Please file
Sparton Tech.
Red file

Marc

BLACK & VEATCH

5728 LBJ Freeway, Suite 300, Dallas, Texas 75240, (214) 770-1500, Fax: (214) 770-1549

February 28, 1995

Mr. Ronald Crossland, Chief
Technical Section (6H-CX)
RCRA Enforcement Branch
U.S. EPA Region 6
1445 Ross Avenue, Suite 1200
Dallas, Texas 75202-27733

VIII

Re: Revisions to Report on the Effectiveness of the Groundwater Recovery Well System in the Upper Flow Zone
Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Dear Mr. Crossland:

Submitted here is the revision to the draft Report on the Effectiveness of the Groundwater Recovery Well System in the Upper Flow Zone (Effectiveness Report) originally submitted to U.S. EPA on July 29, 1992. The Effectiveness Report has been revised in response to U.S. EPA comments received by Sparton Technology on December 20, 1994 and subsequent conversation with Mr. Vincent Malott. This revision is being submitted by Black and Veatch on behalf of Sparton Technology.

Only revised pages are being submitted with revised information shown in shading and the revision date in the page footer. These pages should be substituted in appropriate places in the existing Effectiveness Report. Supplemental information is also provided for inclusion into Appendix 4. A discussion of specific revisions relative to their corresponding EPA comments is detailed in this letter.

1. General. It is our opinion that the Interim Measure initiated in December 1988 is achieving the requirements specified in the Section IV.A. 1.(a)(ii) of the Administrative Order on Consent. This opinion is supported by the capture zone calculations included in this revision as more fully discussed under items 5 and 6 as well as by the results of sampling and analysis completed to date.

2. Groundwater contamination in upper flow zone. Paragraph 2 on page 8 has been deleted as requested.

3. In situ permeability. There is an apparent misunderstanding of the Hvorslev methodology. Hvorslev's report was provided in its entirety in Appendix 3 of the Effectiveness Report. With respect to his report, the use of uniform as shown in figure

2/28/95

A Report Prepared for:

Sparton Technology, Inc.
4901 Rockaway Boulevard, SE
Rio Rancho, New Mexico

REPORT ON THE EFFECTIVENESS OF THE GROUNDWATER RECOVERY WELL SYSTEM IN THE UPPER FLOW ZONE

Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Prepared by HDR Engineering, Inc.
12700 Hillcrest Avenue, Suite 125
Dallas, Texas 75230-2096
August, 1992

Revised by Black and Veatch
5728 LBJ Freeway, Suite 300
Dallas, Texas 75240
February 1995

Pierce L. Chandler, Jr., P.E.
Senior Project Manager

TABLE OF CONTENTS

OGC-004438

TABLE OF CONTENTS (Continued)

OGC-004439

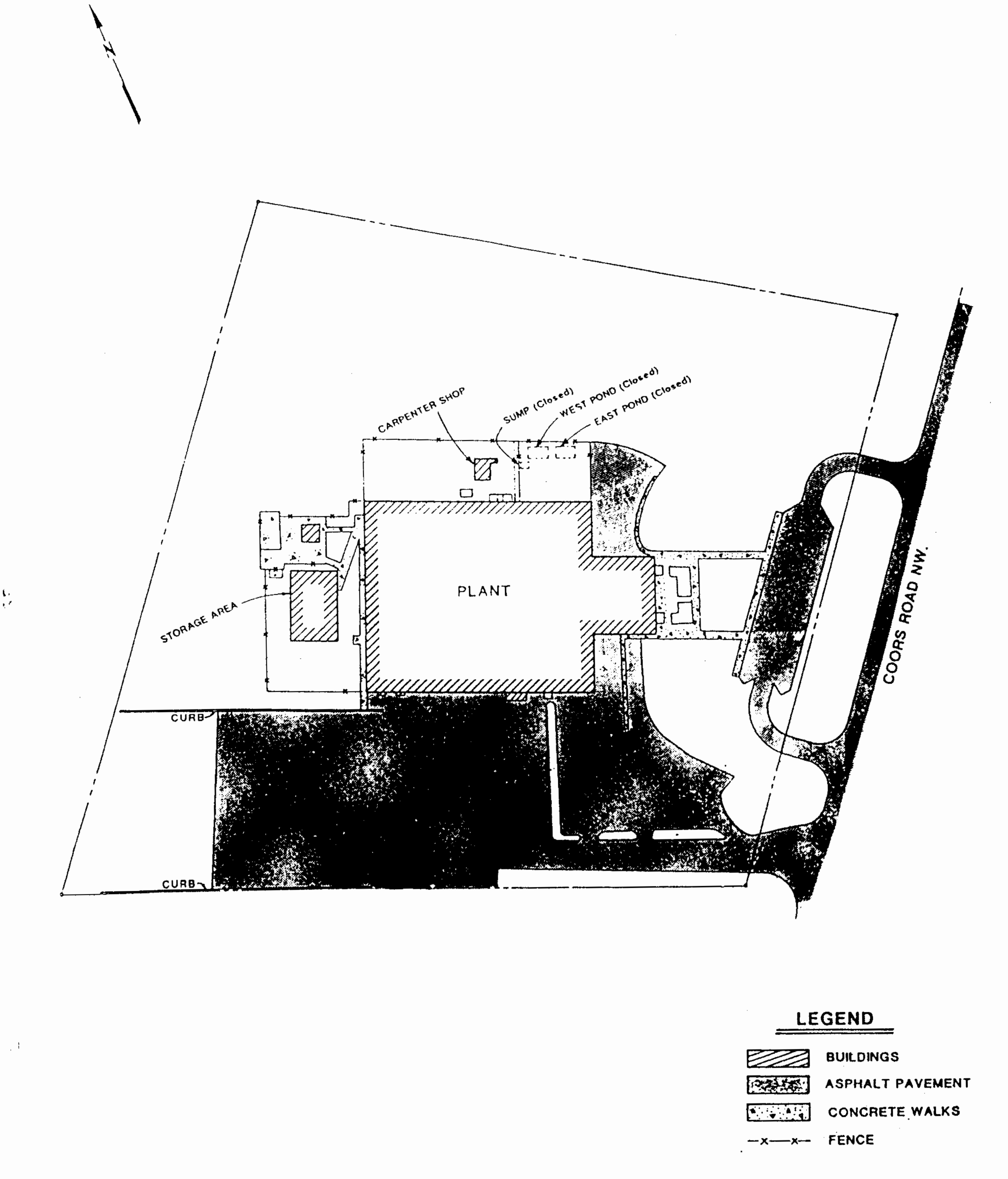
TABLE OF CONTENTS (Continued)

LIST OF FIGURES

I INTRODUCTION

This Report on the Effectiveness of the Groundwater Recovery Well System in the Upper Flow Zone (UFZ) is being submitted pursuant to an Administrative Order on Consent dated October 1, 1988, for the Sparton Technology, Inc. (Sparton) facility located on Coors Road in Albuquerque, New Mexico. In accordance with Section IV.A.1.(a) of the Consent Order, a groundwater recovery well network installed in the upper flow zone and a treatment/disposition system was implemented in December 1988. The purpose of this Interim Measure was to mitigate further off-site migration of contaminants in the upper flow zone. This report presents the results of an evaluation of the effectiveness of that recovery system pursuant to the requirements of Section IV.A.1.(a)ii) of the Consent Order. As required, this report is being furnished within 30 days of receipt of notification by EPA that the Final RCRA Facility Investigation (RFI) report has been approved. The EPA correspondence approving the RFI was dated July 1, 1992, and received by Sparton on July 8, 1992.

As described in the Final RFI report, the pond and sump area located on the north side of the main building is believed to be the source of soil and groundwater contamination at the site. A site layout diagram is shown on Figure 1. Although the historic content of the ponds or sump is not known, the predominant constituents can be inferred from groundwater analyses. It appears that the primary hazardous constituents include trichloroethylene (TCE) and 1,1,1-trichloroethane (TCA) with lesser amounts of methylene chloride (MeCl), 1,1-dichloroethylene (DCE), acetone, and various metals including chromium and lead.



HDR ENGINEERING, INC.
DALLAS, TEXAS

Site Layout Diagram
Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Date 8/92

Figure 1

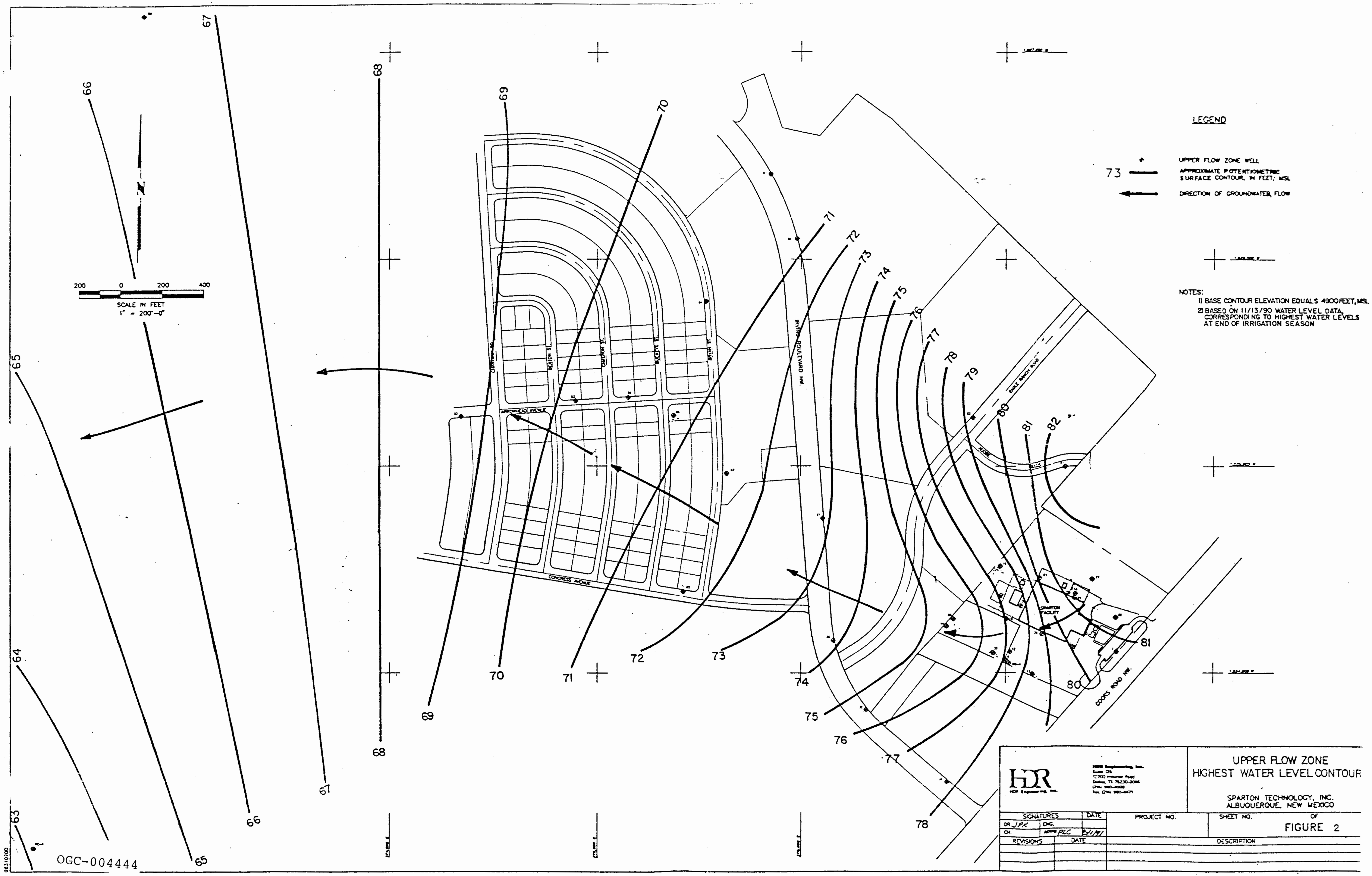
OGC-004442

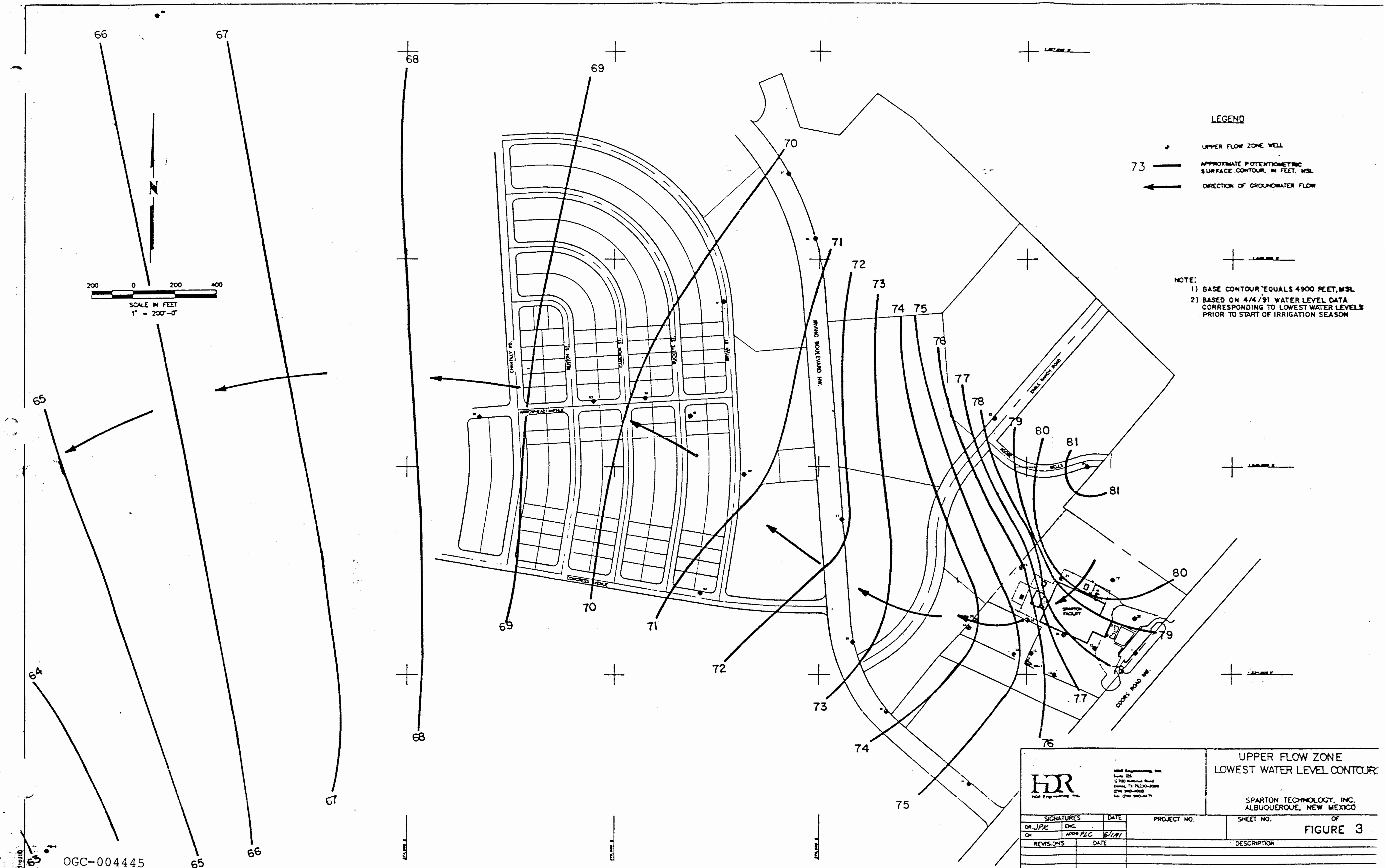
II GROUNDWATER LEVELS AND FLOW DIRECTION IN THE UPPER FLOW ZONE

To establish groundwater levels at the site, bi-weekly water level measurements have been taken at the site since early 1989. A summary of the bi-weekly readings taken during the past year (1991-1992) is included in Appendix 1. Maximum water levels occur to the north of the Sparton facility. The highest groundwater conditions, shown on Figure 2 (Figure 25 from Final RFI Report), occur at the end of the irrigation (recharge) season in November. The lowest groundwater conditions, shown in Figure 3 (Figure 26 from Final RFI Report), occur prior to the start of the irrigation season in April.

As shown on Figures 2 and 3, groundwater gradients in the upper flow zone (UFZ) are generally to the southwest across the Sparton site. Between the facility and Irving Boulevard, the gradients are generally to the west and northwest. Beyond Irving Boulevard, the gradients begin a gradual arc back to the established southwestward regional gradient.

OGC-004443


LEGEND
UPPER FLOW ZONE WELL
73
APPROXIMATE POTENTIOMETRIC SURFACE CONTOUR, IN FEET; MSL
DIRECTION OF GROUNDWATER FLOW
NOTES:
1) BASE CONTOUR ELEVATION EQUALS 4900 FEET, MSL
2) BASED ON 11/13/90 WATER LEVEL DATA, CORRESPONDING TO HIGHEST WATER LEVELS AT END OF IRRIGATION SEASON
SCALE IN FEET
1" = 200'-0"
200 0 200 400
CONGRESS AVENUE
ARROWHEAD AVENUE
IRVING BOULEVARD NW.
COORS ROAD NW.
EAGLE RANCH ROAD
SPARTON FACILITY
63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82
HDR
UPPER FLOW ZONE
HIGHEST WATER LEVEL CONTOUR
SPARTON TECHNOLOGY, INC.
ALBUQUERQUE, NEW MEXICO
SIGNATURES
DATE
DR JPK
CHK.
CH.
APPR PLC
PROJECT NO.
SHEET NO.
OF
FIGURE 2
REVISIONS
DATE
DESCRIPTION
OGC-004444


LEGEND
UPPER FLOW ZONE WELL
73 APPROXIMATE POTENTIOMETRIC SURFACE CONTOUR, IN FEET, MSL
DIRECTION OF GROUNDWATER FLOW
NOTE:
1) BASE CONTOUR EQUALS 4900 FEET, MSL
2) BASED ON 4/4/91 WATER LEVEL DATA CORRESPONDING TO LOWEST WATER LEVELS PRIOR TO START OF IRRIGATION SEASON
SCALE IN FEET
1" = 200'-0"
N
ARROWHEAD AVENUE
CONGRESS AVENUE
IRVING BOULEVARD NW.
COORS ROAD NW.
SPARTON FACILITY
UPPER FLOW ZONE
LOWEST WATER LEVEL CONTOURS
SPARTON TECHNOLOGY, INC.
ALBUQUERQUE, NEW MEXICO
HDR
SIGNATURES
DATE
DR. JPK
ENG.
CH
APPR PLC
6/1/91
PROJECT NO.
SHEET NO.
OF
FIGURE 3
REVISIONS
DATE
DESCRIPTION
OGC-004445

III DESCRIPTION OF GROUNDWATER CONTAMINATION IN UPPER FLOW ZONE

As described in the final RFI report, routine quarterly groundwater analyses were instituted in 1985 under a state-approved program for a number of on-site monitoring wells. The analysis of groundwater from wells in the upper flow zone encountered primarily TCE and TCA with lesser amounts of acetone, DCE, MeCl, and various metals. TCE is the predominant contaminant with respect to concentration as well as areal and vertical extent. Furthermore, there is a much more extensive historical database on TCE analyses. As a result, this report will focus on the fate of TCE in the groundwater in the upper flow zone.

The general areal configuration of the TCE contaminant plume has been determined by contouring TCE concentration data from 22 upper flow zone (UFZ) wells. The TCE plume configuration as of June 1991 is graphically shown on Figure 4. The June 1991 TCE data as well as the previous TCE concentrations and sampling dates are tabulated on Figure 4 (Figure 55 from Final RFI Report). The less than 5 micrograms per liter (mg/l) isopleth or contour represents the detection limit of the perimeter of the plume. Based upon this boundary, the longitudinal length of the plume in June 1991 is approximately 2100 feet northwest from the facility's western property line. The transverse width of the plume is approximately 1400 feet.

LEGEND

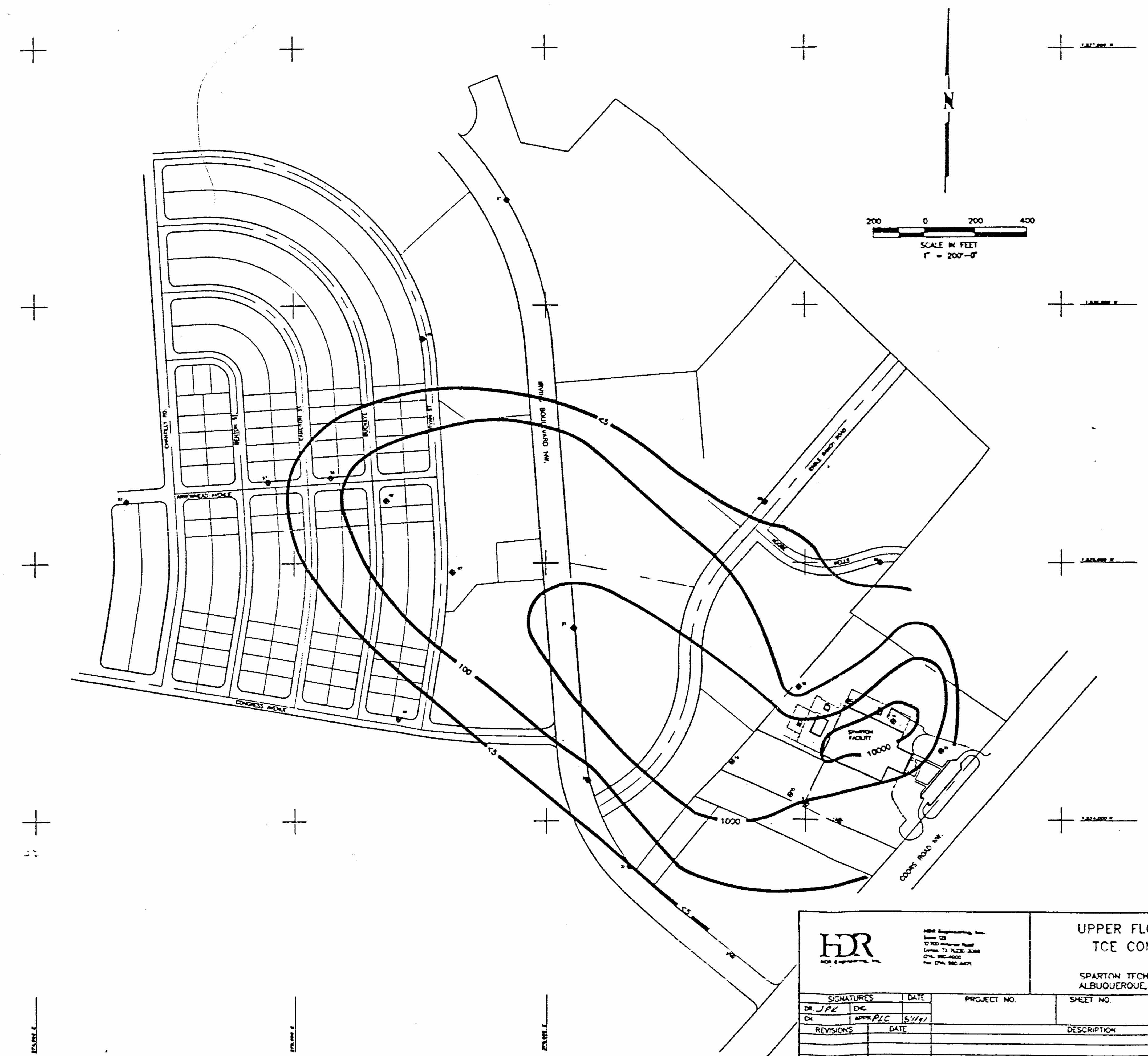
—— 100 —— TCE CONCENTRATION CONTOUR (...)

• UPPER FLOW ZONE WELL

MONITOR WELL NUMBER	SCREEN INTERVAL (FT., MSL)	JUNE, 1991 TCE CONCENTRATION (ug/l)	PREVIOUS TCE CONCENTRATION AND SAMPLING DATE (ug/l)	DATE
9	4981.61–4976.61	1400	* 1900	3rd & 4th Quarter '90
13	4983.25–4973.25	330	* 630	FEB & MAR 1989
14	4980.41–4970.41	1100	* 2400	FEB & MAR 1989
15	4967.49–4977.49	91	* 210	FEB & MAR-1989
16	4979.5–4974.89	17000	* 17500	3rd & 4th Quarter '90
21	4983.86–4978.86	500	* 760	3rd & 4th Quarter '90
22	4976.06–4971.06	110	* 111.5	3rd & 4th Quarter '90
33	4981.29–4971.29	7300	* 7250	FEB & MAR 1989
34	4977.99–4967.99	ND < 5	* ND < 5	AUG 1989
35	4979.3–4969.30	ND < 5	* ND < 5	AUG 1989
36	4977.06–4967.06	22	* 9.45	AUG 1989
37	4976.86–4966.86	2000	* 1450	AUG 1989
47	4975.83–4960.83	120	* 275	JAN 1990
48	4976.31–4961.31	410	* 1015	AUG & SEPT 1990
51	4983.86–4973.86	ND < 5	* 8.45	APR & MAY 1990
52	4975.01–4959.81	ND < 5	* ND < 1	JUN 1990
53	4974.44–4960.24	ND < 5	ND < 1	JUN 1990
57	4977.54–4962.54	ND < 5	ND < 1	AUG 1990
58	4974.89–4959.89	29	* 22	OCT 1990
61	4975.96–4960.96	ND < 5	* ND < 5	OCT 1990
62	4980.00–4965.00	ND < 5	* 2.2	OCT 1990
63	4982.74–4967.74	ND < 5	* ND < 5	OCT 1990

* TWO-SAMPLE AVERAGE

Note: ND indicates non-detection of TCE at analytical limit indicated



HDR

UPPER FLOW ZONE
TCE CONTOURS

SPARTON TECHNOLOGY, INC.
ALBUQUERQUE, NEW MEXICO

SIGNATURES		DATE	PROJECT NO.	SHEET NO. OF
DR JPK	ENG.			FIGURE 4
CH	APPR PLC	5/1/91		
REVISIONS	DATE		DESCRIPTION	

OGC-004447

TCE concentration levels in groundwater samples taken from upper flow zone (UFZ) wells in June 1991 varied from 17,000 µg/l in MW-16 to non-detection (less than 5 µg/l) in several wells. The historic maximum concentration detected in the on-site groundwater is 37,000 µg/l in MW-16.

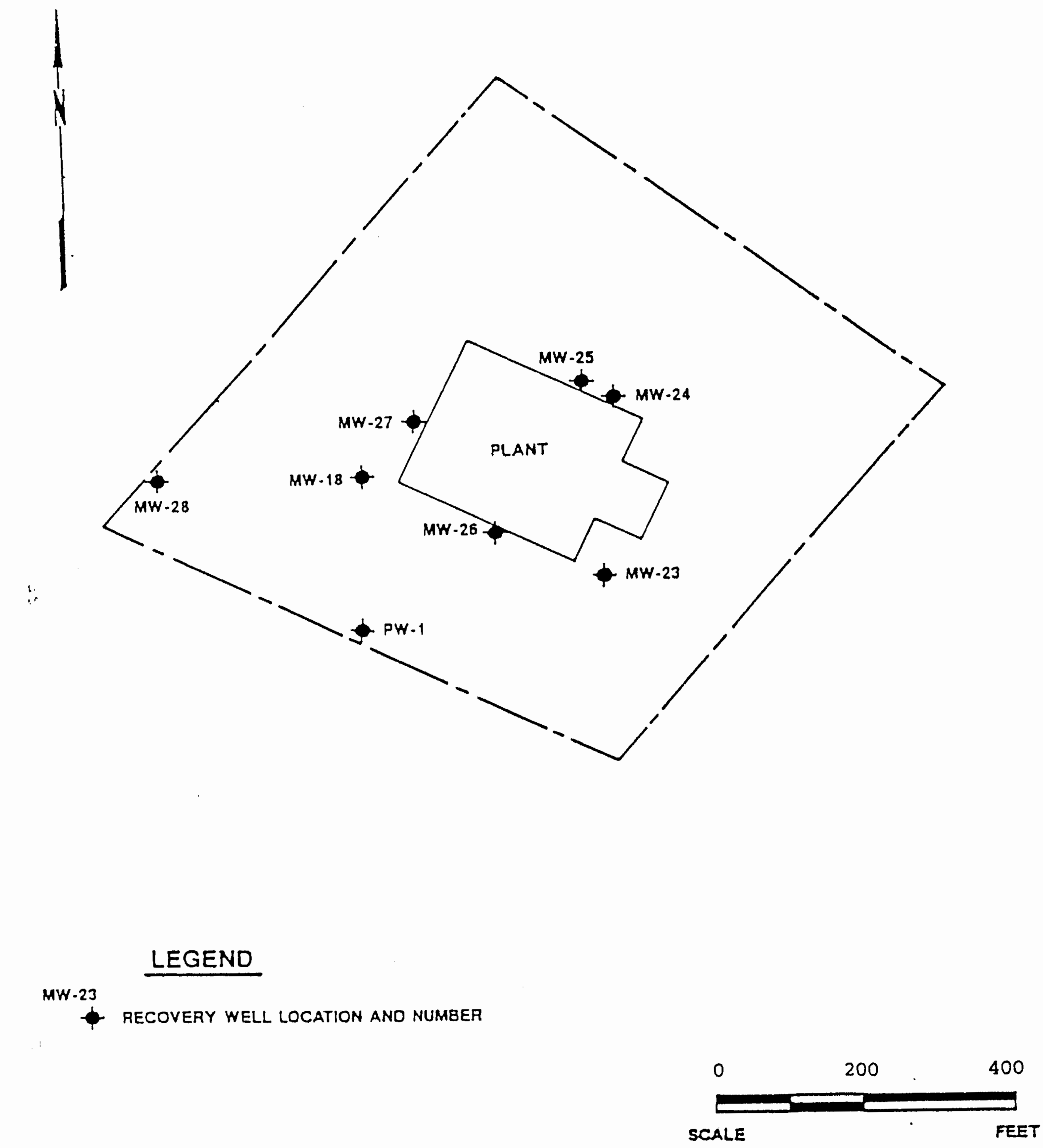
IV GROUNDWATER RECOVERY WELL NETWORK
IN THE UPPER FLOW ZONE

A. General

Pursuant to the requirements of the Consent Order, a groundwater recovery well network was installed in the upper flow zone as an Interim Measure. The purpose of this Interim Measure was to mitigate the spread of the shallow contaminant plume off-site. In order to maximize contaminant removal, the recovery well network utilized a number of on-site wells located in the more contaminated portions of the contaminant plume. The recovery network was designed and constructed according to the provision of the Interim Measures Workplan approved by EPA on March 1, 1989. The network became operational in December 1988.

B. Description of Recovery Well Network in Upper Flow Zone

The network is comprised of eight wells (PW-1, MW-18, MW-23, MW-24, MW-25, MW-26, MW-27, and MW-28) constructed over a four-year period and installed in the upper flow zone of the site at the locations shown on Figure 5. The wells are set in the upper flow zone (UFZ) with screened interval depths ranging from 60 to 78 feet below the existing ground surface. Recovery wells PW-1, MW-18, MW-25, MW-27, and MW-28 are screened across both the highest and lowest groundwater levels. Two of the recovery wells, MW-23 and MW-26, are screened below the lowest groundwater levels. Recovery well MW-24 is screened below the highest groundwater level and across the lowest groundwater level. Table 1 lists the pertinent construction details for each of the eight wells.



HDR ENGINEERING, INC.
DALLAS, TEXAS

Recovery Well Location Plan
Sparton Technology, Inc.
Coors Road Facility
Albuquerque, New Mexico

Date 8/92

Figure 5

Rev. February 1995

OGC-004450

TABLE 1
Recovery Network Well Construction Details

Well No.	Well Diameter (inches)	Well Screen Material	Riser Material	Depth of Screened Interval (feet)	Elevation at top of Screen (ft., MSL)	Construction Date
PW-1	10	PVC(1)	PVC	60-70	4984.54	9/84
MW-18	4	PVC	PVC	68-78	4977.58	5/86
MW-23	2	SS(2)	PVC	72-77	4976.51	8/86
MW-24	2	SS	PVC	68.4-73.4	4980.30	12/86
MW-25	2	SS	PVC	67.7-72.7	4981.30	12/86
MW-26	2	SS	PVC	73-78	4972.71	5/88
MW-27	2	SS	PVC	67-72	4978.50	5/88
MW-28	2	SS	PVC	65-70	4977.69	5/88

(1) Polyvinyl chloride
(2) Stainless Steel

Compressed-air-operated, positive-displacement pumps were installed at or near the bottom of each well. The compressed air is supplied by a central air compressor located in the control building. Air is pumped through piping to the well pumps and pump controllers. Four controllers are provided to control pump operations. Two pumps are controlled by each controller. Each well pump is equipped with a remote well operator to allow independent adjustment of pumping rates for each well. Each well pump discharges through flexible tubing into a common gravity drain or header. Each discharge line is equipped with a two-way sampling valve for sample collection and flow measurement.

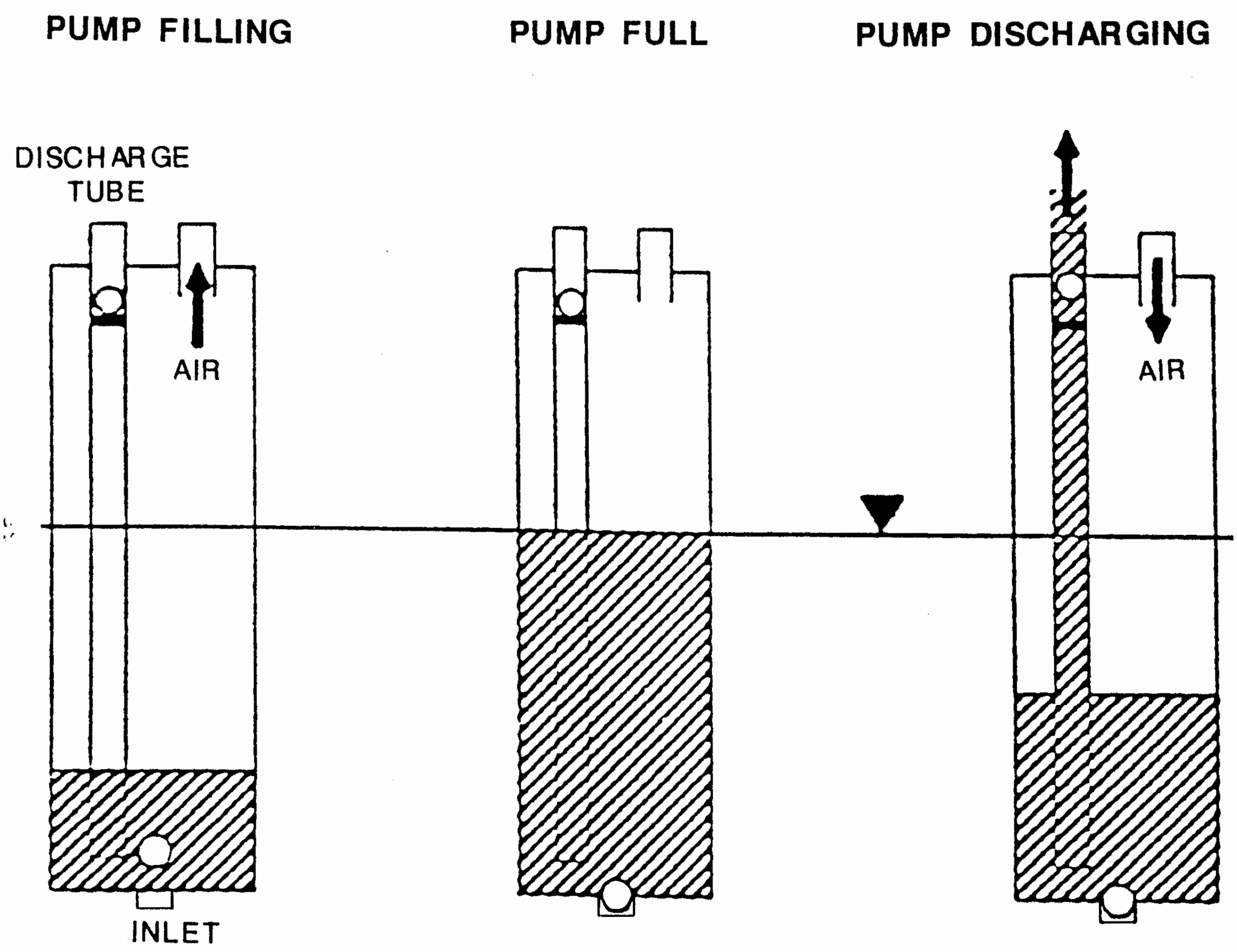
The well pumps are operated by air supplied from the air compressor. Timing devices located in the pump controllers are present to regulate the time to fill the pump chamber and the evacuation time. The timers in the controllers initiate pneumatic signals to the remote well operator located at each wellhead via a 1/4-inch air line. Upon receiving a signal, the remote well operator actuates the pump by allowing air to enter the pump chamber, thus forcing the liquid out of the discharge tubing. Another signal to the remote well operator stops the air flow to the pump chamber. The pump chamber is then allowed to refill for another cycle. An air exhaust vent located at the well cap allows air to be vented from the pump chamber as it fills. The pumping rate of the well may be further adjusted with a throttling valve on the remote well operator. The pump operation sequence is visually depicted on Figure 6.

Groundwater extracted simultaneously at each well location is piped to an air stripper system for treatment and ultimate use in the Sparton Facility. The collection piping system consists of discharge lines encased in secondary piping to provide leak detection and containment. Table 2 describes the pumping flow rate for each recovery well as of late February 1992.

TABLE 2
Current Recovery Well Network Flow Rates

Well No.	Flow Rate (gal/hr)
PW-1	3.7
MW-18	10.0
MW-23	21.3
MW-24	1.0
MW-25	1.8
MW-26	2.0
MW-27	13.4
MW-28	2.9
TOTAL	56.1

OGC-004452



HDR ENGINEERING, INC.
DALLAS, TEXAS

WELL PUMP OPERATION

Date
MKS
8/92

Figure 6

OGC-004453

C. Hydraulic Properties of the Upper Flow Zone

1. Aquifer Pumping Tests

Aquifer pumping tests in the upper flow zone wells were performed at the Sparton site on three separate occasions in 1987 and 1988. The tests were performed, analyzed, and reported by Metric Corporation (Metric Corporation 1987, 1988a, 1988b). Copies of these reports are included in Appendix 2.

Pumping tests were performed in all eight recovery wells and MW-16. Monitoring well MW-16 is a two-inch diameter PVC well with a screen depth interval of 68 to 73 feet below the ground surface. The elevation of the top of the screen is at 4979.50 feet. This well is screened below the highest and lowest groundwater levels. The initial aquifer test (1987) was performed in recovery wells MW-18 and MW-24 as well as monitoring well MW-16. The initial aquifer test used constant drawdown techniques on MW-16 and MW-24 and constant discharge techniques on MW-18 over a relatively long duration (49-72 hours). The pumping tests on MW-16 and MW-24 included drawdown observations in both the pumped well and adjacent observation wells (multiple well tests). The pumping test on MW-18 measured drawdown observations in the pumped well only (single well test).

The second aquifer test (1988a) was performed in recovery wells MW-25 and PW-1 using constant discharge techniques over a relatively long duration (69-72 hours). Both pumping tests included observations in both the pumped well and adjacent observation well (multiple well tests).

OGC-004454

The third aquifer test (1988b) was performed in recovery wells MW-23, MW-26, MW-27, and MW-28 using constant discharge techniques over a relatively long duration (70-72 hours). These pumping tests, however, only measured drawdown in the pumped wells (single well tests).

2. <u>In Situ Permeability</u>

Average flow rates during these tests varied from 0.07 to 0.32 gallons/minute. Maximum drawdown distances observed during the tests varied from approximately 2.2 to 5.0 feet. Based upon the results of the pumping tests, Metric Corporation estimated in situ field permeabilities ranging from 3.91×10^{-5} cm/sec to 4.75×10^{-3} cm/sec. These permeability values correspond to soils having a mixture of sand, silt, and clay such as clayey sands and silty sands.

An independent analysis of the pumping test data was performed using Hvorslev's (1951) formulas for determination of in situ soil permeability. A copy of the original Corps of Engineers publication describing Hvorslev's procedures is included in Appendix 3. The recovery portion of the pumping test data, taken after pump shut-down, was used for these analyses. Based upon the subsurface soils and well construction, Hvorslev's Case G, Well Point-Filter in Uniform Soil, was selected as best representing the site conditions. The recovery portion of the pumping test data represents a variable head test. As a result, the following formula was utilized in our analysis of in situ soil permeability:

$$K_h = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8\ L\ (t_2 - t_1)} \ln \frac{H_1}{H_2}, \text{ for } \frac{2mL}{D} > 4$$

WHERE : K_h = Horizontal Coefficient of Permeability
K_v = Vertical Coefficient of Permeability
m = Transformation Ratio = $\sqrt{K_h / K_v}$
d = Diameter, standpipe
D = Diameter, intake pipe
L = Length of intake
t = time
H_1 = Drawdown at time t_1
H_2 = Drawdown at time t_2

In our analysis, the ratio of K_h to K_v was approximated as 10. In addition, the diameter of the standpipe was equal to the diameter of the intake pipe in all the tested wells.

The in situ permeability values determined with Hvorslev's equation are summarized in Table 3. Sample calculations for all wells are given in Appendix 4. These results are very similar to permeability values calculated with methods described in <u>NAVFAC DM-7.1, Soil Mechanics</u> (U.S. Department of the Navy, 1982) as shown in Table 3. For comparison, the values previously determined by Metric Corporation (see Appendix 2) are also listed in Table 3. Considering the methods of analysis used and the inherent assumptions involved, the Metric values compared very well with the Hvorslev values.

OGC-004456

TABLE 3
Calculated In Situ Field Permeabilities

Well No.	HDR, Inc. (1) (cm/sec)	HDR, Inc. (2) (cm/sec)	Metric Corporation (cm/sec)
PW-1	3.24×10^{-4}	4.375×10^{-4}	1.00×10^{-3}
MW-16	2.39×10^{-4}	1.603×10^{-4}	4.18×10^{-3}
MW-18	3.46×10^{-4}	4.156×10^{-4}	3.26×10^{-4}
MW-23	2.53×10^{-3}	1.450×10^{-3}	8.54×10^{-4}
MW-24	4.36×10^{-4}	4.071×10^{-4}	4.75×10^{-3}
MW-25	4.50×10^{-4}	1.510×10^{-4}	2.18×10^{-3}
MW-26	3.56×10^{-4}	2.746×10^{-4}	3.91×10^{-5}
MW-27	2.90×10^{-3}	2.009×10^{-3}	9.08×10^{-4}
MW-28	2.91×10^{-5}	2.730×10^{-5}	1.07×10^{-3}

(1) Using Hvorslev's Formula for Case G, Variable Head Test
(2) Using methods described in NAVFAC DM-7.1, Soil Mechanics, case F(2) or F(3) depending on the screen length

3. Radius of Influence

Evaluation of the radius of influence for the nine wells used in the aquifer pump tests utilized Sichardt's method (U.S. Department of the Army, 1971, and Powers, 1981). Excerpts discussing Sichardt's procedures from each of these references are included in Appendix 3. The analysis was based on the permeability values determined with Hvorslev's Formula and a saturated upper flow zone thickness of 10 feet. Estimation of the radius of influence utilized the following formula:

$$r_o = C\,(H - h_w)\sqrt{K}$$

WHERE : r_o = Radius of Influence, feet
C = Empirical Relation of K vs. r_o
H = Height of water table (saturated thickness), feet
h_w = Head of water in well, feet
K = Coefficient of Permeability, microns/sec (1 micron = 1×10^{-4} cm)

In the analysis, C was assumed to be 3 for a single well and the term ($H-h_w$) represents well drawdown which was assumed to equal the full saturated thickness of 10 feet. Results of the analysis are summarized on Table 4.

See pg 109 of "Construction dewatering" appndx 3

Also described in Table 4 are the minimum observed radii of influence for aquifer test locations with multiple well readings. These minimum radii of influence represent the horizontal distance between the pumped well and farthest observation well showing identifiable drawdown effects. Due to the limited number of observation wells, the actual radii of influence may exceed these minimum values.

TABLE 4
Radius of Influence

Well No.	Calculated Radius of Influence, r_o (ft)	Minimum observed Radius of Influence (ft)
PW-1	54	10
MW-16	46	50
MW-18	56	--(1)
MW-23	151	--(1)
MW-24	63	60
MW-25	64	25
MW-26	57	--(1)
MW-27	162	--(1)
MW-28	16	--(1)

(1) Single well tests

The permeability values and radii of influence vary because of the heterogeneous and anisotropic nature of the upper flow zone. Capture zone dimensions have been calculated for each well using pumping rates given in Table 2, permeability values from Table 3, and hydraulic gradient data from the Final RFI report.

Calculations utilized the methodology of Todd and Grubb (Fetter, 1994). Calculations are for single wells; grouping effects were not analyzed. Figure 7 visually shows the capture zone for each well. Sample calcualtions are included in Appendix 4.

4. Transmissivity and Storage Coefficient

Assuming an upper flow zone saturated thickness, b, of 10 feet and using the field permeability, K, values described above, transmissivity, T, values for each well location were calculated using the relation $T = Kb$. These values of T are given in Table 5. The aquifer storage coefficient, S, is proportional to transmissivity, T, and time, and inversely proportional to the square of the radius of influence, r_o. Using the transmissivity, T, and radius of influence, r_o, values previously calculated, the calculated storage coefficient at each well location is also listed in Table 5. The equation used to calculated the storage coefficient, S, was derived by Jacob (Lohman, 1979) to determine S from distance-drawdown graphs (see sample calculations in Appendix 4). The calculated storage coefficients indicated semi-confined conditions exist.

TABLE 5
Transmissivity and Storage Coefficient

Well No.	Transmissivity, T (gal/day/ft)	Storage Coefficient, S
PW-1	68.7	0.0205
MW-16	50.7	0.0217
MW-18	73.4	0.0144
MW-23	536.4	0.0261
MW-24	92.5	0.0214
MW-25	95.5	0.0095
MW-26	75.5	0.0207
MW-27	615.0	0.0206
MW-28	6.2	0.0045

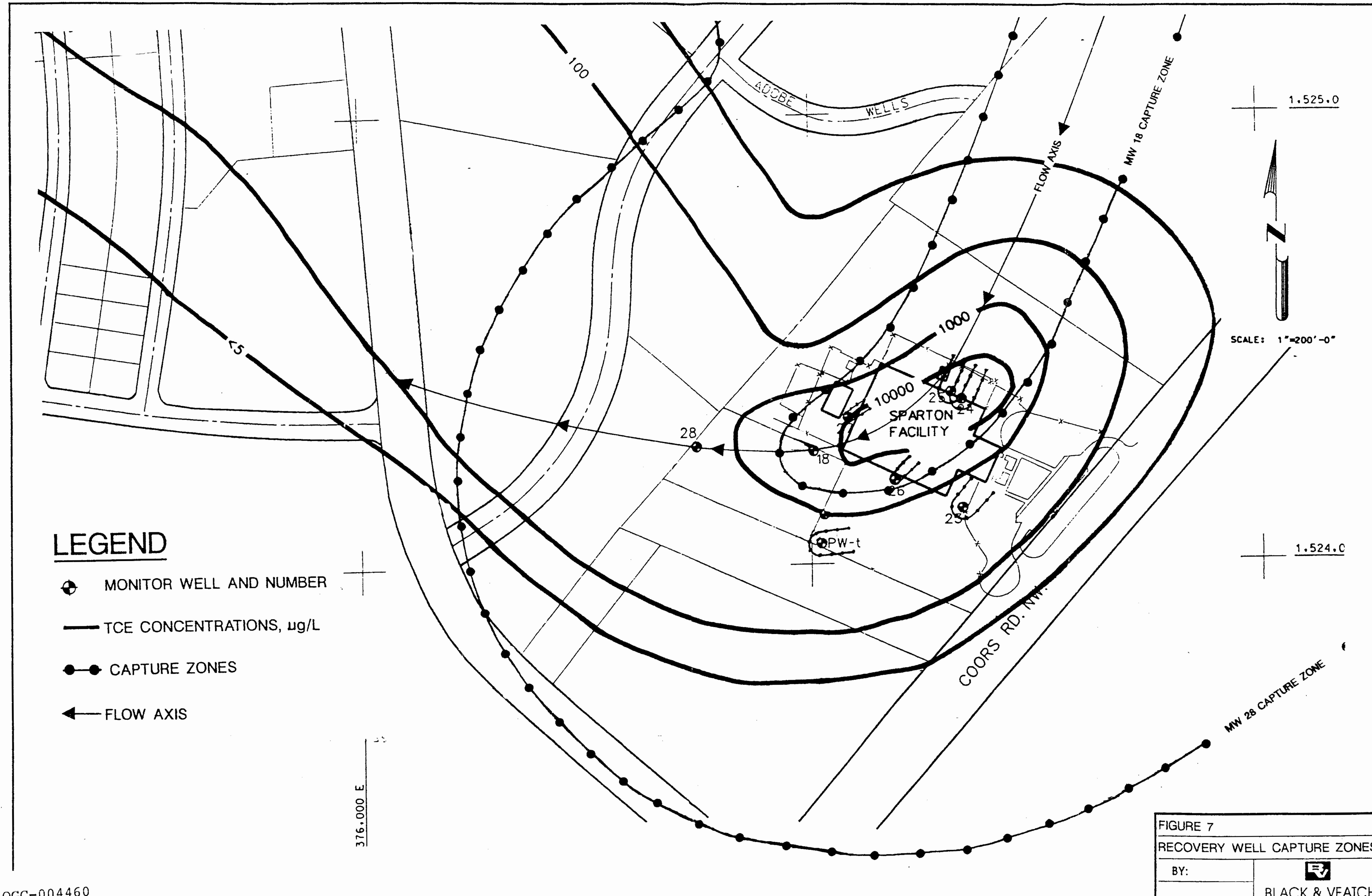


FIGURE 7
RECOVERY WELL CAPTURE ZONES

OGC-004460