0.2062 ft

TEST DATA:
H0 = 1.12 ft
rc = 0.083 ft
rw = 0.16 ft
L = 2.0 ft
b = 2.0 ft
H = 2.0 ft

RISING HEAD RESULT, M-11-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 11, Building 14

M-11-04
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:42

Unit# 00515 Test# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 10:43

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.06
0.0066	4.84
0.0099	2.80
0.0133	2.00
0.0166	2.03
0.0200	2.01
0.0233	1.99
0.0266	1.98
0.0300	1.96
0.0333	1.95
0.0500	1.89
0.0666	1.84
0.0833	1.79
0.1000	1.73
0.1166	1.69
0.1333	1.65
0.1500	1.60
0.1666	1.56
0.1833	1.52
0.2000	1.48
0.2166	1.44
0.2333	1.40
0.2500	1.36
0.2666	1.33
0.2833	1.29
0.3000	1.26
0.3166	1.22
0.3333	1.19
0.4167	1.04
0.5000	0.92
0.5833	0.82

Elapsed Time	Value
0.6667	0.74
0.7500	0.68
0.8333	0.61
0.9167	0.58
1.0000	0.55
1.0833	0.52
1.1667	0.49
1.2500	0.47
1.3333	0.45
1.4166	0.43
1.5000	0.42
1.5833	0.41
1.6667	0.39
1.7500	0.38
1.8333	0.37
1.9167	0.35
2.0000	0.35
2.5000	0.29
3.0000	0.24
3.5000	0.21
4.0000	0.19
4.5000	0.17
5.0000	0.15
5.5000	0.15
6.0000	0.14
6.5000	0.13
7.0000	0.13
7.5000	0.12
8.0000	0.12
8.5000	0.11
9.0000	0.10
9.5000	0.09
10.0000	0.09

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A Q T E S O L V   R E S U L T S

Version 1.10

01/08/92 19:44:04

TEST DESCRIPTION

Data set........... m1104z.set
Data set title..... RISING HEAD RESULT, M-11-04
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 11, Building 14
Test date.......... September 18, 1991

Knowns and Constants:

No. of data points.................... 58
Radius of well casing................. 0.083
Radius of well........................ 0.19
Aquifer saturated thickness........... 4.9
Well screen length.................... 4.9
Static height of water in well........ 4.9
Log(Re/Rw)............................ 2.441
A, B, C............................... 0.000, 0.000, 1.838

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

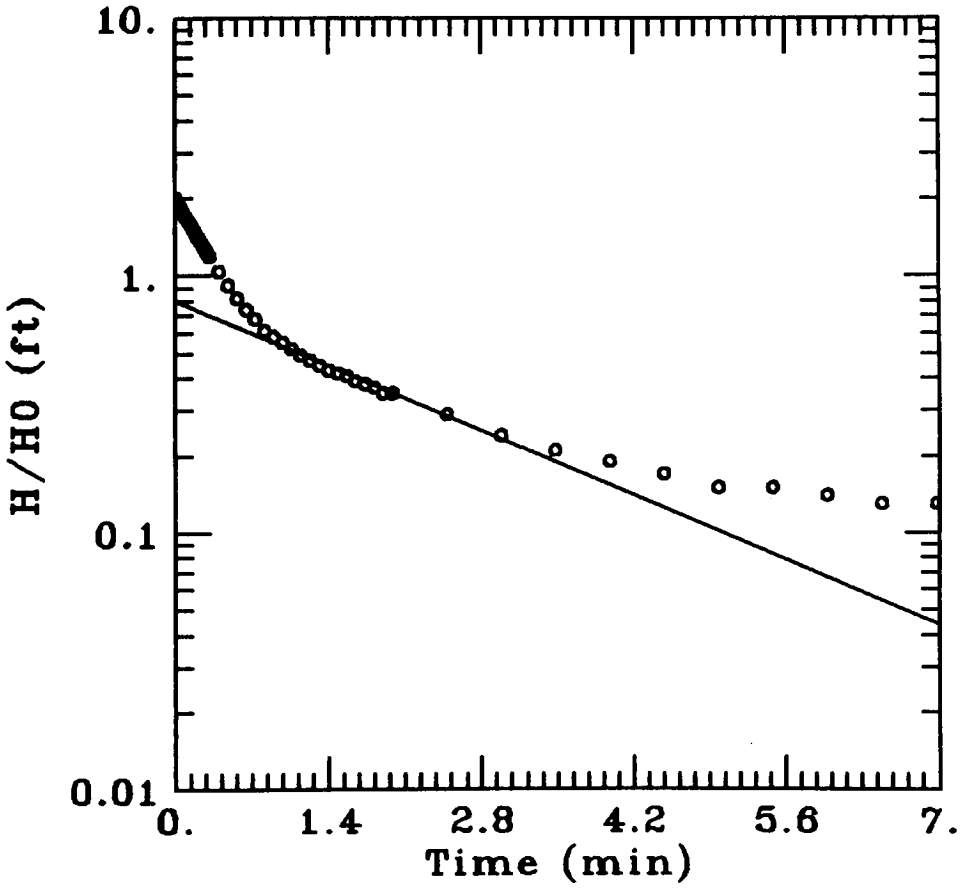
	Estimate
K =	5.4923E-004 ft/min = 2.8 * 10^{-4} cm/sec
y0 =	4.3937E-098

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>>

TYPE CURVE DATA

K = 6.71319E-004
y0 = 7.59904E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	7.599E-001	7.000E+000	4.912E-002		



DATA SET:
m1104z.dat
01/14/92

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.0007112 ft/min
y0 = 0.7066 ft

TEST DATA:
H0 = 2.01 ft
rc = 0.083 ft
rw = 0.18 ft
L = 4.0 ft
b = 4.0 ft
B = 4.0 ft

RISING HEAD RESULT, M-11-04

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 11, Building 14

M-12-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/24 18:36

Unit# 00515 Test# 7

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/24 12:09

Elapsed Time (min)	Value (ft)
0.0000	-0.00
0.0033	-0.01
0.0066	-0.01
0.0099	5.10
0.0133	3.14
0.0166	3.32
0.0200	1.63
0.0233	1.77
0.0266	1.77
0.0300	1.72
0.0333	1.69
0.0500	1.53
0.0666	1.40
0.0833	1.29
0.1000	1.19
0.1166	1.09
0.1333	1.00
0.1500	0.92
0.1666	0.85
0.1833	0.78
0.2000	0.71
0.2166	0.67
0.2333	0.63
0.2500	0.59
0.2666	0.56
0.2833	0.54
0.3000	0.51
0.3166	0.50
0.3333	0.47
0.4167	0.42
0.5000	0.38
0.5833	0.35

Elapsed Time	Value
0.6667	0.33
0.7500	0.32
0.8333	0.28
0.9167	0.28
1.0000	0.28
1.0833	0.28
1.1667	0.27
1.2500	0.26
1.3333	0.26
1.4166	0.25
1.5000	0.24
1.5833	0.24
1.6667	0.23
1.7500	0.22
1.8333	0.21
1.9167	0.21
2.0000	0.20
2.5000	0.16
3.0000	0.15
3.5000	0.14
4.0000	0.14
4.5000	0.13
5.0000	0.10
5.5000	0.10
6.0000	0.10
6.5000	0.09
7.0000	0.07
7.5000	0.07
8.0000	0.06
8.5000	0.06
9.0000	0.05
9.5000	0.04
10.0000	0.05
12.0000	0.05
14.0000	0.05

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A Q T E S O L V   R E S U L T S

Version 1.10

01/08/92 21:15:35

TEST DESCRIPTION

Data set........... m1201z.set
Data set title..... RISING HEAD RESULT, M-12-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 12, Building 10
Test date.......... September 24, 1991

Knowns and Constants:
No. of data points.................. 58
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 5.43
Well screen length.................. 5.43
Static height of water in well...... 5.43
Log(Re/Rw).......................... 2.529
A, B, C............................. 0.000, 0.000, 1.924

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

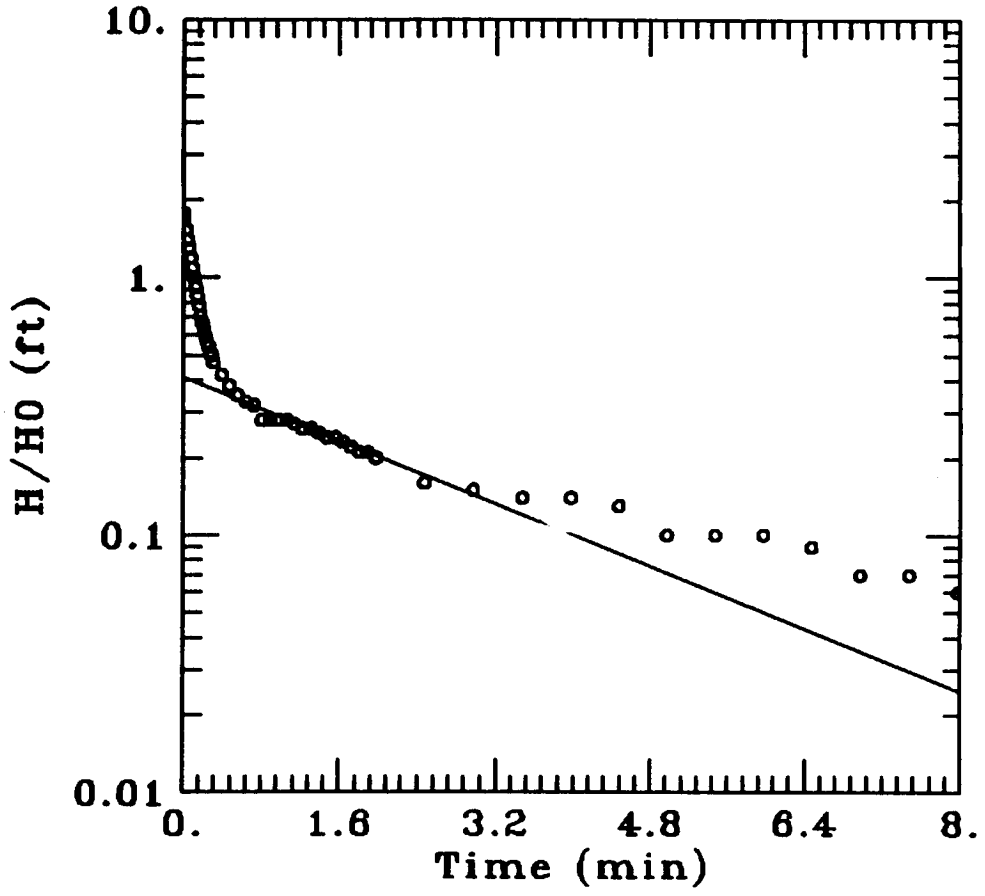
	Estimate
K =	5.2068E-004 ft/min = 2.6×10^{-4} cm/sec
y0 =	6.6365E+265

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 5.20683E-004
y0 = 3.78939E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	3.789E-001	6.500E+000	4.596E-002		



DATA SET:
m1261z.dat
01/10/02

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 24, 1991

ESTIMATED PARAMETERS:
K = 0.000503 ft/min
y0 = 0.4060 ft

TEST DATA:
H0 = 1.77 ft
rc = 0.083 ft
rw = 0.19 ft
L = 5.43 ft
b = 5.43 ft
H = 5.43 ft

RISING HEAD RESULT, M-12-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 12, Building 10

M-12-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/23 19:10

Unit# 00515 Test# 9

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/23 12:09

Elapsed Time (min)	Value (ft)
0.0000	0.01
0.0033	0.01
0.0066	0.12
0.0099	2.65
0.0133	5.03
0.0166	0.64
0.0200	1.88
0.0233	2.69
0.0266	1.34
0.0300	2.35
0.0333	1.80
0.0500	1.86
0.0666	1.82
0.0833	1.77
0.1000	1.72
0.1166	1.68
0.1333	1.64
0.1500	1.60
0.1666	1.57
0.1833	1.54
0.2000	1.51
0.2166	1.47
0.2333	1.44
0.2500	1.41
0.2666	1.38
0.2833	1.36
0.3000	1.33
0.3166	1.30
0.3333	1.28
0.4167	1.16
0.5000	1.06
0.5833	0.97

Elapsed Time	Value
0.6667	0.89
0.7500	0.83
0.8333	0.77
0.9167	0.71
1.0000	0.67
1.0833	0.62
1.1667	0.59
1.2500	0.55
1.3333	0.51
1.4166	0.48
1.5000	0.46
1.5833	0.44
1.6667	0.42
1.7500	0.42
1.8333	0.40
1.9167	0.38
2.0000	0.36
2.5000	0.28
3.0000	0.22
3.5000	0.19
4.0000	0.15
4.5000	0.13
5.0000	0.11
5.5000	0.10
6.0000	0.09
6.5000	0.08
7.0000	0.07
7.5000	0.07
8.0000	0.07
8.5000	0.07
9.0000	0.07
9.5000	0.07
10.0000	0.06
12.0000	0.04
14.0000	0.04
16.0000	0.03
18.0000	0.03
20.0000	0.02

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 21:20:57

==

TEST DESCRIPTION

Data set........... m1202z.set
Data set title..... RISING HEAD RESULT, M-12-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 12, Building 10
Test date.......... September 23, 1991

Knowns and Constants:
- No. of data points.................. 58
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 6.8
- Well screen length.................. 6.8
- Static height of water in well...... 6.8
- Log(Re/Rw).......................... 2.72
- A, B, C............................. 0.000, 0.000, 2.156

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

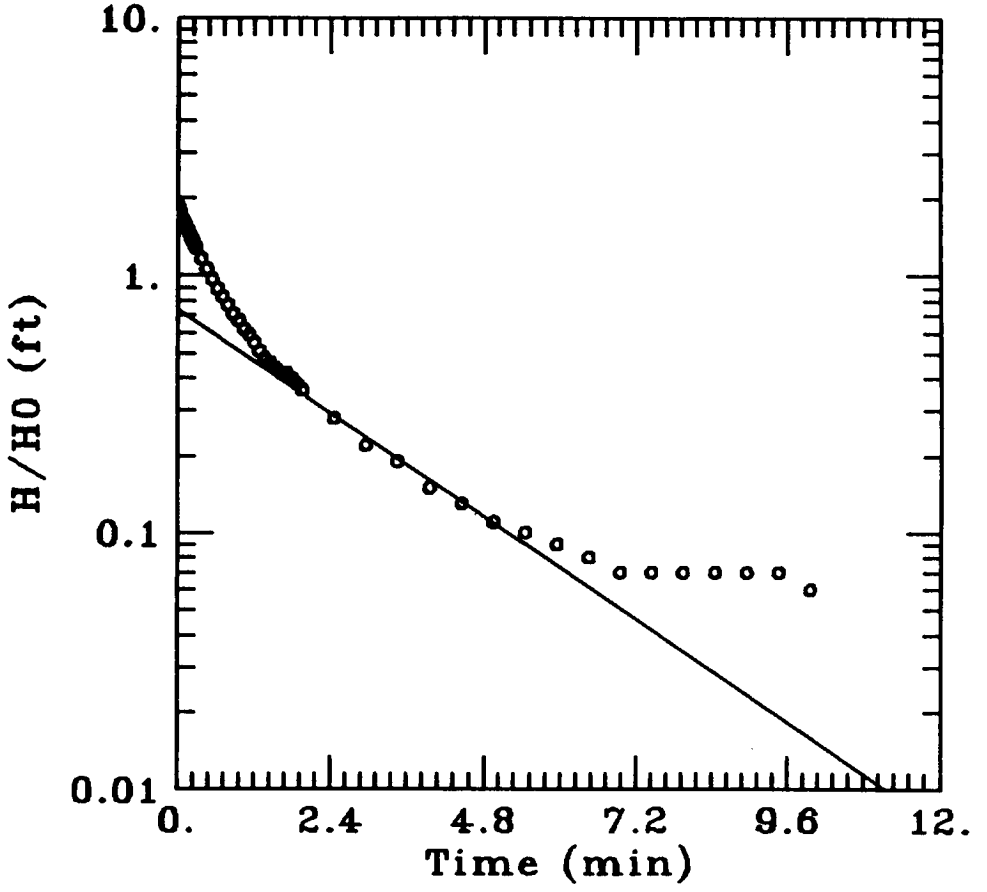
	Estimate
K =	3.4803E-004 ft/min = 1.8*10⁻⁴ cm/sec
y0 =	6.6365E+265

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 5.15239E-004
y0 = 6.95088E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	6.951E-001	1.000E+001	1.651E-002		



DATA SET:
m1202z.out
01/16/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 28, 1991

ESTIMATED PARAMETERS:
K = 0.0005322 ft/min
y0 = 0.7363 ft

TEST DATA:
H0 = 1.06 ft
rc = 0.083 ft
rw = 0.18 ft
L = 6.0 ft
b = 6.0 ft
B = 6.0 ft

RISING HEAD RESULT, M-12-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 12, Building 10

M-12-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/24 18:33

Unit# 00515 Test# 3

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/24 10:41

Elapsed Time (min)	Value (ft)
0.0000	0.04
0.0033	0.06
0.0066	3.33
0.0099	4.02
0.0133	-1.67
0.0166	1.72
0.0200	1.93
0.0233	1.85
0.0266	1.81
0.0300	1.76
0.0333	1.72
0.0500	1.55
0.0666	1.41
0.0833	1.27
0.1000	1.15
0.1166	1.04
0.1333	0.94
0.1500	0.85
0.1666	0.77
0.1833	0.70
0.2000	0.63
0.2166	0.57
0.2333	0.51
0.2500	0.47
0.2666	0.42
0.2833	0.39
0.3000	0.35
0.3166	0.33
0.3333	0.30
0.4167	0.22
0.5000	0.18
0.5833	0.15
0.6667	0.13
0.7500	0.10
0.8333	0.09
0.9167	0.08
1.0000	0.07
1.0833	0.07
1.1667	0.07
1.2500	0.06
1.3333	0.07
1.4166	0.06
1.5000	0.06
1.5833	0.06
1.6667	0.06
1.7500	0.06
1.8333	0.06
1.9167	0.05
2.0000	0.05
2.5000	0.04
3.0000	0.04
3.5000	0.03
4.0000	0.03
4.5000	0.03
5.0000	0.02
5.5000	0.03

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A Q T E S O L V   R E S U L T S
Version 1.10

?-/08/92 — 21:46:36

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TEST DESCRIPTION

Data set........... m1203z.set
Data set title..... RISING HEAD RESULT, M-12-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 12, Building 10
Test date.......... September 24, 1991

Knowns and Constants:
No. of data points.................. 48
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 7.2
Well screen length.................. 7.2
Static height of water in well...... 7.2
Log(Re/Rw).......................... 2.767
A, B, C............................. 0.000, 0.000, 2.226

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

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RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

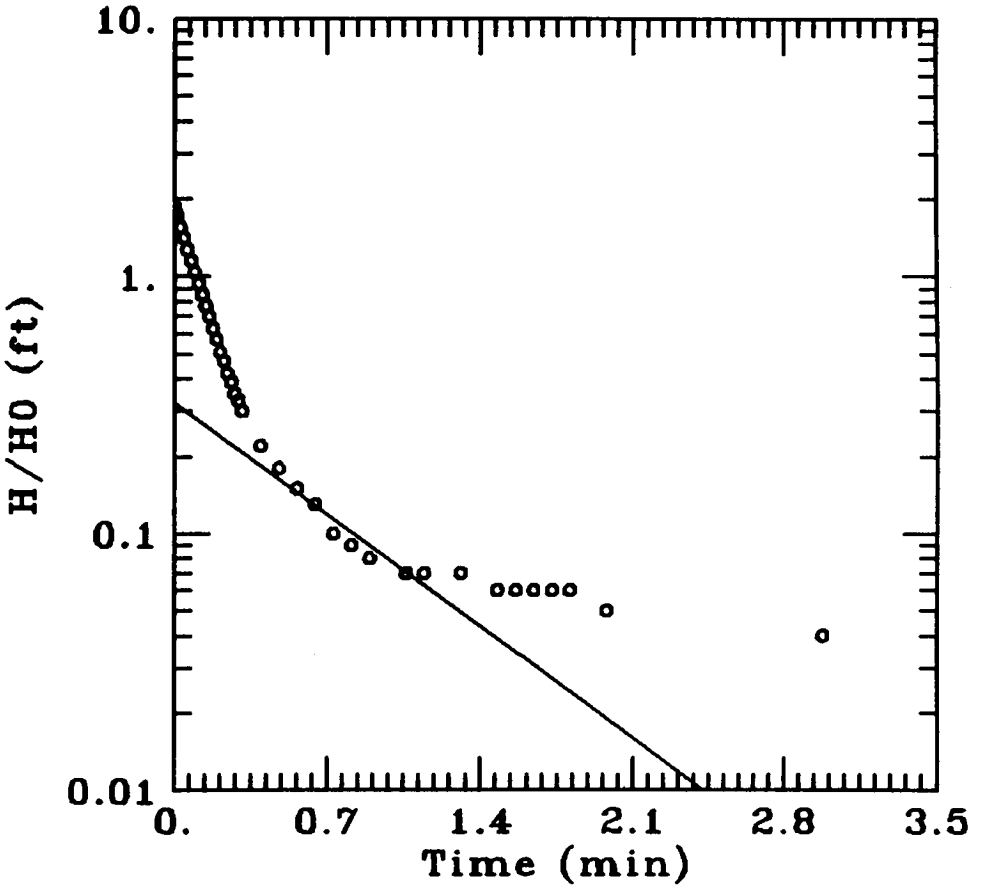
	Estimate
K =	2.2755E-003 ft/min = 1.2 * 10^-3 cm/sec
y0 =	4.3937E-098

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 2.27547E-003
y0 = 4.08010E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.080E-001	5.000E+000	7.556E-005		



DATA SET:
m12032.001
01/14/02

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 24, 1991

ESTIMATED PARAMETERS:
K = 0.001098 ft/min
y0 = 0.381 ft

TEST DATA:
H0 = 1.06 ft
rc = 0.083 ft
rw = 0.18 ft
L = 7.2 ft
D = 7.2 ft
B = 7.2 ft

RISING HEAD RESULT, M-12-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 12, Building 10

M-12-04
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/24 18:35

Unit# 00515 Test# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/24 11:22

Elapsed Time (min)	Value (ft)
0.0000	0.16
0.0033	1.41
0.0066	6.13
0.0099	0.57
0.0133	1.03
0.0166	1.67
0.0200	1.84
0.0233	1.82
0.0266	1.81
0.0300	1.77
0.0333	1.74
0.0500	1.59
0.0666	1.46
0.0833	1.34
0.1000	1.23
0.1166	1.13
0.1333	1.03
0.1500	0.94
0.1666	0.87
0.1833	0.80
0.2000	0.73
0.2166	0.67
0.2333	0.62
0.2500	0.57
0.2666	0.53
0.2833	0.50
0.3000	0.46
0.3166	0.43
0.3333	0.41
0.4167	0.31
0.5000	0.24
0.5833	0.20

M-12-04

Elapsed Time	Value
0.6667	0.17
0.7500	0.15
0.8333	0.13
0.9167	0.11
1.0000	0.10
1.0833	0.09
1.1667	0.08
1.2500	0.07
1.3333	0.07
1.4166	0.07
1.5000	0.05
1.5833	0.05
1.6667	0.05
1.7500	0.05
1.8333	0.04
1.9167	0.04
2.0000	0.04
2.5000	0.03
3.0000	0.03
3.5000	0.03
4.0000	0.02
4.5000	0.02

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 21:57:54

TEST DESCRIPTION

Data set........... m1204z.set
Data set title..... RISING HEAD RESULT, M-12-04
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 12, Building 10
Test date.......... September 24, 1991

Knowns and Constants:
- No. of data points.................. 47
- Radius of well casing............... 0.083
- Radius of well...................... 0.19
- Aquifer saturated thickness......... 7.5
- Well screen length.................. 7.5
- Static height of water in well...... 7.5
- Log(Re/Rw).......................... 2.801
- A, B, C............................. 0.000, 0.000, 2.279

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

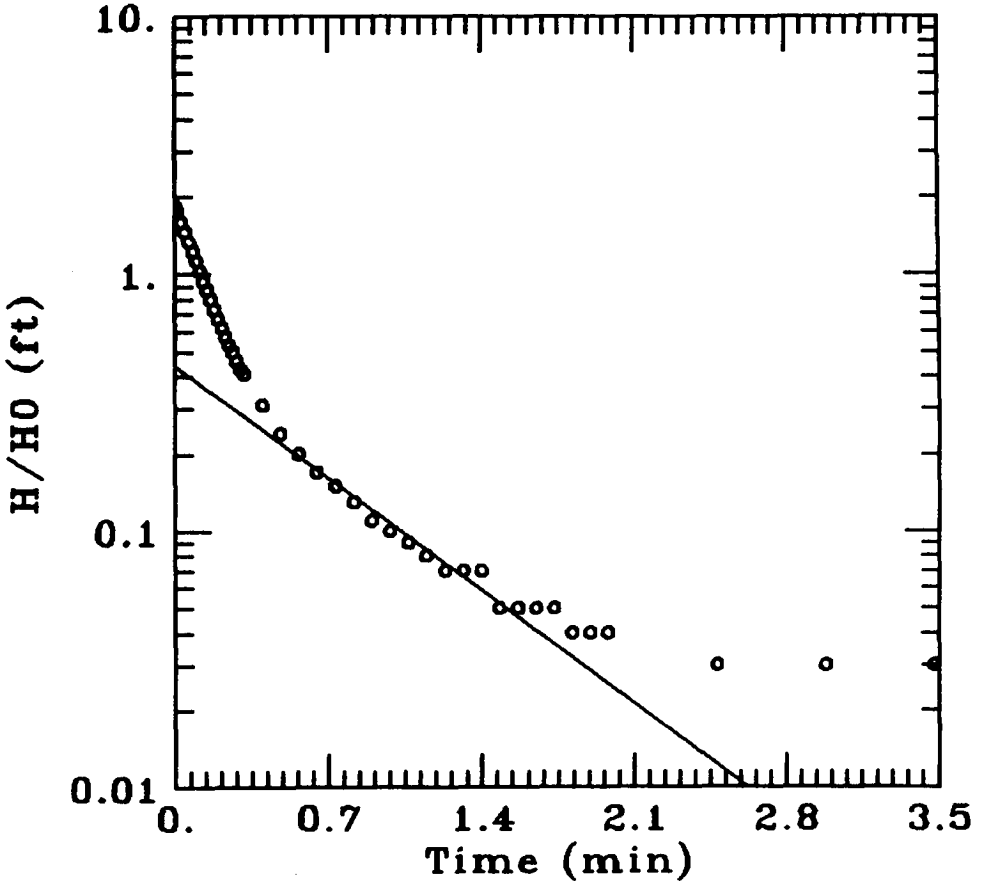
	Estimate
K =	2.3186E-003 ft/min = $1.2 * 10^{-3}$ cm/sec
y0 =	4.3937E-098

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 2.04419E-003
y0 = 4.97741E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	4.977E-001	3.500E+000	1.913E-003		



DATA SET:
m1204z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 24, 1991

ESTIMATED PARAMETERS:
K = 0.001050 ft/min
y0 = 0.4372 ft

TEST DATA:
H0 = 1.04 ft
rc = 0.083 ft
rw = 0.18 ft
L = 7.5 ft
b = 7.5 ft
H = 7.5 ft

RISING HEAD RESULT, M-12-04

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 12, Building 10

M-14-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/26 18:49

Unit# 00515 Test# 3

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/26 10:37

Elapsed Time (min)	Value (ft)
0.0000	-0.00
0.0033	0.15
0.0066	4.68
0.0099	7.28
0.0133	-2.00
0.0166	2.10
0.0200	1.72
0.0233	1.64
0.0266	1.60
0.0300	1.56
0.0333	1.51
0.0500	1.33
0.0666	1.19
0.0833	1.07
0.1000	0.97
0.1166	0.88
0.1333	0.80
0.1500	0.73
0.1666	0.67
0.1833	0.61
0.2000	0.56
0.2166	0.52
0.2333	0.48
0.2500	0.44
0.2666	0.40
0.2833	0.37
0.3000	0.35
0.3166	0.32
0.3333	0.30
0.4167	0.22
0.5000	0.17
0.5833	0.13

M-14-01

Elapsed Time	Value
0.6667	0.11
0.7500	0.09
0.8333	0.07
0.9167	0.06
1.0000	0.05
1.0833	0.04
1.1667	0.04
1.2500	0.03
1.3333	0.03
1.4166	0.02
1.5000	0.02
1.5833	0.01
1.6667	0.01
1.7500	0.00
1.8333	0.00
1.9167	0.00
2.0000	0.00
2.5000	-0.01
3.0000	-0.02

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 22:03:09

==

TEST DESCRIPTION

Data set........... m1401z.set
Data set title..... RISING HEAD RESULT, M-14-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 14
Test date.......... September 26, 1991

Knowns and Constants:
No. of data points.................. 38
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 8.97
Well screen length.................. 8.97
Static height of water in well...... 8.97
Log(Re/Rw).......................... 2.948
A, B, C............................. 0.000, 0.000, 2.543

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

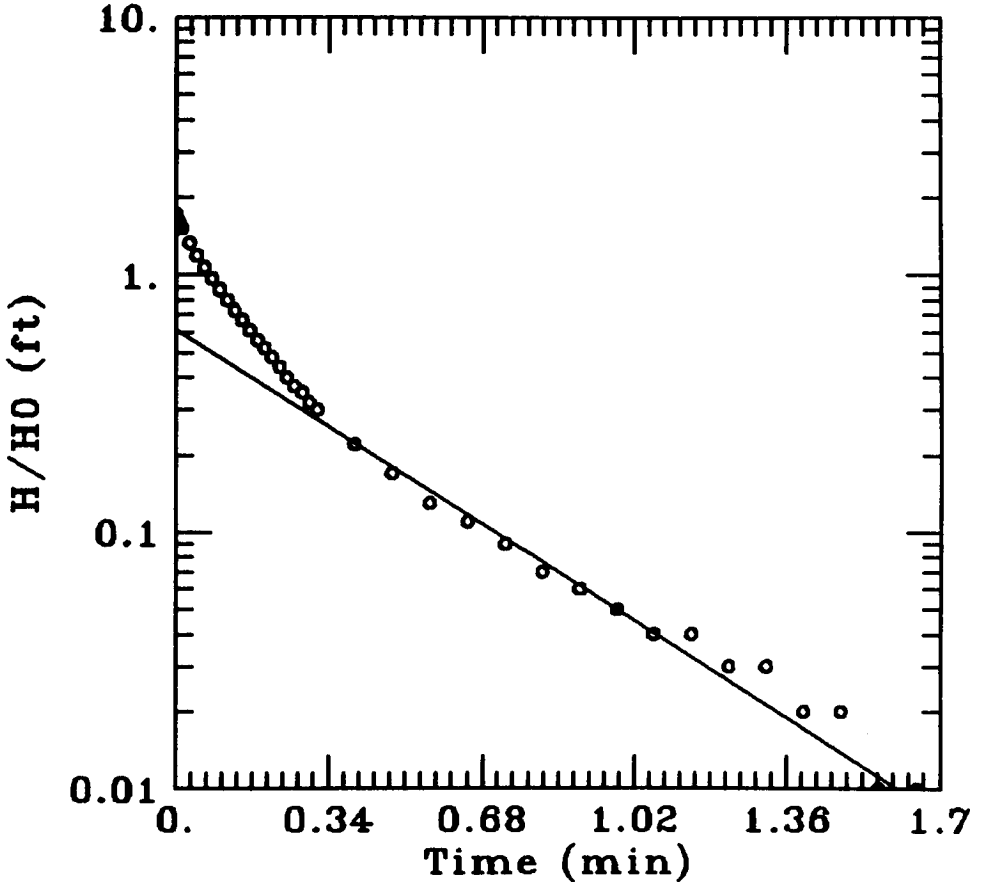
	Estimate
K =	3.3575E-003 ft/min = 1.7 * 10^-3 cm/sec
y0 =	4.3937E-098

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 2.99336E-003
y0 = 6.30957E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	6.310E-001	2.000E+000	3.184E-003		



DATA SET:
m1401z.est
01/10/02

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 26, 1991

ESTIMATED PARAMETERS:
K = 0.002002 ft/min
y0 = 0.6143 ft

TEST DATA:
H0 = 1.72 ft
rc = 0.083 ft
rw = 0.18 ft
L = 8.07 ft
b = 8.07 ft
B = 8.07 ft

RISING HEAD RESULT, M-14-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 14

M-14-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/26 18:53

Unit# 00515 Test# 7

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/26 11:23

Elapsed Time (min)	Value (ft)
0.0000	0.00
0.0033	0.12
0.0066	3.86
0.0099	5.54
0.0133	1.54
0.0166	2.52
0.0200	1.78
0.0233	1.79
0.0266	1.75
0.0300	1.72
0.0333	1.68
0.0500	1.51
0.0666	1.37
0.0833	1.26
0.1000	1.15
0.1166	1.06
0.1333	0.98
0.1500	0.90
0.1666	0.83
0.1833	0.76
0.2000	0.71
0.2166	0.65
0.2333	0.60
0.2500	0.56
0.2666	0.52
0.2833	0.49
0.3000	0.46
0.3166	0.43
0.3333	0.40
0.4167	0.30
0.5000	0.23
0.5833	0.19

Elapsed Time	Value
0.6667	0.15
0.7500	0.12
0.8333	0.09
0.9167	0.08
1.0000	0.07
1.0833	0.06
1.1667	0.05
1.2500	0.04
1.3333	0.04
1.4166	0.03
1.5000	0.03
1.5833	0.02
1.6667	0.02
1.7500	0.02
1.8333	0.02
1.9167	0.01
2.0000	0.01
2.5000	0.00

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 22:24:56

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TEST DESCRIPTION

Data set........... m1402z.set
Data set title..... RISING HEAD RESULT, M-14-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 14
Test date.......... September 26, 1991

Knowns and Constants:
No. of data points.................. 41
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 8.53
Well screen length.................. 8.53
Static height of water in well...... 8.53
Log(Re/Rw).......................... 2.907
A, B, C............................. 0.000, 0.000, 2.464

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	3.0244E-003 ft/min = 1.5×10^{-3} cm/sec
y0 =	1.9613E+105

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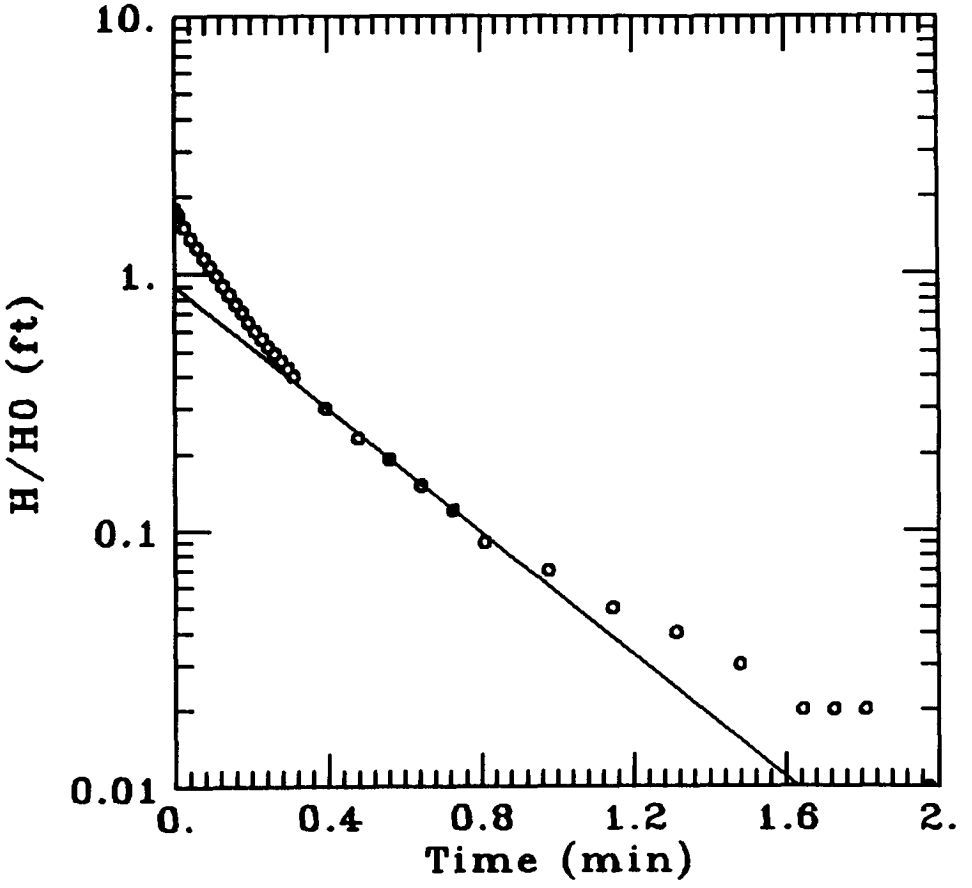
TYPE CURVE DATA

K = 2.76747E-003
y0 = 7.08851E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	7.089E-001	2.000E+000	6.349E-003		



DATA SET:
m1402z.est
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 26, 1991

ESTIMATED PARAMETERS:
K = 0.003244 ft/min
y0 = 0.000 ft

TEST DATA:
H0 = 1.74 ft
rc = 0.083 ft
rw = 0.18 ft
L = 8.53 ft
b = 8.53 ft
B = 8.53 ft

RISING HEAD RESULT, M-14-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 14

M-14-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/26 18:51

Unit# 00515 Test# 5

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/26 11:01

Elapsed Time (min)	Value (ft)
0.0000	-0.06
0.0033	1.45
0.0066	8.28
0.0099	-2.91
0.0133	1.71
0.0166	2.07
0.0200	1.85
0.0233	1.84
0.0266	1.80
0.0300	1.78
0.0333	1.76
0.0500	1.61
0.0666	1.49
0.0833	1.37
0.1000	1.27
0.1166	1.17
0.1333	1.08
0.1500	1.00
0.1666	0.92
0.1833	0.85
0.2000	0.78
0.2166	0.72
0.2333	0.66
0.2500	0.61
0.2666	0.57
0.2833	0.52
0.3000	0.49
0.3166	0.46
0.3333	0.43
0.4167	0.30
0.5000	0.25
0.5833	0.21

M-14-03

Elapsed Time	Value
0.6667	0.18
0.7500	0.16
0.8333	0.14
0.9167	0.12
1.0000	0.11
1.0833	0.10
1.1667	0.09
1.2500	0.09
1.3333	0.08
1.4166	0.08
1.5000	0.07
1.5833	0.07
1.6667	0.07
1.7500	0.06
1.8333	0.06
1.9167	0.06
2.0000	0.06

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 22:28:40

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TEST DESCRIPTION

Data set........... m1403z.set
Data set title..... RISING HEAD RESULT, M-14-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 14
Test date.......... September 26, 1991

Knowns and Constants:
No. of data points.................. 42
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 7.35
Well screen length.................. 7.35
Static height of water in well...... 7.35
Log(Re/Rw).......................... 2.784
A, B, C............................. 0.000, 0.000, 2.252

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	2.5768E-003 ft/min = $1.3 * 10^{-3}$ cm/sec
y0 =	1.9613E+105

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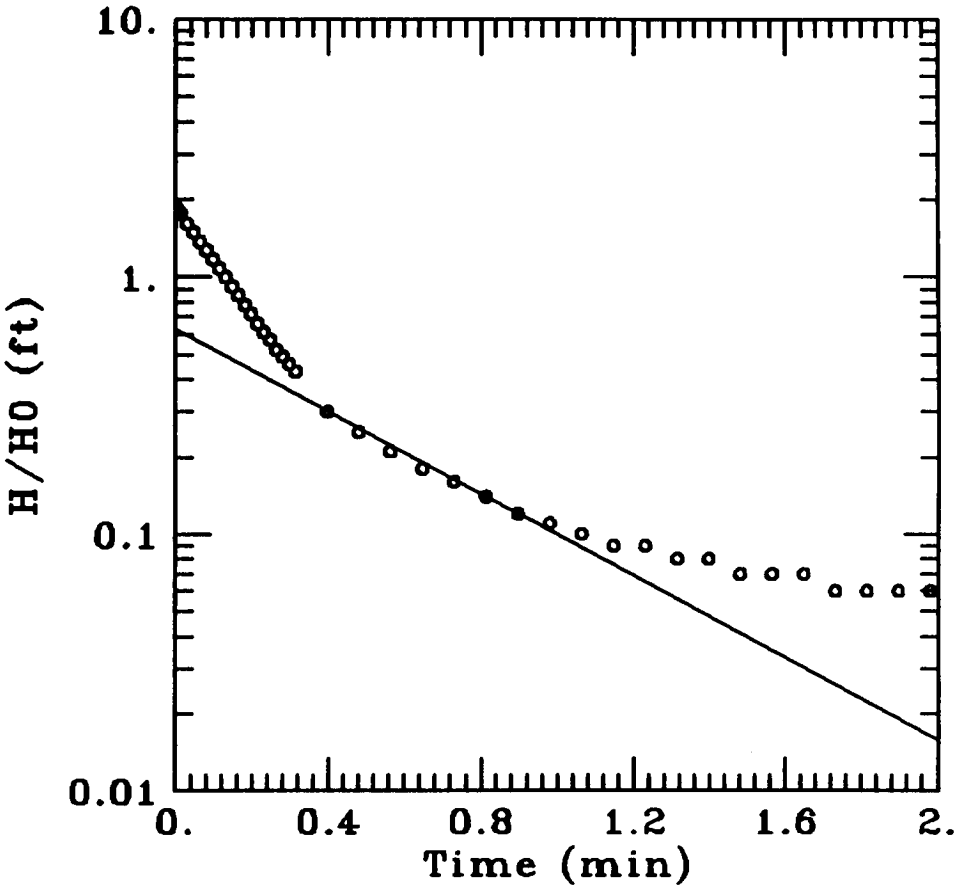
TYPE CURVE DATA

K = 2.30450E-003
y0 = 5.98917E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	5.989E-001	2.000E+000	1.751E-002		



DATA SET:
m1403z.001
01/16/02

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
September 26, 1991

ESTIMATED PARAMETERS:
K = 0.002401 ft/min
y0 = 0.6240 ft

TEST DATA:
H0 = 1.06 ft
rc = 0.083 ft
rw = 0.18 ft
L = 7.96 ft
b = 7.96 ft
B = 7.96 ft

RISING HEAD RESULT, M-14-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 14

M-15-01
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/27 17:36

Unit# 00515 Test# 2

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/27 09:26

Elapsed Time (min)	Value (ft)
0.0000	-0.01
0.0033	0.84
0.0066	3.72
0.0099	5.50
0.0133	0.39
0.0166	0.14
0.0200	0.59
0.0233	0.62
0.0266	0.53
0.0300	0.49
0.0333	0.45
0.0500	0.30
0.0666	0.21
0.0833	0.16
0.1000	0.13
0.1166	0.10
0.1333	0.09
0.1500	0.07
0.1666	0.06
0.1833	0.06
0.2000	0.05
0.2166	0.04
0.2333	0.04
0.2500	0.04
0.2666	0.03
0.2833	0.03
0.3000	0.03
0.3166	0.02
0.3333	0.02
0.4167	0.01
0.5000	0.01
0.5833	0.01

M-15-01

Elapsed Time	Value
0.6667	0.00
0.7500	0.00
0.8333	0.00
0.9167	0.00
1.0000	0.00
1.0833	0.00
1.1667	0.00
1.2500	0.00
1.3333	0.00
1.4166	0.00
1.5000	0.00
1.5833	0.00
1.6667	0.00
1.7500	0.00
1.8333	0.00
1.9167	0.00

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 20:31:53

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TEST DESCRIPTION

Data set........... m1501z.set
Data set title..... RISING HEAD RESULT, M-15-01
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 15
Test date.......... September 27, 1991

Knowns and Constants:
No. of data points.................. 24
Radius of well casing............... 0.083
Radius of well...................... 0.33
Aquifer saturated thickness......... 10
Well screen length.................. 10
Static height of water in well...... 10.3
Log(Re/Rw).......................... 2.598
A, B, C............................. 0.000, 0.000, 1.979

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	6.8484E-003 ft/min = $3.4 * 10^{-2}$ cm/sec
y0 =	-8.9151E-287

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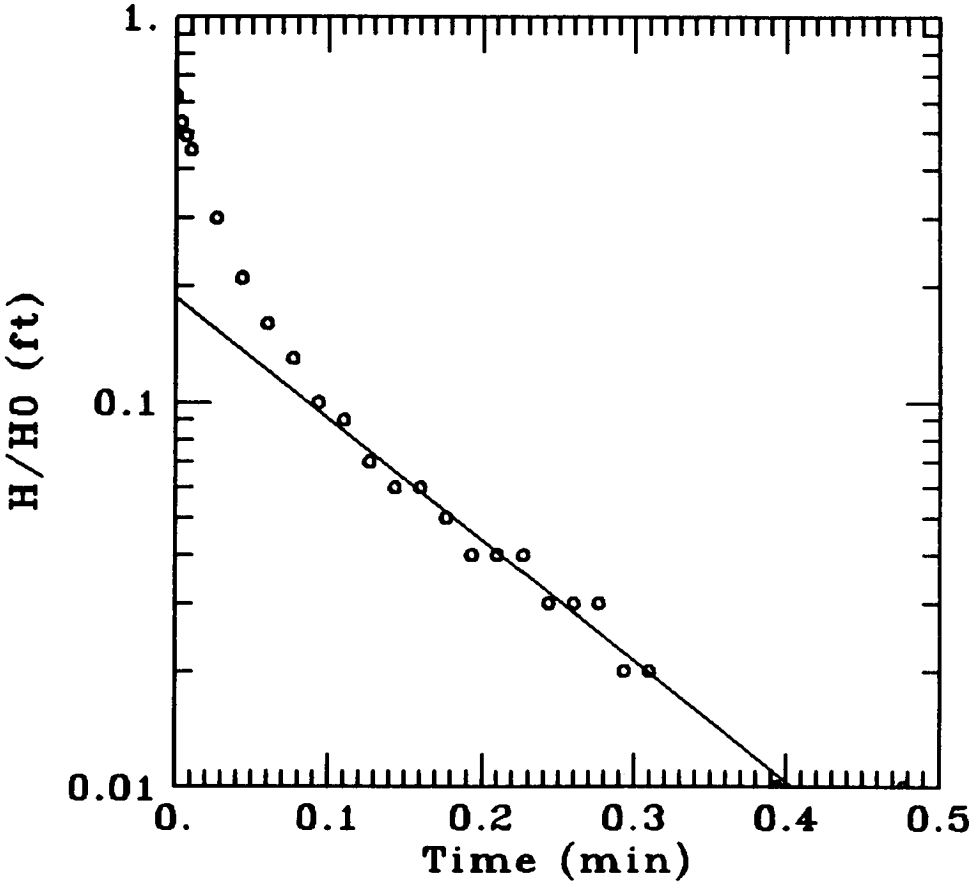
TYPE CURVE DATA

K = 6.42732E-003
y0 = 1.80677E-001

ime	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.807E-001	6.000E-001	2.427E-003		



DATA SET:
m1501z.out
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 27, 1991

ESTIMATED PARAMETERS:
K = 0.000453 ft/min
y0 = 0.1868 ft

TEST DATA:
H0 = 0.62 ft
rc = 0.083 ft
rw = 0.33 ft
L = 10. ft
b = 10. ft
B = 10.3 ft

RISING HEAD RESULT, M-15-01

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 15

M-15-02
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:45

Unit# 00515 Test# 7

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 11:18

Elapsed Time (min)	Value (ft)
0.0000	-0.00
0.0033	0.18
0.0066	5.42
0.0099	8.50
0.0133	3.68
0.0166	-1.19
0.0200	2.48
0.0233	1.15
0.0266	1.34
0.0300	1.27
0.0333	1.23
0.0500	1.07
0.0666	0.94
0.0833	0.83
0.1000	0.73
0.1166	0.65
0.1333	0.57
0.1500	0.51
0.1666	0.46
0.1833	0.42
0.2000	0.38
0.2166	0.35
0.2333	0.32
0.2500	0.30
0.2666	0.28
0.2833	0.27
0.3000	0.25
0.3166	0.24
0.3333	0.23
0.4167	0.19
0.5000	0.15
0.5833	0.14
0.6667	0.12
0.7500	0.11
0.8333	0.10
0.9167	0.09
1.0000	0.08
1.0833	0.08
1.1667	0.07
1.2500	0.07
1.3333	0.07
1.4166	0.06
1.5000	0.06
1.5833	0.06
1.6667	0.06
1.7500	0.05
1.8333	0.05
1.9167	0.05
2.0000	0.05
2.5000	0.05
3.0000	0.04

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A Q T E S O L V   R E S U L T S
Version 1.10

01/08/92 20:55:42

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TEST DESCRIPTION

Data set........... m1502z.set
Data set title..... RISING HEAD RESULT, M-15-02
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 15
Test date.......... September 18, 1991

Knowns and Constants:
No. of data points................... 42
Radius of well casing............... 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 9.83
Well screen length.................. 9.83
Static height of water in well...... 9.83
Log(Re/Rw).......................... 3.022
A, B, C............................. 0.000, 0.000, 2.701

==

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

==

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

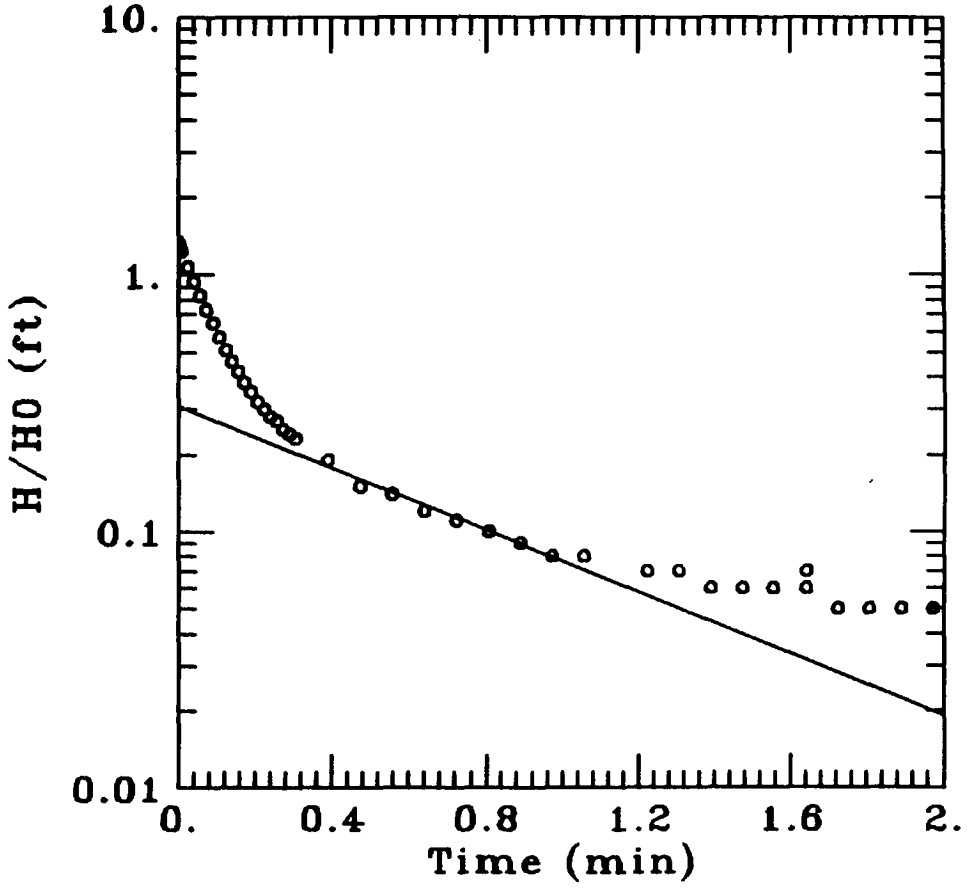
	Estimate
K =	1.2944E-003 ft/min = $6.6 * 10^{-4}$ cm/sec
y0 =	4.3937E-098

<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<>>

TYPE CURVE DATA

K = 1.32756E-003
y0 = 2.80355E-001

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	2.804E-001	2.000E+000	2.284E-002		



DATA SET:
m1502z.001
01/16/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 18, 1991

ESTIMATED PARAMETERS:
K = 0.001471 ft/min
y0 = 0.3065 ft

TEST DATA:
H0 = 1.34 ft
rc = 0.083 ft
rw = 0.18 ft
L = 0.03 ft
B = 0.03 ft
D = 0.03 ft

RISING HEAD RESULT, M-15-02

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 15

M-15-03
RISING HEAD FIELD DATA
NAS ALAMEDA, CTO-121
1991

SE1000B
Environmental Logger
09/18 13:47

Unit# 00515 Test# 9

INPUT 1: Level (F) TOC

Reference 0.00
Scale factor 10.09
Offset 0.00

Step# 0 09/18 11:38

Elapsed Time (min)	Value (ft)
0.0000	-0.02
0.0033	-0.01
0.0066	-0.01
0.0099	2.43
0.0133	6.22
0.0166	9.68
0.0200	-4.31
0.0233	3.69
0.0266	4.36
0.0300	-0.65
0.0333	3.01
0.0500	1.38
0.0666	1.44
0.0833	1.58
0.1000	1.56
0.1166	1.48
0.1333	1.42
0.1500	1.38
0.1666	1.34
0.1833	1.29
0.2000	1.26
0.2166	1.22
0.2333	1.20
0.2500	1.17
0.2666	1.15
0.2833	1.13
0.3000	1.11
0.3166	1.09
0.3333	1.08
0.4167	1.01
0.5000	0.95
0.5833	0.93

M-15-03

Elapsed Time	Value
0.6667	0.90
0.7500	0.86
0.8333	0.83
0.9167	0.80
1.0000	0.76
1.0833	0.73
1.1667	0.70
1.2500	0.67
1.3333	0.64
1.4166	0.60
1.5000	0.58
1.5833	0.56
1.6667	0.55
1.7500	0.53
1.8333	0.51
1.9167	0.49
2.0000	0.47
2.5000	0.36
3.0000	0.28
3.5000	0.22
4.0000	0.16
4.5000	0.13
5.0000	0.10
5.5000	0.07
6.0000	0.05
6.5000	0.04

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A Q T E S O L V   R E S U L T S

Version 1.10

01/08/92 20:47:32

TEST DESCRIPTION

Data set........... m1503z.set
Data set title..... RISING HEAD RESULT, M-15-03
Company............ J.M.MONTGOMERY, CONSULTING ENG
Project............ 2738.0257
Client............. NAVY - WESTDIV
Location........... Site 15
Test date.......... September 18, 1991

Knowns and Constants:

No. of data points.................. 44
Radius of well casing.............. 0.083
Radius of well...................... 0.19
Aquifer saturated thickness......... 9.8
Well screen length.................. 9.8
Static height of water in well...... 9.8
Log(Re/Rw).......................... 3.019
A, B, C............................. 0.000, 0.000, 2.695

ANALYTICAL METHOD

Bouwer-Rice (Unconfined Aquifer Slug Test)

RESULTS FROM VISUAL CURVE MATCHING

VISUAL MATCH PARAMETER ESTIMATES

	Estimate
K =	5.7137E-004 ft/min = 2.9* 10^{-4} cm/sec
y0 =	4.3937E-098

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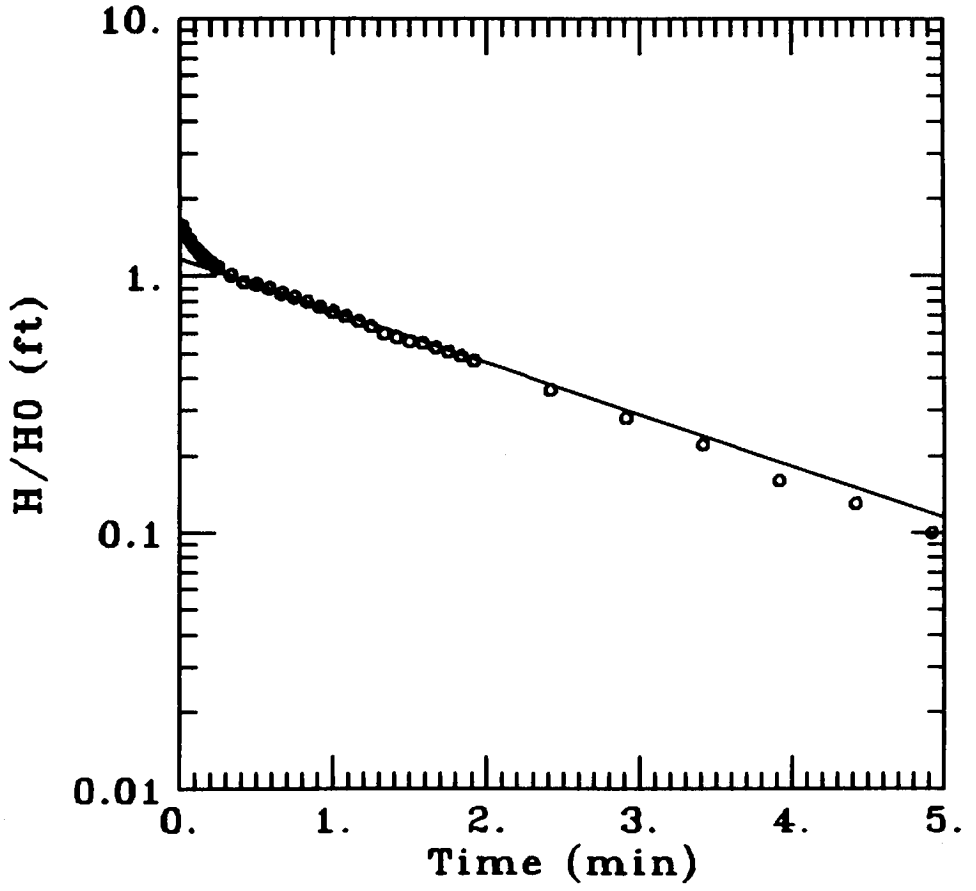
TYPE CURVE DATA

K = 5.20511E-004
y0 = 1.18044E+000

Time	Drawdown	Time	Drawdown	Time	Drawdown
0.000E+000	1.180E+000	7.000E+000	3.809E-002		



DATA SET:
m1503z.001
01/10/02

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
September 10, 1991

ESTIMATED PARAMETERS:
K = 0.0004929 ft/min
y0 = 1.165 ft

TEST DATA:
H0 = 1.63 ft
rc = 0.083 ft
rw = 0.13 ft
L = 0.0 ft
b = 0.0 ft
B = 0.0 ft

RISING HEAD RESULT, M-15-03

J.M.MONTGOMERY, CONSULTING ENG	Client: NAVY - WESTDIV
Project No.: 2738.0257	Location: Site 15

SOIL GAS SURVEY
OF
ALAMEDA NAVAL AIR STATION
ALAMEDA, CALIFORNIA

Submitted to

James M. Montgomery
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Final Report

Submitted by

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July 8, 1991

S44

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SOIL GAS SURVEY OF ALAMEDA NAVAL AIR STATION

INTRODUCTION

This report presents the methods and results of a soil gas investigation for volatile organic compounds performed June 3-14, 1991 at Alameda Naval Air Station in Alameda, California. The investigation was conducted by Hydro Geo Chem, Inc. under contract to James M. Montgomery (JMM). The soil gas investigation was designed to evaluate the near surface distribution of selected aromatic and chlorinated hydrocarbons on the site. The particular areas of interest were Building 459 (Site 7) and the Fire Training Area (Site 14).

BACKGROUND & THEORY

Soil gas surveys consist of the sampling and analysis of the soil gases that reside in the pore space of the unsaturated zone above the water table. Because many common organic compounds and industrial solvents exhibit significant vapor pressures and are relatively insoluble in water, their introduction into subsurface soils results in vapor phase permeation and transport. Should these chemicals reach the water table and travel with the groundwater, vapors will continue to emanate from the contaminated groundwater into overlying soil. Thus organic contamination of the subsurface or groundwater can be detected by measuring the concentration of volatile organics in the soil gas.

The concentration of a volatile organic compound (VOC) in soil gas is a complex function of the distribution of the organic compound and its interaction with the soil. This

interaction depends on a number of soil parameters including soil particle size and mineralogy, the soil's natural and anthropogenic organic content, soil moisture, temperature, lithology, and heterogeneity.

Whatever the source of the VOC in soil gas, its concentration is representative of soils contamination at the point of measurement. Volatile organic contaminants are present in the gas phase in unsaturated pore spaces, in the water contained in the unsaturated soils, and sorbed on the soil particles. The total soils concentration is the sum of the VOC's contained in the three phases. The partitioning of the VOC between gas, liquid and solid phases is dependent on both the soil properties and the chemical properties of the organic compound. Thus, given the chemical properties of the VOC and measurements or reasonable estimates of relevant soil parameters, soil-gas data can be used to provide semi-quantitative estimates of soil contamination.

Since equilibrium between phases is generally rapid compared to the rate of gaseous diffusion, soil gas concentrations can be used to estimate the total soil concentration. The major uncertainties in estimating soil concentration directly from soil gas concentrations are the organic and moisture content of the soils. Chemical properties of particular organic compounds are well known, (i.e., vapor pressure, solubility), and the other relevant soil parameters (i.e., bulk density, porosity) have relatively little effect on soil concentration estimates. The following equation relates soil gas concentrations to total soil concentrations.

$$\frac{C_g}{C_T} = \left[\frac{K_D \rho_b}{H_D} + \frac{\theta_w}{H_D} + (\theta_T - \theta_w)\right]^{-1}$$

Where C_g is the concentration in the gas [M/V air]

C_T is the concentration in the soil [M/V bulk volume soil]

K_D is the water-solid distribution coefficient [M/M solid/M/V water]

ρ_b is the bulk soil density [M/V solid]

H_D is the gas-water distribution coefficient [M/V air/M/V water]

θ_w is the water filled porosity

θ_T is the total porosity

The gas-water distribution coefficient (dimensionless Henry's law constant) is

$$H_D = C_g/C_w = H/RT \approx \rho_g/S$$

where ρ_g is the saturated vapor density [M/V]

and S is the solubility [M/V].

H is the Henry's coefficient

R is the gas constant

T is the temperature in degrees Kelvin

The water-solid distribution coefficient is approximately

$$K_D = \frac{C_s}{C_w} \approx \frac{K_{oc} \cdot \%OC}{100}$$

where C_S is the concentration in the solid (mg/gm)

C_w is the concentration in the water (mg/ml)

K_{OC} is the water-organic carbon distribution coefficient

%OC is the percent organic carbon in the soil

Use of soil gas to infer concentrations of sources at distance (such as groundwater plumes) is necessarily much more qualitative. Soil gas data used in this manner is limited by the lack of information regarding the soil parameters interposed between the source and sampling point. It is therefore generally not possible to make quantitative estimates of groundwater concentrations from soil gas samples collected at distance from the saturated interface. Away from source areas (ie. underground storage tanks, surface spills etc.) where only the groundwater is providing a significant soil gas concentration, soil gas is often an excellent relative indicator of groundwater contamination. The effectiveness of soil gas surveys to delineate groundwater contamination, is, however, dependent on the depth to groundwater, contaminant concentration in the groundwater, and distribution of air permeabilities in the unsaturated zone.

SCOPE OF WORK

Soil gas samples were collected from 72 locations in the investigation area around Building 459 and 44 locations in the Fire Training Area.

The volatile organic compounds that were analyzed at each of the sampling locations included the chlorinated hydrocarbons:

Tetrachloroethene (PCE)

Trichloroethene (TCE)

Trans 1,2 Dichloroethene

Cis 1,2 Dichloroethene

1,1 - Dichloroethene (1,1 - DCE)

the suite of aromatic compounds known as BTEX:

Benzene

Ethylbenzene

Toluene

Meta + Para Xylenes

Ortho Xylene

METHODS AND INSTRUMENTATION

Sampling probes consisted of 1 3/8" OD, EW drill rod tipped by a loosely held hardened-steel disposable point. A probe was driven into the ground at each sampling location to a depth of between 16 inches and 5.0 feet below land surface using a flatbed truck-mounted hydraulically-actuated drive point rig. The probe was then pulled up 6 inches

to expose the sampling interval. A regulated vacuum pump was attached to the probe via a stainless steel adaptor. Three to five times the dead volume of the sampling train was purged to ensure that a representative soil gas sample would be collected. The samples were collected by withdrawing the soil gas from the probe using a Hydro Geo Chem designed, computerized mass-flow controller to regulate flow and measure volume sampled. The volatile organics were trapped and concentrated in a glass cartridge contained in a stainless steel housing. The concentrating cartridge was packed with three activated carbons, Carbotrap, Carbopak-B, and Carbosieve S-III, selected to quantitatively trap organics with widely different volatilities. After sampling, the cartridges were brought to the on-site mobile laboratory for analysis.

Gas chromatographic techniques were used to identify and measure concentrations of the various compounds. The soil gas cartridges were desorbed at a temperature of 340°C using a thermal desorption unit. Samples were injected by the desorber into a gas chromatograph equipped with a megabore capillary column and a photoionization (PID) and Hall conductivity detector. A split from the thermal desorber was sent to a flame ionization detector (FID).

The make and model of the equipment used to perform these on-site analyses included:

Envirochem 850 Thermal Tube Desorber

Varian 3400 Gas Chromatograph

Tracor 1000A Hall Detector

Tracor 703 PID Detector

Varian Flame Ionization (FID) Detector

DB 624 30m Megabore column, J.W. Scientific

Spectra Physics 4400 Chrom Jet Integrator

QUALITY ASSURANCE/QUALITY CONTROL

Quality control and quality assurance were achieved through strict experimental protocol. Chain of custody procedures were observed. All parts of the collection system that come in contact with a sample were cleaned before each use. A systems blank and three calibration runs were performed at the beginning of each day and additional calibrations after every 10 samples.

Standards were prepared from stock mixtures of neat reagent grade compounds prepared by weighing each compound addition to the mixture and weighing an aliquot volume of the final mixture to establish density (weight/volume). For preparation of daily standards, a measured volume of the standard mixture was injected into a nitrogen-filled 1-liter glass gas bottle through a septum side port. A measured volume of the resulting gas mixture was then injected into a 200-ml/min helium stream feeding a glass, carbon-packed concentrating cartridge. After two minutes the cartridge was transferred to the thermal desorber and analyzed exactly as the soil-gas samples.

Prior to each day's sampling, atmospheric field blanks of the entire sampling apparatus were taken and analyzed to check background contamination in the sampling

system and cartridges. In addition, serial duplicates were analyzed from 10% of the sample locations as a measure of reproducibility.

Detection limits were 0.01 micrograms or less per liter of soil gas for all compounds analyzed. Analyses are reported to two significant figures; the minimum amount reported is 0.01 micrograms/liter.

RESULTS

Table 1 presents the measured soil gas concentrations from each sampling location. Concentrations are reported in micrograms per liter (μg/l) of soil gas. Conversion of soil gas concentrations from μg/l (gas) to ppmV can be achieved by the following equation.

$$C_{ppmV} = C_{\mu g/l} \times RT/M_W P$$

where C_{ppmv} = soil gas concentration in ppmV

$C_{\mu g/l}$ = soil gas concentration in μg/l (gas)

R = 0.08205 L-Atm/deg-mole

T = °K

M_W = molecular wgt in grams

P = pressure in atmospheres

For most compounds C_{ppmV} is approximately 0.25 $C_{\mu g/l}$.

TABLE 1
SUMMARY OF ANALYTICAL RESULTS FOR AROMATIC HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas))

SAMPLE	DEPTH	BENZENE	TOLUENE	ETHYL BENZENE	m & p XYLENES	o-XYLENE
FB07JUN#1		0.00	0.09	0.00	0.04	0.00
FB10JUN#1		0.00	0.00	0.00	0.00	0.00
FB11JUN#1		0.00	0.14	0.14	0.15	0.14
FB11JUN#2		0.00	0.00	0.00	0.00	0.00
FB12JUN#1		0.21	0.37	0.11	0.34	0.14
FB12JUN#2		0.00	0.00	0.00	0.00	0.00
FB13JUN#1		0.00	0.00	0.00	0.00	0.00
FB14JUN#1		0.00	0.00	0.00	0.00	0.00
SG-07A-01	3.00	0.00	0.03	0.00	0.00	0.00
SG-07A-02	3.00	0.80	24.00	77.00	470.00	180.00
SG-07A-03-A	3.00	0.50	31.00	22.00	26.00	7.20
SG-07A-03-B	3.00	0.00	21.00	17.00	21.00	5.00
SG-07A-04	2.50	7.10	640.00	600.00	1200.00	980.00
SG-07A-05	2.50	0.13	0.10	0.20	0.00	0.00
SG-07A-06	1.70	53.00	1400.00	0.00	2400.00	1100.00
SG-07A-07	2.00	85.00	310.00	370.00	650.00	310.00
SG-07A-08	1.70	10.00	1000.00	370.00	890.00	430.00
SG-07A-09	1.70	6.90	700.00	450.00	830.00	430.00
SG-07A-10	1.70	39.00	150.00	490.00	250.00	69.00
SG-07A-11	1.70	3.30	570.00	660.00	930.00	450.00
SG-07A-12-A	1.70	10.00	740.00	570.00	1100.00	620.00
SG-07A-12-B	1.70	16.00	640.00	600.00	1100.00	630.00
SG-07A-13	1.70	250.00	730.00	150.00	430.00	190.00
SG-07A-14	1.70	93.00	260.00	220.00	660.00	380.00
SG-07A-15	1.70	0.00	870.00	0.00	2000.00	844.00
SG-07A-16	1.70	9.80	940.00	500.00	980.00	590.00
SG-07A-17	1.70	9.50	870.00	550.00	1100.00	650.00
SG-07A-18	1.70	15.00	1300.00	510.00	990.00	480.00
SG-07A-19	1.70	47.00	29.00	115.00	14.00	12.00
SG-07A-20	1.70	0.00	0.00	0.00	0.40	0.00
SG-07A-21	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-22	1.70	0.00	8.60	7.70	11.00	6.60
SG-07A-23	1.70	0.00	0.00	0.74	0.53	0.55
SG-07A-24	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-25-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-25-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-26	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-27	1.70	0.00	1.10	0.36	0.82	0.00
SG-07A-28	1.70	0.00	0.35	0.00	0.00	0.00
SG-07A-29-A	1.70	0.00	1.70	0.45	1.30	0.68
SG-07A-29-B	1.70	0.00	1.10	0.00	0.62	0.34
SG-07A-30	1.70	0.00	0.60	0.00	0.00	0.00
SG-07A-31	1.70	0.00	7.10	1.50	3.50	1.30

FB = FIELD BLANKS
A & B DENOTE SERIAL DUPLICATES

TABLE 1 - PAGE 2
SUMMARY OF ANALYTICAL RESULTS FOR AROMATIC HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas))

SAMPLE	DEPTH	BENZENE	TOLUENE	ETHYL BENZENE	m & p XYLENES	o-XYLENE
SG-07A-32	1.70	0.00	6.60	2.00	3.30	1.40
SG-07A-33	1.70	0.00	0.00	0.00	0.47	0.00
SG-07A-34	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-35	1.70	0.00	5.00	1.20	5.30	1.80
SG-07A-36	1.70	0.00	11.00	2.30	5.30	2.30
SG-07A-37	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-38	1.70	0.00	1.20	0.00	2.10	0.70
SG-07A-39	1.70	0.00	0.74	0.00	0.51	0.00
SG-07A-40	1.70	0.00	0.00	0.00	0.61	0.00
SG-07A-41-A	1.70	0.00	0.26	0.25	0.69	0.34
SG-07A-41-B	1.70	0.00	0.44	0.00	0.42	0.18
SG-07A-42-A	1.70	0.00	7.30	0.97	4.00	0.85
SG-07A-42-B	1.70	0.00	7.20	0.97	3.90	0.82
SG-07A-43	1.70	0.00	0.28	0.00	0.28	0.00
SG-07A-44	1.70	0.00	0.19	0.18	0.25	0.00
SG-07A-45	1.70	0.00	0.00	0.00	0.17	0.00
SG-07A-46	1.70	0.00	0.00	0.00	0.20	0.00
SG-07A-47	1.70	0.00	0.00	0.00	0.27	0.19
SG-07A-48	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-49	1.70	0.00	0.15	0.00	0.15	0.00
SG-07A-50	1.70	0.00	0.00	0.00	0.17	0.00
SG-07A-51	1.70	0.00	0.08	0.03	0.14	0.06
SG-07A-52	1.70	0.00	0.05	0.03	0.11	0.10
SG-07A-53	1.70	0.00	0.06	0.03	0.11	0.05
SG-07A-54	1.70	0.00	0.09	0.03	0.12	0.06
SG-07A-55-A	1.70	0.00	0.12	0.03	0.13	0.06
SG-07A-55-B	1.70	0.00	0.14	0.03	0.13	0.05
SG-07A-56	1.70	130.00	680.00	0.00	2700.00	1100.00
SG-07A-57	1.70	11.00	680.00	0.00	950.00	800.00
SG-07A-58	1.70	130.00	1000.00	310.00	680.00	320.00
SG-07A-59	1.70	6.00	1200.00	580.00	1100.00	530.00
SG-07A-60	1.70	8.60	850.00	950.00	1400.00	840.00
SG-07A-61	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-62	1.70	2.60	6.00	3.10	5.40	3.30
SG-07A-63	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-64-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-64-B	1.70	0.00	0.48	0.00	0.54	0.00
SG-07A-65	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-66	1.70	0.40	0.00	0.00	0.00	0.00
SG-07A-67	1.70	0.40	1.30	0.64	3.30	1.10
SG-07A-68	0.80	0.00	0.68	0.90	10.00	6.10
SG-07A-69	0.80	0.00	0.68	0.70	1.90	1.70
SG-07A-70	1.70	61.00	100.00	250.00	950.00	690.00

FB = FIELD BLANK
A & B DENOTE SERIAL DUPLICATES

TABLE 1 - PAGE 3
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SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas))

SAMPLE	DEPTH	BENZENE	TOLUENE	ETHYL BENZENE	m & p XYLENES	o-XYLENE
SG-07A-71	1.70	0.00	0.28	0.12	0.41	0.21
SG-07A-72	0.80	0.00	0.13	0.10	0.22	0.12
SG-S14-01	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-02	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-03	4.50	0.00	0.11	0.28	0.73	0.33
SG-S14-04	4.50	0.00	0.00	0.00	0.11	0.00
SG-S14-05-A	4.50	0.00	0.61	0.34	0.47	0.10
SG-S14-05-B	4.50	0.00	0.15	0.00	0.16	0.10
SG-S14-06	4.50	0.00	0.11	0.00	0.13	0.00
SG-S14-07	4.00	0.00	0.17	0.00	0.24	0.10
SG-S14-08	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-09	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-10	1.70	0.00	0.00	0.00	0.45	0.00
SG-S14-11	1.70	0.00	0.28	0.00	0.00	0.00
SG-S14-12	5.00	0.00	0.44	0.22	0.41	0.00
SG-S14-13	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-14	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-15	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-16	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-17	3.00	0.70	1.60	0.00	0.00	5.20
SG-S14-18	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-19	4.00	0.00	0.15	0.00	0.21	0.00
SG-S14-20	4.00	0.00	0.33	0.09	0.32	0.14
SG-S14-21	4.00	140.00	150.00	88.00	64.00	125.00
SG-S14-22	4.00	110.00	140.00	53.00	37.00	57.00
SG-S14-23	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-24	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-25	1.70	5.00	16.00	0.80	8.10	1.20
SG-S14-26	1.70	0.00	0.60	0.00	0.00	0.00
SG-S14-27	4.00	180.00	230.00	110.00	110.00	200.00
SG-S14-28	4.00	1.70	4.10	2.00	1.30	1.80
SG-S14-29	1.70	0.00	0.14	0.00	0.36	0.00
SG-S14-30	2.00	1.70	0.65	0.57	0.91	0.80
SG-S14-31	5.00	0.00	0.10	0.00	0.17	0.00
SG-S14-32-A	4.00	0.00	0.12	0.00	0.22	0.00
SG-S14-32-B	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-33	1.70	23.00	25.00	11.00	17.00	6.30
SG-S14-34	1.70	130.00	150.00	40.00	22.00	10.00
SG-S14-35	1.70	52.00	170.00	17.00	17.00	10.00
SG-S14-36	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-37	1.70	0.00	0.00	0.00	0.00	0.84
SG-S14-38	4.50	0.00	0.14	0.27	0.50	0.18
SG-S14-39-A	5.00	0.00	0.00	0.00	0.00	0.00

FB = FIELD BLANK
A & B DENOTE SERIAL DUPLICATES

TABLE 1 - PAGE 4
SUMMARY OF ANALYTICAL RESULTS FOR AROMATIC HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas))

SAMPLE	DEPTH	BENZENE	TOLUENE	ETHYL BENZENE	m & p XYLENES	o-XYLENE
SG-S14-39-B	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-40-A	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-40-B	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-41	3.50	0.00	0.00	0.00	0.00	0.00
SG-S14-42	3.50	0.00	1.50	1.70	4.40	3.70
SG-S14-43	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-44	1.70	0.00	0.00	0.00	0.00	0.00

FB = FIELD BLANK
A & B DENOTE SERIAL DUPLICATES

TABLE 2
SUMMARY OF ANALYTICAL RESULTS FOR CHLORINATED HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas)

SAMPLE	DEPTH	1,1 DCE	1,2 trans DCE	1,2 cis DCE	TCE	PCE
FB07JUN#1		0.00	0.00	0.00	0.00	0.00
FB10JUN#1		0.00	0.00	0.00	0.00	0.00
FB11JUN#1		0.00	0.00	0.00	0.00	0.00
FB11JUN#2		0.00	0.00	0.00	0.00	0.00
FB12JUN#1		0.00	0.00	0.00	0.00	0.00
FB12JUN#2		0.00	0.00	0.00	0.00	0.00
FB13JUN#1		0.00	0.00	0.00	0.00	0.00
FB14JUN#1		0.00	0.00	0.00	0.00	0.00
SG-07A-01	3.00	0.00	0.00	0.00	0.00	0.00
SG-07A-02	3.00	0.00	0.00	0.00	0.00	0.00
SG-07A-03-A	3.00	0.00	0.00	0.00	0.00	0.00
SG-07A-03-B	3.00	0.00	0.00	0.00	0.00	0.00
SG-07A-04	2.50	0.00	0.00	0.00	0.00	0.00
SG-07A-05	2.50	0.00	0.00	0.00	0.00	0.00
SG-07A-06	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-07	2.00	0.00	0.00	0.00	0.00	0.00
SG-07A-08	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-09	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-10	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-11	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-12-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-12-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-13	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-14	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-15	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-16	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-17	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-18	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-19	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-20	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-21	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-22	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-23	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-24	1.70	0.00	0.00	0.00	0.00	0.01
SG-07A-25-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-25-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-26	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-27	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-28	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-29-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-29-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-30	1.70	0.00	0.00	0.00	0.00	0.00

FB = FIELD BLANK
A & B DENOTE SERIAL DUPLICATES
0.00 = LESS THAN THE DETECTION LIMIT OF 0.01uG/L

TABLE 2 - PAGE 2
SUMMARY OF ANALYTICAL RESULTS FOR CHLORINATED HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas)

SAMPLE	DEPTH	1,1 DCE	1,2 trans DCE	1,2 cis DCE	TCE	PCE
SG-07A-31	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-32	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-33	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-34	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-35	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-36	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-37	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-38	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-39	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-40	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-41-A	1.70	0.00	0.00	0.00	0.00	0.01
SG-07A-41-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-42-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-42-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-43	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-44	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-45	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-46	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-47	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-48	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-49	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-50	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-51	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-52	1.70	0.00	0.00	0.00	0.00	0.01
SG-07A-53	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-54	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-55-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-55-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-56	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-57	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-58	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-59	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-60	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-61	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-62	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-63	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-64-A	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-64-B	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-65	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-66	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-67	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-68	0.80	0.00	0.00	0.00	0.00	0.00

FB = FIELD BLANK
A & B DENOTE SERIAL DUPLICATES
0.00 = LESS THAN THE DETECTION LIMIT OF 0.01uG/L

TABLE 2 - PAGE 3
SUMMARY OF ANALYTICAL RESULTS FOR CHLORINATED HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas))

SAMPLE	DEPTH	1,1 DCE	1,2 trans DCE	1,2 cis DCE	TCE	PCE
SG-07A-69	0.80	0.00	0.00	0.00	0.00	0.00
SG-07A-70	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-71	1.70	0.00	0.00	0.00	0.00	0.00
SG-07A-72	0.80	0.00	0.00	0.00	0.00	0.00
SG-S14-01	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-02	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-03	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-04	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-05-A	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-05-B	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-06	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-07	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-08	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-09	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-10	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-11	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-12	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-13	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-14	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-15	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-16	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-17	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-18	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-19	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-20	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-21	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-22	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-23	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-24	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-25	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-26	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-27	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-28	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-29	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-30	2.00	0.00	0.00	0.00	0.00	0.00
SG-S14-31	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-32-A	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-32-B	4.00	0.00	0.00	0.00	0.00	0.00
SG-S14-33	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-34	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-35	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-36	1.70	0.00	0.00	0.00	0.00	0.00

FB = FIELD BLANK
A & B DENOTE SERIAL DUPLICATES
0.00 = LESS THAN THE DETECTION LIMIT OF 0.01uG/L

TABLE 2 - PAGE 4
SUMMARY OF ANALYTICAL RESULTS FOR CHLORINATED HYDROCARBONS
SOIL GAS SURVEY AT ALAMEDA NAVAL AIR STATION
CONCENTRATIONS ARE REPORTED IN uG/L(gas))

SAMPLE	DEPTH	1,1 DCE	1,2 trans DCE	1,2 cis DCE	TCE	PCE
SG-S14-37	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-38	4.50	0.00	0.00	0.00	0.00	0.00
SG-S14-39-A	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-39-B	5.00	0.00	0.00	0.00	0.00	0.00
SG-S14-40-A	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-40-B	3.00	0.00	0.00	0.00	0.00	0.00
SG-S14-41	3.50	0.00	0.00	0.00	0.00	0.00
SG-S14-42	3.50	0.00	0.00	0.00	0.00	0.00
SG-S14-43	1.70	0.00	0.00	0.00	0.00	0.00
SG-S14-44	1.70	0.00	0.00	0.00	0.00	0.00

N00236.000844
ALAMEDA POINT
SSIC NO. 5090.3

APPENDIX A
CHROMATOGRAMS AND FIELD DATA SHEETS

APPENDIX F – SOIL GAS SURVEY

FINAL
DATA SUMMARY REPORT
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PHASES 2B AND 3

DATED 27 OCTOBER 1992

HYDRO GEO CHEM, INC.

Environmental Technology & Engineering

1430 N. Sixth Avenue
Tucson, Arizona 85705
(602) 623-6981
FAX: (602) 623-6984

September 5, 1991

Ms. Donna Courington
James M. Montgomery Consulting Engineers
365 Lennon Lane
Walnut Creek, California 94598

Contract No: N-62474-88-D-5086
CTO 0121

Dear Ms. Courington:

Please find enclosed the contour maps of the most prevalent constituents detected during the soil gas investigation conducted at Alameda Naval Air Station in June, 1991. We have also prepared sampling point location maps for each area. In order to make these maps more readable, we have eliminated the SG and site designation.

My apologies for the oversight in providing these maps with the report. If I can be of further assistance, please call.

Sincerely,

D. Schumann

Patricia A. Schumann

PAS/jck

SAMPLING LOCATION AND COMPOUND SPECIFIC CONTOUR MAPS OF ALAMEDA NAVAL AIR STATION ALAMEDA, CALIFORNIA

Submitted to

James M. Montgomery
365 Lennon Lane
Walnut Creek, California 94598

Addendum to Final Report

Submitted by

Hydro Geo Chem, Inc.
1430 North Sixth Avenue
Tucson, Arizona 85705

September 5, 1991

TABLE OF CONTENTS

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1	Soil Gas Locations 07A
2	Benzene Concentrations in Soil Gas 07A
3	Toluene Concentrations in Soil Gas 07A
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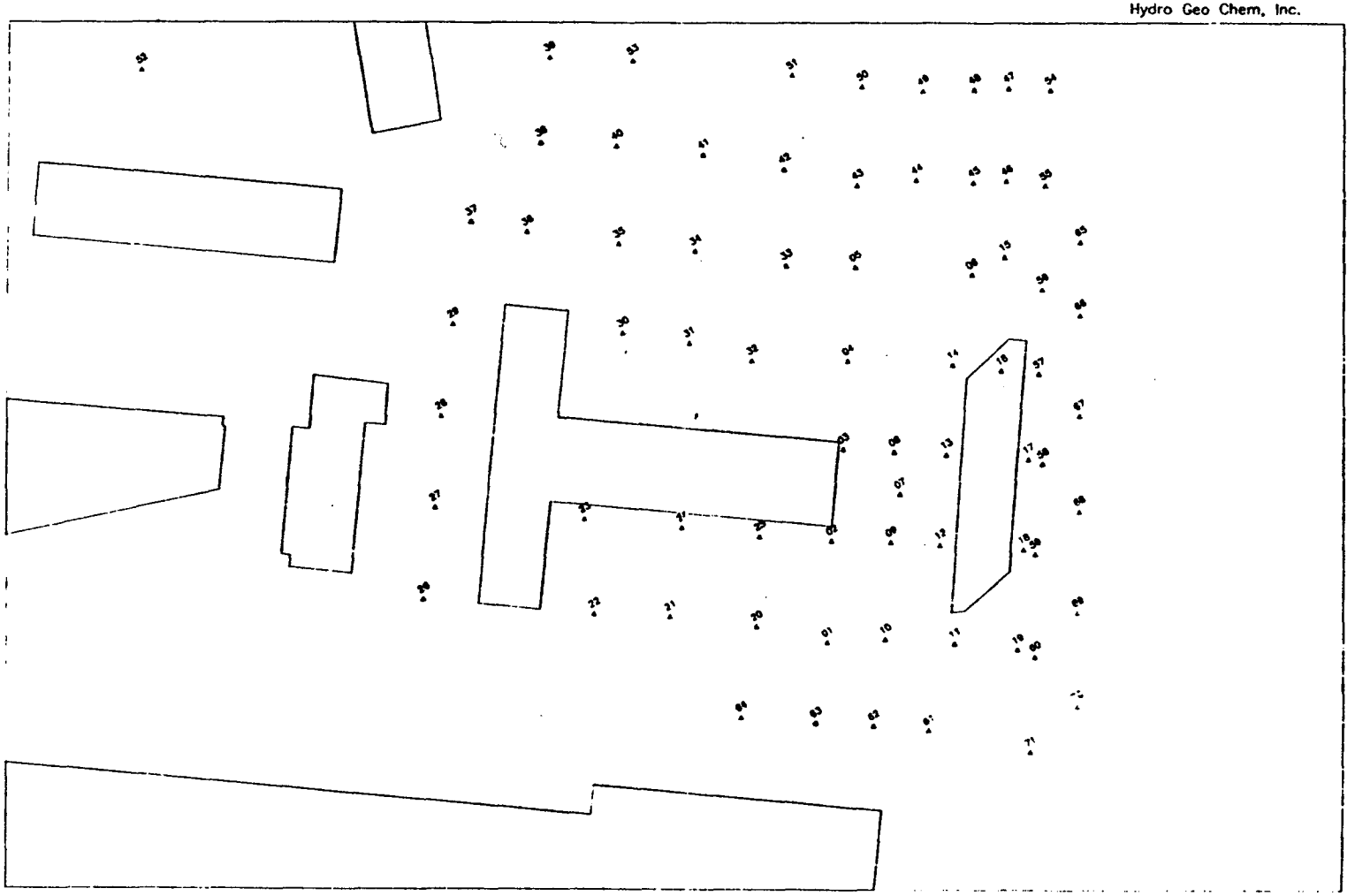
5	M & P Xylene Concentrations in Soil Gas 07A
6	O-Xylene Concentrations in Soil Gas 07A
7	Soil Gas Locations S14A
8	Benzene Concentrations in Soil Gas S14
9	Toluene Concentrations in Soil Gas S14
10	Ethyl Benzene Concentrations in Soil Gas S14
11	M & P Xylene Concentrations in Soil Gas S14
12	O Xylene Concentrations in Soil Gas S14

Soil Gas Locations 07A

Hydro Geo Chem, Inc.



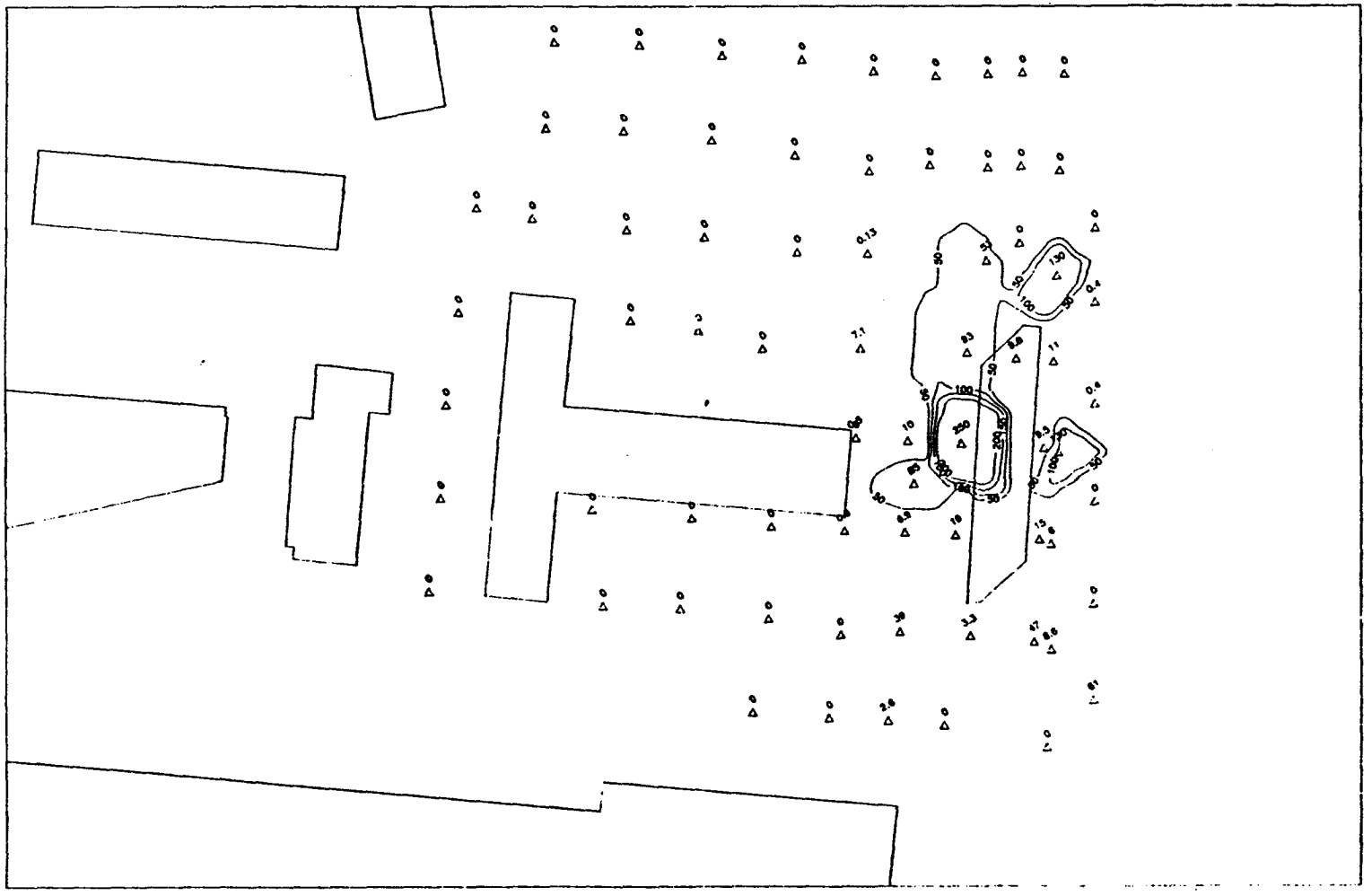
1 in = 47.62 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 1

Benzene Concentrations in Soil Gas 07A (ug/l)

Hydro Geo Chem, Inc.



1 in = 47.62 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 2

Toluene Concentrations in Soil Gas 07A (ug/l)

Hydro Geo Chem, Inc.

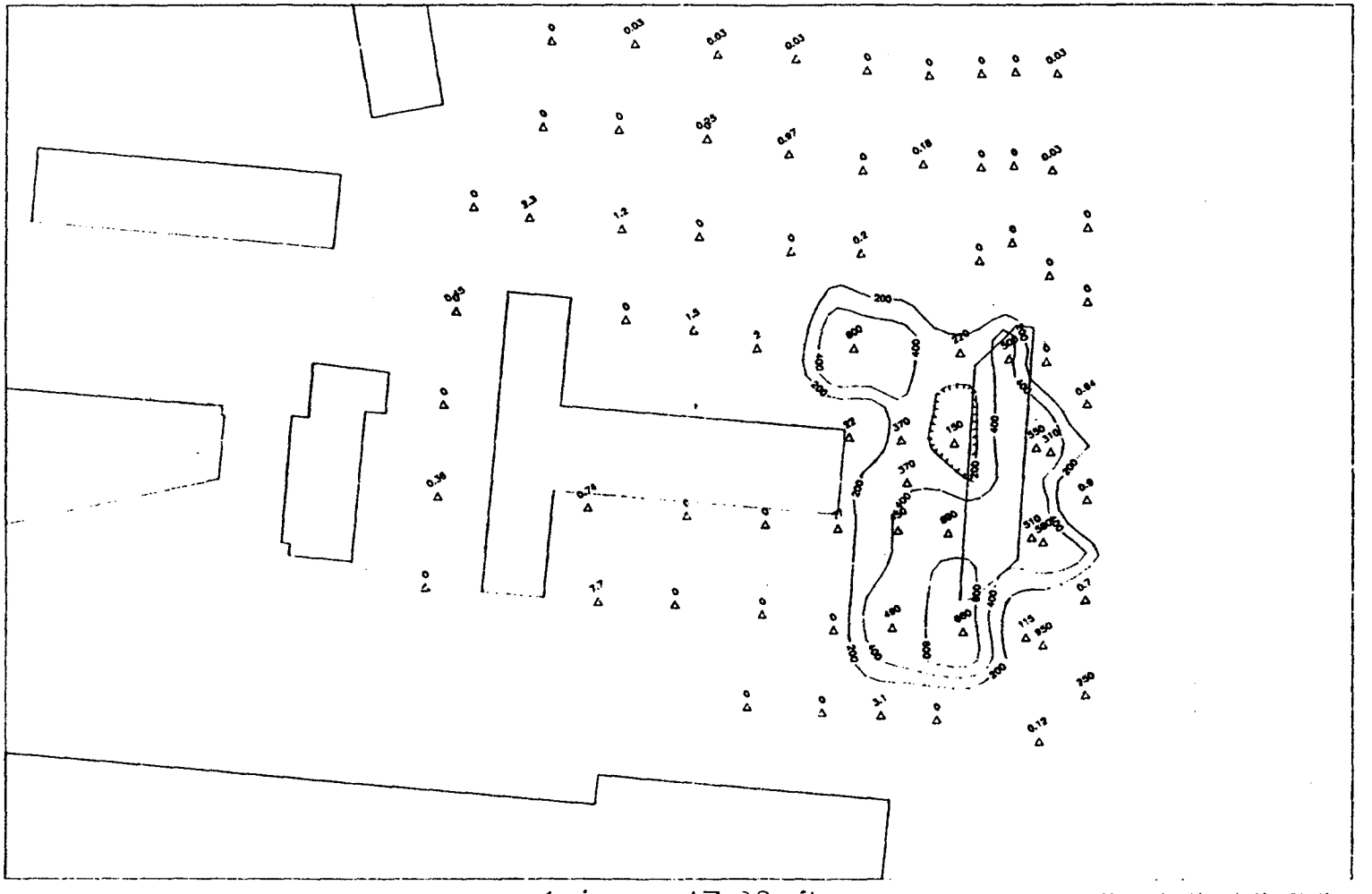
1 in = 47.62 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

FIGURE 3

Ethyl Benzene Concentrations in Soil Gas 07A (ug/l)

Hydro Gec Chem, Inc.



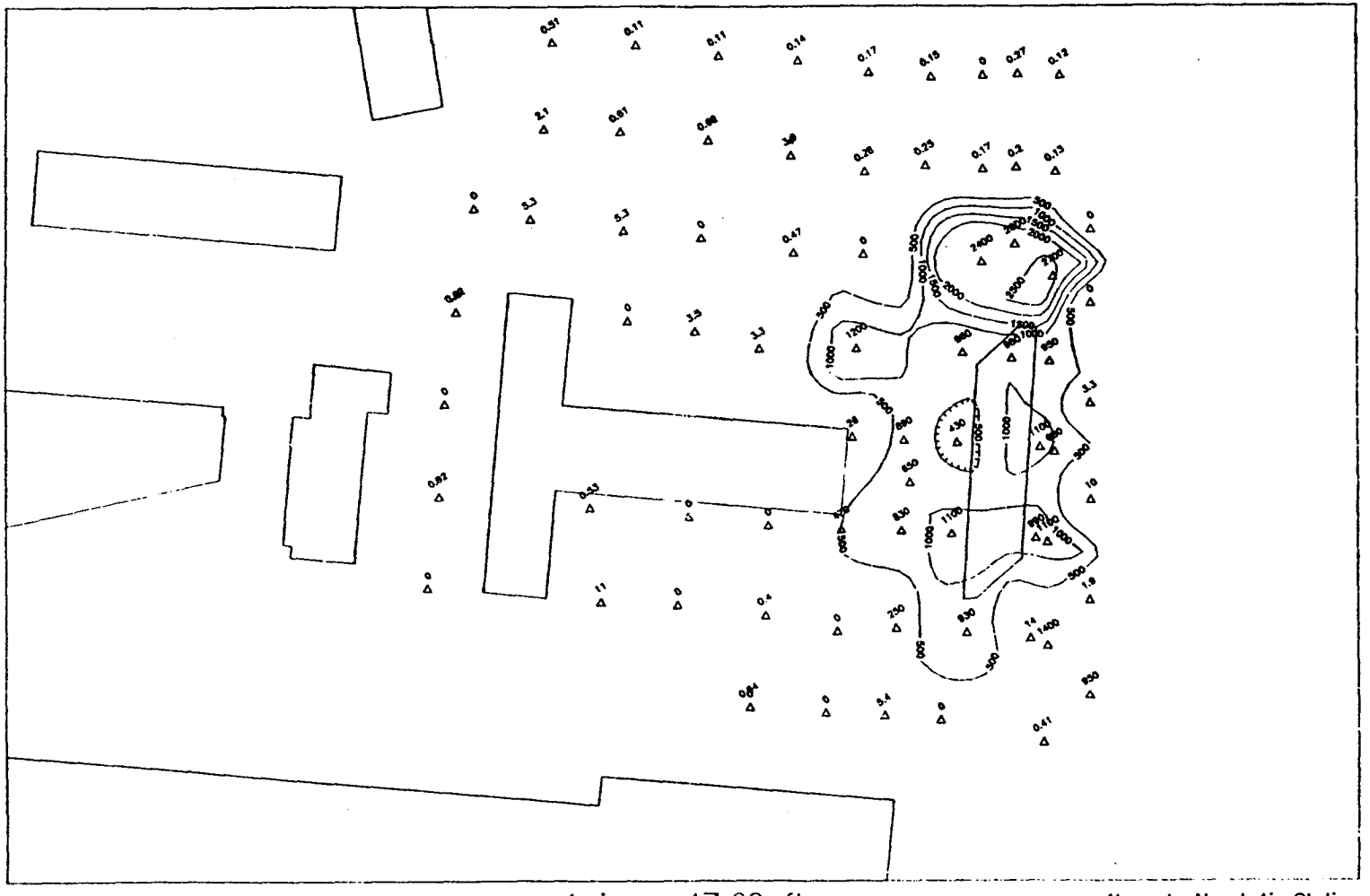
1 in = 47.62 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 4

M & P Xylenes Concentrations in Soil Gas 07A (ug/l)

Hydro Geo Chem, Inc.



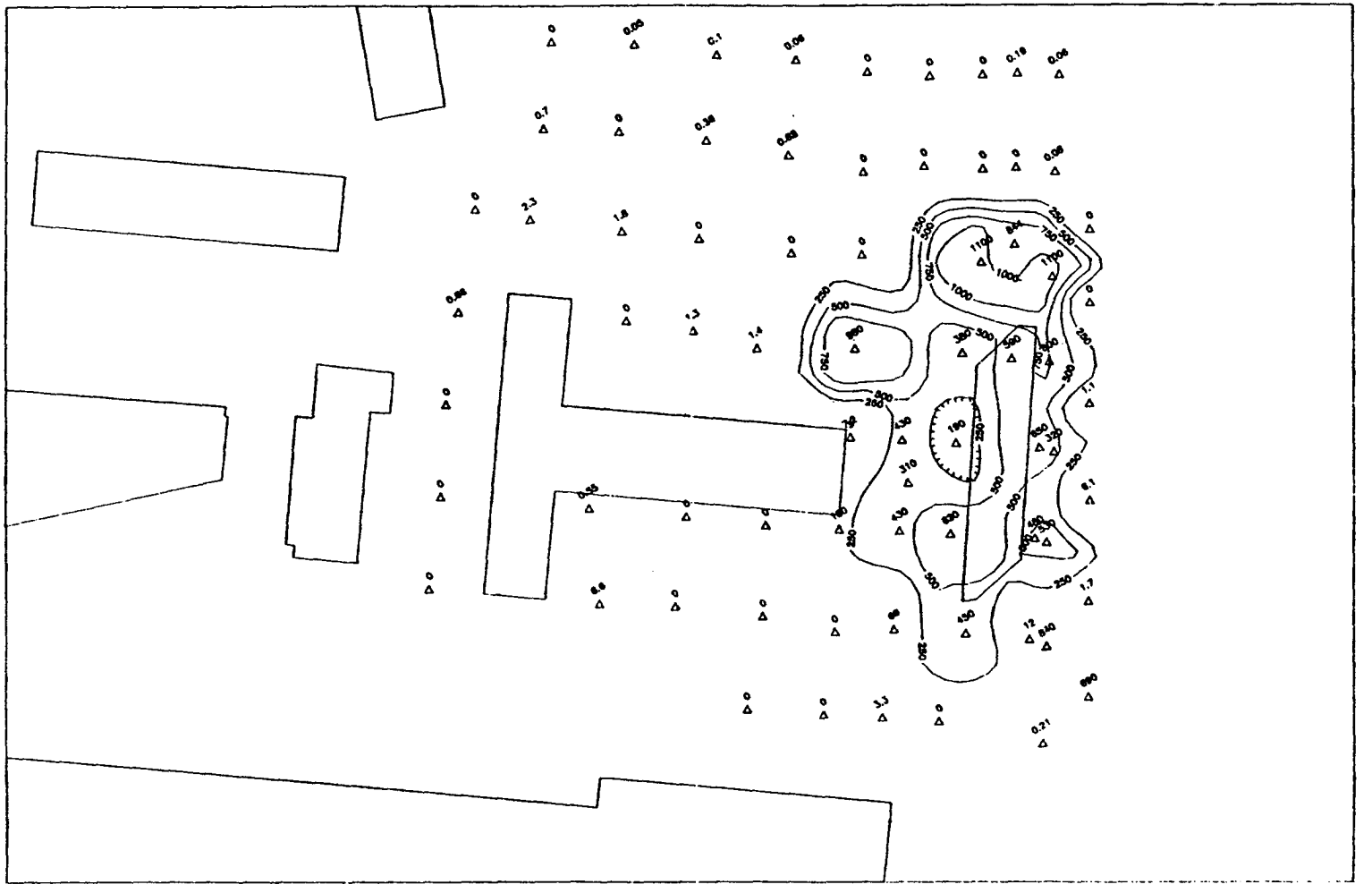
1 in = 47.62 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 5

O-Xylene Concentration in Soil Gas 07A (ug/l)

Hydro Geo Chem, Inc.



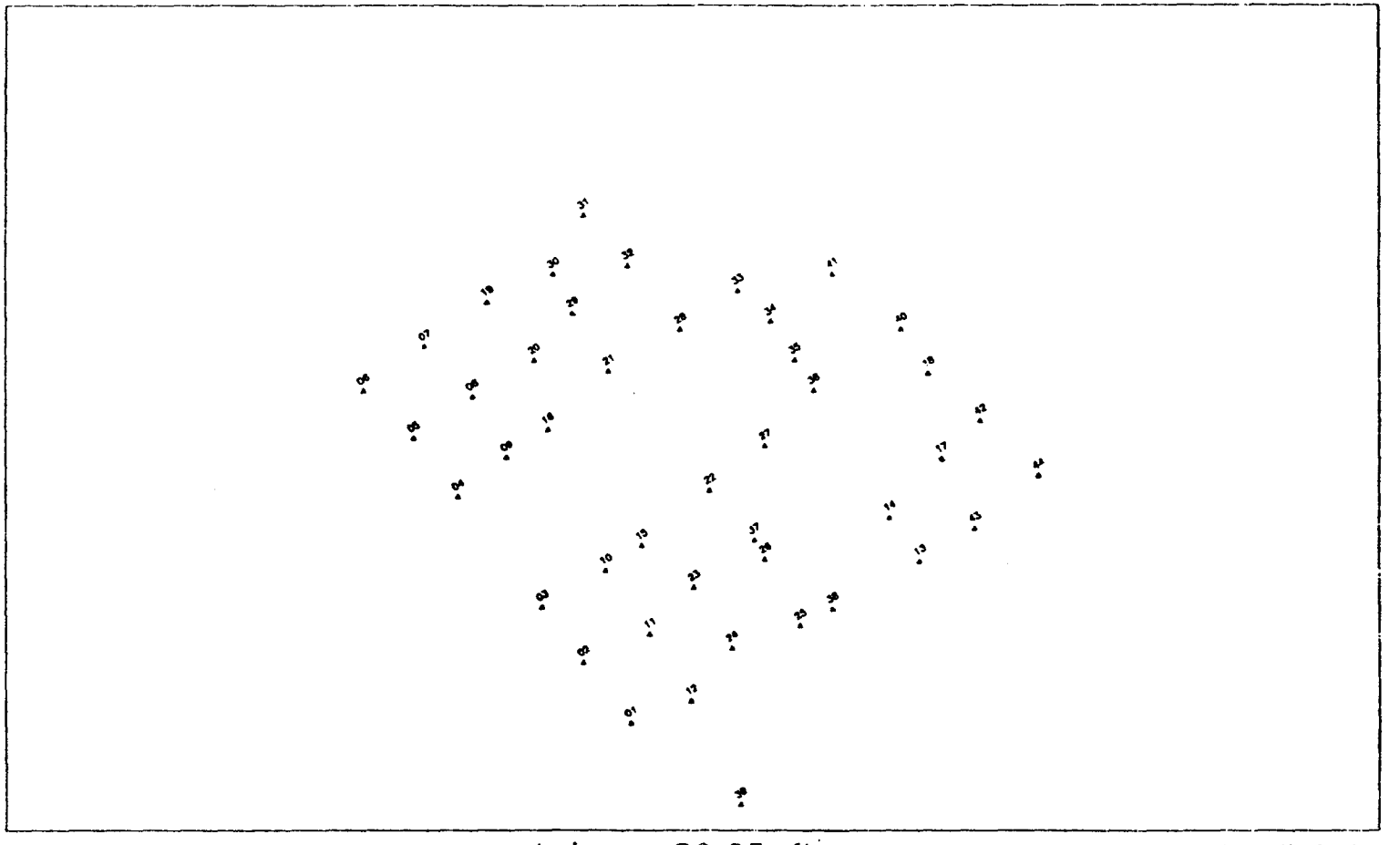
1 in = 47.62 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 6

Soil Gas Locations S14

Hydro Geo Chem, Inc.



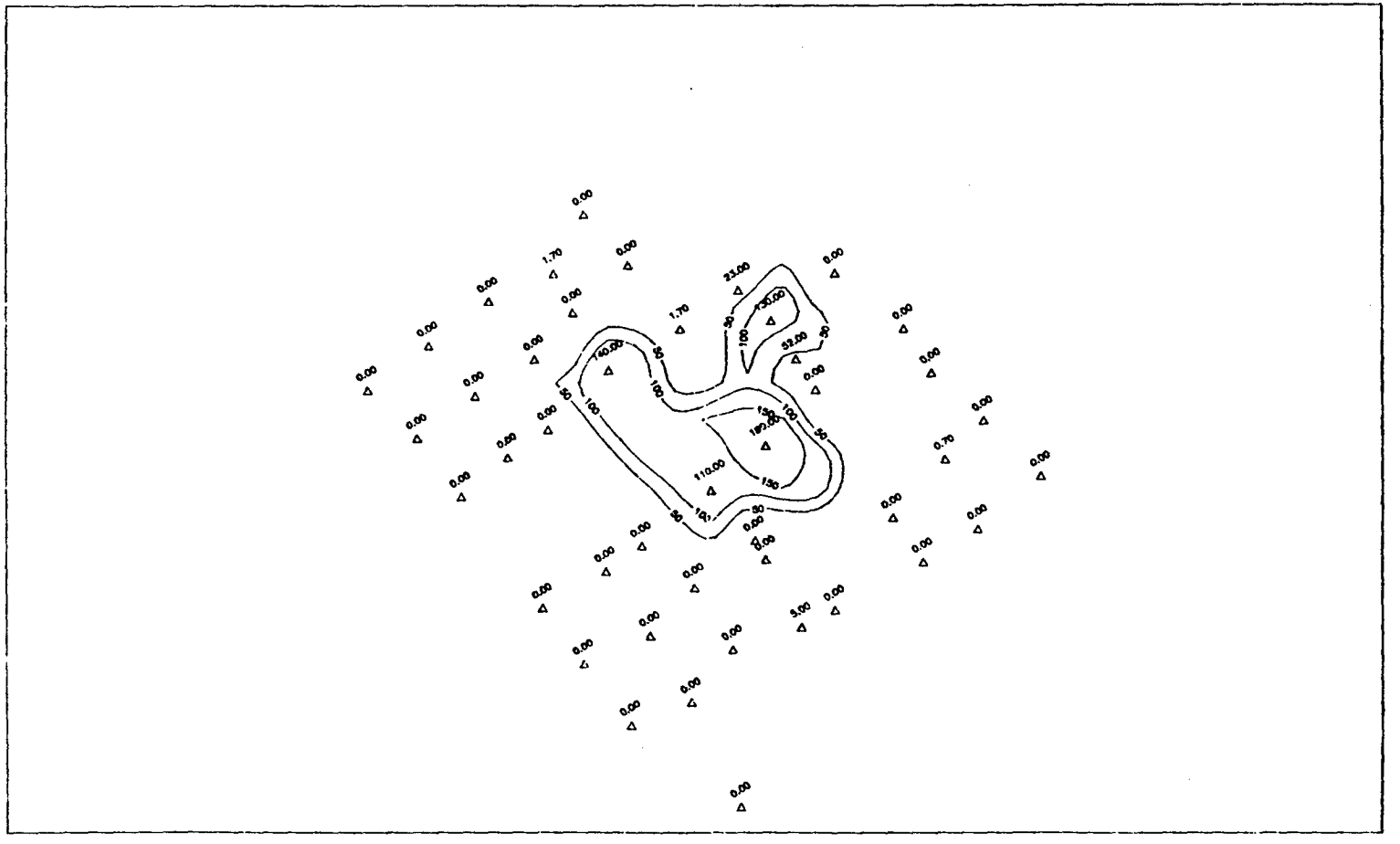
1 in = 89.05 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 7

Benzene Concentrations in Soil Gas S14 (ug/l)

Hydro Geo Chem, Inc.



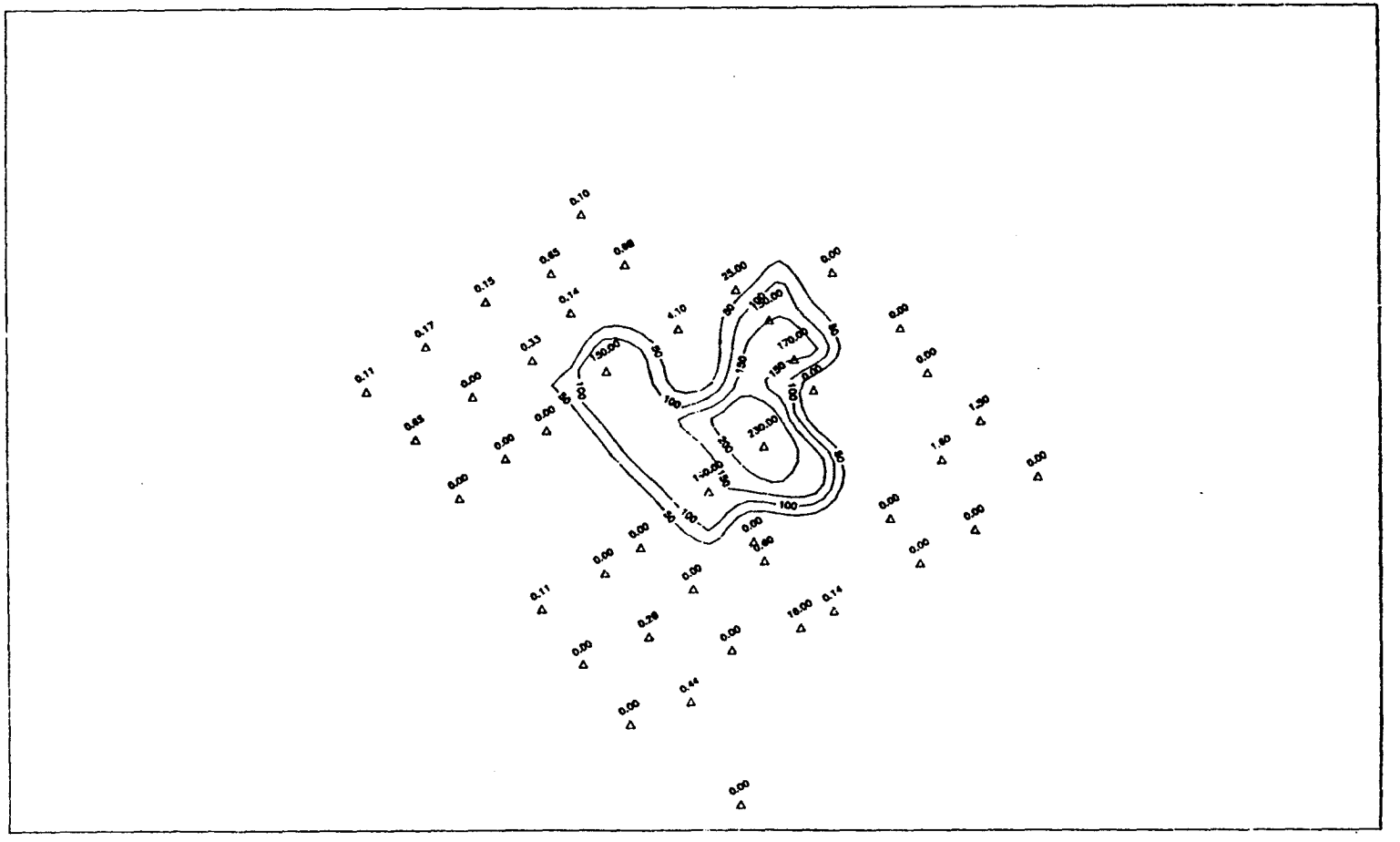
1 in = 89.05 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 8

Toluene Concentrations in Soil Gas S14 (ug/l)

Hydro Geo Chem, Inc.



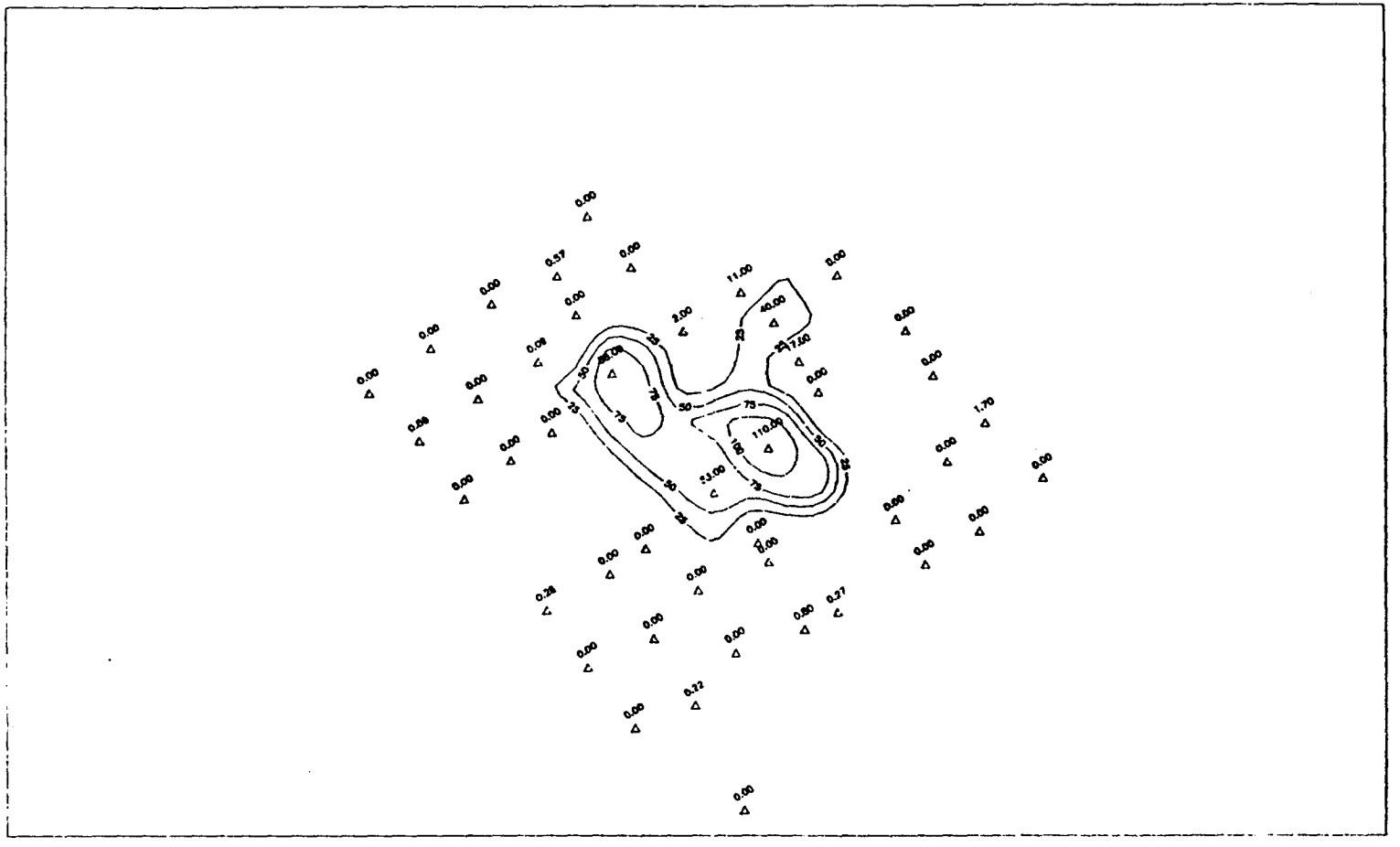
1 in = 89.05 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 9

Ethyl Benzene Concentrations in Soil Gas S14 (ug/l)

Hydro Geo Chem, Inc.



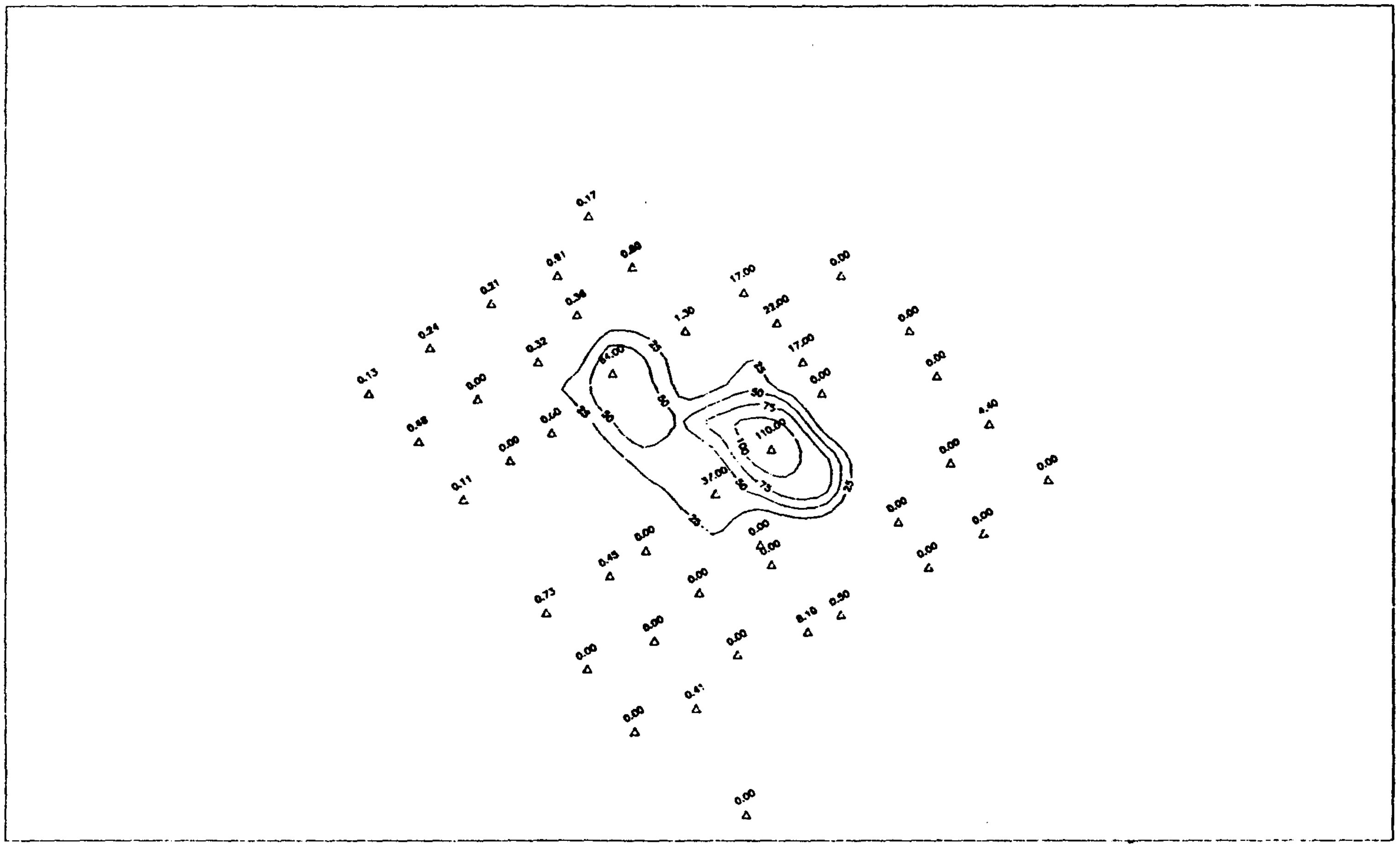
1 in = 89.05 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 10

M & P Xylenes Concentrations in Soil Gas S14 (ug/l)

Hydro Geo Chem, Inc.



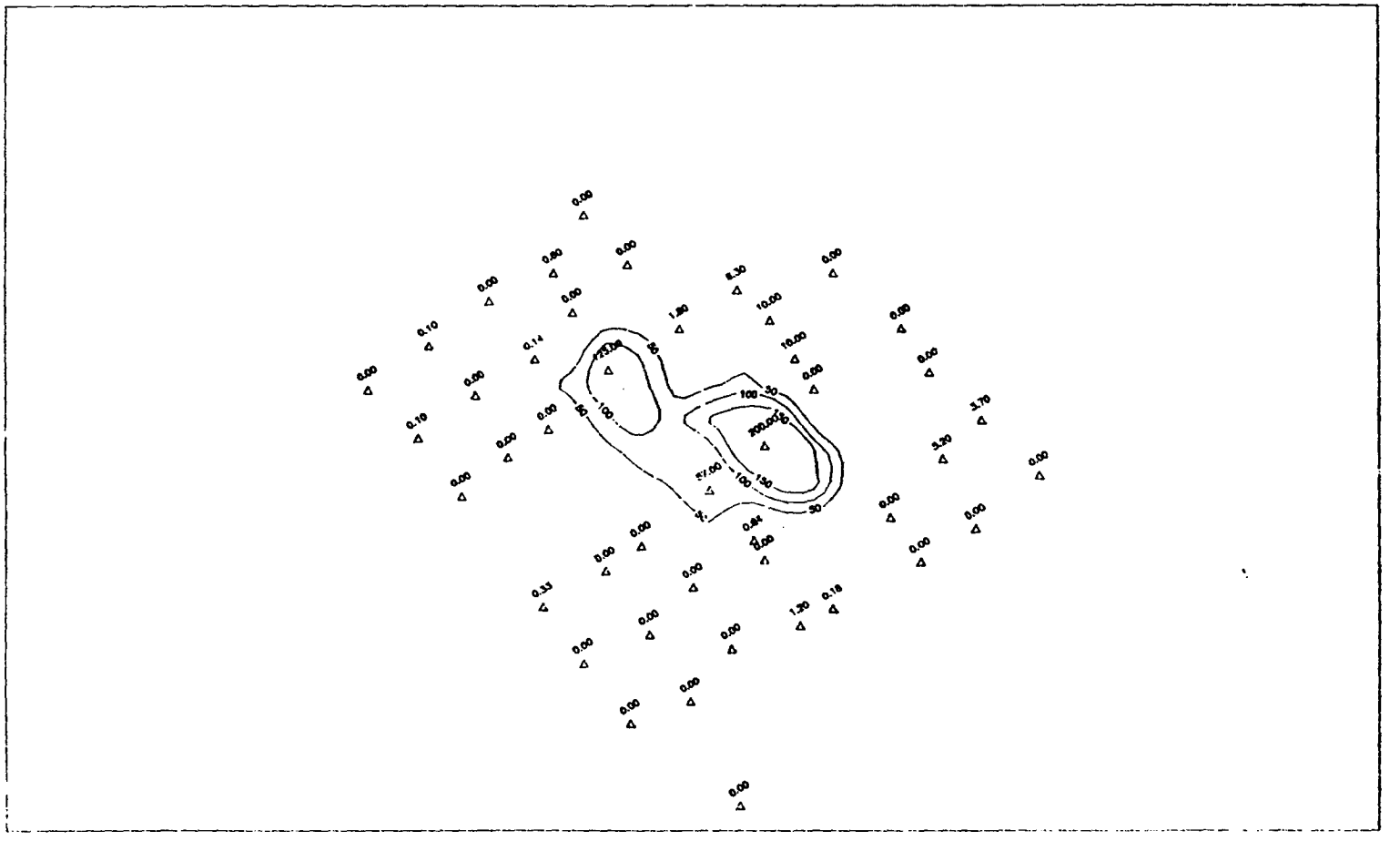
1 in = 89.05 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

FIGURE 11

O-Xylene Concentrations in Soil Gas S14 (ug/l)

Hydro Gec Chem, Inc.



1 in = 89.05 ft

Alameda Naval Air Station
Hydro Geo Chem, Inc.
August, 1991

Figure 12

N00236.000844
ALAMEDA POINT
SSIC NO. 5090.3

APPENDIX G

TO BE CONSIDERED ACTION LEVELS

DATED 27 OCTOBER 1992

APPLIED ACTION LEVELS

NOTE: Applied Action Levels (AALs) are developed according to procedures outlined in **The California Site Mitigation Decision Tree Manual** (CHDS, 1986). AALs are *not* "clean-up numbers," but are intended only for use in the risk appraisal process described in Chapter 7 of **The Decision Tree Manual**. Please refer to the last page of this list for explanatory notes.

Substance	Biological Receptor	AAL_{water} µg/L	AAL_{air} µg/m³	AAL_{soil} contact mg/kg	Test 1 Comment	Test 2 Summation/Comment	Test 3 Summation/Comment
Acenaphthene	Human	20	2			Sum over all media	Sum with **NON-CARCINOGENIC PAHs***
Acenaphthylene	Human	20	2			Sum over all media	Sum with **NON-CARCINOGENIC PAHs***
Aldicarb	Human	20	2			Sum over all media	Sum with **CHOLINESTERASE INHIBITORS**
Aldicarb Sulfone	Human	40	4			Sum over all media	Sum with **CHOLINESTERASE INHIBITORS**
Anthracene	Human	20	2	100		Sum over all media	Sum with **NON-CARCINOGENIC PAHs***
Arsenic	Human	0.01**	0.0002		Detection limit for arsenic in water is 5 µg/l** State ambient air level is 0.002 µg/m³***	Sum over all media	Sum with **CARCINOGENS**
Arsenic	Aquatic	70			Freshwater species		
Arsenic	Aquatic	20			Saltwater species		
Barium	Human	350	5			Sum over all media	Sum with **RENAL TOXINS**
Benzene	Human	0.2	0.07**		Detection limit for benzene in air is 3 µg/m³**	Sum over all media	Sum with **CARCINOGENS**
Benzene	Aquatic	1			Freshwater species		
Benzene	Aquatic	1			Saltwater species		
Benzo(a)pyrene	Human	0.09	0.009			Sum over all media	Sum with **CARCINOGENS**
Cadmium	Aquatic	0.2			Freshwater species		
Cadmium	Aquatic	5			Saltwater species		

* PAHs = Polycyclic Aromatic Hydrocarbons.

** Detection limit as reported by the Hazardous Material Laboratory, CDHS. Contact TSCP Headquarters Toxicologists for guidance when the detection limit for a substance is greater than the health-based criterion.

*** See Proposed Identification of Inorganic Arsenic as a Toxic Air Contaminant, May 1990.

N00236.000844
ALAMEDA POINT
SSIC NO. 5090.3

APPENDIX G – APPLIED ACTION LEVELS

PAGE 2

FINAL
DATA SUMMARY REPORT
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PHASES 2B AND 3

THE ABOVE IDENTIFIED PAGE IS NOT AVAILABLE.

EXTENSIVE RESEARCH WAS PERFORMED BY SOUTHWEST DIVISION TO LOCATE THIS PAGE. THIS PAGE HAS BEEN INSERTED AS A PLACEHOLDER AND WILL BE REPLACED SHOULD THE MISSING ITEM BE LOCATED.

QUESTIONS MAY BE DIRECTED TO:

DIANE C. SILVA
RECORDS MANAGEMENT SPECIALIST
SOUTHWEST
NAVAL FACILITIES ENGINEERING COMMAND
1220 PACIFIC HIGHWAY
SAN DIEGO, CA 92132

TELEPHONE: (619) 532-3676

Substance	Biological Receptor	AAL_{water} µg/L	AAL_{air} µg/m³	AAL_{soil} contact mg/kg	Test 1 Comment	Test 2 Summation/Comment	Test 3 Summation/Comment
n-Hexane	Human	100	200			Sum over all media	Sum with **NEUROTOXINS***
Lead	Aquatic	10			Freshwater species		
Lead	Aquatic	4			Saltwater species		
Lindane	Human	0.2	0.02			Sum over all media	Sum with **CARCINOGENS**
Malathion	Human	800	80			Sum over all media	Sum with **CHOLINESTERASE INHIBITORS**
Mercury (inorganic)	Human	2	0.07			Sum over all media	Sum with **RENAL TOXINS**
Methyl Ethyl Ketone (2-Butanone)	Human	2,000	300			Sum over all media	Sum with **DEVELOPMENTAL TOXINS**
Methyl n-butyl Ketone	Human	30	4			Sum over all media	Sum with NEUROTOXINS
Naphthalene	Human	20	2			Sum over all media	Causes serum chemistry aberrations; Sum with **NON-CARCINOGENIC PAHs****
Naphthalene	Aquatic	600			Freshwater species		
Naphthalene	Aquatic	700			Saltwater species		
Nickel	Human	400	0.1		AAL_{air} not for nickel carbonyl or nickel subsulfide	Test 2 not applicable	Test 3 applicable to air only; Sum with **PULMONARY TOXINS**
Nickel	Aquatic	1			Freshwater species		
Nickel	Aquatic	8			Saltwater species		
Paraquat	Human	200	4			Sum over all media	Sum with **PULMONARY TOXINS**
Parathion, Ethyl	Human	40	0.3			Sum over all media	Sum with **CHOLINESTERASE INHIBITORS**
Parathoin, Methyl	Human	66	7			Sum overall media	Sum with **CHOLINESTERASE INHIBITORS**
Pentachlorophenol	Human	2	0.2			Sum over all media	Sum with **CARCINOGENS**
Pentachlorophenol	Aquatic	5			Freshwater species		
Pentachlorophenol	Aquatic	10			Saltwater species		
Phenanthrene	Human	20	2	100		Sum over all media	Sum with **NON-CARCINOGENIC PAHs****
Phenol	Human	5,000	400			Sum over all media	Sum with **RENAL TOXINS**
Pyrene	Human	20	2			Sum over all media	Sum with **NON-CARCINOGENIC PAHs****

* AAL for n-hexane may need to be reduced when methyl ethyl ketone (MEK) is also present. (MEK may potentiate the neurotoxicity of n-hexane). Contact TSCP Headquarters Toxicologists for guidance.

** PAHs = Polycyclic Aromatic Hydrocarbons.

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APPENDIX G – APPLIED ACTION LEVELS

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FINAL
DATA SUMMARY REPORT
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
PHASES 2B AND 3

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APPLIED ACTION LEVELS AND RISK APPRAISAL MECHANISM

The **California Site Mitigation Decision Manual** (CDHS, 1986) describes a standardized approach to setting waste site mitigation criteria. One of the major elements in the risk assessment process is specifying how exposure criteria, known as Applied Action Levels (AALs) will be developed. The AALs listed in this table represent the established exposure criteria for the specified biological receptors (human or aquatic species) for each substance of each medium (water, air, or soil). With this information, the Risk Appraisal Mechanism (described in Chapter 7 of **The Decision Tree Manual**) is ready to be used to answer the question: "Are the sensitive biological receptors of concern at significant risk?"

The evaluation of risk associated with exposure to contaminants on a hazardous waste site can be accomplished by applying a series of three risk appraisal tests. If any of the tests fail, it is concluded that a sensitive biological receptor of concern is considered at significant risk for an adverse impact. This should initiate a risk management process leading to a decision on whether a remedial action is warranted.

Test 1: The first test in the risk appraisal process evaluates single chemical/single medium exposure. It determines whether a biological receptor receives an excessive exposure to any toxic substance via contact with a contaminated medium (e.g., water, air, soil, or biota). The test compares the level of exposure to a chemical in a medium, abbreviated as C_{medium}, with the AAL criterion for that chemical in the same medium, AAL_{medium}, i.e.,

$$\frac{C_{medium}}{AAL_{medium}}$$

If the resulting value is greater than one, then the test fails, the biological receptor is considered to be at risk of an adverse impact, and a risk management process should be initiated.

Test 2: The second test in the risk appraisal process evaluates single chemical/multiple media exposure. It determines whether a biological receptor receives an excessive exposure to any toxic substance via contact with all pertinent media exposure. The exposures via various media are assumed to be cumulative unless an exception is noted in the Test 2 Comment. Test 2 is:

$$\frac{C_{water}}{AAL_{water}} + \frac{C_{air}}{AAL_{air}} + \frac{C_{soil}}{AAL_{soil\ contact}}$$

If the sum above exceeds unity, then the test fails, the receptor is considered to be at risk of an adverse impact, and a risk management process should be initiated.

Test 3: The third test in the risk appraisal process evaluates multiple chemical/multiple media exposure. It determines whether a biological receptor receives an excessive exposure in all pertinent media to an aggregate of substances which produce the ***same toxic manifestation*** upon which the AALs for these substances are based. Test 3 in this table assumes additivity of such exposures, and appropriate summation is indicated in the Test 3 Comment. This test can be expressed as:

$$\frac{C_{water,1}}{AAL_{water,1}} + \frac{C_{air,1}}{AAL_{air,1}} + \frac{C_{soil,1}}{AAL_{soil\ contact,1}} +$$

$$\frac{C_{water,2}}{AAL_{water,2}} + \frac{C_{air,2}}{AAL_{air,2}} + \frac{C_{soil,2}}{AAL_{soil\ contact,2}} + \ldots + \frac{C_{medium,n}}{AAL_{medium,n}}$$

Test 3 is undertaken for each group of chemicals which produce the same toxic effect. If the sum for any group exceeds unity, then the test fails, the biological receptor is considered to be at risk of an adverse effect, and a risk management process should be initiated.

The risk appraisal mechanism repeats Test 1 through Test 3 for all toxic substances and the identified sensitive biological receptor(s) at a waste site. When any cumulative ratio of concentrations over AALs is greater than 1, then the receptor of concern is considered at risk of an adverse effect, and a risk management process should be initiated.

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