Shell Oil Company

EAST BAY MARKETING DISTRICT

P.O. Box 4023
Concord, CA 94524
(415) 676-1414

July 10, 1990

Mr. Larry Seto
County of Alameda
Department of Environmental Health
Hazardous Materials Division
80 Swan Way, Room 200
Oakland, California 94621

SUBJECT: FORMER SHELL SERVICE STATION
15275 WASHINGTON AVENUE
SAN LEANDRO, CALIFORNIA

Dear Mr. Seto:

Enclosed is a of copy of the GeoStrategies Inc. Aquifer Test Report dated June 29, 1990, presenting the results of the slub and pump test conducted at the subject location.

If you should have any questions or comments regarding this project please do not hesitate to call me at (415) 676-1414 ext. 127.

Very truly yours,

Diane M. Lundquist
District Environmental Engineer

DML/jw

enclosure

cc: Mr. Tom Callaghan, Regional Water Quality Control Board
Mr. John Werfal, Gettler-Ryan Inc.

GeoStrategies Inc.

AQUIFER TEST REPORT

Former Shell Service Station
15275 Washington Avenue
San Leandro, California

Report No. 7615-8

June 29, 1990

GeoStrategies Inc.
2140 WEST WINTON AVENUE
HAYWARD, CALIFORNIA 94545
(415) 352-4800

June 29, 1990

Gettler-Ryan Inc.
2150 West Winton Avenue
Hayward, California 94545

Attn: Mr. John Werfal

Re: AQUIFER TEST REPORT
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

Gentlemen:

This Aquifer Test Report has been prepared for the above referenced site.

If you have any questions, please call.

GeoStrategies Inc. by,

David A. Ferreira
Geologist

Jeffrey L. Peterson
Senior Hydrogeologist
R.E.A. 1021

REGISTERED GEOLOGIST
CHRISTOPHER M. PALMER
№ 1262
CERTIFIED
ENGINEERING
GEOLOGIST
STATE OF CALIFORNIA

Christopher M. Palmer
C.E.G. 1262, R.E.A. 285

DAF/JLP/kjj

Report No. 7615-8

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EXECUTIVE SUMMARY

Site-related activities for the former Shell Service Station located at 15275 Washington Avenue in San Leandro, California which occurred from March to June, 1990 are summarized below:

- Aquifer tests were performed at the site to estimate hydraulic properties of the shallow aquifer. These tests were performed to better understand chemical migration characteristics in the shallow aquifer.

- A variable discharge pumping test (step-test) was conducted on Well SR-1 on March 27, 1990. The step-test was terminated after 52 minutes of pumping at a maximum drawdown of approximately 95 percent of the available water column. Additional steps were not performed due to the low yield of the well.

- Slug tests were performed on Wells S-1, S-3, S-5, S-7, S-9, S-10, S-13, S-14, and S-16 on March 28 and 29, 1990. Calculated transmissivity (T) values ranged from 408 to 11000 gallons per day per foot (gpd/ft) and hydraulic conductivities (K) ranged from 7.3 to 100 feet per day (ft/day). The wide range of transmissivity and hydraulic conductivity values is suspected to be caused by the heterogeneity of the subsurface as well as inherent analysis problems associated with slug tests in clayey aquifers.

- The monitoring well network was sampled on April 18, 1990 after completion of aquifer testing. Water-level data collected prior to sampling were plotted and contoured and show an approximate hydraulic gradient of 0.004 towards the south-southwest.

- Ground-water samples were collected and analyzed for Total Petroleum Hydrocarbons calculated as Gasoline (TPH-Gasoline) and Benzene, Toluene, Ethylbenzene and Xylenes (BTEX). TPH-Gasoline concentrations ranged from None Detected (ND) in Wells S-1, S-6 through S-8, S-10 through S-12, and S-15 through S-17, to 58 parts per million (ppm) in Well S-3. Benzene concentrations ranged from ND in Wells S-1, S-6 through S-8, S-10 through S-12, S-15, and S-17. Benzene concentrations exceeded the current Regional Water Quality Control Board (RWQCB) Maximum Contaminant Level (MCL) in Wells S-3, S-5, S-9, S-13, S-14, S-16, and SR-1.

- GSI recommends that a Remedial Action Plan (RAP) be prepared which will evaluate whether passive remediation via natural degradation would be effective at the site. GSI plans to use the Shell Oil Company "Simulated Benzene Transport Model" to evaluate the feasibility of the model to track natural attenuation of hydrocarbons at the site. GSI also recommend installation of one additional monitoring well to the northwest of Well S-9 to further delineate the hydrocarbon plume.

INTRODUCTION

This report presents the methods, results, and data interpretations for the aquifer tests conducted at the former Shell Service Station located at 15275 Washington Avenue in San Leandro, California (Plate 1), and the ground-water sampling which took place following the tests. The aquifer tests were performed to 1) estimate hydraulic properties of the shallow aquifer, 2) evaluate potential migration pathways for hydrocarbons, 3) tentatively identify wells in hydraulic communication with Well SR-1, and 4) use the results of the aquifer test to selected the appropriate remediation at the site.

Two aquifer testing methods were employed at the site. A pump test was performed on Well SR-1 on March 27, 1990. A review of well sampling purge data in conjunction with subsurface geologic data indicated low flow rates less than 2 gallons per minute (gpm) in most site monitoring wells. After pumping Well SR-1 for approximately 52 minutes, near dewatering occurred. Due to brevity of the step-test, the data collected was not considered to be useful for analysis of aquifer characteristics. Because of the apparent low permeability conditions beneath the site. Slug tests were performed on selected monitoring wells to estimate T-values in the shallow aquifer. Slug tests were performed on March 28 and 29, 1990 in Wells S-1, S-3, S-5, S-7, S-9, S-10, S-13, S-14, and S-16.

HYDROGEOLOGY

The site is located on the bay fringe approximately 14 miles east/ southeast of San Francisco. The surface soils consist of Holocene fine-grained alluvium generally consisting of well-bedded, unconsolidated plastic moderately to poorly sorted carbonaceous silt and clay (Helley, Lajoie, Spangle, and Blair, 1979).

Lithologic boring log data from previous site investigations indicate that the site is underlain primarily by clays and silts which contain thin interbeds of sand and clayey sand. Depth to first encountered groundwater was difficult to ascertain due to the fine grained nature of the sediments. [illegible] data indicate that groundwater occurs at depths of approximately 7.37 to 8.45 feet below ground surface. Visual observations of borehole sidewalls during the installation of recovery well SR-1 using a bucket auger revealed slow water emission from thin sandy interbeds at a depth of approximately 8-10 feet. Based on the lithologic data available, the top of the aquifer appears to correspond with fine-grained silty sand or clayey sand units that occur between approximately 7 and 10 feet below existing grade. Exploratory boring log and well purge data suggest a low permeability, unconfined clayey aquifer beneath the site. The bottom depth of the aquifer unit is not known. For the purpose of our tests, we assumed an aquifer thickness equivalent to the length of the installed well screens below static groundwater. Exploratory boring logs for the site are presented in Appendix A.

As shown on Plate 3, ground-water flow in the shallow aquifer is to the south-southwest with an approximate hydraulic gradient of 0.004. The gradient is suspected to be influenced by the interbeds of sand and clayey sand which are probably distributed at different elevations throughout the subsurface. The hydraulic interconnection between these relatively discreet interbeds is not clearly understood.

PUMP TEST

Procedures

A step-test was performed at the site on March 27, 1990. Due to the low-yield nature of the aquifer, pumping well SR-1 nearly dewatered after 52 minutes of pumping at 2 gpm. Due to the low yield of Well SR-1, slug tests were performed to estimate hydraulic properties of the shallow aquifer.

SLUG TESTING

Procedures

Slug tests were performed in Wells S-1, S-3, S-5, S-7, S-9, S-10, S-13, S-14, and S-16. Waterfalls were measured and recorded immediately prior to slug-in testing in each well. A pressure transducer connected to a Hermit Datalogger Model SE2000 (HERMIT) was then placed in the well approximately 2 feet above the bottom of the well casing and secured at the wellhead. The pressure transducer was referenced to zero immediately prior to introducing the slug into the well. The slug was dropped into the well creating an instantaneous rise in water column. The fall of the water column to static level was continuously measured by the transducer and recorded by the HERMIT. Upon equilibrium, a new test was setup and the transducer reading was referenced to zero again. The slug-out test was started by removing the slug from a well creating an instantaneous fall in the water column. Water-level rise to static level was continuously measured by the transducer and recorded by the HERMIT.

Slug test equipment was decontaminated between tests using an Alconox wash and a clean water rinse.

Data Analysis

Field data consisted of observed and recorded changes in water level over the duration of slug-in and slug-out tests. These data were plotted on arithmetic graph paper in the field using the Ferris and Knowles method (Ferris and Knowles, 1954) for analyzing slug test data. This analysis method enabled estimations of T-values from field data plots using a best-fit straight line graphic approach. Plotting data in the field also permitted tracking the progress of a test and correlation of calculated T-values to lithologic descriptions in exploratory boring logs.

A computer program which utilizes curve matching techniques was also used to analyze the slug test data. The Graphical Well Analysis Package (GWAP) software developed by Groundwater Graphics (August, 1988) uses series of type curves developed after Cooper, Bredehoeft, and Papadopulos (1967) to obtain a "best-fit" curve match to calculate values for transmissivity (T), storativity (S), and hydraulic conductivity (K).

Slug Test Results

Due to the low permeability of the aquifer material, the data plotted using Ferris and Knowles method showed little to no linearity and the transmissivity values calculated were very low. The lack of linearity is suspected to be due to the heterogeneity of the aquifer and associated low permeability, and the difficulty to properly design and develop very low yield wells in clayey aquifer environments. Therefore it our opinion that this method of analysis given the site geology and limitations for well design, may not be applicable to evaluate transmissivity. T-values ranged from 20.8 to 400 gallons per day per foot (gpd/ft). These data are presented in Table 1. The field plots and calculated T-values for this method are presented in Appendix B.

Analysis of the slug test data (slug-in and slug-out) using the GWAP [redacted] derived T-values ranging from [redacted]08 to 11000 gpd/ft. K-values ranged from 7.27 to 99.9 feet per day (ft/day). Calculated S-values ranged from 0.000001 to 0.1. These data have been tabulated and are presented in Table 2. Computer generated plots for the slug-in and slug-out tests are presented in Appendix C.

Calculated values of T and K using the slug test data are very low but consistent with what would be expected considering the amount of clayey material encountered in the subsurface. The wide range in values are most likely attributed to the heterogeneity of the clay (especially the complexity of the interbedded sandy horizons) in the subsurface as well as inherent well construction difficulties in low-permeable, fine grained aquifers where classic well design procedures fail.

GROUND-WATER QUALITY DATA

Groundwater samples were collected from the monitoring network by Gettler-Ryan Inc. (G-R) on April 18, 1990, after the completion of all aquifer testing. Samples were analyzed for Total Petroleum Hydrocarbons calculated as Gasoline (TPH-Gasoline) using EPA Method 8015 (modified) and Benzene, Toluene, Ethylbenzene and Xylenes (BTEX) using EPA Method 8020. All analyses were performed by International Technology (IT) Corporation, a State-certified analytical laboratory located in San Jose, California.

Ground-water samples collected from Wells S-1, S-6, S-7, S-8, S-10, S-11, S-12, S-15 and S-17 were reported as ND for TPH-Gasoline and benzene, and Well S-16 was reported as ND for TPH-Gasoline. TPH-Gasoline concentrations were reported ranging from 0.68 ppm (S-9) to 58 ppm (S-3). Benzene concentrations were reported ranging from 0.0010 ppm (S-16) to 3.8 ppm (S-3). A total of seven wells contain benzene concentrations above the RWQCB MCL. The chemical analytical results for TPH-Gasoline and BTEX are summarized in Table 3, along with the potentiometric data for this sampling.

The areal distribution of hydrocarbons in the shallow groundwater beneath the site has been mapped (Plates 4 and 5). As indicated on Plates 4 and 5, the dissolved hydrocarbon contaminant plume appears to be adequately delineated except to the west of Well S-9. An additional well northwest of Well S-9 is proposed to further delineate the hydrocarbon plume. Plume migration appears to be following the ground-water flow direction. The hydrocarbon plume has essentially maintained the same position during the last 4 monitoring and sampling quarters (1 year) and may be attenuating naturally. A copy of the Gettler-Ryan Inc. (G-R) Groundwater Sampling Report for the April, 1990 sampling is presented in Appendix D. A copy of the Field Methods and Procedures is presented in Appendix E.

DISCUSSION

Chemical analytical data indicate that the hydrocarbon plume is located near the suspected source area and appears to be following ground-water flow direction. Aquifer test data indicate low to high T-values in all wells tested (Table 2). The fairly wide range in T-values are probably influenced by the amount of coarse sediments which are distributed through the subsurface and may not be laterally continuous. These data indicate very low T-values in Wells S-3, S-5 and SR-1 and high T-values in Wells S-1, S-7, S-13, S-14 and S-16.

CONCLUSION

Near dewatering of the aquifer occurred during the step-test at a pumping rate of 2 gpm. Low T- and K-values calculated from the step-test and the slug tests for the observation wells suggest very slow transport of contaminants in the ground-water beneath the site. Exploratory boring log data further support aquifer test conclusions by the lack of appreciable transmissive sediments in the shallow aquifer zone. Furthermore, it is not certain if hydraulic interconnection between the discreet sandy interbeds within the clayey aquifer in the shallow aquifer exists.

Slug test data and step-test data indicate low flow rates in the vicinity of SR-1. Plume configuration appears to be consistent with the potentiometric data. The hydrocarbon plume has essentially maintained the same position during the past year and appears to be attenuating naturally.

Based on aquifer test data and conjunctive geologic/hydrogeologic data for this site, GSI recommends that a Remedial Action Plan (RAP) be prepared to evaluate whether passive remediation via natural degradation would be an effective method of remediation. The RAP will include historical data; previous investigations, potentiometric data and chemical data trends. Additionally, results of the aquifer tests will be used to simulate contaminant migration and natural degradation by soil bacteria using the "Simulated Benzene Transport Model" developed by Shell Oil Company described in Appendix F. GSI also recommends the installation of one additional ground-water monitoring well to the northwest of Well S-9.

References Cited

Cooper, H.H., Jr., Bredehoeft, J.D., and I.S. Papadopulos., 1967. Response of a finite diameter well to an instantaneous charge of water. Water Resources Res., 3, pp.263-269.

Cooper, H.S., Jr., and Jacob, C.E., 1946. A generalized method for evaluating formation constants and summarizing well-field history. Trans. American Geophysical Union, 27(4).

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Ferris, J.G. and Knowles, D.B, 1954. The slug test for estimating transmissibility. USGS Open file report, No. 28.

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Dansby, D.A. and Price, C.A., 1988. Graphical Well Analysis Package (GWAP), Groundwater Graphics, version 2.03.

Helley, E.J., LaJoie, K.R., Spangle, W.E., and Blair, M.L., 1979, Flatland deposits of the San Francisco Bay Region, California - their geology and engineering properties, and their importance to comprehensive planning, Geological Survey Professional Paper 943.

Papadopulos., I.S., Bredehoeft, J.D., and Cooper., H.H., 1973. On the analysis of 'slug test' data. Water Resources Res., 9, pp. 1087-1089.

TABLE 1

Straight Line Method

Well	T (Slug-in)	T (Slug-out)
S-1	136.8	143.9
S-3	48.5	47.3
S-5	83	66
S-7	82.3	83.3
S-9	60.3	50.2
S-10	39.6	35.7
S-13	194.5	281.5
S-14	140	126.5
S-16	208.4	262.6

TABLE 2

GWAP ANALYSIS OF SLUG TEST DATA

WELL NO.	WELL DIA. (INCHES)	SLUG VOL. (GALL)	DATE	TEST	T (GPD/FT)	K (FT/D)	S
S-1	3	0.458	3/29/90	Slug-in	3790	40.9	0.00001
				Slug-out	3720	40.1	0.100
S-3	3	0.458	3/28/90	Slug-in	408	7.27	0.100
				Slug-out	417	7.43	0.100
S-5	4	0.82	3/28/90	Slug-in	1210	15.4	0.001
				Slug-out	592	7.54	0.100
S-7	3	0.458	3/28/90	Slug-in	4900	50.4	0.001
				Slug-out	4470	50.0	0.001
S-9	3	0.458	3/28/90	Slug-in	1450	18.4	0.001
				Slug-out	1260	16.0	0.100
S-10	3	0.458	3/29/90	Slug-in	1070	13.6	0.0001
				Slug-out	742	9.45	0.100
S-13	3	0.458	3/29/90	Slug-in	4270	36.9	0.010
				Slug-out	11000	94.6	0.001
S-14	3	0.458	3/29/90	Slug-in	2630	20.7	0.010
				Slug-out	7590	59.8	0.001
S-16	3	0.458	3/28/90	Slug-in	9340	99.9	0.000001
				Slug-out	7420	79.4	0.010

TABLE 3

GROUND-WATER ANALYSIS DATA

WELL NO	SAMPLE DATE	ANALYSIS DATE	TPH (PPM)	BENZENE (PPM)	TOLUENE (PPM)	ETHYLBENZENE (PPM)	XYLENES (PPM)	WELL ELEV (FT)	STATIC WATER ELEV (FT)	PRODUCT THICKNESS (FT)	DEPTH TO WATER (FT)
S-1	18-Apr-90	19-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	21.55	13.64	----	7.91
S-3	18-Apr-90	23-Apr-90	58.	3.8	1.4	2.4	12.	21.14	13.40	sheen	7.74
S-5	18-Apr-90	21-Apr-90	5.2	1.1	0.04	0.30	0.46	21.41	13.09	----	8.32
S-6	18-Apr-90	19-Apr-90	<0.050	<0.0005	0.0006	<0.0005	0.001	22.02	13.59	----	8.43
S-7	18-Apr-90	19-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	21.47	13.41	----	8.06
S-8	18-Apr-90	19-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	20.72	13.13	----	7.59
S-9	18-Apr-90	19-Apr-90	0.68	0.15	0.0017	0.050	0.037	20.96	13.31	----	7.65
S-10	18-Apr-90	19-Apr-90	<0.050	<0.0005	0.0009	<0.0005	0.002	20.86	13.15	----	7.71
S-11	18-Apr-90	19-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	21.26	12.84	----	8.42
S-12	18-Apr-90	20-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	21.05	13.00	----	8.05

CURRENT REGIONAL WATER QUALITY CONTROL BOARD MAXIMUM CONTAMINANT LEVELS
Benzene 0.001 ppm Xylenes 1.750 ppm Ethylbenzene 0.68 ppm

CURRENT DHS ACTION LEVELS
Toluene 0.100 ppm

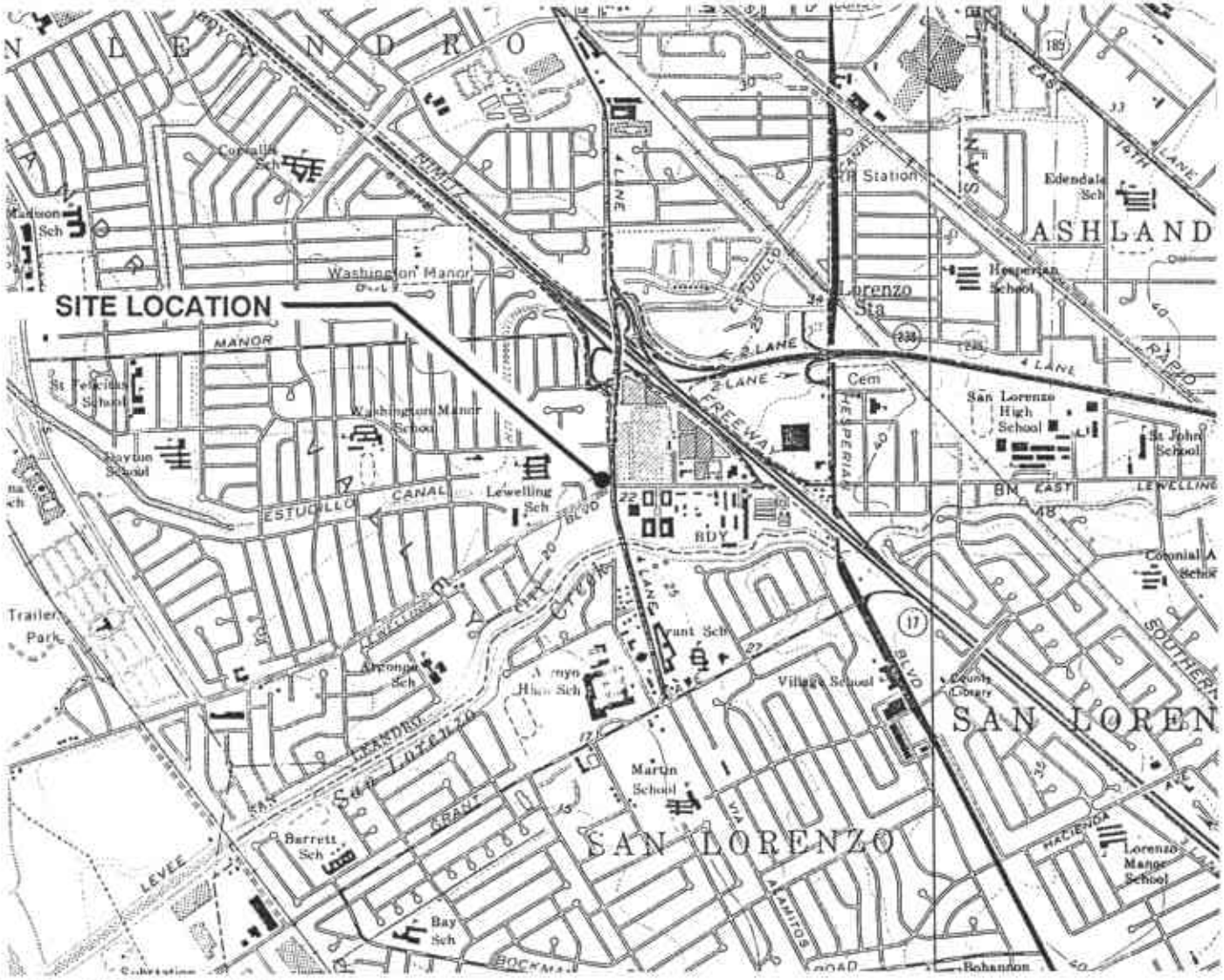
TPH = Total Petroleum Hydrocarbons as Gasoline
PPM = Parts Per Million SD = Duplicate Sample SF = Field Blank SR = Recovery Well TB = Trip Blank

Note: 1. All data shown as <x are reported as ND (none detected).
2. Static Water Elevations referenced to mean sea level (MSL). Elevations are corrected for free product using a correction factor of 0.8.
3. DHS Action Levels and MCLs are subject to change pending State review.

TABLE 3

GROUND-WATER ANALYSIS DATA

WELL NO	SAMPLE DATE	ANALYSIS DATE	TPH (PPM)	BENZENE (PPM)	TOLUENE (PPM)	ETHYLBENZENE (PPM)	XYLENES (PPM)	WELL ELEV (FT)	STATIC WATER ELEV (FT)	PRODUCT THICKNESS (FT)	DEPTH TO WATER (FT)
S-13	18-Apr-90	20-Apr-90	0.085	0.0087	<0.0005	<0.0005	<0.001	20.57	12.84	----	7.73
S-14	18-Apr-90	20-Apr-90	1.2	0.20	0.11	0.030	0.096	20.44	13.07	----	7.37
S-15	18-Apr-90	20-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	22.22	13.77	----	8.45
S-16	18-Apr-90	20-Apr-90	<0.050	0.0010	<0.0005	<0.0005	<0.001	21.82	13.63	----	8.19
S-17	18-Apr-90	20-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	20.95	13.00	----	7.95
SR-1	19-Apr-90	20-Apr-90	1.0	0.13	0.047	0.047	0.22	21.45	----	----	8.17
SD-3	18-Apr-90	24-Apr-90	75.	3.7	1.4	2.5	13.	----	----	----	----
SF-7	18-Apr-90	20-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	----	----	----	----
TB	18-Apr-90	19-Apr-90	<0.050	<0.0005	<0.0005	<0.0005	<0.001	----	----	----	----



N

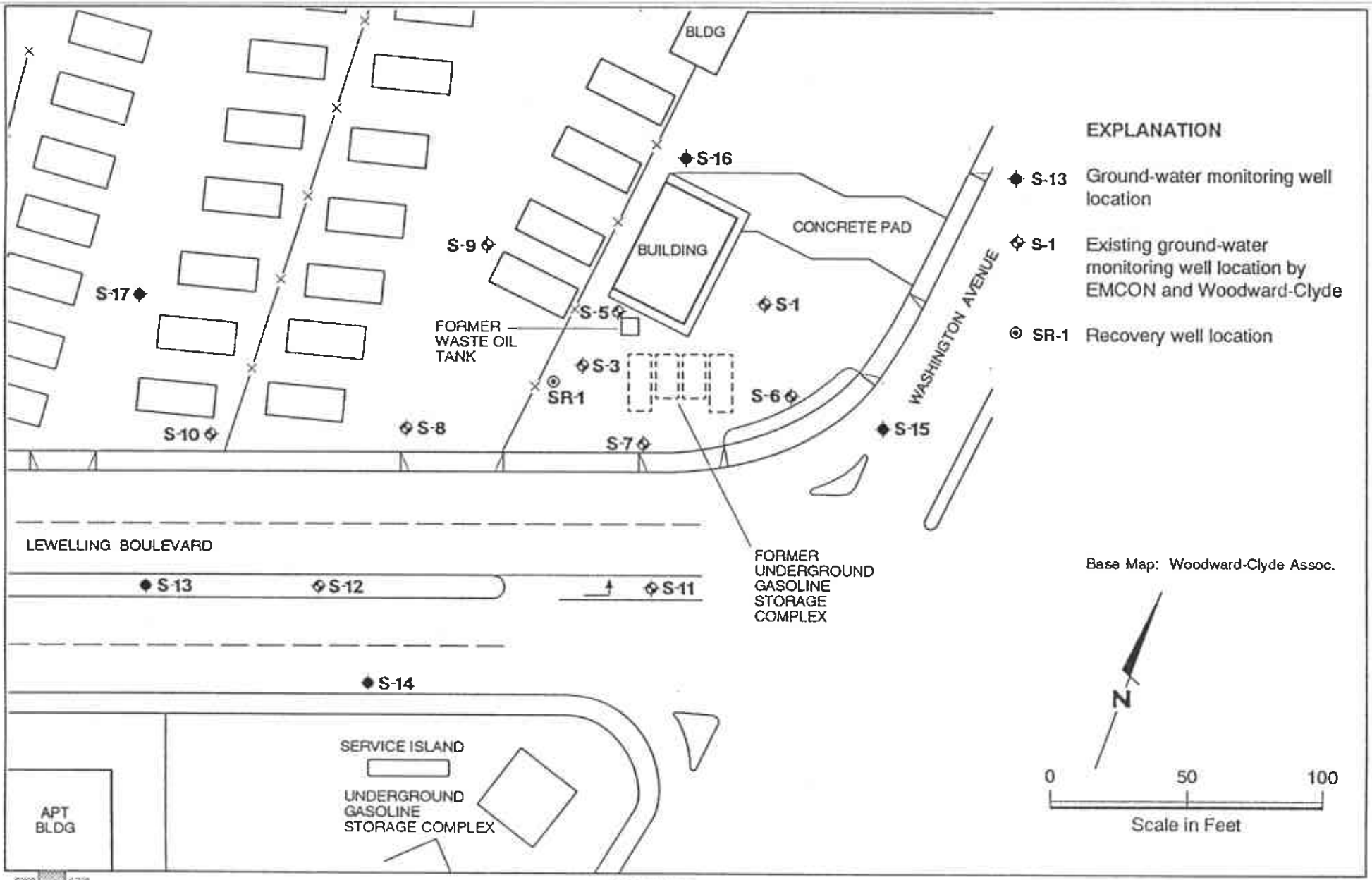
Approximate Scale : 1" = 2000'

GeoStrategies Inc.

Vicinity Map
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

PLATE
1

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		11/89		

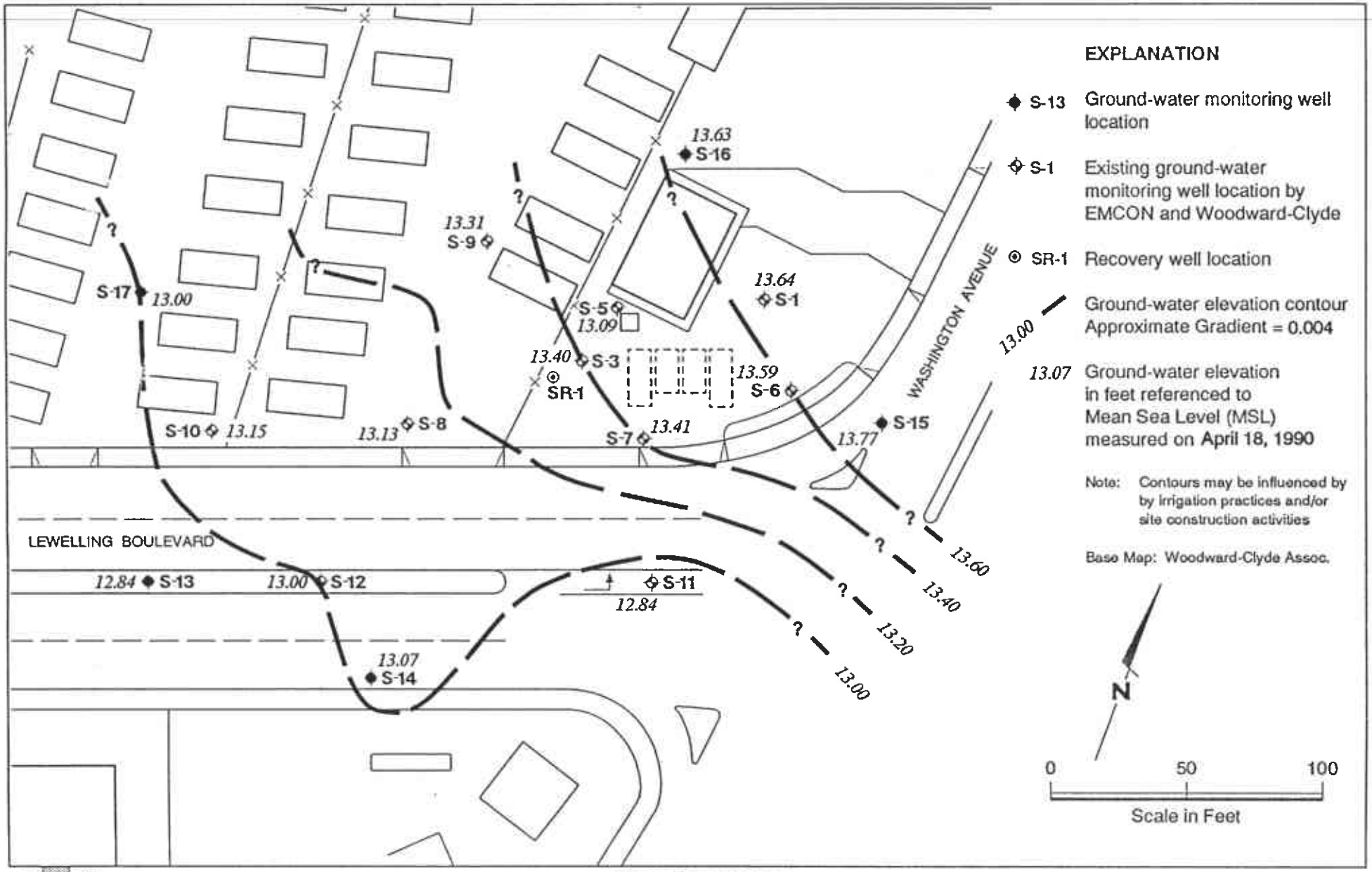


GeoStrategies Inc.

Site Plan
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

PLATE
2

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CMP CEG 1262	5/90		

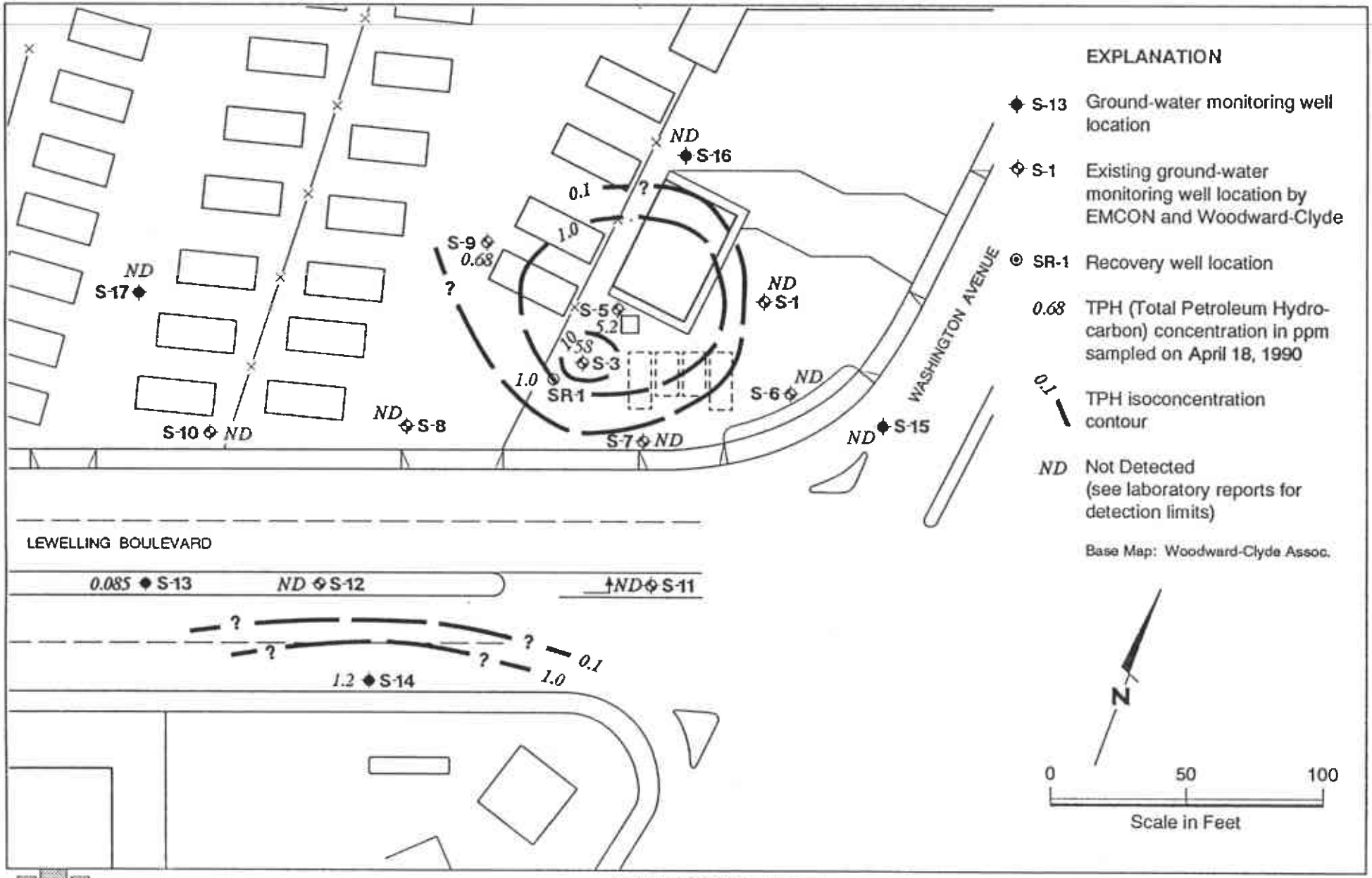


GeoStrategies Inc.

Potentiometric Map
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

PLATE **3**

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP CEG 1262	5/90		

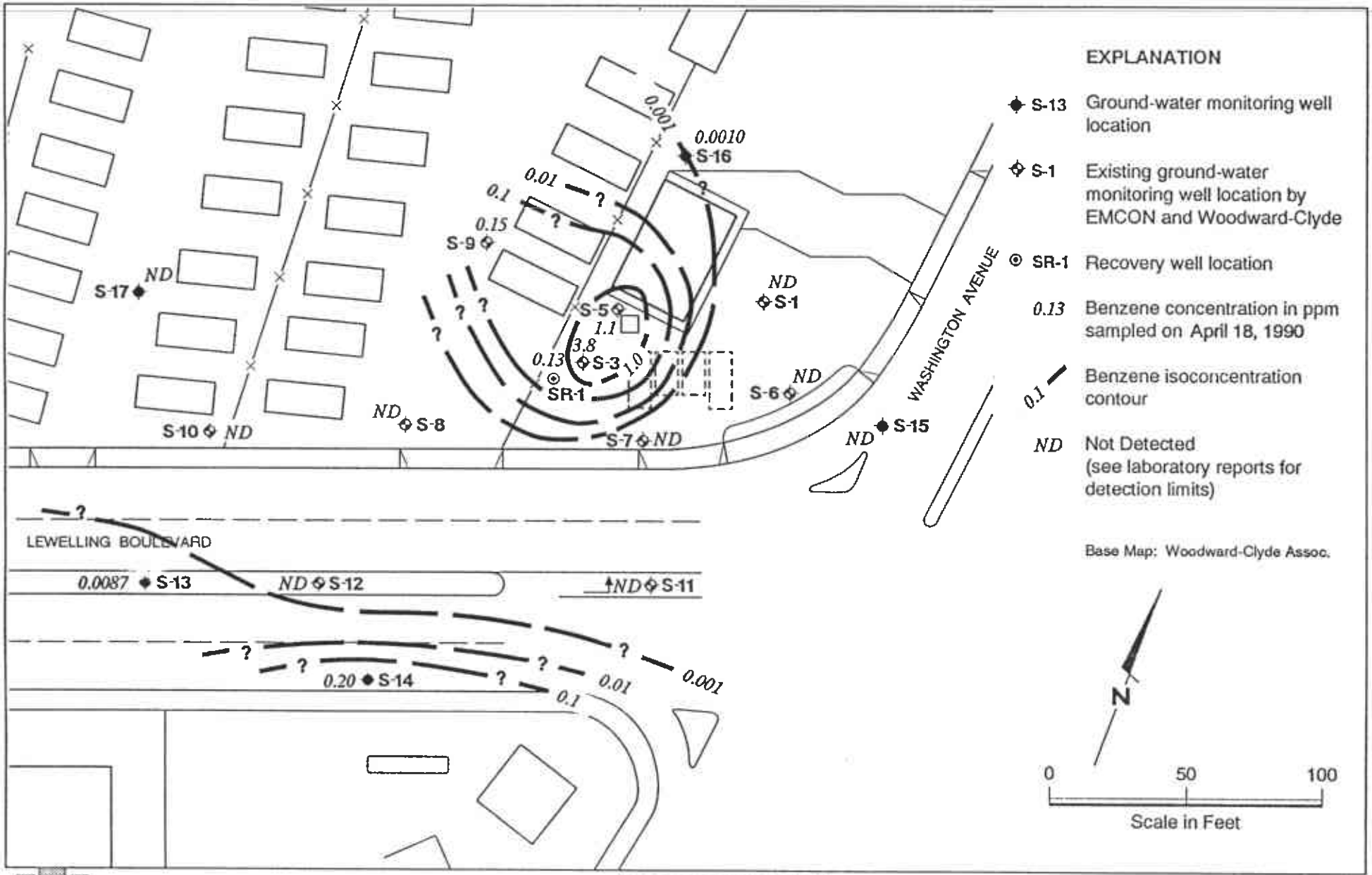


GeoStrategies Inc.

TPH Isoconcentration Map
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

PLATE
4

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP REG 1262	5/90		



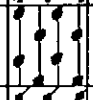
GeoStrategies Inc.

Benzene Isoconcentration Map
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

PLATE
5

JOB NUMBER	REVIEWED BY HG/CEG	DATE	REVISED DATE	REVISED DATE
7615	Chmp CEG 1262	5/90		

APPENDIX A
EXPLORATORY BORING LOGS
WELL CONSTRUCTION DETAILS

MAJOR DIVISIONS					TYPICAL NAMES
COARSE-GRAINED SOILS MORE THAN HALF IS COARSER THAN NO. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
			GP		POORLY GRADED GRAVELS WITH OR WITHOUT SAND, LITTLE OR NO FINES
		GRAVELS WITH OVER 15% FINES	GM		SILTY GRAVELS, SILTY GRAVELS WITH SAND
			GC		CLAYEY GRAVELS, CLAYEY GRAVELS WITH SAND
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
			SP		POORLY GRADED SANDS WITH OR WITHOUT GRAVEL, LITTLE OR NO FINES
		SANDS WITH OVER 15% FINES	SM		SILTY SANDS WITH OR WITHOUT GRAVEL
			SC		CLAYEY SANDS WITH OR WITHOUT GRAVEL
FINE-GRAINED SOILS MORE THAN HALF IS FINER THAN NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTS WITH SANDS AND GRAVELS
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY CLAYS WITH SANDS AND GRAVELS, LEAN CLAYS
			OL		ORGANIC SILTS OR CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS, FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC SILTS OR CLAYS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT		PEAT AND OTHER HIGHLY ORGANIC SOILS

Perm	- Permeability
Consol	- Consolidation
LL	- Liquid Limit (%)
PI	- Plastic Index (%)
G_s	- Specific Gravity
MA	- Particle Size Analysis
2.5 YR 6/2	- Soil Color according to Munsell Soil Color Charts (1975 Edition)
5 GY 5/2	- GSA Rock Color Chart

☒	- No Soil Sample Recoverd
■	- "Undisturbed" Sample
⊠	- Bulk or Classification Sample
▽	- First Encountered Ground Water Level
▼	- Piezometric Ground Water Level
Penetration	- Sample drive hammer weight - 140 pounds falling 30 inches. Blows required to drive sampler 1 foot are indicated on the logs

GeoStrategies Inc.

Unified Soil Classification - ASTM D 2488-85 and Key to Test Data

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.01 BORING NO. S-1

PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling, San Leandro PAGE 1 OF 2

BY JB DATE 6/18/85 SURFACE ELEV.

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
				0			ASPHALT
						GC FILL	CLAYEY GRAVEL; Fill; dark olive gray (5Y, 3/2); fine to coarse gravel; 30-35% fines; damp; no product odor.
						CL	CLAY; dark gray (5Y, 4/1); trace fine sand; slightly silty; moist; no product odor.
				5			
			▽				
	1.25	28		10			@8.5': black (2.5Y, 3/0); no product odor.
							@10': grayish brown (2.5Y, 5/2); stiff; wet; slight product odor.
	3.0	25		15			
	1.5	12		20			@20': light olive brown (2.5Y, 5/4); very silty; firm; wet; no product odor.

REMARKS Drilled using 8-inch continuous flight hollow-stem auger. Converted to a 3-inch monitoring well, detailed on Plate C.

EMCON ASSOCIATES

PLATE A

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.01 BORING NO. S-1

PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling, San Leandro PAGE 2 OF 2

BY JB DATE 6/18/85 SURFACE ELEV.

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
				20			HOLE TERMINATED AT 21½ FEET.
				25			

REMARKS

EMCON ASSOCIATES

WELL DETAILS

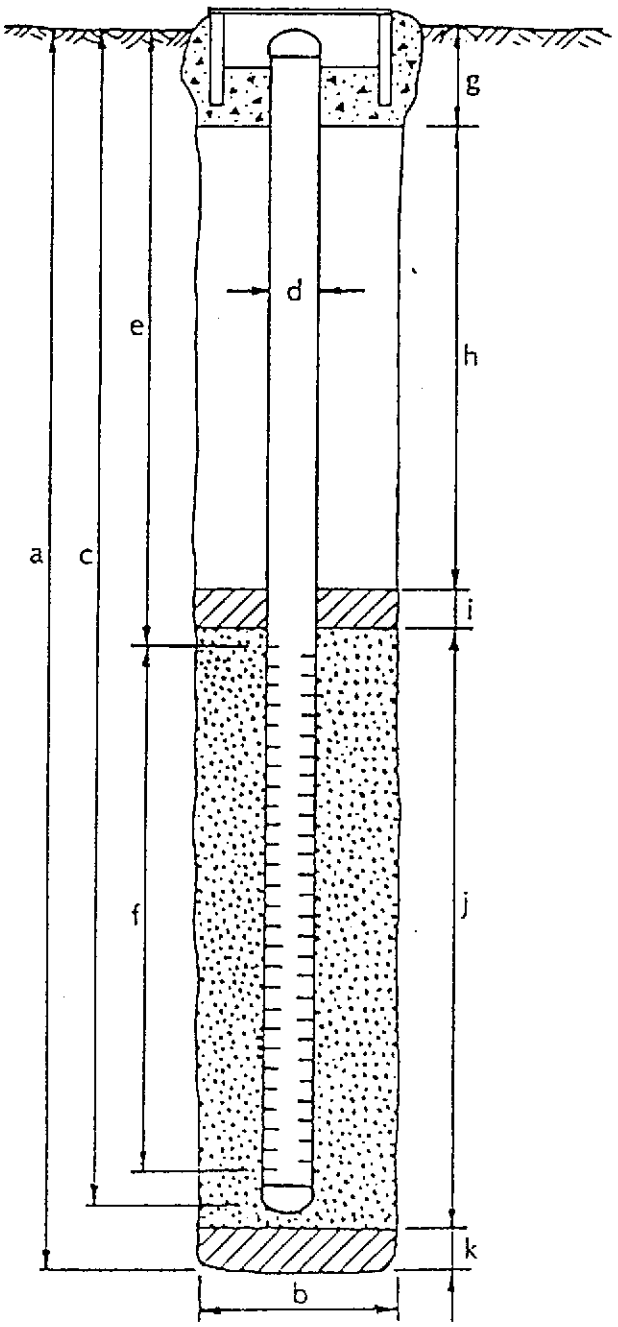
PROJECT NUMBER 738-08.01 — BORING / WELL NO. S-1

PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling — TOP OF CASING ELEV. ____

COUNTY Alameda — GROUND SURFACE ELEV. ____

WELL PERMIT NO. ____ — DATUM ____

G-5 vault box (Std.)



EXPLORATORY BORING

a. Total depth 21½ ft.

b. Diameter 8 in.

Drilling method Hollow-Stem Auger

WELL CONSTRUCTION

c. Casing length 19 ft.

Material Schedule 40 PVC

d. Diameter 3 in.

e. Depth to top perforations 4 ft.

f. Perforated length 15 ft.

Perforated interval from 4 to 19 ft.

Perforation type Machined Slot

Perforation size 0.020 inch

g. Surface seal 1 ft.

Seal material Cement

h. Backfill 2 ft.

Backfill material Cement

i. Seal ½ ft.

Seal material Bentonite

j. Gravel pack (3½ to 19') 15½ ft.

Pack material 6 x 12 Monterey Sand

k. Bottom seal 2½ ft.

Seal material Bentonite 20-21½
Compacted Clay 19-20

PLATE C

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.01 BORING NO. S-2

PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling, San Leandro PAGE 1 OF 1

BY JB DATE 6/18/85 SURFACE ELEV.

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/FT)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
				0		GC FILL	ASPHALT GRAVEL; Fill; 30% fines
						CL	CLAY; dark gray (5Y, 3/1); trace fine sand; slightly silty; moist; slight product odor.
			▽	5		SM	SILTY SAND; very dark gray (5Y, 3/1); 50% fine sand; 50% silt; loose; wet; strong product odor.
	2.0	32				CL	CLAY; black (2.5Y, 2/0); slightly silty ; very stiff; very moist; slight product odor.
				10			
	3.0	28		15			@13.5': grayish brown (2.5Y, 5/2); stiff; wet; no product odor.
	1.75	15		20			@18.5': light brownish gray (2.5Y, 6/2); 40% silt; trace fine sand; stiff; wet; no product odor. HOLE TERMINATED AT 20 FEET.

REMARKS Drilled using 8-inch continuous flight hollow-stem auger.
Converted to 3-inch monitoring well, detailed on Plate E.

EMCON ASSOCIATES

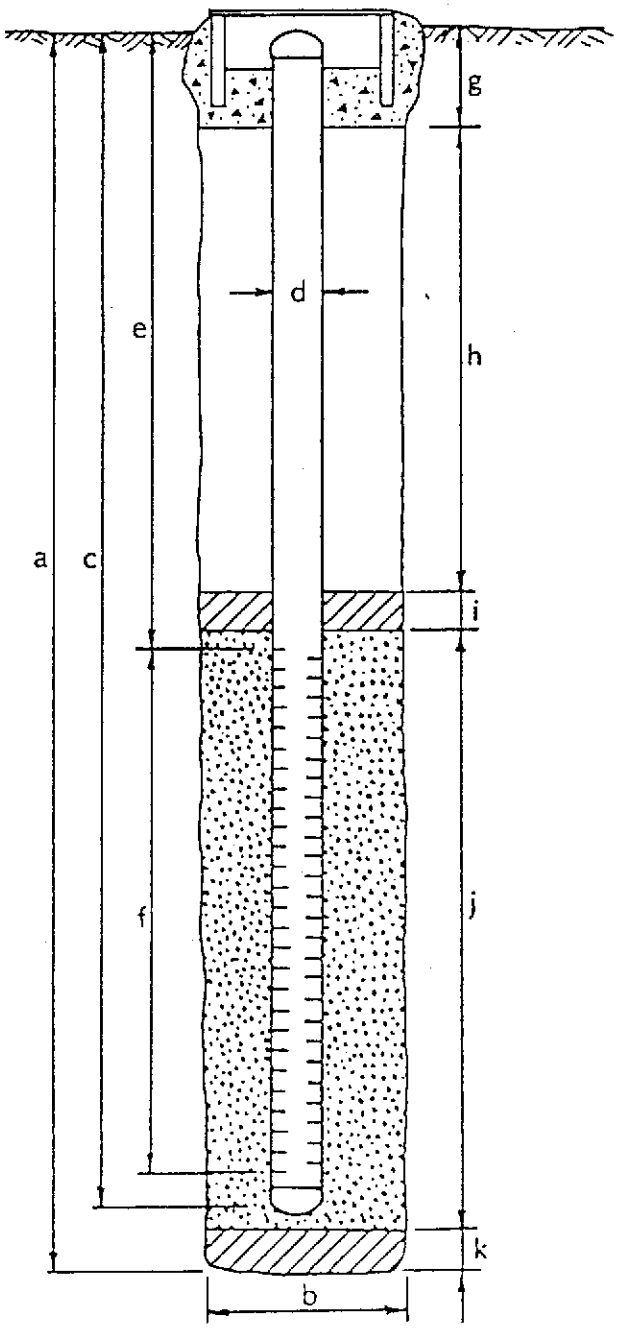
PLATE D

WELL DETAIL

PROJECT NUMBER 738-08.01
PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling
COUNTY Alameda
WELL PERMIT NO.

BORING / WELL NO. S-2
TOP OF CASING ELEV.
GROUND SURFACE ELEV.
DATUM

G-5 vault box (Std.)



EXPLORATORY BORING

a. Total depth 20 ft.
b. Diameter 8 in.
Drilling method Hollow-Stem Auger

WELL CONSTRUCTION

c. Casing length 18½ ft.
Material Schedule 40 PVC
d. Diameter 3 in.
e. Depth to top perforations 4 ft.
f. Perforated length 14½ ft.
Perforated interval from 4 to 18½ ft.
Perforation type Machined Slot
Perforation size 0.020 inch
g. Surface seal 1 ft.
Seal material Cement
h. Backfill 2 ft.
Backfill material Cement
i. Seal ½ ft.
Seal material Bentonite
j. Gravel pack (3½ to 18½') 15 ft.
Pack material 6 x 12 Monterey Sand
k. Bottom seal 1½ ft.
Seal material Compacted clay

PLATE E

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.01 BORING NO. S-3

PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling, San Leandro PAGE 1 OF 1

BY JB DATE 6/18/85 SURFACE ELEV.

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/FT.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
				0			ASPHALT
					GP		GRAVEL; Fill
					CL		CLAY; dark gray (5Y, 3/1); slightly silty; trace fine sand; moist; slight product odor.
				5	SM-ML		SILTY SAND TO SANDY SILT; very dark gray (5Y, 3/1); 50% fine sand; 50% silt; loose; wet; strong product odor; saturated with product
		12	▽				
					CL		CLAY; dark gray (5Y, 4/1); silty; firm; very moist; slight product odor.
				10			@ 10': no product odor.
	1.25	11					
				15			@ 15': stiff; wet; no product odor.
	3.0	24					HOLE TERMINATED AT 16½ FEET.
				20			

REMARKS Drilled using 8-inch continuous flight hollow-stem auger. Converted to 3-inch monitoring well, detailed on Plate G.

EMCON ASSOCIATES

PLATE F

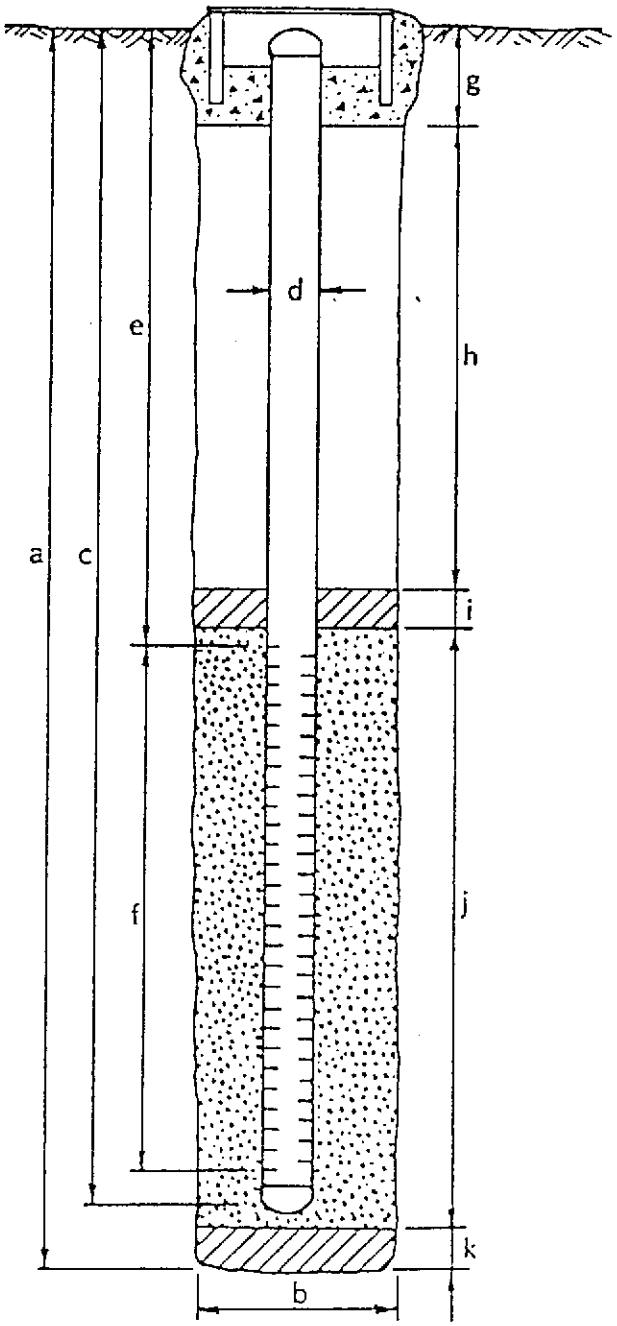
WELL DETAIL

EMCON ASSOCIATES

PROJECT NUMBER 738-08.01
PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling
COUNTY Alameda
WELL PERMIT NO. _____

BORING / WELL NO. S-3
TOP OF CASING ELEV. _____
GROUND SURFACE ELEV. _____
DATUM _____

C-5 vault box (Std.)



EXPLORATORY BORING

a. Total depth 16½ ft.
b. Diameter 8 in.
Drilling method Hollow-Stem Auger

WELL CONSTRUCTION

c. Casing length 16½ ft.
Material Schedule 40 PVC
d. Diameter 3 in.
e. Depth to top perforations 4 ft.
f. Perforated length 12½ ft.
Perforated interval from 4 to 16½ ft.
Perforation type Machined Slot
Perforation size 0.020 inch
g. Surface seal 1 ft.
Seal material Cement
h. Backfill 1 ft.
Backfill material Cement
i. Seal 1 ft.
Seal material Bentonite
j. Gravel pack (3 to 16½') 13½ ft.
Pack material 6x12 Monterey Sand
k. Bottom seal - ft.
Seal material -

PLATE G

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.01 BORING NO. S-4

PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling, San Leandro PAGE 1 OF 1

BY JDB DATE 6/18/85 SURFACE ELEV.

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/FT.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
				0			CONCRETE.
						GW	GRAVEL FILL.
						CL	CLAY; dark gray (2.5Y, 3/2); slightly silty; moist; slight product odor.
				5		SP-ML	SILTY SAND to SANDY SILT; very dark gray (5Y, 3/1); loose; wet; strong product odor; saturated with product.
		11	▽				
						CL	CLAY; dark gray (5Y, 4/1); very silty; firm; wet; moderate product odor.
				10			
	2.0	9					
				15			@ 15': less silt; stiff; no product odor.
	2.75	24					
							HOLE TERMINATED AT 18 FEET.
				20			

REMARKS Drilled using 8-inch continuous flight hollow-stem auger. converted to 3-inch monitoring well as detailed on Plate I.

EMCON ASSOCIATES

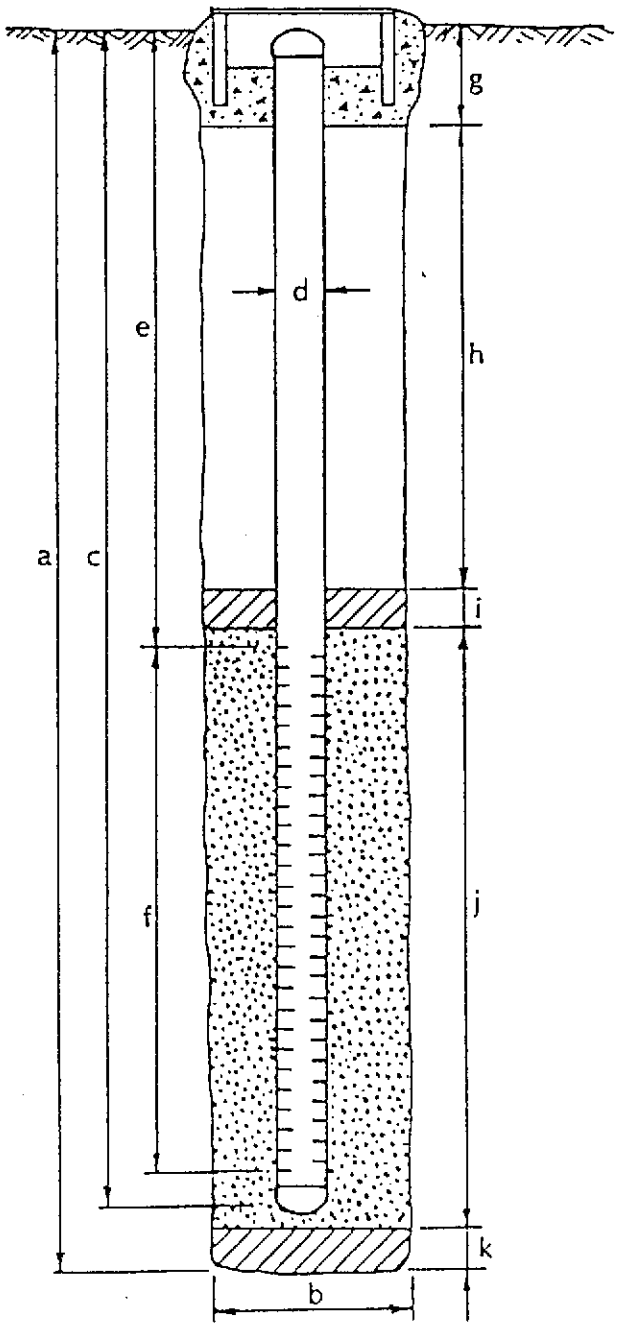
PLATE H

WELL DETAILS

PROJECT NUMBER 738-08.01
PROJECT NAME Gettler-Ryan, Shell @ Washington & Lewelling
COUNTY Alameda
WELL PERMIT NO. _____

BORING / WELL NO. S-4
TOP OF CASING ELEV. _____
GROUND SURFACE ELEV. _____
DATUM _____

G-5 vault box (Std.)



EXPLORATORY BORING

a. Total depth 18 ft.
b. Diameter 8 in.
Drilling method Hollow-Stem Auger

WELL CONSTRUCTION

c. Casing length 18 ft.
Material Schedule 40 PVC
d. Diameter 3 in.
e. Depth to top perforations 4 ft.
f. Perforated length 14 ft.
Perforated interval from 4 to 18 ft.
Perforation type Machined Slot
Perforation size 0.020 inch
g. Surface seal 1 ft.
Seal material Cement
h. Backfill 1 ft.
Backfill material Cement
i. Seal 1 ft.
Seal material Bentonite
j. Gravel pack (3 to 18') 15 ft.
Pack material 6x12 Monterey Sand
k. Bottom seal - ft.
Seal material -

PLATE I

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.03 BORING NO. S-5

PROJECT NAME Gettler-Ryan, Shell, Washington & Lewelling PAGE 1 OF 2

BY JDB SURFACE ELEV. 21.71'

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
						GP	ASPHALT GRAVEL-FILL; coarse baserock.
						CL	CLAY; dark gray (5Y, 4/1); 98-100% low- to moderate-plasticity fines; <2% fine sand; stiff; damp; no gasoline odor. @4': slight gasoline odor.
	1.25	9	▼ ▽	5	1	SC	CLAYEY SAND; dark gray (5Y, 4/1); 20-40% low-plasticity fines; 60-80% fine sand; loose; moist; slight to moderate gasoline odor.
						ML CH-CL	SANDY SILT; dark gray (5Y, 4/1); 70-90% non-plastic fines; 10-30% fine sand; stiff; moderate gasoline odor.
	1.5	17		10	2		CLAY; black (5Y, 2.5/1); 100% moderate- to high-plasticity fines; occasionally calcareous; stiff to very stiff; wet in voids; slight gasoline odor to 10 feet.
						CH	
	2.25	22		15	3		@14': gray (5Y, 5/1); 100% high-plasticity fines; very stiff; very moist; no gasoline odor. @19': abundant caliche disseminated; no gasoline odor.
	2.0	29		20	4		

REMARKS

Drilled with 8- and 12-inch continuous-flight, hollow-stem auger drilling equipment. Converted to a 4-inch monitoring well as detailed on Plate B.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 738-08.03 BORING NO. S-5

PROJECT NAME Gettler-Ryan, Shell, Washington & Lewelling PAGE 2 OF 2

BY JDB SURFACE ELEV. 21.71'

TORVANE (TSF)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
				20			BOTTOM OF BORING AT 20.5 FEET
				25			
				30			
				35			
				40			

REMARKS

WELL DETAILS

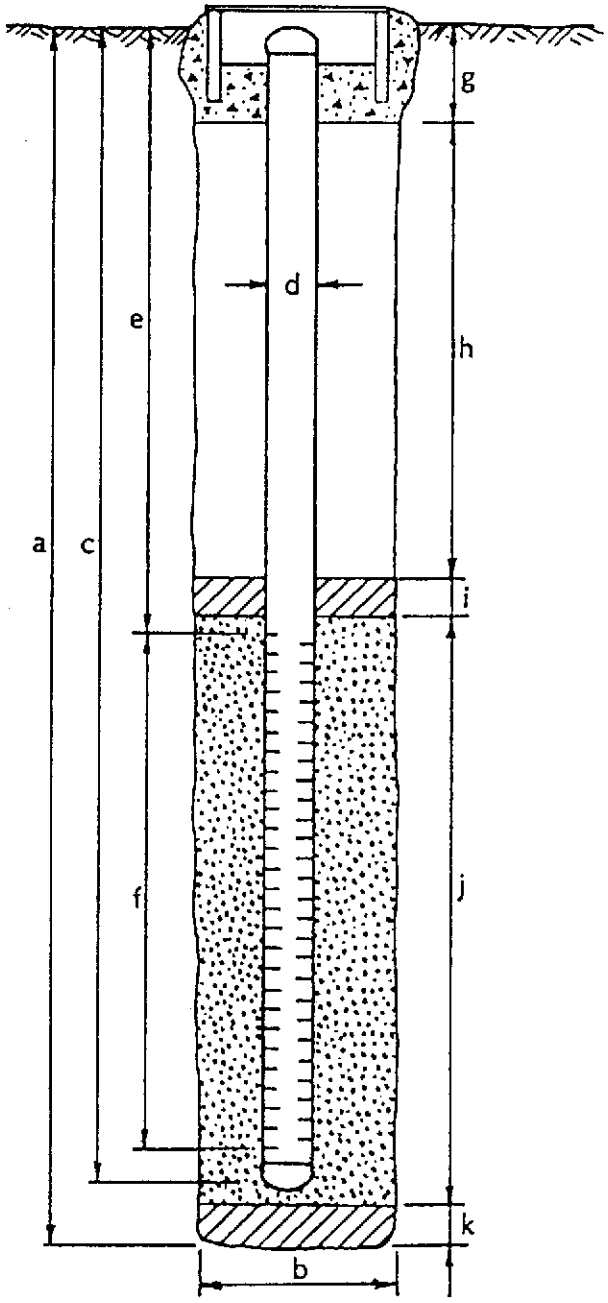
PROJECT NUMBER 738-08.03 BORING / WELL NO. S-5

PROJECT NAME Shell, Washington & Lewelling, San Leandro TOP OF CASING ELEV. 21.24'

COUNTY Alameda GROUND SURFACE ELEV. 21.71'

WELL PERMIT NO. _____ DATUM Project

G-5 vault box (Std.)



EXPLORATORY BORING

a. Total depth 20½ ft.

b. Diameter 12 in.

Drilling method Hollow-stem auger

WELL CONSTRUCTION

c. Casing length 18½ ft.

Material schedule 40 PVC

d. Diameter 4 in.

e. Depth to top perforations 3½ ft.

f. Perforated length 15 ft.

Perforated interval from 18½ to 3½ ft.

Perforation type machined slot

Perforation size 0.020 inch

g. Surface seal (1 - 0') 1 ft.

Seal material concrete

h. Backfill (1½ - 1') ½ ft.

Backfill material concrete

i. Seal (2½ - 1½') 1 ft.

Seal material bentonite

j. Gravel pack (18½ - 2½') 16 ft.

Pack material 6x12 Monterey Sand

k. Bottom seal (20½ - 18½') 2 ft.

Seal material compacted clay

PLATE C

Woodward-Clyde Consultants

PROJECT NAME GETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION 15275 Washington Ave., San Leandro, CA (S-12)			ELEVATION AND DATUM
DRILLING AGENCY Bay Land Drilling	DRILLER Tom/Mack		DATE STARTED / DATE FINISHED 11/4
DRILLING EQUIPMENT CME - 55			COMPLETION DEPTH 24.5' / SAMPLER Modified California
DRILLING METHOD 8" Hollow stem auger	DRILL BIT CME Carbide		NO. OF SAMPLES / DIST. 5 / UNDIST. 5
SIZE AND TYPE OF CASING Sch 40 3" PVC	FROM 24.0 TO 0.5 FT.		WATER LEVEL / FIRST 8' / COMPL. — / 24 HRS. —
TYPE OF PERFORATION 0.02"	FROM 23.5 TO 3.5 FT.		LOGGED BY: G. Heyman / CHECKED BY: M. Bonkowski
SIZE AND TYPE OF PACK 2/12 Monterey Sand	FROM 24.0 TO 3.0 FT.		
TYPE OF SEAL NO. 1 1/2" Bentonite Pellets	FROM 3 TO 2.5 FT.		
NO. 2 Cement grout	FROM 2.5 TO surface FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION	USCS	Well Construction
			Asphaltic Concrete		
5	1	pushed @ 200 lbs	CLAYEY SAND to SANDY CLAY grading down to SILTY CLAY TO CLAYEY SILT greenish gray at top with gray mottling in middle and bottom of sample, very fine sand, low plasticity, moist, generally homogeneous OVM jumped to 190 ppm then settled at 120 ppm Weak Hydrocarbon odor	CL	
10	2	4 5 7	SILTY CLAY dark brownish gray, some very fine sand, low plasticity, firm, moist to wet, few beds of clay, sand to 1/4" thick OVM = 20 ppm Weak Hydrocarbon odor	CL	
15	3	5 6 11	CLAY to SILTY CLAY medium grayish brown, some silt grading to silty clay, medium plasticity, wet homogeneous Driller indiccates drilling through a series of 2 - 4" gravel layers from 16 - 19' OVM = 0 ppm No Hydrocarbon odor	CL	
20	4	3 4 5	CLAY to SANDY CLAY medium grayish brown, little to some very fine sand occasionally grading to sandy clay, low to medium plasticity, firm, saturated No Hydrocarbon odor	CL	
			CLAYEY SAND to SANDY CLAY medium yellow brown, very fine sand, saturated OVM = 1 ppm No Hydrocarbon odor		
	5	4 5 7	SILTY CLAY to CLAYEY SILT medium yellow brown, up to some very fine sand, low to medium plasticity, saturated OVM = 0 ppm No Hydrocarbon odor	CL	
25			Total Depth = 24.5 feet * = Laboratory Sample		
30					
35					

Woodward-Clyde Consultants

PROJECT NAME: BETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION: 15275 Washington Ave., San Leandro, CA (S-6)			ELEVATION AND DATUM
DRILLING AGENCY: Bay Land Drilling	DRILLER: Tom/Mack		DATE STARTED / DATE FINISHED: 11/3/88
DRILLING EQUIPMENT: CME - 55			COMPLETION DEPTH: 24.5' / SAMPLER: Modified California
DRILLING METHOD: 8" Hollow stem auger	DRILL BIT: CME Carbide		NO. OF SAMPLES: DIST. 5 / UNDIST. 5
SIZE AND TYPE OF CASING: Sch 40 3" PVC	FROM 24.0 TO 0.5 FT.		WATER LEVEL: FIRST 8' / COMPL. — / 24 HRS. —
TYPE OF PERFORATION: 0.02"	FROM 24.0 TO 4.0 FT.		LOGGED BY: R. Siegel / CHECKED BY: M. Bonkowski
SIZE AND TYPE OF PACK: 2/12 Monterey Sand	FROM 24.5 TO 3.0 FT.		
TYPE OF SEAL: NO. 1 1/2" Bentonite Pellets	FROM 3 TO 2.5 FT.		
TYPE OF SEAL: NO. 2 Cement grout	FROM 2.5 TO 0.5 FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION	USCS	Well Construction
			Asphaltic Concrete		
			FILL black, pebbly clay, moist		
5	1*	pushed @ 150 lbs	SILTY CLAY gray black, low plasticity, moist to dry, moderately cohesive, some vegetative debris with iron - oxide staining OVM = 482 ppm Hydrocarbon odor	CL	
10	2*	5 7 9	SANDY to SILTY CLAY mottled brown and black, fine to medium sand with 5% pebbles up to 1/4", moist to dry, low cohesiveness - grades in B and A sample tubes to clay, black, dry, very dense and cohesive, 5% silt OVM = 1.3 ppm	CL	
15	3	5 9 14	CLAY mottled black and brown, very stiff, dry, cohesive OVM = 26.5 ppm	CL	
			B and C tubes - same as sample 3		
20	4	5 11 15	SANDY to SILTY CLAY light brown with some black mottling, moderate cohesion, some vegetative debris with iron oxide staining OVM = 0.8 ppm	CL	
	5	5 7 8	CLAY black to mottled brown and black, minor silt (<5%), very stiff, dry, cohesive OVM = 2.6 ppm	CL	
25			SILTY to SANDY CLAY light brown, fine sand, moist to dry, moderate cohesion, based on drilling resistance, probably a number of alternating clay and sandy clay layers from 15' to bottom of hole		
			Total Depth = 24.5 feet		
30			* = Laboratory Sample		
35					

Woodward-Clyde Consultants

PROJECT N. SETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION 15275 Washington Ave., San Leandro, CA (S-7)			ELEVATION AND DATUM
DRILLING AGENCY Bay Land Drilling	DRILLER Tom/Mack		DATE STARTED 11/3/88 DATE FINISHED
DRILLING EQUIPMENT CME - 55			COMPLETION DEPTH 24.5' SAMPLER Modified California
DRILLING METHOD 8" Hollow stem auger	DRILL BIT CME Carbide		NO. OF SAMPLES DIST. 5 UNDIST. 5
SIZE AND TYPE OF CASING Sch 40 3" PVC	FROM 24.0 TO 0.5 FT.		WATER LEVEL FIRST ~8' COMPL. — 24 HRS. —
TYPE OF PERFORATION 0.02"	FROM 24.0 TO 4.0 FT.		LOGGED BY: R. Siegel
SIZE AND TYPE OF PACK 2/12 Monterey Sand	FROM 24.5 TO 3.0 FT.		CHECKED BY: M. Bonkowski
TYPE OF SEAL NO. 1 Bentonite	FROM 3 TO 2.5 FT.		
NO. 2 Cement grout	FROM 2.5 TO 0.5 FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION		USCS	Well Construction
			Asphaltic Concrete			
5	1*	pushed @ 200 lbs	FILL - CLAY silty sandy clay with large pebbles to 2" diameter, plastic, moist to wet, cohesive, Note: pipe encountered at ~5', moved auger over slightly	OVM = 9.0 ppm	CL	
10	2*	5 6 10	CLAY black mottled with green, low plastiviey, stiff, dry, moderate cohesion	OVM = 32 ppm	CL	
15	3	6 9 12	SILTY CLAY mottled black and brown, gravelly clay present in top, stiff, dry, moderate cohesion	OVM = 2.2 ppm	CL	
20	4	7 7 9	same as Silty Clay above	OVM = 1.8 ppm	CL	
	5	2 3 2	same as Silty Clay above but some fine sands present	OVM = 0.6 ppm		
25			Total Depth = 24.5 feet * = Laboratory Sample			
30						
35						

Woodward-Clyde Con . hts

PROJECT NA GETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION 15275 Washington Ave., San Leandro, CA (S-8)			ELEVATION AND DATUM
DRILLING AGENCY Bay Land Drilling	DRILLER Tom/Mack		DATE STARTED 11/3/88 DATE FINISHED
DRILLING EQUIPMENT CME - 55			COMPLETION DEPTH 24.5' - SAMPLER Modified California
DRILLING METHOD 8" Hollow stem auger	DRILL BIT CME Carbide		NO. OF SAMPLES DIST. 5 UNDIST. 5
SIZE AND TYPE OF CASING Sch 40 3" PVC	FROM 24.0 TO 0.5 FT.		WATER LEVEL FIRST ~8' COMPL. — 24 HRS. —
TYPE OF PERFORATION 0.02"	FROM 24.0 TO 4.0 FT.		LOGGED BY: R. Siegel CHECKED BY: M. Bonkowski
SIZE AND TYPE OF PACK 2/12 Monterey Sand	FROM 24.5 TO 3.0 FT.		
TYPE OF SEAL NO. 1 1/2" Bentonite Pellets	FROM 3 TO 2.5 FT.		
NO. 2 Cement grout	FROM 2.5 TO 0.5 FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION		USCS	Well Construction
			Asphaltic Concrete			
5	1*	5 7 9	FILL - SILTY CLAY some pebbles to 1", low plasticity, moist, low cohesion	OVM = 43 ppm Very strong Hydrocarbon odor	CL	
10	2*	5 7 14	SILTY to SANDY CLAY mottled black and brown, fine to medium sand, a few pebbles to 1/4" diameter, poorly sorted, dry to moist	OVM = 1.4 ppm	CL	
15	3*	5 9 14	as above, poor recovery, resampled from same depth gravels and pebbles present in clay, pebbles to 1/8", increased moisture, decreased cohesion	OVM = 453 ppm	CL	
20	4*	3 5 7	as above then goes to (A tube), Silty to Sandy Clay, light brown, fine sand, moist to dry, moderate cohesion	OVM = 4.8 ppm	CL	
	5*	5 6 10	No recovery after 2 attempts			
25			Total Depth = 24.5 feet * = Laboratory Sample			
30						

Woodward-Clyde Consultants

PROJECT NAME GETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION 15275 Washington Ave., San Leandro, CA (S-9)		ELEVATION AND DATUM	
DRILLING AGENCY Bay Land Drilling	DRILLER Tom/Mack	DATE STARTED / DATE FINISHED 11/4/88	
DRILLING EQUIPMENT CME - 55		COMPLETION DEPTH 18'	SAMPLER Modified California
DRILLING METHOD 8" Hollow stem auger	DRILL BIT CME Carbide	NO. OF SAMPLES 4 DIST.	UNDIST. —
SIZE AND TYPE OF CASING Sch 40 3" PVC	FROM 18.0 TO 0.5 FT.	WATER LEVEL FIRST 8' +/-	COMPL. 8.2' 24 HRS. —
TYPE OF PERFORATION 0.02"	FROM 17.5 TO 4.0 FT.	LOGGED BY: G. Heyman	CHECKED BY: M. Bonkowski
SIZE AND TYPE OF PACK 2/12 Monterey Sand	FROM 18 TO 3.0 FT.		
TYPE OF SEAL NO. 1 1/2" Bentonite Pellets	FROM 3 TO 2.5 FT.		
NO. 2 Cement grout	FROM 2.5 TO surface FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION	USCS	Well Construction
			Asphaltic Concrete		
			FILL - SAND and GRAVEL		
			SILTY CLAY to CLAYEY SILT (cuttings) dark gray, little to some very fine sand, low to medium plasticity, moist to wet	Moderate Hydrocarbon odor	
5	1*	pushed @ 150 lbs	SILTY CLAY to CLAYEY SILT dark gray, some very fine sand, low plasticity, soft, moist, homogeneous	OVM = 540 ppm Strong Hydrocarbon odor	CL
10	2*	3 4 5	SANDY SILT to SANDY CLAY medium gray grading down to medium brown, very fine sand, low plasticity, wet, few vesicles less than 1 mm diameter, few root traces	OVM = 27 ppm Weak Hydrocarbon odor	CL
15	3	5 6 12	CLAY to SILTY CLAY medium gray brown to green brown, occasionally little very fine sand, little to some silt, medium plasticity, moist with wet to saturated areas adjacent to vesicles, few root fragments, few vesicles	OVM = 8 ppm No Hydrocarbon odor	CL-CH
20	4		CLAYEY SILT to SILTY CLAY medium gray brown, medium plasticity, firm, wet	OVM = 5 ppm No Hydrocarbon odor	CL-ML-SM
			SANDY SILT to SILTY SAND light yellow brown, very fine sand, little to some clay, wet to saturated		
			Total Depth = 20.5 feet		
			* = Laboratory Sample		
25					
30					
35					

Woodward-Clyde Cor. nts

PROJECT N. SETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION 15275 Washington Ave., San Leandro, CA (S-10)			ELEVATION AND DATUM
DRILLING AGENCY Bay Land Drilling	DRILLER Tom/Mack		DATE STARTED 11/4/88 DATE FINISHED
DRILLING EQUIPMENT CME - 55			COMPLETION DEPTH 18' - SAMPLER Modified California
DRILLING METHOD 8" Hollow stem auger	DRILL BIT CME Carbide		NO. OF SAMPLES DIST. 4 UNDIST. —
SIZE AND TYPE OF CASING Sch 40 3" PVC	FROM 18.0 TO 0.5 FT.		WATER LEVEL FIRST 8' +/- COMPL. 7 1' 24 HRS. —
TYPE OF PERFORATION 0.02"	FROM 17.5 TO 4.0 FT.		LOGGED BY: G. Heyman CHECKED BY: M. Bonkowski
SIZE AND TYPE OF PACK 2/12 Monterey Sand	FROM 18 TO 3.0 FT.		
TYPE OF SEAL NO. 1 1/2" Bentonite Pellets	FROM 3 TO 2.5 FT.		
NO. 2 Cement grout	FROM 2.5 TO surface FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION	USCS	Well Construction
			Asphaltic Concrete		
5	1"	pushed @ 100 lbs	SILTY to SANDY SILT dark gray, very fine sand, low plasticity, soft, moist, homogeneous OVM = 0 ppm No Hydrocarbon odor	CL	
10	2"	3, 4, 7	Interlayered SILTY CLAY and CLAYEY SAND dark greenish gray, little very fine sand in clay, low plasticity, moist, wet with few saturated areas OVM = 3.7 ppm No Hydrocarbon odor Weak Hydrocarbon odor in 20 minutes	CL-SC	
15	3	5, P, O	CLAY to SILTY CLAY light to medium brown, low to medium plasticity, moist, few off-white brittle veinlets 2 - 3 mm thick OVM = 0 ppm No Hydrocarbon odor	CL-CH	
20	4	4, 5, 7	SILTY CLAY medium gray brown, some very fine sand, trace fine gravel, medium plasticity, wet to occasionally saturated No Hydrocarbon odor	CL-CH	
25			Total Depth = feet * = Laboratory Sample		
30					
35					

Woodward-Clyde Consultants

PROJECT NAME: SETTLER-RYAN NO. 8820011A

MONITORING WELL LOCATION: 15275 Washington Ave., San Leandro, CA (S-11)			ELEVATION AND DATUM
DRILLING AGENCY: Bay Land Drilling	DRILLER: Tom/Mack		DATE STARTED: 11/4/88 DATE FINISHED
DRILLING EQUIPMENT: CME - 55			COMPLETION DEPTH: 24.5' / SAMPLER: Modified California
DRILLING METHOD: 8" Hollow stem auger	DRILL BIT: CME Carbide		NO. OF SAMPLES: DIST. 5 / UNDIST. 5
SIZE AND TYPE OF CASING: Sch 40 3" PVC	FROM 24.5 TO 0.5 FT.		WATER LEVEL: FIRST 8' / COMPL. 7.8' / 24 HRS. —
TYPE OF PERFORATION: 0.02"	FROM 24.0 TO 4.0 FT.		LOGGED BY: G. Heyman / CHECKED BY: M. Bonkowski
SIZE AND TYPE OF PACK: 2/12 Monterey Sand	FROM 24.5 TO 3.5 FT.		
TYPE OF SEAL: NO. 1 1/2" Bentonite Pellets	FROM 3.5 TO 3.0 FT.		
TYPE OF SEAL: NO. 2 Cement grout	FROM 3.0 TO 0.5 FT.		

Depth (feet)	Samples	Blows	MATERIAL DESCRIPTION		USCS	Well Construction
			Asphaltic Concrete and base rock			
5	1	pushed @ 175 lbs	SILTY to SANDY CLAY greenish gray, silt and very fine grained sand, content varies vertically, low plasticity, firm, moist, numerous vesicles less than 1 mm diameter	OVM = 110 ppm Moderate Hydrocarbon odor	CL	
				Strong Hydrocarbon odor in cuttings at 8'		
10	2	4, 7, 9	SILTY CLAY to CLAYEY SILT dark brown, little to some very fine sand, low plasticity, moist to wet, few vesicles	OVM = 0 ppm No Hydrocarbon odor	CL-ML	
15	3	5, 10, 11	SILTY CLAY greenish brown, little to some very fine sand, medium plasticity, wet with saturated areas, gravel layers 1 - 2" thick from 16 - 18' (driller)	OVM = 0 ppm No Hydrocarbon odor	CL	
20	4*	3, 4, 4	SILTY CLAY with Interbedded CLAYEY SAND to SANDY CLAY Clay is grayish brown, medium plasticity, wet with saturated areas, sand is light yellow brown, very fine grained, loose, wet to saturated, up to 3" thick	OVM = 0.5 ppm No Hydrocarbon odor	CL-SC	
25	5	4, 7, 8	SANDY CLAY to CLAYEY SAND layers are up to 5" thick, as above	No Hydrocarbon odor	CL	
			Total Depth = 24.5 feet			
			* = Laboratory Sample			
30						
35						

Field location of boring:

Project No.: 7615	Date: 4/26/89	Boring No: S-13	
Client: Shell			
Location: 15275 Washington Ave/Lewelling			
City: San Leandro		Sheet 1 of 2	
Logged by: DAF	Driller: Bayland		

Casing installation data:

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Top of Box Elevation: Datum:

Water Level	8.4'	7.3'		
Time	11:50am			
Date	4/26	5/10		

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
				1				PAVEMENT SECTION - 2 feet.
				2				
				3				CLAY (CL)- dark gray (10YR 4/1); soft; damp; low plasticity; trace gravel; no chemical odor.
				4				
350	150	S&H	S-13-5'	5				color change to dark olive gray (5Y 3/2); no chemical odor.
		push						
				6				
				7				
				8				
				9				▼
50	2	S&H	S-13-					
	3		10'	10				SILTY SAND (SM)- light olive brown (2.5Y 5/4); loose; damp; 20-30% silt; mottled brown; no chemical odor.
	6							
				11				
				12				CLAY (CL)- dark olive gray (5Y 3/2), medium stiff; damp; low plasticity; trace gravel; rootholes; no chemical odor.
				13				
				14				
40	3	S&H	S-13-					color change to very dark gray (5Y 3/1) mottled; organics present; no chemical odor.
	5		15'	15				
	7							
				16				
				17				▽ becoming saturated at 17.5 feet.
				18				
				19				
0	2	S&H	S-13-					SANDY SILT (ML)- light yellowish brown (2.5Y 6/4); medium stiff; saturated;
	3		20'	20				

Remarks:

GeoStrategies Inc.

BORING NO. S-13

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	5/89		

Field location of boring:

Project No.: 7615	Date: 4/26/89	Boring No: S-13	
Client: Shell			
Location: 15275 Washington Ave/Lewelling			
City: San Leandro		Sheet 2 of 2	
Logged by: DAF	Driller: Bayland		

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Casing installation data:

Top of Box Elevation: Datum:

Water Level				
Time				
Date				

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	4							15% very fine to fine sand; 10% clay;
				21				trace organics; rootholes; mottled
								brown & black; no chemical odor.
				22				
				23				
				24				
25	2	S&H	S-13-					SILTY CLAY (CL-ML)- light olive brown
	3		25'	25				(2.5Y 5/4); medium stiff; moist; trace
	4							organics; mottled brown & black;
								no chemical odor.
								Bottom of boring 24.0 feet,
								Sampled to 25.5 feet
								4/26/89

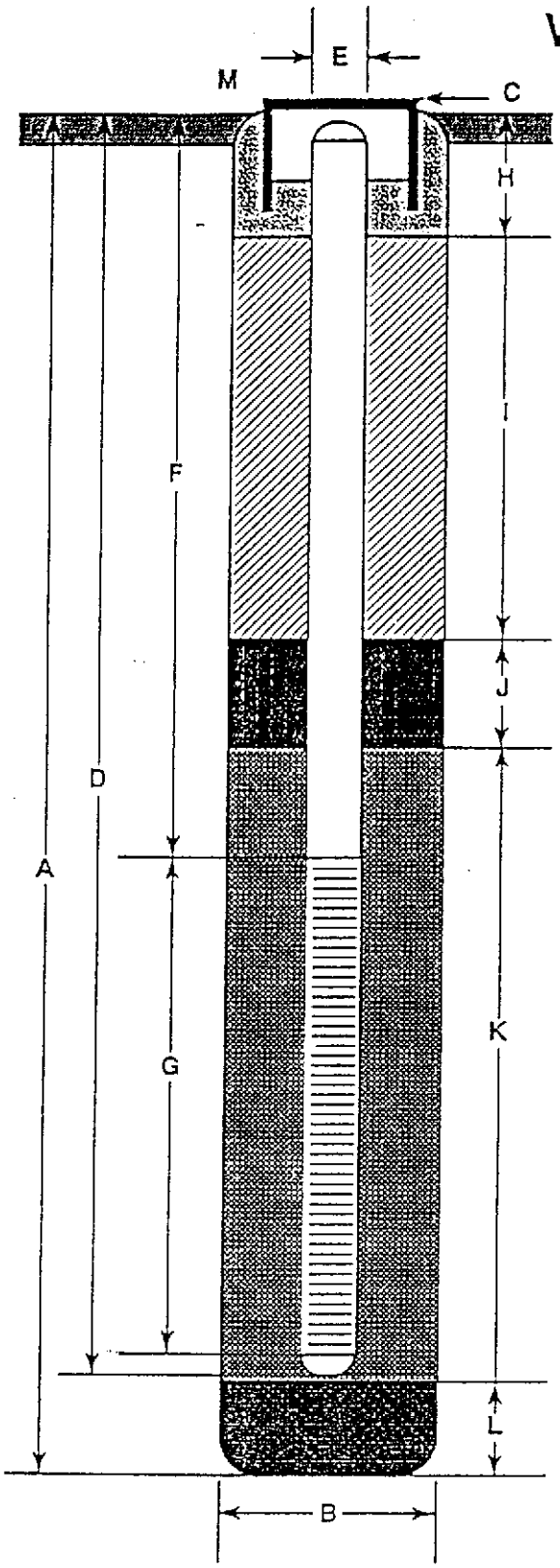
Remarks:

GSI GeoStrategies Inc.

BORING NO. S-13

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/89		

WELL CONSTRUCTION DETAIL



A Total Depth of Boring 24 ft.

B Diameter of Boring 8 in.
Drilling Method HOLLOW STEM AUGER

C Top of Box Elevation 20.57 ft.
☐ Referenced to Mean Sea Level
☒ Referenced to Project Datum

D Casing Length 23.5 ft.
Material SCH 40 PVC

E Casing Diameter 3 in.

F Depth to Top Perforations 4 ft.

G Perforated Length 20 ft.
Perforated Interval from 4 to 24 ft.
Perforation Type FACTORY SLOTTED
Perforation Size 0.020

H Surface Seal 2.5 ft.
Seal Material CONCRETE

I Backfill ft.
Backfill Material

J Seal 0.5 ft.
Seal Material BENTONITE

K Gravel Pack 21 ft.
Pack Material LONESTAR 2/12 & #3

L Bottom Seal ft.
Seal Material

M CHRISTY BOX

GSI GeoStrategies Inc.

Well Construction Detail
Former Shell Service Station
15275 Washington Ave.
San Leandro

WELL NO. S-13

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CMP CEG 1262	5/89		

Field location of boring:

Project No.: 7615 | Date: 4/26/89 | Boring No: S-14

Client: Shell

Location: 15275 Washington Ave/Lewelling

City: San Leandro | Sheet 1 of 2

Logged by: DAF | Driller: Bayland

Casing installation data:

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Top of Box Elevation: | Datum:

Water Level	9'			
Time	10:00am			
Date	4/26/89			

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
				1				PAVEMENT SECTION - 2 feet.
				2				
				3				SILTY CLAY (CL-ML)- dark gray (2.5Y N4); soft; damp.
				4				becoming firm at 5 feet; with slight
500	150	S&H	S-14-5'	5				odor.
		push						
				6				
				7				SILTY SAND (SM)- olive (5Y 4/3); loose;
				8				damp; 30% medium sand; 20% very fine to fine sand; trace clay; no chemical
				9				odor, comment: drill cuttings.
50	2	S&H	S-14-					▼ CLAY (CL)- dark gray (2.5Y N4); stiff; damp; low plasticity; no chemical odor.
	3		10'	10				
	4							CLAY WITH SAND (CL)- light yellowish
				11				brown (2.5Y 6/4); medium stiff; damp;
				12				10% very fine to fine sand; 5-10% silt; trace caliche nodules; mottled; no
				13				chemical odor.
				14				CLAY (CL)- dark gray (2.5Y N4); stiff;
0	2	S&H	S-14-					damp; low plasticity; pockets of silt;
	6		15'	15				trace black & brown organics; no
	7							chemical odor.
				16				color change to grayish brown (2.5Y 5/2) at 15 feet.
				17				
				18				
				19				▽ becoming saturated at 19 feet.
50	2	S&H	S-14-					
	6		20'	20				

Remarks:

GSI GeoStrategies Inc.

BORING NO. S-14

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	5/89		

Field location of boring:

Project No.: 7615 | Date: 4/26/89 | Boring No: S-14

Client: Shell

Location: 15275 Washington Ave/Lewelling

City: San Leandro | Sheet 2 of 2

Logged by: DAF | Driller: Bayland

Casing installation data:

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Top of Box Elevation: | Datum:

Water Level				
Time				
Date				

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	7				■			
				21				SANDY SILT (ML)- light yellowish brown (2.5Y 6/4); medium stiff; saturated; 30% very fine to fine sand; 5-10% clay; trace caliche nodules; mottled brown & black; no chemical odor.
				22				
				23				
				24				
	2	SPT			■			
	2			25	■			CLAY (CL)- grayish brown (2.5Y 5/2); medium stiff; damp; low plasticity; trace caliche nodules; no chemical odor
	4				■			
								Bottom of boring 24.0 feet, sampled to 25.5 feet 4/26/89

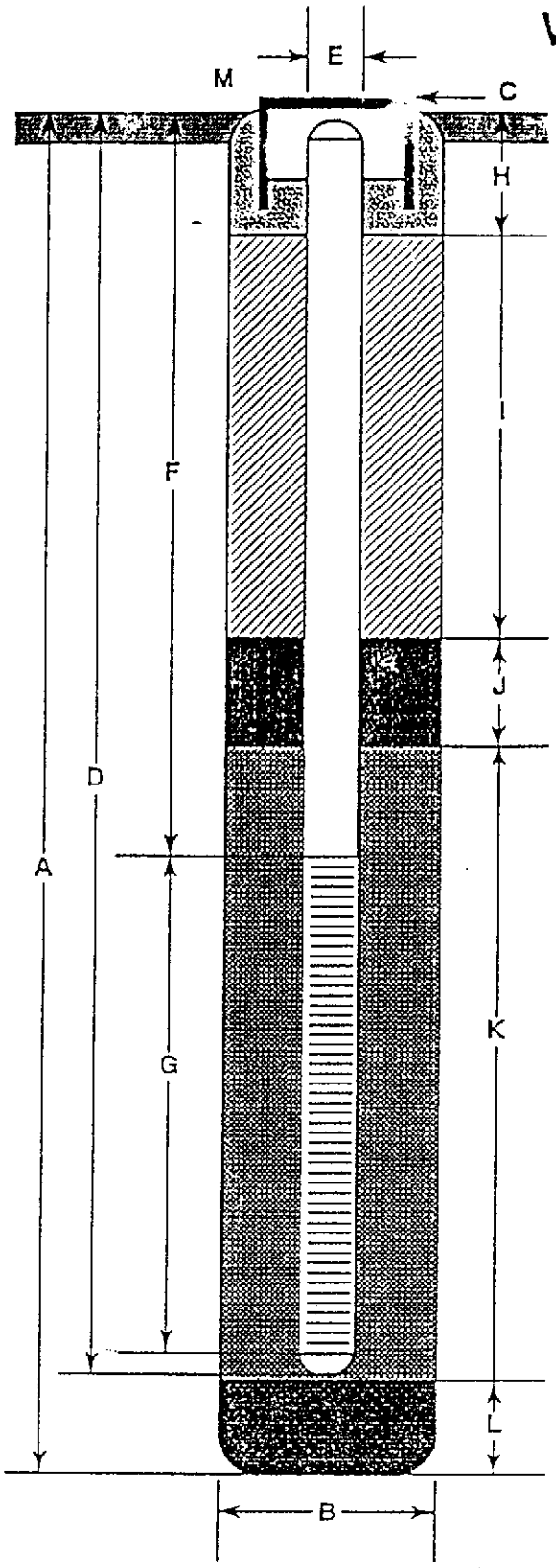
Remarks:

GeoStrategies Inc.

BORING NO. S-14

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/89		

WELL CONSTRUCTION DETAIL



A Total Depth of Boring 24 ft.

B Diameter of Boring 8 in.
Drilling Method HOLLOW STEM AUGER

C Top of Box Elevation 20.44 ft.
☐ Referenced to Mean Sea Level
☒ Referenced to Project Datum

D Casing Length 23.5 ft.
Material SCH 40 PVC

E Casing Diameter 3 in.

F Depth to Top Perforations 4 ft.

G Perforated Length 20 ft.
Perforated Interval from 4 to 24 ft.
Perforation Type FACTORY SLOTTED
Perforation Size 0.020

H Surface Seal 2.5 ft.
Seal Material CONCRETE

I Backfill ft.
Backfill Material

J Seal 0.5 ft.
Seal Material BENTONITE

K Gravel Pack 21 ft.
Pack Material LONESTAR 2/12 & #3

L Bottom Seal ft.
Seal Material

M CHRISTY BOX

GSI GeoStrategies Inc.

Well Construction Detail
Former Shell Service Station
15275 Washington Ave.
San Leandro

WELL NO. S-14

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP CEG 12/6/2	5/89		

Field location of boring:

Project No.: 7615	Date: 4/26/89	Boring No: S-15	
Client: Shell			
Location: 15275 Washington Ave/Lewelling			
City: San Leandro		Sheet 1 of 2	
Logged by: DAF	Driller: Bayland		
Casing installation data:			
Drilling method: Hollow Stem Auger			
Hole diameter: 8 inch	Top of Box Elevation:	Datum:	
Water Level	8.3'		
Time	2:25pm		
Date	4/26/89		

PID (ppm)	Blowsft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
				1				PAVEMENT SECTION - 2.5 feet.
				2				
				3				CLAY (CL)- very dark grayish brown (2.5Y 3/2); medium stiff; damp; low plasticity; trace gravel.
				4				
55	150	S&H	S-15-5'	5				SILTY CLAY (CL-ML) -olive (5Y 4/3); soft; damp; low plasticity; mottled brown.
		push		6				
Driller notes change @ 7'				7				SILTY SAND (SM) -olive brown (2.5Y 4/4); loose; moist; poorly graded; trace clay.
				8				
				9				▼
35	2	S&H	S-15-	10				CLAY (CL) -very dark gray (5Y 3/1); stiff; damp; low plasticity; trace gravel; mottled brown; rootholes.
	2		10'					
	4			11				
				12				
				13				
				14				becoming soft; 5% silt; trace caliche nodules at 14 feet.
55	1	S&H	S-15-	15				CLAY (CL) -olive gray (5Y 4/2); stiff; damp; low plasticity; mottled; trace caliche nodules.
	4		15'					
	8			16				
				17				
				18				becoming saturated at 18.5 feet.
				19				▽ SILTY CLAY (CL-ML) -light olive brown (2.5Y 5/4); medium stiff; saturated; trace organics; trace caliche nodules.
NM	3	SPT		20				
	2							

Remarks:

GeoStrategies Inc.

BORING NO. S-15

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	5/89		

Field location of boring:

Project No.: 7615 | Date: 4/26/89 | Boring No: S-15

Client: Shell

Location: 15275 Washington Ave/Lewelling

City: San Leandro | Sheet 2 of 2

Logged by: DAF | Driller: Bayland

Casing installation data:

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Top of Box Elevation: | Datum:

Water Level				
Time				
Date				

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	4							
				21				
				22				
				23				CLAY (CL) -very dark gray (5Y 3/1); medium stiff; damp; low plasticity.
				24				
NM	1	SPT						SILTY CLAY (CL-ML) - light olive brown
	3			25				(2.5Y 5/4); medium stiff; damp; some
	5							sandy lenses.
								Bottom of boring 24.0 feet,
								Sampled to 25.5 feet
								4/26/89

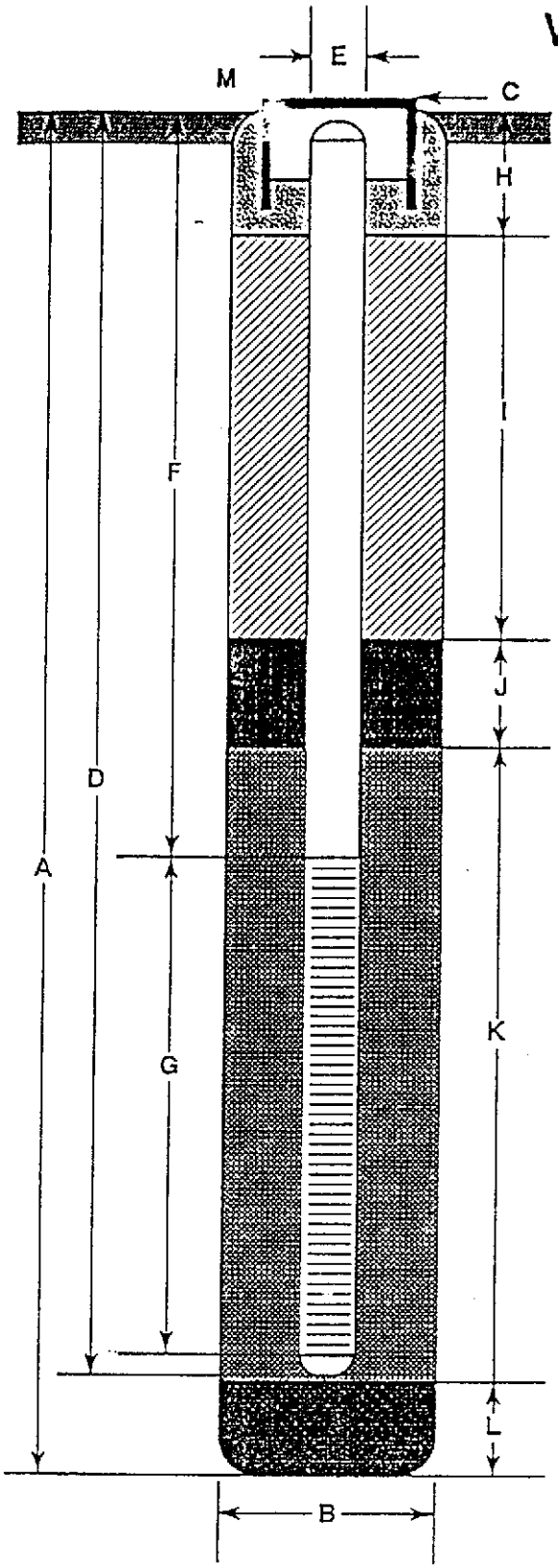
Remarks:

GeoStrategies Inc.

BORING NO. S-15

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/89		

WELL CONSTRUCTION DETAIL



A Total Depth of Boring 24 ft.

B Diameter of Boring 8 in.
Drilling Method HOLLOW STEM AUGER

C Top of Box Elevation 22.22 ft.
☐ Referenced to Mean Sea Level
☒ Referenced to Project Datum

D Casing Length 23.5 ft.
Material SCH 40 PVC

E Casing Diameter 3 in.

F Depth to Top Perforations 4 ft.

G Perforated Length 20 ft.
Perforated Interval from 4 to 24 ft.
Perforation Type FACTORY SLOTTED
Perforation Size 0.020

H Surface Seal 2.5 ft.
Seal Material CONCRETE

I Backfill ft.
Backfill Material

J Seal 0.5 ft.
Seal Material BENTONITE

K Gravel Pack 21 ft.
Pack Material LONESTAR 2/12 & #3

L Bottom Seal ft.
Seal Material

M CHRISTY BOX

GSI GeoStrategies Inc.

Well Construction Detail
Former Shell Service Station
15275 Washington Ave.
San Leandro

WELL NO.
S-15

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	5/89		

Field location of boring:

Project No.: 7615 | Date: 4/25/89 | Boring No: S-16

Client: Shell

Location: 15275 Washington Ave/Lewelling

City: San Leandro | Sheet 1 of 2

Logged by: DAF | Driller: Bayland

Casing installation data:

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Top of Box Elevation: | Datum:

Water Level: 8.5'

Time: 10:30am

Date: 4/25/89

PID (ppm)	Blowsft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
				1				PAVEMENT SECTION - 2 feet.
				2				
				3				CLAY WITH GRAVEL (CL) -dark grayish brown (10 YR 4/2); medium stiff; damp; 5% subrounded pebbles; slight mottling.
				4				
560	150	S&H	S-16-5'	5				CLAY (CL) -dark grayish brown (10YR 4/2); medium stiff; moist; 5% silt; slight mottling; strong chemical odor.
		push		6				
				7				
				8				
				9				▼
0	3	S&H	S-16-	10				CLAY (CL) -very dark grayish brown (10YR 3/2); stiff; damp; increasing silt; trace sand; root structures.
	4		10'					
	6							
				11				
				12				
				13				
				14				
0	3	S&H	S-16-	15				CLAY (CL) -grayish brown (10YR 5/2); stiff; damp; trace organics; mottled; root structures.
	6		15'					
	7							
				16				
				17				
				18				
				19				
0	3	S&H	S-16-	20				SANDY CLAY (CL) -pale brown (10YR 6/3); stiff; damp.
	4		20'					

Remarks:

GeoStrategies Inc.

BORING NO. S-16

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	Cliff CEG 1262	5/89		

Field location of boring:

Project No.: 7615	Date: 4/25/89	Boring No: S-16	
Client: Shell			
Location: 15275 Washington Ave/Lewelling			
City: San Leandro		Sheet 2 of 2	
Logged by: DAF	Driller: Bayland		

Casing installation data:

Drilling method: Hollow Stem Auger

Hole diameter: 8 inch

Top of Box Elevation: Datum:

Water Level				
Time				
Date				

OVA (ppm)	Blowcnt. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	5							▽
				21				CLAYEY SAND (SC) -pale brown (10 YR 6/3); loose; saturated.
				22				
				23				
				24				
0	1	S&H	S-16-					SILTY CLAY (CL-ML) -brown (10YR 5/3); soft; damp; 10% silt; <10% fine sand;
	1		25'	25				trace organics; mottled gray & orange.
	1							
								Bottom of boring 24.0 feet, sampled to 25.5 feet. 4/25/89

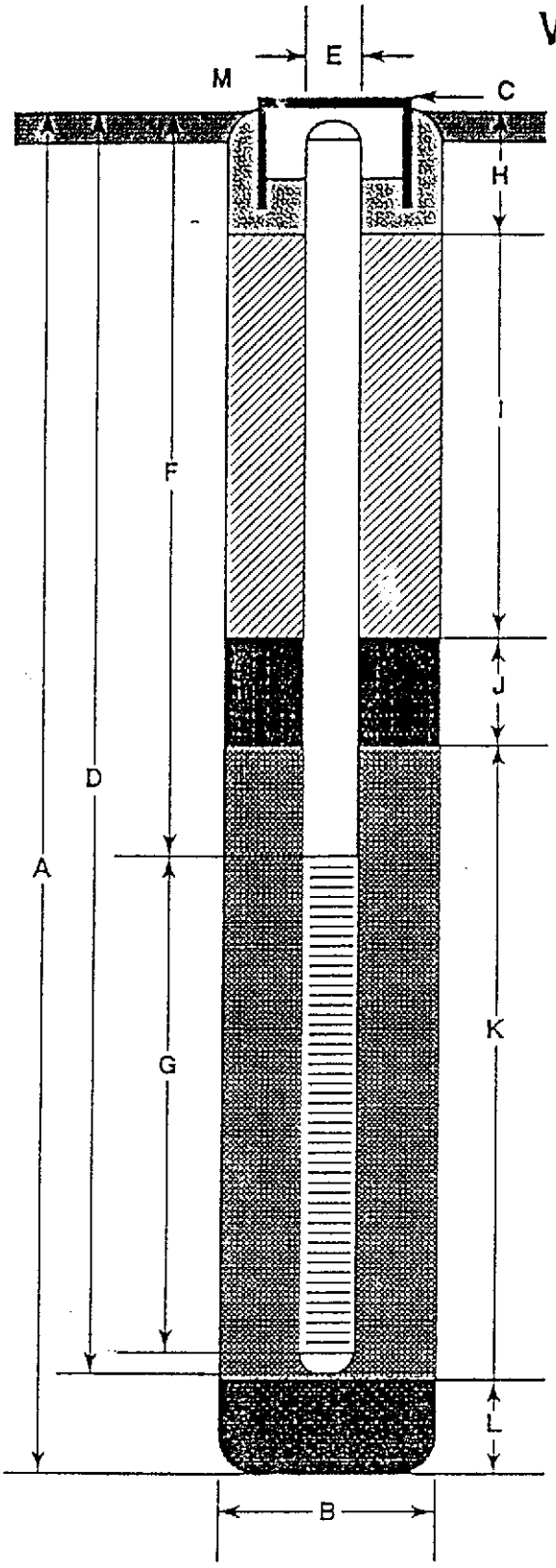
Remarks:

GeoStrategies Inc.

BORING NO. S-16

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/89		

WELL CONSTRUCTION DETAIL



A Total Depth of Boring 24 ft.

B Diameter of Boring 8 in.
Drilling Method HOLLOW STEM AUGER

C Top of Box Elevation 21.82 ft.
☐ Referenced to Mean Sea Level
☒ Referenced to Project Datum

D Casing Length 23.5 ft.
Material SCH 40 PVC

E Casing Diameter 3 in.

F Depth to Top Perforations 4 ft.

G Perforated Length 20 ft.
Perforated Interval from 4 to 24 ft.
Perforation Type FACTORY SLOTTED
Perforation Size 0.020

H Surface Seal 2.5 ft.
Seal Material CONCRETE

I Backfill ft.
Backfill Material

J Seal 0.5 ft.
Seal Material BENTONITE

K Gravel Pack 21 ft.
Pack Material LONESTAR 2/12 & #3

L Bottom Seal ft.
Seal Material

M CHRISTY BOX

GeoStrategies Inc.

Well Construction Detail
Former Shell Service Station
15275 Washington Ave.
San Leandro

WELL NO. S-16

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	5/89		

Field location of boring:

Project No.: 7615 | Date: 4/25/89 | Boring No: S-17

Client: Shell

Location: 15275 Washington Ave/Lewelling

City: San Leandro | Sheet 1 of 2

Logged by: DAF | Driller: Bayland

Casing installation data:

Drilling method: Hollow Stemm Auger

Hole diameter: 8 inch

Top of Box Elevation: | Datum:

Water Level	7.5'							
Time	12.50 pm							
Date	4/25/89							

PID (ppm)	Blowsft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
				1				PAVEMENT SECTION - 2 feet.
				2				
				3				SILTY SAND (SM) -very dark gray (5Y 3/1); loose; dry; >50% very fine to fine sand; trace clay.
				4				
12.5	150	S&H	S-17-5'	5				SILTY CLAY (CL-ML) -dark greenish gray (5GY 4/1); medium stiff; damp; 5% very fine to fine sand; slight mottling - olive green & gray; moderate chemical odor.
		push		6				
				7				
				8				▼ SANDY SILT (ML) -dark greenish gray (5GY 4/1); loose; saturated; 40% fine to very fine sand; 10% clay; weak chemical odor.
				9				
0	3	S&H	S-17-	10				
	4		10'					
	7			11				SILTY CLAY WITH SAND (CL-ML) -dark gray (5Y 4/1), stiff; damp; 15-20% very fine to fine sand; trace caliche nodules; trace organics; mottled; rootholes.
				12				
				13				
				14				gravels up to 1 cm at 14 feet.
NM	2	SPT		15				CLAY (CL) -grayish brown (5Y 5/2); stiff; damp; trace caliche nodules up to 1 cm; mottled; occasional sand lens.
	4							
	7							
				16				
				17				
				18				SANDY SILT (ML) -light yellowish brown (10 YR 6/4); loose; saturated; 30% very fine to fine sand; trace clay; trace caliche nodules; trace medium grain sized sand.
				19				
NM	2	SPT		20				
	2							

Remarks:

GeoStrategies Inc.

BORING NO. S-17

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	5/89		

Field location of boring:

Project No.: 7615 | Date: 4/25/89 | Boring No: S-17
Client: Shell
Location: 15275 Washington Ave/Lewelling
City: San Leandro | Sheet 2 of 2
Logged by: DAF | Driller: Bayland
Casing installation data:

Drilling method: Hollow Stemm Auger
Hole diameter: 8 inch
Top of Box Elevation: | Datum:

Water Level			
Time			
Date			

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	4							increasing clay at 20.5 feet.
				21				
				22				
				23				SILTY CLAY (CL-ML) -olive (5Y 5/3);
				24				firm; damp; 10% very fine to fine sand;
NM	NM	SPT						trace caliche nodules; trace medium to
				25				coarse grain sized sand; trace organics;
								trace saturated silt pockets.
								Bottom of boring 24.0 feet,
								Sampled to 25.5 feet.
								4/25/89

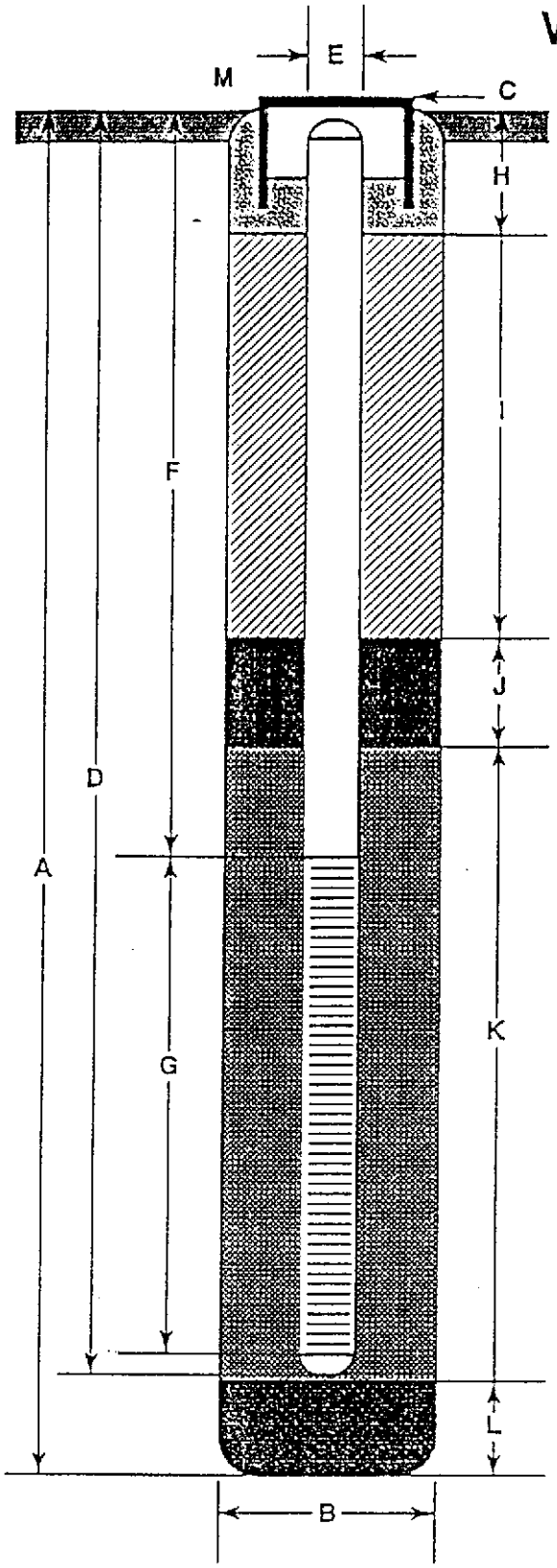
Remarks:

GeoStrategies Inc.

BORING NO. S-17

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/89		

WELL CONSTRUCTION DETAIL



A Total Depth of Boring 24 ft.

B Diameter of Boring 8 in.
Drilling Method HOLLOW STEM AUGER

C Top of Box Elevation 20.95 ft.
☐ Referenced to Mean Sea Level
☒ Referenced to Project Datum

D Casing Length 23.5 ft.
Material SCH 40 PVC

E Casing Diameter 3 in.

F Depth to Top Perforations 4 ft.

G Perforated Length 20 ft.
Perforated Interval from 4 to 24 ft.
Perforation Type FACTORY SLOTTED
Perforation Size 0.020

H Surface Seal 2.5 ft.
Seal Material CONCRETE

I Backfill ft.
Backfill Material

J Seal 0.5 ft.
Seal Material BENTONITE

K Gravel Pack 21 ft.
Pack Material LONESTAR 2/12 & #3

L Bottom Seal ft.
Seal Material

M CHRISTY BOX

GeoStrategies Inc.

Well Construction Detail
Former Shell Service Station
15275 Washington Ave.
San Leandro

WELL NO.
S-17

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP RG 12862	5/89		

Field location of boring: (See Plate 2)	Project No.: 7615	Date: 10/27/89	Boring No: SR-1
	Client: Shell Oil Company		
	Location: 15275 Washington Avenue		
	City: San Leandro, California		Sheet 1 of 3
	Logged by: M.J.J.	Driller: Bayland	
Drilling method: Hollow-Stem Auger	Casing installation data: Pilot Boring		
Hole diameter: 8-inches	Top of Box Elevation:		Datum:

Water Level	12.5	10.9	
Time			
Date	10/27/89	10/27/89	

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
								PAVEMENT SECTION - 4 inches
				1				
								FILL - Gravel (GW) - dark brown (10YR 3/3), damp, very loose.
				2				
								FILL - Clay with Silt (CL) - black (5Y 2.5/1), damp, soft, high plasticity; ≤ 5% coarse sand; strong chemical odor.
				3				
				4				
231	2							
	3	S&H	SR1-5	5				
	4							CLAY (CL) - black (2.5Y N3/2), damp, soft, medium plasticity; interbeds of clayey sand (SP-SC); sand is very fine to fine; interbeds occur as discrete units 3 to 5 inches thick; contain 10-20% fines; strong chemical odor.
	3			6				
243	4	S&H	SR1-6.5					
	5			7				
	1							
296	2	S&H	SR1-8	8				
	3							
	2			9				
	4							moderate chemical odor.
373	6	S&H	SR1-10	10				
	2							COLOR CHANGE to black (10YR 3.3) at 10.5 feet.
108	4	S&H		11		▼		SILTY SAND (SM) - moist, loose, interbedded with
	6		SR1-					clayey silt (ML-CL), medium plasticity; no chemical odor.
			11.5	12				
				13				CLAY (CL) - very dark grayish brown (10YR 3/2), damp, stiff, high plasticity; fractured texture; no chemical odor.
				14				
	2							
4.3	4	S&H	SR1-15	15				
	8							first encountered water at 16.0 feet. Increasing sand at
				16		▽		16 feet. Interbedded clay with sand and clayey sand
								(observed during drilling with bucket auger, 11/16/89)
				17				
				18				
				19				

Remarks:

GeoStrategies Inc.

Log of Boring

BORING NO. SR-1

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CEG 1262	11/89		

Field location of boring:	Project No.: 7615	Date: 10/27/89	Boring No:
(See Plate 2)	Client: Shell Oil Company		SR-1
	Location: 15275 Washington Avenue		
	City: San Leandro, California		Sheet 2 of 3
	Logged by: M.J.J.	Driller: Bayland	
Drilling method: Hollow-Stem Auger	Casing installation data: Pilot Boring		
Hole diameter: 8-inches	Top of Box Elevation:	Datum:	

	Water Level			
	Time			
	Date			

PID (ppm)	Blows/ft or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	2							
80	4	S&H	SR1-20	20				
	6							
				21				CLAYEY SILT (ML-CL) - light olive brown (2.5Y 5/4), saturated, medium plasticity; 30% clay; 5% fine to medium sand; no chemical odor.
				22				
				23				
				24				CLAY with SAND (CL) - olive gray (5Y 4/2), saturated, stiff, high plasticity; 20% very fine to fine sand; no chemical odor.
	3							
66	3	S&H	SR1-30	25				
	6							
				26				SILT with SAND (ML) - light olive brown (2.5Y 5/4), saturated, stiff; 15% fine to medium sand; 20-30% clay; no chemical odor.
				27				
				28				
				29				SAND with SILT (SP-SM) - light olive brown (5Y 4/2), fine sand, saturated, medium dense; well sorted; 10% silt; trace clay; laminae of silt 0.25 inches thick in shoe; iron oxide staining; no chemical odor.
	3							
10	8	S&H	SR1-30	30				
	10							
				31				
				32				
				33				
				34				SILTY SAND (SM) - light olive brown (5Y 4/2), saturated, dense; very fine to medium sand; 15% silt; trace clay; no chemical odor.
	5							
34	7	S&H	SR1-35	35				
	18							
				36				
				37				
				38				
				39				SAND (SP) - dark grayish brown (2.5Y 3/2), saturated, dense, very fine to medium sand; interbeds of fine

Remarks:

GSI GeoStrategies Inc.

Log of Boring

BORING NO. SR-1

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP CEG 1262	11/89		

Field location of boring:	Project No.: 7615	Date: 10/27/89	Boring No:
(See Plate 2)	Client: Shell Oil Company		SR-1
	Location: 15275 Washington Avenue		
	City: San Leandro, California		Sheet 3
	Logged by: M.J.J.	Drill: Bayland	of 3
	Casing installation data: Pilot Boring		
Drilling method: Hollow-Stem Auger	Top of Box Elevation:		Datum:
Hole diameter: 8-inches	Water Level		
	Time		
	Date		

PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Description
	9							silty sand 0.5 to 3.0 inches thick; no chemical odor.
8.2	13	S&H	SR1-40	40				
	17							Bottom of boring at 40.5 feet.
				41				Bottom of sample at 40.5 feet.
								10/27/89
				42				
				43				
				44				
				45				
				46				
				47				
				48				
				49				
				50				
				51				
				52				
				53				
				54				
				55				
				56				
				57				
				58				
				59				

Remarks: Boring caved to 30 feet, Bentonite from 19 to 30 feet.

GeoStrategies Inc.

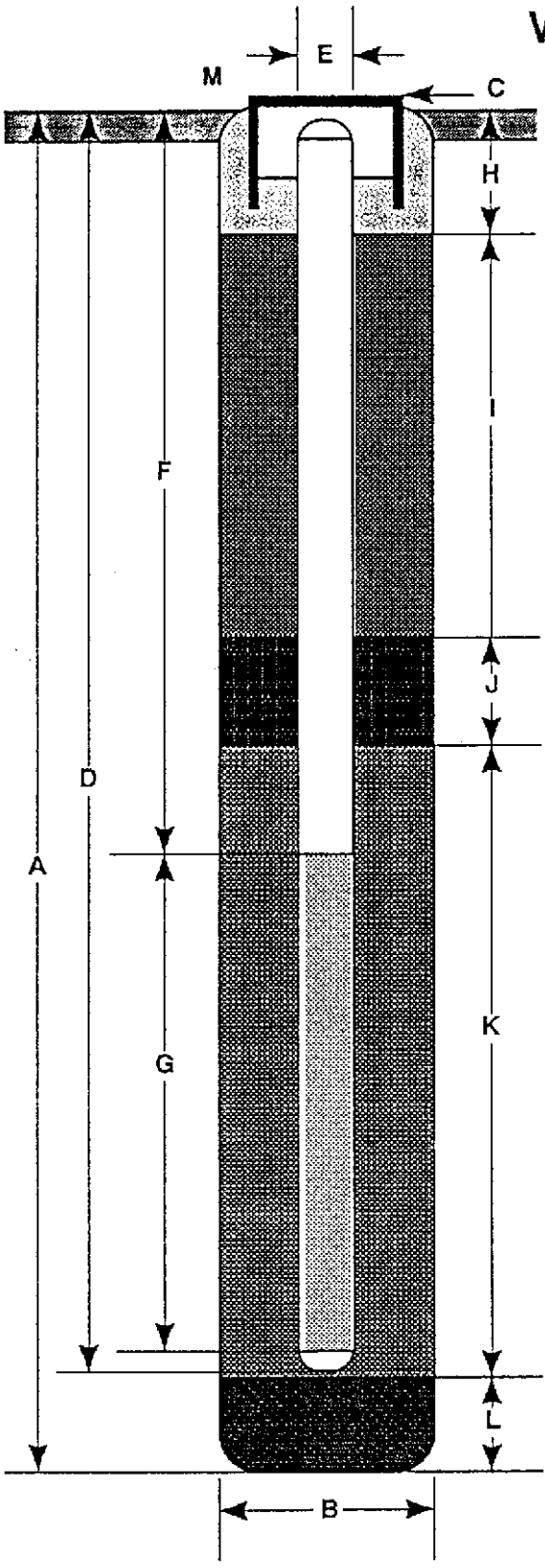
Log of Boring

BORING NO.

SR-1

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP 12/62	11/89		

WELL CONSTRUCTION DETAIL



A Total Depth of Boring 40.5 ft.

B Diameter of Boring 20 in.
Drilling Method Bucket Auger

C Top of Box Elevation ft.
☐ Referenced to Mean Sea Level
☐ Referenced to Project Datum

D Casing Length 21 ft.
Material Schedule 40 PVC

E Casing Diameter 6 in.

F Depth to Top Perforations 6.5 ft.

G Perforated Length 15 ft.
Perforated Interval from 6.5 to 21.5 ft.
Perforation Type Machine Slot
Perforation Size 0.020 in.

H Surface Seal from 0.5 to 1.0 ft.
Seal Material concrete

I Backfill from 1.0 to 4.5 ft.
Backfill Material cement

J Seal from 4.5 to 5.5 ft.
Seal Material Bentonite

K Gravel Pack from 5.5 to 21.5 ft.
Pack Material 2/12 Lonestar sand

L Bottom Seal 21.5-30 ft.
Seal Material Bentonite

M Christy Box

Note: 30 to 40.5 Native Material (slough)

GeoStrategies Inc.

Well Construction Detail

WELL NO. SR-1

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615	CWP CEG 1262	10/89		

APPENDIX B
SLUG TEST FIELD DATA PLOTS

SLUG TEST

Date March 29, 1990

Well S-1

Slug-in

V = 0.458 gals

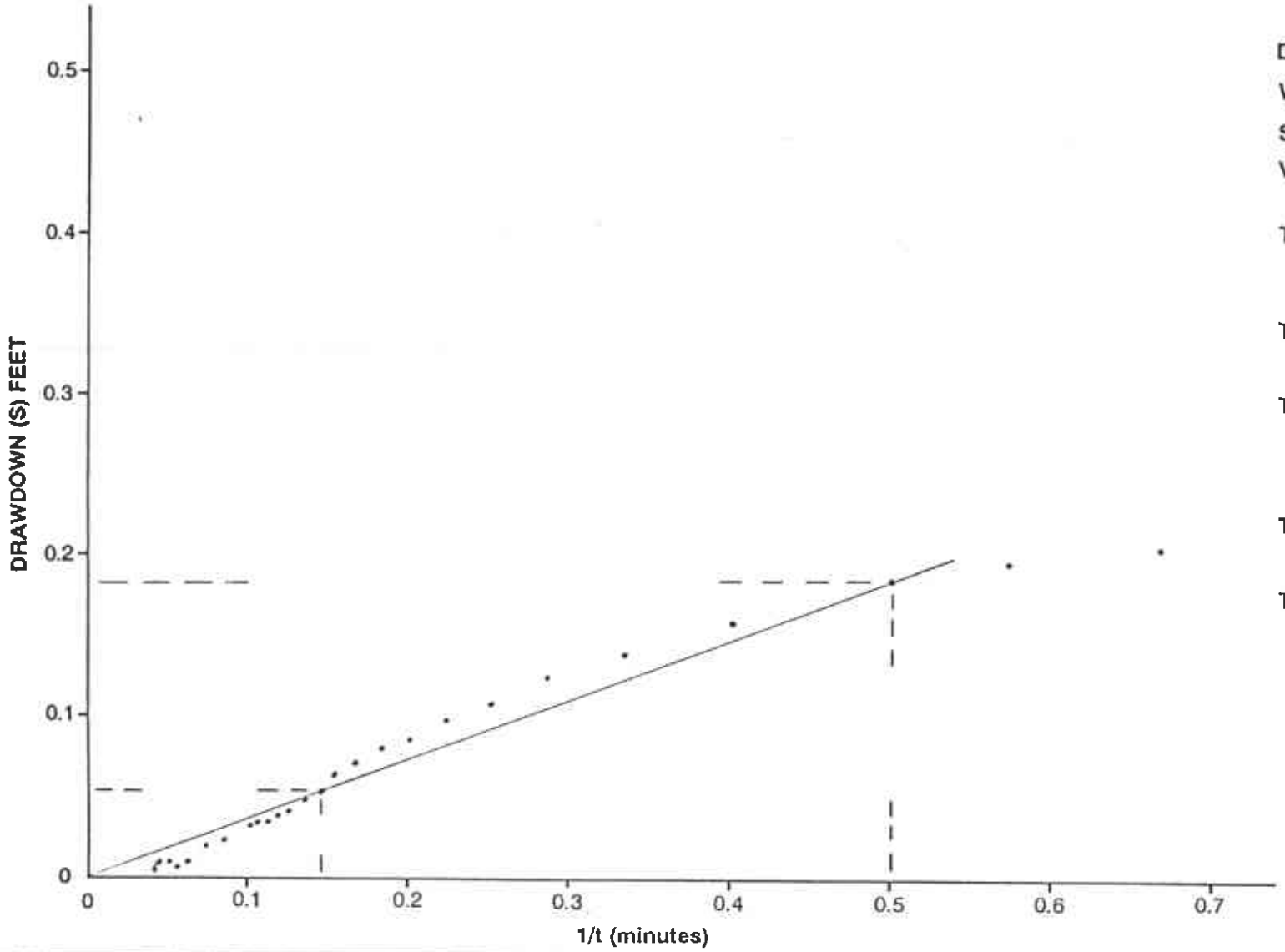
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.185}$$

T_E = 141.9 gpd/ft

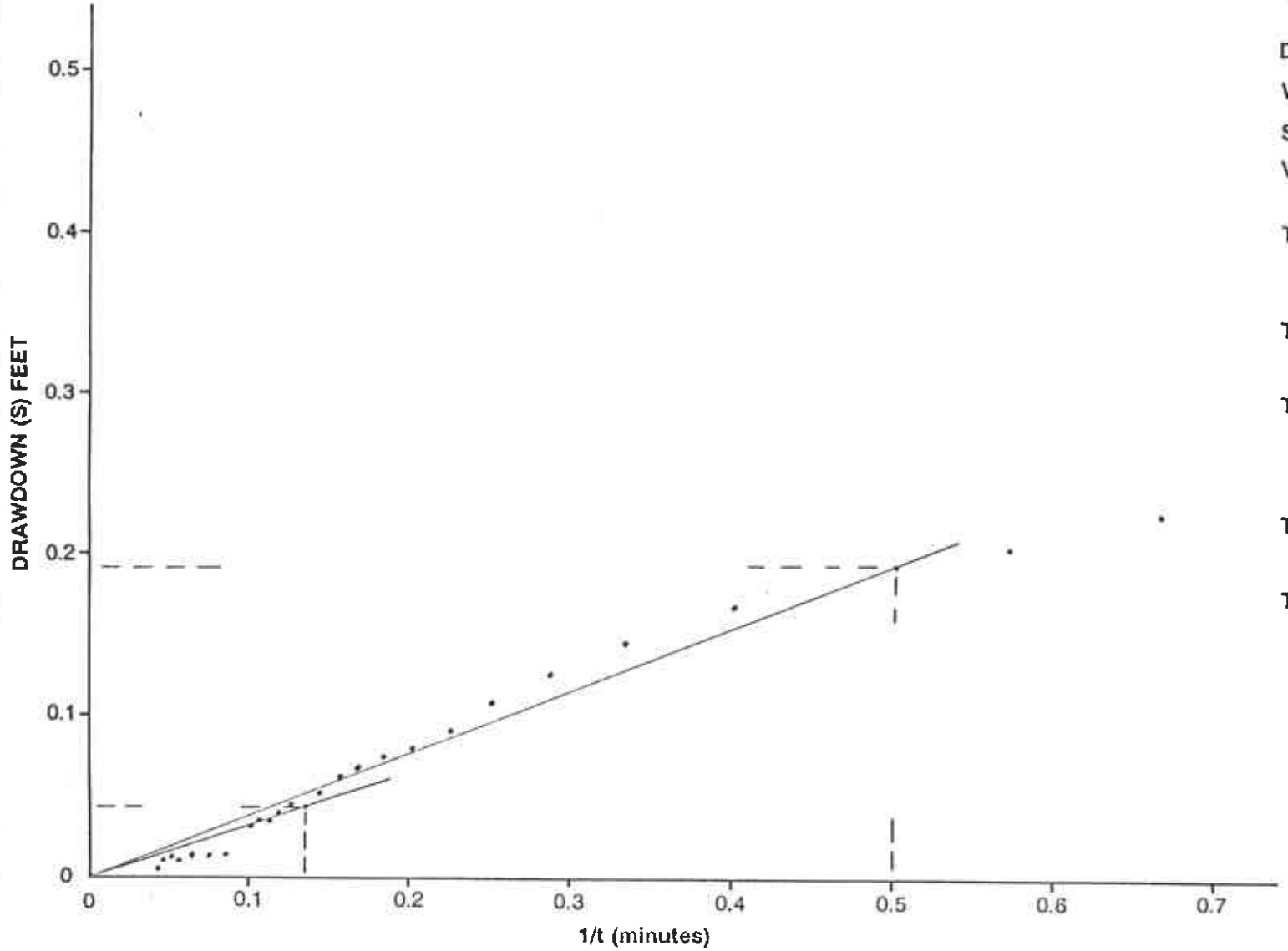
$$T_L = \frac{114.6\ (0.458)\ 0.143}{0.57}$$

T_L = 131.7 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 29, 1990

Well S-1

Slug- out

V = 0.458 gals

$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.196}$$

T_E = 133.8 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.132}{0.045}$$

T_L = 153.9 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 28, 1990

Well S-3

Slug-in

V = 0.458 gals

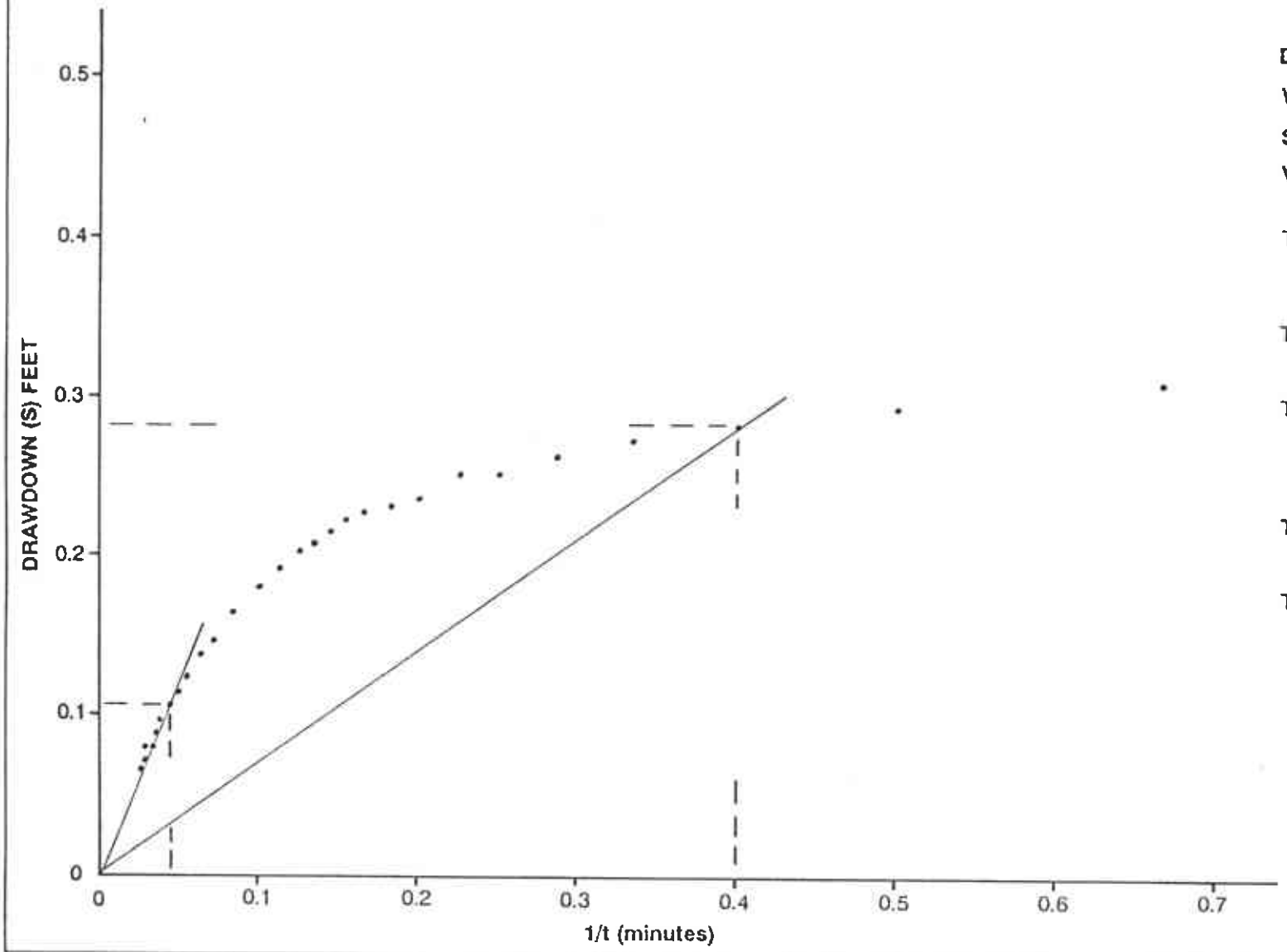
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.4}{0.28}$$

T_E = 75 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.045}{0.107}$$

T_L = 22 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 28, 1990

Well S-3

Slug-out

V = 0.458 gals

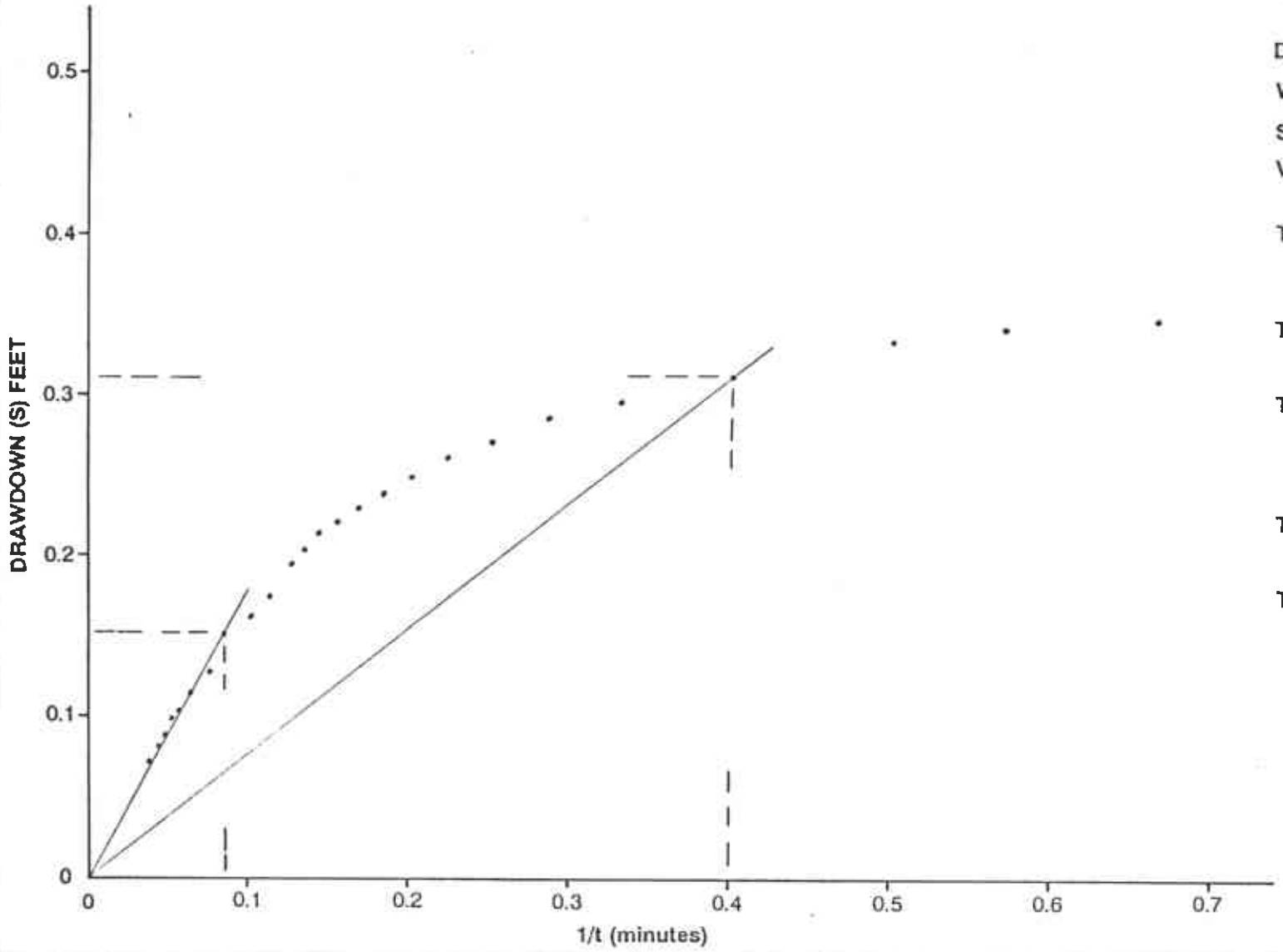
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.4}{0.315}$$

T_E = 66.7 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.082}{0.155}$$

T_L = 27.8 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 28, 1990

Well S-5

Slug-In

V = 0.82 gals

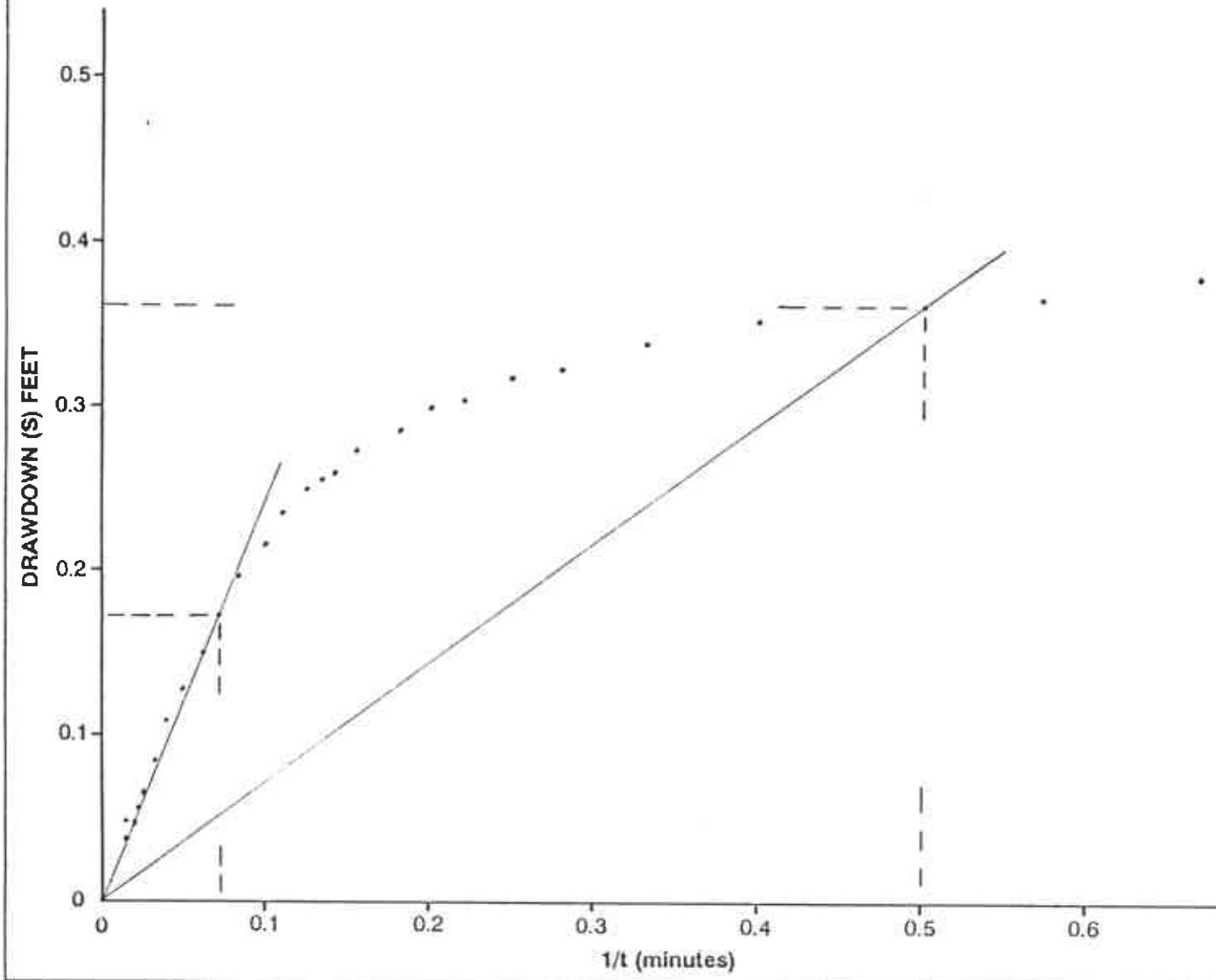
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.82)\ 0.5}{0.367}$$

T_E = 128 gpd/ft

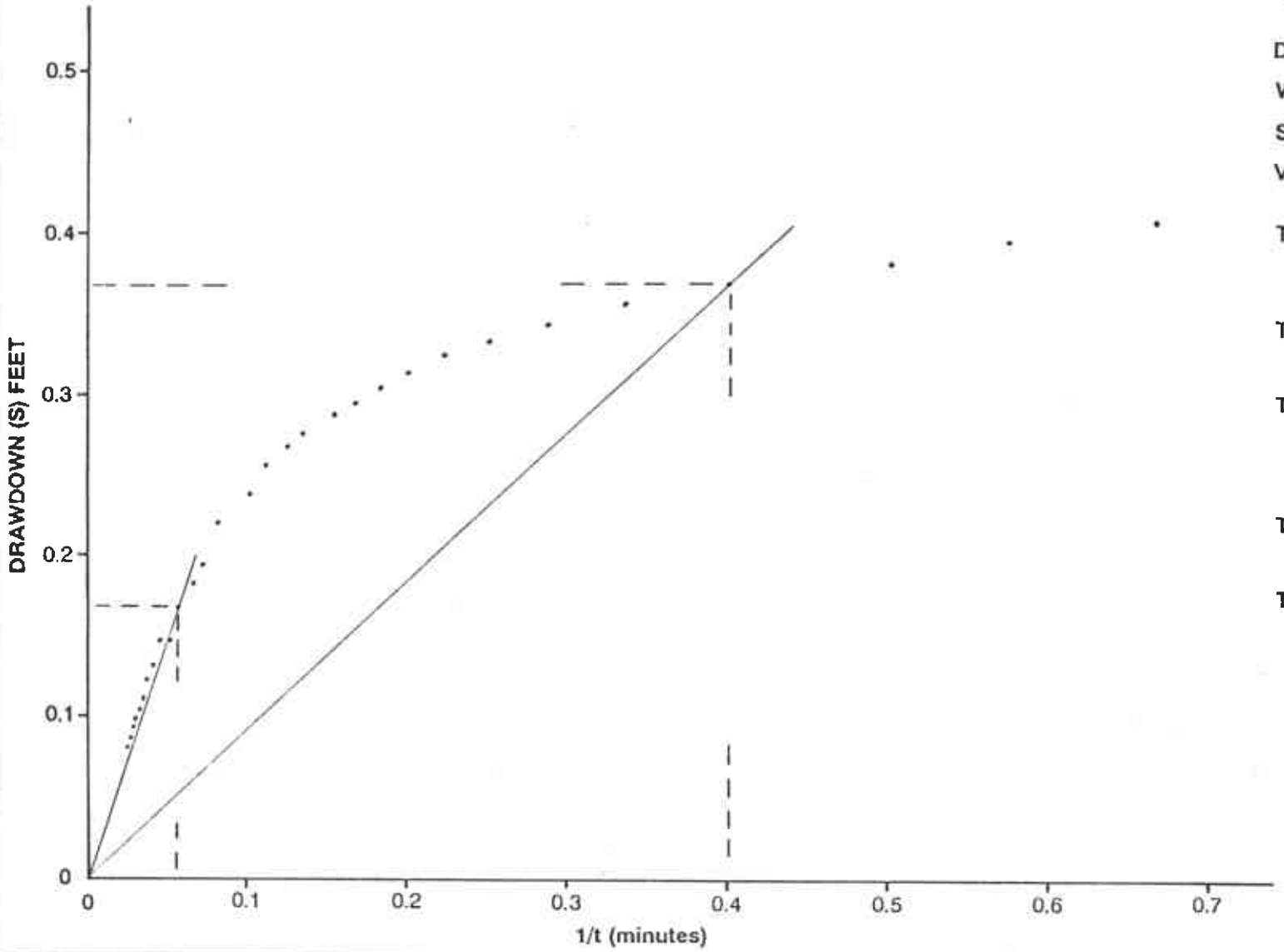
$$T_L = \frac{114.6\ (0.82)\ 0.072}{0.178}$$

T_L = 38 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 28, 1990

Well S-5

Slug-out

V = 0.82 gals

$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.82)\ 0.4}{0.37}$$

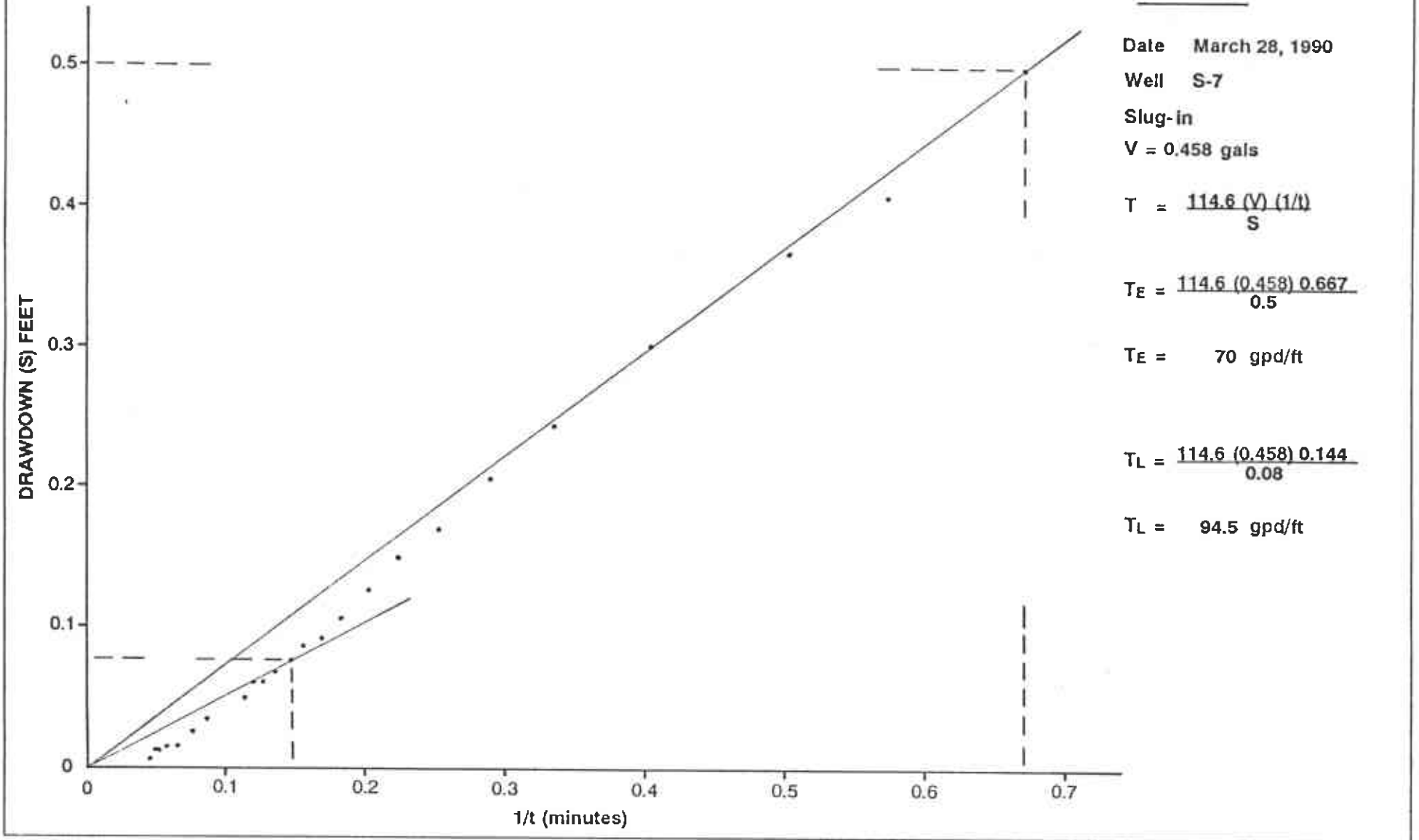
T_E = 101.6 gpd/ft

$$T_L = \frac{114.6\ (0.82)\ 0.055}{0.17}$$

T_L = 30.4 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 28, 1990

Well S-7

Slug-in

V = 0.458 gals

$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.667}{0.5}$$

T_E = 70 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.144}{0.08}$$

T_L = 94.5 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 28, 1990

Well S-7

Slug-out

V = 0.458 gals

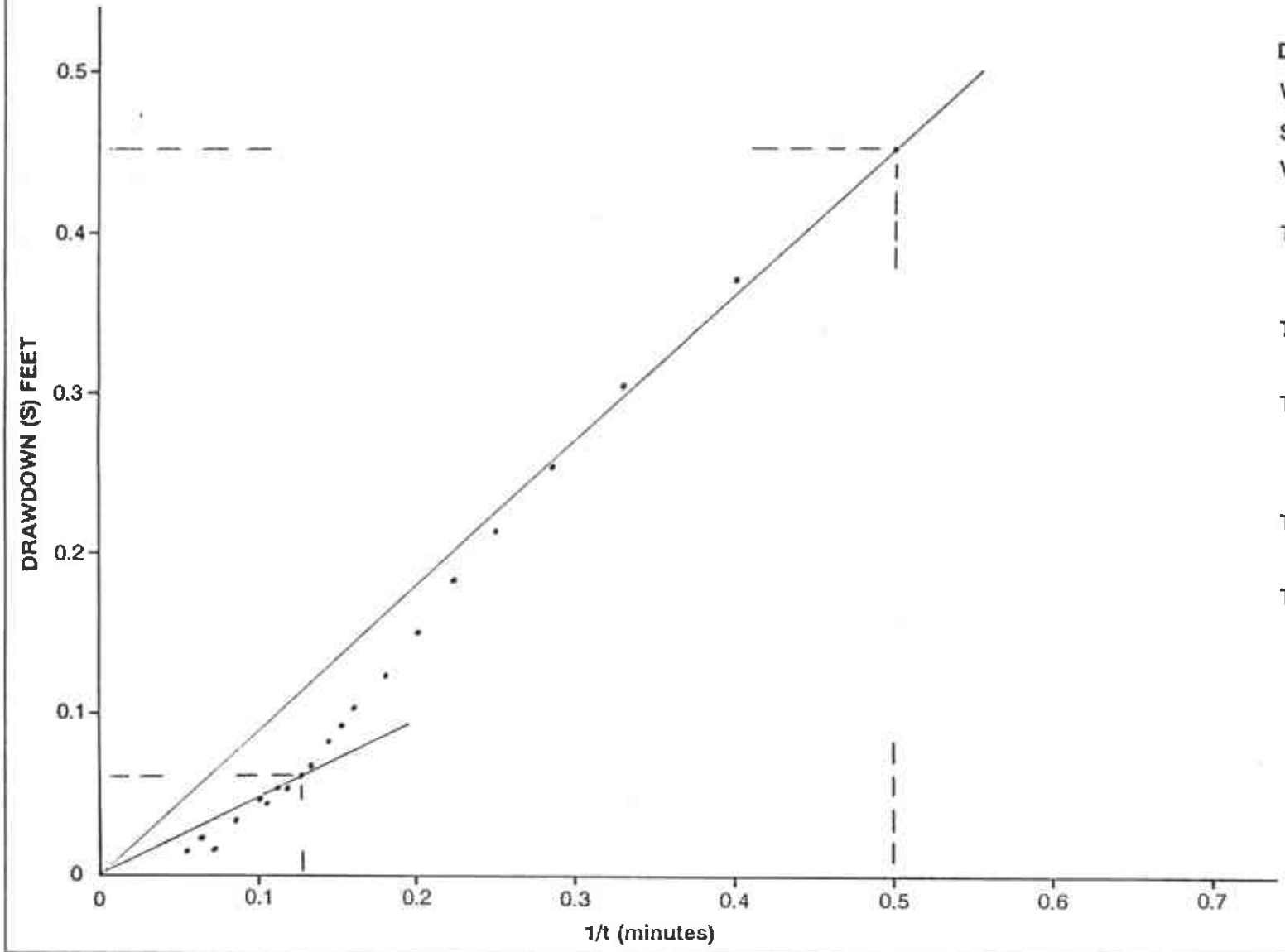
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.456}$$

T_E = 57.6 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.125}{0.06}$$

T_L = 109 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 28, 1990

Well S-9

Slug- in

V = 0.458 gals

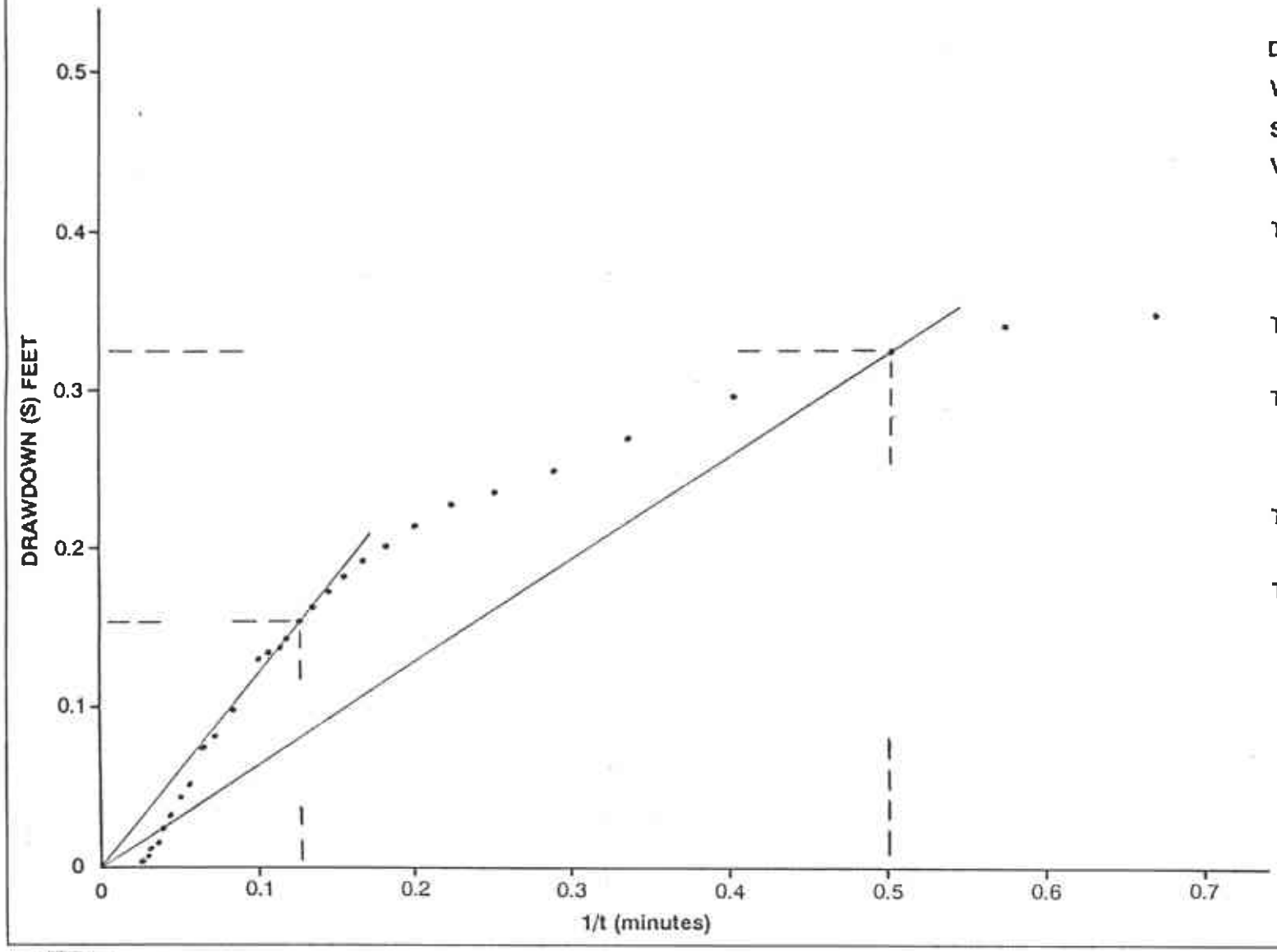
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.33}$$

T_E = 79.5 gpd/ft

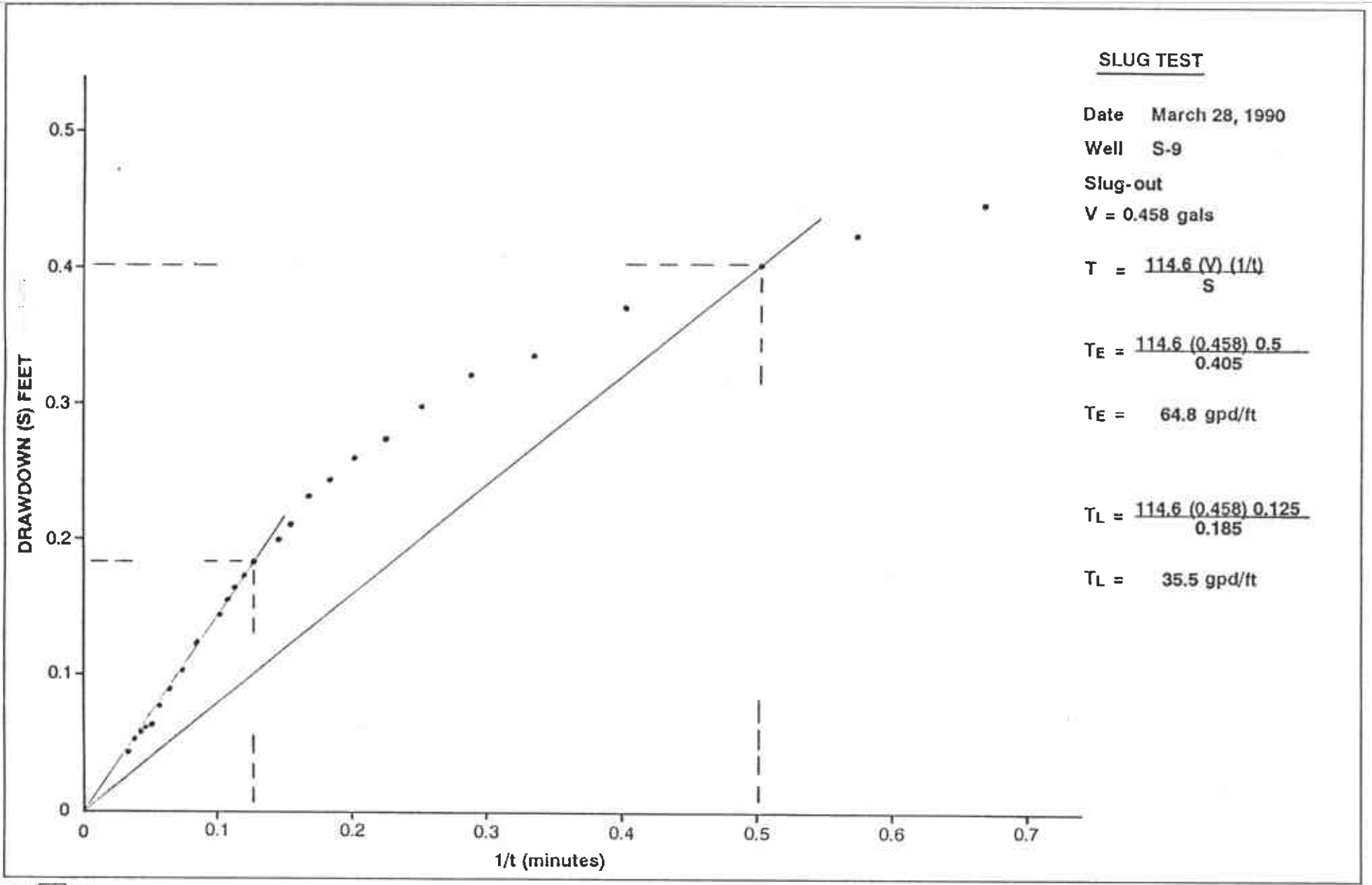
$$T_L = \frac{114.6\ (0.458)\ 0.125}{0.16}$$

T_L = 41 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 28, 1990

Well S-9

Slug-out

V = 0.458 gals

$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.405}$$

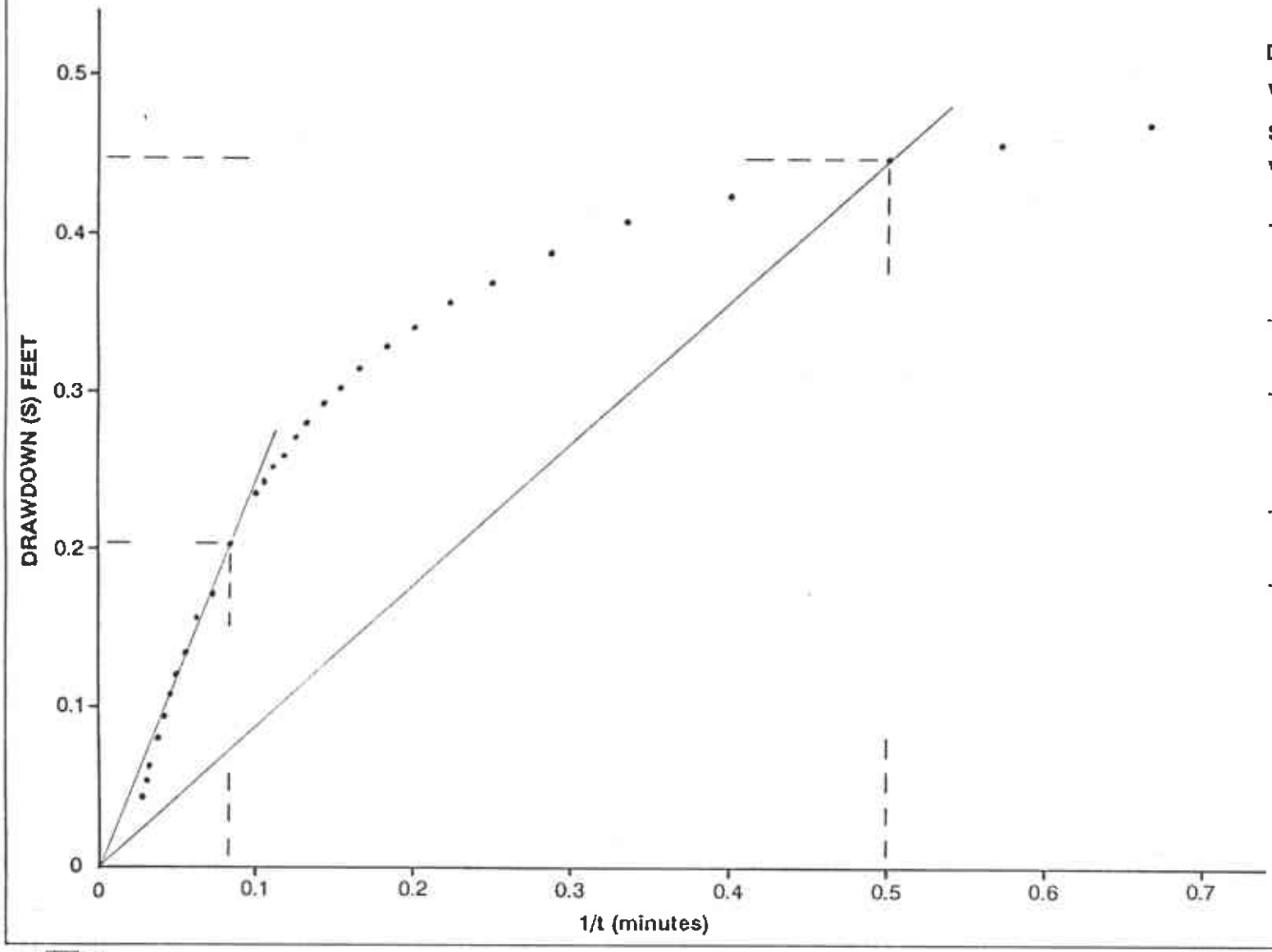
T_E = 64.8 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.125}{0.185}$$

T_L = 35.5 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 29, 1990

Well S-10

Slug-in

V = 0.458 gals

$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.45}$$

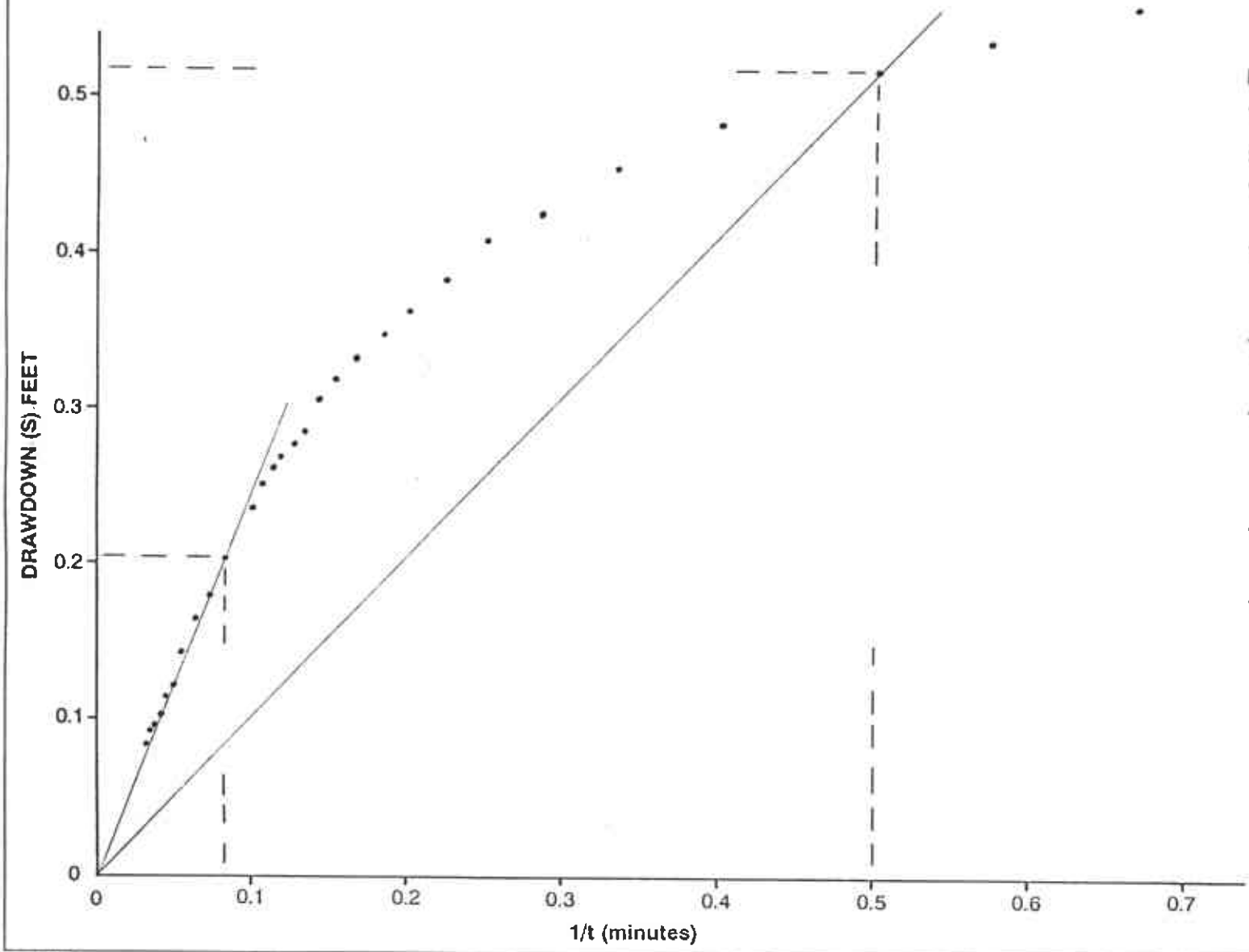
T_E = 58.3 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.082}{0.207}$$

T_L = 20.8 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 29, 1990

Well S-10

Slug-out

V = 0.458 gals

$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.5}{0.52}$$

T_E = 50.5 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.083}{0.208}$$

T_L = 20.9 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 29, 1990

Well S-13

Slug-in

V = 0.458 gals

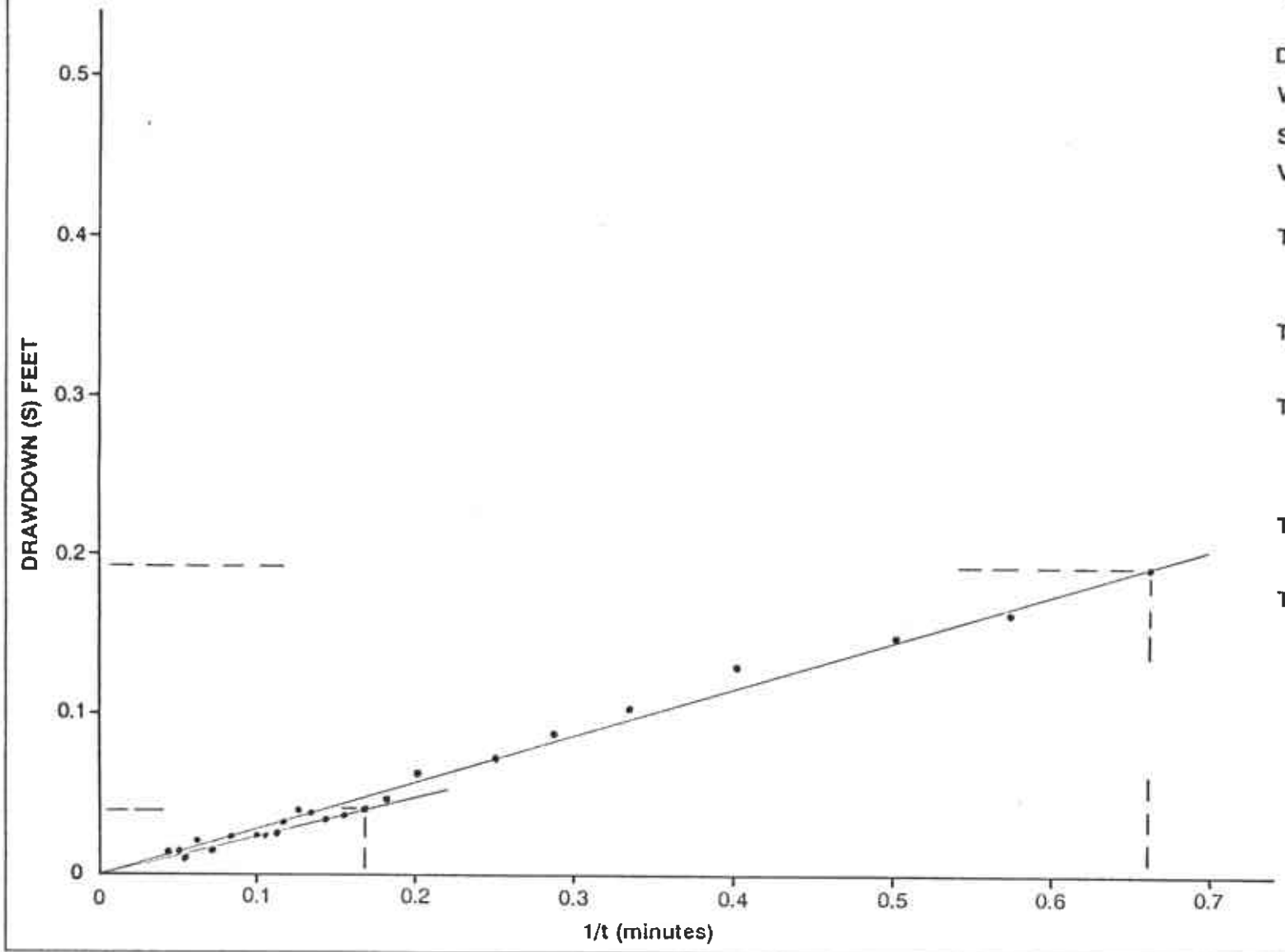
$$T = \frac{114.6\,(V)\,(1/t)}{S}$$

$$T_E = \frac{114.6\,(0.458)\,0.659}{0.197}$$

T_E = 175 gpd/ft

$$T_L = \frac{114.6\,(0.458)\,0.167}{0.041}$$

T_L = 214 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 29, 1990

Well S-13

Slug-out

V = 0.458 gals

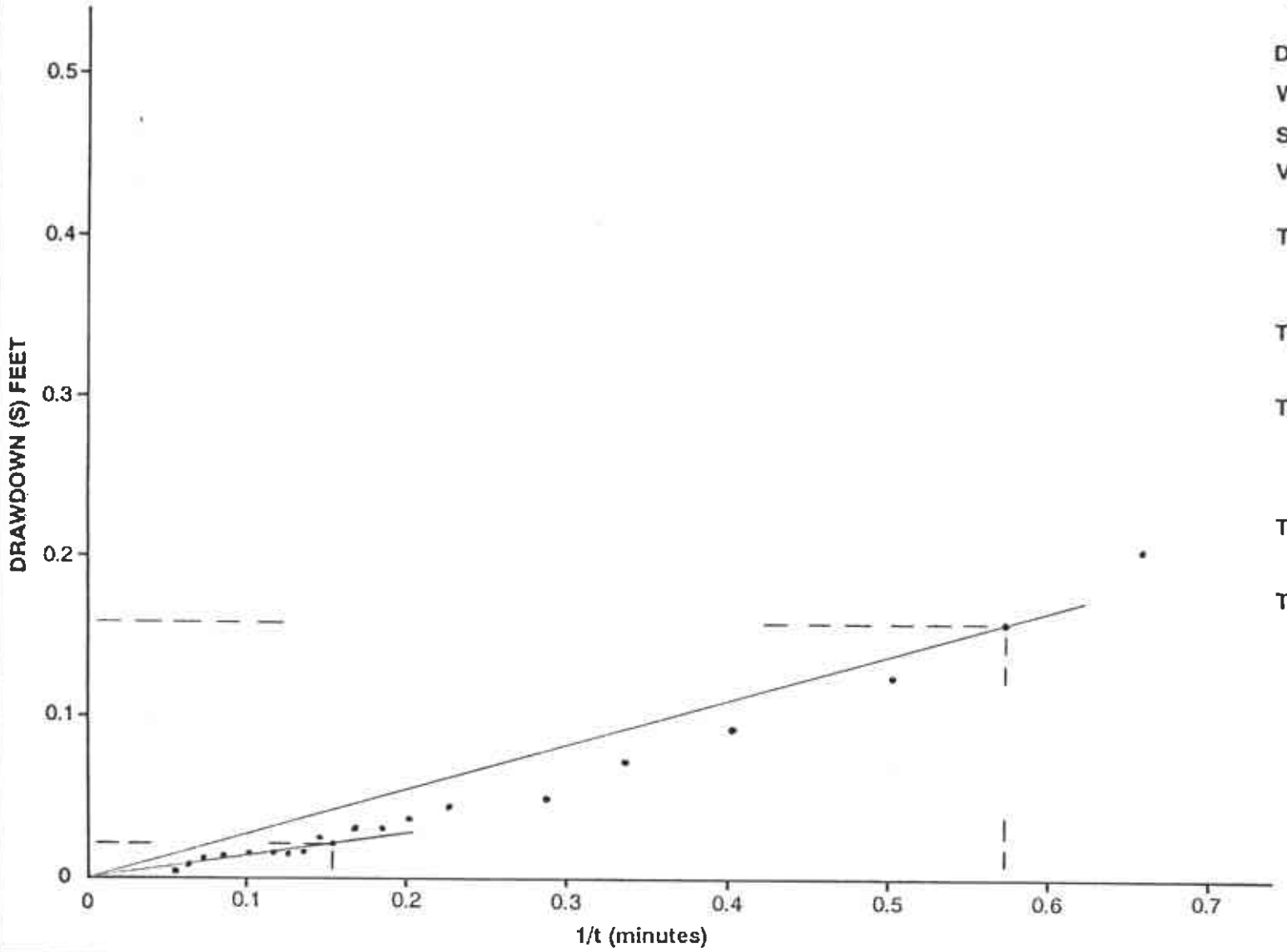
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.569}{0.16}$$

T_E = 186 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.151}{0.021}$$

T_L = 377 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 29, 1990

Well S-14

Slug-in

$V = 0.458$ gals

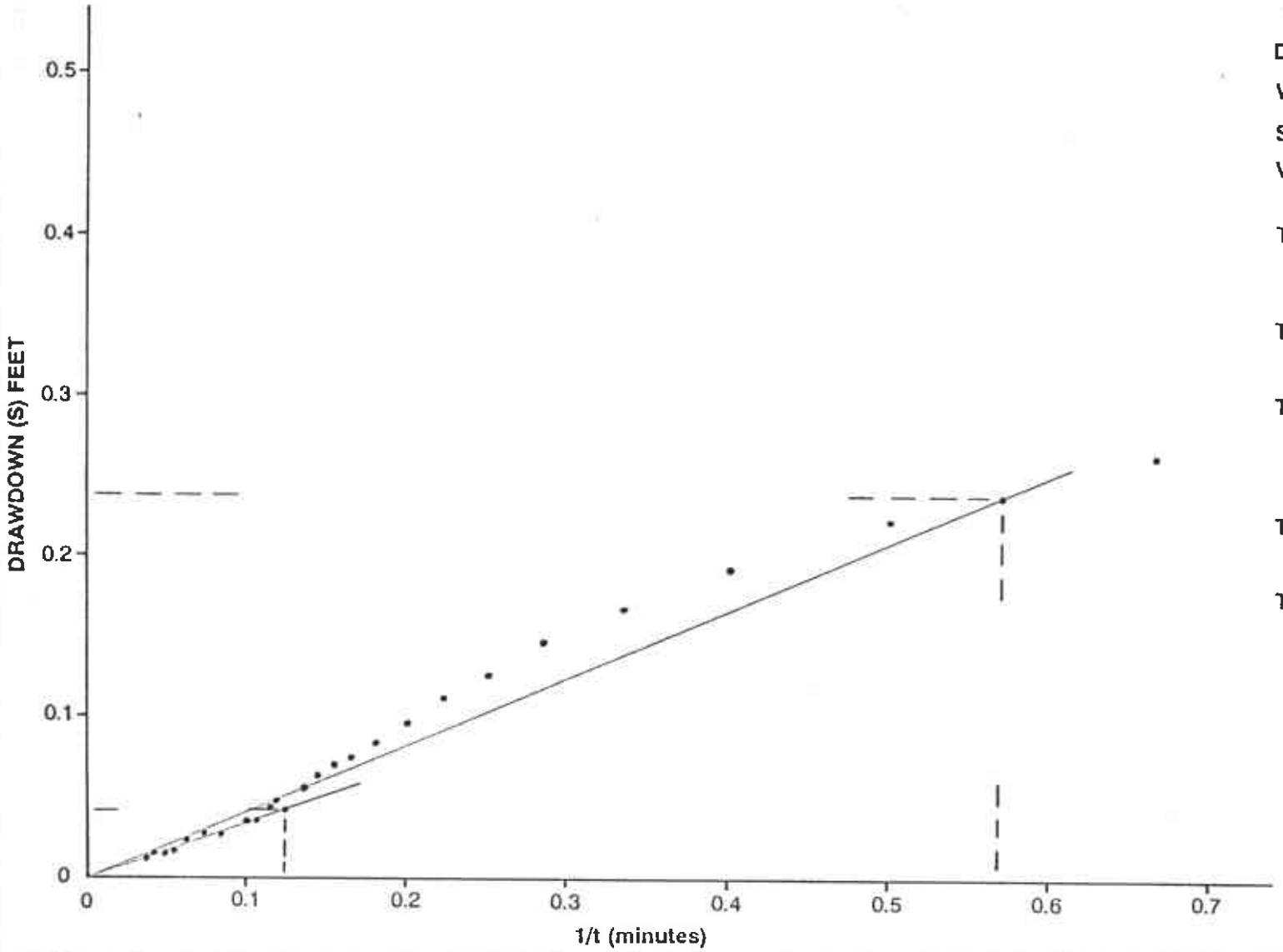
$$T = \frac{114.6\,(V)\,(1/t)}{S}$$

$$T_E = \frac{114.6\,(0.458)\,0.568}{0.240}$$

$T_E =$ 124 gpd/ft

$$T_L = \frac{114.6\,(0.458)\,0.125}{0.042}$$

$T_L =$ 156 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG / CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 29, 1990

Well S-14

Slug-out

V = 0.458 gals

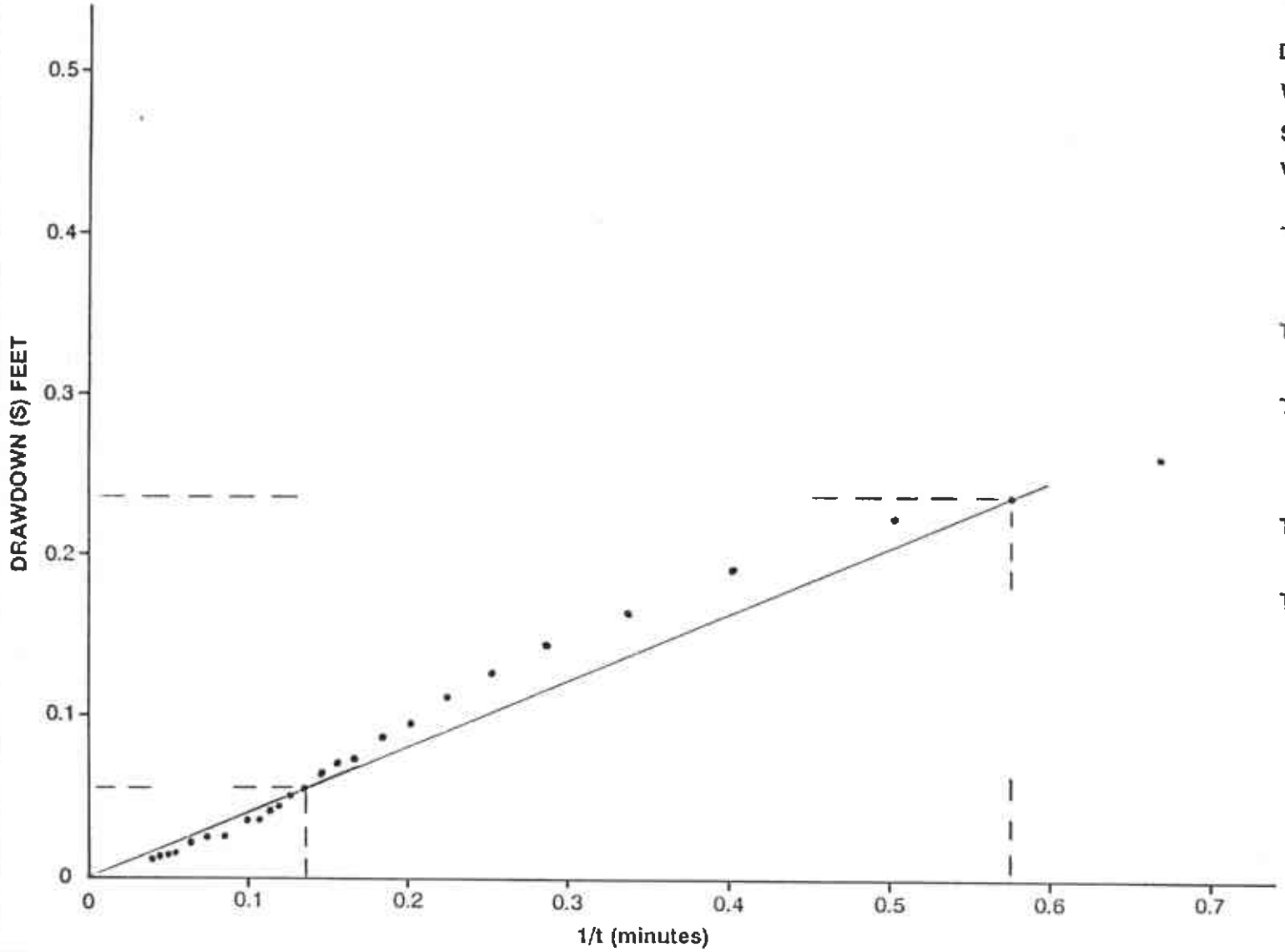
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.574}{0.239}$$

T_E = 126.06 gpd/ft

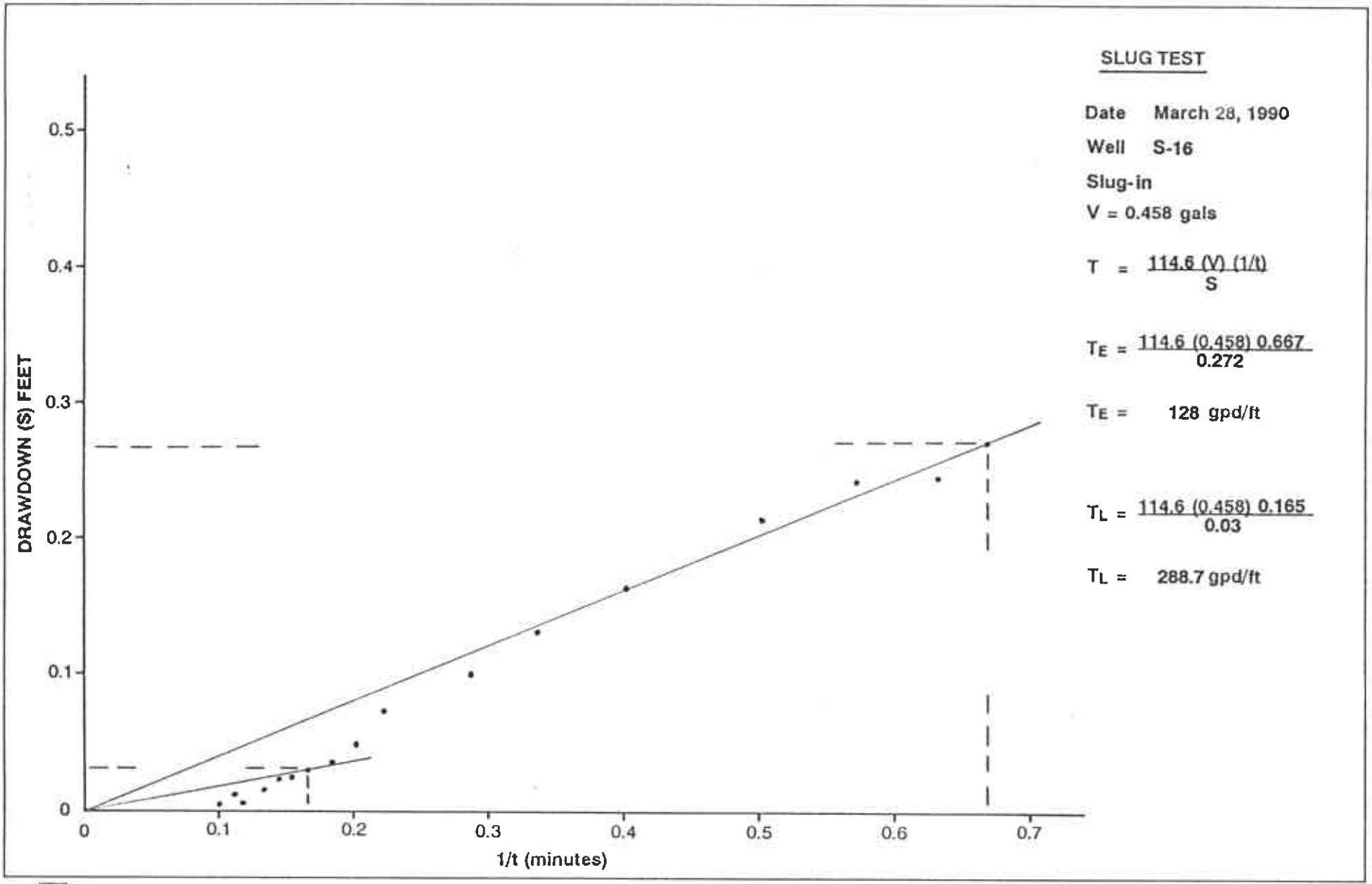
$$T_L = \frac{114.6\ (0.458)\ 0.133}{0.055}$$

T_L = 126.92 gpd/ft



GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		



SLUG TEST

Date March 28, 1990

Well S-16

Slug-in

V = 0.458 gals

$T = \frac{114.6\ (V)\ (1/t)}{S}$

$T_E = \frac{114.6\ (0.458)\ 0.667}{0.272}$

T_E = 128 gpd/ft

$T_L = \frac{114.6\ (0.458)\ 0.165}{0.03}$

T_L = 288.7 gpd/ft

GeoStrategies Inc.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

SLUG TEST

Date March 28, 1990

Well S-16

Slug-out

V = 0.458 gals

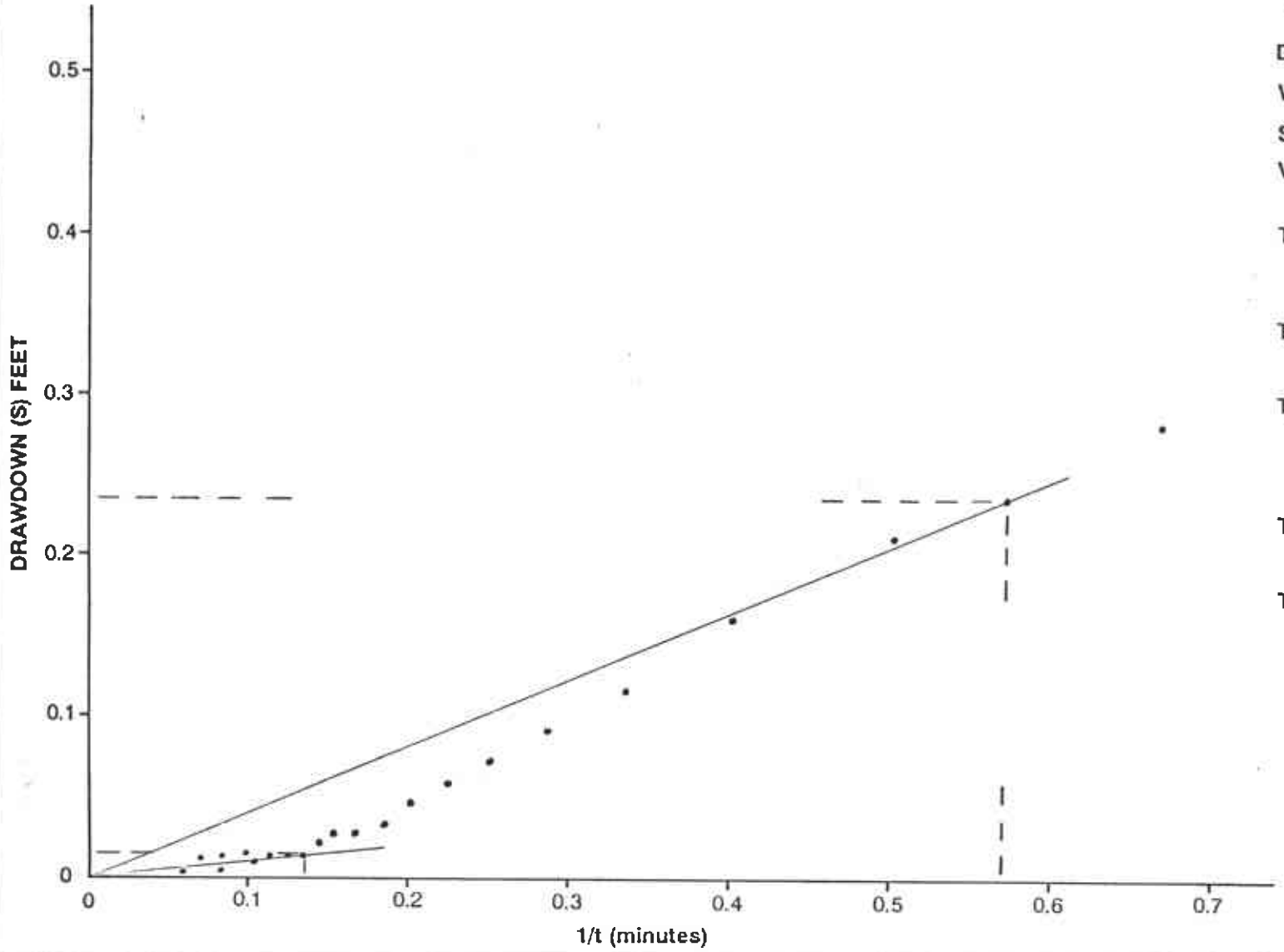
$$T = \frac{114.6\ (V)\ (1/t)}{S}$$

$$T_E = \frac{114.6\ (0.458)\ 0.57}{0.24}$$

T_E = 124.67 gpd/ft

$$T_L = \frac{114.6\ (0.458)\ 0.145}{0.019}$$

T_L = 400.56 gpd/ft

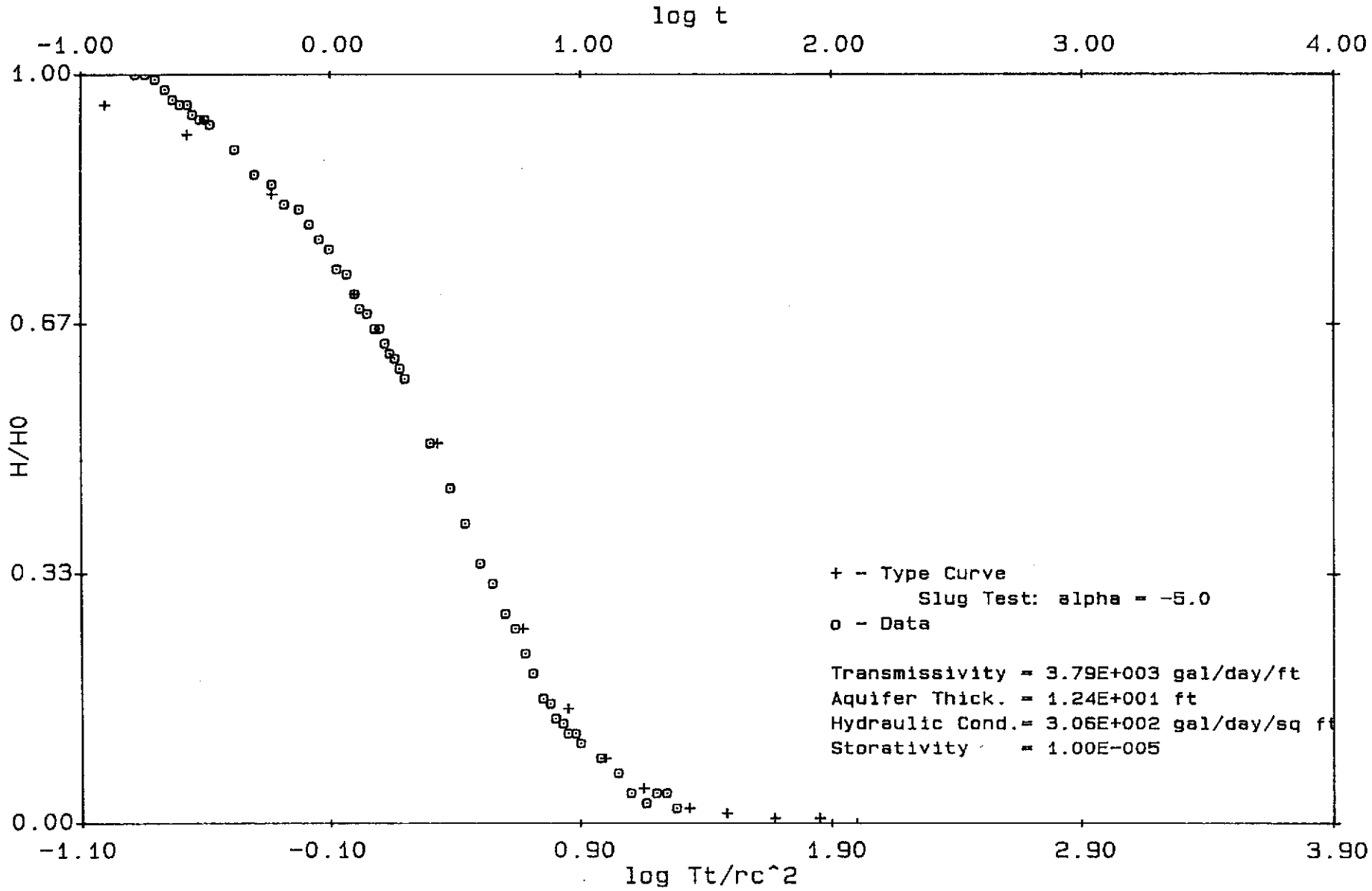


GeoStrategies Inc.

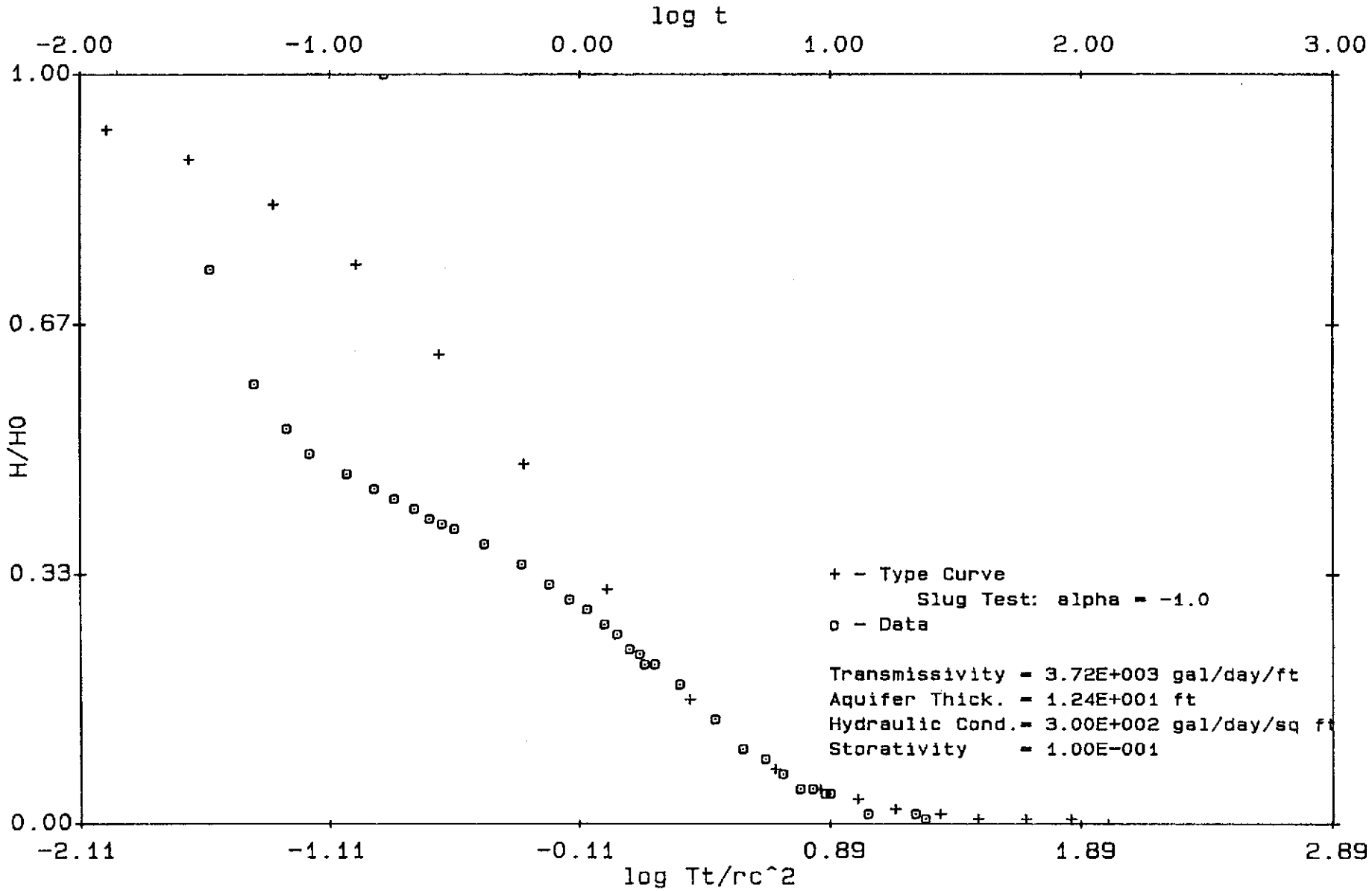
JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
7615		5/90		

APPENDIX C
GWAP SLUG TEST DATA PLOTS

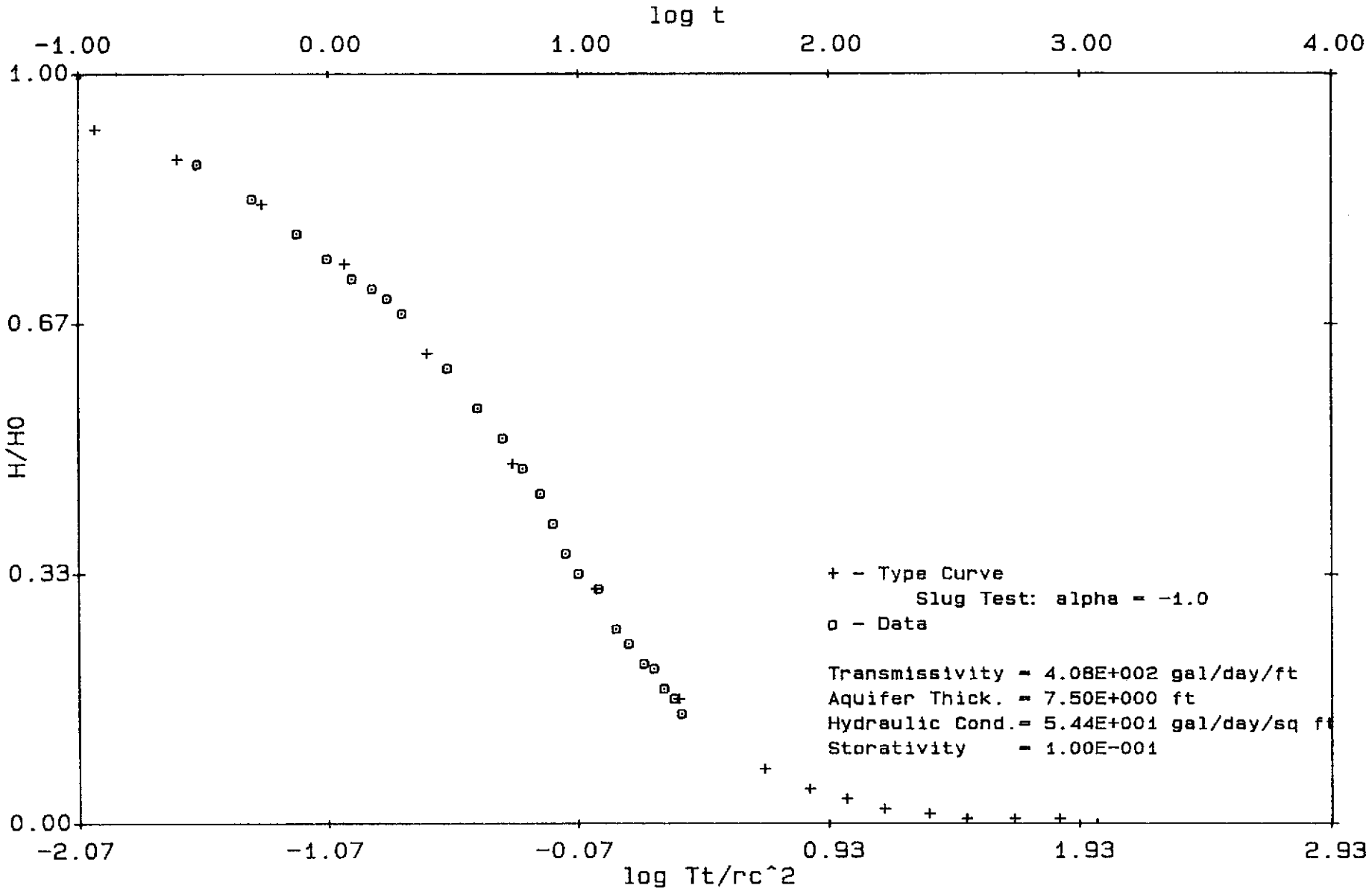
Project # 7615 S-1 Slug-in



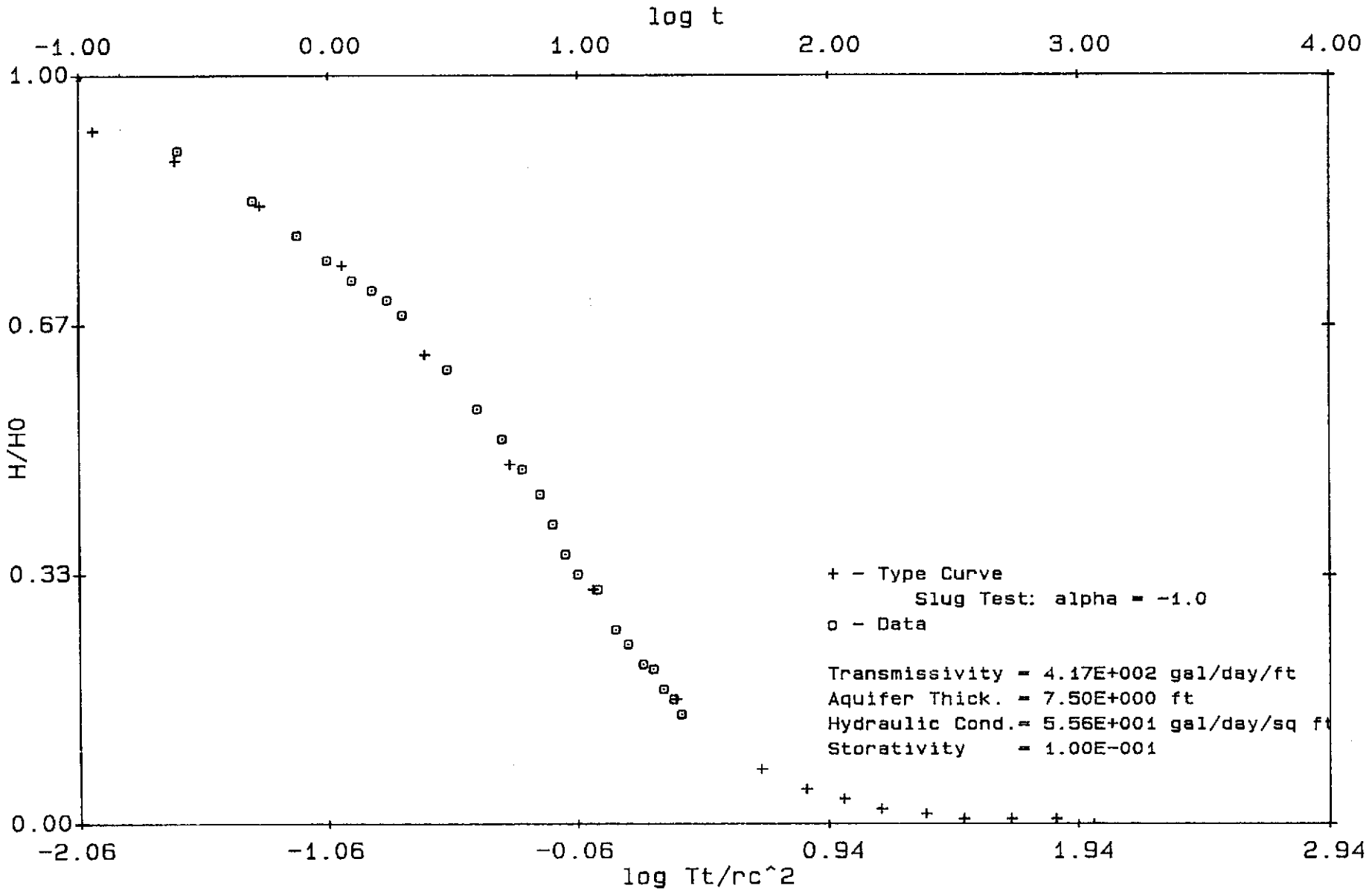
Project # 7615 S-1 Slug-out



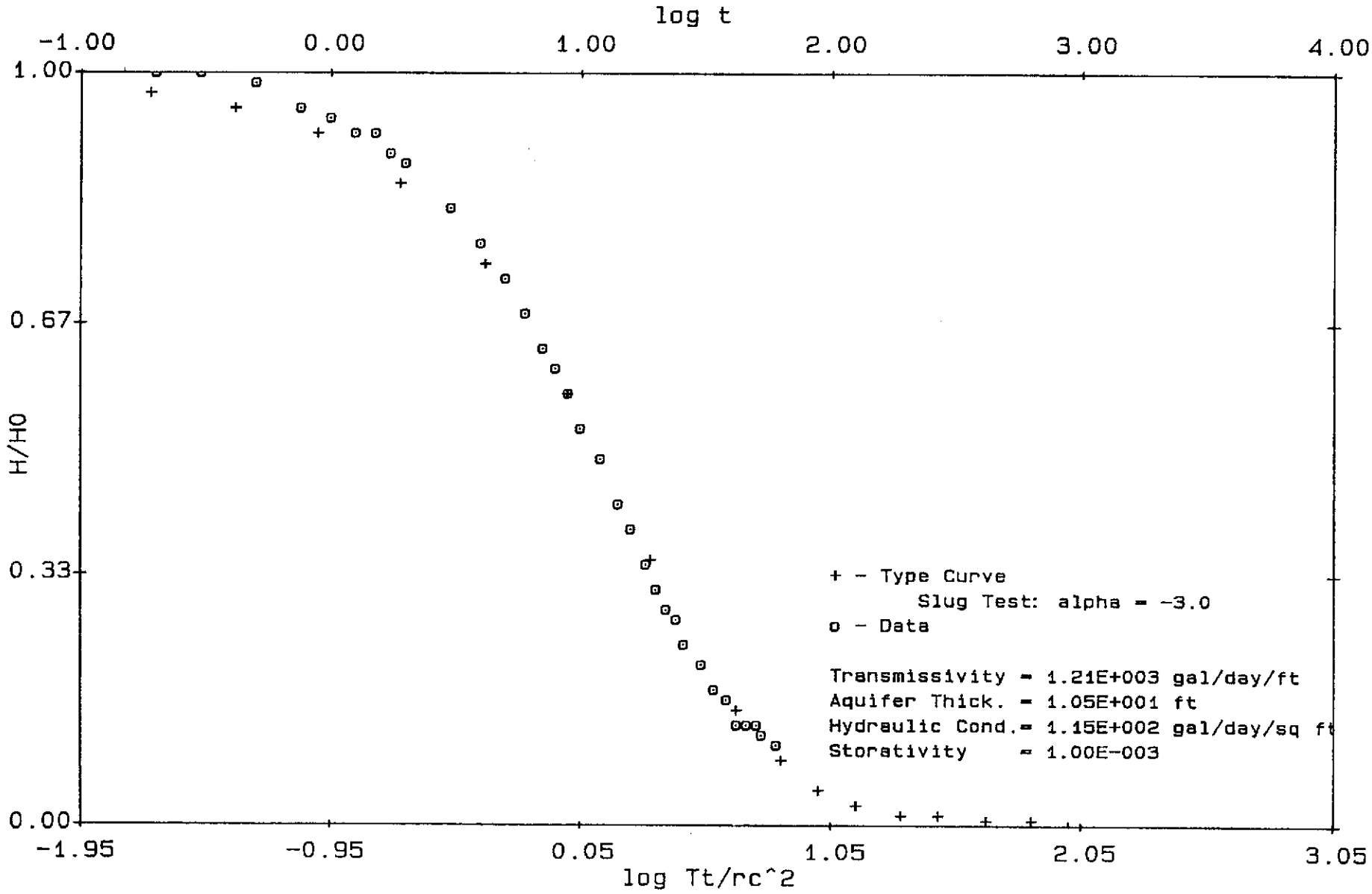
Project # 7615 S-3 Slug-in



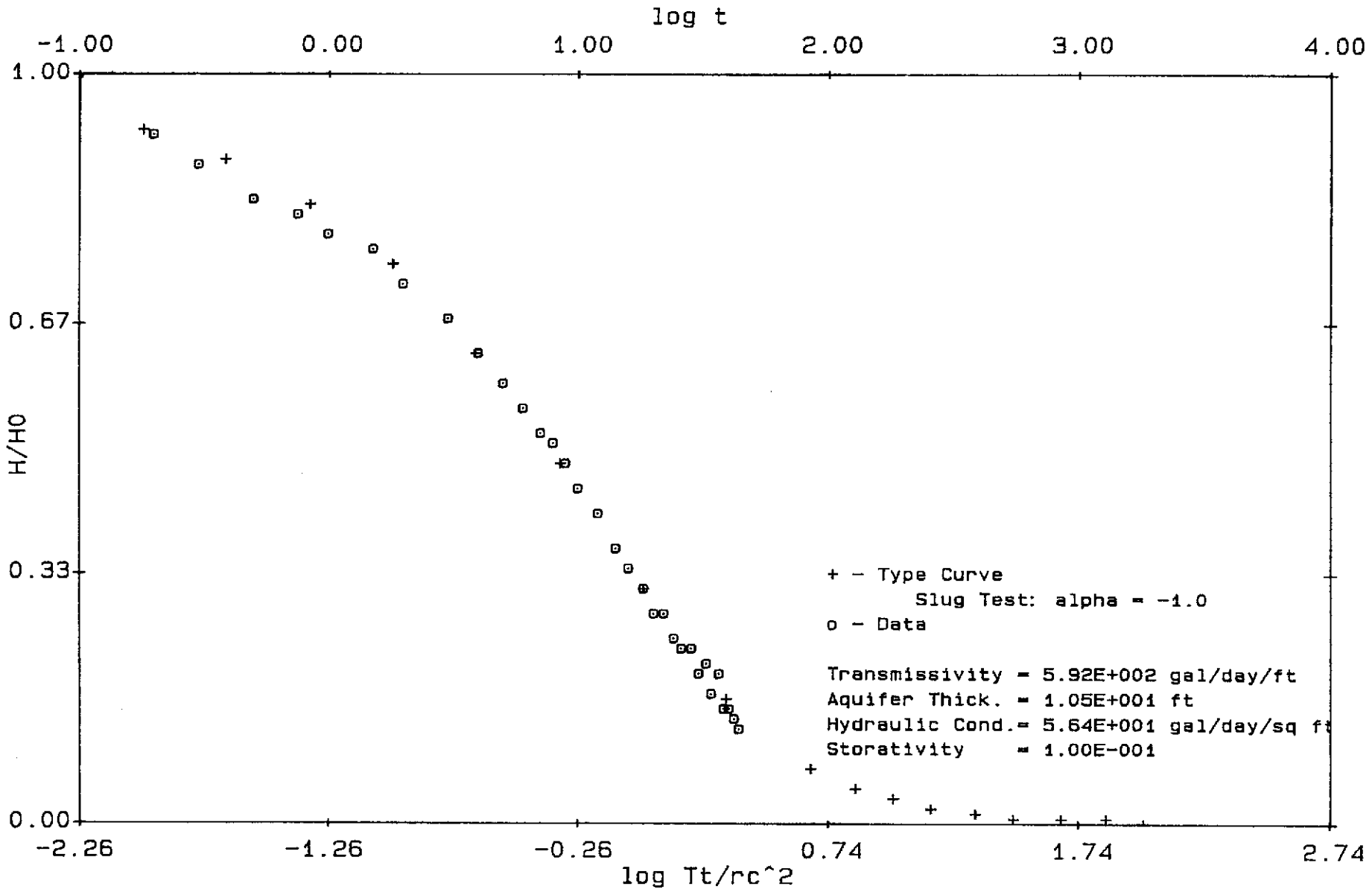
Project # 7615 S-3 Slug-out



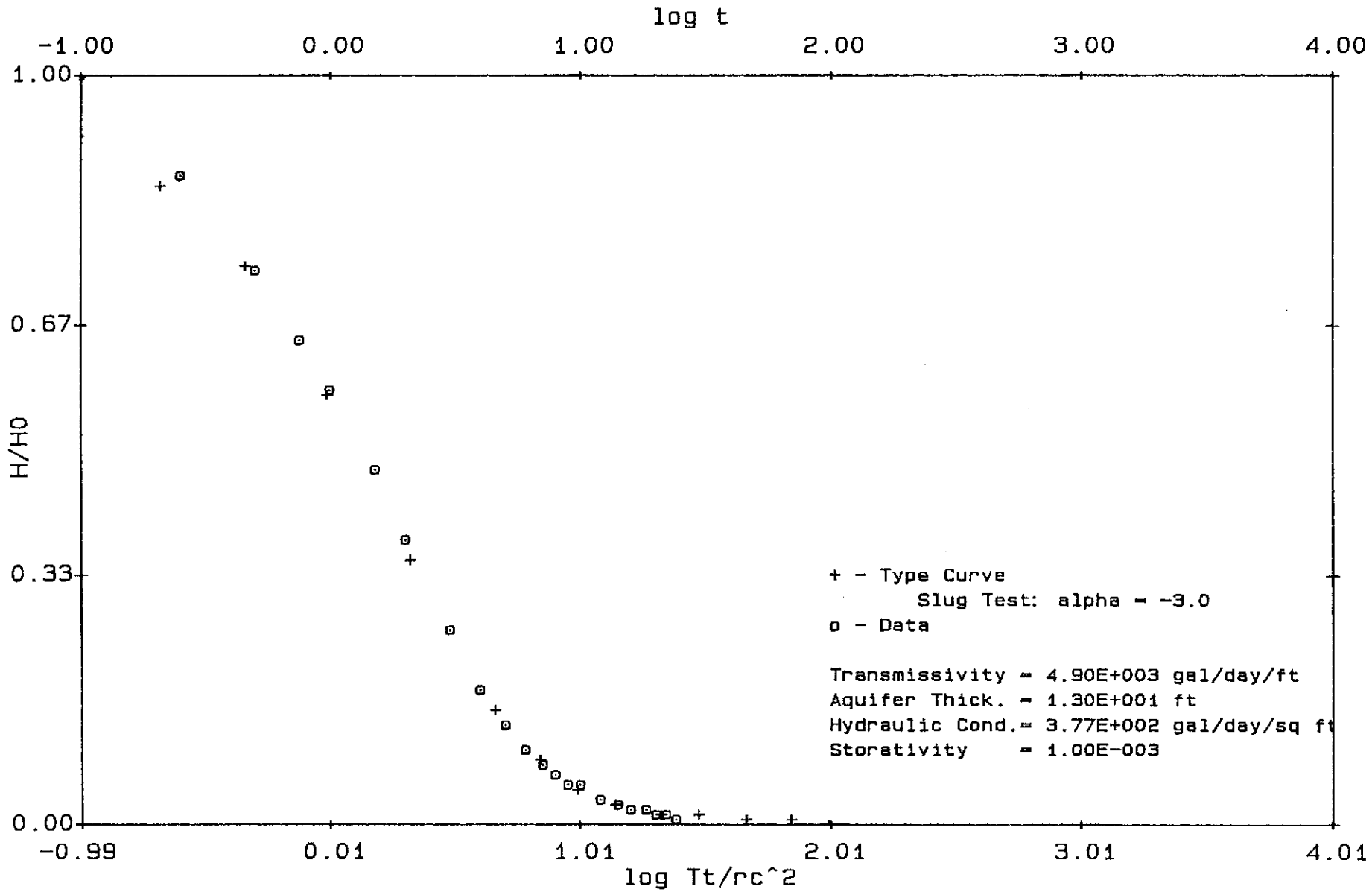
Project # 7615 S-5 Slug-in



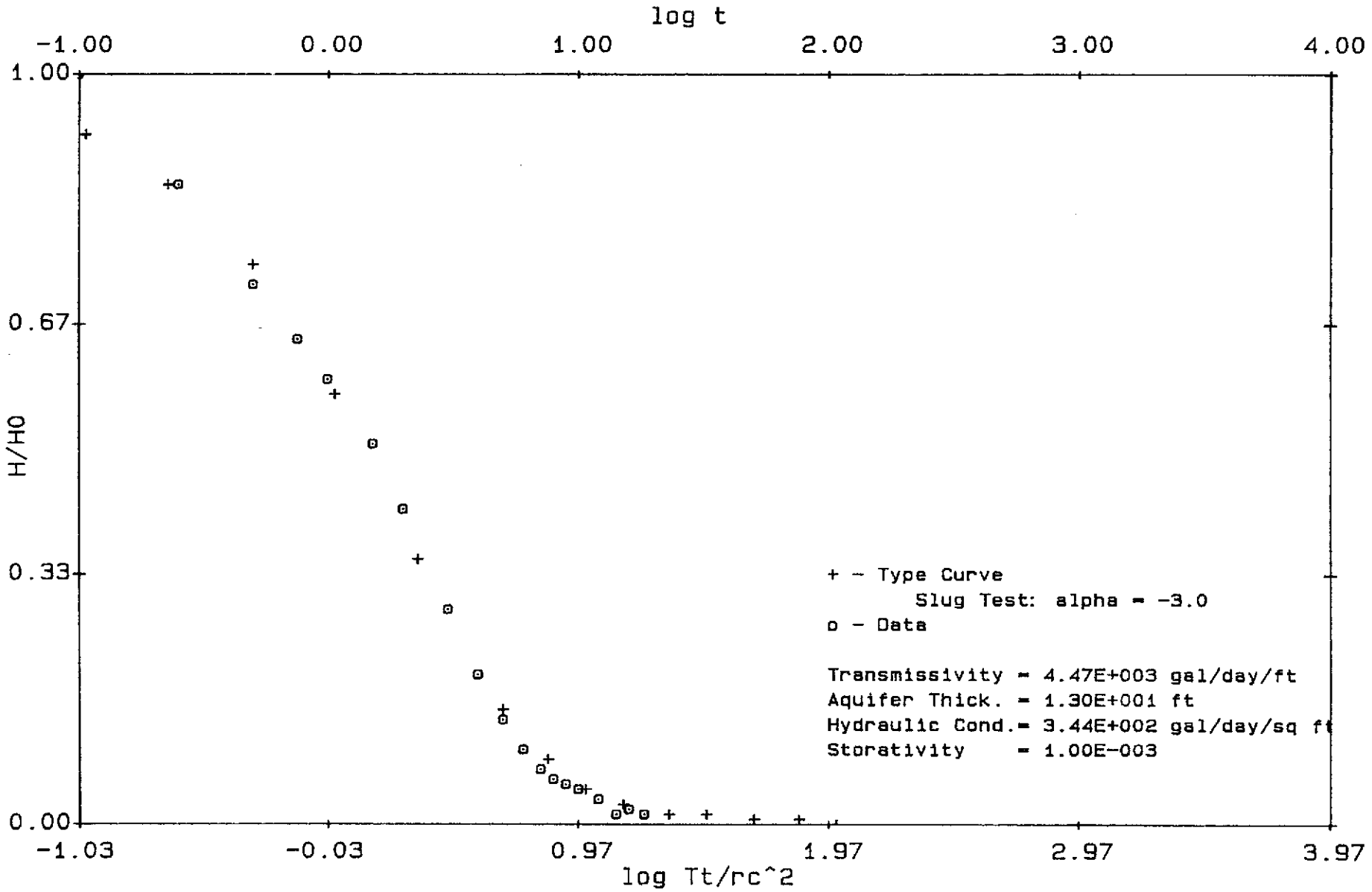
Project # 7615 S-5 Slug-out



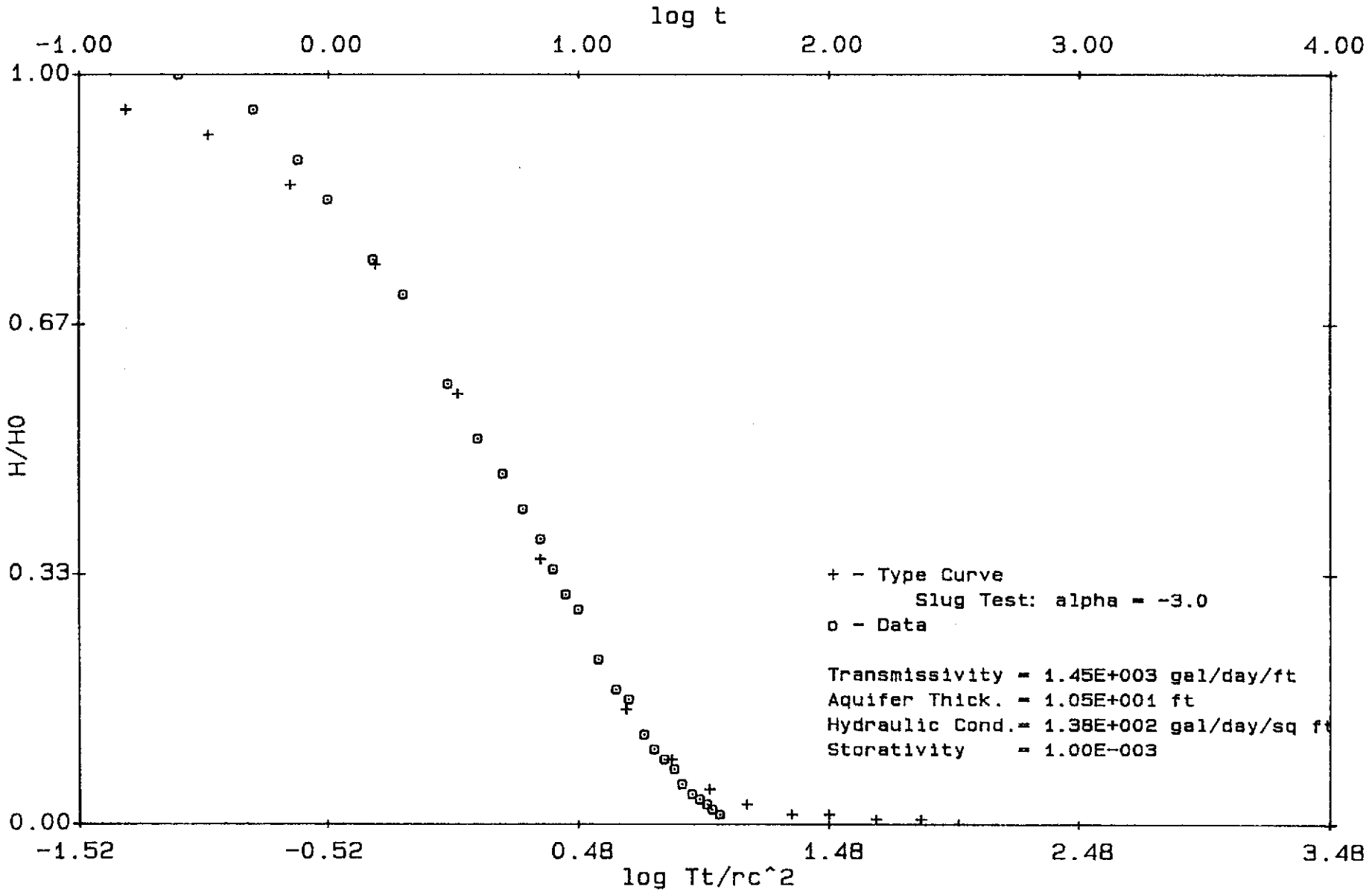
Project # 7615 S-7 Slug-in



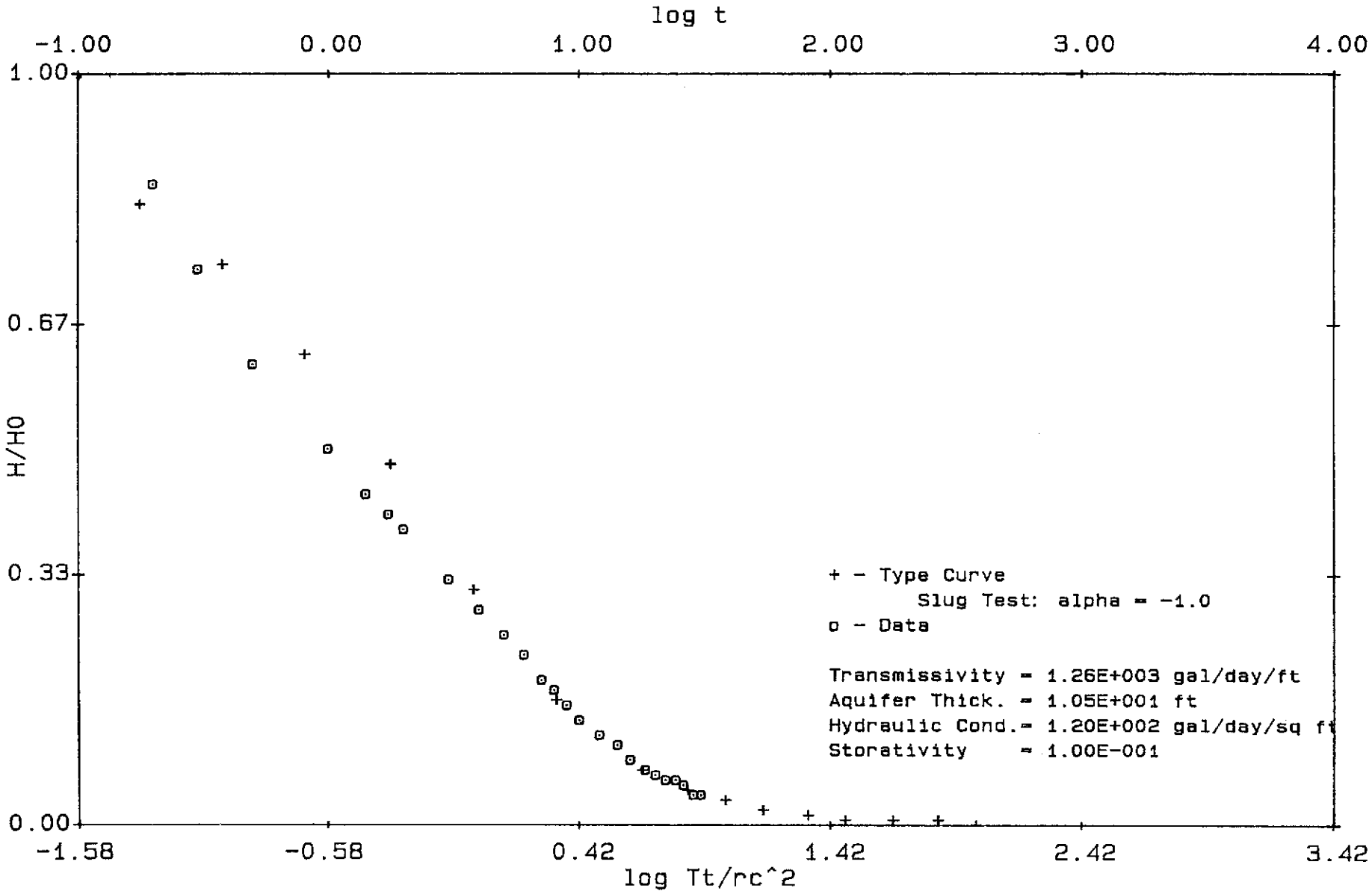
Project # 7615 S-7 Slug-out



Project # 7615 S-9 Slug-in



Project # 7615 S-9 Slug-out



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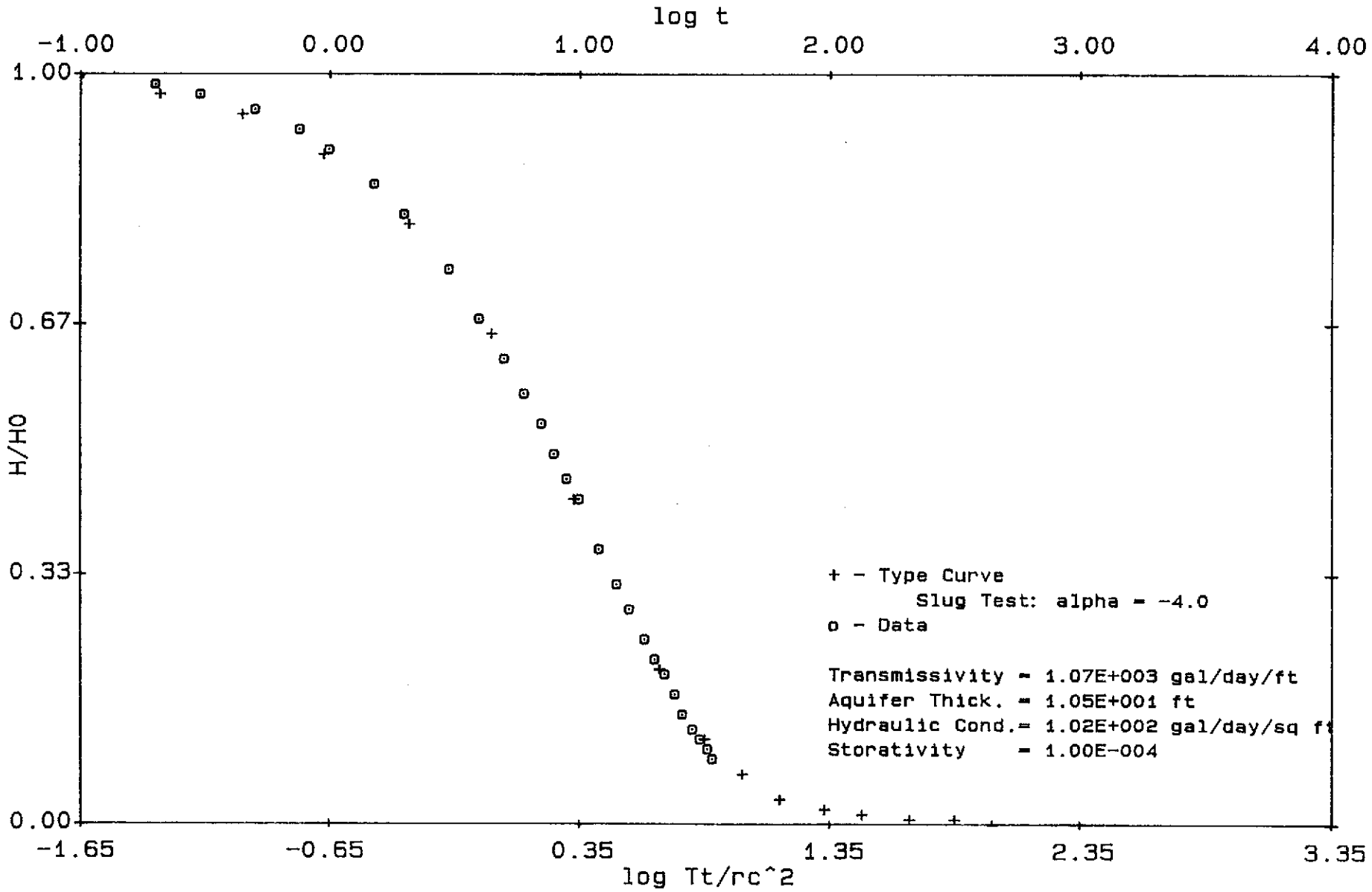

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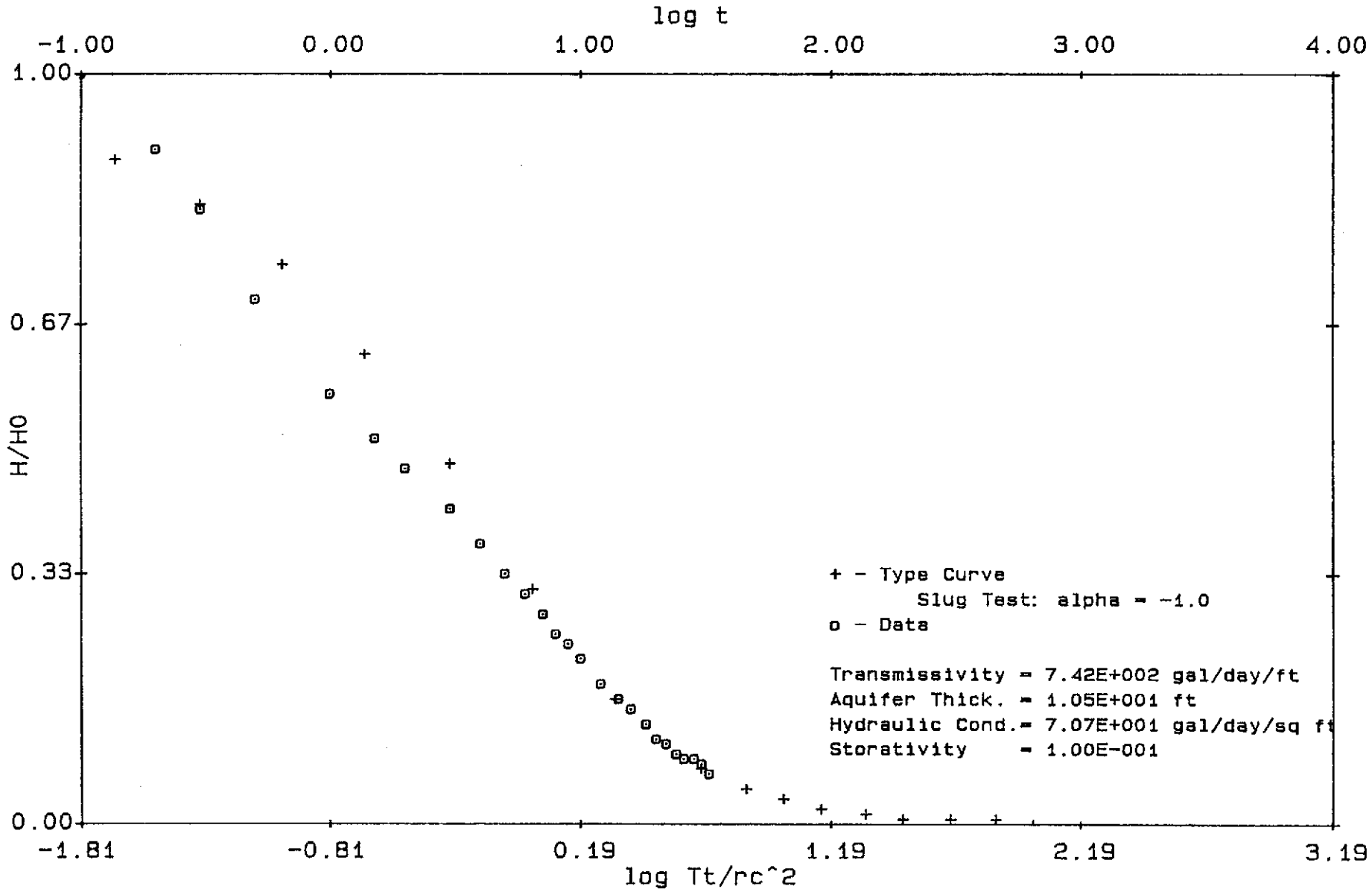

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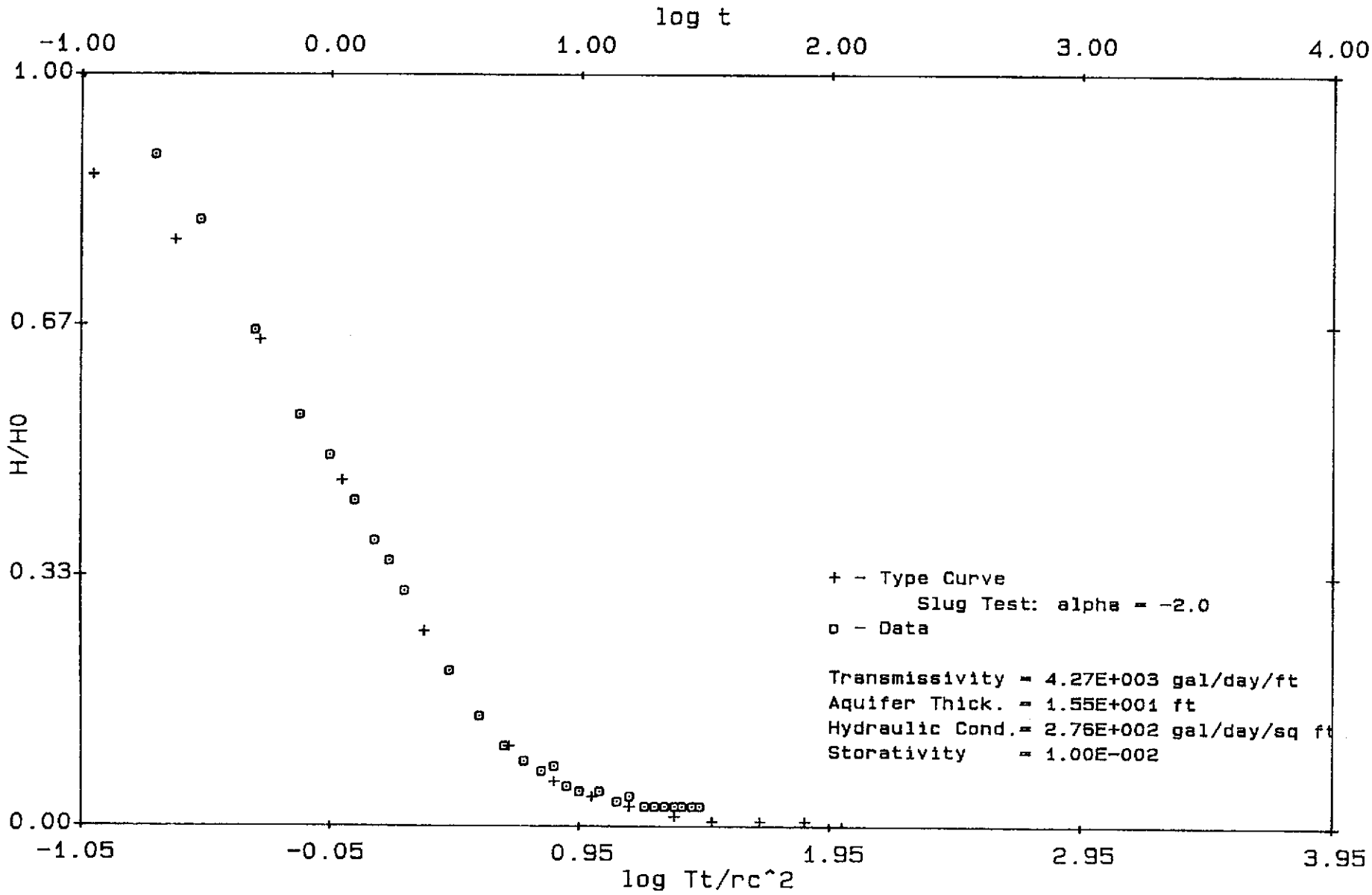

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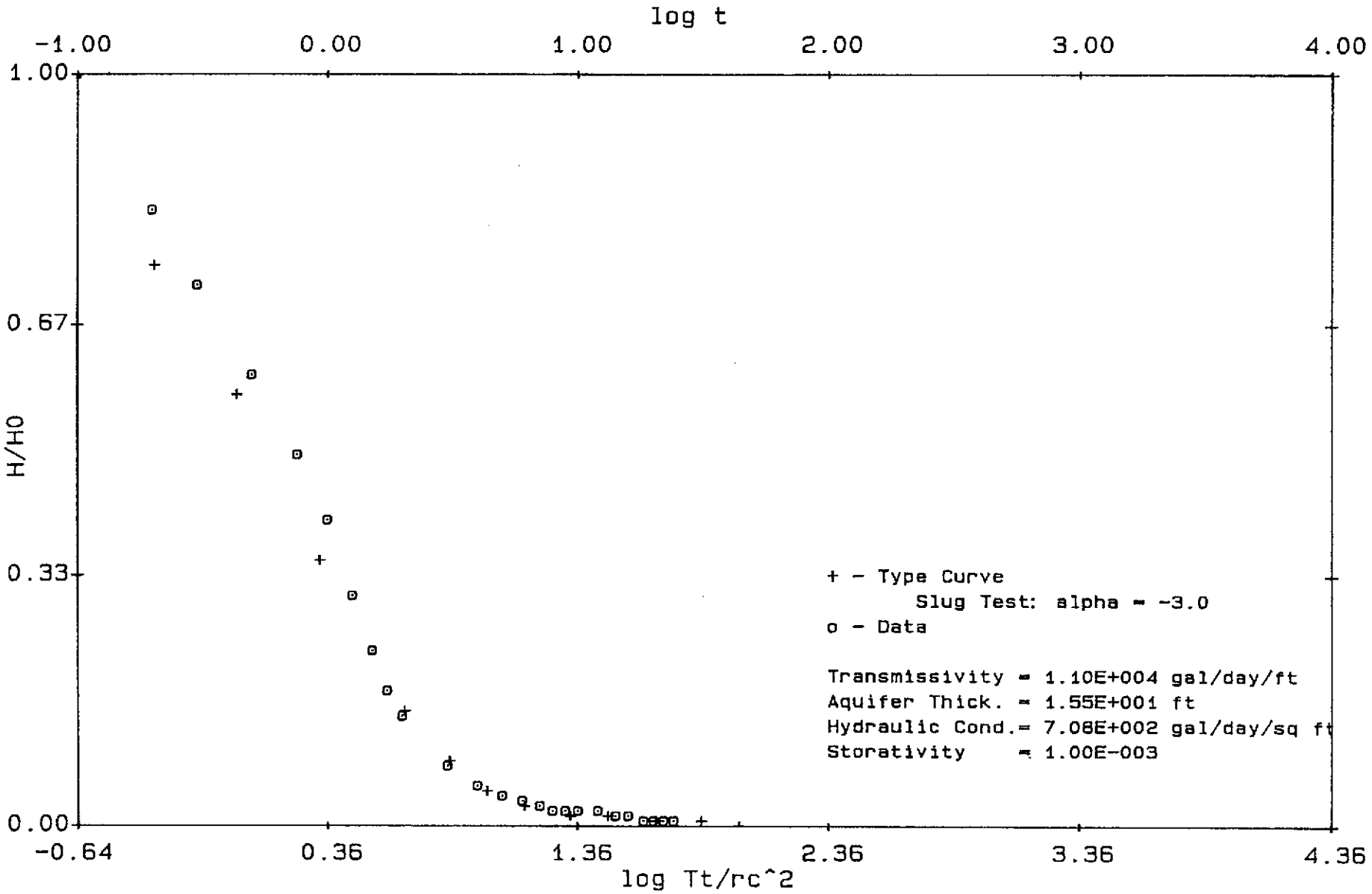
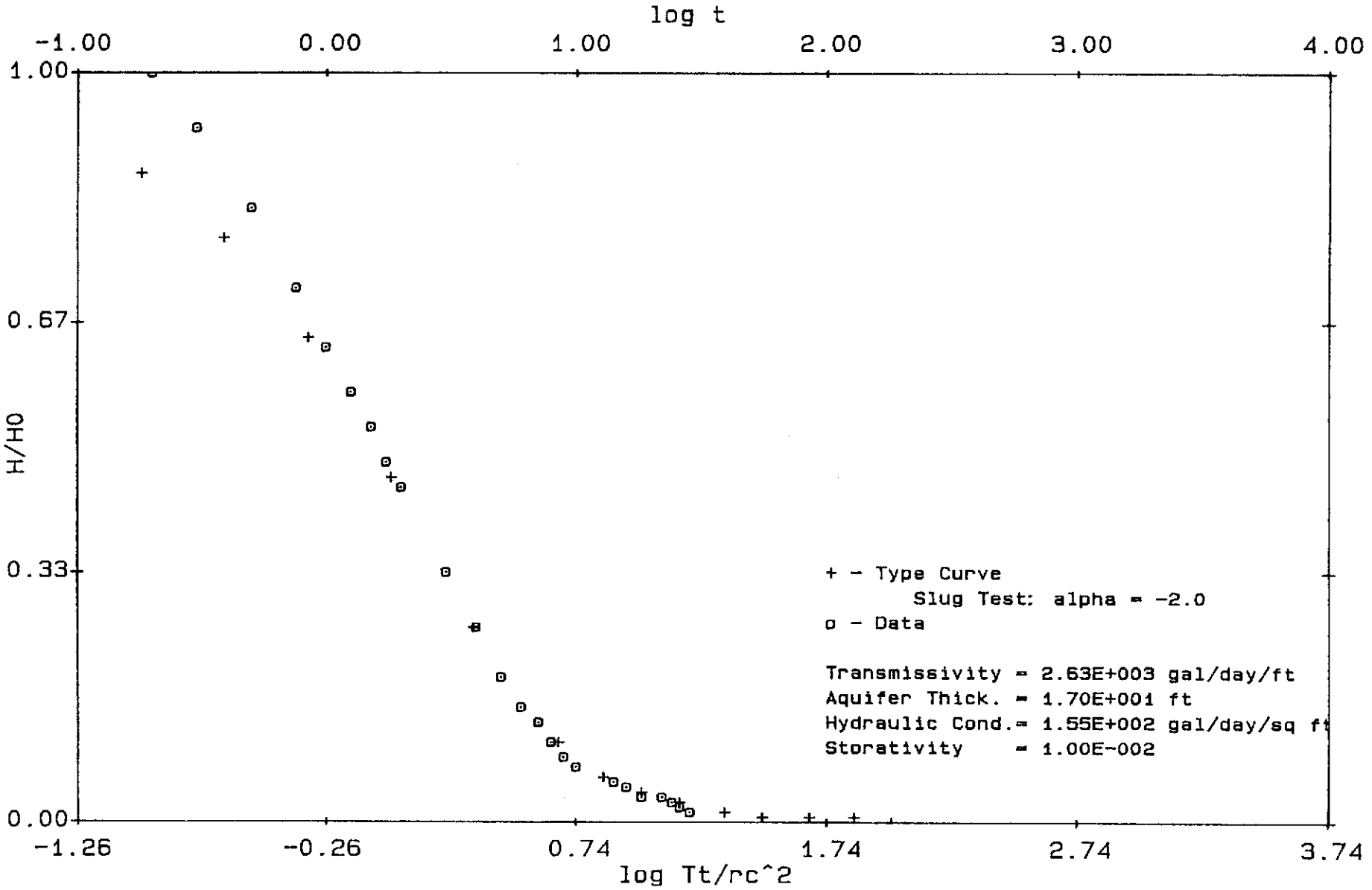


Project # 7615 S-14 Slug-in



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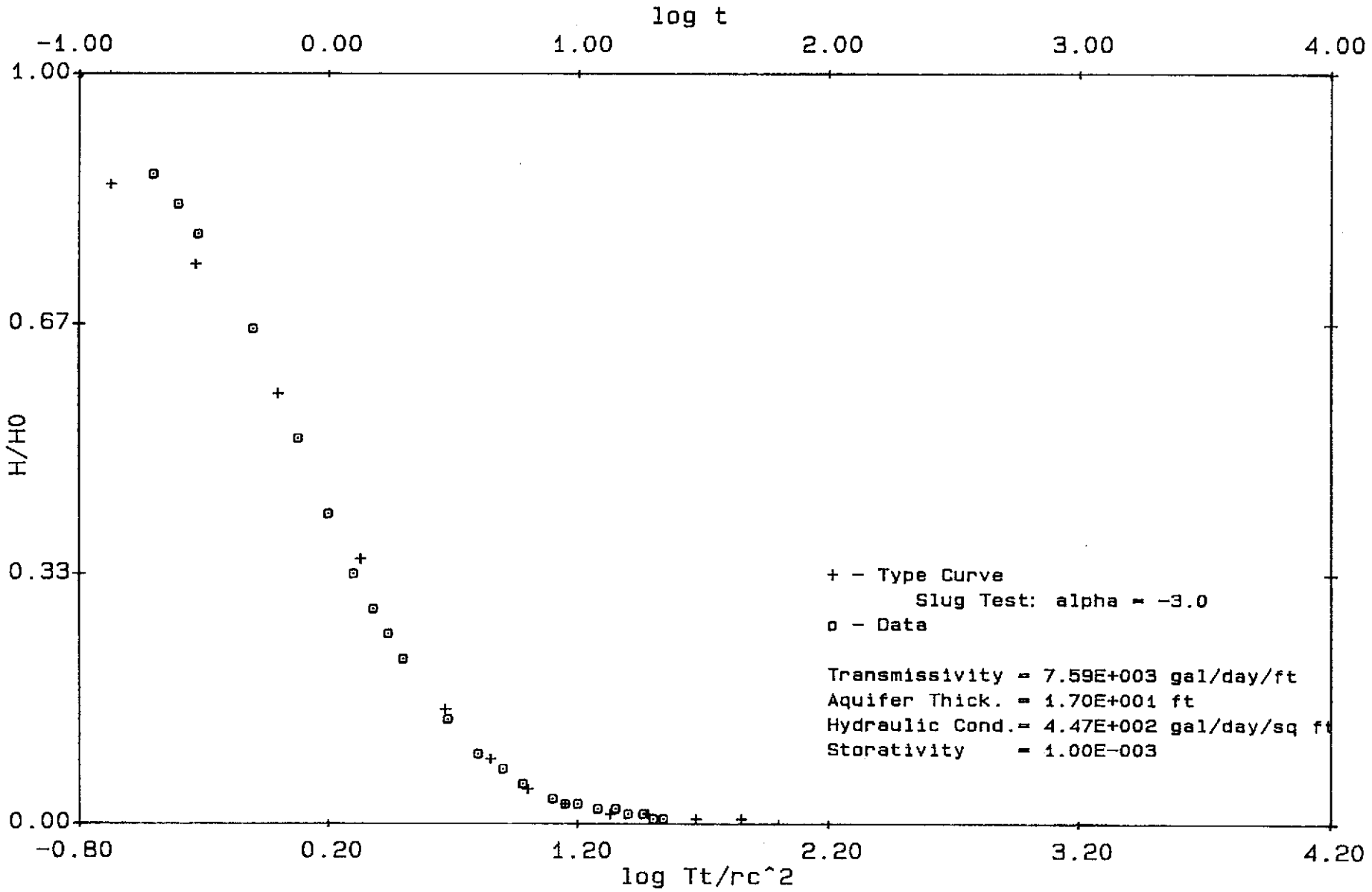

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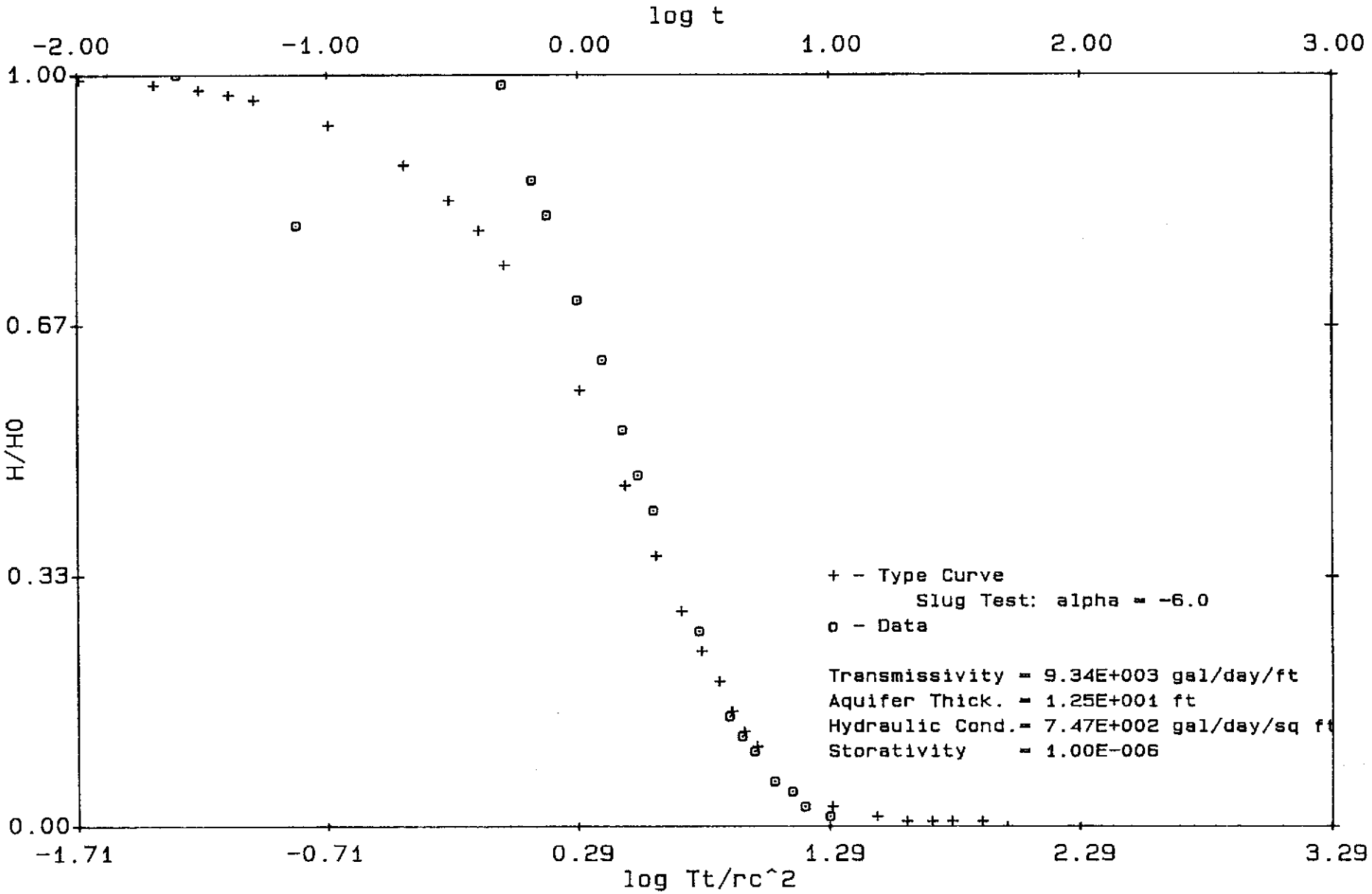

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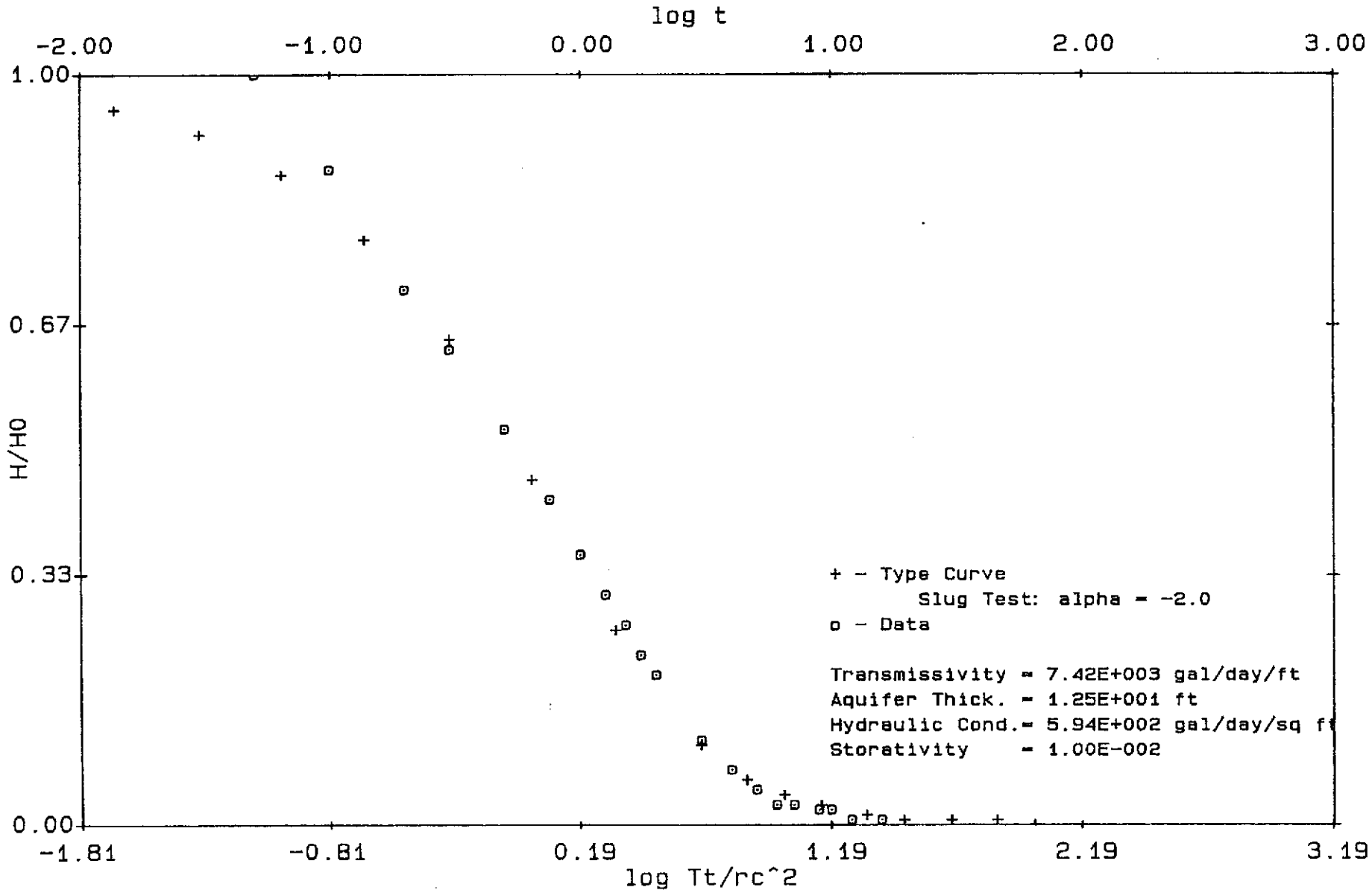


APPENDIX D
G-R GROUNDWATER SAMPLING REPORT

gettler — ryan inc.

May 8, 1990

GROUNDWATER SAMPLING REPORT

Referenced Site: Former Shell Service Station
15275 Washington Avenue
San Leandro, California

Sampling Date: April 18, 1990

This report presents the results of the quarterly groundwater sampling and analytical program conducted by Gettler-Ryan Inc. on April 18, 1990 at the referenced location. The site, located on the northwest corner of Washington Avenue and Lewelling Boulevard, is no longer an operating service station. The former station had underground storage tanks which contained petroleum products.

There are currently seven groundwater monitoring wells on site and nine off site at the locations shown on the attached site map. Prior to sampling, each well was inspected for total well depth, water level, and presence of separate phase product using an electronic interface probe. A clean acrylic bailer was used to visually confirm the presence and thickness of separate phase product. Groundwater depths ranged from 7.37 to 8.45 feet below grade. A product sheen was observed in well S-3.

The wells were then purged and sampled. The purge water was contained in drums for proper disposal. Standard sampling procedure calls for a minimum of four case volumes to be purged from each well. Each well was purged while pH, temperature, and conductivity measurements were monitored for stability. Details of the final well purging results are presented on the attached Table of Monitoring Data. In cases where a well dewatered or less than four case volumes were purged, groundwater samples were obtained after the physical parameters had stabilized. Under such circumstances the sample may not represent actual formation water due to low flow conditions.

Samples were collected, using Teflon bailers, in properly cleaned and laboratory prepared containers. All sampling equipment was thoroughly cleaned after each well was sampled and steam cleaned upon completion of work at the site. The samples were labeled, stored on blue ice, and transported to the laboratory for analysis. A field blank (SF-7) and a trip blank, supplied by the laboratory, were included and analyzed to assess quality control. A duplicate sample (SD-3) was submitted without well designation to assess laboratory performance. Analytical results for the blanks are included in the Certified Analytical Report (CAR's). Chain of custody records were established noting sample identification numbers, time, date, and custody signatures.

1992 national avenue • hayward, california 94545-1787 • (415) 783-7500

The samples were analyzed at International Technology Corporation - Santa Clara Valley Laboratory located at 2055 Junction Avenue, San Jose, California. The laboratory is assigned a California DHS-HMTL Certification number of 137. The results are presented as a Certified Analytical Report, a copy of which is attached to this report.

Tom Paulson
Sampling Manager

attachments

TABLE OF MONITORING DATA
GROUNDWATER WELL SAMPLING REPORT

WELL I.D.	S-1 **	S-3 SD-3	S-5	S-6	S-7	S-8
Casing Diameter (inches)	3	3	4	3	3	3
Total Well Depth (feet)	19.9	15.3	18.4	24.6	20.9	24.3
Depth to Water (feet)	7.91	7.74	8.32	8.43	8.06	7.59
Free Product (feet)	none	sheen	none	none	none	none
Reason Not Sampled		----	----	----	----	----
Calculated 3 Case Vol.(gal.)	----	11.6	26.4	24.4	19.5	25.2
Did Well Dewater?	----	yes	no	yes	no	no
Volume Evacuated (gal.)	----	10	33	21	26	31
Purging Device	----	Suction	Suction	Suction	Suction	Suction
Sampling Device	----	Bailer	Bailer	Bailer	Bailer	Bailer
Time	----	11:42	12:18	09:39	11:39	11:06
Temperature (F)*	----	65.3	65.7	67.1	67.0	67.4
pH*	----	7.29	7.20	7.59	7.29	7.26
Conductivity (umhos/cm)*	----	5540	7010	4980	6100	7840

* Indicates Stabilized Value

** A portion of field notes were lost for S-1

TABLE OF MONITORING DATA
GROUNDWATER WELL SAMPLING REPORT

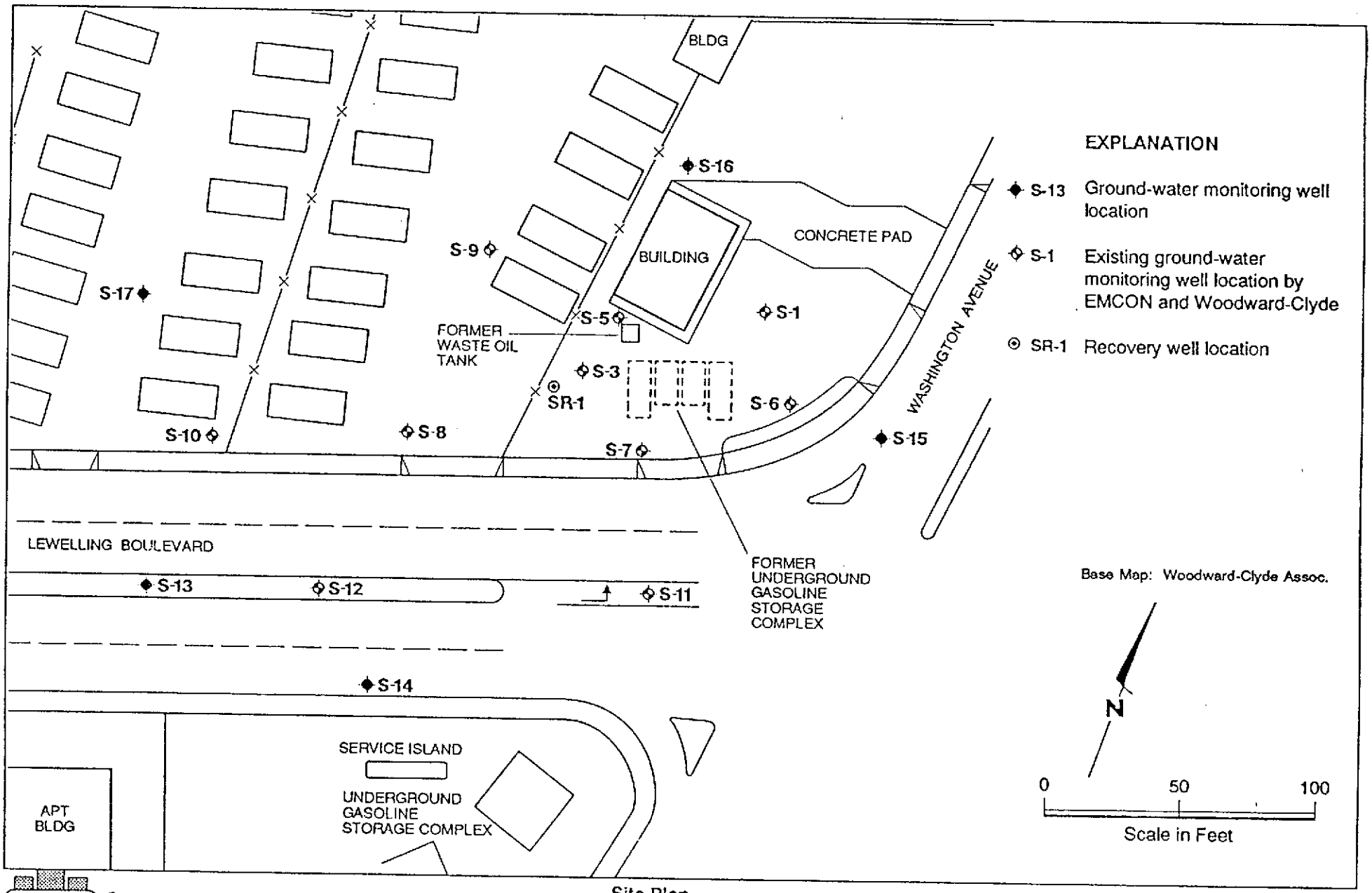
WELL I.D.	S-9	S-10	S-11	S-12	S-13	S-14
Casing Diameter (inches)	3	3	3	3	3	3
Total Well Depth (feet)	17.9	18.1	22.5	24.0	23.8	22.7
Depth to Water (feet)	7.65	7.71	8.42	8.05	7.73	7.37
Free Product (feet)	none	none	none	none	none	none
Reason Not Sampled	----	----	----	----	----	----
Calculated 3 Case Vol.(gal.)	15.6	16.0	21.4	24.0	24.4	23.3
Did Well Dewater?	yes	yes	yes	yes	no	no
Volume Evacuated (gal.)	10	12	13.5	16	31	31
Purging Device	Suction	Suction	Suction	Suction	Suction	Suction
Sampling Device	Bailer	Bailer	Bailer	Bailer	Bailer	Bailer
Time	11:00	10:29	08:55	08:27	08:27	08:56
Temperature (F)*	66.7	62.7	65.8	65.2	65.5	64.1
pH*	7.25	7.53	7.70	7.60	7.53	7.50
Conductivity (umhos/cm)*	6930	4130	4870	5380	6300	5620

* Indicates Stabilized Value

TABLE OF MONITORING DATA
GROUNDWATER WELL SAMPLING REPORT

WELL I.D.	S-15	S-16	S-17	SR-1
Casing Diameter (inches)	3	3	3	6
Total Well Depth (feet)	23.2	20.3	24.4	21.3
Depth to Water (feet)	8.45	8.19	7.95	8.17
Free Product (feet)	none	none	none	none
Reason Not Sampled	----	----	----	----
Calculated 3 Case Vol.(gal.)	22.4	18.4	25.2	78.8
Did Well Dewater?	no	no	no	no
Volume Evacuated (gal.)	28	24	31.5	99
Purging Device	Suction	Suction	Suction	Suction
Sampling Device	Bailer	Bailer	Bailer	Bailer
Time	09:38	12:41	10:31	13:30
Temperature (F)*	67.5	64.0	66.5	66.1
pH*	7.66	7.30	7.51	7.15
Conductivity (umhos/cm)*	4500	6250	5030	7980

* Indicates Stabilized Value



GeoStrategies Inc.

Site Plan
Former Shell Service Station
15275 Washington Avenue
San Leandro, California

PLATE

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE
615		11/89		

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Shell Oil Company
Gettler-Ryan
2150 West Winton
Hayward, CA 94545
Tom Paulson

Date: 05/04/90

Work Order: TO-04-180 P.O. Number: MOH 880-021

This is the Certificate of Analysis for the following samples:

Client Work ID: GR3615,15275 Washngtn,S.Lndro
Date Received: 04/18/90
Number of Samples: 11
Sample Type: aqueous

* invoice / report w/TO-04-181

TABLE OF CONTENTS FOR ANALYTICAL RESULTS

Reviewed and Approved:

Suzanne Veaudry
Project Manager

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-1
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: TO04180-01
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-180

TEST NAME: **Petroleum Hydrocarbons**

SAMPLE ID: **S-3**
SAMPLE DATE: **04/18/90**
LAB SAMPLE ID: **T004180-02**
SAMPLE MATRIX: **aqueous**
RECEIPT CONDITION: **Cool pH < 2**

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/23/90
Low Boiling Hydrocarbons	8015		04/23/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	2.5	58.
BTEX		
Benzene	0.02	3.8
Toluene	0.02	1.4
Ethylbenzene	0.02	2.4
Xylenes (total)	0.05	12.

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-5
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004180-03
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/21/90
Low Boiling Hydrocarbons	8015		04/21/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	1.0	5.2
BTEX		
Benzene	0.01	1.1
Toluene	0.01	0.04
Ethylbenzene	0.01	0.30
Xylenes (total)	0.02	0.46

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-6
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004180-04
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	0.0006
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	0.001

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-7
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004180-05
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-8
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004180-06
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-9
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: TO04180-07
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	0.68
BTEX		
Benzene	0.0005	0.15
Toluene	0.0005	0.0017
Ethylbenzene	0.0005	0.050
Xylenes (total)	0.001	0.037

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-180

TEST NAME: **Petroleum Hydrocarbons**

SAMPLE ID: **S-10**
SAMPLE DATE: **04/18/90**
LAB SAMPLE ID: **T004180-08**
SAMPLE MATRIX: **aqueous**
RECEIPT CONDITION: **Cool pH < 2**

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	0.0009
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	0.002

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: **Petroleum Hydrocarbons**

SAMPLE ID: **S-11**
SAMPLE DATE: **04/18/90**
LAB SAMPLE ID: **TO04180-09**
SAMPLE MATRIX: **aqueous**
RECEIPT CONDITION: **Cool pH < 2**

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: **Petroleum Hydrocarbons**

SAMPLE ID: **S-12**
SAMPLE DATE: **04/18/90**
LAB SAMPLE ID: **TO04180-10**
SAMPLE MATRIX: **aqueous**
RECEIPT CONDITION: **Cool pH < 2**

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: Trip Blank
SAMPLE DATE: not spec
LAB SAMPLE ID: TO04180-11
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/19/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-180

TEST CODE TPHVB TEST NAME TPH Gas,BTEX by 8015/8020

The method of analysis for low boiling hydrocarbons is taken from EPA Methods 8015, 8020 and 5030. The sample is examined using the purge and trap technique. Final detection is by gas chromatography using a flame ionization detector as well as a photoionization detector. The result for total low boiling hydrocarbons is calculated as gasoline and includes benzene, toluene, ethylbenzene and xylenes.

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYTICAL SERVICES

CERTIFICATE OF ANALYSIS

Shell Oil Company
Gettler-Ryan
2150 West Winton
Hayward, CA 94545
Tom Paulson

Date: 05/04/90

Work Order: TO-04-181 P.O. Number: MOH 880-021

This is the Certificate of Analysis for the following samples:

Client Work ID: GR3615,15275 Washngtn,S.Lndro
Date Received: 04/18/90
Number of Samples: 9
Sample Type: aqueous

* invoice / report w/TO-04-180

TABLE OF CONTENTS FOR ANALYTICAL RESULTS

Reviewed and Approved:

Suzanne Veaudry
Project Manager

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-181

TEST NAME: **Petroleum Hydrocarbons**

SAMPLE ID: **S-13**
SAMPLE DATE: **04/18/90**
LAB SAMPLE ID: **TO04181-01**
SAMPLE MATRIX: **aqueous**
RECEIPT CONDITION: **Cool pH < 2**

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.05	0.085
BTEX		
Benzene	0.0005	0.0087
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-181

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-14
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: TO04181-02
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/19/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	1.2
BTEX		
Benzene	0.002	0.20
Toluene	0.0005	0.11
Ethylbenzene	0.0005	0.030
Xylenes (total)	0.001	0.096

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-181

TEST NAME: **Petroleum Hydrocarbons**

SAMPLE ID: **S-15**
SAMPLE DATE: **04/18/90**
LAB SAMPLE ID: T004181-03
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-181

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-16
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004181-04
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	0.0010
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-181

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: S-17
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: TO04181-05
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-181

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: SD-3
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004181-06
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/24/90
Low Boiling Hydrocarbons	8015		04/24/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	2.5	75.
BTEX		
Benzene	0.02	3.7
Toluene	0.02	1.4
Ethylbenzene	0.02	2.5
Xylenes (total)	0.05	13.

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-181

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: SF-7
SAMPLE DATE: 04/18/90
LAB SAMPLE ID: T004181-07
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.050	None
BTEX		
Benzene	0.0005	None
Toluene	0.0005	None
Ethylbenzene	0.0005	None
Xylenes (total)	0.001	None

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: T0-04-181

TEST NAME: Petroleum Hydrocarbons

SAMPLE ID: SR-1
SAMPLE DATE: 04/19/90
LAB SAMPLE ID: T004181-09
SAMPLE MATRIX: aqueous
RECEIPT CONDITION: Cool pH < 2

RESULTS in Milligrams per Liter:

	METHOD	EXTRACTION DATE	ANALYSIS DATE
BTEX	8020		04/20/90
Low Boiling Hydrocarbons	8015		04/20/90

PARAMETER	DETECTION LIMIT	DETECTED
Low Boiling Hydrocarbons calculated as Gasoline	0.25	1.0
BTEX		
Benzene	0.002	0.13
Toluene	0.002	0.047
Ethylbenzene	0.002	0.047
Xylenes (total)	0.005	0.22

IT ANALYTICAL SERVICES
SAN JOSE, CA

Company: Shell Oil Company
Date: 05/04/90
Client Work ID: GR3615,15275 Washngtn,S.Lndro

Work Order: TO-04-181

TEST CODE **TPHVB** TEST NAME **TPH Gas,BTEX by 8015/8020**

The method of analysis for low boiling hydrocarbons is taken from EPA Methods 8015, 8020 and 5030. The sample is examined using the purge and trap technique. Final detection is by gas chromatography using a flame ionization detector as well as a photoionization detector. The result for total low boiling hydrocarbons is calculated as gasoline and includes benzene, toluene, ethylbenzene and xylenes.

Page 1 of 2 — TO-04780

Getter - Ryan Inc. ENVIRONMENTAL DIVISION — 0566 **Chain of Custody**

COMPANY Shell Oil Company JOB NO. _____

JOB LOCATION 15275 Washington Ave / Lewelling Blvd

CITY San Leandro, CA PHONE NO. (415) 783-7500

AUTHORIZED John Werfal DATE 4/18/90 P.O. NO. 3615

SAMPLE ID	NO. OF CONTAINERS	SAMPLE MATRIX	DATE/TIME SAMPLED	ANALYSIS REQUIRED	SAMPLE CONDITION LAB ID
S-1	3	Liquid	4-18-90 / 12:15	THC (gas) BTXE	Cool/ok
S-3			/ 11:42		
S-5			/ 12:18		
S-6			/ 9:39		
S-7			/ 11:39		
S-8			/ 11:06		
S-9			/ 11:00		
S-10			/ 10:29		
S-11			/ 8:55		
S-12			/ 8:27		
Trip	1				

RELINQUISHED BY: Guadalupe Sanchez 4-18-90

RECEIVED BY: 4-18-90 17:30

RELINQUISHED BY: 4-18-90 18:55

RECEIVED BY:

RELINQUISHED BY:

RECEIVED BY LAB: 4/18/90 1855

DESIGNATED LABORATORY: IT SCV DHS #: 137

REMARKS: WIC # 204-6852-1008

AFE # 086611

Normal TAT

EXP. CODE 5440

Shell Eng. Diane Lundquist

DATE COMPLETED 4-18-90 FOREMAN G. Sanchez

ORIGINAL

Gettler - Ryan Inc. — ENVIRONMENTAL DIVISION — Page 2 of 2 — TO-04-181 — 0577 Chain of Custody

COMPANY: Shell Oil Company — JOB NO.:

JOB LOCATION: 15275 Washington Ave / Lewelling Blvd

CITY: San Leandro, CA — PHONE NO: (415) 783-7500

AUTHORIZED: John Werfal — DATE: 4-18-90 — P.O. NO.: 3615

SAMPLE ID	NO. OF CONTAINERS	SAMPLE MATRIX	DATE/TIME SAMPLED	ANALYSIS REQUIRED	SAMPLE CONDITION LAB ID
S-13	3	Liquid	4-18-90 / 8:27	THC (gas) BTXE	Cool/ok (Y)
S-14			/ 8:56		
S-15			/ 9:38		
S-16			/ 12:46		
S-17			/ 10:31		
SD-3			/ —		
SF-7			/ 1139		
trip blank	2 / 1		— / —		
SR-1	3		4-18-90 / 13:30		

RELINQUISHED BY: Guadalupe Sanchez 4-18-90

RECEIVED BY: [signature] 4-18-90 ~~17:30~~ ~~07:30~~

RELINQUISHED BY: [signature] 4-18-90 18:55

RECEIVED BY:

RELINQUISHED BY:

RECEIVED BY LAB: [signature] 4/18/90 1855

DESIGNATED LABORATORY: IT SCV — DHS #: 137

REMARKS: WIC # 204-6852-1008

AFE # 086611

Normal TAT

EXP CODE 5440

Shell Eng. Diane Lundquist

DATE COMPLETED: 4-18-90 — FOREMAN: G-Sanchez

ORIGINAL

APPENDIX E
FIELD METHODS AND PROCEDURES

FIELD METHODS AND PROCEDURES

EXPLORATION DRILLING

Mobilization

Prior to any drilling activities, GeoStrategies Inc. (GSI) will verify that necessary drilling permits have been secured.

Utility locations will be located and drilling will be conducted so as not to disrupt activities at a project site. GSI will obtain and review available public data on subsurface geology and if warranted, the location of wells within a half-mile of the project site will be identified. Drillers will be notified in advance so that drilling equipment can be inspected prior to performing work.

Drilling

The subsurface investigations are typically performed to assess the lateral and vertical extent of petroleum hydrocarbons present in soils and groundwater. Drilling methods will be selected to optimize field data requirements as well as be compatible with known or suspected subsurface geologic conditions.

Monitoring wells are installed using a truck-mounted hollow-stem auger drill rig or mud-rotary drill rig. Typically, the hollow-stem rig is used for wells up to 100 feet, if subsurface conditions are favorable. Wells greater than 100-feet deep are typically drilled using mud-rotary techniques. When mud rotary drilling is used, an electric log will be performed for additional lithological information. Also during mud rotary drilling, precautions will be taken to prevent mud from circulating contaminants by using a conductor casing to seal off contaminated zones. Samples will be collected for lithologic logging by continuous chip, and where needed by drive sample or core as specified by the supervising geologist.

Soil Sampling

Shallow soil borings will be drilled using a truck-mounted hollow-stem auger drilling rig, unless site conditions favor a different drilling method. Drilling and sampling methods will be consistent with ASTM Method D-1452-80. The auger size will be a minimum 6-inch nominal outside-diameter (O.D). No drilling fluids will be used during this drilling method. The augers and other tools used in the bore hole will be steam cleaned before use and between borings to minimize the possibilities of cross-contamination between borings.

Soil samples are typically collected at 5-foot intervals as a minimum from ground surface to total depth of boring. Additional soil samples will be collected based on significant lithologic changes and/or potential chemical content. Soil samples from each sampling interval will be lithologically described by a GSI geologist (Figure 1). Soil colors will be described using the Munsell Color Chart. Rock units will be logged using appropriate lithologic terms, and colors described by the G.S.A. Rock Color Chart.

Head-space analyses will be performed to check for the evidence of volatile organic compounds. Head-space analyses will be performed using an organic vapor analyzer; either an OVA, HNU, or OVM. Organic vapor concentrations will be recorded on the GSI field log of boring (Figure 1). The selection of soil samples for chemical analysis are typically based on the following criteria:

1) Soil discoloration
2) Soil odors
3) Visual confirmation of chemical in soil
4) Depth with respect to underground tanks (or existing grade)
5) Depth with respect to ground water
6) OVA reading

Soil samples (full brass liners) selected for chemical analysis are immediately covered with aluminum foil and the liner ends are capped to prevent volatilization. The samples are labeled and entered onto a Chain-of-Custody form, and placed in a cooler on blue ice for transport to a State-certified analytical laboratory.

Soil cuttings are stockpiled on-site. Soils are sampled and analyzed for site-specific chemical parameters. Disposition of soils is dependent of chemical analytical results of the samples.

Soil Sampling - cont.

Soil borings not converted to monitoring wells will be backfilled (sealed) to ground surface using either a neat cement or cement-bentonite grout mixture. Backfilling will be tremied by continuously pumping grout from the bottom to the top of the boring where depth exceeds 20' or as required by local permit requirements.

All field and office work, including exploratory boring logs, are prepared under the direction of a registered geologist.

Monitoring Well Installation

Monitoring well casing and screen will be constructed of Schedule 40, flush-joint threaded polyvinylchloride (PVC). The well screen will be factory mill-slotted unless additional open area is required (eg. conversion to an extraction well in a low-yield aquifer). The screen length will be placed adjacent to the aquifer material to a minimum of 2-feet above encountered water. No screen shall be placed in a borehole that potentially creates hydraulic interconnection of two or more aquifer units. Screen slot size and well sand pack will be compatible with encountered aquifer materials, as confirmed by sieve analysis.

Monitoring wells will be completed below grade (Figure 2) unless special conditions exist that require above-grade completion design. In the event a monitoring well is required in an aquifer unit beneath an existing aquifer, the upper aquifer will be sealed off by installing a steel conductor casing with an annular neat cement or cement-bentonite grout seal. This seal will be continuously tremie pumped from the bottom of the annulus to ground surface.

The monitoring well sand pack will be placed adjacent to the entire screened interval and will extend a recommended minimum distance of 2-feet above the top of the screen. No sand pack will be placed that interconnects two or more aquifer units. A minimum 2-foot bentonite pellet or bentonite slurry seal will be placed above the sand pack. Sand pack, bentonite, and cement seal levels will be confirmed by sounding the annulus with a calibrated weighted tape. The remaining annular space above the bentonite seal will be grouted with a bentonite-cement mixture and will be tremie-pumped from the bottom of the annular space to the ground surface. The bentonite content of the grout will not exceed 5 percent by weight. A field log of boring and a field well completion form will be prepared by GSI for each well installed.

Decontamination of drilling equipment before drilling and between wells will consist of steam cleaning, and/or Alconox wash.

Well Development

All newly installed wells will be properly developed within 48 hours of completion. No well will be developed until the well seal has set a minimum of 12 hours. Development procedures will include one or more of the methods described below:

Bailing

Bailing will be used to remove suspended sediments and drilling fluids from the well, where applicable. The bailer will be raised and lowered through the column of water in the well so as to create a gentle surging action in the screened interval. This technique may be used in conjunction with other techniques, such as pumping, and may be used alone if the well is of low yield.

Pumping

Pumping will be used in conjunction with bailing or surging. The pump will be operated in such a manner as to gently surge the entire screened interval of the well. This may involve operating the pump with a packer type mechanism attached and slowly raising and lowering the pump, or by cycling the pump off and on to allow water to move in and out of the screened interval. Care will be used not to overpump a well.

Surging

Surging will be performed on wells that are screened in known or suspected high yield formations and/or on larger diameter (recovery) wells. A surge block will be raised and lowered through the entire screened interval, forcing water in and out of the well screen and sand pack. Pumping or air lifting will be used in conjunction with this method of development to remove any sediment brought into the well during surging.

Air Lifting

Air lifting will be used to remove sediment from wells as an alternative to pumping under certain conditions. When appropriate, a surge block designed for use with air lifting will be used to agitate the entire screened interval and water will be lifted out of the well using forced air. When air lifting is performed, the air source will be either nitrogen or filtered air and the procedure will be performed gently to prevent any damage to the well screen or casing and to insure that discharged water is contained.

Well Development - cont.

All well developing equipment will be thoroughly decontaminated prior to development using a steam cleaner and/or Alconox detergent wash and clean water rinse. During development procedures, field parameters (temperature, specific conductance and pH) will be monitored and recorded on well development forms (Figure 3). Equilibration requirements consist of a minimum of three readings with the following accuracy standards:

pH	± 0.1 pH units
Specific Conductance	± 10% of full scale reading
Temperature	± 0.5 degrees Celsius

The wells will be developed until water is visibly clear and free of sediment, and well purging parameters stabilized. A minimum of 8 to 10 well volumes will be purged from each well, if feasible. If well purging parameters have not stabilized before 10 casing volumes have been removed, well development will continue until purging parameters have stabilized and formation water is being drawn into the well. The adequacy of well development will be judged by the field technician performing the well development and based on known formation conditions.

Well Surveying

Monitoring wells will be surveyed to obtain top of box elevations to the nearest ±0.01 foot. Water level measurements will be recorded to the nearest ±0.01 foot and referenced to Mean Sea Level (MSL). If additional wells are required, then existing and newly installed wells are surveyed relative to MSL.

GROUND-WATER SAMPLING AND ANALYSIS

Quality Assurance/Quality Control Objectives

The sampling and analysis procedures employed by Gettler-Ryan Inc. (G-R) for ground-water sampling and monitoring follow specific Quality Assurance/Quality Control (QA/QC) guidelines. Quality Assurance objectives have been established by G-R to develop and implement procedures for obtaining and evaluating water quality and field data in an accurate, precise, and complete manner so that sampling procedures and field measurements provide information that is comparable and representative of actual field conditions. Quality Control (QC) is maintained by G-R by using specific field protocols and requiring the analytical laboratory to perform internal and external QC checks. It is the goal of G-R to provide data that are accurate, precise, complete, comparable, and representative. The definitions for accuracy, precision, completeness, comparability, and representativeness are as follows:

- Accuracy - the degree of agreement of a measurement with an accepted referenced or true value.

- Precision - a measure of agreement among individual measurements under similar conditions. Usually expressed in terms of the standard deviation.

- Completeness - the amount of valid data obtained from a measurement system compared to the amount that was expected to meet the project data goals.

- Comparability - expresses the confidence with which one data set can be compared to another.

- Representativeness - a sample or group of samples that reflects the characteristics of the media at the sampling point. It also includes how well the sampling point represents the actual parameter variations which are under study.

As part of the G-R QA/QC program, applicable federal, state, and local reference guidance documents are followed. The procedures outlined in these regulations, manuals, handbooks, guidance documents, and journals are incorporated into the G-R sampling procedures to assure that; (1) ground-water samples are properly collected, (2) ground-water samples are identified, preserved, and transported in a manner such that they are representative of field conditions, and (3) chemical analysis of samples are accurate and reproducible.

gettler — ryan inc. (415) 783-7500
general and environmental contractors

Guidance and Reference Documents Used to Collect Groundwater Samples

These documents are used to verify G-R sampling procedures and are consistent with current regulatory guidance. If site specific work and sampling plans are required, those plans will be developed from these documents, and newly received applicable documents.

U.S.E.P.A. - 330/9-51-002	NEIC Manual for Groundwater/Subsurface Investigation at Hazardous Waste Sites
U.S.E.P.A. - 530/SW611	Procedures Manual for Groundwater Monitoring at Solid Waste Disposal Facilities (August, 1977)
U.S.E.P.A. - 600/4-79-020	Methods for Chemical Analysis of Water and Wastes (1983)
U.S.E.P.A. - 600/4-82-029	Handbook for Sampling and Sample Preservation of Water and Wastewater (1982)
U.S.E.P.A. - 600/4-82-057	Test Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (July, 1982)
U.S.E.P.A. - SW-846#, 3rd Edition	Test Methods for Evaluating Solid Waste - Physical/Chemical Methods (November, 1986)
40 CFR 136:3e,Table II (Code of Federal Regulations)	Required Containers, Preservation Techniques, and Holding Times
Resources Conservation and Recover Act (OSWER 9950.1)	Groundwater Monitoring Technical Enforcement Guidance Document (September, 1986)
California Regional Water Quality Control Board (Central Valley Region)	A Compilation of Water Quality Goals (September, 1988); Updates (October, 1988)
California Regional Water Quality Control Board (North Coast, San Francisco Bay, and Central Valley)	Regional Board Staff Recommendations for Initial Evaluations and Investigation of Underground Tanks: Tri-Regional Recommendations (June, 1988)

Guidance and Reference Documents Used to Collect Groundwater Samples (cont.)

Regional Water Quality Control Board (Central Valley Region)	Memorandum: Disposal, Treatment, and Refuse of Soils Contaminated with Petroleum Fractions (August, 1986)
State of California Department of Health Services	Hazardous Waste Testing Laboratory Certification List (March, 1987)
State of California Water Resources Control Board	Leaking Underground Fuel Tank (LUFT) Field Manual (May, 1988), and LUFT Field Manual Revision (April, 1989)
State of California Water Resources Control Board	Title 23, (Register #85.#33-8-17-85), Subchapter 16: Underground Tank Regulations; Article 3, Sections 2632 and 2634; Article 4, Sections 2645, 2646, 2647, and 2648; Article 7, Sections 2670, 2671, and 2672 (October, 1986: including 1988 Amendments)
Alameda County Water District	Groundwater Protection Program: Guidelines for Groundwater and Soil Investigations at Leaking Underground Fuel Tank Sites (November, 1988)
American Public Health Association	Standard Methods for the Examination of Water and Wastewaters, 16th Edition
Analytical Chemistry (journal)	Principles of Environmental Analysis, Volume 55, Pages 2212-2218 (December, 1983)
Napa County	Napa County Underground Storage Tank Program: Guidelines for Site Investigations; February 1989.
Santa Clara Valley Water District	Guidelines for Preparing or Reviewing Sampling Plans for Soil and Groundwater Investigation of Fuel Contamination Sites (January, 1989)

Guidance and Reference Documents Used to Collect Groundwater Samples (cont.)

Santa Clara Valley Water District	Investigation and Remediation at Fuel Leak sites: Guidelines for Investigation and Technical Report Preparation (March 1989)
Santa Clara Valley Water District	Revised Well Standards for Santa Clara County (July 18, 1989)
American Petroleum Institute	Groundwater Monitoring & Sample Bias; API Publication 4367, Environmental Affairs Department, June 1983
American Petroleum Institute	A Guide to the Assessment and Remediation of Underground Petroleum Releases; API Publication 1628, February 1989
American Petroleum Institute	Literature Summary: Hydrocarbon Solubilities and Attenuations Mechanisms, API Publication 4414, August 1985
Site Specific (as needed)	General and specific regulatory documents as required.

Because ground-water samples collected by G-R are analyzed to the parts per billion (ppb) range for many compounds, extreme care is exercised to prevent contamination of samples. When volatile or semi-volatile organic compounds are included for analysis, G-R sampling crew members will adhere to the following precautions in the field:

1. A clean pair of new, disposable gloves are worn for each well being sampled.

2. When possible, samples are collected from known or suspected wells that are least contaminated (i.e. background) followed by wells in increasing order of contamination.

3. Ambient conditions are continually monitored to maintain sample integrity.

When known or potential organic compounds are being sampled for, the following additional precautions are taken:

1. All sample bottles and equipment are kept away from fuels and solvents. When possible, gasoline (used in generators) is stored away from bailers, sample bottles, purging pumps, etc.

2. Bailers are made of Teflon or Stainless Steel. Other materials such as plastic may contaminate samples with phthalate esters which interfere with many Gas Chromatography (GC) analyses.

3. Volatile organic ground-water samples are collected so that air passage through the sample does not occur or is minimal (to prevent volatiles from being stripped from the samples): sample bottles are filled by slowly running the sample down the side of the bottle until there is a positive convex meniscus over the neck of the bottle; the Teflon side of the septum (in cap) is positioned against the meniscus, and the cap screwed on tightly; the sample is inverted and the bottle lightly tapped. The absence of an air bubble indicates a successful seal; if a bubble is evident, the cap is removed, more sample is added, and the bottle is resealed.

4. Extra Teflon seals are brought into the field in case seals are difficult to handle and/or are dropped. Dropped seals are considered contaminated and are not used. When replacing seals or if seals become flipped, care is taken to assure that the Teflon seal faces down.

Sample analysis methods, containers, preservatives and holding times are shown on Table 1.

Laboratory and field handling procedures of samples are monitored by including QC samples for analysis with every submitted sample lot from a project site. QC samples may include any combination of the following:

A. Trip Blank: Used for purgeable organic compounds only; QC samples are collected in 40 milliliter (ml) sample vials filled in the analytical laboratory with organic-free water. Trip blanks are sent to the project site, and travel with project site samples. Trip blanks are not opened, and are returned from a project site with the project site samples for analysis.

B. Field Blank: Prepared in the field using organic-free water. These QC samples accompany project site samples to the laboratory and are analyzed for specific chemical parameters unique to the project site where they were prepared.

C. Duplicates: Duplicated samples are collected "second samples" from a selected well and project site. They are collected as either split samples or second-run samples collected from the same well.

D. Equipment Blank: Periodic QC sample collected from field equipment rinsate to verify decontamination procedures.

The number and types of QC samples are determined as follows:

A. Up to 2 wells - Trip Blank Only

B. 2 to 5 Wells - 1 Field Blank and 1 Trip Blank

C. 5 to 10 Wells - 1 Field blank, 1 Trip Blank, and 1 Duplicate

D. More than 10 Wells - 1 Field Blank, 1 Trip Blank, and 1 Duplicate per each 12 wells

E. If sampling extends beyond one day, quality control samples will be collected for each day.

Additional QC is performed through ongoing and random reviews of duplicate samples to evaluate the precision of the field sampling procedures and analytical laboratory. Precision of QC data is accomplished by calculating the Relative Percent Difference (RPD). The RPD is evaluated to assess whether values are within an acceptable range (typically ± 20% of duplicate sample).

SAMPLE COLLECTION

This section describes the routine procedures followed by G-R while collecting ground-water samples for chemical analysis. These procedures include decontamination, water-level measurements, well purging, physical parameter measurements, sample collection, sample preservation, sample handling, and sample documentation. Critical sampling objectives for G-R are to:

1. Collect ground-water samples that are representative of the sampled matrix and,

2. Maintain sample integrity from the time of sample collection to receipt by the analytical laboratory.

Sample analyses methods, containers, preservation, and holding times are presented in Table 1.

Decontamination Procedures

All physical parameter measuring and sampling equipment are decontaminated prior to sample collection using Alconox or equivalent detergent followed by steam cleaning with deionized water. Any sampling equipment surfaces or parts that might absorb specific contaminants, such as plastic pump valves, impellers, etc., are cleaned in the same manner.

Sample bottles, bottle caps, and septa used for sampling volatile organics are thoroughly cleaned and prepared in the laboratory. Sample bottles, bottle caps, and septa are protected from all potential chemical contact before actual usage at a sample location.

During field sampling, equipment placed in a well are decontaminated before purging or sampling the next well. The equipment are decontaminated by cleaning with Alconox or equivalent detergent followed by steam cleaning with deionized water.

Water-Level Measurements

Prior to purging and sampling a well, the static-water levels are measured in all wells at a project site using an electric sounder and/or calibrated portable oil-water interface probe (Figure 4). Both static water-level and separate-phase product thickness are measured to the nearest ±0.01 foot. The presence of separate-phase product is confirmed using a clean, acrylic or polyvinylchloride (PVC) bailer, measured to the nearest ±0.01 foot with a decimal scale tape.

Water-Level Measurements (continued)

The monofilament line used to lower the bailer is replaced between wells with new line to preclude the possibility of cross-contamination. Field observations (e.g. well integrity, product color, turbidity, water color, odors, etc.) are noted on the G-R Well Sampling Field Data Sheet shown in Figure 4. Before and after each use, the electric sounder, interface probe and bailer are decontaminated by washing with Alconox or equivalent detergent followed by rinsing with deionized water to prevent cross-contamination.

As mentioned previously, water-levels are measured in wells with known or suspected lowest dissolved chemical concentrations to the highest dissolved concentrations.

Well Purging

Before sampling occurs, well casing storage water and interstitial water in the artificial sand pack will be purged using (1) a positive displacement bladder pump constructed of inert, non-wetting, Teflon and stainless steel, (2) a pneumatic-airlift pumping system, (3) a centrifigal pumping system, or (4) a Teflon or Stainless steel bailer (Figure 5). Methods of purging will be assessed based on well size, location, accessibility, and known chemical conditions. Individual well purge volumes are calculated from borehole volumes which take into account the sand packed interval in the well annular space. As a general rule, a minimum of 3 and a maximum of 10 borehole volumes will be purged. Wells which dewater or demonstrate slow recharge periods (i.e. low-yield wells) during purging activities may be sampled after fewer purging cycles. If a low-yield (low recovery) well is to be sampled, sampling will not take place until at least 80 percent of the previously measured water column has been replaced by recharge, or as per local requirements. Physical parameter measurements (temperature, pH, and specific conductance) are closely monitored throughout the well purging process and are used by the G-R sampling crew as indicators for assessing sufficient purging. Purging is continued until all three physical parameters have stabilized. Specific conductance (conductivity) meters are read to the nearest ± 10 umhos/cm, and are calibrated daily. pH meters are read to the nearest ± 0.1 pH units and are calibrated daily. Temperature is read to the nearest 0.1 degree F. Calibration of physical parameter meters will follow manufacturers specifications. Monitoring wells will be purged according to the protocol presented in Figure 5. Collected field data during purging activities will be entered on the G-R Well Sampling Field Data Sheet shown in Figure 4. Copies of the G-R Field Data Sheets will be reviewed by the G-R Sampling Manager for accuracy and completeness.

DOCUMENTATION

Sample Container Labels

Each sample container will be labeled by an adhesive label, noted in permanent ink immediately after the sample is collected. Label information will include:

Sample point designation (i.e. well number or code)

Sampler's identification

Project number

Date and time of collection

Type of preservation used

Well Sampling Data Forms

In the field, the G-R sampling crew will record the following information on the Well Sampling Data Sheet for each sample collected:

Project number

Client

Location

Source (i.e. well number)

Time and date

Well accessibility and integrity

Pertinent well data (e.g. depth, product thickness, static water-level, pH, specific conductance, temperature)

Calculated and actual purge volumes

Chain-of-Custody

A Chain-of-Custody record (Figure 6) shall be completed and accompany every sample and every shipment of samples to the analytical laboratory in order to establish the documentation necessary to trace sample possession from time of collections. The record will contain the following information:

- Sample or station number or sample identification (ID)
- Signature of collector, sampler, or recorder
- Date and time of collection
- Place of collection
- Sample type
- Signatures of persons involved in chain of possession
- Inclusive dates of possession

Samples shall always be accompanied by a Chain-of-Custody record. When transferring the samples, the individual relinquishing and receiving the samples will sign, date, and note the time on the Chain-of-Custody record. G-R will be responsible for notifying the laboratory coordinator when and how many samples will be sent to the laboratory for analysis, and what types of analyses shall be performed.

TABLE 1

SAMPLE ANALYSIS METHODS, CONTAINERS, PRESERVATIONS, AND HOLDING TIMES

Parameter	Analytical Method	Reporting Units	Container	Preservation	Maximum Holding Time
Total Petroleum Hydrocarbons (gasoline)	EPA 8015 (modified)	mg/l ug/l	40 ml. vial glass, Teflon	cool, 4 C HCl to pH<2	14 days (maximum)
Benzene Toluene Ethylbenzene Xylenes (BTEX)	EPA 8020	mg/l ug/l mg/l	50 ml. vial glass, Teflon lined septum 1 l glass, Teflon	cool, 4 C HCl to pH<2	7 days (w/o preservative) 14 days (w preservative)
Oil & Grease	SM 503E	ug/l	lined septum	H_2SO_4 to pH<2	28 days (maximum)
Total Petroleum Hydrocarbons (Diesel)	EPA 8015 (modified)	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Halogented Volatile Organics (chlorinated solvents)	8010	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Non chlorinated solvents	8020	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C HCl to pH<2	14 days (maximum)
Volatile Organics	8240	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool, 4 C	14 days (maximum)
Semi-Volatile Organics	8270	mg/l ug/l	40 ml. vial glass, Teflon lined septum	cool , 4 C	14 days (maximum)
Specific Conductance (Field test)		umhos/cm			
pH (Field test)		pH units			
Temperature (Field test)		Deg F			

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FIELD EXPLORATORY BORING LOG

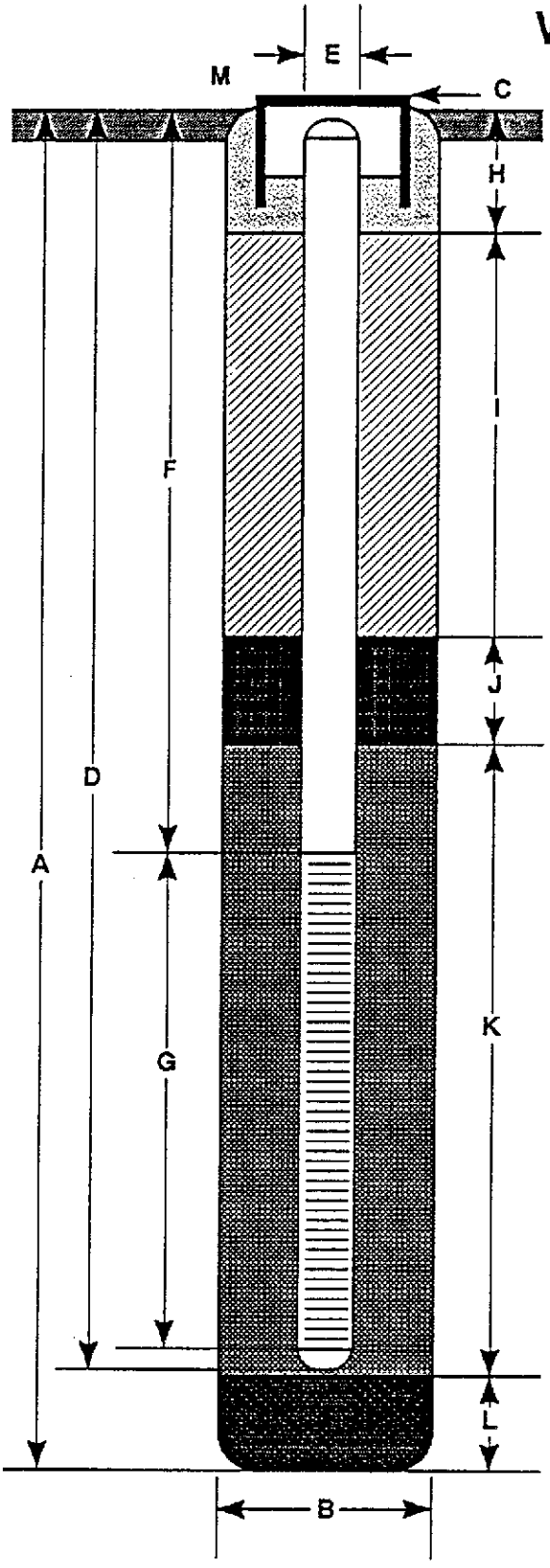
FIGURE 1

Field location of boring:	Project No.:	Date:	Boring No:
	Client:		
	Location:		
	City:		Sheet
	Logged by:	Driller:	of
Drilling method:	Casing installation data:		
Hole diameter:	Top of Box Elevation:		Datum:

								Water Level				
PID (ppm)	Blows/ft. or Pressure (psi)	Type of Sample	Sample Number	Depth (ft.)	Sample	Well Detail	Soil Group Symbol (USCS)	Time				
								Date				
										Description		

WELL CONSTRUCTION DETAIL

FIGURE 2



A Total Depth of Boring _____ ft.

B Diameter of Boring _____ in.
Drilling Method _____

C Top of Box Elevation _____ ft.
☐ Referenced to Mean Sea Level
☐ Referenced to Project Datum

D Casing Length _____ ft.
Material _____

E Casing Diameter _____ in.

F Depth to Top Perforations _____ ft.

G Perforated Length _____ ft.
Perforated Interval from _____ to _____ ft.
Perforation Type _____
Perforation Size _____ in.

H Surface Seal from _____ to _____ ft.
Seal Material _____

I Backfill from _____ to _____ ft.
Backfill Material _____

J Seal from _____ to _____ ft.
Seal Material _____

K Gravel Pack from _____ to _____ ft.
Pack Material _____

L Bottom Seal _____ ft.
Seal Material _____

M _____

Note: Depths measured from initial ground surface

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Well Construction Detail

WELL NO.

JOB NUMBER	REVIEWED BY RG/CEG	DATE	REVISED DATE	REVISED DATE

WELL DEVELOPMENT FORM FIGURE 3

Page_____ of_____

==========

(to be filled out in office)

Client_____ SS#_____ Job#_____

Name_____ Location_____

Well#_____ Screened Interval_____ Depth_____

Aquifer Material_____ Installation Date _____

Drilling Method_____ Borehole Diameter_____

Comments regarding well installation:_____

_____

_____

==========

(to be filled out in the field) Name_____

Date_____ Development Method_____

Total Depth_____ - Depth to liquid_____ = WaterColumn_____

Product thickness_____

_____ x _____ x _____ x 0.0408 = _____gals
Water Column Diameter (in.) #Vol

Purge Start_____ Stop_____ Rate_____ gpm

Gallons	Time	Clarity	Temp.	pH	Conductivity
0					

Total gallons removed_____ Development stop time_____

Depth to liquid _____at_____(time)

Odor of water_____ Water discharged to_____

Comments_____

_____

_____

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General and Environmental Contractors

WELL SAMPLING FIELD DATA SHEET

FIGURE 4

COMPANY _____ JOB # _____

LOCATION _____ DATE _____

CITY _____ TIME _____

Well ID. _____ Well Condition _____

Well Diameter _____ in. Hydrocarbon Thickness _____ ft.

Total Depth _____ ft.

Depth to Liquid- _____ ft.

Volume Factor (VF)			
	2" = 0.17	6" = 1.50	12" = 5.80
	3" = 0.38	8" = 2.60	
	4" = 0.66	10" = 4.10	

(# of casing volumes) _____ x _____ x(VF) _____ = (Estimated Purge Volume) _____ gal.

Purging Equipment _____

Sampling Equipment _____

Starting Time _____ Purging Flow Rate _____ gpm.

(Estimated Purge Volume) _____ gal. / (Purging Flow Rate) _____ gpm. = (Anticipated Purging Time) _____ min.

Time	pH	Conductivity	Temperature	Volume

Did well dewater? _____ If yes, time _____ Volume _____

Sampling Time _____ Weather Conditions _____

Analysis _____ Bottles Used _____

Chain of Custody Number _____

COMMENTS _____

FIGURE 5

Monitoring Well Sampling Protocol Schematic

Sampling Crew Reviews Project Sampling Requirements/Schedule

↓

Field Decontamination and Instrumentation Calibration

↓

Check Integrity of Well (Inspect for Well Damage)

↓

Measure and Record Depth to Water and Total Well Depth (Electric Well Sounder)

↓

Check for Floating Product (Oil/Water Interface Probe)

Floating Product Present

↓

Confirm Product Thickness (Acrylic or PVC Bailer)

↓

Collect Free-Product Sample

↓

Dissolved Product Sample Not Required

↓

Record Data on Field Data Form

Floating Product Not Present

↓

Purge Volume Calculation

$V = \pi (r/12)^2 h(\_\% \text{ vol})(7.48) = \_\_\_ / \text{gallons}$

V = Purge volume (gallons)

$\pi = 3.14159$

h = Height of Water Column (feet)

r = Borehole radius (inches)

↓

Evacuate water from well equal to the calculated purge volume while monitoring groundwater stabilization indicator parameters (pH, conductivity, temperature) at intervals of one casing volume.

Well Dewaters after One Purge Volume (Low yield well)

↓

Well Recharges to 80% of Initial Measured Water Column Height in Feet within 24 hrs. of Evacuation.

↓

Measure Groundwater Stability Indicator Parameters (pH, Temperature, Conductivity)

↓

Collect Sample and Complete Chain-of-Custody

↓

Preserve Sample According to Required Chemical Analysis

↓

Transport to Analytical Laboratory

Well Readily Recovers

↓

Record Groundwater Stability Indicator Parameters from each Additional Purge Volume

Stability indicated when the following Criteria are met:

pH :	± 0.1 pH units
Conductivity:	± 10%
Temperature:	1.0 degrees F

Groundwater Stability Achieved

↓

Collect Sample and Complete Chain-of-Custody

↓

Preserve Sample According to Required Chemical Analysis

↓

Transport to Analytical Laboratory

Groundwater Stability Not Achieved

↓

Continue Purging Until Stability is Achieved

↓

Collect Sample and complete Chain-of-Custody

↓

Preserve Sample According to Required Chemical Analysis

↓

Transport to Analytical Laboratory

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ENVIRONMENTAL DIVISION

Chain of Custody
FIGURE 6

COMPANY _____ JOB NO. _____

JOB LOCATION _____

CITY _____ PHONE NO. _____

AUTHORIZED _____ DATE _____ P.O. NO. _____

SAMPLE ID	NO. OF CONTAINERS	SAMPLE MATRIX	DATE/TIME SAMPLED	ANALYSIS REQUIRED	SAMPLE CONDITION LAB ID

RELINQUISHED BY: _____ RECEIVED BY: _____

RELINQUISHED BY: _____ RECEIVED BY: _____

RELINQUISHED BY: _____ RECEIVED BY LAB: _____

DESIGNATED LABORATORY: _____ DHS #: _____

REMARKS: _____

DATE COMPLETED _____ FOREMAN _____

APPENDIX F
BENZENE TRANSPORT MODEL

SIMULATION OF BENZENE TRANSPORT

(July 1987)

M. W. Kemblowski, A. J. Stabenau

Shell Development Company
Westhollow Research Center

Assumptions

Although the groundwater flow field is not truly uniform, and the streamlines show mild curvature, it was assumed that the flow system can be approximated assuming a uniform velocity distribution (Figure 1). This assumption may result in small discrepancies between the actual and predicted concentration distributions. The pore-water velocity q was estimated as follows:

$$q = k \cdot i/n$$

where:

k = hydraulic conductivity. Variable head tests performed at the site provided the following values:

Well No.	k [gpd/ft^2]	k [ft/d]
S-1	32.1	4.3
S-4	83.3	11.2
S-6	41.6	5.6

For modeling purposes it was assumed that k = 10 ft/day. It is a conservative assumption, since the chosen value is close to the upper range of hydraulic conductivity, and therefore produces higher pore-water velocities, which in turn results in a higher source mass flux calculated by the model.

i = hydraulic gradient, estimated to be i = 0.007 (Figure 1).

n = porosity, estimated to be n = 0.4, which is typical for the type of soils that underlie the service station.

Using these parameters, the pore-water velocity is estimated as q = .175 ft/day.

Source strength and location. The following benzene concentrations were measured in the samples taken from the monitoring wells:

	Benzene Concentration, ppb									
Well No.	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
Jan. 1986	24	2	ND	1800	NM	NM	NM	NM	NM	NM
June 1986	210	67	ND	3000	ND	59	0.7	ND	ND	NM
Nov. 1986	18	14	2.5	4800	ND	790	ND	ND	ND	22
Jan. 1987	35	50	ND	3600	ND	1200	1.7	ND	ND	18
Apr. 1987	16	23	ND	4000	ND	270	ND	ND	ND	0.6

* NM - not measured (the wells did not exist)
** ND - not detected (below 0.5 ppb)

At the beginning of the investigation, it was thought that the previous storage complex (Figure 1) was the source of groundwater contamination. The spatial distribution of the benzene concentration confirms this hypothesis. The most contaminated well (well S-4) is located downgradient from the storage complex, whereas the wells located on both sides of the complex (wells S-1 and S-2) show much lower benzene concentrations. The time series of the monitored benzene concentrations in wells S-2, S-4, S-6, and S-10 are shown in Figures 2 through 5. Analysis of these data indicates that in two wells (S-2 and S-10) the benzene concentration levels are declining. This is particularly evident for well S-10 (Figure 5), which is located some 165 ft downgradient from the source. This concentration decline may be due to increased biodegradation activity resulting from adaptation of the microbial population to the contaminant plume. The well closest to the source (well S-4, Figure 3), however, does not show any significant decrease in the benzene concentration levels. The benzene concentration in this well fluctuates about 4 ppm level, most likely due to the precipitation events and groundwater level fluctuations. Therefore, it was conservatively decided to use the average concentrations for the last three measurement dates as representative of the benzene distribution. For the wells used in calibration, these average values are: S-4 - 4133 ppb, S-6 - 753 ppb, and S-10 - 14 ppb.

The horizontal size of the source, Y, in the direction perpendicular to the flow direction was estimated, based on the analysis of the flow and chemical data, to be Y = 30 ft. It was assumed that the source was submerged about 5 ft below the water table. It is a conservative assumption, but in order to change it we would have to obtain some information about the three-dimensional concentration distribution near the source.

Dispersive properties of the aquifer were assumed to be constant. Based on the data available in the literature, the following values were estimated: α_x = 5 ft, α_y = 0.5 ft, and α_z = 0.01 ft, where α_x, α_y, α_z are longitudinal, transverse (horizontal), and vertical dispersivities, respectively.

Biodegradation rate. Recent laboratory and field experiments indicate that benzene is biodegraded at the average rate of 5 - 10% per week. Assuming that the process can be described as first-order decay, the decay constant is calculated to be between 0.007/day to 0.015/day. This gives us the order of magnitude for the decay constant. The actual value is estimated based on the field data.

Continuous Release Model

The transient, three-dimensional concentration distribution of continuously released contaminant from a source of constant concentration, C_o, and constant dimensions Y and Z (where Y = horizontal dimension in the direction perpendicular to flow, Z = vertical size of the source in the saturated zone, may be described by

$$C(x,y,z,t) = \frac{C_o}{8} \exp\left\{ \frac{x}{2\alpha_x} \left[1-(1+4m\alpha_x/q)^{1/2}\right]\right\}$$

$$\operatorname{erf}\left\{\left[x-qt\,(1+4m\alpha_x/q)^{1/2}\right]/\left[2\,(\alpha_x qt)^{1/2}\right]\right\}$$

$$\left\{\operatorname{erf}\left[(y+Y/2)/2(\alpha_y x)^{1/2}\right] - \operatorname{erf}\left[(y-Y/2)/2(\alpha_y x)^{1/2}\right]\right\}$$

$$\left\{\operatorname{erf}\left[(z+Z)/2(A\alpha_z x)^{1/2}\right] - \operatorname{erf}\left[(z-Z)/2(\alpha_z x)^{1/2}\right]\right\}$$

For the steady-state conditions, the concentration distribution at the water table along the centerline (y = 0, z = 0) may be calculated as follows:

$$c(x) = C_o \exp\left\{\frac{x}{2\alpha_x}\left[1 - (1+4m\alpha_x/q)^{1/2}\right]\right\}$$

$$\operatorname{erf}\left[\frac{Y}{4(\alpha_y x)^{1/2}}\right] \operatorname{erf}\left[\frac{Z}{2(\alpha_z x)^{1/2}}\right]$$

This equation was utilized to fit the field data and to estimate the degradation rate characteristic to the site. Figure 6 shows the distribution of computed and observed benzene concentration. The observed data are the averages from the last three measurements in wells S-4 (x = 0), S-6 (x = 90 ft), and S-10 (x = 165 ft). The simulation was performed for m = 0.0032/day. It may be seen that the model fits the concentration in well S-6 quite well. The difference between the observed and simulated concentrations at well S-10 may be caused by

higher degradation rate between wells S-6 and S-10, due to lower benzene concentration. Such behavior has been observed in laboratory experiments. Figure 7 shows the benzene concentration distribution at the low concentration (<100 ppb) region. Analysis of this distribution indicates that, according to the calibrated model, benzene concentration should not exceed 7 ppb at the distance larger than some 350 ft downgradient from well S-4.

Summary

A benzene mass transport model for the Shell Service Station was developed. The input parameters were estimated based on the field investigation (seepage velocity, source size and concentration), calibration procedure (biodegradation rate), and other studies (dispersivities). The calibrated benzene degradation rate is m - 0.0032/day. The results indicate that the biodegradation process should reduce the benzene concentration below 7 ppb at some 350 ft from the source.

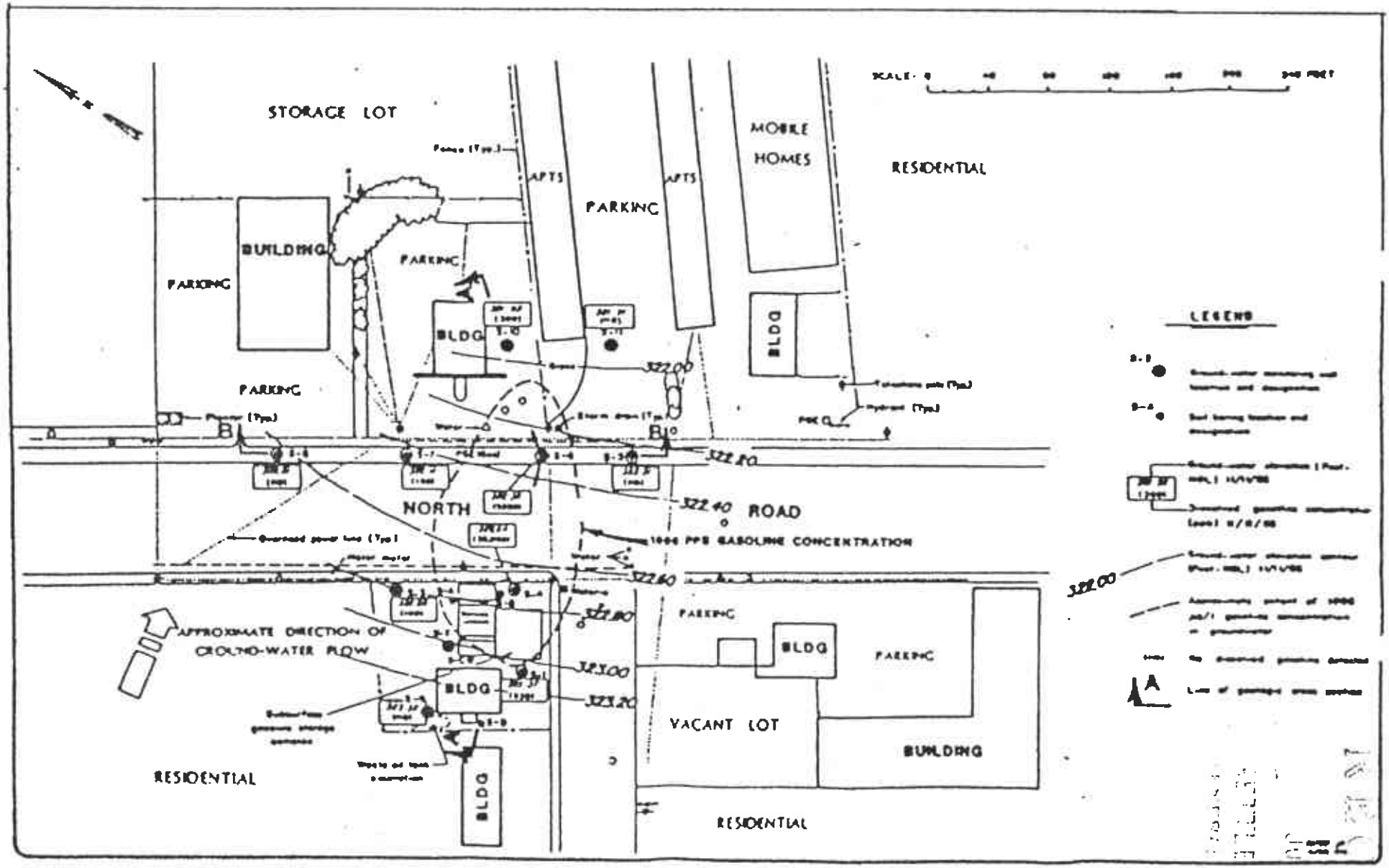

FIGURE 1. SITE PLAN

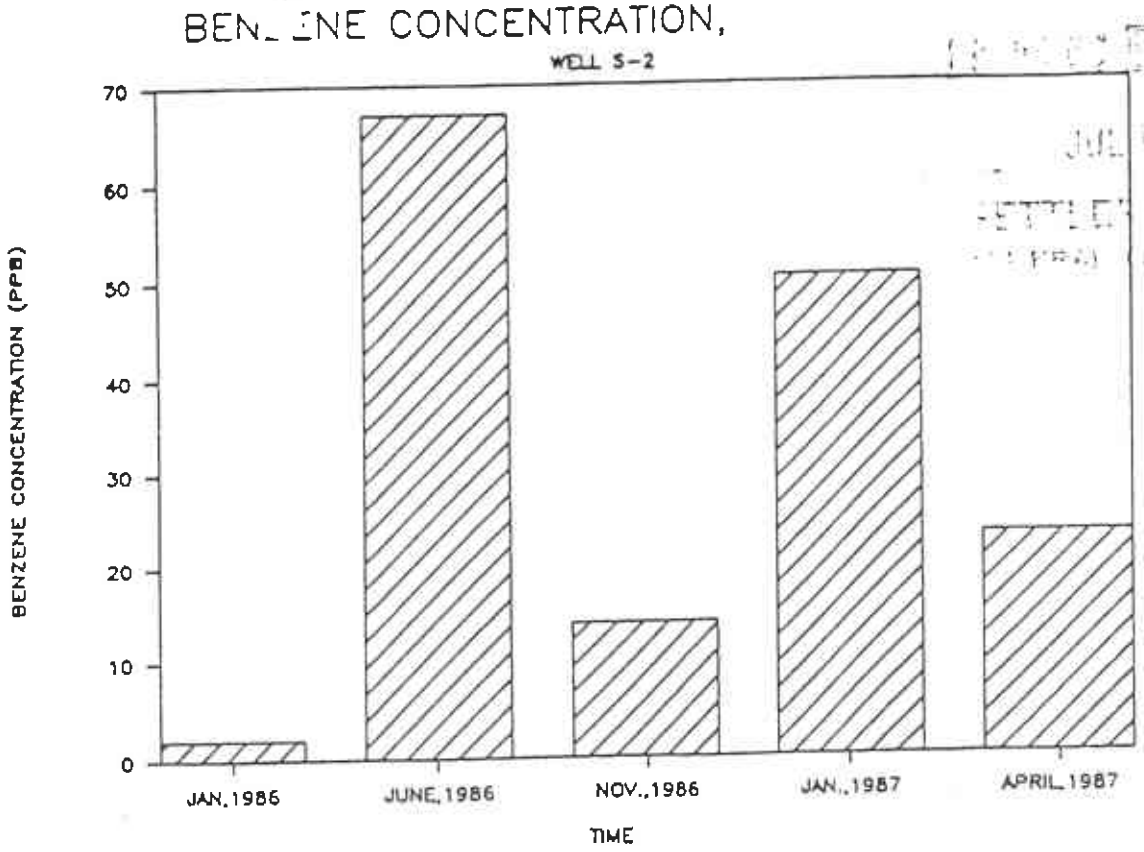

FIGURE 2. OBSERVED BENZENE CONCENTRATION
WELL S-2

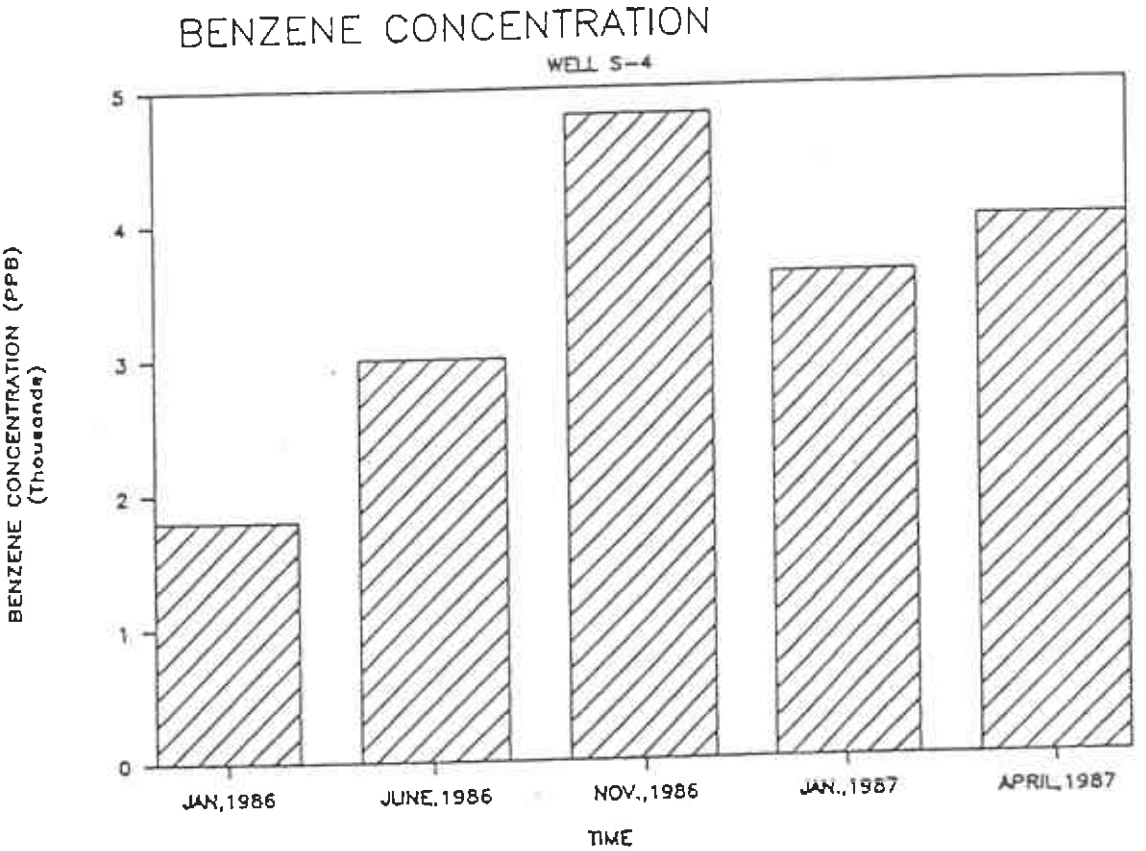

FIGURE 3. OBSERVED BENZENE CONCENTRATION
WELL S-4

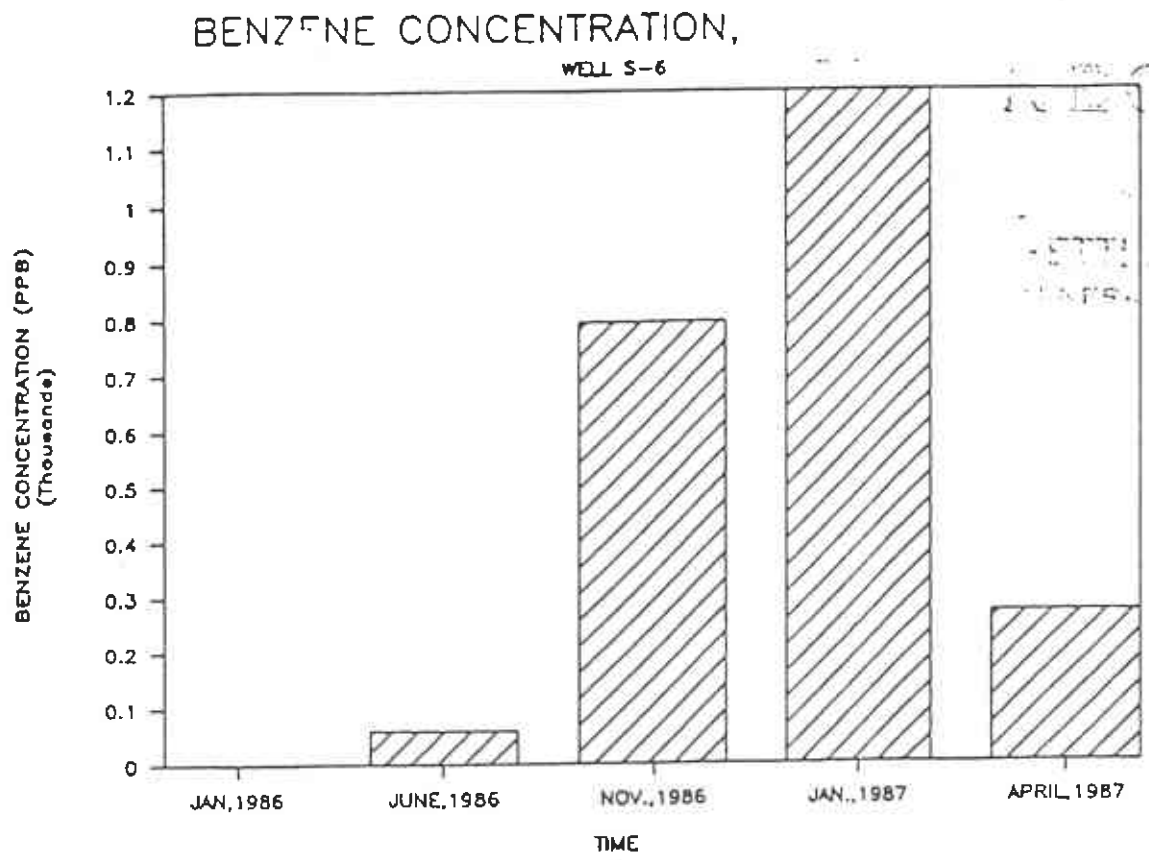

FIGURE 4. OBSERVED BENZENE CONCENTRATION
WELL S-6

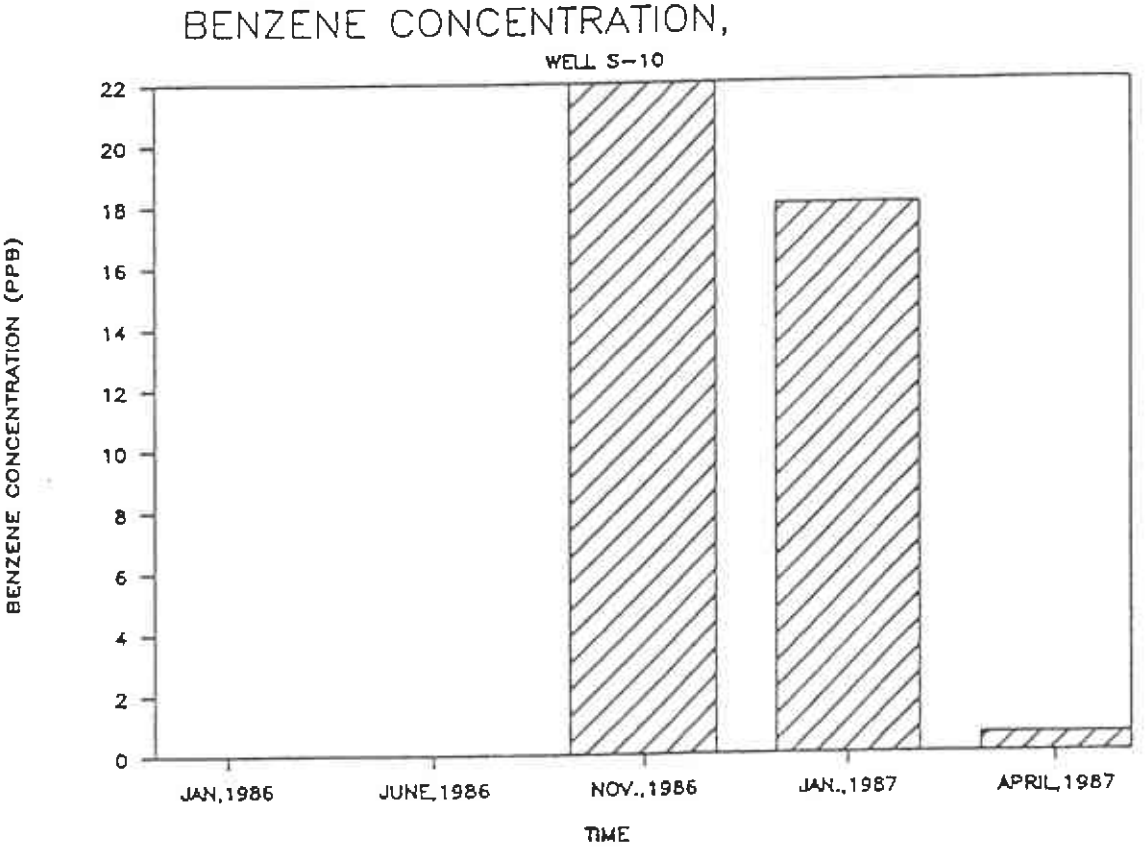

FIGURE 5. OBSERVED BENZENE CONCENTRATION
WELL S-7

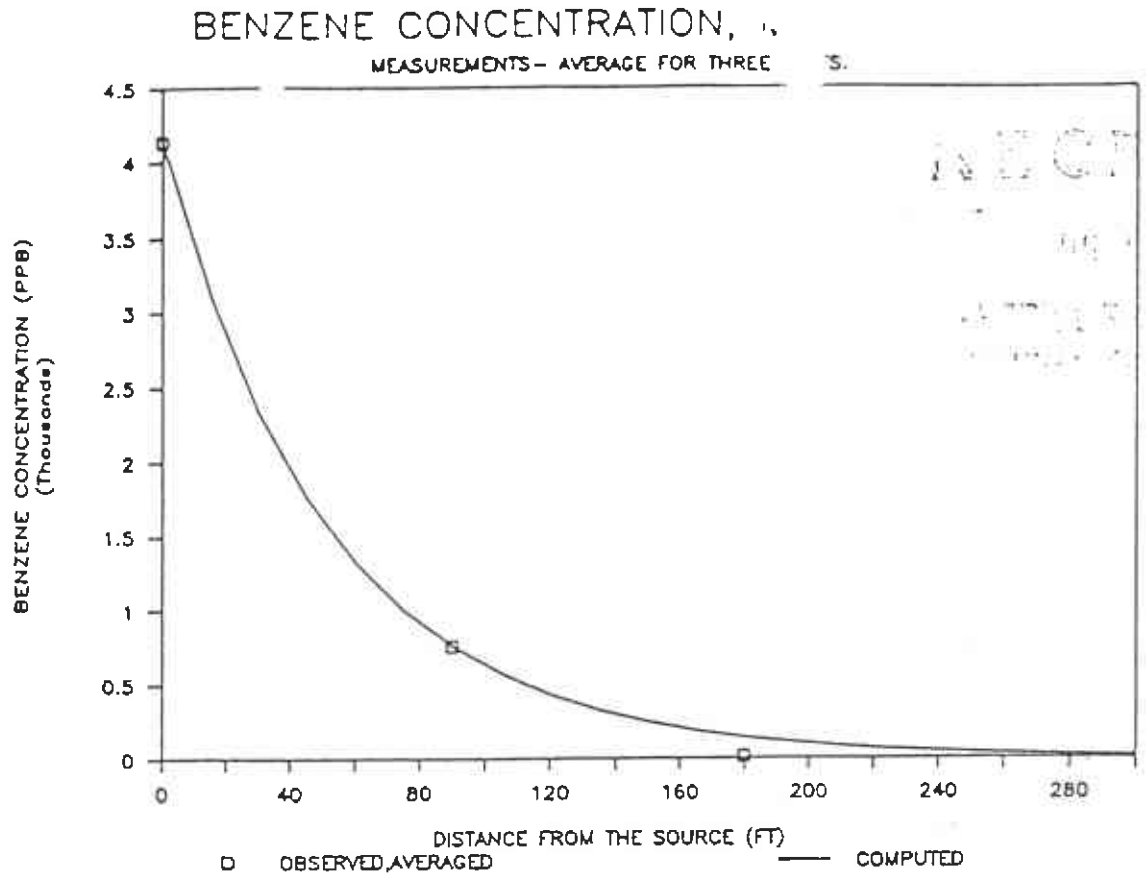

FIGURE 6. OBSERVED AND COMPUTED BENZENE CONCENTRATION DISTRIBUTION DOWNSTREAM FROM THE SOURCE

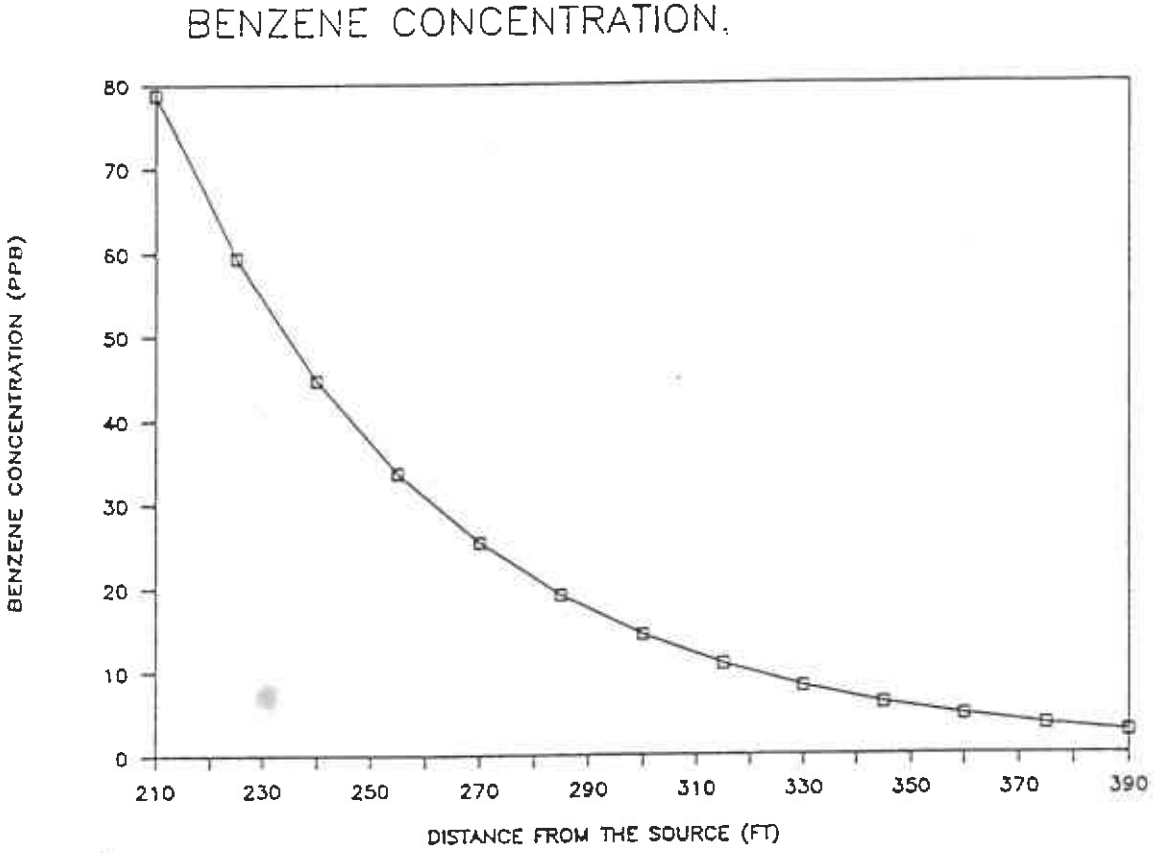

FIGURE 7. COMPUTED BENZENE CONCENTRATION -- LOW CONCENTRATION REGION