GW - 1

REPORTS

YEAR(S):

1994

GROUNDWATER TECHNOLOGY

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INTERIM MEASURES REPORT
BLOOMFIELD REFINING COMPANY
#50 COUNTY ROAD 4990
BLOOMFIELD, NEW MEXICO

March 3, 1994

Prepared for:

Bloomfield Refining Company
P.O. Box 159
Bloomfield, New Mexico

Prepared by:

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BRCIntem.rep

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1.0 INTRODUCTION

This Interim Measures (IM) Report summarizes the activities conducted in accordance with Part IV.1 of the Administrative Order on Consent (Docket #VI-303-H) dated December 31, 1992 between the United States Environmental Protection Agency (USEPA) Region VI and Bloomfield Refining Company (BRC). The report documents the implementation of the IM workplan dated April 20, 1993 and approved by USEPA Region VI.

The objectives of the Interim Measures are to:

- Inhibit off-site seepage of phase separate hydrocarbons (PSH) by the addition and operation of new recovery points to the currently operating system.
- Continue to recover PSH to remove/reduce the source of dissolved hydrocarbons in groundwater beneath the site; and
- Continue facility maintenance, monitoring and inspection schedules to prevent releases of product to the environment.

1.1 Background

The BRC facility consists of 287 acres and is located at #50 County Road 4990 (Sullivan Road) in Bloomfield, San Juan County, New Mexico (Figure 1). The refinery is situated on a bluff approximately 100 feet above and immediately south of the San Juan River, which flows westerly. On the bluff and between the river and the process area of the facility is the Hammond Ditch. The ditch is an unlined man-made channel for irrigation water supply and borders all but the southern side of the process area of the facility.

1.2 Setting

The current facility layout is shown in Figure 2. The refinery offices, warehouse space, maintenance shops, drum storage area and raw water ponds are located in the western portion of the property and along Sullivan Road. Process areas are located east of the offices. The eastern most portion of the property contains the tank farm, the waste water treatment evaporation ponds, and the fire training area.

1.3 Geology and Hydrogeology

The site is underlain by Quaternary Jackson Lake Terrace deposits comprised of 10 to 15 feet of coarse-grained fluvioglacial outwash deposits blanketed by wind-blown loess. These coarse grained (sands grading to cobbles) unconformably overly the Nacimiento Formation which is a thick (570 feet) layer of black carbonaceous mudstone with interbedded white sandstones. Seeps have been observed along the contact between the consolidated Nacimiento and unconsolidated Jackson Lake deposits. Perched, shallow groundwater in the Quaternary deposits is encountered between 6 and 40 feet below ground surface, generally increasing in depth from west to east across the site. Groundwater flows to the northwest and west, toward Hammond Ditch and the San Juan River. The ditch is known to influence groundwater flow at the site; during the non-irrigation season, BRC dikes the ditch to maintain a mounding effect year-round which inhibits groundwater flow to the north (toward the seeps).

2.0 EXISTING GROUNDWATER REMEDIATION SYSTEM

Several PSH recovery wells have been in service at the site since 1989. Three recovery wells (RW-1, RW-2, and RW-3) began pumping PSH in January 1989. Six more recovery wells (RW-14 through RW-19) were installed and began operation in August 1990. Each pre-existing recovery well is plumbed to either the 10,000 gallon recovery tank (Tank 33) or to the sewer and API separator. Recovery pumps (built by BRC) are compressed air-operated and timer systems which cycle at an approximate rate of 0.5 gpm. Up until the implementation of the IM workplan, only recovery well RW-18 contained air driven Ejector Systems (model U-3000) recovery pump. Pumping of wells RW-1 and RW-3 was discontinued in 1993 due the absence of PSH. Tank 33 has routinely been gauged and emptied to the plant sewer which is equipped with an API separator.

3.0 INSTALLATION OF THE INTERIM MEASURES RECOVERY WELLS

3.1 Recovery Well Installation

On July 19, 1993, recovery wells RW-22 and RW-23 were installed in accordance with the approved IM workplan. These wells are located in the vicinity of tanks 3, 4 and 5 as indicated in Figure 2. Boreholes for each well were constructed using a down-the-hole hammer (10 inch diameter) and casing techniques. The borehole for RW-22 was terminated at the top of Nacimiento formation at 34 feet below grade. Each well was constructed using 15-feet of 6-inch ID 0.020" slotted fiberglass screen attached to flush threaded 6-inch ID fiberglass riser pipe to the surface. The annular space in the vicinity of the screen was backfilled with washed quartz sand (12/20 Colorado Silica) capped with a 2-foot bentonite seal. The remaining annular space was backfilled with a portland cement grout. The surface completion of each well consisted of a steel protective pipe filled with concrete. The riser pipe is secured with a lockable cap. Boring logs with well construction diagrams are presented in Appendix A.

3.2 Installation of PSH Recovery Pumps

In July, 1993, the newly installed recovery wells (RW-22 and RW-23) were checked for PSH with an ORS Interface Probe. The interface probe is capable of detecting 0.01 foot thick layers of petroleum and other non-aqueous phase liquids (NAPLs). A visible sheen was observed on water surface which was not large enough to require the installation of a skimmer pump, but it was enough to prohibit collection and analysis of a groundwater sample. Therefore, PSH recovery pumps were not installed in these wells. Instead, PSH recovery pumps were installed in wells RW-18 and RW-19 which contained PSH. The wells may be sampled during Phase III of the RFI Workplan, if the presence of a sheen is no longer observed.

QED Pulse Pump systems were installed in wells RW-18 and RW-19. Each recovery system is modular and consists of a groundwater table depression pump and a hydrocarbon recovery skimmer pump. These pumps are configured and installed in each well as illustrated in Figure 3. Control modules located at the surface can be used to adjust flow rates for the PSH and water table depression pump. Specifications and operating parameters are presented in Appendix B. Both pumps are operated by the refinery compressed air system.

3.3 Installation of Air Sparge System

An air sparge system was installed north of Hammond Ditch near the refinery flare. The system was designed and installed by BRC staff in order to mitigate seeps present along Nacimiento contact below the refinery and above the San Juan River. A profile view of the system is presented in Figure 4. The system is comprised of 29 feet of perforated 4 inch ID PVC placed below the water level connected by a Tee fitting to a 4 inch ID riser pipe. The system is attached to the refinery air system which delivers approximately 80 psi.

The system was installed in September 1993 and operated continuously since then. The system has not been effective because of insufficient water depth. When Hammond Ditch flow was stopped, the sparge well became dry - perhaps the air sparge has dried the area. The efficiency of the system will be evaluated when irrigation resumes (April 1994). If necessary, the sparge system will be re-installed at a greater depth.

3.4 Gauge of Liquid Levels in Wells

A round of fluid levels were collected from all monitoring and recovery wells on February 4, 1994. At each well, the depth to PSH (if present), depth to water and total depth were measured using an interface probe. The interface probe is capable of detecting 0.01 foot thick layers of petroleum and other non-aqueous phase liquids (NAPLs). Table 1 summarizes the measurements collected on February 4, 1994.

The measuring point of each monitoring well was surveyed to a common datum by a registered surveyor. Table 2 presents the plant coordinates and measuring point elevation of each monitoring well and recovery well at BRC.

Figure 5 is a water table contour map developed from the February 4, 1994 fluid levels. The water table contour map infers a westerly flow for groundwater at the site.

Figure 6 is a separate phase hydrocarbon isopleth map. The map is prepared by contouring the thickness of petroleum hydrocarbons detected in each well on February 4, 1994. The map indicates an accumulation of PSH near wells RW-18 and RW-19. The size of the petroleum hydrocarbon plume (the area containing PSH) has decreased in comparison to the map presented in the IM workplan and based upon October 1991 data (Figure 7). Further, the plume has increased in thickness, especially in the areas surrounding wells RW-18 and RW-19 which contain new QED pulse pump skimmers. An increase in PSH thickness was observed in the new well RW-23 (0.39 feet). Measurable PSH was not observed during well installation (July 1993).

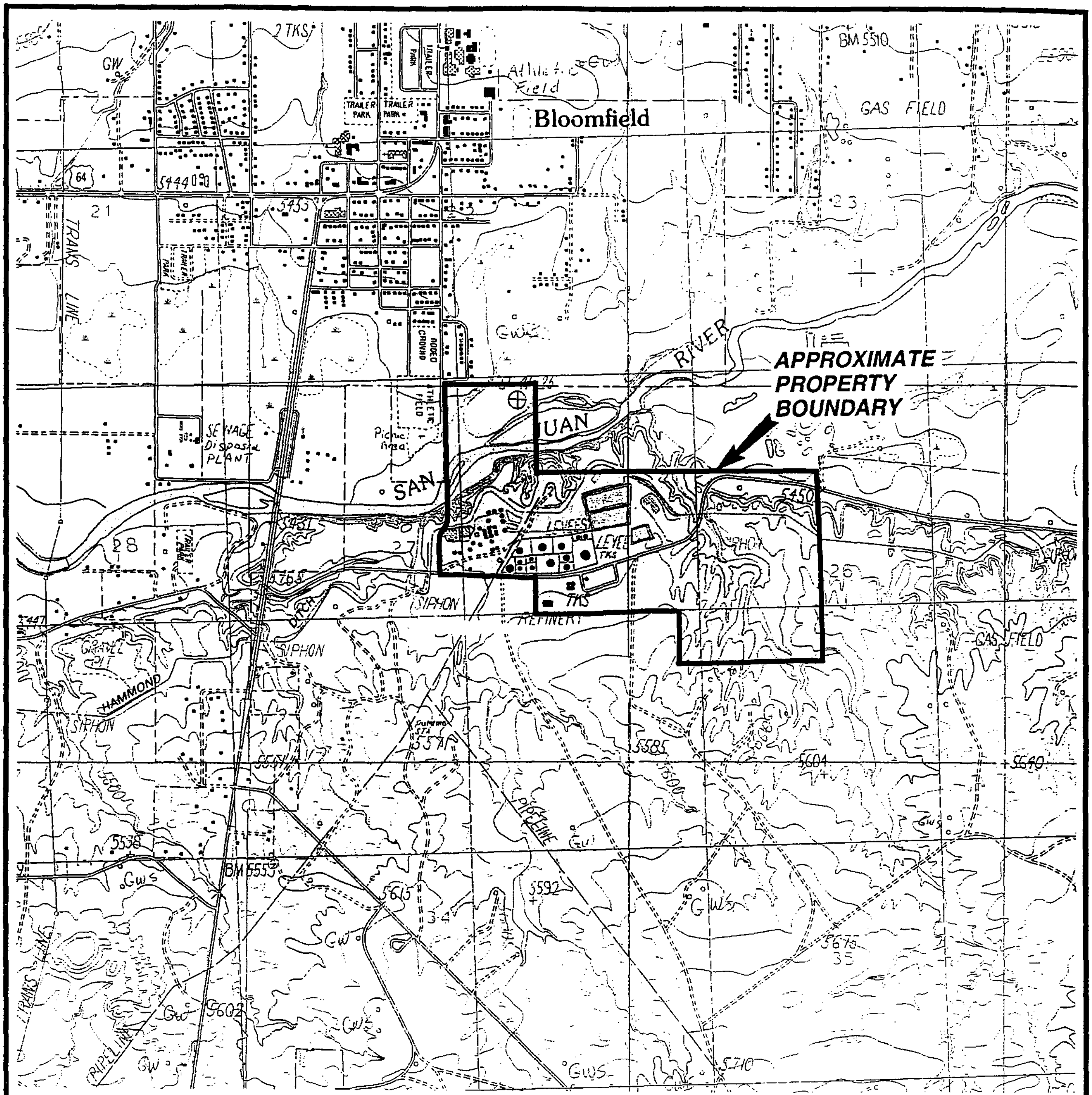
4.0 SUMMARY

The objectives described in the Interim Measures Workplan (April 1993) have been accomplished. These objectives are fulfilled by the following:

- The installation of recovery wells RW-22 and RW-23.
- The installation of dual phase recovery pump systems in wells RW-18 and RW-19.
- The aerial decrease of phase separated hydrocarbons across the site.
- The institution of horizontal and vertical controls for each well and the development of a site wide groundwater table contour map.

The presence of PSH in recovery well RW-23 (detected in February 1994) will be addressed by installing a QED Pulse Pump System identical to the pumps present in wells RW-18 and RW-19. Further, the air sparge system will be evaluated when flow in Hammond Ditch resumes. If necessary the system will be modified to improve operation efficiency.

Currently, the facility's wastewater treatment capability is limited by the capacity of the evaporation ponds. BRC is currently completing a Class I underground irrigation well. This well will increase the facility's wastewater treatment capacity. When operational and at the time concurrent with the implementation of corrective measures, other recovery wells may be equipped with water table depression pumps (if required) to enhance PSH removal.



LEGEND

SITE BOUNDARY

NEW MEXICO

QUADRANGLE LOCATION

N

1000 0 2000

SCALE IN FEET

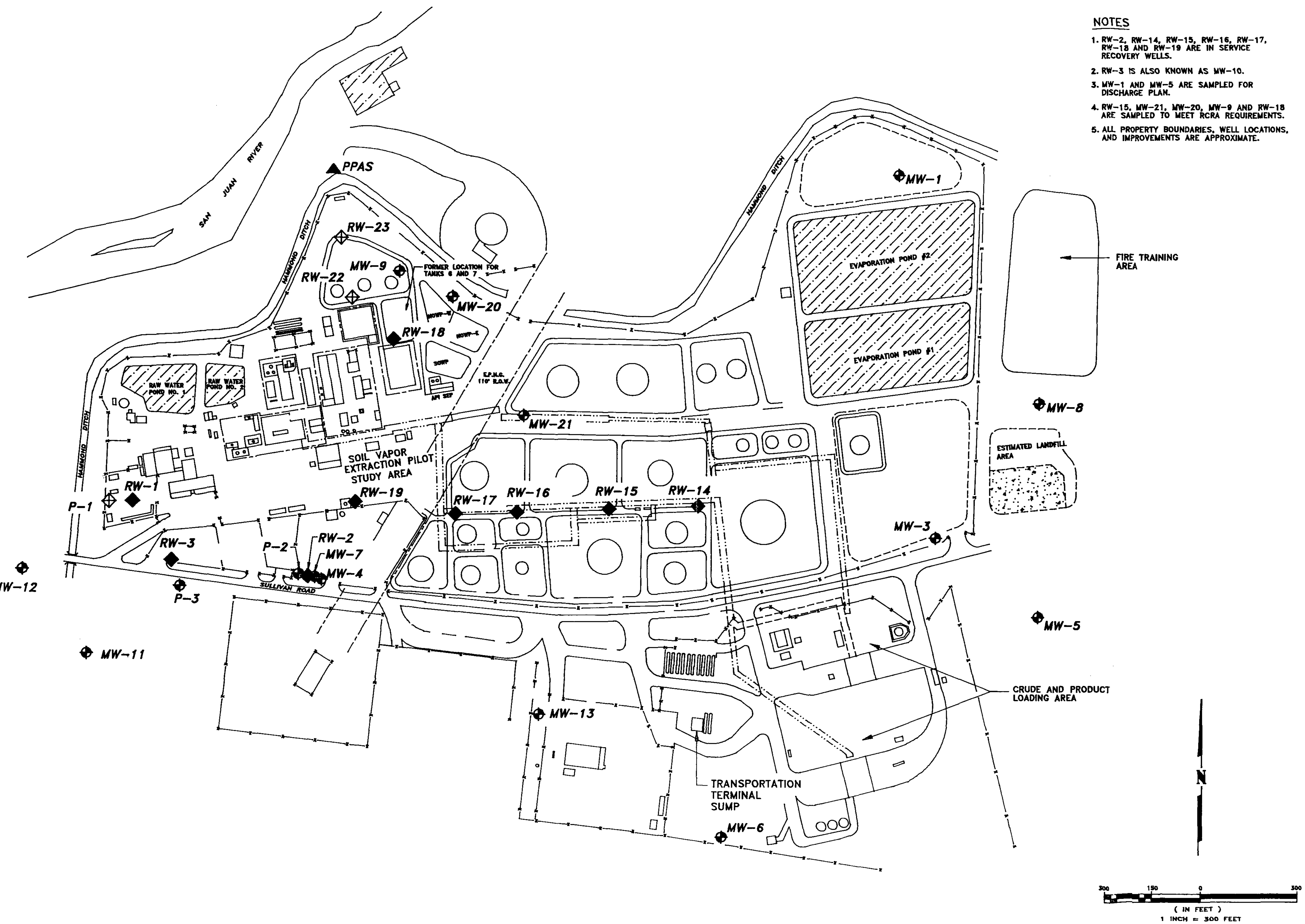
BLOOMFIELD, N. MEX. QUADRANGLE
PROVISIONAL EDITION
1985
36107-F8-TF-024

Bloomfield Refining Company
A Gary Energy Corporation Subsidiary
#50 COUNTY ROAD 4990
BLOOMFIELD, NEW MEXICO

GROUNDWATER TECHNOLOGY
2501 YALE BLVD. SE, SUITE 204
ALBUQUERQUE, N.M. 87106 (505) 242-3113

SITE LOCATION

DESIGNED BY: CD	DETAILED BY: EF	CHECKED BY:
DATE: 2/2/93		FILE: BL-SITELOC
PROJECT NO.: 023353014		CONTRACT:
DRAWING: FIGURE 1		REVISION: -



NOTES

1. RW-2, RW-14, RW-15, RW-16, RW-17, RW-18 AND RW-19 ARE IN SERVICE RECOVERY WELLS.
2. RW-3 IS ALSO KNOWN AS MW-10.
3. MW-1 AND MW-5 ARE SAMPLED FOR DISCHARGE PLAN.
4. RW-15, MW-21, MW-20, MW-9 AND RW-18 ARE SAMPLED TO MEET RCRA REQUIREMENTS.
5. ALL PROPERTY BOUNDARIES, WELL LOCATIONS, AND IMPROVEMENTS ARE APPROXIMATE.

NO.	DATE	BY	REVISION

LEGEND

-··-··- PIPEWAY

– – – – – UNDERGROUND PIPEWAY

—x— FENCE

MW-1 EXISTING MONITORING WELL

RW-1 EXISTING RECOVERY WELL

RW-23 NEW RECOVERY WELL

PPAS PERFORATED PIPE AIR SPARGE POINT

ATTENTION

SIGNATURE	DATE
PROJECT GEO:	
PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

Bloomfield Refining Company
A Gary Energy Corporation Subsidiary
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BLOOMFIELD, NEW MEXICO

GROUNDWATER TECHNOLOGY
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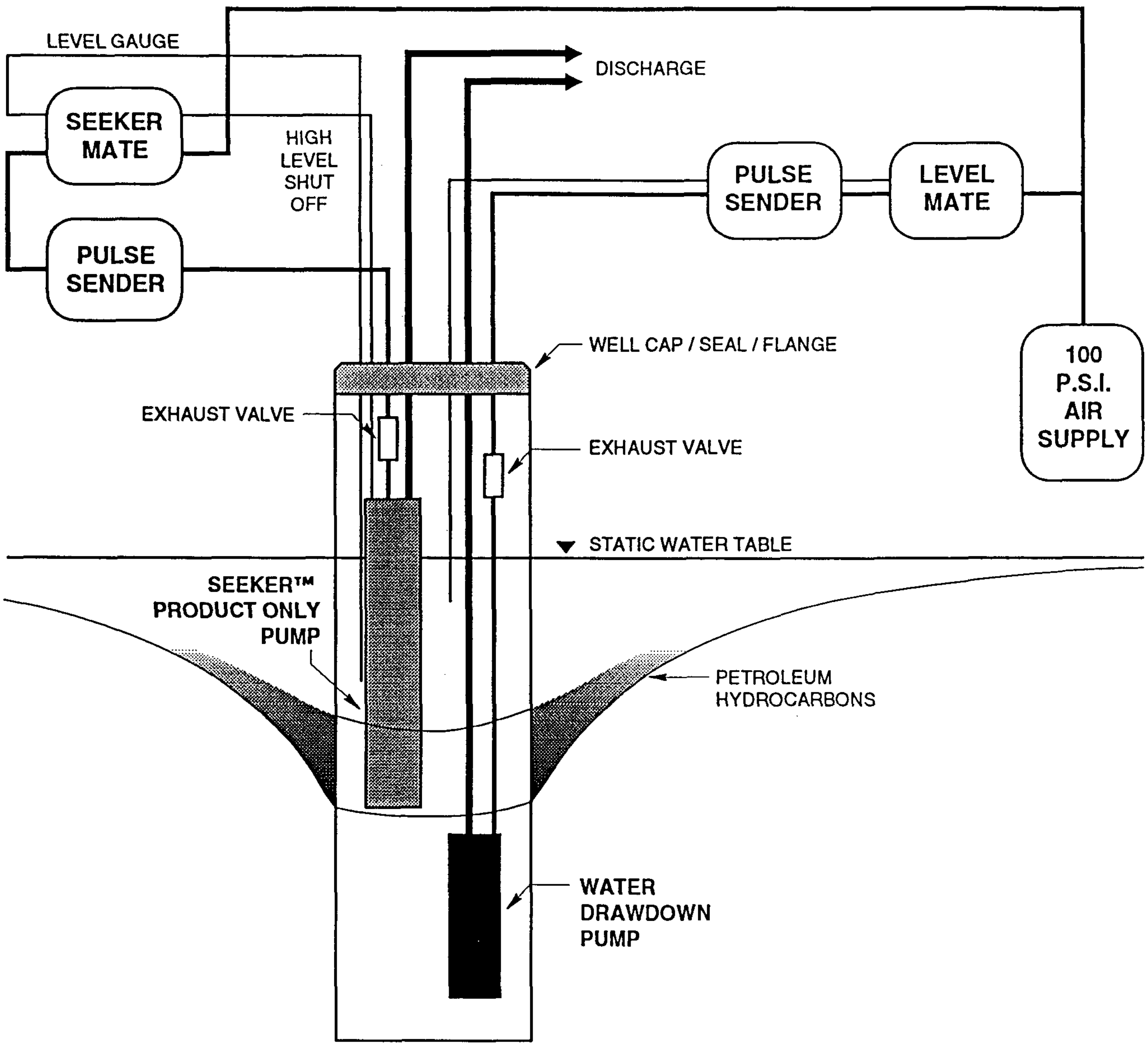
(505) 242-3113

MONITORING AND RECOVERY WELL LOCATIONS
(EXISTING AND NEW)
FEBRUARY 1994

DESIGNED BY:	DRAFTED BY:	CHECKED BY:
C.W.S.	J. ML	CWS

DATE:	FILE:
FEBRUARY -1994	WELLS-N.DWG
PROJECT NO.: 023353014	CONTRACT:
DRAWING:	REVISION: 0

FIGURE 2



DRAWN BY	FOLDER	FILE	CHECKED BY	APPROVED BY
JU 2/16/94	Bloomfield Refining Co.	PlsPump	CJS	

BLOOMFIELD REFINING COMPANY

PNEUMATIC PULSE PUMP HYDROCARBON RECOVERY SYSTEM

FIGURE 3

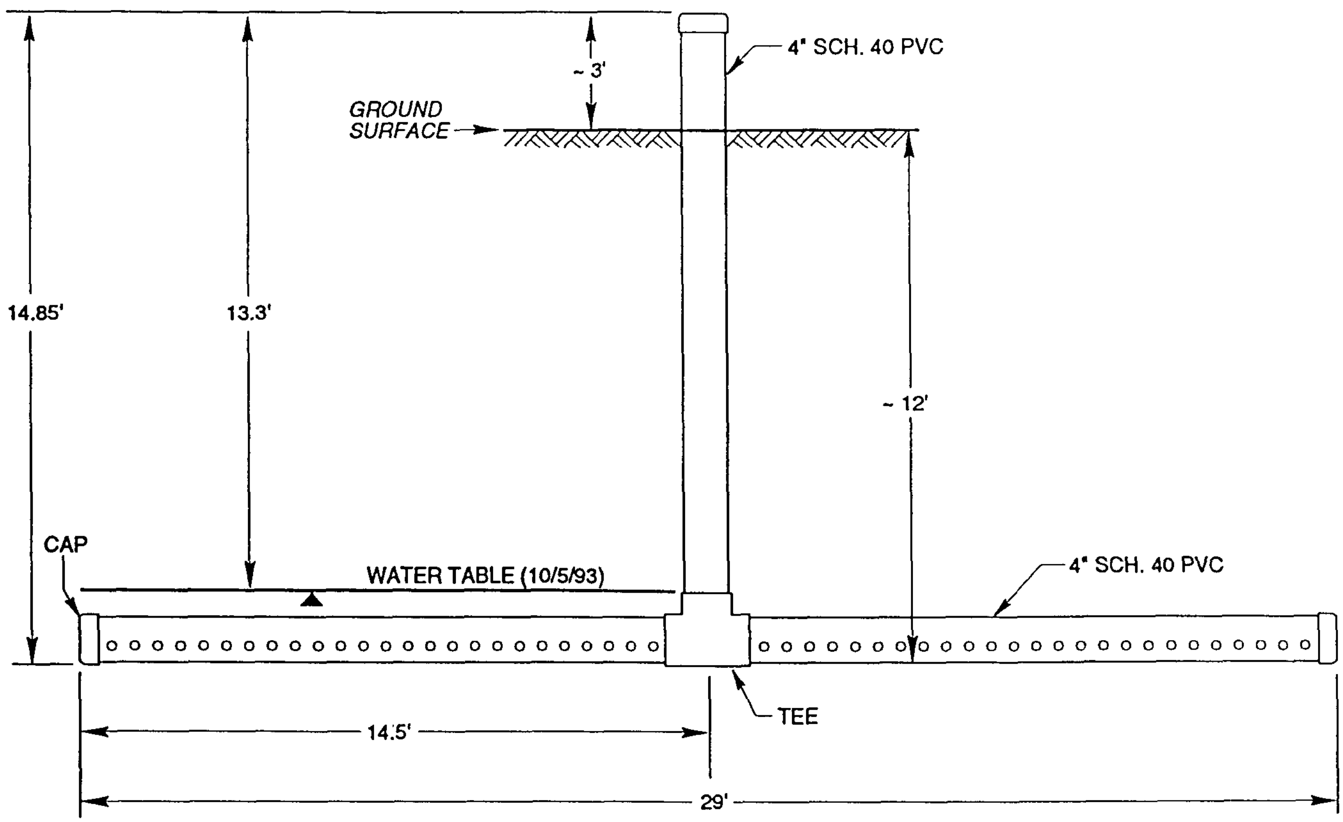
LOCATION: BLOOMFIELD, NEW MEXICO

PROJECT NO.: 023353014-30

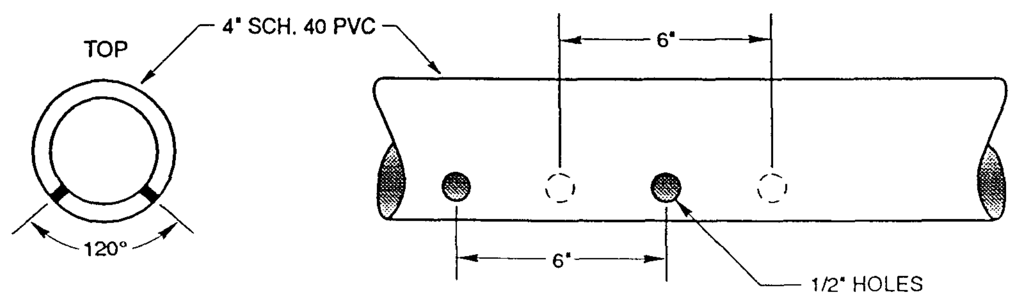
GROUNDWATER TECHNOLOGY

APPROVED BY	CHECKED BY	FILE	FOLDER	DRAWN BY
	Cws	As-built	Bloomfield Refining Co.	CS 2/14/94

CROSS SECTION



PERFORATION DETAILS



BLOOMFIELD REFINING COMPANY - INTERIM MEASURES

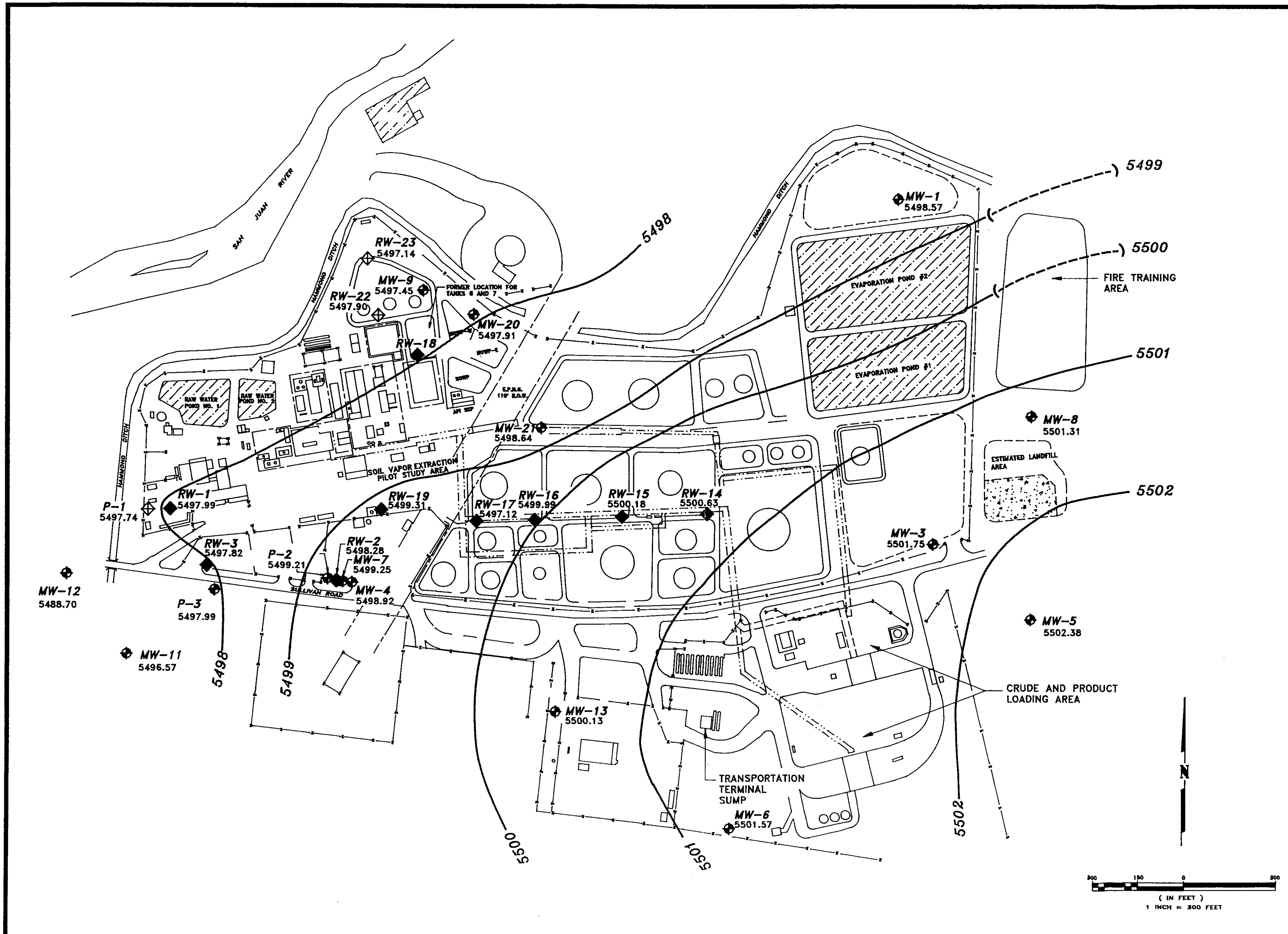
PERFORATED PIPE AIR SPARGE SYSTEM INSTALLED PERPENDICULAR TO SEEP

FIGURE **4**

LOCATION: BLOOMFIELD, NEW MEXICO

PROJECT NO.: 023353014-30

GROUNDWATER TECHNOLOGY



NO.	DATE	BY	REVISION

LEGEND

PIPEWAY

UNDERGROUND PIPEWAY

FENCE

MW-1 EXISTING MONITORING WELL

RW-1 EXISTING RECOVERY WELL

RW-23 NEW RECOVERY WELL

5501 WATERTABLE CONTOUR
CONTOUR INTERVAL = 1 FEET

ATTENTION

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PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

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A Gary Energy Corporation Subsidiary
#50 COUNTY ROAD 4990
BLOOMFIELD, NEW MEXICO

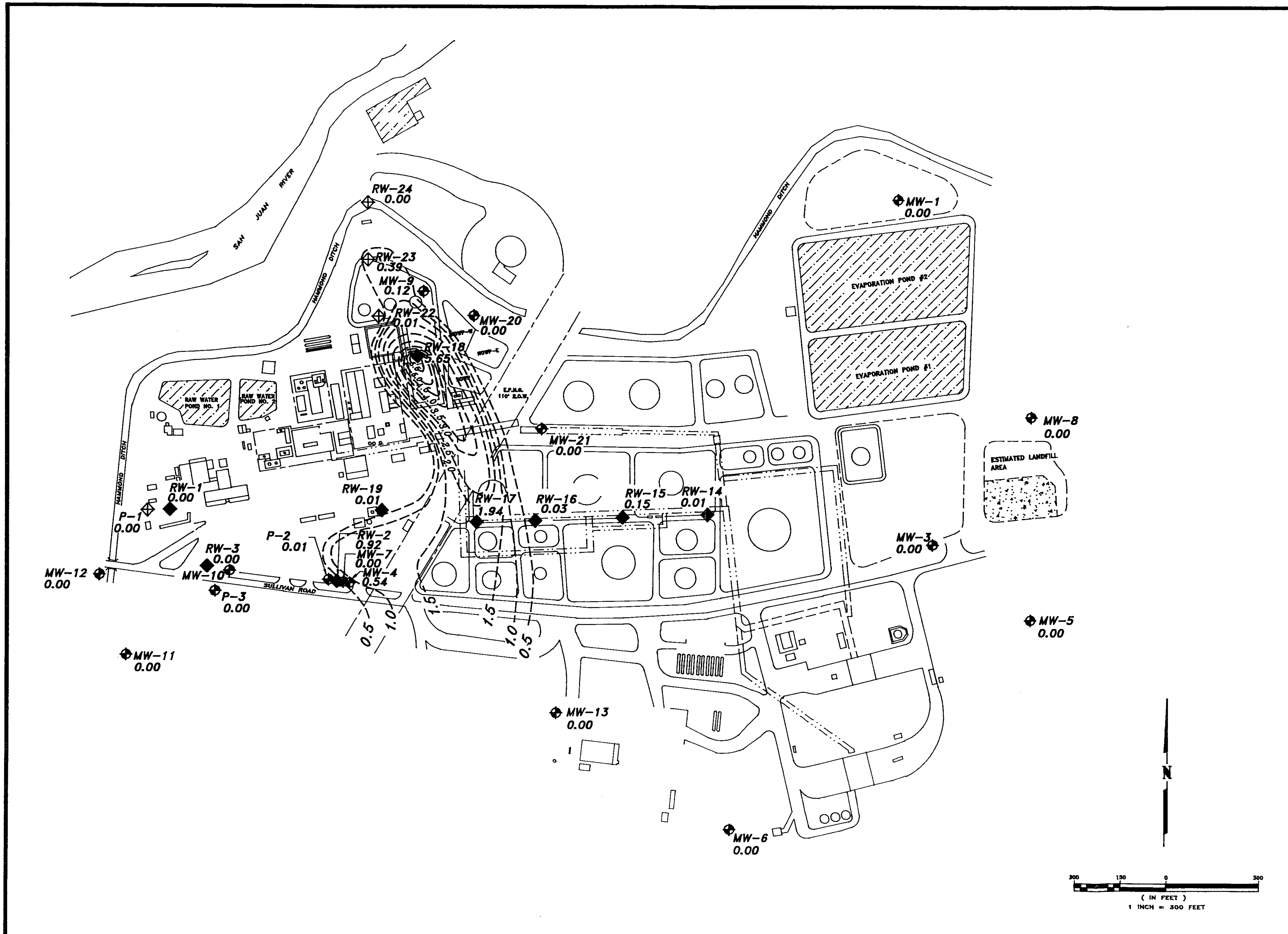
GROUNDWATER TECHNOLOGY
2501 YALE BLVD. SE, SUITE 204
ALBUQUERQUE, NEW MEXICO 87106
(505) 242-3113

WATER TABLE CONTOUR MAP
FEBRUARY 4, 1994

DESIGNED BY:	DRAFTED BY:	CHECKED BY:
C.W.S.	J. ML	ag

DATE:	FILE:
FEBRUARY - 1994	GW2-94
PROJECT NO.: 023353014	CONTRACT:
DRAWING:	REVISION: 0

FIGURE 5



NO.	DATE	BY	REVISION

LEGEND

- —·—·— PIPEWAY
- — — — UNDERGROUND PIPEWAY
- MW-1 EXISTING MONITORING WELL
- RW-22 NEW RECOVERY WELL
- RW-15 EXISTING RECOVERY WELL
- 1.94 HYDROCARBON THICKNESS (IN FEET)

—0.50—
HYDROCARBON THICKNESS CONTOUR (IN FEET)
CONTOUR INTERVAL = .50 FOOT

ATTENTION

SIGNATURE	DATE
PROJECT GEO:	
PROJECT ENGR:	
PROJECT MGR:	
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BLOOMFIELD, NEW MEXICO

GROUNDWATER TECHNOLOGY
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(505) 242-3113

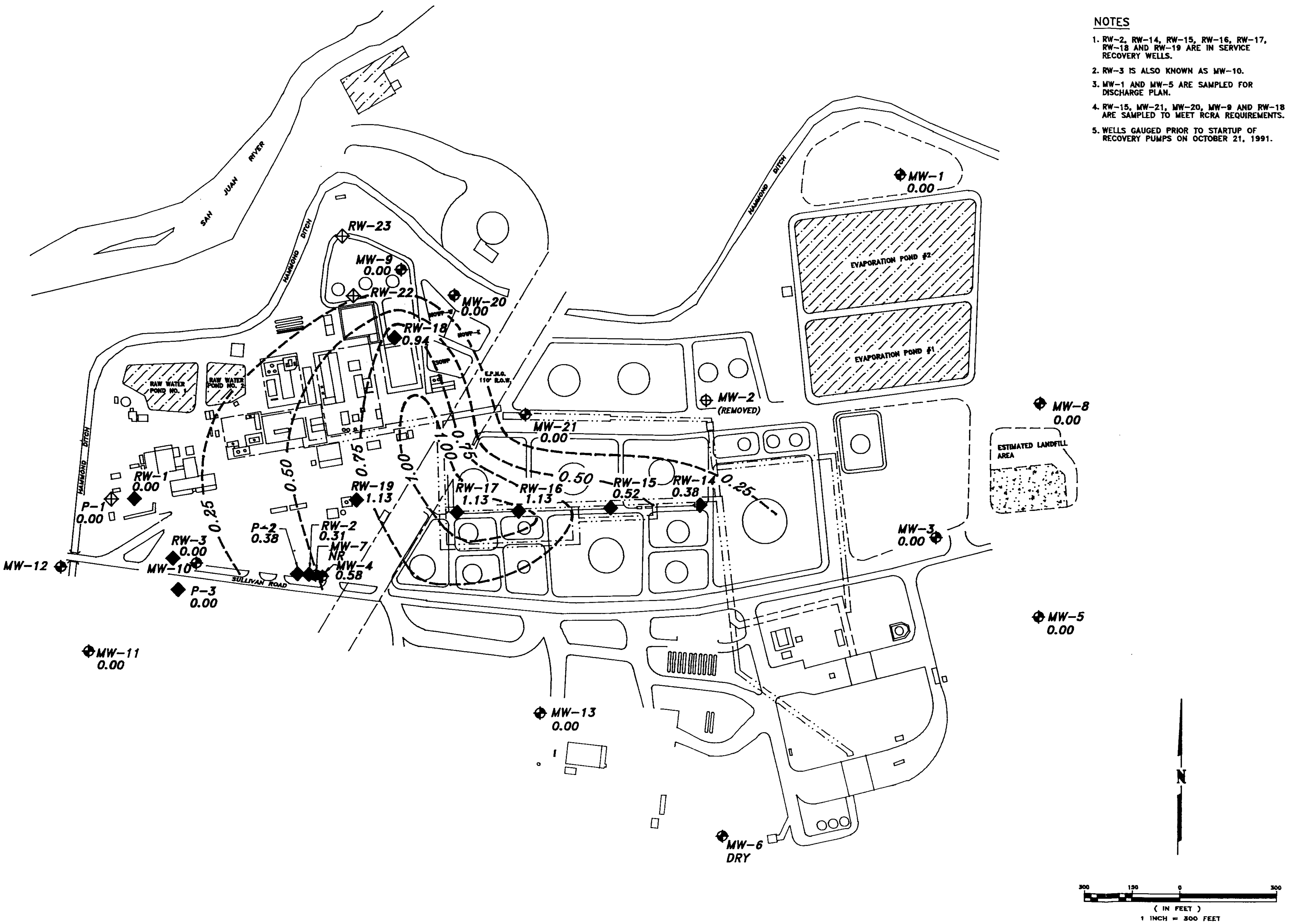
SEPARATE PHASE HYDROCARBON ISOPLETH

FEBRUARY 1994

DESIGNED BY:	DRAFTED BY:	CHECKED BY:
C.W.S.	J. ML	CWS

DATE:	FILE:
FEBRUARY – 1994	SPHC-N.DWG
PROJECT NO.:	CONTRACT:
023353014	
DRAWING:	REVISION: 0

FIGURE 6



NOTES

1. RW-2, RW-14, RW-15, RW-16, RW-17, RW-18 AND RW-19 ARE IN SERVICE RECOVERY WELLS.
2. RW-3 IS ALSO KNOWN AS MW-10.
3. MW-1 AND MW-5 ARE SAMPLED FOR DISCHARGE PLAN.
4. RW-15, MW-21, MW-20, MW-9 AND RW-18 ARE SAMPLED TO MEET RCRA REQUIREMENTS.
5. WELLS GAUGED PRIOR TO STARTUP OF RECOVERY PUMPS ON OCTOBER 21, 1991.

NO.	DATE	BY	REVISION

LEGEND

- ·—·—·— PIPEWAY
- — — — — UNDERGROUND PIPEWAY
- MW-1 EXISTING MONITORING WELL
- RW-1 EXISTING RECOVERY WELL
- RW-22 PROPOSED RECOVERY WELL
- MW-2 FORMER MONITORING WELL
- 0.00 HYDROCARBON THICKNESS (IN FEET)
- —0.25— HYDROCARBON THICKNESS CONTOUR (IN FEET) CONTOUR INTERVAL = .25 FOOT

ATTENTION

SIGNATURE	DATE
PROJECT GEO:	
PROJECT ENGR:	
PROJECT MGR:	
CLIENT:	

Bloomfield Refining Company
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#50 COUNTY ROAD 4990
BLOOMFIELD, NEW MEXICO

GROUNDWATER TECHNOLOGY
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(505) 242-3113

SEPARATE PHASE HYDROCARBON ISOPLETH
OCTOBER – 1991

DESIGNED BY:	DRAFTED BY:	CHECKED BY:
SB	J. ML	CWS

DATE:	FILE:
FEBRUARY-1994	SPHC1091.DWG
PROJECT NO.: 023353014	CONTRACT:
DRAWING:	REVISION: 0

FIGURE 7

TABLE 1
SUMMARY OF FLUID LEVELS AND
WELL CONSTRUCTION INFORMATION
AT THE BLOOMFIELD REFINING COMPANY

FEBRUARY 4, 1994

WELL NO	DATE INSTALL	ELEV T.O.P (FT)	STICKUP (FT)	ELEV. GRADE (FT)	DEPTH OF CASING FR T.O.P. (FT)	FROM T.O.P. TO LIQ. (FT)	HC THICKNESS (FT)	ELEV. TOP OF LIQUID (FT)	ELEV. TOP OF WATER (FT)	ELEV. TOP OF SCREEN (FT)	ELEV. BTM. OF SCREEN (FT)	ELEV. TOP OF GRAVEL (FT)	ELEV. TOP OF NACIMTO (FT)
MW-1	02/08/84	5515.78	1.7	5514.08	24.65	17.21	0.00	5498.57	5498.57	5511.13	5491.13	5509.08	5492.08
MW-3	02/09/84	5535.88	1.0	5534.88	39.35	34.13	0.00	5501.75	5501.75	5516.53	5496.53	5507.88	5494.88
MW-4	02/09/84	5524.46	1.4	5523.06	32.50	25.00	0.54	5499.46	5498.92	5511.96	5491.96	5508.06	5491.06
MW-5	02/06/84	5545.13	1.0	5544.13	51.61	42.75	0.00	5502.38	5502.38	5513.52	5493.52	5509.13	5497.13
MW-6	02/07/84	5551.20	1.6	5549.60	49.63	49.63	0.00	5501.57	5501.57	5521.57	5501.57	5508.60	5500.60
MW-7	02/25/86	5524.25	1.1	5523.15	62.11	25.00	0.00	5499.25	549.25	5474.14	5464.14	5506.15	5491.15
MW-8	02/28/86	5531.17	1.0	5530.17	34.94	29.86	0.00	5501.31	5501.31	5518.23	5498.23	5510.17	5496.17
MW-9	03/03/86	5519.77	1.7	5518.07	33.99	22.20	0.12	5497.57	5497.45	5507.78	5487.78	5503.07	5489.77
RW-1	08/31/88	5526.01	1.4	5524.61	40.98	28.02	0.00	5497.99	5497.99	5507.21	5491.61	5506.61	5492.01
P-1	08/30/88	5524.49	0.8	5523.69	42.45	26.75	0.00	5497.74	5497.74	5503.19	5487.19	5503.69	5487.19
RW-2	08/29/88	5523.61	0.5	5523.11	38.03	24.41	0.92	5499.20	5498.28	5506.58	5490.88	5508.11	5491.11
P-2	08/29/88	5523.86	0.8	5523.06	38.33	24.65	0.01	5499.21	5499.20	5506.13	5490.83	5510.06	5491.56
RW-3	03/04/86	5516.96	1.4	5515.56	33.93	19.14	0.00	5497.82	5497.82	5505.03	5485.03	5505.56	5492.56
P-3	09/01/88	5507.31	0.8	5506.51	22.80	9.32	0.00	5497.99	5497.99	5500.36	5489.91	5506.51	5492.51
MW-11	07/31/87	5506.89	3.6	5503.29	24.73	10.32	0.00	5496.57	5496.57	5497.16	5487.16	5503.29	5493.29
MW-12	08/01/87	5498.42	2.5	5495.92	14.22	9.72	0.00	5488.70	5488.70	5494.20	5484.20	5495.92	5485.92
MW-13	09/03/88	5538.54	3.3	5535.24	53.00	38.36	0.00	5500.18	5500.18	5506.51	5490.74	5508.24	5490.24
RW-14	08/06/90	5534.13	1.9	5532.23	43.00	33.49	0.01	5500.64	5500.63	5511.13	5493.13	5508.23	5493.73
RW-15	08/07/90	5533.44	1.7	5531.74	43.40	33.11	0.15	5500.33	5500.18	5510.04	5492.04	5512.74	5496.74
RW-16	08/07/90	5532.09	1.8	5530.29	43.10	32.24	0.03	5499.85	5499.82	5508.99	5490.99	5511.29	5492.79
RW-17	08/07/90	5530.46	1.6	5528.86	41.55	31.40	1.94	5499.06	5497.12	5508.91	5490.91	5503.86	5493.56
RW-18	08/08/90	5526.08	2.6	5523.48	39.95	27.75	5.65	5498.33	5492.68	5506.13	5488.13	5504.48	5494.48
RW-19	08/08/90	5527.27	1.5	5525.77	36.70	27.95	0.01	5499.32	5499.31	5510.57	5492.57	5505.77	5492.77
MW-20	09/13/91	5516.46	1.8	5514.66	27.18	18.55	0.00	5497.91	5497.91	5506.28	5491.28	5504.16	5490.66
MW-21	09/16/91	5518.62	1.6	5517.02	30.93	19.98	0.00	5498.64	5498.64	5504.69	5489.69	5505.02	5492.52
RW-22	07/19/93	5521.05	3.0	5518.05	35.73	23.15	0.01	5497.90	5497.89	5503.32	5487.32	5503.05	5491.05
RW-23	07/19/93	5517.74	2.0	5515.74	35.39	20.6	0.39	5497.14	5496.75	5500.35	5484.35	5508.74	5486.74
MW-24	09/15/93	5508.23	3.0	5505.23	14.85	14.85	0.00	5493.38	5493.38	5493.38	5493.38	5503.23	5492.88

TABLE 2
PLANT COORDINATES AND
WELL MEASURING POINT ELEVATION
AT THE BLOOMFIELD REFINING COMPANY

JANUARY 1994

WELL NO	NORTHING	EASTING	ELEVATION
MW-1	6313.75	7342.73	5515.78
MW-3	5214.51	7501.30	5535.88
MW-4	5007.85	5633.77	5524.46
MW-5	4947.06	7893.25	5545.13
MW-6	4392.33	6962.73	5551.20
MW-7	5009.52	5610.66	5524.25
MW-8	5690.40	7823.17	5531.17
MW-9	5918.01	5856.97	5519.77
MW-11	4629.22	4898.06	5506.89
MW-13	4661.14	6352.28	5538.54
MW-20	5809.61	6055.15	5516.46
MW-21	5551.94	6254.30	5518.62
RW-22	5845.82	5715.45	5521.05
RW-23	5985.66	5693.04	5517.74
MW-24	6149.05	5616.35	5508.23
MW P1	5483.12	5040.84	5524.49
P-2	5019.44	5565.54	5523.86
P-3	4915.61	5166.46	5507.31
RW-1	5186.60	5099.73	5526.01
RW-2	5013.34	5595.62	5523.61
RW-3	5036.15	5177.28	5516.96
RW-14	5288.15	6771.80	5534.13
RW-15	5269.06	6576.37	5533.44
RW-16	5250.93	6369.59	5532.09
RW-17	5224.85	6034.38	5530.46
RW-18	5698.90	5857.98	5526.08
RW-19	5236.70	5655.38	5527.27

APPENDIX A

SOIL BORING AND WELL CONSTRUCTION LOGS

Drilling Log

GROUNDWATER TECHNOLOGY

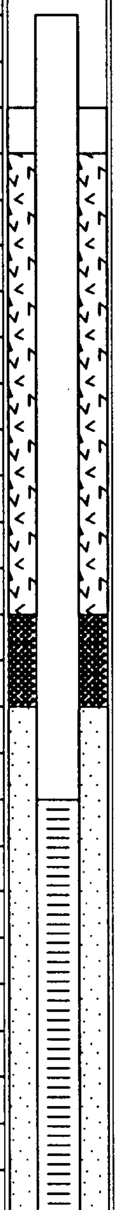
Recovery Well **RW-22**

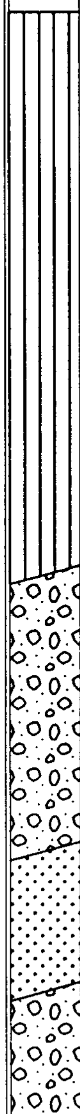
Project *Bloomfield/50 CR4990* Owner *Bloomfield Refining Co.*
Location *Bloomfield, New Mexico* Proj. No. *023353014*
Surface Elev. *5518.05 ft.* Total Hole Depth *34 ft.* Diameter *10 in.*
Top of Casing *5521.05 ft.* Water Level Initial *19 ft.* Static
Screen: Dia *6 in.* Length *16 ft.* Type/Size *FRE/0.020 in.*
Casing: Dia *6 in.* Length *17/2 ft.* Type *FRE*
Fill Material *12/20 Co. Silica* Rig/Core *Speedstar 15-THH*
Drill Co. *Beeman Bros.* Method *Air Percussion*
Driller *Leo Beeman* Log By *Jerry May* Date *07/19/93* Permit #
Checked By License No.

See Site Map For Boring Location

COMMENTS:

Start @ 1230 hrs. 2 ft silt leg installed from 31 to 33 feet





Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
-2							
0							
1							Tan SILT (moist)
4							Same as above
5		214					
6						ML	
10		46					Same as above
12							Gray COBBLES (trace or no fines)
15		NA				GW	
18							Light gray-stained poorly-graded fine SAND with trace of gravel (moist-wet)
19		1,450					*Groundwater encountered at 19' on 7/19/93*
20						SP	
21							Dark-gray-stained COBBLES with trace fines (moist)
22						GW	
24							

Drilling Log

GROUNDWATER TECHNOLOGY

Recovery Well **RW-22**

Project Bloomfield/50 CR4990 Owner Bloomfield Refining Co.
Location Bloomfield, New Mexico Proj. No. 023353014

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
24							
25		1,146				GW	
26							
27							Encountered weathered limestone (moist)
28							(Dry at 28 feet)
30		858					
32							
33		96					
34							End of boring at 34 feet (1355 hrs.). Installed recovery well screened from 15 to 31 feet on 7/19/93.
36							
38							
40							
42							
44							
46							
48							
50							
52							
54							
56							

Drilling Log

GROUNDWATER TECHNOLOGY

Recovery Well **RW-23**

Project: Bloomfield/50 CR4990	Owner: Bloomfield Refining Co.
Location: Bloomfield, New Mexico	Proj. No. 023353014
Surface Elev. 5515.74 ft.	Total Hole Depth 33 ft.
Diameter 10 in.	Top of Casing 5517.74 ft.
Water Level Initial 19 ft.	Static
Screen: Dia 6 in.	Length 16 ft.
Type/Size FRE/0.020 in.	Casing: Dia 6 in.
Length 15/2 ft.	Type FRE
Fill Material 12/20 Co. Silica	Rig/Core Speedstar 15-THH
Drill Co. Beeman Bros.	Method Air Percussion
Driller Leo Beeman	Log By Jerry May
Date 07/19/93	Permit #
Checked By	License No.

See Site Map For Boring Location

COMMENTS:

Start @ 1630 hrs. 2 ft. silt leg installed from 31 to 33 feet

Depth (ft.)	PID (ppm)	Sample ID	Blow Count/ % Recovery	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
1				GW	Gravel with fines (dry)
2				CL	Brown silty CLAY (moist, medium plasticity)
5.5	0			CL	
7				GW	Gravel and COBBLES (no fines)
10.5	32			GW	
11				GW	Same as above with little fines
15	54			GW	Gravel and COBBLES with trace of fines (dry)
16	74			GW	Gray-stained, same as above
18	2,914			GM	Black-stained GRAVEL with some fines (moist)
19				GM	*Groundwater encountered at 19 feet on 7/19/93*
24.5	105			GM	

GROUNDWATER TECHNOLOGY

Drilling Log

Recovery Well **RW-23**

Project Bloomfield/50 CR4990 Owner Bloomfield Refining Co.
Location Bloomfield, New Mexico Proj. No. 023353014

Depth (ft.)	Well Completion	PID (ppm)	Sample ID	Blow Count/ % Recovery	Graphic Log	USCS Class.	Description (Color, Texture, Structure) Trace < 10%, Little 10% to 20%, Some 20% to 35%, And 35% to 50%
24		105					Gravel and some tan fines (moist)
26						GM	
28							
		17					Light gray weathered limestone (dry)
30							
32							
		0					End of boring at 33 feet (1750 hrs). Installed recovery well screened from 15 to 31 feet on 7/19/93.
34							
36							
38							
40							
42							
44							
46							
48							
50							
52							
54							
56							

APPENDIX B

DOCUMENTATION FOR THE PNEUMATIC PULSE PUMP HYDROCARBON RECOVERY SYSTEM

LP1501 SEEKER PUMP & L376 SEEKERMATE MANUAL

THE THREE MAIN COMPONENTS OF YOUR SEEKER PUMP SYSTEM

1. THE SEEKER LP 1501 FLOATING LAYER PUMP- THE PUMP WHICH USES A SYSTEM OF FLOATS TO ALLOW THE INLET OF THE PUMP TO STAY WITHIN THE FLOATING PRODUCT LAYER IN A WELL EVEN IF PRODUCT STATIC LEVEL CHANGES. THIS ALLOWS FOR PRODUCT- ONLY RECOVERY DOWN TO A THICKNESS OF ABOUT 1/4" WITHOUT CONTINUAL PUMP POSITION ADJUSTMENTS.

2. THE L376 SEEKERMATE MODULE- READS BACK PRESSURE FROM THE CHANGING DEPTH OF LIQUID LEVELS IN THE WELL BY USING BUBBLER LINES. THIS BACK PRESSURE TELLS YOU BY THE L376'S GAGE HOW DEEP YOU SHOULD PLACE YOUR PUMP IN YOUR WELL FOR OPTIMUM RESULTS.

3. THE L360 PULSE SENDER PUMP CONTROLLER- THE MAIN CONTROLLER OF YOUR SYSTEM, WHICH CONTROLS THE AIR PRESSURE (P.S.I.) DELIVERED FROM YOUR COMPRESSOR TO YOUR PUMP, AND ALSO CONTROLS THE PRESSURIZING AND VENTING OF THE PUMP.TIMES ARE CHANGED BY ADJUSTING THE SET OF TIMERS ON YOUR L360 WHICH ALLOWS YOUR PUMP TO PERFORM AT ITS PEAK CAPABILITY.

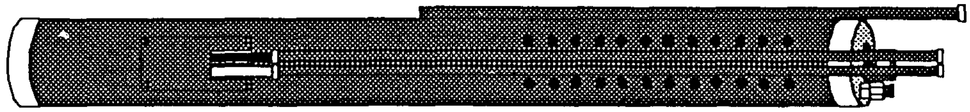
P/N 35933

INDEX

FOR EACH SINGLE SYSTEM ORDERED YOU SHOULD RECEIVE THE FOLLOWING ITEMS:

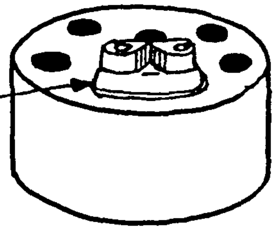
INVENTORY CHECKLIST

1. **LP1501 SEEKER PUMP WITH HOSE CONNECTS** (MAKE SURE TO INSPECT PUMP BODY FOR ANY DENTS OR INCREASES THAT MAY HAVE OCCURRED DUE TO IMPROPER HANDLING DURING SHIPMENT. THE UNIT MAY NOT TO OPERATE PROPERLY IF INNER FLOATS ARE RESTRICTED FROM MOVING FREELY.



2. **WELL CAP WITH CAM CLEAT ATTACHED**

CAM CLEAT

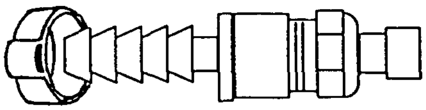


3. **FOUR LENGTHS OF COLOR CODED HOSES AND ONE LENGTH OF NYLON ROPE:**

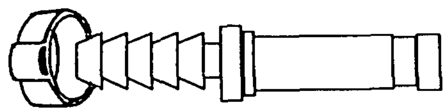
A.) RED, "HIGH LEVEL INTERRUPT", HOSE
B.) BLUE, "GAGE AIR", HOSE
C.) GREEN, "PUMP DISCHARGE", HOSE
D.) BLACK, "PUMP AIR SUPPLY", HOSE
E.) LENGTH OF NYLON ROPE

4. **FITTINGS:** THE ONLY TOOLS YOU WILL NEED ARE A SCREWDRIVER, A KNIFE, AND A CLAMP TOOL.

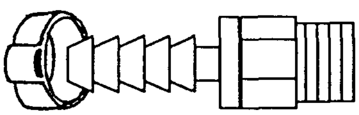
A.) ONE QUICK CONNECT NIPPLE W/ HOSE CLAMP.



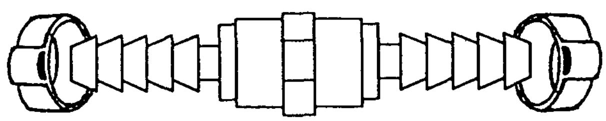
C.) TWO 1/4" STRAIGHT CONNECTS W/ HOSE CLAMP.



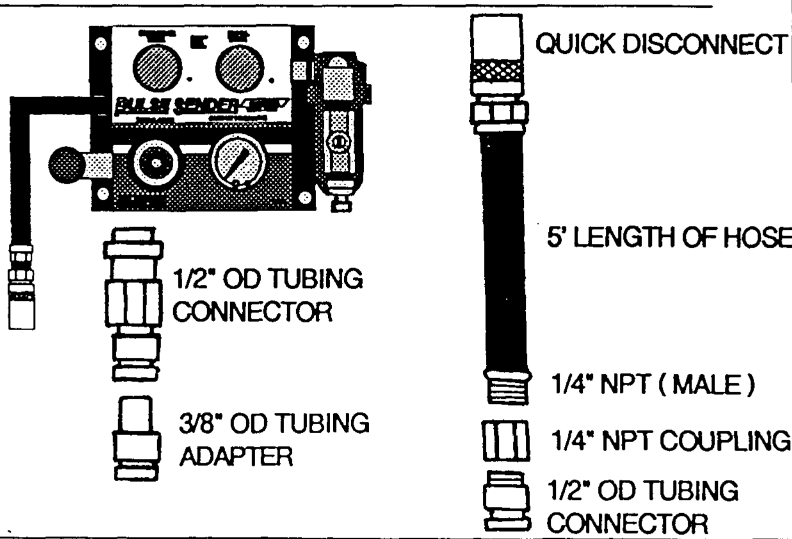
B.) ONE 1/4" MALE PIPE THREAD W/ HOSE CLAMP.



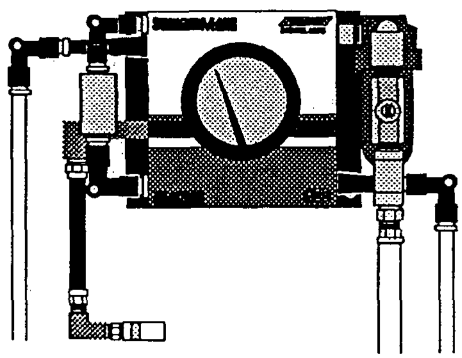
D.) ONE DOUBLE BARB W/ HOSE CLAMPS.



5. **L360 PULSE SENDER CONTROLLER W/ ACCESSORIES**

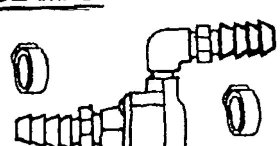


6. **L376 SEEKER MATE GAGE (IF ORDERED)**



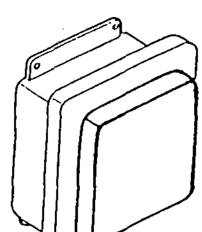
7. **PUMP AIR LINE EXHAUST VALVE**

W/ HOSE CLAMPS.



8. **CLAMP TOOL**

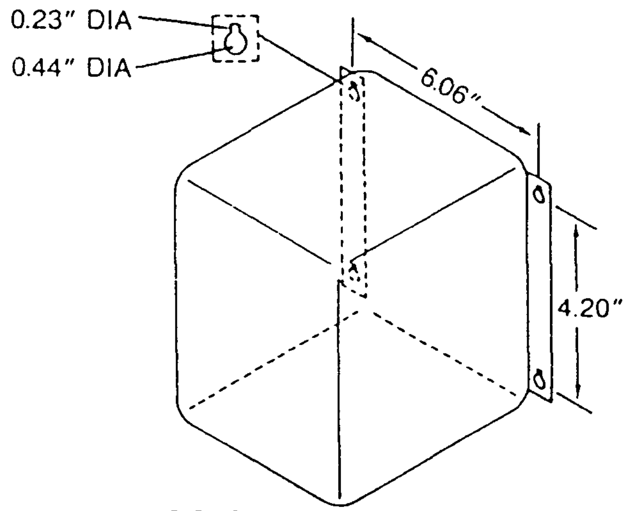
9. **35890 WEATHER TIGHT ENCLOSURE FOR CONTROLLER MODULES (IF ORDERED)**



INSTALLATION

1. MOUNTING YOUR CONTROL MODULES

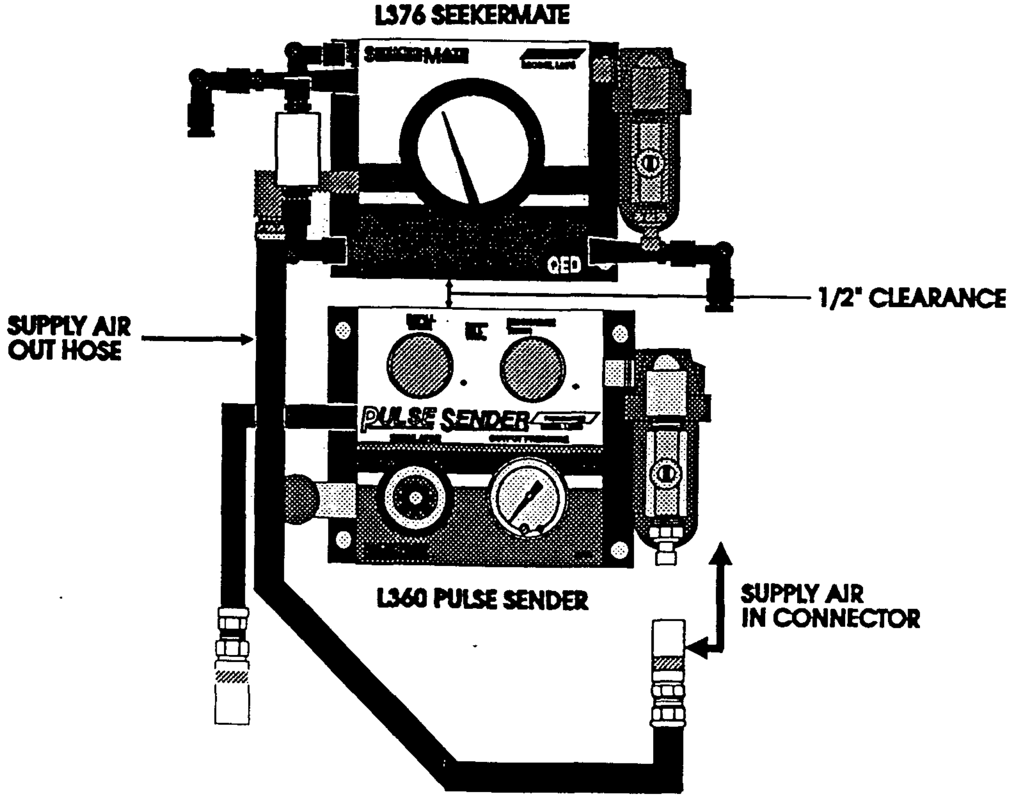
FIND A PROPER LOCATION TO MOUNT YOUR CONTROLLER MODULES, WHERE THEY WILL BE CLOSE TO YOUR WELL AND WILL BE WELL PROTECTED FROM HARSH WEATHER. THE L376 SEEKERMATE SHOULD BE MOUNTED DIRECTLY ABOVE YOUR L360 PULSE SENDER CONTROLLER WITH APPROXIMATELY 1/2" SPACE BETWEEN THE TOP OF YOUR L360 AND THE BOTTOM OF YOUR L376, SO THE HOSE CONNECTION BETWEEN YOUR MODULES WILL REACH AND FIT PROPERLY. (IF YOU HAVE PURCHASED AN OPTIONAL 35890 WEATHER TIGHT MODULE ENCLOSURE THIS HAS ALREADY BEEN DONE FOR YOU,SIMPLY MOUNT YOUR ENCLOSURE IN CLOSE PROXIMITY TO YOUR WELL)



DIMENSIONS AND MOUNTING L376 & L360

2. CONNECTING YOUR L376 TO YOUR L360

ONCE YOU HAVE MOUNTED YOUR CONTROLLER MODULES YOU CAN CONNECT THE TWO UNITS TOGETHER BY ATTACHING THE BLACK HOSE COMING OUT OF THE LEFT HAND SIDE OF THE L376 MARKED,"SUPPLY AIR OUT", TO THE CONNECTOR ON THE RIGHT HAND SIDE OF THE L360 MARKED,"SUPPLY AIR IN",.



IMPORTANT NOTE

3. REMOVE ORANGE WARNING LABEL AND ATTACHED SHIPPING WIRE FROM THE PUMP'S BODY (THE PUMP WILL NOT FUNCTION UNLESS THE SHIPPING WIRE HAS BEEN REMOVED).

4. ATTACH COLOR CODED HOSES TO THEIR CORRESPONDING COLOR CODED HOSE CONNECTORS ON THE TOP OF THE PUMP (FIGURE 1). ATTACH NYLON ROPE TO THE SUPPORT RING ALSO LOCATED ON THE TOP OF THE PUMP (FIGURE 2).

FIGURE ONE

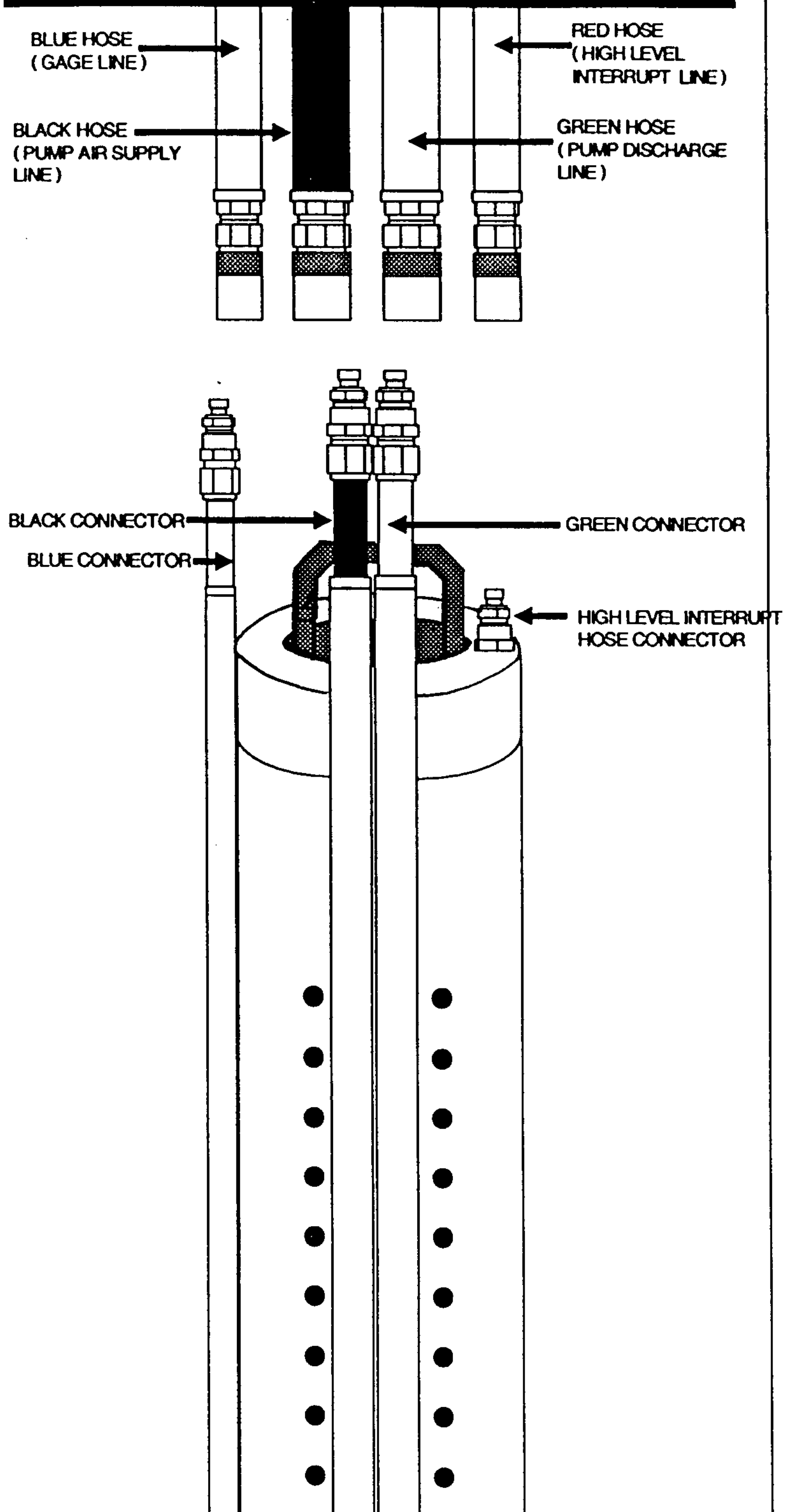
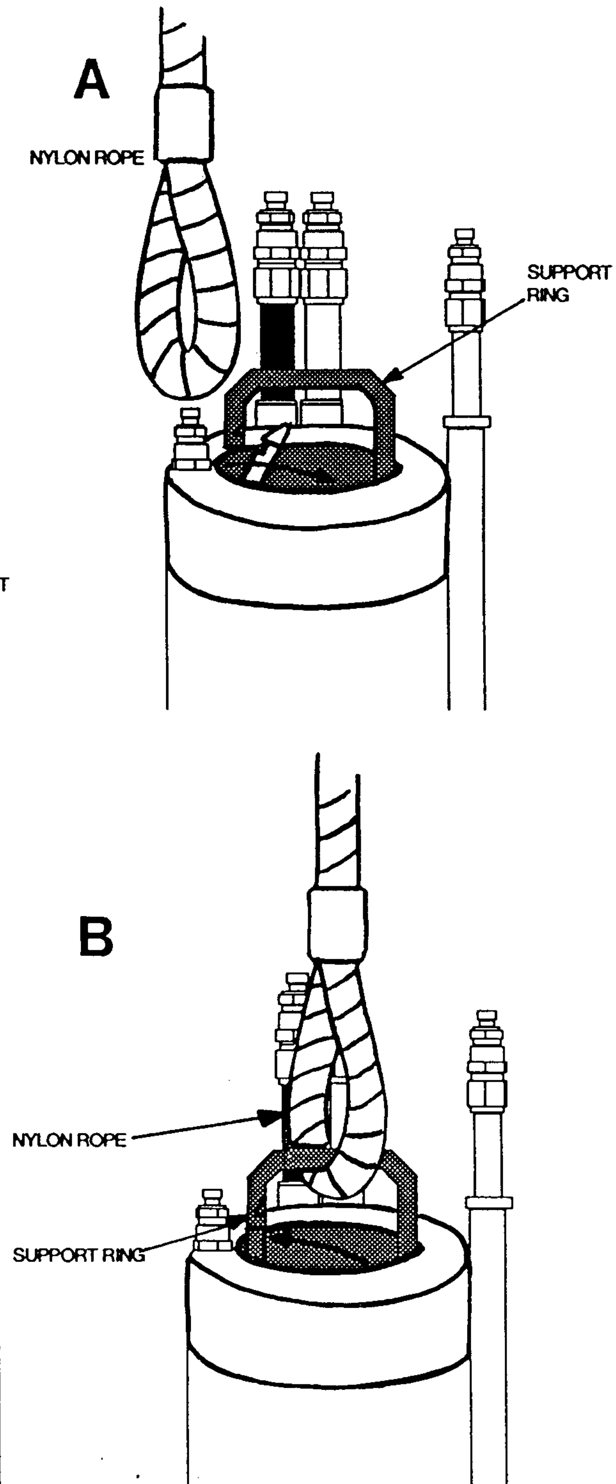
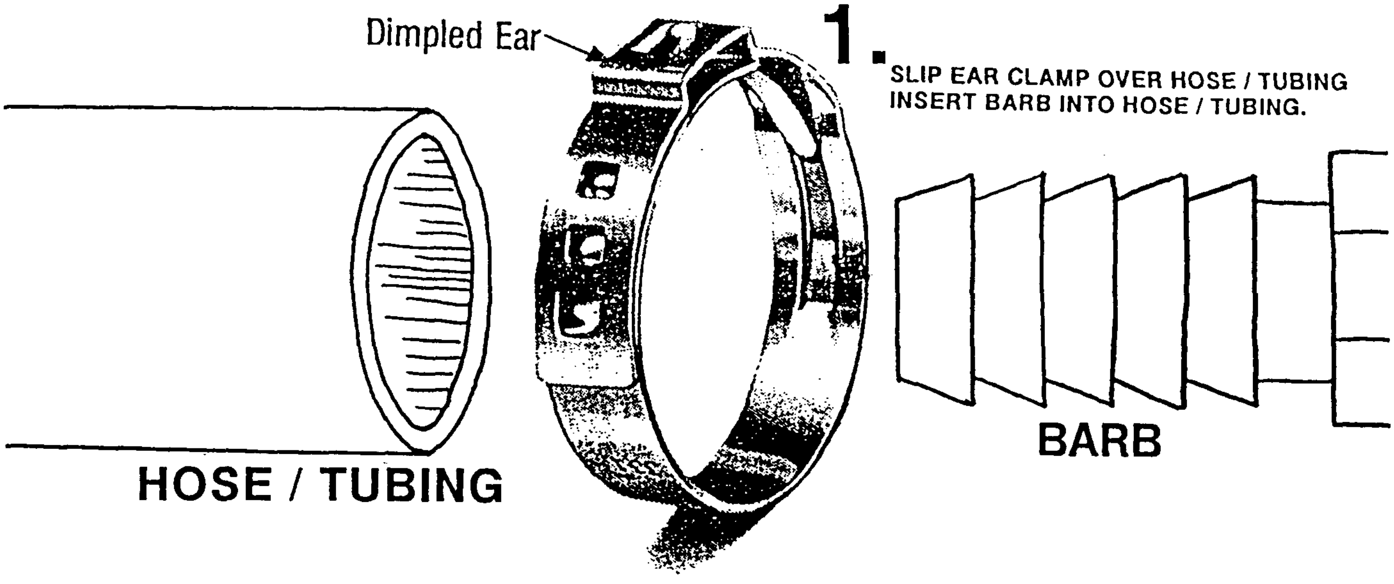


FIGURE TWO

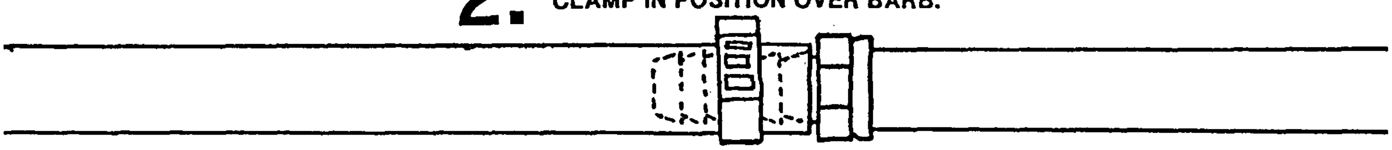


HOSE CLAMP INSTRUCTIONS

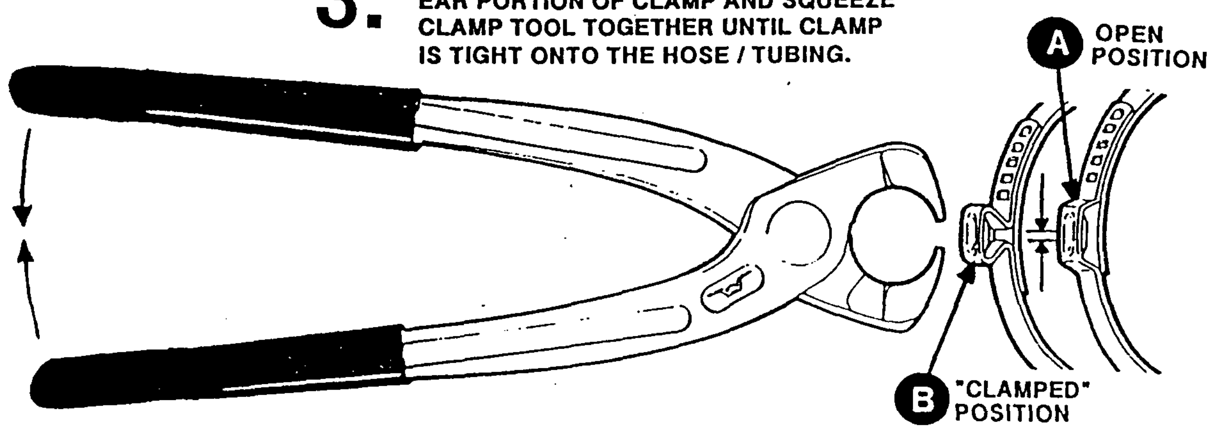
1. SLIP EAR CLAMP OVER HOSE / TUBING INSERT BARB INTO HOSE / TUBING.



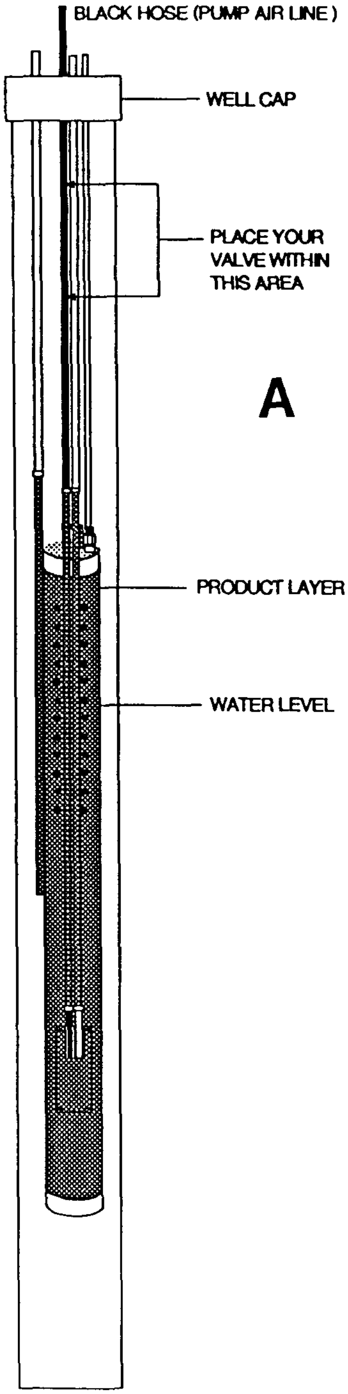
2. CLAMP IN POSITION OVER BARB.



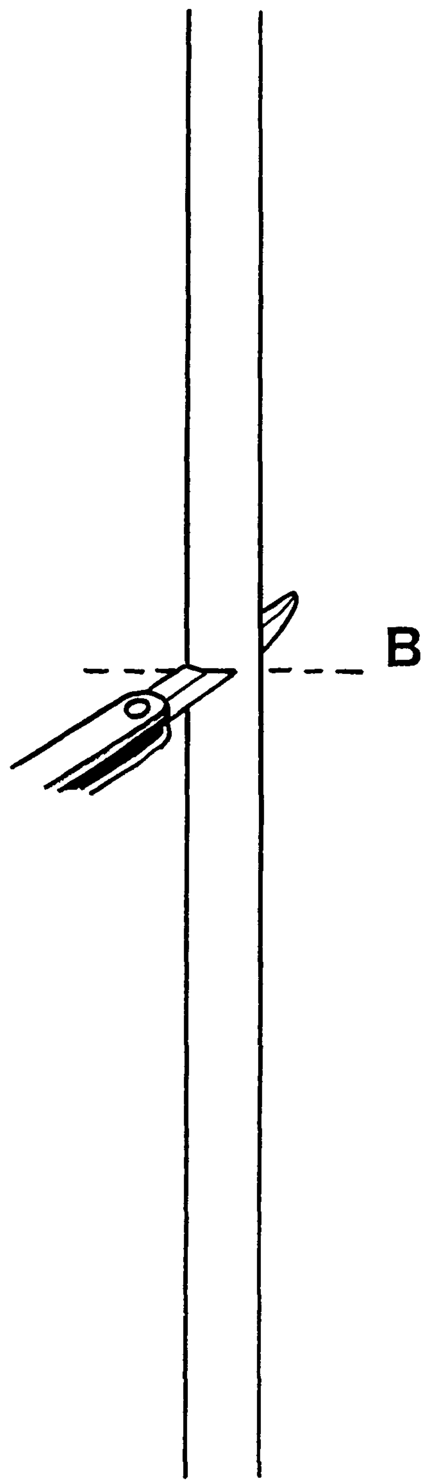
3. PLACE CLAMP TOOL OVER DIMPLED EAR PORTION OF CLAMP AND SQUEEZE CLAMP TOOL TOGETHER UNTIL CLAMP IS TIGHT ONTO THE HOSE / TUBING.



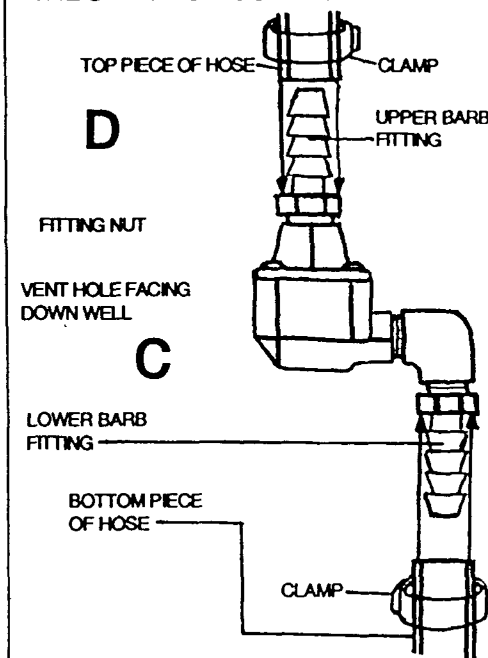
5. INSTALL PUMP EXHAUST VALVE INTO THE BLACK,(AIR SUPPLY) HOSE. THE VALVE SHOULD BE PLACED AT A POINT IN THE HOSE WHERE IT WILL NOT BE SUBMERGED AND WILL ALSO ALLOW FOR ANY FUTURE PUMP RE-ADJUSTMENTS WHICH MAY BECOME NECESSARY. WE WOULD RECOMMEND VALVE PLACEMENT SOMEWHERE WITHIN THE AREA SHOWN BELOW,ROUGHLY 2-3 FEET BELOW THE WELL CAP.

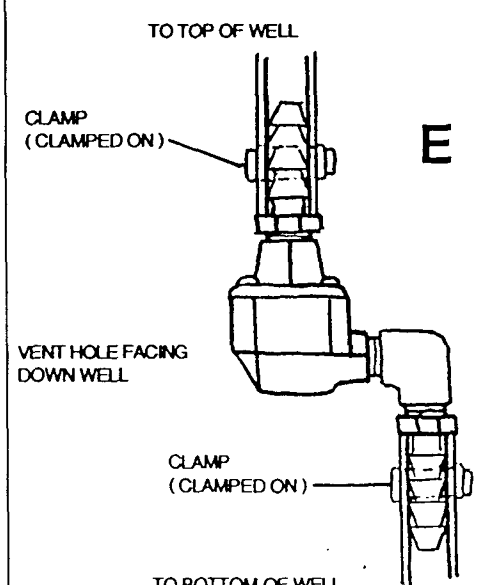


6. AFTER IDENTIFYING THE BLACK PUMP AIR SUPPLY HOSE AND DETERMINING THE POINT WHERE YOU WILL BE PLACING YOUR VALVE, CUT THE HOSE AT THAT POINT.

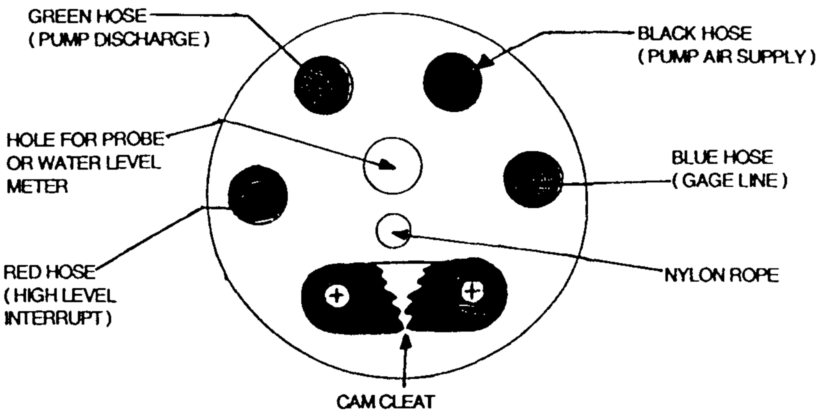


7.IT IS IMPORTANT TO MAKE SURE THAT YOUR VALVE IS INSTALLED IN IT'S PROPER, UPRIGHT POSITION (THE EXHAUST VALVE WILL NOT WORK IF IT IS NOT). THE LARGE VENT HOLE SHOULD BE ON THE BOTTOM OF THE VALVE AS PICTURED. SLIDE CLAMP OVER THE HOSE END. INSERT THE BOTTOM BARBED VALVE FITTING INTO THE BOTTOM SECTION OF THE HOSE AND PUSH IT ON UNTIL IT IS FLUSH WITH THE FITTING NUT OF THE BARB. TIGHTEN CLAMP DOWN OVER THE BARB. DO THE SAME WITH THE TOP FITTING OF THE VALVE. WHEN FINISHED, THE VALVE SHOULD LOOK THE SAME AS FIGURE E.

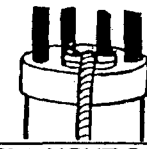




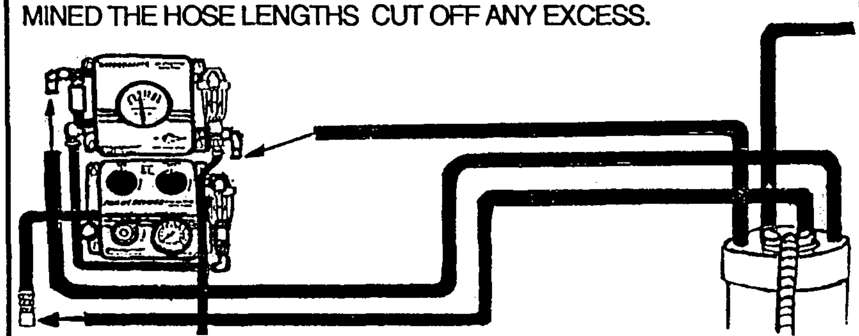
8. PASS HOSES AND NYLON ROPE THROUGH THE WELL CAP.



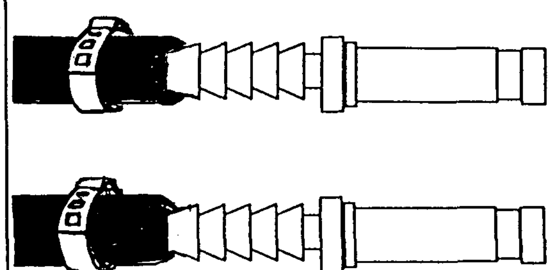
9. INSERT PUMP INTO WELL AND LOWER SLOWLY. CONTINUE TO LOWER UNTIL THE PUMP MAKES CONTACT WITH THE WATER IN THE WELL CASING AND THEN LOWER PUMP APPROXIMATELY 4 FEET MORE TO ALLOW FOR FURTHER FINE ADJUSTMENTS WHICH WILL BE MADE LATER. SLIDE WELL CAP DOWN ON TOP OF WELL CASING THEN SECURE PUMP AT IT'S PRESENT DEPTH BY PASSING NYLON ROPE THROUGH THE CAM CLEAT OF THE WELL CAP.



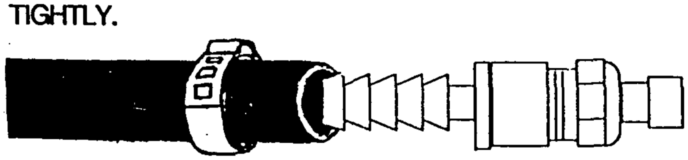
10. MEASURE HOSE LENGTHS ABOVE THE CAP SO THAT THEY REACH FROM THE WELL CAP TO THE CONTROLLER MODULES THEN ADD A MINIMUM OF 2-3 FEET EXTRA TO ALLOW FOR ANY FUTURE RE-ADJUSTMENTS. WHEN YOU HAVE DETERMINED THE HOSE LENGTHS CUT OFF ANY EXCESS.



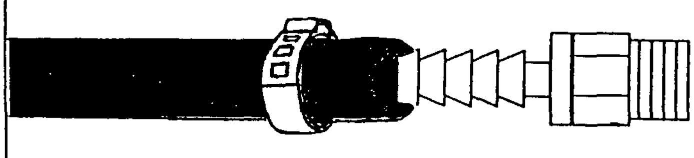
11. ATTACH STRAIGHT CONNECT FITTINGS INTO THE ENDS OF THE BLUE GAGE HOSE AND INTO THE RED HIGH LEVEL INTERRUPT HOSE.



12. SLIDE HOSE CLAMP OVER THE END OF THE BLACK AIR SUPPLY HOSE. INSERT BARBED END OF QUICK CONNECT FITTING INTO HOSE UNTIL FLUSH WITH THE FITTING NUT. SLIDE HOSE CLAMP UP TO WITHIN 1/4" OF FITTING NUT AND TIGHTEN CLAMP DOWN TIGHTLY.

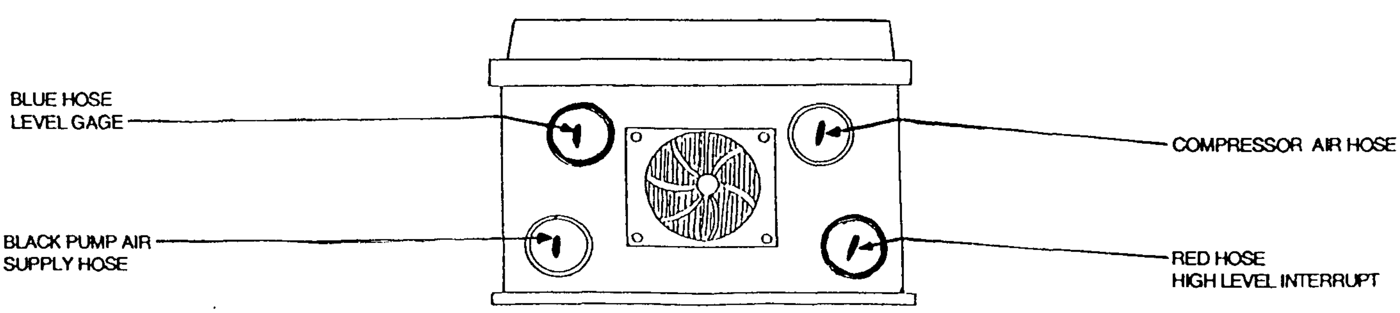


13. ATTACH 1/4" MALE PIPE THREAD FITTING INTO THE GREEN DISCHARGE HOSE.



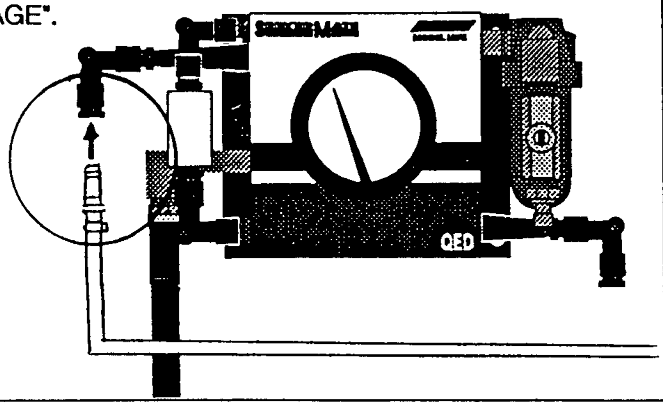
NOTE:

IF YOU HAVE PURCHASED THE OPTIONAL WEATHER TIGHT ENCLOSURE FOR YOUR CONTROLLER MODULES YOU WILL NEED TO PASS YOUR HOSES THROUGH THE BOTTOM OF THE ENCLOSURE AS SHOWN BELOW, BEFORE CONNECTING THEM TO YOUR CONTROLLER MODULES. PASS HOSES THROUGH ENCLOSURE AS YOU COME ACROSS THEM INDIVIDUALLY IN THE INSTRUCTIONS. YOU MAY NEED TO REFER BACK TO THIS DIAGRAM.

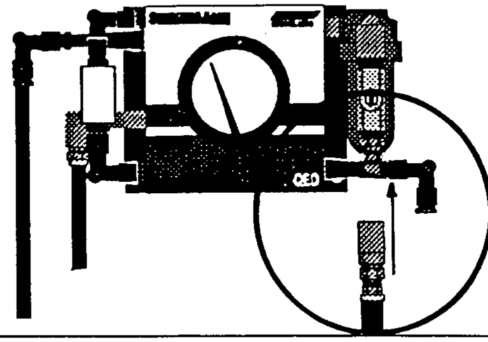


BOTTOM VIEW OF ENCLOSURE

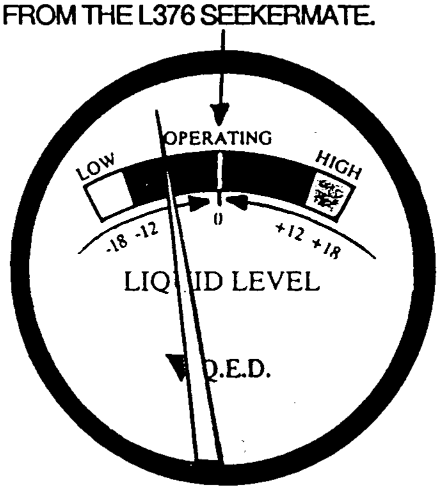
14. CONNECT BLUE GAGE HOSE TO THE LEFT HAND SIDE OF THE L376 SEEKERMATE MARKED,"LEVEL GAGE".



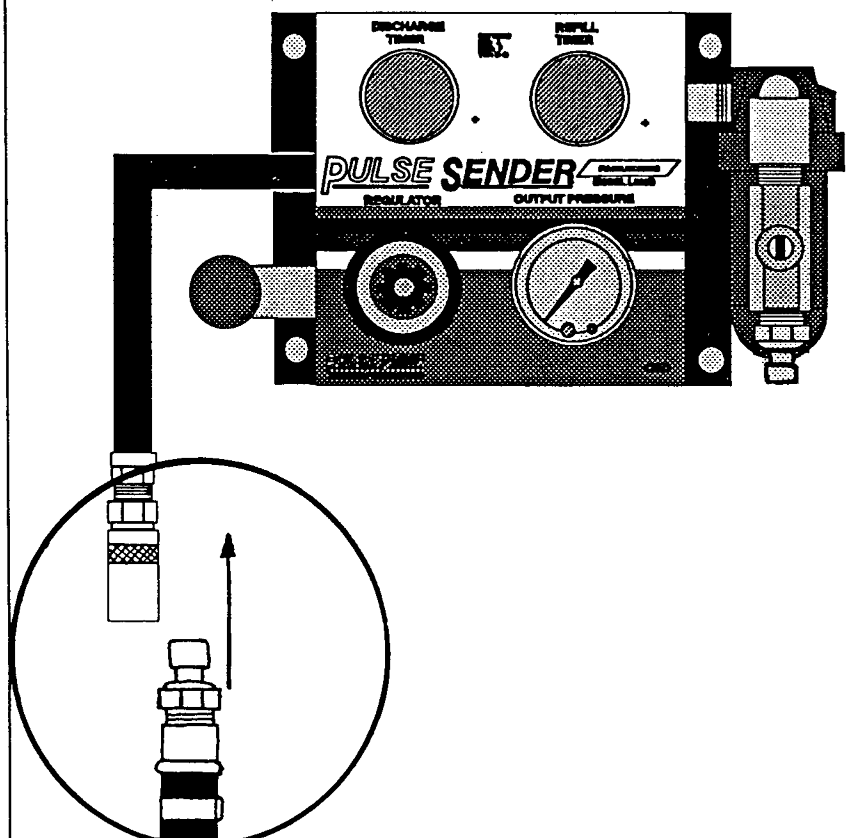
15. CONNECT YOUR AIR SUPPLY SOURCE TO THE RIGHT HAND SIDE OF THE L376 SEEKERMATE MARKED, "AIR IN FROM COMPRESSOR". THE L376'S GAGE SHOULD NOW BE OPERATIONAL.



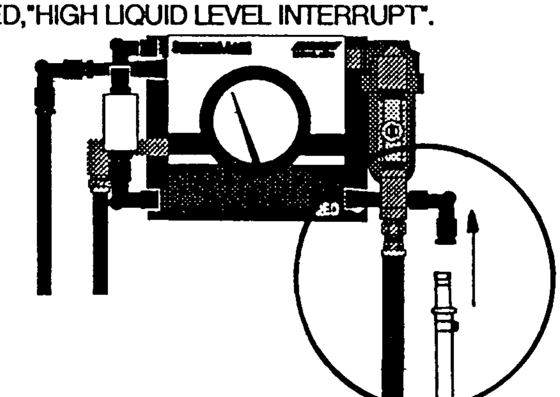
16. RELEASE NYLON ROPE FROM CAM CLEAT AND RAISE OR LOWER PUMP WHILE WATCHING THE GAGE ON THE L376 SEEKERMATE. ADJUST PUMP ACCORDINGLY UNTIL GAGE READS IN THE BLUE OPERATION ZONE. FOR OPTIMUM RESULTS THE GAGE SHOULD READ ON THE "0" SETTING IN THE CENTER OF THE OPERATION ZONE. ONCE PUMP IS AT OPTIMUM DEPTH SECURE ITS POSITION BY PASSING THE NYLON ROPE BACK THROUGH THE CAM CLEAT ON THE WELL CAP. DISCONNECT YOUR AIR SOURCE FROM THE L376 SEEKERMATE.



17. CONNECT BLACK PUMP AIR SUPPLY HOSE FROM THE WELL CAP TO THE FITTING ON THE LEFT HAND SIDE OF THE L360 PULSE SENDER CONTROLLER MARKED "PUMP AIR OUT".



18. ATTACH YOUR RED HIGH LEVEL INTERRUPT HOSE TO THE RIGHT HAND SIDE OF THE L376 SEEKERMATE MARKED,"HIGH LIQUID LEVEL INTERRUPT".

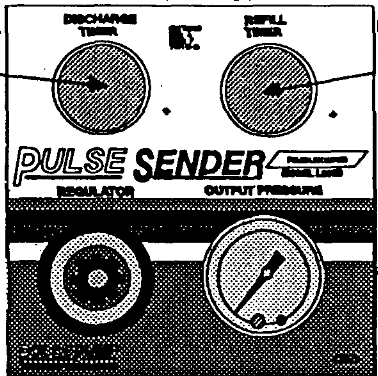


19.PUMP IS NOW READY FOR OPERATION. PROCEED TO THE "ADJUSTMENTS AND OPERATION" PORTION OF THIS MANUAL.

ADJUSTMENTS & OPERATION

1. SET THE REFILL AND DISCHARGE TIMERS OF THE L360 ON A LONG REFILL/DISCHARGE TIME (ABOUT 15 SECONDS OR THE "D" SETTING).THIS SETTING ENSURES THAT YOUR PUMP HAS AN AMPLE AMOUNT OF TIME TO FILL COMPLETELY AND GIVE YOU AN ACCURATE MEASUREMENT OF YOUR PUMP'S INTERNAL CAPACITY. THIS MEASUREMENT IS USED AS YOU OPTIMIZE YOUR PUMP TO MAKE SURE IT IS PUMPING AT FULL CAPACITY.

L360 PULSE SENDER

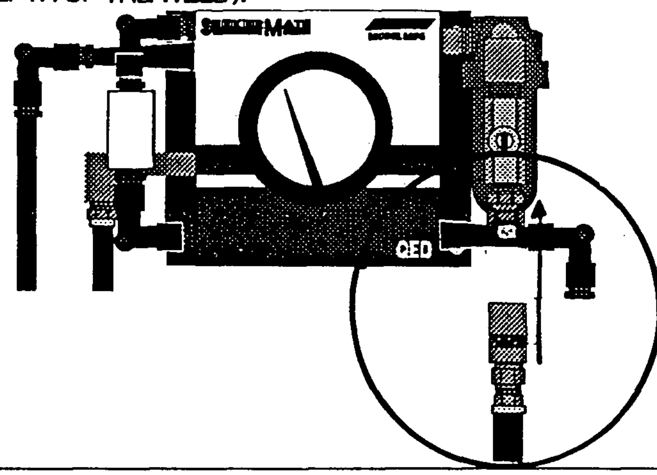


TIMER SETTING CHART

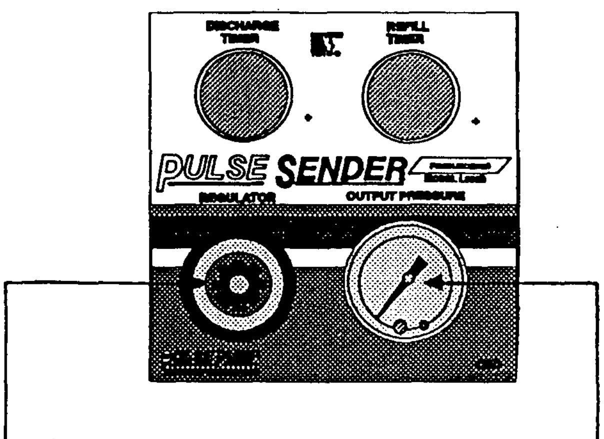
A	B	C	D	E	F
1 SEC.	3 SEC.	9 SEC.	15 SEC.	30 SEC.	42 SEC.

(TIMES ARE APPROXIMATE)

2. RE-ATTACH YOUR AIR SOURCE TO THE RIGHT HAND SIDE OF THE L376 SEEKERMATE MARKED,"AIR IN FROM COMPRESSOR". LIQUID SHOULD BEGIN TO FLOW THROUGH THE PUMP'S GREEN DISCHARGE HOSE AFTER 5-15 CYCLES OF PUMPING,(DEPENDING ON THE DEPTH OF THE WELL).



3. SHOULD AN ADJUSTMENT IN THE AMOUNT OF AIR PRESSURE DELIVERED TO THE PUMP BECOME NECESSARY YOU CAN DO SO WITH THE AIR REGULATOR LOCATED ON THE L360. TO UNLOCK REGULATOR PULL UP ON THE YELLOW KNOB. TO INCREASE PRESSURE TURN YELLOW KNOB CLOCKWISE TO DECREASE PRESSURE TURN KNOB COUNTER CLOCKWISE. APPROXIMATELY 40 P.S.I. IS ADEQUATE FOR SEEKER PUMP OPERATION. THE P.S.I. OUTPUT THE L360'S REGULATOR HAS BEEN PRE-SET TO 60 . P.S.I. THIS ADJUSTMENT SHOULD ONLY BE NECCESSARY IN DEEPER WELL SITUATIONS (BEYOND 130').



4. MEASURE THE LIQUID DISCHARGED DURING ONE CYCLE. (THE VOLUME OF THE LIQUID MAY BE SLIGHTLY LESS THAN THE INTERNAL VOLUME CAPACITY OF THE PUMP).

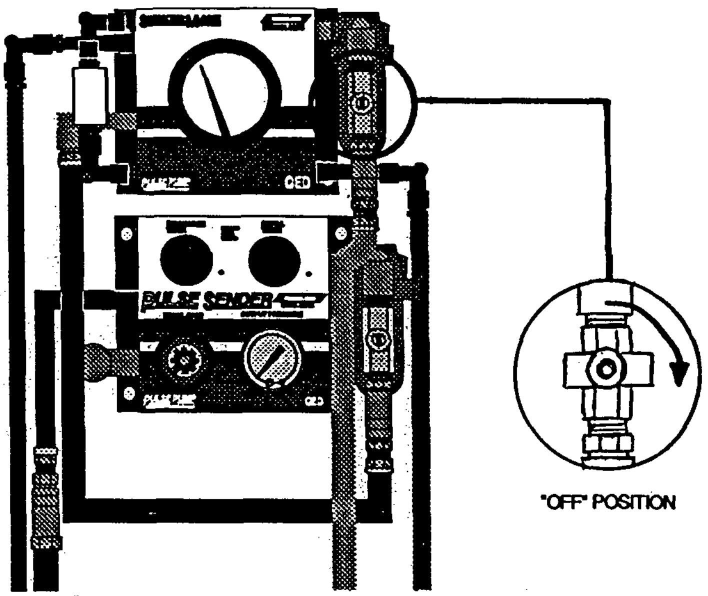
THE SEEKER PUMP'S INTERNAL CAPACITY

MILLILITERS	LITERS	GALLONS
45	.045	.01

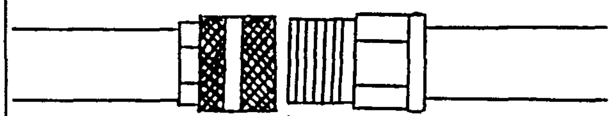
5. DECREASE THE DISCHARGE TIMER'S TIME GRADUALLY, (ALLOW THE PUMP TO GO THROUGH IT'S CYCLE 3-5 TIMES BETWEEN EACH ADJUSTMENT), UNTILYOU BEGIN TO SEE A DROP IN THE VOLUME OF THE LIQUID COMING OUT OF YOUR DISCHARGE HOSE. INCREASE THE DISCHARGE TIME SLIGHTLY UNTIL YOU YOU ARE ONCE AGAIN GETTING THE AMOUNT DISCHARGED PER CYCLE THAT YOU MEASURED IN STEP 4. THE DISCHARGE CYCLE OPTIMIZATION IS NOW COMPLETE.

6. DECREASE THE REFILL TIMER'S TIME GRADUALLY, AGAIN ALLOWING THE PUMP TO CYCLE 3-5 TIMES BETWEEN EACH ADJUSTMENT YOU MAKE. CONTINUE TO DECREASE THE REFILL TIME UNTIL YOU BEGIN TO SEE A DROP IN THE VOLUME OF THE LIQUID COMING OUT OF YOUR DISCHARGE HOSE. NOW INCREASE THE REFILL TIME SLIGHTLY UNTIL YOU ARE ONCE AGAIN GETTING THE AMOUNT OF LIQUID DISCHARGED PER CYCLE THAT YOU MEASURED IN STEP 4. REFILL CYCLE OPTIMIZATION IS NOW COMPLETE AND YOUR PUMP SHOULD NOW BE OPERATING AT IT'S FULL CAPACITY.

7. SHUT OFF AIR TO PUMP SO YOU CAN HOOK-UP YOUR DISCHARGE HOSE TO YOUR DISCHARGE LINE. TO SHUT AIR OFF TURN YELLOW SWITCH TO THE RIGHT. (TO TURN AIR BACK ON AGAIN RETURN SWITCH TO ITS ORIGINAL POSITION)



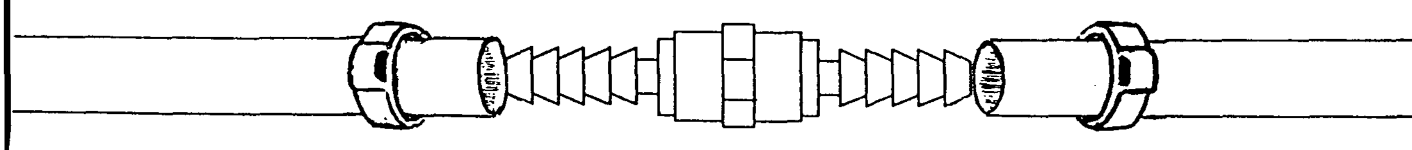
8. ATTACH YOUR DISCHARGE LINE,(USER SUPPLIES THEIR OWN DISCHARGE HOSE/ TUBE OR PIPE), TO THE GREEN PUMP DISCHARGE HOSE (1/4" MALE PIPE THREAD).



9. YOUR SEEKER SYSTEM SHOULD NOW BE FULLY OPERATIONAL.

NOTE:

THE DOUBLE BARB FITTING YOU HAVE BEEN SUPPLIED WITH IS TO BE USED TO RE-ATTACH TWO PIECES OF HOSE TOGETHER SHOULD YOU MAKE A MISTAKE BY CUTTING A HOSE LENGTH IN THE WRONG PLACE. TO USE PUSH HOSE ON TO BARBS UNTIL HOSE ENDS ARE FLUSH WITH THE FITTING NUT. SECURE CLAMPS WITH THE CLAMP TOOL.

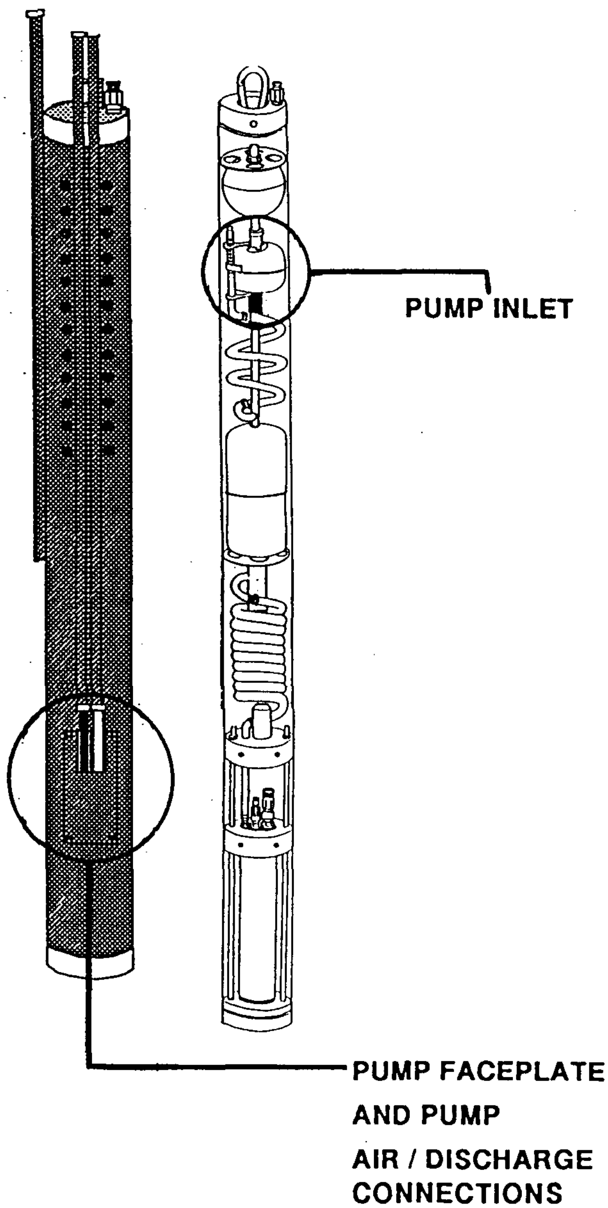


INTERNAL PUMP INLET ADJUSTMENT

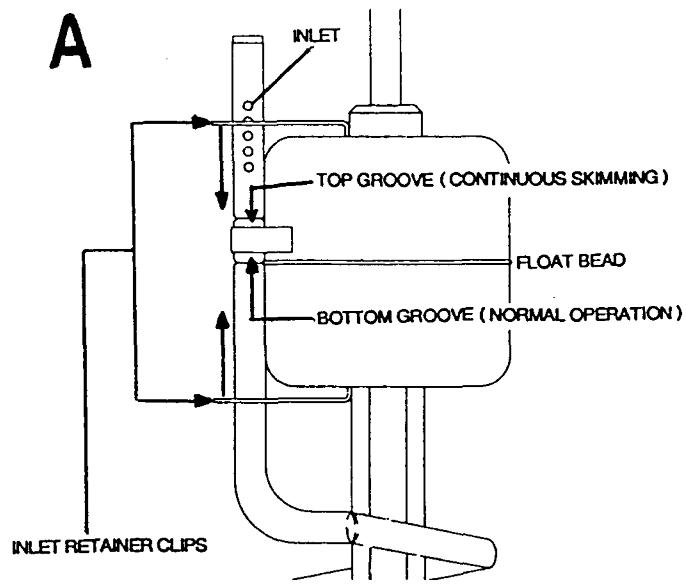
The LP1501 "SEEKER PUMP" is equipped, (internally), with an adjustable hydrocarbon inlet. The pump's inlet can be lowered to allow a thinner final product layer to be achieved if the inlet is lowered far enough, the upper portion of the water can also be removed.

To adjust inlet, pinch the retainer clip together and gently work the inlet downward until the desired position is reached. In some cases the inlet may prove difficult to dislodge from the factory set, "KEEPER GROOVE". If this is the case, gently tap the top of the inlet with a tool until the inlet tube is dislodged, then work the inlet tube downward as previously described.

Remove pump face plate by removing the 4 screws holding it in place. Disconnect the pump air and discharge lines. The pump's internal components should be free to slide out the bottom of the pump. Once internal components are removed locate the pump inlet.

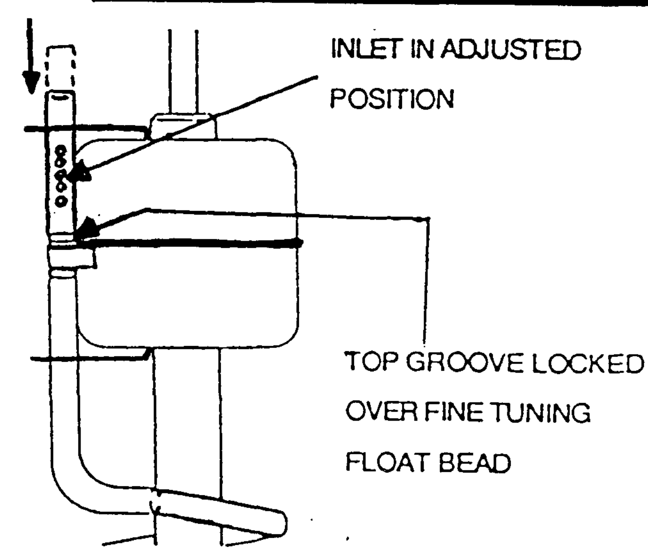


A

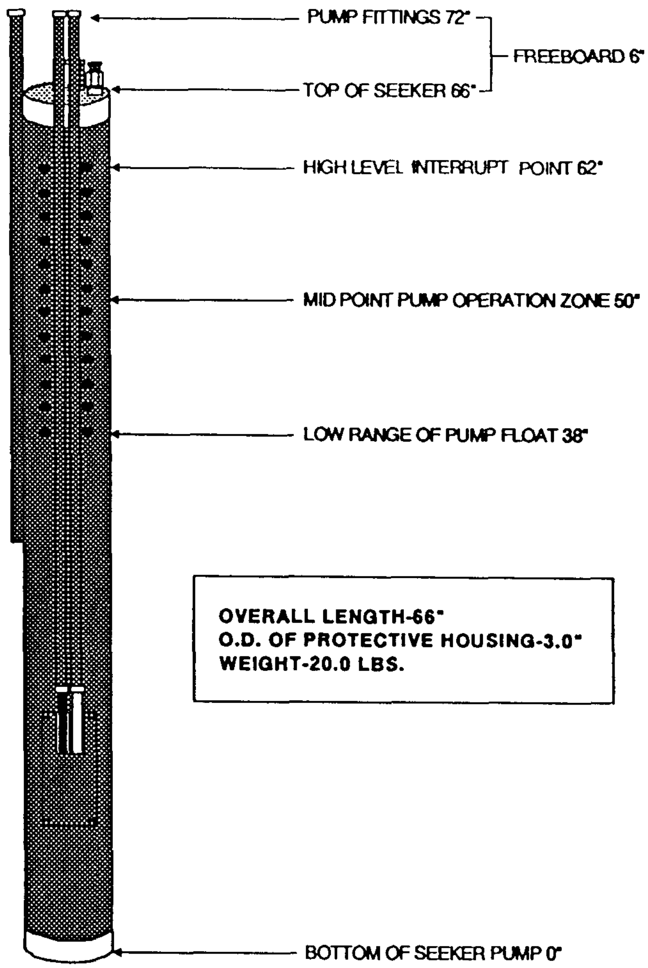


The pump's inlet can be lowered to allow for continuous skimming of the surface of the water after the product layer has been removed. To lower the inlet into this position pinch the inlet retainer clip together and lower the inlet until the top groove is locked over the float bead.

B

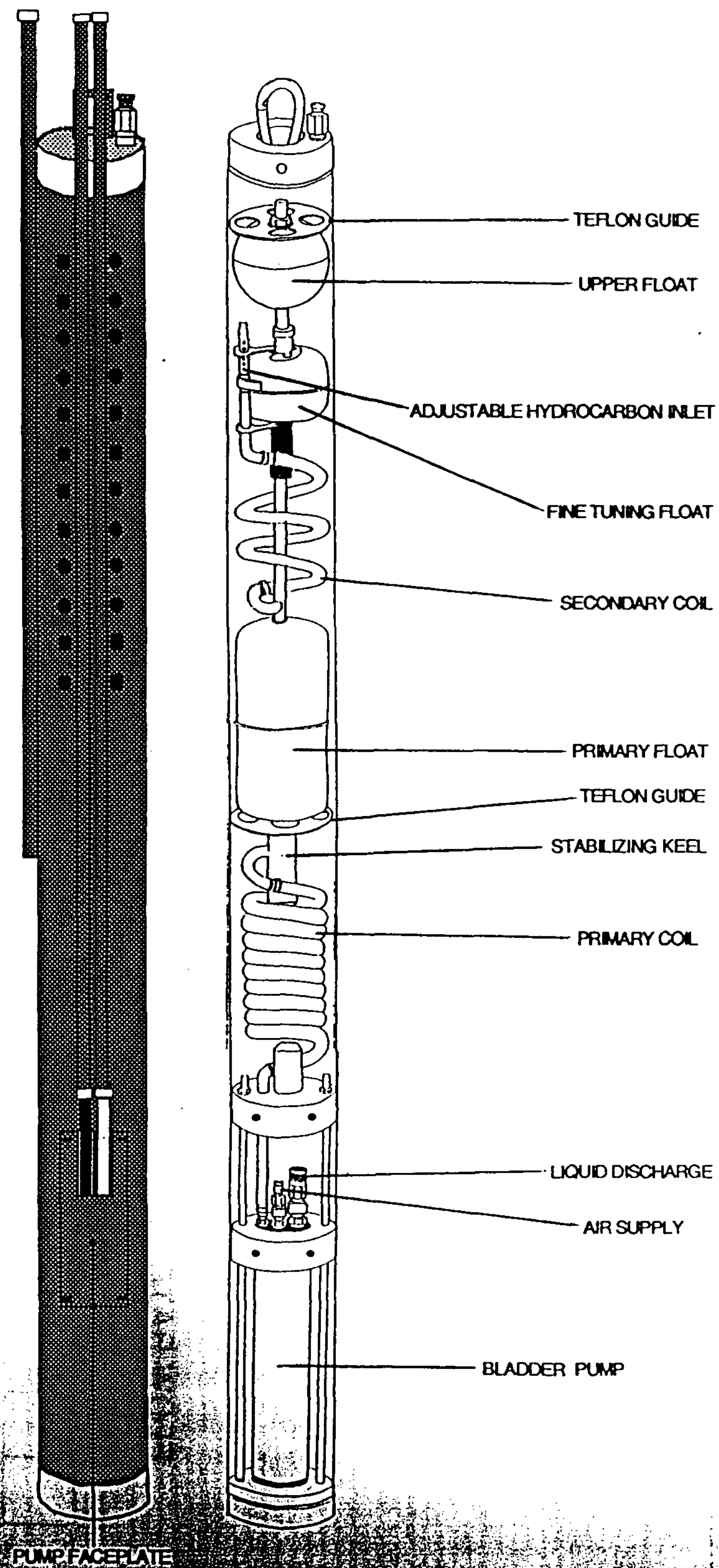


PUMP DIMENSIONS



OVERALL LENGTH-66"
O.D. OF PROTECTIVE HOUSING-3.0"
WEIGHT-20.0 LBS.

INSIDE VIEW OF PUMP



DESCRIPTION:

THE SEEKER IS AN ALL-PNEUMATIC PUMP AND FLOAT SYSTEM DESIGNED TO REMOVE FLOATING HYDROCARBONS, WITHOUT PUMPING WATER, FROM 4" DIAMETER AND LARGER WELLS. THE UNIQUE LAYERED FLOAT DESIGN DELIVERS MODERATE FLOW RATE PRODUCT PUMPING (0 TO .25 G.P.M.). HYDROCARBON LAYERS AS SMALL AS 1/4" OR LESS* CAN BE RECOVERED AND THE FLOAT HAS THE ABILITY TO FOLLOW STATIC WATER LEVEL CHANGES OF UP TO 24". A STATIC WATER LEVEL SENSING TUBE EASES POSITIONING OF THE SEEKER IN THE WELL.

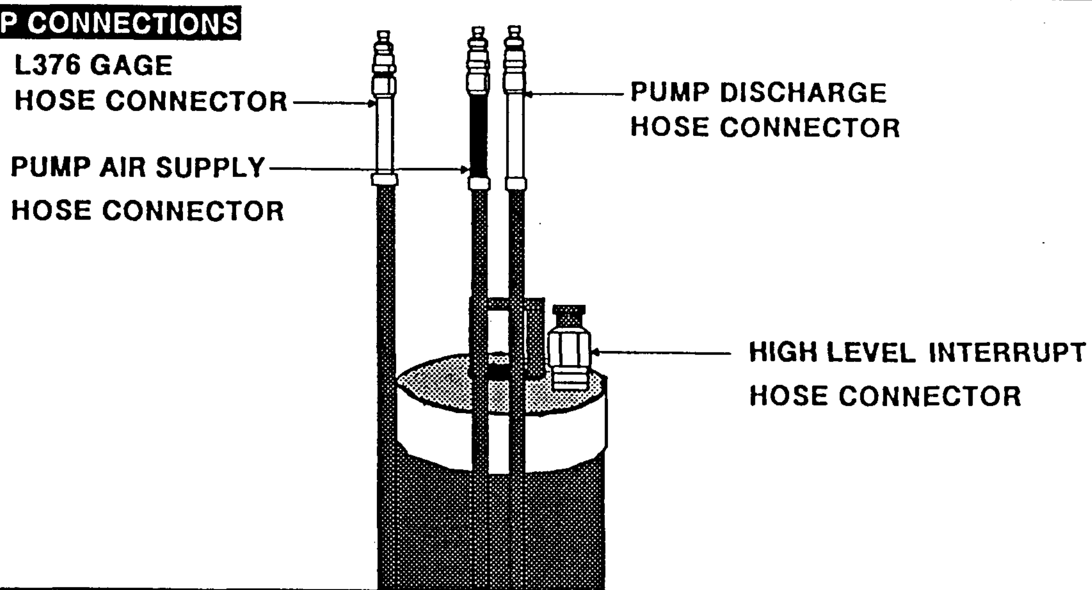
THE WHOLE ASSEMBLY IS HOUSED INSIDE A SMOOTH STAINLESS STEEL CYLINDER FOR EASE OF INSTALLATION AND OPERATION - NO FLOATS TO HANG UP INSIDE YOUR WELL. THE SEEKER HAS BEEN DESIGNED TO WORK WITH STANDARD PULSE-LINK SERIES PNEUMATIC CONTROL MODULES.

MATERIALS:

PUMP-316 STAINLESS STEEL AND NYLON
FLOAT-316 STAINLESS STEEL
HOUSING-316 STAINLESS STEEL
END CAPS- NYLON
FLOAT DRAIN TUBE-GASOLINE RESISTANT TYGON

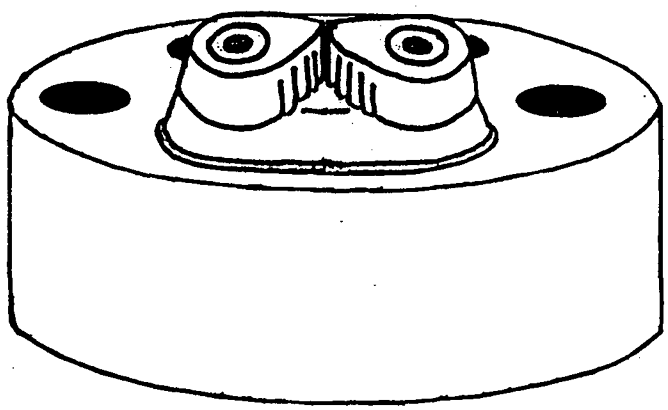
* PRODUCT-ONLY PUMPING OF LAYER THICKNESS OF LESS THAN 1/4" IS POSSIBLE DEPENDING ON FLOAT LOCATION WITHIN ITS OPERATING RANGE AND DENSITY OF THE HYDROCARBON.

TOP OF PUMP CONNECTIONS



SEEKER CAPS

4" CAP L230C
6" CAP L230E
8" CAP L230G



SEEKER HOSES

H25C 25' HOSE CONTROLLER
H25G 25' HOSE ON/OFF

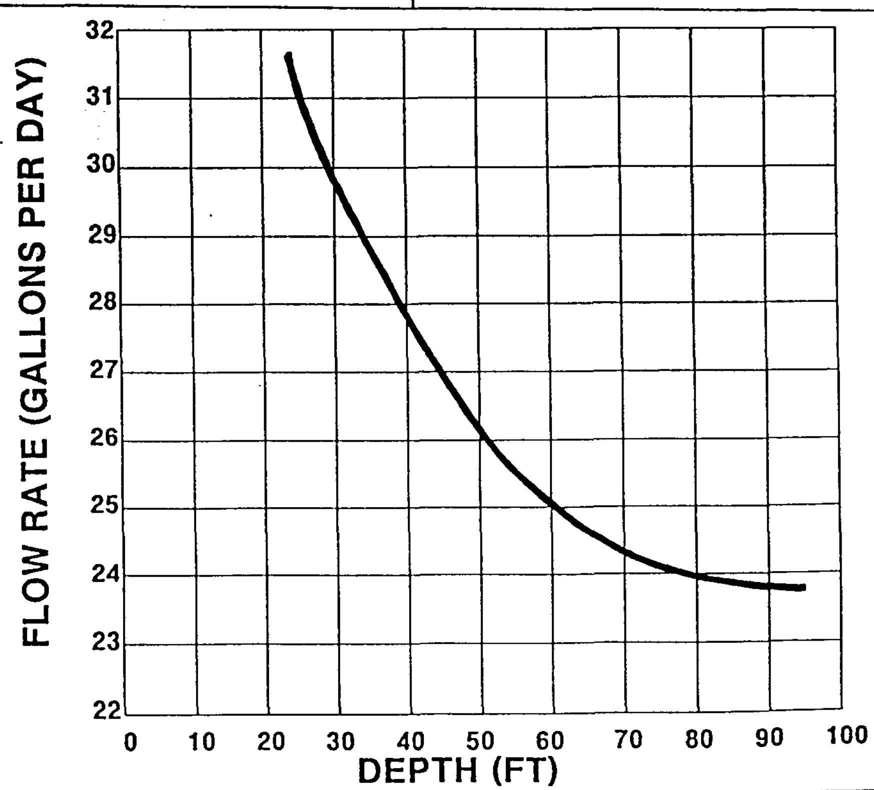
H50C 50' HOSE CONTROLLER
H50G 50' HOSE ON/OFF

H100C 100' HOSE CONTROLLER
H100G 100' HOSE ON/OFF

SEEKER FLOW RATES

Conditions:

1.5 SCFM air-flow, 0-100 PSI.



Pneumatic Cleanup Pumping Guide

INFORMATION YOU REQUESTED

from: ______________________

I would be glad to help you further.
Please call 1-800-624-2026
or fax the enclosed form.

QED
GroundWater Specialists

QED Ground Water Specialists

EXPRESS FAX

FAX QED your data and we'll turn it around fast!

FAX to: (313) 995-1170 or Call: 1-800-624-2026

Name ______________________________

Company ______________________________

Title ______________ Phone ______________

Address ______________ FAX ______________

City/State/Zip ______________________________

Please send/FAX:

☐ **Free Cost Estimate/System Design For My Project**
(Requires completion of information on pages 12-13 of this guide.)

☐ **Free Cost Estimate/System Consultation**
(QED will call for necessary site/application background information.)

☐ **Ground Water Specialists Catalog**
with much more detailed information about the pumps and accessories mentioned in this booklet

☐ Please call to discuss this special situation (hard-to-find product, unusual application, etc.).

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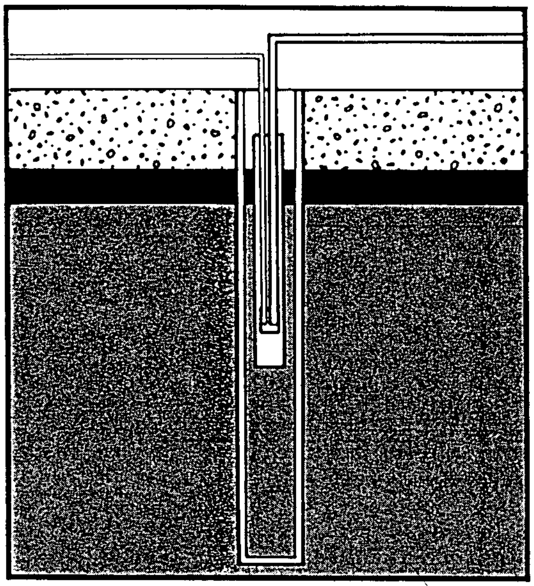
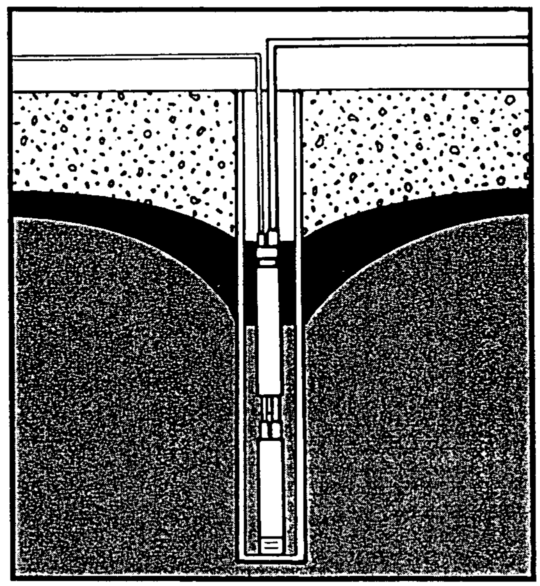
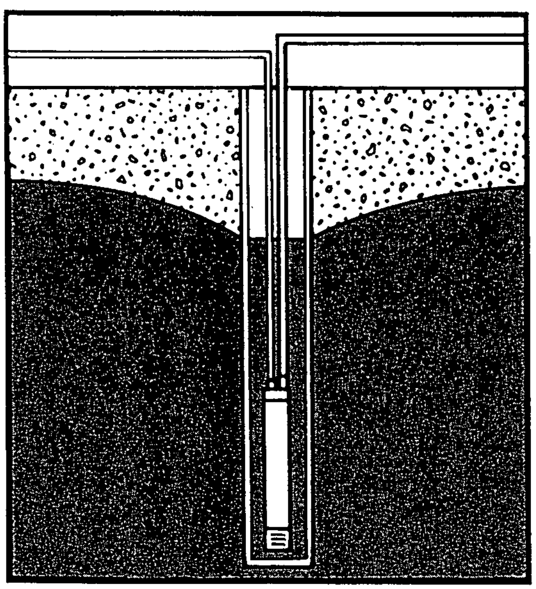
QED
Ground Water
Specialists

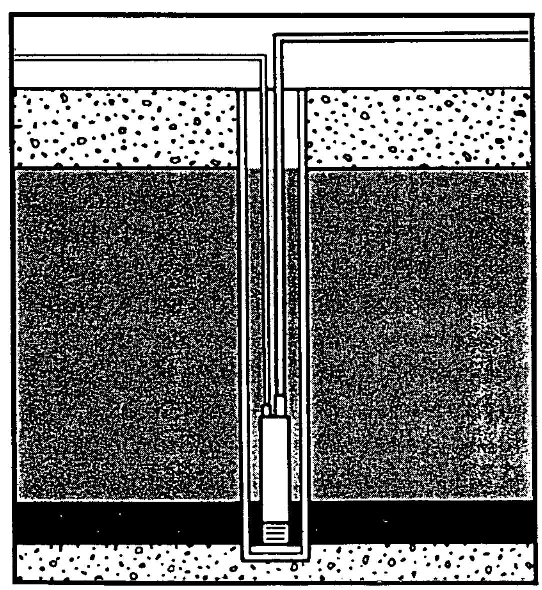
Cleanup Pumping Guide

Pneumatic Pumping For Reliable, Cost-Effective Ground Water Remediation


PRODUCT-ONLY PUMPING


PRODUCT PUMPING WITH DRAW-DOWN


GRADIENT CONTROL PUMPING


LOW TO MODERATE FLOW PUMPING

PULSEPUMP®
CLEANUP PUMPING SYSTEMS

TABLE OF CONTENTS

Ground Water Remediation Pumping: Philosophies and Practical Options

Every ground water remediation project is different. Even the most basic cleanup situation, such as an underground storage tank leak at a filling station, has several variables to be considered, including soil type, water table depth, aquifer thickness and flow, the size and age of the leak, the type of hydrocarbon released, the site location and activity, even regulatory and legal issues.

This booklet presents concise descriptions of the most widely-used pumping methods for ground water cleanup. It concentrates on pneumatic pumping, which we believe provides the best performance at the lowest cost for a large majority of cleanup applications (except those where continuous, very high-rate pumping can and should be used). Pneumatic pumping systems offer many advantages over the main alternative (electric submersible pumps), including no shock or explosion hazard; greater reliability with lower maintenance; a much broader choice of materials; light weight and easy installation; and more advanced control options.

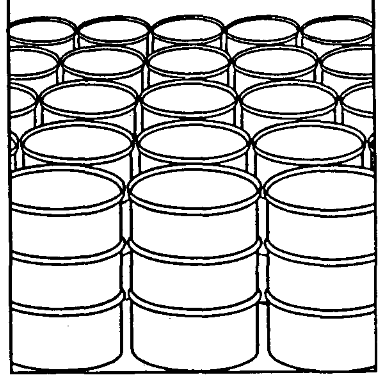
It's important to note that the methods presented are not mutually exclusive, and in many cases are combined to provide optimum removal of contamination during various phases of cleanup. For example, a project might begin with the removal of any separate-phase contamination, using skimming pumps to recover floating contaminants, often combined with separate drawdown pumps to enhance the contaminant recovery and control the migration of contamination on the site. Once the contaminant layers have been substantially removed, pumping systems are often converted to remove total fluids from the well, pumping for longer periods at lower pumping rates.

There are also additional methods of ground water and soil remediation. These may be used in conjunction with remediation pumping or occasionally alone, depending on the site. See page 3 for a brief listing.

NOTE ON PUMPING RATES: Maximum pump flow rates are important only as they relate to well yield and desirable or feasible daily pumping rates. In most soil types, remediation wells typically yield from several hundred to several thousand gallons of water, and typically much less product, per day. Since 1 gallon per minute equals 1,440 gallons over 24 hours, it's clear that a continuously operating 1 to 2 GPM pneumatic pump will deliver total flow performance equal to a 10 or 20 GPM electric pump which operates intermittently.

Did You Know?

A pump with a flow rate of 1 GPM will fill 26 55-gallon drums every day!



FLOW RATE CONVERSION

GPM	GPD	No. of 55 Gal Drums Filled
1	1,440	26
2	2,880	52
3	4,320	79
4	5,760	105
5	7,200	131
6	8,640	157
7	10,080	183
8	11,520	209
9	12,960	236
10	14,400	262

GPM: Gallons Per Minute
GPD: Gallons Per Day

GLOSSARY

AQUIFER - layer of permeable soil or rock saturated with ground water.
CONDENSATE - condensed liquid, mostly water, that accumulates in gas venting risers (e.g. at landfills and soil vapor extraction wells).
DRAW-DOWN - lowering the water table in and around the well by pumping faster then the aquifer can replenish itself.
GRADIENT CONTROL - pumping approach that uses well placement and pumping rates to control movement of the ground water in part of the aquifer.
INLET, ACTIVE - pump inlet that follows changes in the surface of the aquifer (i.e., by floating or other automatic adjustment).
INLET, PASSIVE - pump inlet that remains stationary, requiring manual adjustment.
LAYER, FLOATING - free-phase (undissolved) hydrocarbons light enough to float on top of the aquifer; LNAPLs.
LAYER, SINKING - heavy free-phase hydrocarbons that sink to the bottom of the aquifer; DNAPLs.
LEACHATE - liquid that collects at the bottom of landfill cells, containing various organic and inorganic compounds.
PLUME - body of contaminated ground water that moves from the pollution source down gradient through the aquifer.
PNEUMATIC PUMPS - devices that use compressed air or gas to move liquids. In simple pneumatic displacement pumps, gas pushes liquid directly; in bladder pumps, a flexible bladder squeezes the liquid, preventing direct contact and air emissions of volatiles.
PRODUCT-ONLY PUMPING - approach that aims to collect only floating hydrocarbons without pumping water.
RECOVERY, PRODUCT - collection of hydrocarbons that are or can be separated from ground water for reuse or disposal.
REMEDIATION PUMPING - removal of contaminants to restore the aquifer to a clean condition; can include product recovery and contaminated ground water extraction, plus specialized techniques (e.g. leachate pumping).
TOTAL FLUIDS PUMPING - collection of all liquids present in the well, including ground water and any free-phase hydrocarbons.
YIELD, WELL - the maximum rate at which liquid can be continuously pumped from a well and still be replenished by the aquifer.

LEACHATE PUMPING/LARGE SYSTEMS

Landfill leachate management and other large-scale, multi-well projects can be almost a separate application with different pumping and control concerns. See pages 10-11 for more information, or call QED to talk to one of the specialists in our leachate/large systems division.

ADDITIONAL TECHNOLOGIES

Only part of the contamination can be removed from most sites by merely drilling wells and pumping out the plume of contaminated ground water, plus any free-phase product present. Significant volumes of soil may contain absorbed contaminants, and soil gases can harbor volatile vapors. Additional techniques used (*usually in conjunction with pumping*) to complete site remediation include:

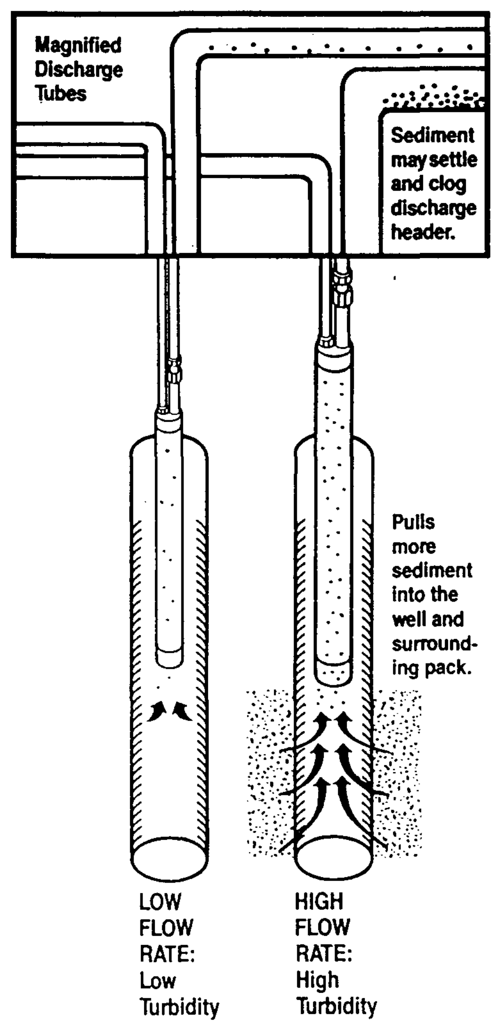
- *Vacuum extraction*—suction used to remove volatile vapors from soil. Gases may be collected from wells used for remediation pumping; low-flow pumps can clear gas-venting wells of condensate that would reduce the screen area under vacuum.
- *Trench and sump (French drain)*—method used to intercept shallow contaminant plumes in very tight soils. Trench is excavated, backfilled with coarse material (gravel), and liquid is removed from a sump. While preferred for very shallow sites with tight soils, construction cost and site impact are drawbacks in deeper applications. (See illustration on page 10.)
- *Above-ground bioremediation*—some contaminants can be broken down by microorganisms into harmless by-products.

NON-PUMPING TECHNIQUES:

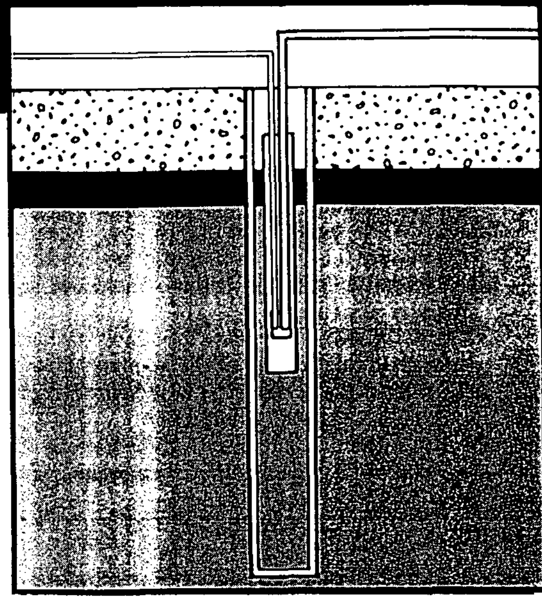
- *Bentonite slurry walls*—creation of an underground barrier to limit plume movement. Not intended as a final solution, but to halt further spread of contamination. Expensive; generally used in critical or "big" applications.
- *In-situ bioremediation*—may reduce or eliminate need for pumping or excavation, but can require injection of supplemental nutrients and may not work in tight soils.
- *Soil treatments*—soils can be treated in-situ by *steam injection* to free absorbed contaminants for collection (used with thick or viscous liquids), or by *contaminant solidification/stabilization* techniques, which trap contaminants. Soils may also be excavated and decontaminated by a variety of means including *venting, washing, bioremediation, thermal processing,* or *incineration.*

Did You Know?

Low flow rates entrain fewer solids and promote better well performance in disturbed soil and landfills.



Product-Only Pumping



FLOATING LAYER RECOVERY

HOW IT WORKS:

With proper inlet positioning, one pump can "skim off" just the floating product layer—without collecting any water or using a second draw-down pump—from wells, sumps or trenches.

Some systems employ a fixed, "passive" inlet that needs to be manually repositioned if the levels of hydrocarbon and/or water fluctuate during pumping.

Other techniques use a floating, "active" inlet which rises and falls with changes in level. In addition, some methods utilize hydrophobic screens, membranes, or similar means as a primary or secondary method of excluding water from the pumped product.

PROS:

- Very useful on many projects as a "quick response" method to begin removing as much floating product as possible while waiting for permits required before ground water can be pumped.
- When working properly delivers pure product for reuse or recycling.
- Can minimize the amount of contaminated ground water pumped.
- Maximizes recovery along "saturated" pathways.
- Reduces hydrocarbon contact with new soils, which can be caused by drawdown pumping.

CONS:

All Systems—

- Recovery time may be longer in some soils than with draw-down pumping.
- Doesn't control gradient of contaminated ground water plume.
- Only for product that flows easily (no high viscosity liquids).

Fixed Inlets—

- May require frequent repositioning of pump.
- High likelihood of pumping water along with product.

Floating Inlets—

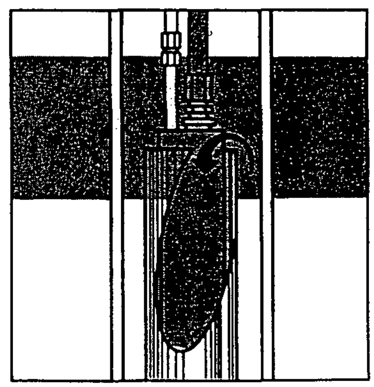
- Simple mono float systems don't position inlet precisely over entire range, often pump some water or run dry.

Mechanical Active Inlets—

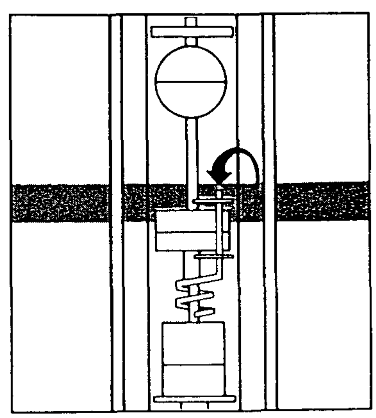
- Require positioning sensors which may fail (plate-out, bio-foul, thick product fouling).
- Much more complicated, lower reliability, more moving parts.
- Many use electricity.

Hydrophobic Screens—

- Biological growth, mineral deposits, or coalesced liquids (emulsification) can clog screens requiring frequent cleaning or replacement. Screens may also "wet out" and allow water to pass.



Fixed Inlet—
Floating layer flows over top of inlet "can" when product/water interface is properly located.



Active Inlet—
Float buoyancy follows level changes, keeping pinpoint inlet in proper position to pump only floating layer.

FLOATING LAYER—FIXED INLET SKIMMING

Objective: To recover a thick floating hydrocarbon layer with as little water as possible; manual adjustment of inlet position.
Operation: A pump with inlet placed at the top in the floating layer (QED's Pulse Pump® Eliminator™ with top-inlet adapter) skims off hydrocarbon. The bubbler tube signals the level control module, which turns the pump off when liquid level falls and the pump fails to refill. As the well level of ground water and/or hydrocarbon fluctuates, the pump must be manually repositioned to keep the inlet within the floating layer.
Options: A top-inlet Pulse Pump Solo™ may also be used, and in most cases will automatically keep the well level from rising too far above the inlet. However, it will still need to be manually repositioned if the level falls for some reason other than over-pumping.

FLOATING LAYER— "ACTIVE" MULTI-FLOAT INLET

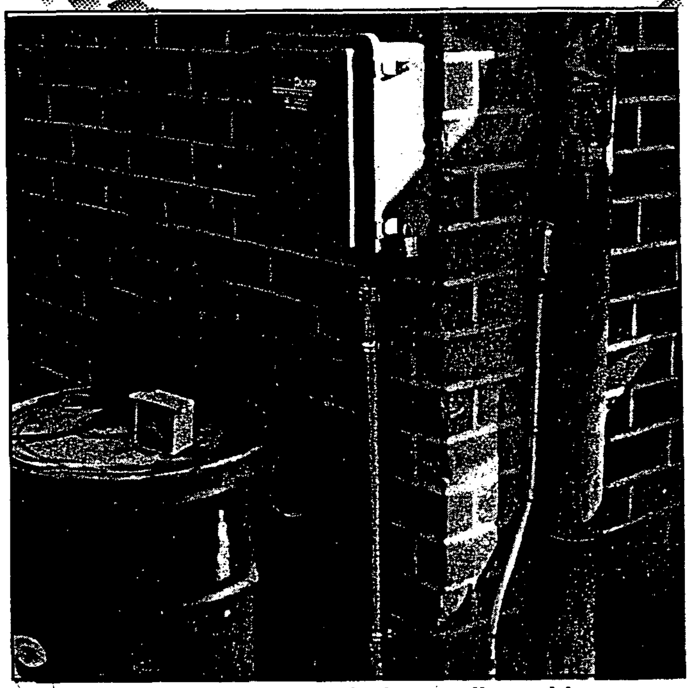
Objective: To collect pure floating hydrocarbon automatically, without pumping any water, even if the well level fluctuates, and without the ongoing maintenance headache of hydrophobic screens.
Operation: The pump (Pulse Pump Seeker™) is placed so that its inlet's 24-inch "working range" coincides with the hydrocarbon layer in the well; the floating inlet then can follow rising or falling well levels. A bubbler tube shows pump submergence on a gauge at the well head, aiding proper positioning.

In use, the triple float system keeps the inlet precisely located at the product layer, delivering pure product from layers as thin as 1/8" under equilibrium conditions.
Options: The system can be adjusted to pump floating hydrocarbon down to a sheen if recovery of a small amount of water is permissible.

Turnpike rest stop follows floating layer non-stop

. . . Large amount of floating product; fluctuating static water level.

Using Seeker, QED's active, multi-float inlet system, over 7,000 gallons of product were recovered in the first year of operation—with no water. The consultant who specified the equipment had tried other active inlet pumps (simple mono-float systems), but said Seeker is "the only one that works."



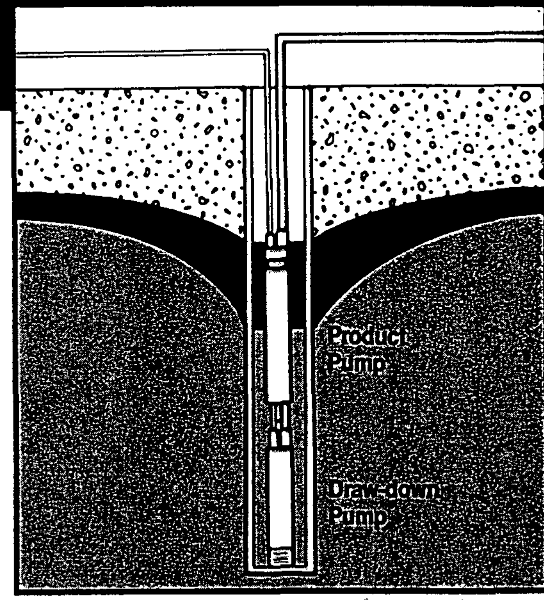
Eliminator pumps are used in four wells at this California metalworking facility to skim hazardous solvent without releasing volatiles into the air.

East coast oil terminal pumps product while waiting for permit

. . . Free product had to be removed as effectively as possible while waiting for a discharge permit to pump water.

Four Seeker pumps were installed for immediate operation. At the same time, Alpha draw-down pumps were installed below the Seekers, but not turned on until permits were issued. In the meantime, thousands of gallons of pure product were recovered. Total system is now running—Alpha pumps with level control draw water and product down into the active operating range of the Seekers.

Draw-Down Pumping with Floating Product Recovery



FLOATING LAYER RECOVERY: With Draw-Down

HOW IT WORKS:

Uses two pumps in a centralized well or wells; one higher-rate pump, the draw-down pump, removes enough ground water to lower the static water level in the well, creating a "cone of depression"—a low spot in the water table extending outward from the well.

Floating hydrocarbon moves down the slope and pools at the bottom of the depression. A second, product pump with inlet located above the depressed water surface pumps out the hydrocarbons that collect there.

In high-permeability soils, electric submersible or high-rate pneumatic pumps can be used for draw-down, and will create a cone of depression that extends a considerable horizontal distance, allowing wells to be spaced far apart

In "tight", low-permeability soils, lower-flow pneumatic pumps can withdraw enough water for draw-down; in these soils, cones of depression are narrow and steeply sloped, and wells must be placed closer together. Under these conditions, lower-flow, multi-well pumping out-performs the high-flow centralized well approach, especially when the product tends to be in pockets rather than evenly distributed.

PROS:

- In appropriate soils (coarse sand or gravel with high hydraulic conductivities), can enhance the flow of product toward the well.
- Can speed the recovery process by pulling the contaminant plume back toward the center, preventing product migration by changing site gradient of flow.

CONS:

- It is not as effective with tight soils, low-yield wells, and/or thin floating layers.
- Implementation may be delayed by discharge permit requirements for the draw-down water.
- May extract more contaminated ground water than can be treated economically.
- Pulling down hydrocarbon layer can contaminate "clean" or "relatively clean" soil zones formerly below the water table.
- Mixing of recovered product and water is a high probability.
- In some soils, a huge volume of water must be pumped to collect a very small amount of product.
- When electric pumps are used, additional problems can include shock and explosion hazard; excessive size, weight, and cost of pumps; unreliable performance (especially from hydrocarbons attacking pump seals); high/low level sensing failure; sensors may require frequent cleaning (sensors are frequently the weak link in system reliability).
- Large diameter high flow wells may be expensive to drill.

FLOATING LAYER—FIXED INLET SKIMMING WITH DRAW-DOWN

Objective: To recover floating hydrocarbons with a ground water draw-down pump to increase product yield.

Operation: The draw-down pump (electric submersible or pneumatic) removes enough ground water to create a funnel-shaped "cone of depression" in the aquifer surrounding the well. Floating hydrocarbon accumulates in a thicker layer for pumping by the product pump (Eliminator with top-inlet adapter).

Options: Depending on well yield rate, draw-down pumping can be performed by a Pulse Pump Solo or Alpha pump, or even by a high-rate Eliminator if the ground water is highly contaminated by volatiles and air emissions in the pump exhaust must be controlled.

A top-inlet Solo may be used as both product and draw-down pump in one (see Total Fluids Pumping, page 9).

FLOATING LAYER—"ACTIVE" MULTI-FLOAT INLET WITH DRAW-DOWN

Objective: To recover pure floating product, while separately pumping contaminated ground water for remediation (and/or to increase product yield).

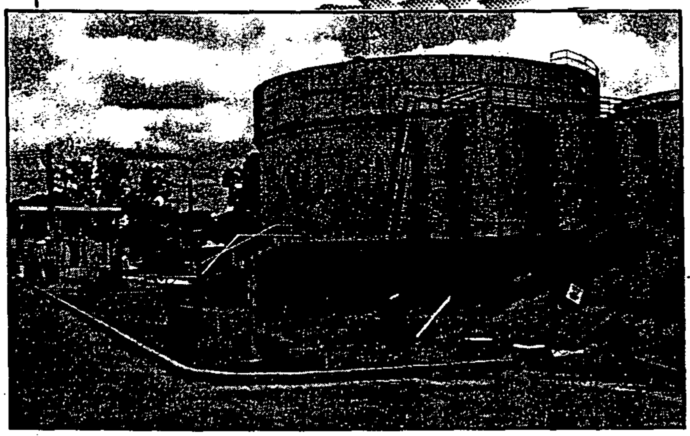
Operation: The draw-down pump (electric submersible or pneumatic) collects ground water for treatment and disposal. Removal of the ground water also creates a "cone of depression" at the aquifer surface, causing a thicker layer of hydrocarbon to collect for recovery by the product pump (Seeker), which self-adjusts to follow well level changes.

Options: In some systems, both pumps are installed together, but only the product pump is operated at first. This allows fast initial recovery of thick accumulations of hydrocarbon. Later, the draw-down pump can be activated (or added, if it was not originally installed) when ground water discharge permits are obtained and/or when product yield decreases, requiring creation of a cone of depression to accelerate hydrocarbon collection.

West coast refinery skims thousands of gallons of product

...Deep wells (to 90') with several feet of floating product, requiring flow rates >1 GPM with on/off level control.

High-rate (rather than standard) Eliminator pumps were installed to deliver the required flow. In the first month of operation, the system pumped no water and recovered several thousand gallons of product.



At this Southwestern U.S. petroleum distribution center, one Seeker pump in a centrally-located well operates continuously to keep the floating layer pumped down to a minimum.

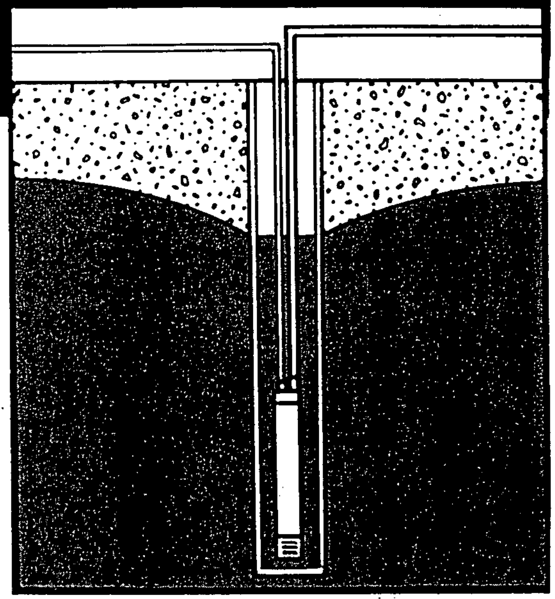
Northwestern convenience store uses 2-pump draw-down system

...10" of free floating product present in a 4" diameter monitoring well.

Well recovery rate data indicated that ½ to 1 GPM pumping rate would be sufficient to create draw-down and increase product yield; product to be pumped to a separator, so a moderate amount of water was permissible.

Using a standard Eliminator for product pumping and a small-diameter Alpha for draw-down, so far the product pump has pumped no water, and floating layer thickness is down to 3". With fine-tuning, product layer can be reduced even further using this system.

"Gradient Control" Total Fluids/ Ground Water Pumping



GRADIENT CONTROL PUMPING:
Contaminated Ground Water

HOW IT WORKS:

A single high-rate pump in a central well, or a series of pumps in a "picket fence" or other arrangement of wells, can remove enough ground water to reverse or impede the aquifer's flow gradient, pulling the outer edges of the contaminant plume back toward the wells.

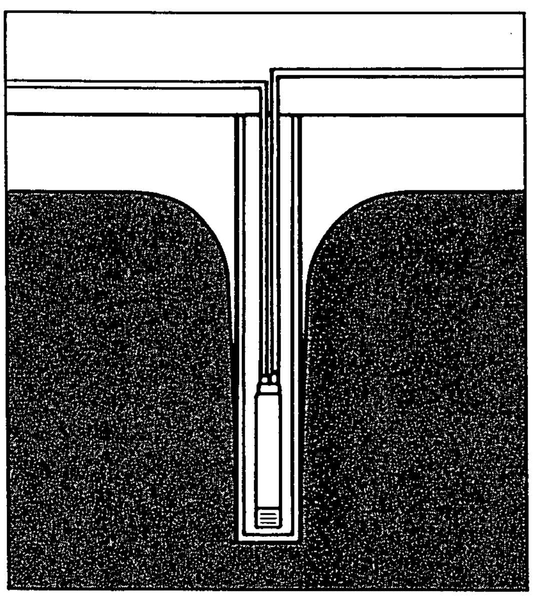
As an option, the pump may be placed in a top-inlet "can" so that, in addition to contaminated ground water, it collects whatever floating layer is present.

PROS:

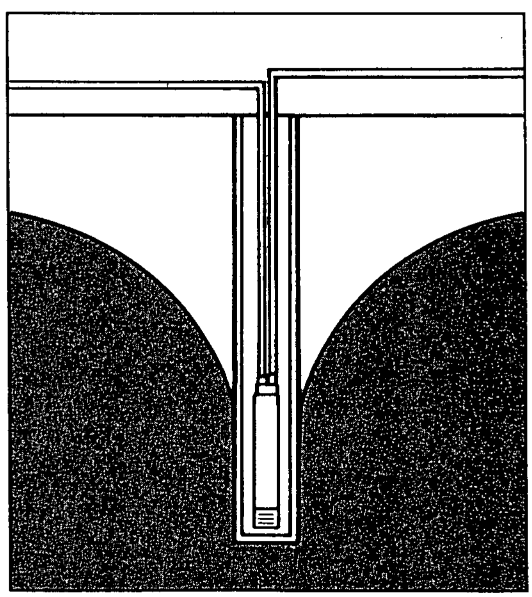
- In the right soils (sand/gravel), can stop or reverse spread of contaminant plume, and speed the recovery process.
- High flow systems, where appropriate, require fewer pumps and controls than lower flow approaches.

CONS:

- Higher-flow systems won't work well in tight soils, low-yield wells.
- Permit acquisition may delay implementation.
- Bottom-inlet pump will always leave some product layer in the well (although) volume recovered may be high); top-inlet high-flow submersible pump mixes product with water to a great extent.
- Volatiles may cause air emission problems in pneumatic pump exhaust if bladder is not used.
- Typical problems with electric submersibles: shock or explosion hazard; excessive pump size, weight, and cost; unreliable performance, especially from attack on pump and/or seals by corrosives or aggressive organics downwell; level sensor failure.



In "tight", low-permeability soils, pumping only affects a narrow zone immediately around the well.



In higher-permeability soils, pumping affects a wider radius, so wells may be placed farther apart.

CONTAMINATED GROUNDWATER PUMPING

Objective: To pump contaminated groundwater from aquifer for remediation.

Operation: A pneumatic pump with bottom inlet (here, a Solo) is fully submerged in each remediation well. A slotted inlet screen increases pump durability by excluding coarse solids. Solo operates itself without an external air cycle controller, only running when there's enough water in the well to fill the pump.

Options: Alpha™ pneumatic pumps provide continuous pumping with a basic cycle controller, or on/off operation with a bubbler tube and a level control module.

Eliminator bladder pumps use the same controllers as Alpha, but prevent air contact with the liquid, eliminating exhaust emissions of volatiles.

Note: both Alpha and Eliminator are available in models for 2" wells; Solo requires 4" or larger wells.

TOTAL FLUIDS PUMPING—GROUNDWATER PLUS FLOATING LAYER

Objective: To pump contaminated ground water and any floating hydrocarbon which may be present, using only one pump per well.

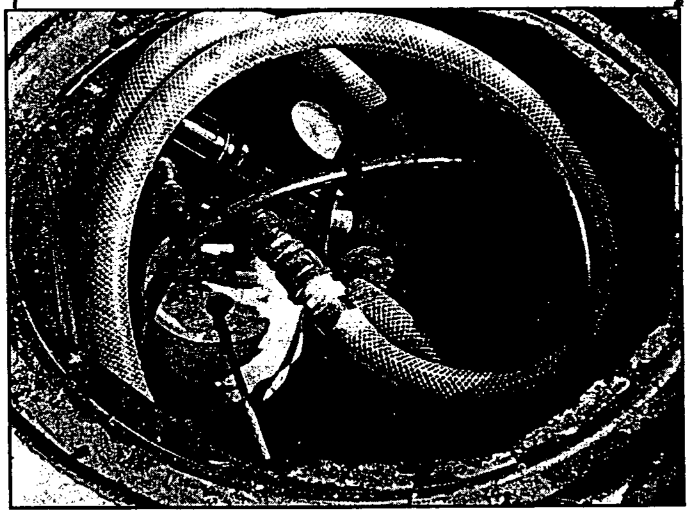
Operation: A pump (Solo) with optional top-inlet is submerged in each well. Ground water flows over the top of the inlet "can" and into the pump. Flow rate is set high enough to create draw down in the aquifer surrounding the well. At equilibrium the pump will collect any floating product present while automatically pumping ground water as fast as the well can produce it. Gentle pumping action minimizes product/water mixing.

Options: Eliminator pumps with top-inlet adapters may be used if air emissions of volatiles or biogrowth are concerns. A level control module with bubbler tube placed inside the inlet "can" provides on/off control.

New Jersey gas station keeps contaminated ground water out of sight

...Pumping hydrocarbon-contaminated ground water (old contamination—no free product present). Nine wells put in, 20-25' deep and 20-40' apart.

Solo pumps were specified because of: ease of installation (one day for the whole project); fast delivery from stock; and unobtrusive operation with no above-ground controllers—keeping the ongoing remediation out of sight, without interfering in day-to-day business at the gas station.



Downwell at this site in Nebraska, Solo pumps with top inlet adapters are used to recover floating hydrocarbons. Note the absence of control panels at the wellhead.

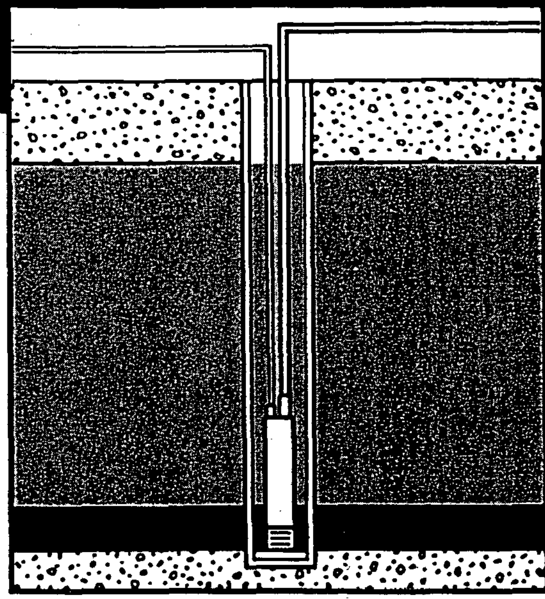
Southwestern industrial plant collects total fluids with one pump

...Contaminated ground water—an old spill with some free product (1/4" to a sheen). Client wanted to collect any recoverable floating product, along with the contaminated water, from an 85' deep low-recovery well.

Solo with optional top inlet adapter was chosen as the simplest system available. The pump was placed at the bottom of the well, several feet below the static water level. In operation, the pump draws the low-recovery well down to the inlet level, insuring collection of all available free product.

Low to Moderate Flow Pumping:

Total Fluids, Ground Water, Leachate, Sinking Layer



LOW-FLOW PUMPING:
Leachate or Sinking Layer

HOW IT WORKS:

Low to moderate rate pneumatic pumps can be positioned in wells located down gradient to intercept the moving contaminant plume. In many soils, this is more effective than gradient control pumping at limiting plume spread and delivering contaminated ground water for treatment and disposal.

Landfill leachate pumping is one specialized application in which long-term, high-rate pumping is usually not necessary. Instead, the critical factor is whether the pump can deliver reliable operation with the high viscosity, high solids content, corrosive and/or aggressive liquids found at many landfills.

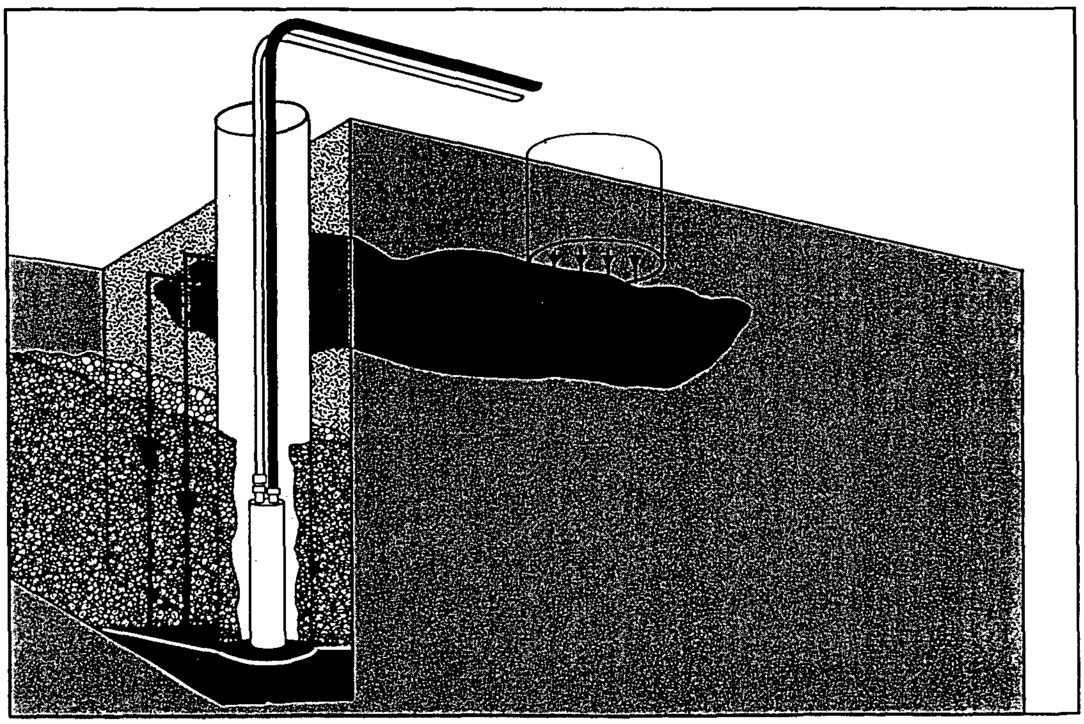
Another specialized application is sinking layer pumping—removal of dense, non-aqueous phase liquids (DNAPLs) which sink and form a discrete layer at the bottom of the aquifer. Bottom-inlet pumps are placed where the sinking layer settles and can collect most of the product with relatively little water pumping when conditions are right.

PROS:

- With a suitable modular control system, can be tailored to optimize flow over a wide range of recovery rates, especially low to moderate rates common in many soil types.
- For many projects is more cost-effective than high-flow systems.
- Proper well location and vertical pump positioning can minimize unnecessary pumping of uncontaminated portions of the aquifer.
- Is the only feasible solution for "pinpoint" applications—separate landfill cells, isolated sinking layer pools, etc.
- Lower flow leachate pumping will lessen solids entrainment in discharge lines, reducing plugging.

CONS:

- Requires more pumps, and may require more sophisticated control, than single well systems.



Moving contaminant plume in shallow tight soil is intercepted by trench. Liquid collects in sump at the lower end of the trench and is collected by a low-flow pump.

TOTAL-FLUIDS PUMPING—LANDFILL LEACHATE AND/OR CONDENSATE

Objective: To collect leachate from landfill wells, keeping levels as low as possible to minimize liquid head pressure on liner seams, reducing the chance of leakage through the liner; to dewater gas-venting risers by removing condensate to increase gas recovery.

Operation: Leachate—a pneumatic pump (Alpha) with bottom inlet and slotted screen is placed at the bottom of the leachate riser or well. At first, high levels of leachate may require continuous pumping; later, on/off level control can be set so the pump runs only when necessary to keep leachate below a specified level. Low flow settings help avoid solids mobilization in the system, minimizing deposition and clogging downstream in the discharge tubing or header.

Note: The Alpha can pump down to within 6" of its lower end, so liquid levels can be kept very low even without a sump in the well.

Condensate—a pneumatic pump (Alpha) with on/off level control effectively keeps water levels down in both landfill gas recovery and soil venting risers without introducing any source of electricity (and possible explosion-causing sparks) within the explosive environment.

Options: Leachate—Alpha pumps are available in various materials to insure reliable performance in any downwell environment. Economical PVC is the standard-duty workhorse, with stainless/Teflon® models for certain solvents, and all-Teflon for leachates containing the harshest combinations of corrosive acids or caustic bases plus aggressive solvents.

PVC or stainless Solo pumps provide automatic on/off level control for special applications. Note: standard Solo pumps need 42" submergence (in a sump, for example) to operate; optional short Solo models can pump down to less than a foot of liquid.

Condensate/Leachate—Solo pumps are ideal for wells under pressure or vacuum; because control is located in the pump, operation is unaffected by pressure differences inside and outside the well.

SINKING LAYER PUMPING

Objective: To recover heavy hydrocarbons (e.g., chlorinated solvents) that sink to the bottom of the aquifer.

Operation: A bottom-inlet pump (Alpha) is placed at the lowest point in a well whose casing is slotted to allow liquid from the bottom of the aquifer to enter; a sump can be installed to allow deeper accumulations of any dense hydrocarbons (DNAPLs). The pump is normally operated intermittently at low flow, as the hydrocarbons tend to move slowly and collect in small amounts.

Options: A bladder pump (Eliminator) can be used if exhaust air emissions of volatile hydrocarbons must be prevented.

Louisiana wood treatment plant recovers heavy, dirty creosote

...Ground water contaminated by creosote—needed low flow, bottom-loading pumps for the 4" diameter wells. Electric submersible pumps could not handle the solids present.

Since flow characteristics of the wells were equal, three stainless/Teflon Alpha pumps were installed, running off one controller with remote operators. The system has been recovering several gallons/day for several years with no problems.

Carolina landfill tames electric-eating leachate

...Corrosion by leachate was causing serious problems with standard electric submersible pumps. One consultant recommended a very expensive exotic alloy-bodied submersible pump.

County officials opted for two 4-5 GPM PVC-bodied Alpha pump systems for one quarter the price of one of the special electric pumps. Pulse Pump system was installed in their two leachate sumps in late 1980's, with no degradation of pump material to date.

SITE DATA

Site name & location (optional)______________________________

Site type (e.g., gas station, landfill, factory) ________________________

APPLICATION DATA

Pumping application ______________________________

(e.g., leaking underground tank at gas station, fuel spill at train yard, leachate recovery at landfill)

☐ TOTAL FLUIDS PUMPING Liquid pumped ____________________

(e.g., ground water, leachate, condensate)

Dissolved contaminants:

Name/conc. ________________ Name/conc. ________________

Free-phase contaminants:

Name________________ Name________________

☐ FLOATING LAYER PUMPING Name of floating product ________________

Configuration desired:
- ☐ Product-only pumping
- ☐ Separate pumps for product and draw-down
- ☐ Total-fluids pump collecting both product and ground water

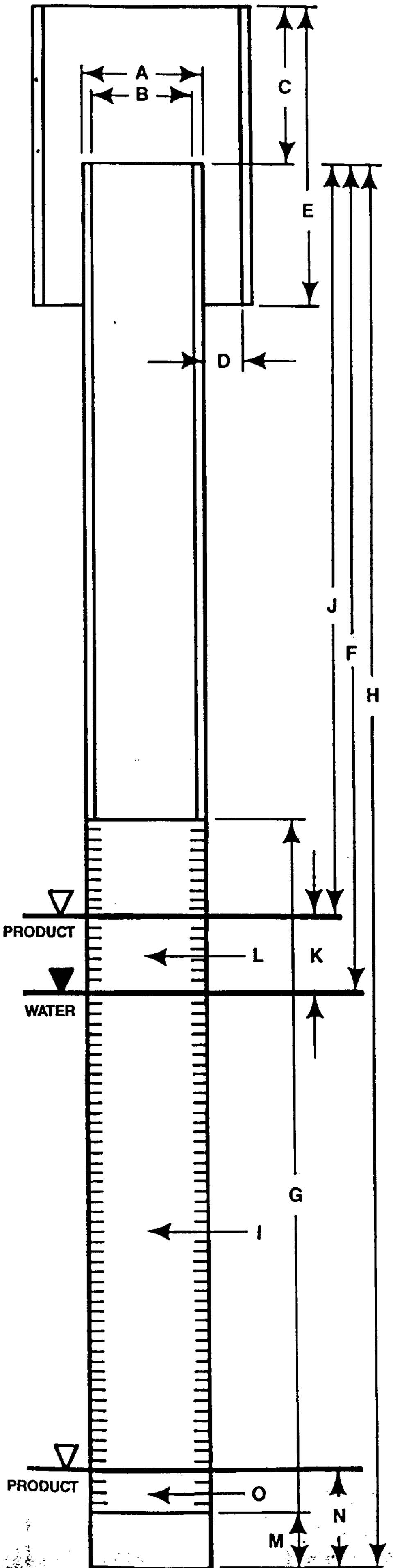
☐ SINKING LAYER PUMPING Name of sinking product ________________

AIR SUPPLY DATA

For best performance, all systems require 1-4 SCFM at 100psi of clean, dry air per pump (2-3 SCFM per Alpha pump, 1-2 SCFM per Seeker or Eliminator, 2-4 SCFM per Solo). We recommend: 10 micron particle filtration, <10 ppm oil, dew point 20°F below minimum operating temperature.

- ☐ Suitable air supply on-site
- ☐ Air supply package required
- ☐ Air tubing required: (compressor to well head)

SCALE:



WELL DATA

Number of wells ____________ Flow rate required per well (GPD) ____________

Well completion: ☐ above grade ____________ ☐ below grade ____________ ☐ at grade

Water temperature ____________(Important for Seeker only)

☐ Vacuum extraction utilized:

What system ____________ inches mercury ______ inches water ______

CONTROLLER DATA

☐ Control desired at well (preferred)

☐ Control desired elsewhere ____________
(state where, show details in site sketch)

Distance from compressor to controller(s) ____________

Distance from controller to well, or to furthest well ____________

Distance between wells ____________
(give minimum and maximum, show in sketch)

Controller vault dimensions ____________

Pumping mode desired: ☐ On/off level control ☐ Continuous pumping
(Note: flow rate must be compatible with well yield)

If multiple well on/off level control desired:

☐ Individual well control ☐ All wells controlled by a master well

DATA	WELL I.D. NUMBER					
A Well casing diameter - O.D.						
B Well casing diameter - I.D.						
C Clearance from top of well casing to top of outer casing/vault						
D Clearance of outer casing/vault to well casing						
E Outer casing/vault depth						
F Depth to top of static water						
G Screen length						
H Depth of well						
I Water yield (GPM)						
J Depth to top of static product						
K Product thickness						
L Product yield (GPM)						
M Sump length						
N Sinking layer thickness						
O Sinking layer yield (GPM)						

The Choice for Remediation Pumping: Pulse Pump Users

These are just a few of the rapidly growing number of consulting engineers and end-users who have made Pulse Pump their choice. Thousands of systems are in use, across the U.S. and internationally, at sites ranging from RCRA cleanup projects and multinational corporations to corner gas stations and municipal landfills.

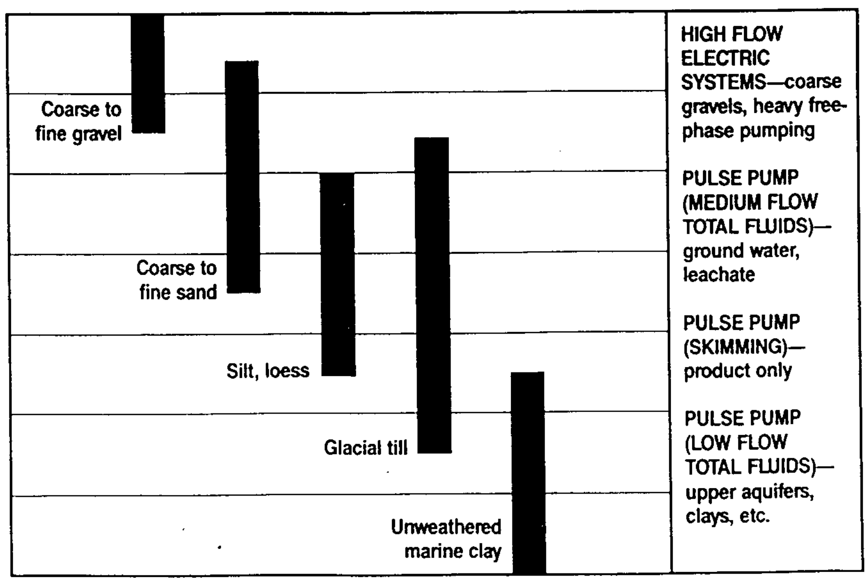
The one thing all these users and projects have in common is their need for the most reliable, cost-effective remediation pumping performance available: Pulse Pump.

Aaron Environmental
Acadian Environmental
Adrian Brown Consultants
Alaskan Oil Inc.
Alliance Environmental
Allied International Sales
Amerada Hess Corporation
American Chrome & Chemical Corp.
American Environmental
Amoco
Anania Geologic Engineering
Anderson Equipment
Appalachian Timber Services
Applied Earth Sciences Inc.
Applied Geosciences Inc.
AquaTech Consultants Inc.
Arco Pipeline Co.
Asarco Inc.
ATEC Associates Inc.
Atlanta Testing & Engineering
Aucoin and Associates
Automotive Component Group
AWRC
Robert B. Balter Co.
BASF Corporation
Belpar Environmental
Bing Yen and Associates
BP Oil Company
Braun Environmental
Bridgeport-Piedmont Mfg.
MP Brown Associates
Browning-Ferris Industries
Burgeap, Paris
Burlington Northern RR
Canonie Environmental
Carbon Air Services Inc.
Carolina Rock Wool Co.
Cascade Earth Sciences
Richard Catlin and Associates
Cenex Asphalt
Certified Environmental Consultants
Chemical Waste Management Inc.
Chevron USA Inc.
City of Crete (NE)
City of Sacramento (CA)
City of Tracey (CA)
Colfax Creosoting Co.
Columbia Helicopters
Conestoga-Rovers Associates
Connecticut Light & Power
Conoco Inc.
Converse Consultants
T.W. Cooper Inc.
Corporate Environmental Advisors
Leroy Crandall & Associates
Cura Inc.
CWA Group Inc.
Dames and Moore
Dart Industries Inc.
Deffenbaugh Industries
Delta Environmental Consultants
Dow Chemical Co. USA
Duke Power Company
Dunn Geoscience Corporation
E.I. Dupont
Earth Resources Corporation
Earth Systems Environmental
Ecova Corporation
Edgerton Environmental Services Inc.
EIS Environmental
Elixer Industries
Empire Soils
Encon International
ENCOR
Ensafe
Environmental Audit Co.
Environmental Sampling & Analysis
Environmental Science and Engineering Inc.
Environmental Systems of Canada Ltd
Environmental Technology Inc.
Envirosafe Services
ERC Environmental
ERM (Environmental Resources Mgt.)
ESSO
Etheridge Petroleum
Evax Technologies Inc.
Exceltech Inc.
Fehr-Graham and Associates
Fletcher Oil Refining Co.
Florida Power Corporation
Fort Bend County Eng. Dept. (TX)
Foth and Van Dyke
Fry Environmental
GEI Consultants Inc.
Geosystems Consultants Inc.
Geotechnical/Environmental/Services
Geotrans
Geraghty and Miller Inc.
Giant Refining Co.
General Motors Technical Center
W R Grace
Gregory Boat Co.
Greiner Well Co.
Griffin Remediation Services
Groundwater Associates
Groundwater Protection Inc.
Groundwater Technology Inc.
Gulf of Maine Research
GWL Inc.
Haag Environmental Co.
Handex Corporation
Hanson Well Drilling and Pump Co. Inc.
Harding, Lawson, Associates
Hargis and Associates Inc.
Hart Crowser
Heritage Remediation/Engineering Inc.
Holland Oil Co.
Homes Oil Co. Inc.
Hoosier Environmental Services
Howard R. Green Co.
Hunt Refining Co.
Huxford Pole & Timber Co.
HWS Technologies
Hydro-Environmental Technologies Inc.
Hydrofluent Inc.
Hydro Group Inc.
Hydrosearch Inc.
Industrial Oil Tank Services
Irving Oil
Jetline Services
Kelco Group Inc.
Kelley Dewatering
Kerr McGee
Kestrel Drilling & Remediation
Knoll Environmental
Laidlaw
P.E. La Moreaux and Associates
Law Engineering Inc.
LCP Chemical & Plastics Inc.
Leggette, Brashears & Graham Inc.
Levine Fricke
Lustco Inc.
M&E Technology
Maecorp Inc.
Major Paint Co.
Marathon Oil

Martin Marietta Corporation
John Mathes & Associates
McClaren/Hart Environmental
Metcalf & Eddy Inc.
MJK Construction
Mobil Oil
Modular Remediation Systems
James M. Montgomery Engineers
National Convenience Stores
New Hanover County (NC)
North. Michigan Exploration Co.
NUS Corporation
Nu-Tech
HC Nutting Co.
N.Y. S. & W. Railway Corporation
Occidental Chemical Corporation
Oil Field Engineers & Consultants
Olin Corporation
Oryx Energy Co.
Pacific Gas and Electric
Payne Riemer Group, Inc.
Pelo
Petro Canada
Petro Tech Inc.
Petroleum Environmental Consultants
Petroleum Marketers Equipment
Petroleum Testing Service
Petron Environmental
Pieco Orlando Inc.
Pleasant Valley Vegetable Co-op
Pollution Equipment Co.
Pollution Management, Inc.
PSI Environmental Services
Quarles Oil Company, Inc.
Radian Corporation
Remediation Technologies
Retec
Rexene Products Co.
Reynolds Metals Co.
Rimtech
Roadway Services Inc.
Rollins Environmental Services
Rosengarten Smith & Associates Inc.
Ryder Truck Rental
Samsel Services Co.
Sanders Lead
SCS Engineers
Seacor Inc.
Shell Oil Company
Sima Drilling Co.
Sinclair Oil Co.
Society Bank
Soil Exploration Services
Soil Tech
Southland Oil
Southwestech Labs
Southwestern Laboratories
Southwestern Public Service
Spartan Technologies
Spartanburg City School (SC)
Spatco Environmental Services
Spontex Inc.
Stover & Bentley Associates
Sun Pro Services
Sun Star Foods
Sweet-Edwards/EMCON Inc.
Technicolor
Techsas, Inc.
Terra Technologies
Terracon Environmental Consultants
Testing Engineers & Consultants
Texaco
Texas Utilities Electric
Thompson Engineering
TMI Environmental Services
TRC Environmental Consultants
US Army Corps Of Engineers
US Geological Survey
US Navy
Vector III Environmental
Wapora Inc.
Warren Petroleum
Warzyn Engineering
Waste Management Inc.
Water Equipment Services
Water Work Corp.
Wehran Envirotech
Weiss Associates
Westech Fuel Equipment
Western Massachusetts Electric
Western Technologies
Westinghouse Environmental and Geotechnical Services
Roy F. Weston
Woodward Clyde Consultants
World Oil Co.
Yonkers Industries
York Hospital
YWC Midwest
Zecco Inc.

Did You Know?

In most pumping applications, product inflow rates tend to be low to moderate. Contaminants tend to move more slowly than water, and few soil types deliver well yield great enough to require high-flow electric submersible pumps.



REASONS TO CONSIDER PNEUMATIC PUMPS INSTEAD OF ELECTRIC SUBMERSIBLES

1. **No Shock or Explosion Hazard**
All-pneumatic Pulse Pumps eliminate the danger of electrocution, and minimize the possibility of sparks igniting flammable or explosives materials often encountered at remediation sites.

2. **More Reliable, Lower Maintenance**
Pulse Pumps have fewer moving parts, handle intermittent low flow pumping better, and resist abrasion and clogging from high solids content much better than electric submersible pumps.

3. **Materials to Match Any Job**
Unlike the limited choice available in electric pumps, Pulse Pumps come in a broad range of resistant materials—including Teflon, PVC, and type 316 stainless steel, with no seals subject to attack by corrosives or solvents.

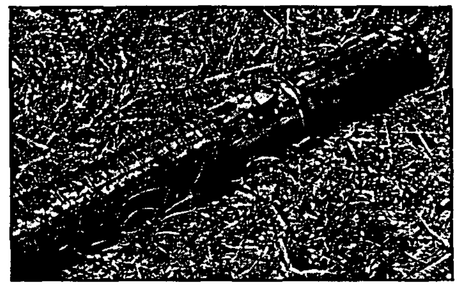
4. **Lightweight, Easy to Install**
Pulse Pump systems are simple for one person to install—with no electricians, hoists, winches, or specialized tools required.

5. **Superior Control Capabilities**
Instead of burned-out motors, or level sensors that require frequent cleaning, Pulse Pumps provide a choice of control options: continuous pumping (all models can run dry without damage); reliable bubbler tube on/off level controls; modular controllers for unlimited multi-well flexibility; even pumps that automatically follow fluctuating well levels or turn themselves off and on in response to changing conditions.

MATERIAL COMPATIBILITY

	Q-TAL	PVC	TEFLON	BRASS	STAINLESS SS	NYLON
Gasoline	•	•	•	•	•	•
Diesel Fuel	•	•	•	•	•	•
Jet Fuel	•	•	•	•	•	•
Fuel Oil	•	•	•	•	•	•
Chlorinated Solvents	*		•	•	•	*
Acids	*	•	•		•	
Hydrochloric	*	•	•			
Bases	*	•	•		•	•

* Excellent for most ground water applications, consult factory for high concentrations



Stainless steel electric submersible after three months in leachate.

The GroundWater EXPRESS™

We want to hear from you...

Cleanup pumping can be complicated. If you have a question, unique problem, or unusual situation, please call and talk it over with one of our application experts. We're known for fast, innovative, custom solutions to special needs.

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What Pulse Pump Customers have to say about QED...

“I don't have time to waste, so it's great that QED takes care of it all. Your custom caps really make it easy.”

Remediation Site
J.K. Austin, Texas

“I really like working with you at QED because you're not 'salesmen.'”

Landfill
B.E., University Park, Illinois

“The Seeker is the best product-only pump on the market. It's the only one that really does what it's supposed to do.”

Chemical Mfg.
B.A., Tulsa, Oklahoma

“Solo pumps like a champ. All you have to do is put it in the ground.”

Landfill
D.W., Seattle, Washington

“Solo is the best pump made for condensate pumping.”

Landfill
A.U., Seattle, Washington

“I couldn't believe you checked out and shipped back my controller on the same day.”

Remediation Site
B.F., South Hope, Maine

“Topnotch service from QED. I brag about it all the time.”

Refinery
B.D., Tulsa, Oklahoma

“We thought the Seeker wasn't working because the collection tank wasn't filling up. Actually, the guys at the site were fueling their cars with the pumped product! Thanks for checking things out on-site.”

Manufacturing Site
T.G., Minneapolis, Minnesota

“Your delivery is so good, it's ridiculous! It's hard to believe that there are companies that can really deliver so fast.”

Chemical Site
B.S., Monroeville, Pennsylvania

“Our project needs changed, and QED covered us by exchanging the pumps for a more suitable model.”

Research Facility
J.T., Livermore, California

Cleanup pumping made easy

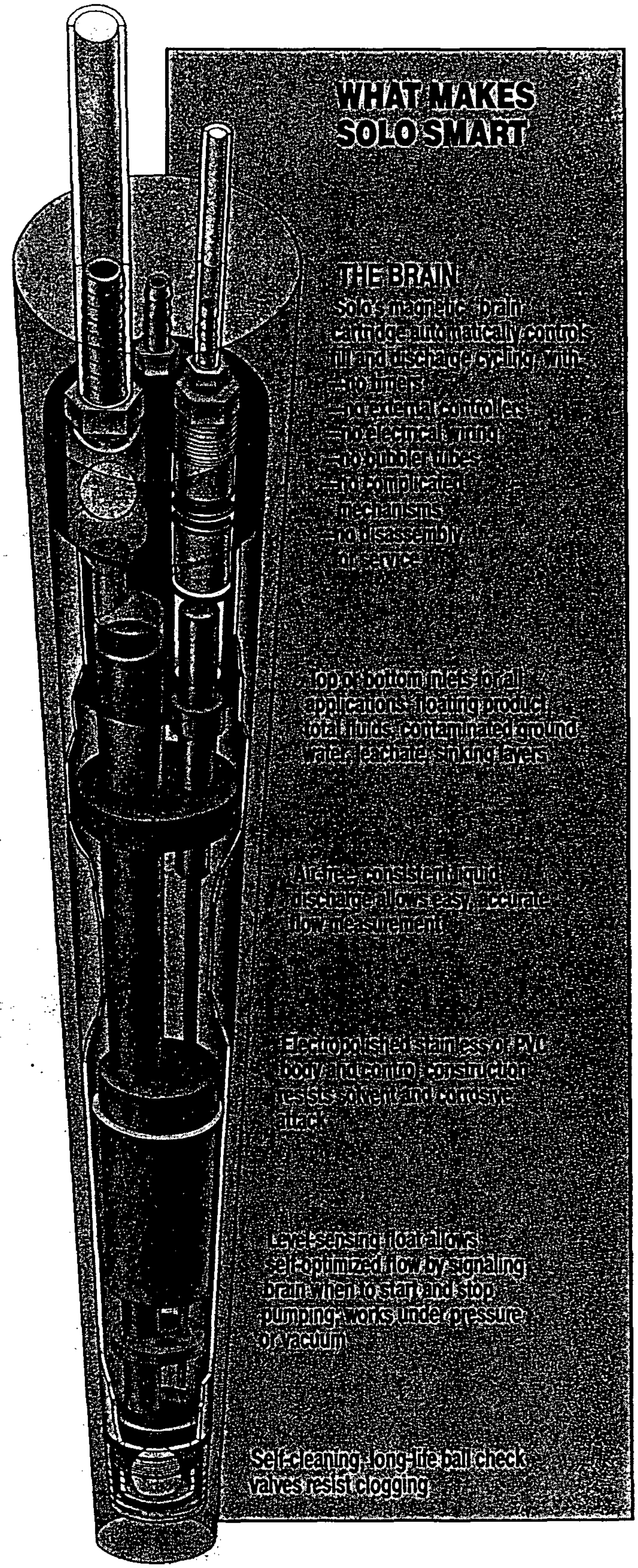
with control built right into the pump

Nobody knew how simple ground water cleanup pumping could be, until QED put self-adjusting on/off control and level sensing into the Pulse Pump® Solo™.

Pneumatics have always delivered advantages in low to moderate flow cleanup: fully adjustable flow; inherent safety, with no shock or explosion hazard; and reliable solids-handling design.

Now, Solo intelligent pumps take cleanup and leachate pumping a quantum leap forward. Control built into a field-replaceable cartridge makes Solo the simplest, most reliable system ever to specify, install, and operate.

QED's applications specialists and local representatives make it even easier to go Solo. Call 800/624-2026 toll-free for details.



SOLO™ Intelligent Pumps

QED GroundWater Specialists
P.O. Box 3726, Ann Arbor, MI 48106