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GET

Geo Environmental Technology

Alameda County
MAR 07 2003
Environmental Health

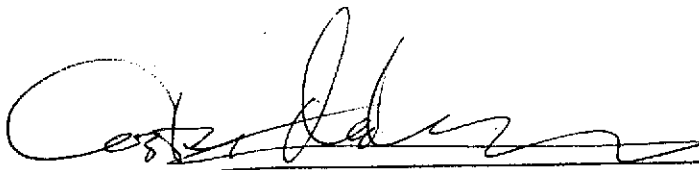
PUMP TEST

For

Livermore Gas and Mini Mart
160 Holmes Street
Livermore, California

Prepared by

Geo Environmental Tech
343 Soquel Avenue, #33
Santa Cruz, CA 95062



Costas Orountiotis
Project Manager

12/30/02

Date



Kenneth L. Meleen
Senior Engineer



December 30, 2002

Date

December 2002

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GET

Geo Environmental Technology

GROUNDWATER PUMP TEST

Livermore Gas and Mini Mart
167 Holmes Street
Livermore, CA

1.0 INTRODUCTION

This report documents the 6/27/02 performance of a groundwater pump test at the Livermore Gas and Mini Mart (LGMM), located at 167 Holmes Street, in Livermore, California. Work was performed at the request of the Alameda County Environmental Health Services (ACEH). An electronic copy of the ACEH directive is presented in Appendix A. A Site Vicinity Map is presented as Figure 1; Figure 2 is a Site Plan.

The objective of this investigation was to determine the sustainable groundwater extraction rate from the well (yield) and the radius of pumping influence (cone of depression). This information will be utilized to determine the effectiveness of migration control and pump and treat remediation methods at the subject site.

2.0 BACKGROUND/SITE HISTORY

On 2/26/99, a soil boring was advanced in the northern section of the property, about 10 feet from the edge of First Street sidewalk, to log the soil profile and determine depth to groundwater. A groundwater grab sample was collected and analyzed for Total Petroleum Hydrocarbons as gasoline (TPHg), benzene, toluene, ethyl-benzene, total xylenes (BTEX) and methyl tertiary butyl ether (MTBE). The sample was found to be impacted by petroleum hydrocarbons (TPHg: 100,000 ug/l, Benzene: 6,100 ug/l, MTBE: 60,000 ug/L). The results were communicated to the Livermore-Pleasanton Fire Department (LPPD) and a UST Unauthorized Release Report was generated.

On 4/5/99, three gasoline and one diesel USTs, associated dispensers and piping were removed, manifested and disposed, under permit by the LPPD. The pit was over-excavated and samples were collected from native soil beneath the USTs; sample analysis indicated the presence of petroleum hydrocarbons in soil. Total Petroleum Hydrocarbons as diesel (TPHd) were detected at low levels (61 mg/kg) in the soil stockpile, but not beneath the diesel tank; Total Petroleum Hydrocarbons as gasoline (TPHg) concentrations ranged from undetectable to 80 mg/kg in all samples; MTBE concentrations ranged from 24 to 110 mg/kg.

On 5/20/99 soil samples were collected beneath the dispenser islands. TPHg was found beneath the east dispenser island in varying concentrations ranging from 32 mg/kg to 6,500 mg/kg; TPHd beneath the diesel dispenser was detected at 1300 mg/kg; no MTBE was detected beneath the dispenser islands.

On 7/26/00, three soil borings were drilled onsite to an approximate depth of 30-feet below ground surface (bgs). Soil samples were collected for analyses. Upon completion of drilling activities, the soil borings were converted to groundwater monitoring wells (MW1, MW2 and MW3) by installing 2-inch diameter, Schedule 40, factory threaded polyvinyl chloride (PVC) casing, factory slotted (0.010-inch). The slotted interval extends from 15 to 30 feet bgs. The wells were sampled on 8/11/00 and analyzed for TPHd, TPHg, BTEX and MTBE. The sample results indicated significant hydrocarbon impact in the groundwater. Directly downgradient well MW1 had concentrations of TPHg and MTBE of 170,000 ug/L and 320,000 ug/L respectively. A "Well Installation Report" was issued by ETIC Engineering on 9/22/00.

On 10/19/00 groundwater samples were collected as part of quarterly monitoring at the site. Samples were analyzed for TPHd, TPHg, BTEX and MTBE. The sample results confirmed the presence of significant hydrocarbon impact in the groundwater. Directly downgradient well MW1 had concentrations of TPHg and MTBE of 170,000 ug/L and 200,000 ug/L respectively. Geo Environmental Technologies issued a "Quarterly Monitoring Report" on January 31, 2000.

On 02/22/01 groundwater samples were collected as part of quarterly monitoring at the site. Samples were analyzed for TPHd, TPHg, BTEX and MTBE. The sample results confirmed the presence of significant hydrocarbon impact in the groundwater. Directly downgradient well MW1 had concentrations of TPHg and MTBE of 11,000 ug/L and 190,000 ug/L respectively. Geo Environmental Technologies issued a "Quarterly Monitoring Report" on March 31, 2001.

On 05/30/01 groundwater samples were not collected because all three monitoring wells were found to be dry. The monitoring wells also were dry in August and November 2001.

On 10/29/01 three offsite monitoring wells and a 6" diameter onsite extraction well were installed. Following the installation of onsite extraction well and three offsite monitoring wells groundwater samples were collected on 11/14/01. Monitoring wells MW1, MW2 and MW3 were all dry. Groundwater samples were collected from the four newly installed wells as part of quarterly monitoring at the site. Samples were analyzed for TPHd, TPHg, BTEX and MTBE. Sample results confirmed the presence of significant hydrocarbon concentrations offsite and an areal impact to groundwater. Directly downgradient extraction well EX1 contained concentrations of TPHg and MTBE of 2,000 ug/L and 2,200 ug/L respectively. Geo Environmental Technologies issued a "Quarterly Monitoring Report" on March 31, 2001. Construction details of all wells are presented in Table 1.

On 5/7/02 groundwater beneath the site was again sampled. Extraction well EX1 contained 7,700 ug/l TPHg and 6,200 ug/l MTBE. GET issued a report on 5/28/02.

3.0 SITE CONTACTS

The following is a listing of site contacts, addresses and phone numbers.

UST Operator: Livermore Gas and Mini Mart
Attention: Manwel and Samira Shuwayhat
160 Holmes Street
Livermore, CA 94520
Phone: (925) 455-4212

Local Oversight Agency: ACEHS
Attention: Eva Chu
1131 Harbor Bay Parkway, Suite 250
Alameda, CA 94502
Phone: (510) 567-6700

Environmental consultant: Geo Environmental Technologies
Attention: Costas Orountiotis
343 Soquel Avenue, #33
Santa Cruz, CA 95062
Phone: (831) 423-8780

4.0 PUMP TEST

4.1 Static Groundwater Elevation

Groundwater elevations in extraction well EX1 were monitored intermittently over 24 hours prior to test start-up, for potential trends in water table changes. Observed fluctuations in elevation did not exceed ± 0.01 foot.

4.2 Pumping System

A short, 30-minute pumping test was conducted in well EX1 located at Livermore Gas & Mini Mart, 160 Holmes Street in Livermore, California. This included a 60-minute record of recovered data.

To run the test, a GRUNDFUS submersible pump with continuous flow control was used. The pump was placed at a depth of about 52 feet, i.e., 25 feet below the static water table. Flow was controlled with a ball valve and measured totalizer flow meter. Water was stored in 55-gallon drums and 6,500-gallon Baker tanks. The test lasted only 30-minutes due to low well yield, resulting in dynamic water table decrease to pump intake level. Total volume of extracted water was only 4.03 cubic feet, 30 gallons at the average pumping yield of 1 gpm.

During the test, water level (drawdown) in tested well was measured with the Hermit data logger and double checked manually, using a Solinst, electronic water meter.

Water level in tested well and monitoring wells MW1, MW2, MW3, MW4, MW5 and MW6 was measured prior to the start off the test. During the test, water level was measured only in wells MW1 and MW2.

During the pumping phase of the test, there was no measured response from any other monitoring wells; therefore, only data from extraction well EX1 was used to calculate aquifer parameters of transmissivity and hydraulic conductivity. Based on water levels in all monitoring wells prior to test startup, the hydraulic gradient was calculated at 0.01 ft/ft. Groundwater flow direction was to the north. Printouts of the field data are presented in Appendix B. Data analysis and graphs are presented in Appendix C.

Analysis of data from pumping test was performed using the Infinite Extent Aquifer Pump Test Analysis Software, Version 3.2, by Theis Automatic Parameter Estimation and by Theis recovery straight line method.

Theis Recovery Straight Line method was used, as it is more reliable for a single well test. Residual drawdown points versus log of time (t/t') are plotted on semi-log paper. A straight line is fit through the plotted points and the slope of the line is determined, i.e. the residual drawdown difference $\Delta s'$ per log cycle of t/t' . Transmissivity $T=KD$ is calculated from the following equation:

$$\Delta s' = 2.3Q/4\pi KD, KD = \Delta s' / 2.3Q$$

Where:

Q-pumping rate, m^3/day (1 gpm, $5.45 m^3/day$)

K-hydraulic conductivity, m^2/day

D-aquifer thickness, m (25 feet, 7.6 m)

Aquifer transmissivity by Theis Automatic Parameter Estimation was calculated to be $3.13 m^2/day$, 1.4 square feet/day.

Aquifer transmissivity by Theis Straight Line method was estimated to be $0.11 m^2/day$, 1.18 square feet/day.

Estimated aquifer parameters were used to calculate the extent of the capture zone for well EX1 pumping at the rate of 1 gpm and 0.5 gpm, assuming aquifer porosity of 10 percent, hydraulic gradient of 0.01, and average transmissivity of Well Head Protection Area (WHPA) for which software Version 2.11 was used. This is a modular, semi-analytical groundwater flow model designed to help with Well Head Protection Area delineation.

Capture zones were calculated for 100 and 365 days.

At a pumping rate of 1 gpm, the capture zone perpendicular to groundwater flow direction, extends approximately 190 feet after one year of pumping and is presented in Figure 3. At the rate of 0.5 gpm, the capture zone perpendicular to groundwater flow direction, extends 130 feet after one year of pumping and is presented in Figure 4. Figure 5 presents 365-day capture zones at the 0.5 gpm pumping rate using well EX1 and a second well.

5.0 DISCUSSION AND RECOMMENDATIONS

Under the present condition of the well EX1, continuous pumping at a rate of 1 gpm is unlikely. An estimated drawdown at the pumping rate of 1 gpm, under steady state conditions could reach about 80 feet. However, based on soil description from the well EX1 borehole, this well should have significantly higher capacity. To reach an optimal capacity, the well should be re-developed so silty and clayey material smeared along borehole wall during drilling is removed.

The pump test results indicate that a "pump and treat" system under present conditions is not the most viable means of migration control. Full implementation of such a system would incur large costs for small quantities of contaminants removed. However, a small scale, low intensity, interim source removal system may be utilized based on the results of the pump test. It can be expanded if well redevelopment increases aquifer yield.

A Soil Vapor Extraction Feasibility test for soil and groundwater cleanup, using MW1 as a single soil vapor extraction well will be performed on 3/28/03. This study may be combined with Air sparging for higher hydrocarbon removal rates.

GET recommends the following:

1. Complete a downgradient potential receptor survey and conduit study. Based on the data evaluate whether source removal rather than migration control should be prioritized.
2. Perform a Soil Vapor Extraction (SVE) test; such a test has been scheduled for 3/28/03.
3. Upon completion of the SVE test, prepare an Interim Remedial Action Plan to proceed with site remediation using a soil vapor extraction and air sparging system. The property owner will use the plan as the relevant bid package as per the three bid requirement of the State Reimbursement Fund. Start the system permitting process as soon as possible. The BAAQMD will require about two months to review and approve applications for vapor extraction systems.

Questions regarding this report should be addressed to GET at (831) 423-8780

TABLE 1 - Well Construction Details

Livermore Gas and Minimart, 160 Holmes, Livermore, California

Well Number	Date Installed	Total Depth (feet bgs)	Borehole Diameter (inches)	Casing Diameter (inches)	Slot (inch)	Interval					DTW 9/11/02 (feet)
						Screen (feet)	Blank Casing (feet)	Sand Pack (feet)	Bentonite Seal (feet)	Cement Grout (feet)	
MW-1	07/26/00	30	8	2	0.01	30-15	15-0.5	30-13	13-11	11-1.0	26.16
MW-2	07/26/00	30	8	2	0.01	30-15	15-0.5	30-13	13-11	11-1.0	25.96
MW-3	07/26/00	30	8	2	0.01	30-15	15-0.5	30-13	13-11	11-1.0	26.61
MW-4	10/30/01	50	8	2	0.01	50-20	20-0.5	50-18	18-16	16-0.5	26.66
MW-5	10/30/01	50	8	2	0.01		20-0.5	50-18	18-16	16-0.5	27.99
MW-5	10/30/01	50	8	2	0.01		20-0.5	50-18	18-16	16-0.5	27.03
EX1	10/30/01	55	10	6	0.01	55-30	30-0.5	55-28	28-26	26-0.5	

Notes: bgs Below ground surface
DTW Depth to water

TABLE 2 - Groundwater Analytical Results

Livermore Gas and Minimart, 160 Holmes, Livermore, California

Well ID.	Date	DTW (feet)	TPHd (µg/L)	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-Benzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
MW1	08/11/00		57000	170000	6400	7600	4200	9700	320000
	10/19/00	21.94	17000	170000	8400	3200	2700	10000	200000
	02/22/01	22.91	11000	82000	5100	1000	13000	8700	190000
	05/30/01	Dry							
	11/14/01	Dry							
	05/07/02	Dry							
	09/11/02	26.16	NA	130000	7700	1100	4500	1500	<5000
	12/01/02	27.55	NS	NS	NS	NS	NS	NS	NS
MW2	08/11/00		1900	4500	220	52	160	170	3000
	10/19/00	21.80	1300	3400	150	21	100	70	1900
	02/22/01	22.87	880	7600	25	< 10	69	25	2200
	05/30/01	Dry							
	11/14/01	Dry							
	05/07/02	26.70	86	400	5.4	<0.50	1.9	2.3	230
	09/11/02	25.96	NA	260	1.3	<0.50	0.57	0.77	200
	12/11/02	27.56	120	250	7.9	1.6	13	9.9	180
MW3	08/11/00		260	59	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	10/19/00	22.45	< 65	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	02/22/01	23.51	100	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	05/30/01	Dry							
	11/14/01	Dry							
	05/07/02	Dry							
	09/11/02	26.61	NA	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	12/11/02	28.18	Dry						
MW-4	11/14/01	33.84	90	510	4	< 0.50	< 0.50	< 0.50	14
	05/07/02	26.75	< 50	150	3.5	0.5	< 0.50	< 0.50	48
	09/11/02	26.66	NA	< 50	< 0.50	< 0.50	< 0.50	< 0.50	15
	12/11/02	28.39	< 50	< 50	< 0.50	< 0.50	< 0.50	< 0.50	24
MW-5	11/14/01	34.94	< 66	< 50	< 0.50	< 0.50	< 0.50	< 0.50	8.2
	05/07/02	27.90	< 50	140	< 0.50	< 0.50	< 0.50	< 0.50	110
	09/11/02	27.99	NA	< 50	< 0.50	< 0.50	< 0.50	< 0.50	6.3
	12/11/02	29.50	< 50	73	< 0.50	< 0.50	< 0.50	< 0.50	160
MW-6	11/14/01	33.88	< 50	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	05/07/02	27.01	< 67	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	09/11/02	27.03	NA	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 5.0
	12/11/02	28.77	< 50	< 50	< 0.50	< 0.50	< 0.50	< 0.50	< 1.0

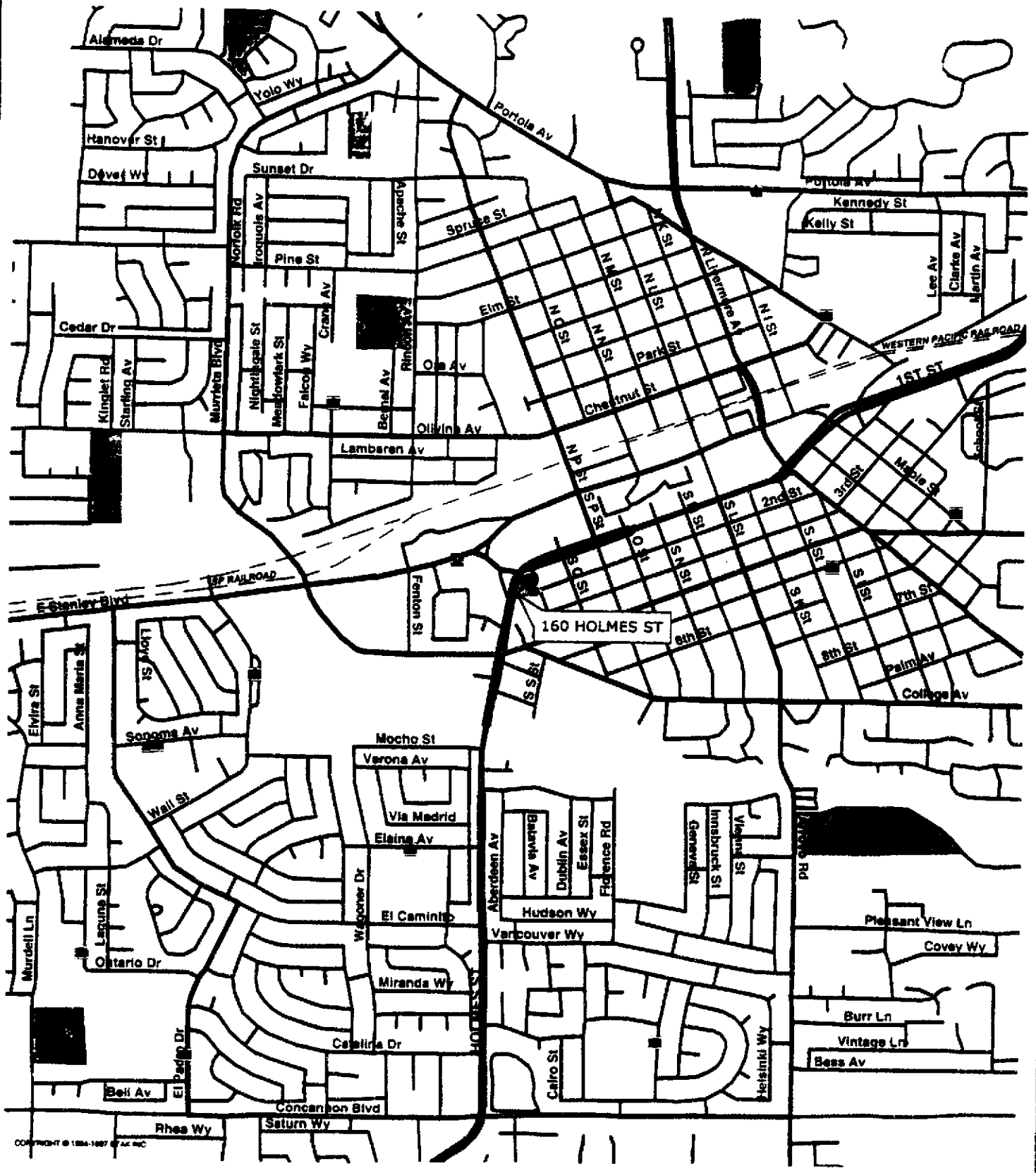
TABLE 2 - Groundwater Analytical Results

Livermore Gas and Minimart, 160 Holmes, Livermore, California

Well ID.	Date	DTW (feet)	TPHd (µg/L)	TPHg (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethyl-Benzene (µg/L)	Xylenes (µg/L)	MTBE (µg/L)
EX1	11/14/01	33.41	2000	13000	180	1000	330	3200	2200
	05/07/02	27.58	560	7700	320	< 25	66	150	6200
	09/11/02	NM	NA	2800	32	< 13	14	< 13	2500
	12/11/02	27.98	100	3000	81	< 0.50	44	< 1	4800

Notes: DTW: Depth to Groundwater
NM: Not Measured
NA: Not Analyzed
TPHg: Total Petroleum Hydrocarbons as gasoline
TPHd: Total Petroleum Hydrocarbons as diesel
MTBE: Methyl tertiary Butyl Ether
µg/L: Micrograms per liter

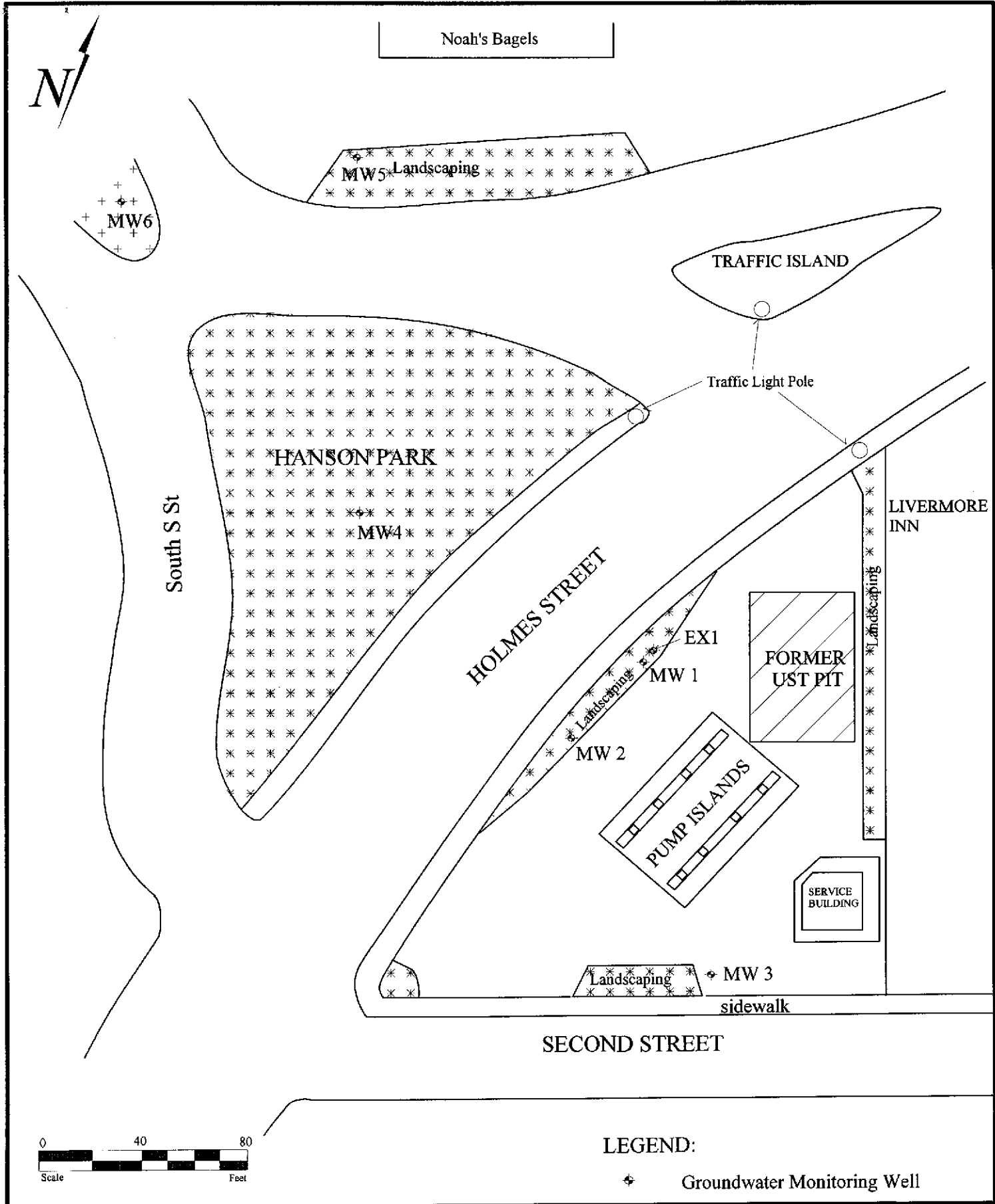
Figures



**Geo
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SITE VICINITY MAP
 Livermore Gas and Minimart
 160 Homes Street, Livermore, CA

Figure No.
 1
 Project
Manwel



**Geo
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SITE PLAN
 Livmore Gas and Minimart
 160 Homes Street, Livmore, CA

Figure No.
2
 Project
Manwel

Noah's Bagels



MW6

MW5 Landscaping

TRAFFIC ISLAND

Traffic Light Pole

HANSON PARK

HOLMES STREET

South S St

LIVERMORE INN

MW2 Landscaping

FORMER UST PIT

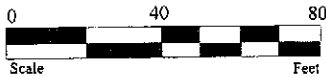
PUMP ISLANDS

SERVICE BUILDING

MW3 Landscaping

sidewalk

SECOND STREET



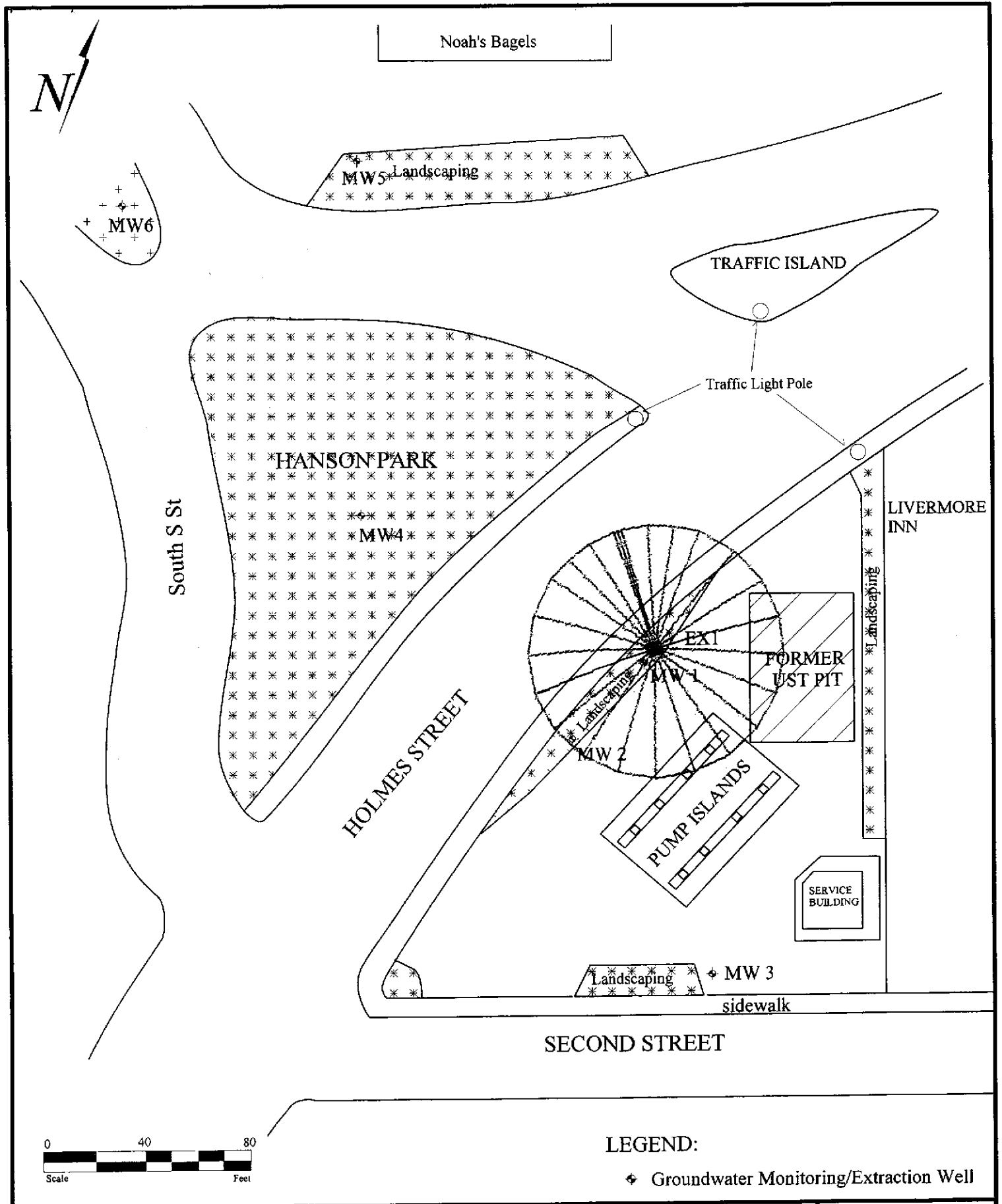
LEGEND:

◆ Groundwater Monitoring/Extraction Well

Geo Environmental Technologies

Pumping rate: 1 gpm
Number of wells: 1
Livermore Gas and Minimart
160 Homes Street, Livermore, CA

Figure No. 3
Project Manwel Pump test



LEGEND:
 ◆ Groundwater Monitoring/Extraction Well

Pumping rate: 0.5 gpm
 Number of wells: 1
 Livermore Gas and Minimart
 160 Homes Street, Livermore, CA

Figure No.
 4
 Project
 Manwel Pump test

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 Environmental
 Technologies**



Noah's Bagels

MW6

MW5 Landscaping

TRAFFIC ISLAND

Traffic Light Pole

HANSON PARK

South S St

HOLMES STREET

LIVERMORE INN

FORMER UST PIT

MW4

PUMP ISLANDS

SERVICE BUILDING

Landscaping

MW3

sidewalk

SECOND STREET



LEGEND:

◆ Groundwater Monitoring/Extraction Well

**Geo
Environmental
Technologies**

Pumping rate: 0.5 gpm
Number of wells: 2
Livermore Gas and Minimart
160 Homes Street, Livermore, CA

Figure No.
5
Project
Manwel Pump test

Appendix A

ACEHS Directive

RO0000324

February 22, 2002

Mr. Manwel Shuwayhat
Livermore Gas and Mini Mart
160 Holmes Street
Livermore, CA 94550

RE: Aquifer Pump Test and MTBE Treatment Study for 160 Holmes Street, Livermore, CA

Dear Mr. Shuwyahat:

I have completed review of Geo Environmental Technologies' (GET) February 2002 *Offsite Assessment and Installation of Groundwater Monitoring Wells* report prepared for the above referenced site. Three off-site groundwater monitoring wells and one on-site extraction well were installed. Surprisingly, groundwater from the new off-site wells did not contain TPHg, BTEX and MTBE at the magnitude expected. Rather, low levels were detected. The on-site extraction well contained 13,000ppb TPHg, 180ppb benzene and 2,200ppb MTBE. On-site wells MW-1 through MW-3 were not monitored since they remain dry.

GET recommended to proceed with an aquifer pump test and MTBE treatment study. GET also recommended to perform a soil vapor extraction test, while the shallow wells remain dry. This office concurs with the recommendations. The aquifer pump test and soil vapor test and MTBE treatment study should be commence within 60 days of the date of this letter, or by April 25, 2002.

If you have any questions, I can be reached at (510) 567-6762.

eva chu
Hazardous Materials Specialist

email: Costas Orountiotis
Danielle Stefani

Appendix B

Recovery Data

SE1000C
Environmental Logger
06/29 10:25

Unit# 01035 Test 1

Setups:	INPUT 1

Type	Level (F)
Mode	TOC
I.D.	00001

Reference	0.000
Linearity	0.070
Scale factor	15.250
Offset	-0.020
Delay mSEC	50.000

Step 1 06/28 10:30:44

Elapsed Time	INPUT 1

0.0066	0.004
0.0100	0.009
0.0133	0.009
0.0166	0.009
0.0200	0.004
0.0233	0.004
0.0266	0.009
0.0300	0.009
0.0333	0.009
0.0366	0.009
0.0400	0.009
0.0433	0.009
0.0466	0.009
0.0500	0.014
0.0533	0.009
0.0566	0.009
0.0600	0.009
0.0633	0.009
0.0666	0.014
0.0700	0.009
0.0733	0.014
0.0766	0.014
0.0800	0.009
0.0833	0.009
0.0866	0.009
0.0900	0.009
0.0933	0.009
0.0966	0.004
0.1000	0.009
0.1033	0.009
0.1066	0.009
0.1100	0.009
0.1133	0.014
0.1166	0.009

0.1200	0.009
0.1233	0.009
0.1266	0.014
0.1300	0.014
0.1333	0.009
0.1366	0.014
0.1400	0.009
0.1433	0.009
0.1466	0.009
0.1500	0.009
0.1533	0.009
0.1566	0.009
0.1600	0.009
0.1633	0.009
0.1666	0.009
0.1700	0.009
0.1733	0.009
0.1766	0.014
0.1800	0.009
0.1833	0.009
0.1866	0.014
0.1900	0.009
0.1933	0.009
0.1966	0.009
0.2000	0.014
0.2033	0.014
0.2066	0.009
0.2100	0.009
0.2133	0.009
0.2166	0.014
0.2200	0.009
0.2233	0.009
0.2266	0.009
0.2300	0.009
0.2333	0.009
0.2366	0.009
0.2400	0.009
0.2433	0.009
0.2466	0.009
0.2500	0.009
0.2533	0.009
0.2566	0.009
0.2600	0.009
0.2633	0.009
0.2666	0.004
0.2700	0.009
0.2733	0.009
0.2766	0.009
0.2800	0.009
0.2833	0.009
0.2866	0.009
0.2900	0.009
0.2933	0.009
0.2966	0.009
0.3000	0.009
0.3033	0.009
0.3066	0.009

0.3100	0.004
0.3133	0.009
0.3166	0.009
0.3200	0.009
0.3233	0.009
0.3266	0.009
0.3300	0.004
0.3333	0.009
0.3500	0.009
0.3666	0.009
0.3833	0.009
0.4000	0.009
0.4166	0.014
0.4333	0.009
0.4500	0.004
0.4666	0.009
0.4833	0.009
0.5000	0.009
0.5166	0.009
0.5333	0.009
0.5500	0.009
0.5666	0.004
0.5833	0.009
0.6000	0.009
0.6166	0.009
0.6333	0.004
0.6500	0.009
0.6666	0.009
0.6833	0.004
0.7000	0.009
0.7166	0.009
0.7333	0.004
0.7500	0.009
0.7666	0.009
0.7833	0.009
0.8000	0.009
0.8166	0.009
0.8333	0.004
0.8500	0.004
0.8666	0.009
0.8833	0.009
0.9000	0.009
0.9166	0.009
0.9333	0.009
0.9500	0.009
0.9666	0.004
0.9833	0.004
1.0000	0.009
1.2000	0.009
1.4000	0.004
1.6000	0.004
1.8000	0.004
2.0000	-0.009
2.2000	-0.009
2.4000	-0.009
2.6000	-0.004
2.8000	-0.009

3.0000	-0.009
3.2000	-0.009
3.4000	-0.009
3.6000	-0.004
3.8000	-0.009
4.0000	-0.009
4.2000	-0.004
4.4000	-0.004
4.6000	-0.004
4.8000	-0.009
5.0000	-0.009
5.2000	-0.009
5.4000	-0.009
5.6000	-0.004
5.8000	-0.004
6.0000	-0.009
6.2000	0.000
6.4000	-0.004
6.6000	-0.004
6.8000	-0.004
7.0000	-0.062
7.2000	-0.236
7.4000	-0.410
7.6000	-0.574
7.8000	-0.743
8.0000	-0.897
8.2000	-1.066
8.4000	-1.235
8.6000	-1.390
8.8000	-1.549
9.0000	-1.703
9.2000	-1.858
9.4000	-2.017
9.6000	-2.162
9.8000	-2.321
10.0000	-2.476
12.0000	-3.963
14.0000	-5.360
16.0000	-6.631
18.0000	-7.849
20.0000	-8.957
22.0000	-9.968
24.0000	-10.897
26.0000	-11.739
28.0000	-12.509
30.0000	-13.201
32.0000	-13.816
34.0000	-14.363
36.0000	-14.848
38.0000	-15.279
40.0000	-15.642
42.0000	-15.967
44.0000	-16.243
46.0000	-16.481
48.0000	-16.684
50.0000	-16.854
52.0000	-16.994

SE1000C
Environmental Logger
06/29 10:36

Unit# 01035 Test 2

Setups: INPUT 1

Type Level (F)
Mode TOC
I.D. 00001

Reference 0.000
Linearity 0.070
Scale factor 15.250
Offset -0.020
Delay mSEC 50.000

Step 0 06/28 11:37:02

Elapsed Time INPUT 1

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0.0033 -17.450
0.0066 -17.533
0.0100 -17.474
0.0133 -17.470
0.0166 -17.474
0.0200 -17.440
0.0233 -17.416
0.0266 -17.431
0.0300 -17.479
0.0333 -17.470
0.0366 -17.416
0.0400 -17.387
0.0433 -17.406
0.0466 -17.440
0.0500 -17.387
0.0533 -17.387
0.0566 -17.368
0.0600 -17.431
0.0633 -17.392
0.0666 -17.353
0.0700 -17.324
0.0733 -17.319
0.0766 -17.343
0.0800 -17.305
0.0833 -17.290
0.0866 -17.343
0.0900 -17.271
0.0933 -17.290
0.0966 -17.266
0.1000 -17.227
0.1033 -17.334
0.1066 -17.130
0.1100 -17.242

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0.1233	-17.213
0.1266	-17.188
0.1300	-17.193
0.1333	-17.183
0.1366	-17.179
0.1400	-17.179
0.1433	-17.150
0.1466	-17.159
0.1500	-17.169
0.1533	-17.154
0.1566	-17.130
0.1600	-17.164
0.1633	-17.125
0.1666	-17.145
0.1700	-17.140
0.1733	-17.067
0.1766	-17.106
0.1800	-17.101
0.1833	-17.106
0.1866	-17.111
0.1900	-17.067
0.1933	-17.077
0.1966	-17.072
0.2000	-17.067
0.2033	-17.043
0.2066	-17.038
0.2100	-17.053
0.2133	-17.028
0.2166	-17.019
0.2200	-17.004
0.2233	-17.053
0.2266	-17.019
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0.2466	-16.965
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0.2566	-16.970
0.2600	-16.936
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0.2666	-16.951
0.2700	-16.912
0.2733	-16.941
0.2766	-16.917
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0.2966	-16.864
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0.3133	-16.820
0.3166	-16.839
0.3200	-16.830
0.3233	-16.825
0.3266	-16.810
0.3300	-16.801
0.3333	-16.825
0.3500	-16.776
0.3666	-16.723
0.3833	-16.699
0.4000	-16.665
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0.4333	-16.597
0.4500	-16.573
0.4666	-16.539
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0.5000	-16.456
0.5166	-16.432
0.5333	-16.393
0.5500	-16.369
0.5666	-16.340
0.5833	-16.321
0.6000	-16.306
0.6166	-16.258
0.6333	-16.224
0.6500	-16.175
0.6666	-16.161
0.6833	-16.127
0.7000	-16.117
0.7166	-16.083
0.7333	-16.049
0.7500	-16.011
0.7666	-15.982
0.7833	-15.967
0.8000	-15.923
0.8166	-15.914
0.8333	-15.885
0.8500	-15.846
0.8666	-15.802
0.8833	-15.822
0.9000	-15.773
0.9166	-15.739
0.9333	-15.705
0.9500	-15.676
0.9666	-15.652
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2.8000	-13.569
3.0000	-13.443
3.2000	-13.274
3.4000	-13.138
3.6000	-13.114
3.8000	-13.041
4.0000	-12.935
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4.4000	-12.843
4.6000	-12.780
4.8000	-12.780
5.0000	-12.722
5.2000	-12.649
5.4000	-12.610
5.6000	-12.567
5.8000	-12.504
6.0000	-12.417
6.2000	-12.397
6.4000	-12.315
6.6000	-12.296
6.8000	-12.301
7.0000	-12.286
7.2000	-12.228
7.4000	-12.170
7.6000	-12.112
7.8000	-12.102
8.0000	-11.996
8.2000	-12.005
8.4000	-11.947
8.6000	-11.947
8.8000	-11.836
9.0000	-11.831
9.2000	-11.846
9.4000	-11.744
9.6000	-11.739
9.8000	-11.715
10.0000	-11.652
12.0000	-12.693
14.0000	-13.375

0.1133	-17.843
0.1166	-17.848
0.1200	-17.843
0.1233	-17.843
0.1266	-17.843
0.1300	-17.843
0.1333	-17.843
0.1366	-17.843
0.1400	-17.843
0.1433	-17.843
0.1466	-17.843
0.1500	-17.843
0.1533	-17.843
0.1566	-17.843
0.1600	-17.843
0.1633	-17.848
0.1666	-17.848
0.1700	-17.843
0.1733	-17.843
0.1766	-17.843
0.1800	-17.843
0.1833	-17.843
0.1866	-17.848
0.1900	-17.843
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0.1966	-17.843
0.2000	-17.848
0.2033	-17.843
0.2066	-17.843
0.2100	-17.848
0.2133	-17.843
0.2166	-17.843
0.2200	-17.843
0.2233	-17.843
0.2266	-17.848
0.2300	-17.843
0.2333	-17.843
0.2366	-17.848
0.2400	-17.843
0.2433	-17.843
0.2466	-17.843
0.2500	-17.848
0.2533	-17.843
0.2566	-17.843
0.2600	-17.843
0.2633	-17.843
0.2666	-17.843
0.2700	-17.848
0.2733	-17.848
0.2766	-17.843
0.2800	-17.848
0.2833	-17.843
0.2866	-17.843
0.2900	-17.848
0.2933	-17.843
0.2966	-17.848
0.3000	-17.848

0.3033	-17.848
0.3066	-17.848
0.3100	-17.843
0.3133	-17.843
0.3166	-17.843
0.3200	-17.843
0.3233	-17.848
0.3266	-17.843
0.3300	-17.848
0.3333	-17.843
0.3500	-17.848
0.3666	-17.848
0.3833	-17.848
0.4000	-17.848
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0.4666	-17.586
0.4833	-17.440
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0.5333	-16.951
0.5500	-16.815
0.5666	-16.704
0.5833	-16.578
0.6000	-16.490
0.6166	-16.384
0.6333	-16.287
0.6500	-16.214
0.6666	-16.093
0.6833	-16.020
0.7000	-15.938
0.7166	-15.851
0.7333	-15.763
0.7500	-15.691
0.7666	-15.618
0.7833	-15.565
0.8000	-15.468
0.8166	-15.419
0.8333	-15.337
0.8500	-15.250
0.8666	-15.197
0.8833	-15.124
0.9000	-15.032
0.9166	-14.979
0.9333	-14.930
0.9500	-14.838
0.9666	-14.756
0.9833	-14.688
1.0000	-14.606
1.2000	-13.937
1.4000	-13.642
1.6000	-13.322
1.8000	-13.070
2.0000	-12.765
2.2000	-12.557
2.4000	-12.271

2.6000	-11.928
2.8000	-11.700
3.0000	-11.405
3.2000	-11.192
3.4000	-10.916
3.6000	-10.611
3.8000	-10.379
4.0000	-10.113
4.2000	-9.881
4.4000	-9.648
4.6000	-9.378
4.8000	-9.073
5.0000	-8.850
5.2000	-8.633
5.4000	-8.372
5.6000	-8.120
5.8000	-7.840
6.0000	-7.588
6.2000	-7.375
6.4000	-7.134
6.6000	-6.926
6.8000	-6.776
7.0000	-6.626
7.2000	-6.307
7.4000	-6.186
7.6000	-6.036
7.8000	-5.824
8.0000	-5.563
8.2000	-5.365
8.4000	-5.142
8.6000	-4.910
8.8000	-4.683
9.0000	-4.572
9.2000	-4.456
9.4000	-4.321
9.6000	-4.133
9.8000	-3.905
10.0000	-3.717
12.0000	-1.727
14.0000	0.014
16.0000	0.014
18.0000	0.019
20.0000	0.019
22.0000	0.038
24.0000	0.028
26.0000	0.000
28.0000	0.014

Appendix C

Calculations and graphs

Client: MANWEL
 Title: Pumping test EX1
 Site Name: Gas & Minimart
 Location: 160 Holmes Street, Livermore, CA
 Test Date: 6/28/02
 Print Time: Fri Aug 30 13:25:58 2002

Analysis by Theis Automatic Parameter Estimation
 Discharge Rate is 5.45 m³/day
 Pumping Well Radius is 0.076 meters
 Aquifer Thickness is 7.5 meters

RESULTS

Pumping Well Time	Drawdown	Transmissivity	Storativity
days	meters	m ² /day	
0.0049	3.07		
0.0069	3.95	0.116867	0.136064
0.0104	5.425	0.0790029	0.152971
0.0139	6.41	0.101992	0.140123
0.0174	7.178	0.108081	0.135251
0.0208	7.4908	0.240114	0.0309741

Arithmetic Mean of Transmissivity
 0.129211 m²/day
 1.39079 square feet per day
 10.4038 gal/day/ft

Arithmetic Mean of Hydraulic Conductivity
 0.0172282 meters/day
 1.994e-05 cm/sec
 0.0565222 feet per day
 0.422709 gal/day/ft²

Geometric Mean of Hydraulic Conductivity
 0.0159424 meters/day
 1.84518e-05 cm/sec

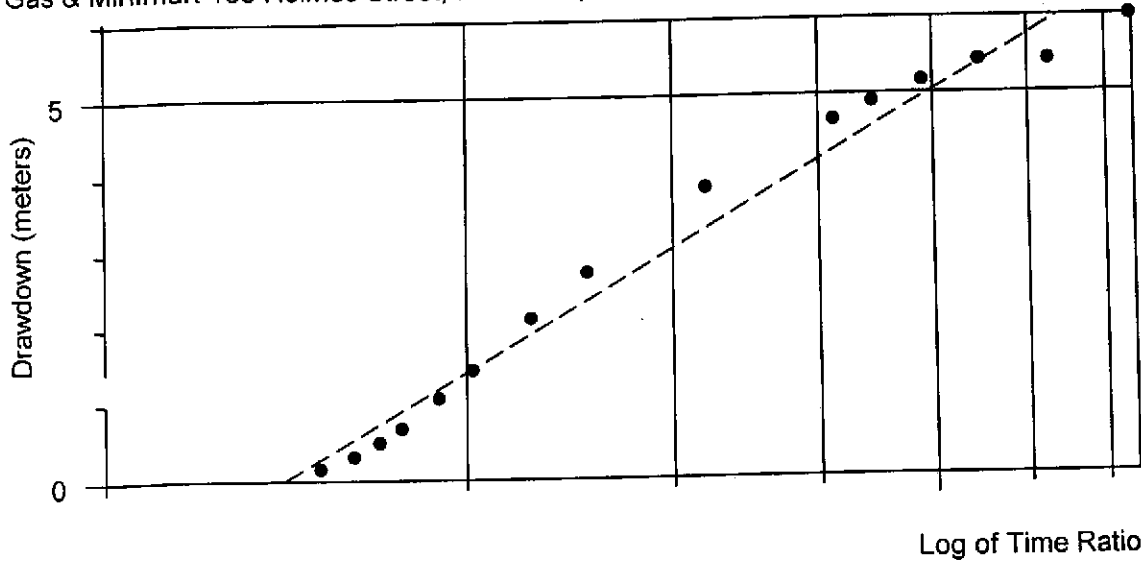
0.0523037 feet per day
0.39116 gal/day/ft²

Arithmetic Mean of Storativity = 0.119077
Geometric Mean of Storativity = 0.104088

Pumping test EX1 6/28/02

Gas & Minimart 160 Holmes Street, Livermore, CA

Theis Recovery

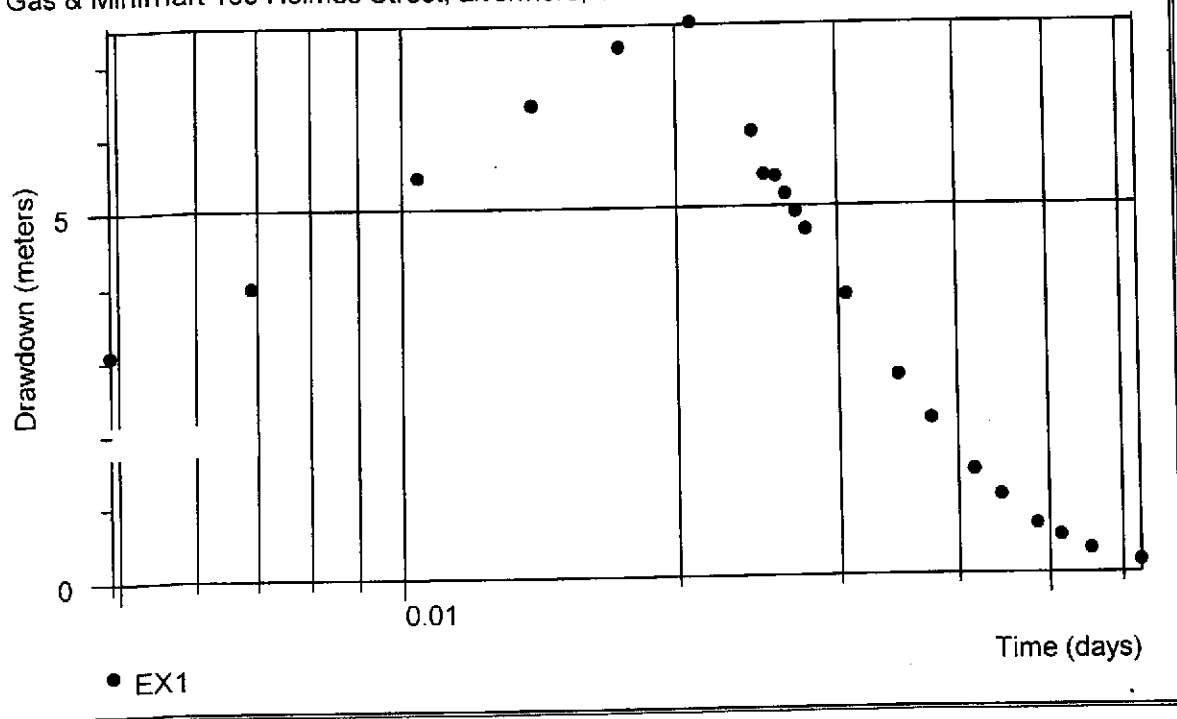


Transmissivity = 0.109128 m²/day
Well EX1 at distance of 0.076 meters
Pumping Well is EX1
Client: MANWEL

Pumping test EX1 6/28/02

Semi-Log Graph

Gas & Minimart 160 Holmes Street, Livermore, CA



Pumping test EX1 6/28/02

Arithmetic Graph

Gas & Minimart 160 Holmes Street, Livermore, CA

