WESTERN GEOLOGIC RESOURCES INC.
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JUL 23 '90

17 July 1990

Mr. Robert Foss
Chevron USA
2410 Camino Ramon
San Ramon, California 94583

Re: Vadose Zone Characterization:
Vadose Well Installation and Vacuum Extraction Testing
Chevron Service Station #92582
7420 Dublin Boulevard
Dublin, California
WGR Job # 1-124.04

Dear Mr. Foss:

This letter report presents methodologies and data for vadose zone well installation and the soil vapor extraction test conducted at former Chevron service station #92582 located in Dublin, California. The scope of work included drilling three vadose zone monitoring wells, collecting soil samples during drilling, analysis of the soil samples, conducting a soil vapor extraction test and collecting air samples from the soil vapor air stream during the test. The air stream evacuated from the vadose zone contained hydrocarbons. Even though vadose zone vacuum monitoring wells responded minimally to the induced vacuum created by the test, these data suggest a permanent soil vapor extraction system could be designed and operated to produce a reduction in hydrocarbon concentrations in the soils.

BACKGROUND

Historical analytic results and water level measurements as presented in the following reports are available on Tables 1 and 2 respectively.

In February 1989, three underground storage tanks were removed under the supervision of Blaine Tech Services, Inc. (BTS) of San Jose, California. BTS collected soil and water samples from the excavated area confirming Total Petroleum Hydrocarbons (TPH) in the soil and low- to medium-boiling point hydrocarbons in the groundwater (EPA Methods 8015 and 8020). Based on the hydrocarbon concentrations in both the soil and water samples, Western Geologic Resources, Inc. (WGR) was contracted by Chevron to oversee further excavation and proper disposal of the excavated soil.

During March 1989, WGR supervised excavation and separation of approximately 180 cubic yards of pea gravel into Class I and Class II stockpiles. Approximately 2,846 gallons of water containing petroleum hydrocarbons were pumped out of the excavated area. All material was properly disposed in appropriate landfills (Reference WGR report 12 April 1989).

Soil borings were collected and analyzed, confirming the existence of TPH on the north and south side of the most southern pump island (EPA Methods 8015 and 8020). In May 1989, additional excavation of approximately 100 cubic yards of material was conducted (Reference WGR report August 1989).

On 23 May 1989, representatives from WGR and Chevron met with Gil Wistar, Hazardous Materials Specialist with the Alameda County Health Agency, to discuss the implementation of a soil vapor extraction system in the vicinity of the pump islands, due to limited access in this area of the site. The installation of a soil-vapor system was approved, the excavation process was terminated, the 100 cubic yards of material properly disposed of and the excavated area backfilled with pea gravel in June of 1989. WGR staff coordinated the installation of underground piping for a future soil-vapor extraction system. The piping was installed near the pump islands and in the underground storage tank backfill.

On 2 August 1989, groundwater was sampled and analyzed. Although no detectable Total Purgeable Petroleum Hydrocarbons (TPPH), aromatic hydrocarbons or halocarbons were found in samples from groundwater monitoring wells EA-1, EA-2 and EA-3, samples taken from the 10-inch diameter PVC casing installed within the underground fuel tank backfill confirmed concentrations of 100,000 ppb TPPH, aromatic hydrocarbons and halocarbons (EPA Method 8260). This 10-inch casing was installed in the backfill to allow for safe drilling in the future (Reference WGR report 30 October 1989).

On 6 November 1989, a second set of groundwater samples again taken from EA-1, EA-2 and EA-3. TPPH, aromatic hydrocarbons and halocarbons were not detected in these samples (EPA Method 8015 and 8240). Groundwater samples were not collected from the 10-inch diameter PVC casing as it was not intended as a groundwater monitoring well (Reference WGR report 1 February 1990).

SOIL VAPOR EXTRACTION TEST

At Chevron's request WGR installed three vadose zone monitoring wells, VW-1, VW-2 and VW-3 (Figure 2). A soil vapor extraction test was performed using a previously installed, 3-inch diameter slotted pipe (extraction pipe) installed 6 feet below grade between the pump islands as the extraction point (Figure 3). VW-1, VW-2, VW-3, EA-1 and the other previously installed 3-inch slotted pipe (stub-out 1) were used as vacuum monitoring points. Soil sample results from the three wells and soil vapor extraction test results are presented below.

FIELD PROCEDURES: VADOSE ZONE WELL INSTALLATION

WGR's standard well installation procedure is included as Attachment 1. A staff geologist as well as the project engineer were on-site during drilling. Appendix A presents the boring logs and Figure 4 presents a standard vadose zone well installation. The two inch diameter wells were bored to 9 feet below grade and slotted from 3 feet to 9 feet below grade. Installation was initiated and completed on 1 May 1990.

SOIL VAPOR EXTRACTION TEST

The soil vapor extraction test was conducted on 22 May through 25 May 1990. The test equipment consisted of 2-inch diameter piping running from the previously installed 3-inch diameter slotted pipe (extraction pipe) to a water-dropout. A fresh air bleed valve was installed to allow for fine tuning the vacuum and flowrate at the extraction pipe. The air, pulled through the extraction pipe and bleed valve, was then filter through two 200-pound activated carbon vessels arranged in series. A regenerative blower capable of drawing a maximum vacuum of 59 inches of water and a maximum air flowrate of 127 standard cubic feet per minute (SCFM) was placed after the carbon vessels and exhausted through an eight-foot stack to the atmosphere. Various pressure/vacuum gauges, velocity ports and sampling ports were placed throughout the system for data collection (Figure 5).

All vadose zone monitoring wells were sealed from the atmosphere during the test. Ports to allow for vacuum monitoring were installed.

The system was installed and started at 16:14 on 22 May 1990. Data was collected according to the procedure outlined in Attachment 2.

The test was completed at 11:10, 25 May 1990.

DATA

Soil samples collected during boring of VW-1, VW-2 and VW-3 had total petroleum hydrocarbon/gasoline (TPH-G) levels of 96, 33 and 74 parts per million (ppm) respectively at 8 feet below grade. These levels represent the maximum for these wells. Benzene, toluene, ethyl-benzene and total xylenes (BTEX) were also reported. All BTEX compounds were below 10 ppm.

The velocity measured at the various ports were used to calculate volumetric flow rates. The vacuum gauges on the test skid were used to check for pressure drop through the system. The velocity, vacuum readings and volumetric flow rates are presented in Table 3. A total of approximately 206,150 cubic feet of air was evacuated from the vadose zone during the duration of the test. Vacuum data collected from the vadose zone monitoring wells is included in Table 4. Maximum vacuums were reported as follows: vadose monitoring well, VW-1, measured a vacuum of 0.2 inches of water; vadose monitoring well, VW-2, measured a vacuum of 1.09 inches of water; vadose zone monitoring well, VW-3, measured a vacuum of 0.15 inches of water; groundwater monitoring well, EA-1, had a vacuum of 1.53 inches of water; and, stub-out pipe 1, showed a vacuum of 0.32 inches of water (Figure 6).

Air samples collected during the soil vapor extraction test also contained TPH-G and BTEX and are described in greater detail in the following section.

RESULTS

Due to the low permeability to air of clayey soils surrounding the previously installed piping and pea gravel backfill, as well as the unique layout of the extraction piping system, an accurate radius of influence calculation could not be made. The permeability to air of the surrounding clay soils was estimated to be less than 0.01 Darcy (Reference, "A Practical Approach to the Design, Operation, and Monitoring of In Situ Soil-Venting Systems, P.C. Johnson, et all, Groundwater Monitoring Review, Spring 1990).

Air samples for TPH-G had a maximum concentration of 7,900 at the beginning of the test and decreased to a minimum of 1,600 ppm at 2,049 minutes into the test. The concentration of benzene in air samples had a maximum concentration of 26,000 parts per billion (ppb) at the beginning of the test and a minimum concentration of 5,300 ppb at 2,049 minutes into the test. Toluene concentrations ranged from a maximum of 12,000 ppb at 2,049 minutes into the test and decreased to a minimum of 6,200 ppb at the completion of the test. Ethyl-benzene levels varied from a maximum of 1,600 ppb at 1,389 minutes into the test and had a minimum of 690 recorded at 3,095 minutes into the test. Total xylenes had a maximum concentration of 13,000 ppb at 3,389 minutes into the test and a minimum of 4,600 ppb at 2,049 minutes into the test (See Figure 7).

COMMENTS AND CONCLUSIONS

The area tested was previously backfilled with high permeability pea gravel that created channeling of air during the test as demonstrated by the high flow rates and low vacuum readings at the extraction point (Figure 8). This affected the flow of air from the surrounding soils as demonstrated by the low vacuum readings recorded at the vadose zone monitoring wells.

Air samples collected suggest that removal of hydrocarbons from the low permeability soils is feasible. However, the process would be slow since the test data also suggest that extraction of the compounds is carried out by diffusion. This is demonstrated by the relatively flat curves for BTEX compounds and the increase of TPH concentration in the middle of the curve generated from the air sample concentrations versus time.

An accurate estimate of operating time for a permanent soil vapor extraction system can not calculated at this time. However, a permanent system could be designed and time-lines generated as additional data are collected during system operation.

Western Geologic Resources is please to provide geologic and environmental services to Chevron and hope this report meets your needs. If you have any questions or comments, please contact us at (415) 457-7595.

Sincerely,
Western Geologic Resources, Inc.

Eric D. Stevenson
Senior Staff Engineer

J. Mark Inglis
Principal Hydrogeologist

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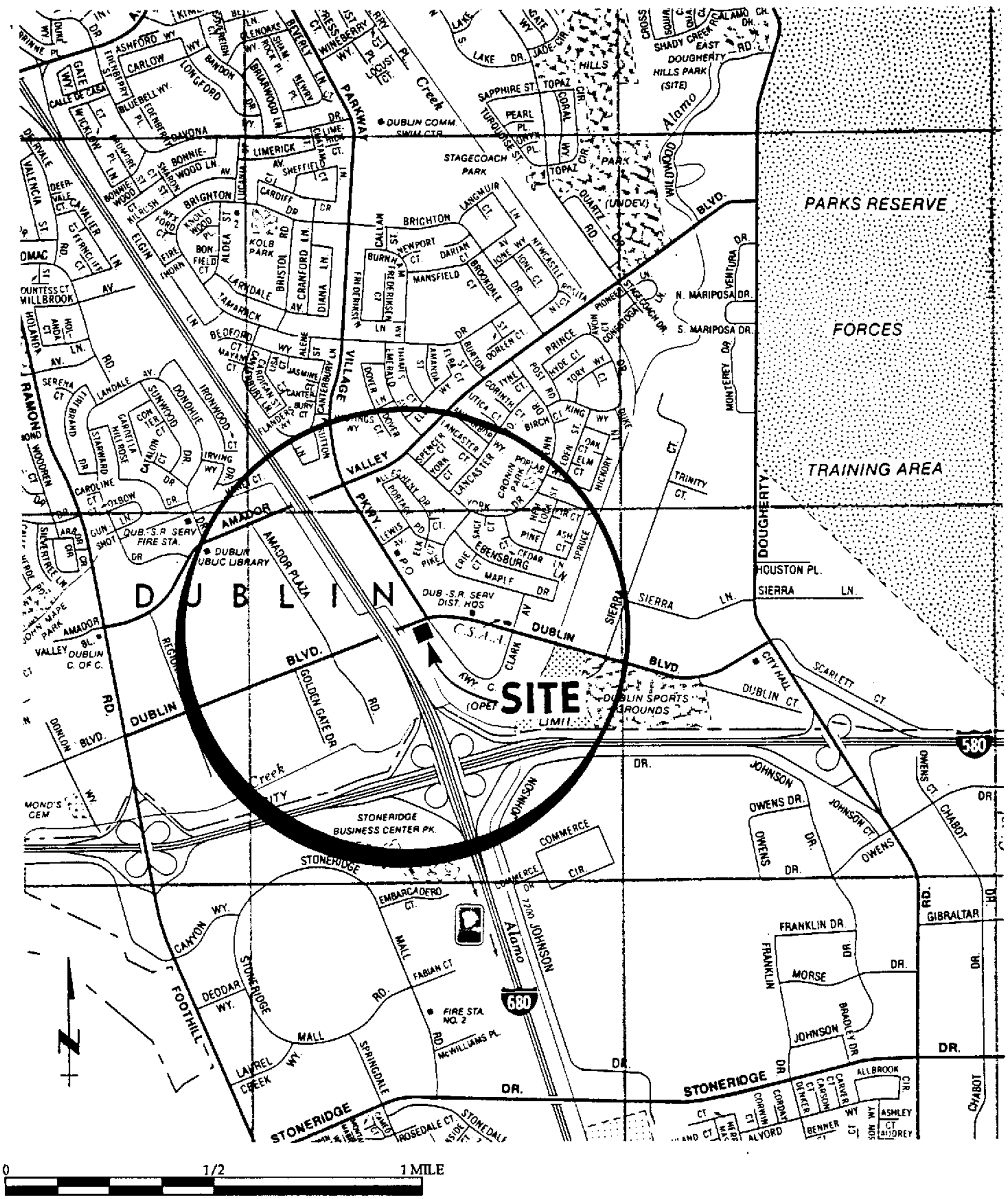
FIGURES



Site Location Map
Former Chevron Service Station #92582
Dublin, California

FIGURE
1

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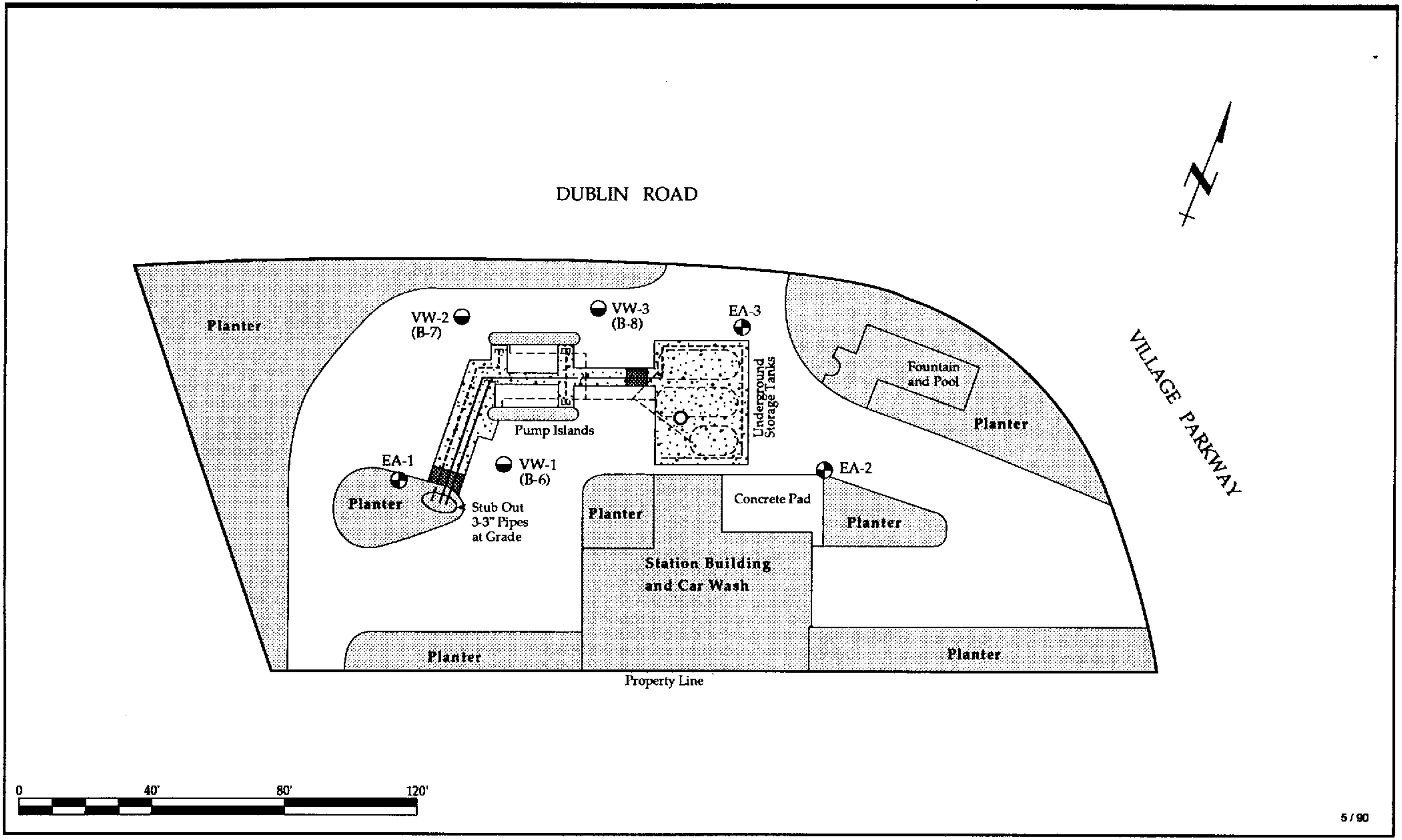

LEGEND

EA-1	Groundwater Monitor Well		Pea-Gravel Backfill
○	10" Diameter PVC Casing		Bentonite Grout
VW-1	Vadose Monitor Well		
-------	Perforated 3" Pipe, buried		
———	Non-Perforated 3" Pipe, buried		

Site Map with Vadose Monitor Well Locations
Former Chevron Service Station #92582
Dublin, California

FIGURE
2

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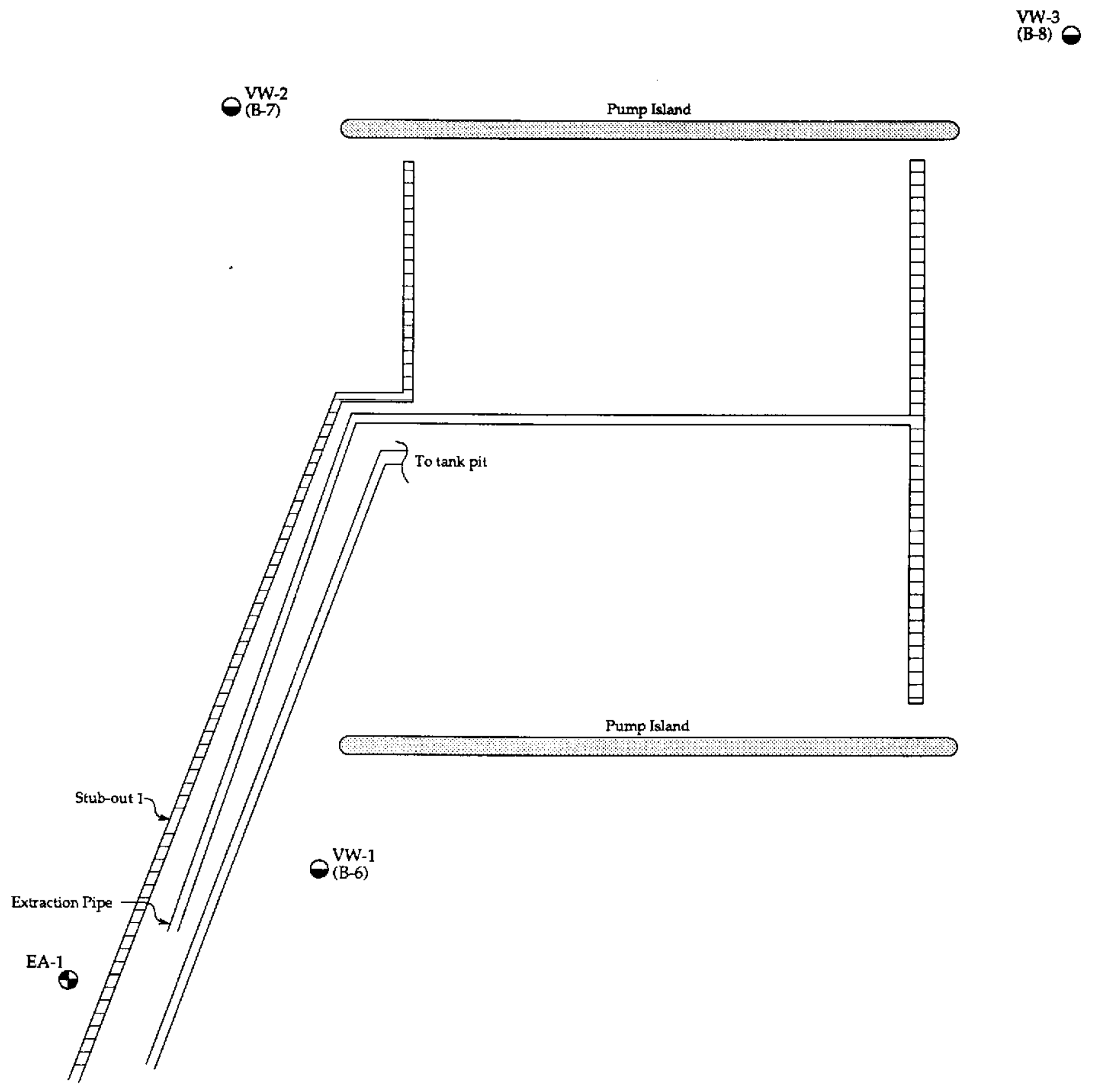
1-124.04



NOT TO SCALE

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LEGEND

VW-2 Vadose Well Locations

EA-1 Monitor Well Locations

Three Inch Diameter Vapor Extraction Piping Layout
Former Chevron Service Station #92582
Dublin, California

FIGURE 3

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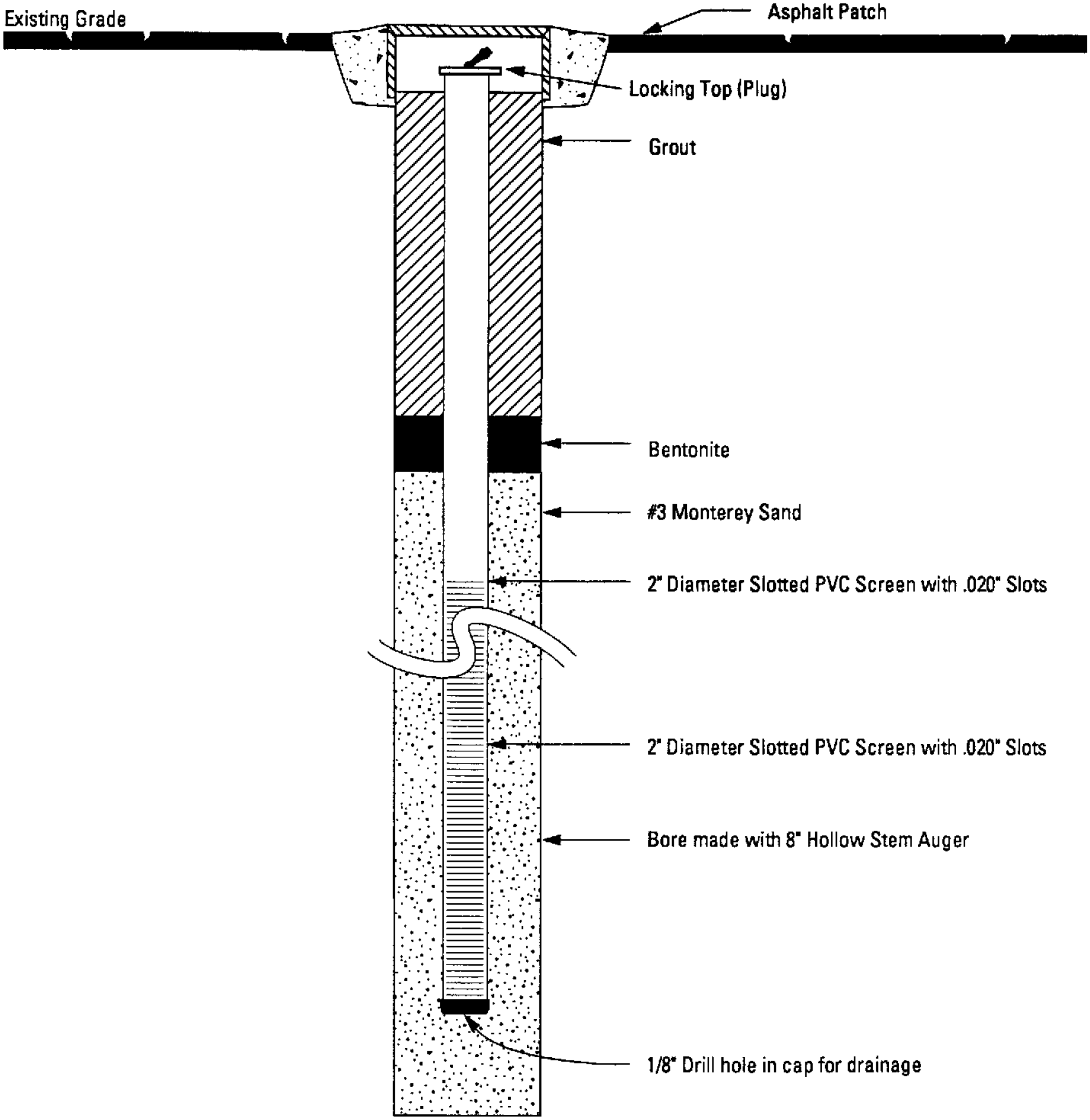

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Typical Vent Well Construction Details

FIGURE

4

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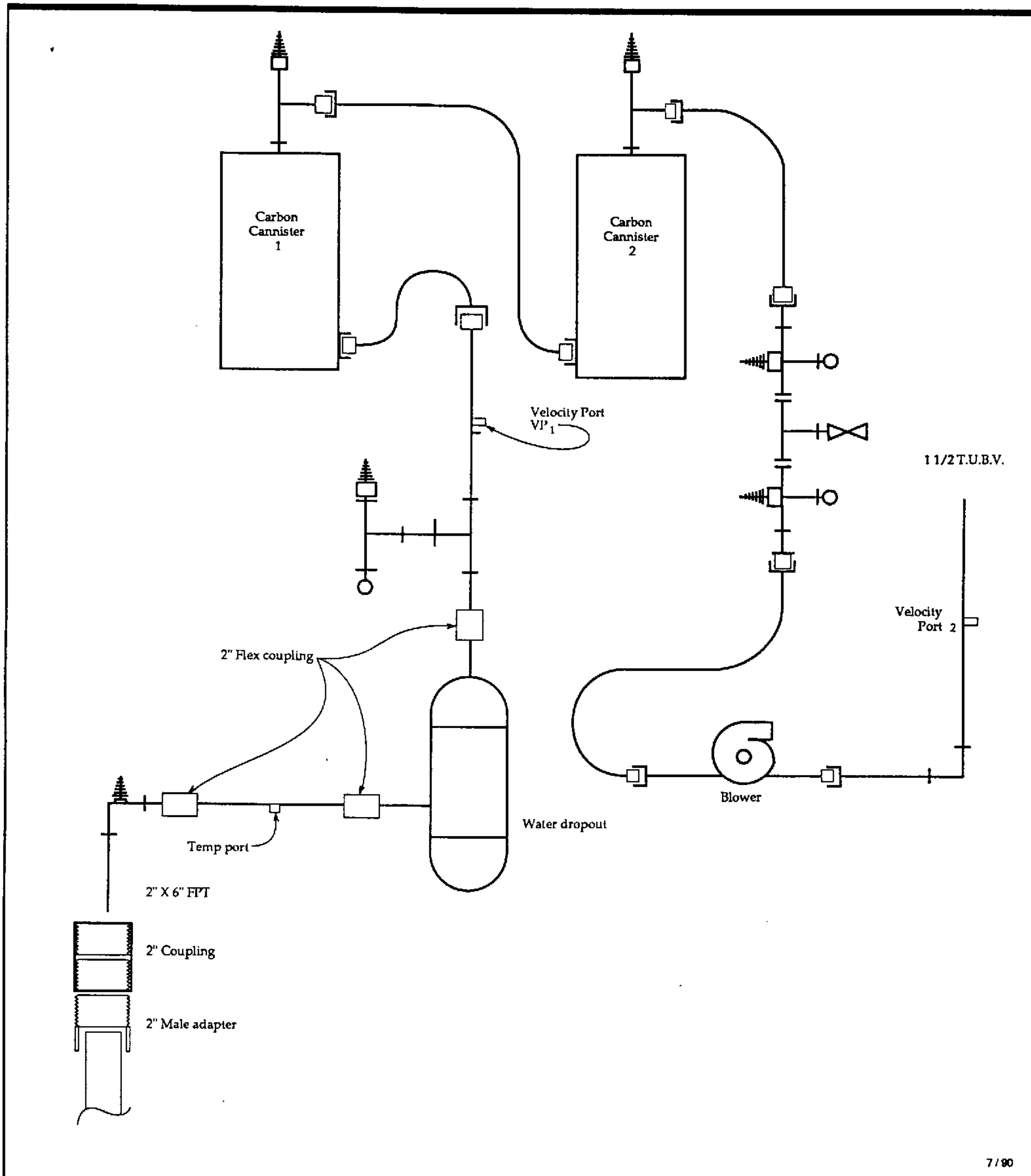

LEGEND

Manometer/Sample Quick Disconnect

Vacuum Gauges

Fresh Air Bleed Valve

Vapor Extraction System
Former Chevron Service Station #92582
Dublin, California

FIGURE

5

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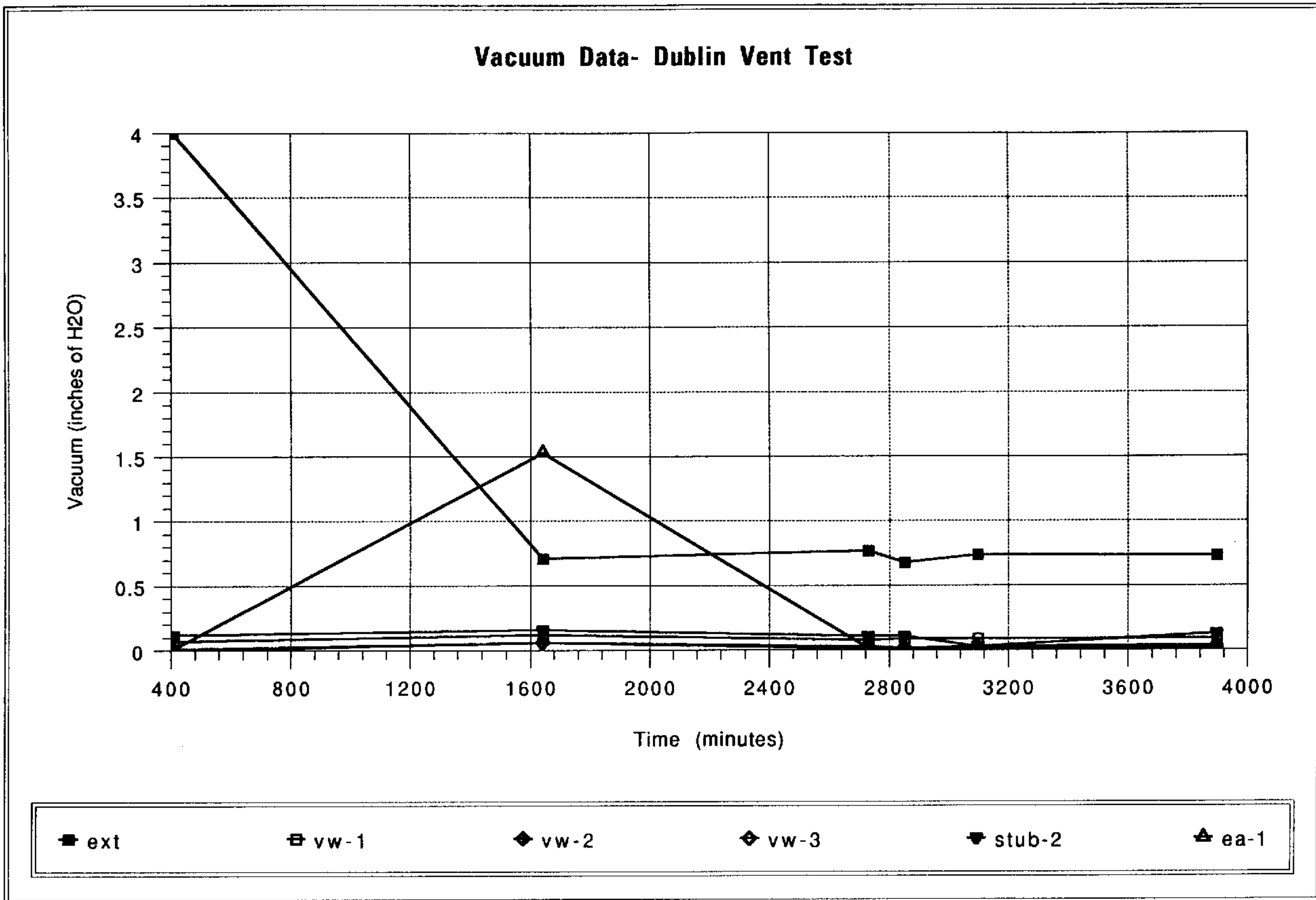

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Figure 6: Vadose Well Vacuum

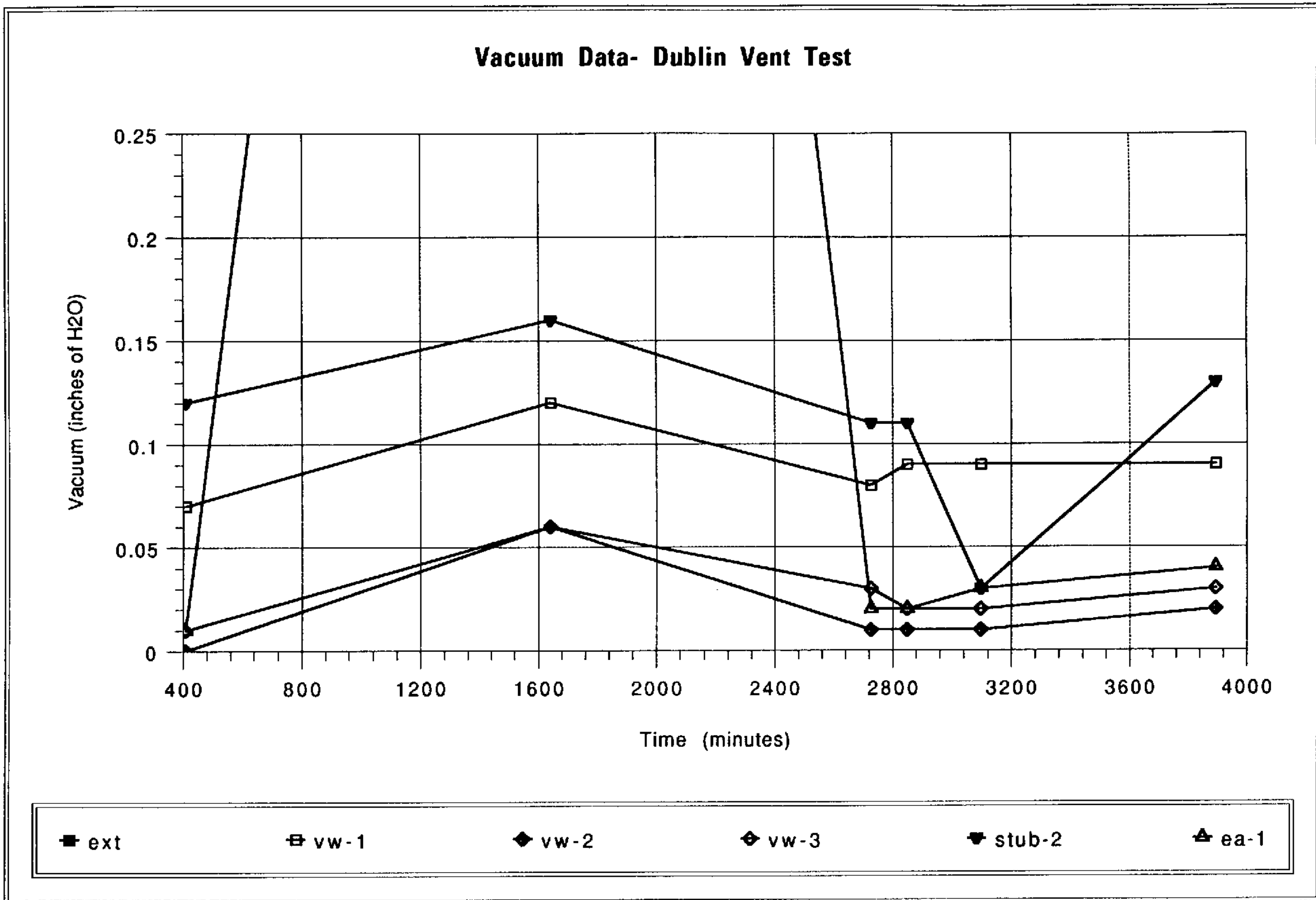

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Figure 6: Vadose Well Vacuum (Expanded View)

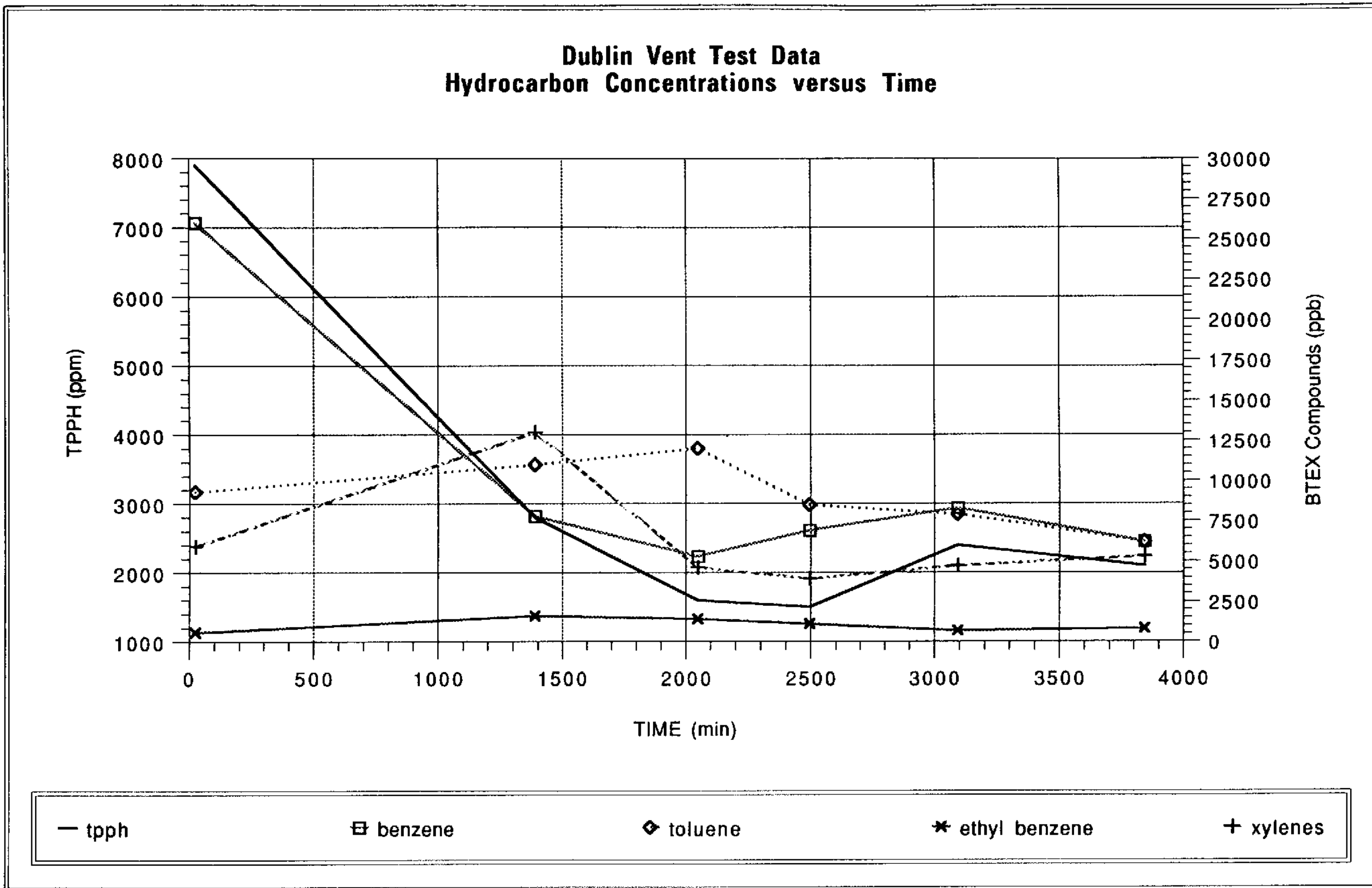

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Figure 7: BTEX Compounds

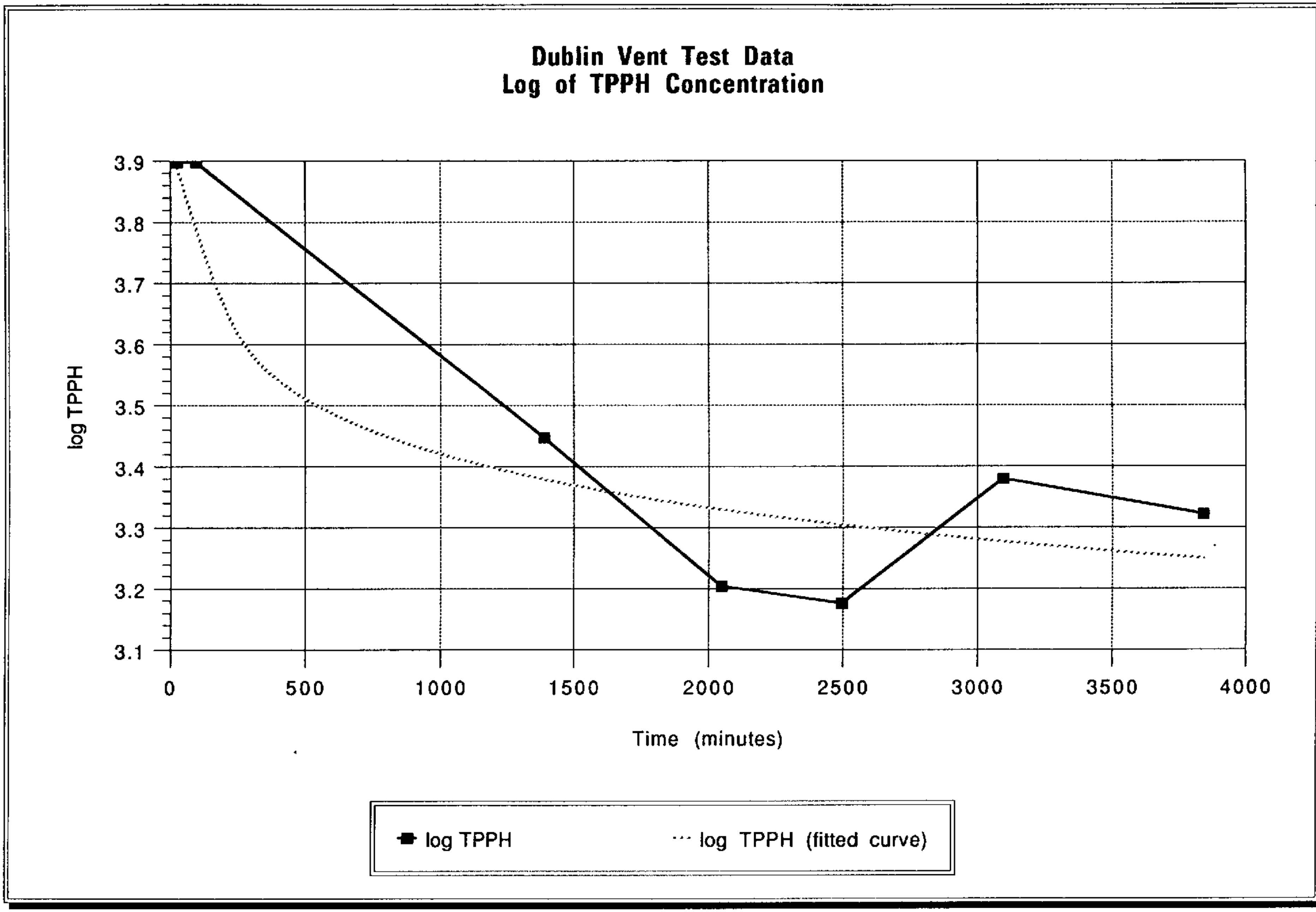


Figure 7: TPPH Log

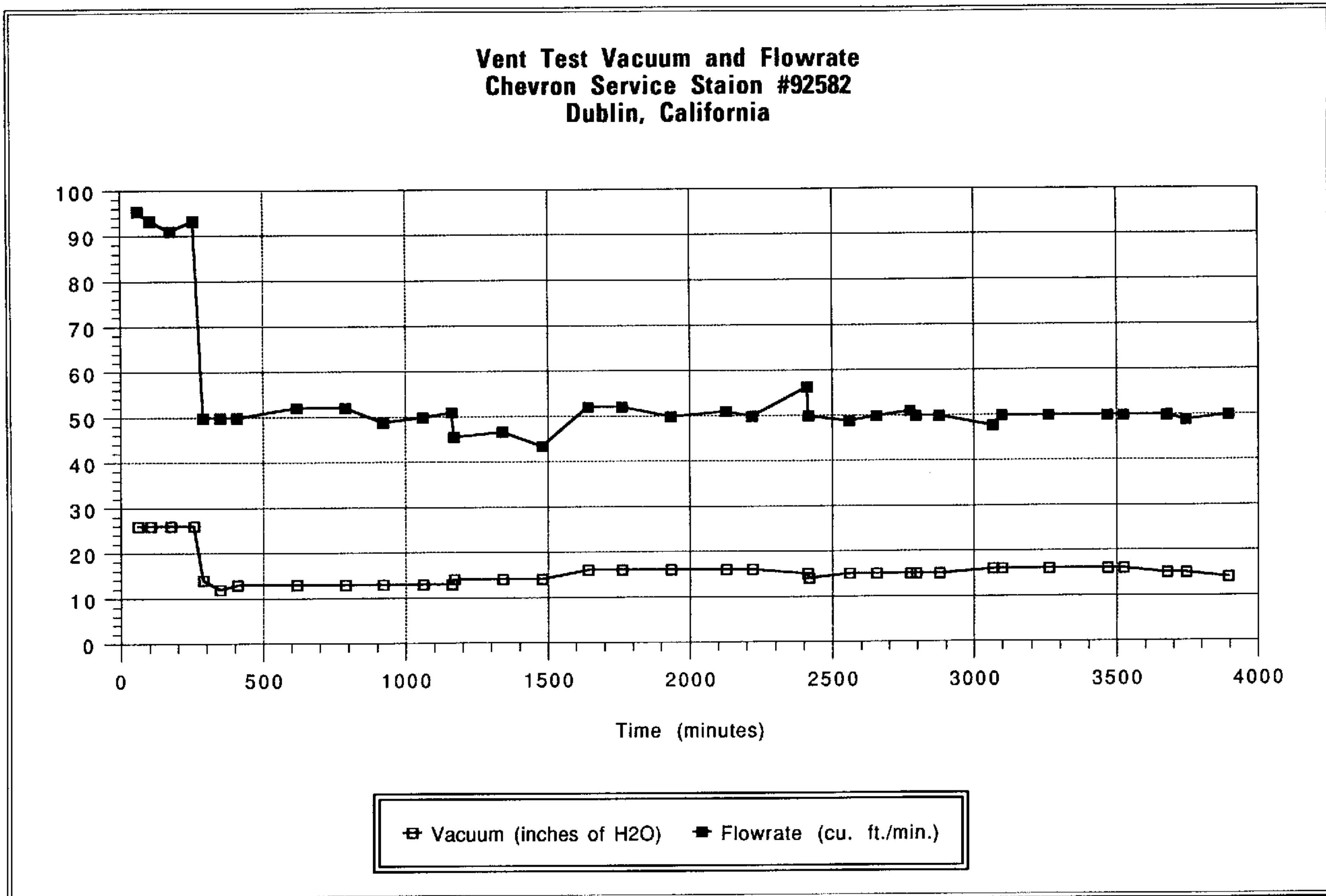


Figure8: Vent Test Vacuum and Flowrate

TABLES

TABLE 1. Analytic Results: Groundwater Samples
Chevron Station #92582
Dublin, California

Well ID #	Date	Lab	EPA Method	TPPH	FC	Benzene	Toluene	E-Benz	Xylenes	EDC
				<-------------------------			ppb		------------------------->	
EA-1	17 Oct 88*	NA	NA	<50.0	---	<0.5	<0.5	<0.5	<0.5	---
EA-1	20 Dec 88*	PL	8015/8020	<50.0	---	<0.5	<0.5	<0.5	<0.5	---
EA-1	28 Mar 89*	PL	8015/8020	<250	---	<0.5	<0.5	<0.5	<0.5	---
EA-1	2 Aug 89	CCAS	8260	<50.0	---	<0.1	<0.1	<0.1	<0.1	<0.1
EA-2	17 Oct 88*	NA	NA	<50.0	---	<0.5	<0.5	<0.5	1.2	---
EA-2	20 Dec 88*	PL	8015/8020	<50.0	---	<0.5	<0.5	<0.5	<0.5	---
EA-2	28 Mar 89*	PL	8015/8020	<250	---	<2.0	<0.5	<0.5	<0.5	---
EA-2	2 Aug 89	CCAS	8260	<50.0	---	<0.1	<0.1	<0.1	<0.1	<0.1
EA-3	17 Oct 88*	NA	NA	<50.0	---	1.8	<0.5	<0.5	3.0	---
EA-3	20 Dec 88*	PL	8015/8020	240	Gas	90.0	1.2	13.0	3.3	---
EA-3	28 Mar 89*	PL	8015/8020	2300	Gas	380.0	130.0	240.0	910.0	---
EA-3	2 Aug 89	CCAS	8260	<50.0	---	<0.1	<0.1	<0.1	<0.1	<0.1
10" PVC CASING	2 Aug 89	CCAS	8260	100,000	Gas	8,700	14,000	1,700	17,000	50
10" PVC CASING Duplicate	2 Aug 89	CCAS	8260	110,000	Gas	9,200	14,000	1,800	13,000	50
EB	28 Mar 89*	PL	8015/8020	<250.0	---	<0.5	<0.5	<0.5	<0.5	---
TB	28 Jul 89	CCAS	8260	<50.0	---	<0.1	<0.1	<0.1	<0.1	<0.1

NOTES:

TPPH = Total Purgeable Petroleum Hydrocarbons
FC = Fuel Characteristics
E-Benz = Ethylbenzene
EDC = 1,2-Dichloroethane
ppb = Parts-Per-Billion
* = Sample collected by EA Engineering, Science and Technology, Inc.
PL = Pace Laboratories, Inc.
CCAS = Central Coast Analytical Services, Inc.
EB = Equipment Blank
TB = Travel Blank
Gas = Gasoline
< = Less than indicated detection limit
NA = Not Available
--- = Not Analyzed/Not Applicable

TABLE 2. Liquid Level Measurements
Chevron Station #92582
Dublin, California

Well ID #	Date	DTLH	DTW	LHT	TOC*	Elev-LH	Elev-W
			<----------	----------	ft ----------	----------	---------->
EA-1	24 Oct 88*	---	10.64	---	333.41	---	322.77
EA-1	2 Nov 88*	---	10.69	---	333.41	---	322.72
EA-1	20 Dec 88*	---	10.51	---	333.41	---	322.90
EA-1	28 Mar 89*	---	9.87	---	333.41	---	323.54
EA-1	2 Aug 89	---	10.34	---	333.41	---	323.07
EA-2	24 Oct 88*	---	9.70	---	332.59	---	322.89
EA-2	2 Nov 88*	---	10.03	---	332.59	---	322.56
EA-2	20 Dec 88*	---	9.98	---	332.59	---	322.61
EA-2	28 Mar 89*	---	8.80	---	332.59	---	323.79
EA-2	2 Aug 89	---	9.44	---	332.59	---	323.15
EA-3	24 Oct 88*	---	11.03	---	333.64	---	322.61
EA-3	2 Nov 88*	---	11.03	---	333.64	---	322.61
EA-3	20 Dec 88*	---	10.96	---	333.64	---	322.68
EA-3	28 Mar 89*	---	9.77	---	333.64	---	322.87
EA-3	2 Aug 89	---	10.65	---	333.64	---	322.99
10" PVC CASING	2 Aug 89	---	9.83	---	NA	---	---

NOTES:

- * = Data obtained by EA Engineering, Science, and Technology, Inc.
- DTLH = Depth-to-Liquid Hydrocarbon
- DTW = Depth-to-Water
- TOC = Top-of-Casing Elevation
- Elev-LH = Elevation of Liquid Hydrocarbons
- Elev-W = Elevation of Water
- NA = Not Available
- --- = Not Measured

TABLE 3.

Time (minutes)	Velocity At Well Head (ft/min)	Flowrate From Vadose (cu. ft/min)	Cumulative Flow From Well (cu. ft)	Velocity At Stack (ft/min)	Flowrate At Stack (cu. ft/min)	Cumulative Flow Through Carbon (cu. ft.)
59	4400	95	5627	4400	95	5627
104	4300	93	9821	4300	93	9821
174	4200	91	16194	4200	91	16194
255	4300	93	23745	4300	93	23745
289	2300	49	25440	4400	95	26987
349	2300	49	28431	4500	97	32840
409	2300	49	31423	4600	99	38823
619	2400	52	42348	4500	97	59308
789	2400	52	51192	4500	97	75891
920	2250	48	57581	4600	99	88953
1060	2300	49	64561	4600	99	102913
1162	2350	50	69757	4700	101	113305
1169	2100	45	70076	4700	101	114019
1340	2150	46	78046	4700	101	131440
1479	2000	43	84072	4800	104	145903
1642	2400	52	92552	4900	106	163217
1762	2400	52	98795	4900	106	175963
1934	2300	49	107370	4700	101	193487
2129	2350	50	117304	4700	101	213354
2220	2300	49	121841	4750	102	222724
2413	2600	56	132718	4800	104	242805
2418	2300	49	132968	4800	104	243325
2559	2250	48	139845	4900	106	258302
2656	2300	49	144681	4700	101	268185
2776	2350	50	150794	4700	101	280410
2796	2300	49	151791	4800	104	282491
2879	2300	49	155929	4800	104	291128
3069	2200	47	164990	4800	104	310897
3099	2300	49	166486	4900	106	314084
3262	2300	49	174612	4800	104	331044
3467	2300	49	184833	4800	104	352374
3525	2300	49	187725	4800	104	358409
3678	2300	49	195353	5200	112	375655
3746	2250	48	198670	4800	104	382730
3896	2300	49	206148	5200	112	399638

TABLE 4. Vacuum Data

Time (minutes)	Extraction Well	VW-1	VW-2	VW-3	STUB-1	EA-1
	<----------------Vacuum Inches of Water---------------->					
409	4.00	0.07	0.00	0.01	0.12	0.01
1642	0.71	0.12	0.06	0.06	0.16	1.53
2729	0.77	0.08	0.01	0.03	0.11	0.02
2850	0.68	0.09	0.01	0.02	0.11	0.02
3099	0.74	0.09	0.01	0.02	0.03	0.03
3896	0.73	0.09	0.02	0.03	0.13	0.04

1-124.04/T4JL0

ATTACHMENTS

STANDARD OPERATING PROCEDURES
RE: ROTARY DRILLING MONITORING WELL INSTALLATION AND DEVELOPMENT
SOP-7

Stratigraphic test holes for monitoring wells may be drilled using truck-mounted drill rigs capable of: air and/or mud-rotary drilling, and continuous wire-line coring and/or drilling with tri-cone roller or fixed-blade drag bits. Generally, rotary drilling is used when conventional auger drilling is initially not possible or becomes no longer possible. Various drilling fluids (muds or air), are used to keep the hole from caving and to remove cuttings. These are chosen according to the formations expected to be encountered and the nature of the monitoring program. Samples may be collected directly from cores. A geologist from Western Geologic Resources continuously logs each test hole during drilling, and constantly checks drilling returns for odors. All drilling equipment is steam cleaned between test holes to prevent cross-contamination.

Frequently, hollow-stem augers are used to drill and sample to a minimum depth, or to auger refusal. The augers can be left in place as temporary surface casing. The center plug is then removed and coring is carried out through the augers. Alternatively, a shallow conductor casing or surface casing may be set by drilling to a desired depth with a large diameter bit, setting the casing, and proceeding with the coring. After total depth is reached, the test hole may be geophysically logged and/or hydraulically tested. If the casing is not to be set at the bottom of the hole, the lower portion of the hole may be grouted or backfilled according to well installation guidelines. Next, the test hole is drilled-out (reamed) after removal of the hollow-stem augers or conductor casing, if necessary, with a bit that is a minimum of 4 inches larger than the outside diameter of the well casing.

Upon reaching total depth for the reamed portion of the hole, the drilling fluid is circulated to remove cuttings and thinned as necessary. The selected casing is then placed down the hole. Monitoring wells are cased with threaded, factory-perforated and blank casing. No solvents or cements are used to assemble the casing. Centering devices may be affixed to the casing if there is concern that an even distribution of filter material and grout within the borehole annulus will not be attained. The well casing is thoroughly washed and steam-cleaned prior to installation. All recoverable drilling fluids and cuttings are collected for temporary storage and then are disposed of properly depending on analytic results.

After setting the casing, sand or gravel filter material is poured or tremied in to fill the annular space from the bottom of the hole to the top of the perforated interval. A 1- to 2-foot thick bentonite plug is placed above this filter material to prevent grout from infiltrating down into the filter material. Neat cement, containing about 5% bentonite, is then tremied into the annular space from the top of the bentonite plug to the surface. A lockable, water-tight cap is placed on each wellhead. Traffic-rated Christy boxes are installed around the wellhead for wells in parking lots and driveways while steel stove pipes are usually set over wellheads in landscaped areas.

After installation, the wells are thoroughly developed to remove residual drilling materials from the wellbore, and to improve well performance by removing any fine material in the filter pack that can pass from the formation into the well. Well development techniques used include pumping, bailing, surging, swabbing, jetting, flushing, and airlifting. All development water is collected for temporary storage in 55-gallon drums, and is then properly disposed of depending on analytic results. To assure that cross-contamination does not occur between wells during drilling and development, all development equipment is steam-cleaned prior to introduction into a new well.

ATTACHMENT 2

The soil vacuum extraction test will be conducted according to the following procedures:

1. Mobilize.
2. Secure power.
3. Place and check all equipment.
4. Start blower.
5. Read pressure gauges and air velocity on test skid and record readings, confirm proper operation every 15 to 30 minutes and record any deviations;

    a. Read pressure gauges on vadose wells continuously until vacuum is noted. Once a pressure drop occurs, readings will be recorded every 15 minutes.

6. Collect air samples every hour for two hours after blower begins operation and every five hours thereafter. Air samples will be collected in three liter Tedlar bags. Two bags will be filled at each sampling to accommodate laboratory sample volume requirements.

    a. Screen every sample with the FID or PID if needed and record results.
    b. Samples taken at the beginning, end and one third and two third points will be analyzed for TPH and BTEX.
    c. Samples not sent for analysis will be flushed with nitrogen and the bags reused.

7. Take FID readings of exhaust every 15 minutes and record results. Should levels exceed 5 ppm for more than 5 minutes, check levels with PID. If PID does not produce a reading, assume the gas producing the FID readings is methane. If PID reads higher than 5 ppm for more than 5 minutes contact project engineer or his designee.

8. When pressure readings at the furthest vadose well stabilize for two hours, pressure readings vary by 1% of less on all wells or after 72 hours, whichever happens first, shut blower down.

9. When the blower is shut down, vacuum pressure will be measured for two hours or until wells have recovered to 50% of atmospheric pressure.

10. Demobilize and police area.

Any deviations from the plan should be documented accordingly and should be approved verbally by the senior engineer, field operations manager or their designee.

ANALYSIS

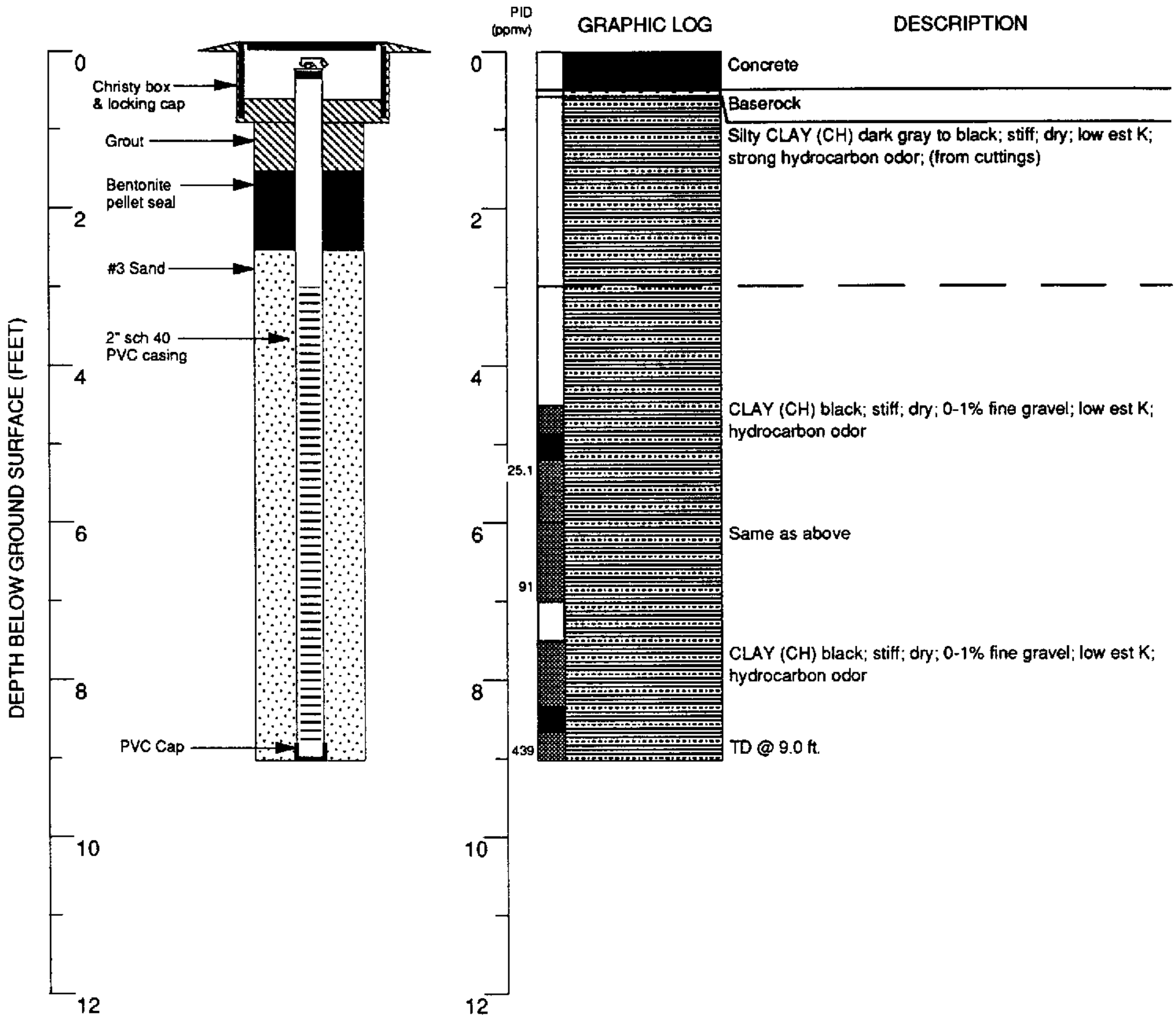
The data obtained from the vapor extraction test will be analyzed by several methods to determine the soil characteristics and their potential impact on the extraction and treatment system design. Some of the methods being considered for data analysis include:

- Time-vacuum analysis
- Distance-vacuum analysis
- Time-recovery analysis

Other methods of analysis may be employed if it is established that they are appropriate for the conditions of the test.

Chemical analysis of selected air samples collected during the test will be performed. The test will be broken into four equal sampling intervals. The sample taken at the beginning of the first interval and the last sample taken in the fourth interval will be analyzed. Samples taken near the beginning of the second and third intervals will be stored until the end of the test when the beginnings of these intervals can be determined. The samples taken closest to the beginning of the second and third interval will also be analyzed. Analytic results will be used to evaluate vapor extraction rates aiding in the design of the final extraction system.

APPENDICES



Logged by:	Ken Leonard	Drilling Company:	B & F Drilling (Chempro)	Well Head Completion:	Christy box & locking cap
Project Mgr:	Tom Howard	Drilling Method:	8.25" Hollow stem auger	Type of Sampler:	2" split barrel
Dates Drilled:	5/1/90	Driller:	Breese Franks	TD (Total Depth):	9.0 ft.

EXPLANATION

- Water level during drilling
- Water level in completed well
- Location of recovered drill sample
- Location of sample sealed for chemical analysis
- Sieve sample
- Grab sample

Contacts:
- Solid where certain
- Dotted where approximate
- Dashed where uncertain
- Hachured where gradational
- est K — Estimated permeability (hydraulic conductivity) 1K = primary 2K = secondary
- NR — No recovery

Boring Log and Well Completion Details
VW-2 (Boring B-7)

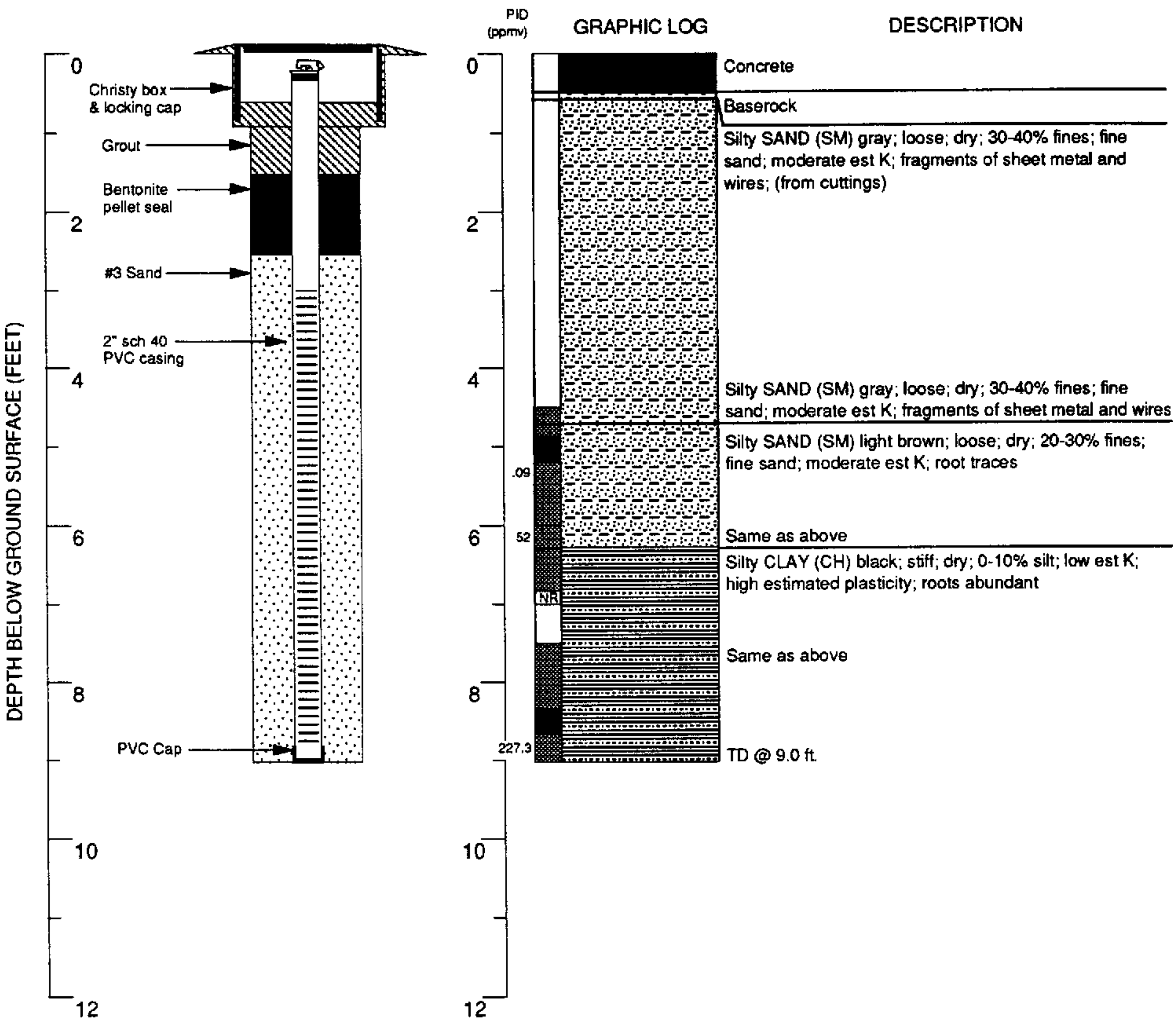
Chevron Service Station #92582
Dublin, California

VADOSE WELL

2

WESTERN GEOLOGIC RESOURCES, INC.

1-124.05



Logged by:	Ken Leonard	Drilling Company:	B & F Drilling (Chempro)	Well Head Completion:	Christy box & locking cap
Project Mgr:	Tom Howard	Drilling Method:	8.25" Hollow stem auger	Type of Sampler:	2" split barrel
Dates Drilled:	5/1/90	Driller:	Breese Franks	TD (Total Depth):	9.0 ft.

EXPLANATION

- Water level during drilling
- Water level in completed well
- Location of recovered drill sample
- Location of sample sealed for chemical analysis
- Sieve sample
- Grab sample

Contacts:
- Solid where certain
- Dotted where approximate
- Dashed where uncertain
- Hachured where gradational
- est K — Estimated permeability (hydraulic conductivity) 1K = primary 2K = secondary
- NR — No recovery

Boring Log and Well Completion Details
VW-3 (Boring B-8)

Chevron Service Station #92582
Dublin, California

VADOSE WELL

3

WESTERN GEOLOGIC RESOURCES, INC.

1-124.05

SUPERIOR ANALYTICAL LABORATORY, INC.
1555 BURKE, UNIT I • SAN FRANCISCO, CA 94124 • PHONE (415) 647-2081

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 80811
CLIENT: Western Geologic Resources
CLIENT JOB NO.: 1-124.05

DATE RECEIVED: 05/04/90
DATE REPORTED: 05/08/90

Lab Number	Customer Sample Identification	Date Sampled	Date Analyzed
80811- 1	B.6 5.0	05/01/90	05/05/90
80811- 2	B-6 8.5	05/01/90	05/07/90
80811- 3	B-7 5.0	05/01/90	05/05/90
80811- 4	B-7 8.5	05/01/90	05/05/90
80811- 5	B-8 5.0	05/01/90	05/05/90
80811- 6	B-8 8.5	05/01/90	05/05/90

Laboratory Number:	80811 1	80811 2	80811 3	80811 4	80811 5
ANALYTE LIST	Amounts/Quantitation Limits (mg/Kg)				
OIL AND GREASE:	NA	NA	NA	NA	NA
TPH/GASOLINE RANGE:	1	74	1.5	33	ND<1
TPH/DIESEL RANGE:	NA	NA	NA	NA	NA
BENZENE:	0.12	0.80	0.055	2.6	ND<0.05
TOLUENE:	ND<0.05	2.5	ND<0.05	4.5	ND<0.05
ETHYL BENZENE:	ND<0.05	0.81	ND<0.05	2.8	ND<0.05
XYLENES:	0.10	5.2	ND<0.05	3.7	ND<0.05

Laboratory Number:	80811 6
ANALYTE LIST	Amounts/Quantitation Limits (mg/Kg)
OIL AND GREASE:	NA
TPH/GASOLINE RANGE:	96
TPH/DIESEL RANGE:	NA
BENZENE:	0.90
TOLUENE:	3.5
ETHYL BENZENE:	1.5
XYLENES:	9.4

SUPERIOR ANALYTICAL LABORATORY, INC.

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C E R T I F I C A T E   O F   A N A L Y S I S

ANALYSIS FOR TOTAL PETROLEUM HYDROCARBONS
Diesel by Modified EPA SW-846 Method 8015
Gasoline by Purge and Trap: EPA MEthod 8015/5030
ANALYSIS FOR BENZENE, TOLUENE, ETHYL BENZENE & XYLENES
by EPA SW-846 Methods 5030 and 8020

QA/QC INFORMATION
SET: 80811

NA = ANALYSIS NOT REQUESTED
ND = ANALYSIS NOT DETECTED ABOVE QUANTITATION LIMIT

mg/Kg = part per million (ppm)

OIL AND GREASE ANALYSIS By Standard Methods Method 503E:
Duplicate RPD NA
Minimum Detection Limit in Soil: 20mg/kg

Modified EPA Method 8015 for Extractable Hydrocarbons:
Minimum Quantitation Limit for Diesel in Soil: 10mg/kg
Daily Standard run at 200mg/L; RPD Diesel = NA
MS/MSD Average Recovery = NA; Duplicate RPD = NA

8015/5030 Total Purgable Petroleum Hydrocarbons:
Minimum Quantitation Limit for Gasoline in Soil: 1mg/kg
Daily Standard run at 2mg/L; RPD Gasoline = 2
MS/MSD Average Recovery = 93%; Duplicate RPD = 7

8020/BTXE
Minimum Quantitation Limit in Soil: 0.005mg/kg
Daily Standard run at 20ug/L, RPD = 10%
MS/MSD Average Recovery = 110%; Duplicate RPD = 6

Richard Srna, Ph.D.
Labortory Manager

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C E R T I F I C A T E   O F   A N A L Y S I S

LABORATORY NO.: 10702
CLIENT: WESTERN GEOLOGIC RESOURCES
CLIENT ID: 1-124.05

DATE RECEIVED: 05/22/90
DATE ANALYSED: 05/23/90
DATE REPORTED: 05/24/90

ANALYSIS FOR VOLATILE PETROLEUM HYDROCARBONS
by Modified EPA SW-846 Methods 8015 AND 5030

Lab #	Sample Id	Concentration Gasoline Range
1	1A1	7900 ppm
2	2A2	2800 ppm
3	2C2	ND< 30 ppm

MINIMUM DETECTION LIMIT IN AIR 30 ppm.
Concentrations expressed v/v assuming standard temperature and pressure and an average molecular weight for gasoline equal to that of hexane.

QA/QC SUMMARY: STANDARD RUN FOR CALIBRATION CHECK: < 15 % DIFF.
MS/MSD 86 % RECOVERY AVEAGE; % RSD < 4 %.

Richard Srna, Ph.D

Laboratory Director

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C E R T I F I C A T E   O F   A N A L Y S I S

LABORATORY NO.: 10702
CLIENT: WESTERN GEOLOGIC RESOURCES
JOB NO.: 1-124.05

DATE SAMPLED: 05/22/90
DATE RECEIVED: 05/23/90
DATE ANALYZED: 05/24/90

ANALYSIS FOR BENZENE, TOLUENE, ETHYL BENZENE AND XYLENES
EPA SW-846 METHODS 5030 AND 8020 IN AIR

LAB #	SAMPLE ID	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
1	1A1	26000	9300	570	5900
2	2A2	7800	11000	1600	13000
3	2C2	ND< 85	ND< 250	ND< 65	ND< 65

MINIMUM DETECTION LIMITS IN AIR:
BENZENE: 85 ppb ; ETHYL BENZENE 65 ppb
TOLUENE: 250 ppb ; XYLENES: 250 ppb.
Concentrations assume standard temperature and pressure and are expressed V/V.

QA/QC Summary:
Daily standards run at 20 ug/L; RPD = <15%
MS/MSD: Average Recovery = 105 % ; Duplicate RPD = < 7 % .

Richard Srna, Ph.D.

Laboratory Director

SUPERIOR ANALYTICAL LABORATORY, INC.
1555 BURKE, UNIT I • SAN FRANCISCO, CA 94124 • PHONE (415) 647-2081

CERTIFICATE OF ANALYSIS

LABORATORY NO.: 10704
CLIENT:WESTERN GEOLOGIC RESOURCES
CLIENT ID: 1-124.05

DATE RECEIVED:05/24/90
DATE ANALYSED:05/25/90
DATE REPORTED:05/25/90

ANALYSIS FOR VOLATILE PETROLEUM HYDROCARBONS
by Modified EPA SW-846 Methods 8015 AND 5030

Lab #	Sample Id	Concentration Gasoline Range
1	3A3	1600 ppm
2	2B2	1500 ppm
3	3C3	ND< 30 ppm
4	4A1	1500 ppm

MINIMUM DETECTION LIMIT IN AIR 30 ppm.
Concentrations expressed v/v assuming standard temperature and pressure and an average molecular weight for gasoline equal to that of hexane.

QA/QC SUMMARY: STANDARD RUN FOR CALIBRATION CHECK: < 15 % DIFF.
MS/MSD 94 % RECOVERY AVEAGE; % RSD < 4 %.

Richard Srna, Ph.D

Laboratory Director

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CERTIFICATE OF ANALYSIS

LABORATORY NO.: 10704
CLIENT: WESTERN GEOLOGIC RESOURCES
JOB NO.: 1-124.05

DATE SAMPLED: 05/24/90
DATE RECEIVED: 05/24/90
DATE ANALYZED: 05/25/90

ANALYSIS FOR BENZENE,TOLUENE,ETHYL BENZENE AND XYLENES
EPA SW-846 METHODS 5030 AND 8020 IN AIR

LAB #	SAMPLE ID	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
1	3A3	5300	12000	1400	4600
2	3B3	ND< 85	330	ND< 65	290
3	3C3	ND< 85	ND< 250	ND< 65	ND< 65
4	4A1	6900	8500	1100	3900

MINIMUM DETECTION LIMITS IN AIR:
BENZENE: 85 ppb ; ETHYL BENZENE 65 ppb
TOLUENE: 250 ppb ; XYLENES: 250 ppb.
Concentrations assume standard temperature and pressure and are expressed V/V.

QA/QC Summary:
Daily standards run at 20 ug/L; RPD = <15%
MS/MSD: Average Recovery = 96 % ; Duplicate RPD = < 3 % .

Richard Srna, Ph.D.
Laboratory Director

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CERTIFICATE OF ANALYSIS

LABORATORY NO.: 10708
CLIENT: WESTERN GEOLOGIC RESOURCES
CLIENT ID: 1-124.05

DATE RECEIVED: 05/25/90
DATE ANALYSED: 05/25/90
DATE REPORTED: 05/26/90

ANALYSIS FOR VOLATILE PETROLEUM HYDROCARBONS
by Modified EPA SW-846 Methods 8015 AND 5030

Lab #	Sample Id	Concentration Gasoline Range
1	5A3	2400 ppm
2	5B3	63 ppm
3	5C3	ND< 30 ppm
4	6A3	2100 ppm
5	6B3	560 ppm
6	6C3	ND< 30 ppm

MINIMUM DETECTION LIMIT IN AIR 30 ppm.
Concentrations expressed v/v assuming standard temperature and pressure and an average molecular weight for gasoline equal to that of hexane.

QA/QC SUMMARY: STANDARD RUN FOR CALIBRATION CHECK: < 15 % DIFF.
MS/MSD 91 % RECOVERY AVEAGE; % RSD < 4 %.

Richard Srna, Ph.D

Laboratory Director

SUPERIOR ANALYTICAL LABORATORY, INC.

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C E R T I F I C A T E   O F   A N A L Y S I S

LABORATORY NO.: 10708
CLIENT: WESTERN GEOLOGIC RESOURCES
JOB NO.: 1-124.05

DATE SAMPLED: 05/25/90
DATE RECEIVED: 05/25/90
DATE ANALYZED: 05/26/90

ANALYSIS FOR BENZENE,TOLUENE,ETHYL BENZENE AND XYLENES
EPA SW-846 METHODS 5030 AND 8020 IN AIR

LAB #	SAMPLE ID	BENZENE	TOLUENE	ETHYL BENZENE	XYLENES
1	5A3	8300	7900	690	4700
2	5B3	ND< 85	ND< 250	ND< 65	ND< 250
3	5C3	ND< 85	ND< 250	ND< 65	ND< 65
4	6A3	6200	6200	830	5300
5	6B3	ND< 85	ND< 250	ND< 65	ND< 250
6	6C3	ND< 85	ND< 250	ND< 65	ND< 250

MINIMUM DETECTION LIMITS IN AIR:
BENZENE: 85 ppb ; ETHYL BENZENE 65 ppb
TOLUENE: 250 ppb ; XYLENES: 250 ppb.
Concentrations assume standard temperature and pressure and are expressed V/V.

QA/QC Summary:
Daily standards run at 20 ug/L; RPD = <15%
MS/MSD: Average Recovery =106   Duplicate RPD = < 7 % .

Richard Srna, Ph.D.

Laboratory Director

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