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S. S. PAPADOPULOS & ASSOCIATES, INC.
ENVIRONMENTAL & WATER-RESOURCE CONSULTANTS

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January 9, 2002

United States Environmental Protection Agency (3 copies)
Region VI - Technical Section (6EN-HX)
Compliance Assurance & Enforcement Division
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Dallas, TX 75202
Attn: Sparton Technology, Inc. Project Coordinator Michael Hebert

Director (1 copy)
Water & Waste Management Division
New Mexico Environment Department
1190 St. Francis Drive, 4th Floor
Santa Fe, NM 87505

✓Chief (1 copy)
Hazardous & Radioactive Materials Bureau
New Mexico Environment Department
1190 St. Francis Drive, 4th Floor
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Groundwater Bureau
New Mexico Environment Department
1190 St. Francis Drive, 4th Floor
Santa Fe, NM 87505

Subject: Sparton Technology, Inc. Former Coors Road Plant Remedial Program
Report on the "Results of Investigations Conducted in Monitoring Well MW-71"

Gentlemen:

On behalf of Sparton Technology, Inc. (Sparton), S. S. Papadopulos & Associates, Inc. (SSP&A) is pleased to submit the attached report that presents the results of investigations conducted in monitoring well MW-71. The report was prepared by SSP&A in cooperation with Metric Corporation.

I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to assure that qualified personnel

properly gather and evaluate the information submitted. Based upon my inquiry of either the person or persons who manage the system and/or the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I further certify, to the best of my knowledge and belief, that this document is consistent with the applicable requirements of the Consent Decree entered among the New Mexico Environment Department, the U.S. Environmental Protection Agency, Sparton Technology, Inc., and others in connection with Civil Action No. CIV 97 0206 LH/JHG, United States District Court for the District of New Mexico. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions concerning the report, please contact me.

Sincerely,

S. S. PAPADOPULOS & ASSOCIATES, INC.

Stavros S. Papadopulos, PhD, PE
Founder & Senior Principal

cc: Mr. Baird Swanson, NMED, Albuquerque, NM, w/ 1 copy
Secretary, Sparton Technology, Inc., w/ 1 copy
Mr. R. Jan Appel, w/1 copy
Mr. James B. Harris, w/1 copy
Mr. Tony Hurst, w/2 copies
Mr. Gary L. Richardson, w/1 copy

Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

Results of Investigation Conducted in Monitoring Well MW-71

January 9, 2002

Sparton Technology, Inc.
Former Coors Road Plant
Remedial Program

Results of Investigation Conducted in Monitoring Well MW-71

Prepared For:

Sparton Technology, Inc.
Rio Rancho, New Mexico

Prepared By:

S.S. Papadopulos & Associates, Inc.
Bethesda, Maryland
&
Metric Corporation
Albuquerque, New Mexico

January 9, 2002

Table of Contents

Page

Introduction 1

Purging Test 3

Deviation Survey 7

Plugging of MW-71 9

Proposed Location for the Replacement Well 10

Tables

Table 1 Monitoring Well MW-71 Purge Test Data 4

Table 2 Monitoring Well MW-71 Deviation Survey Data 8

Figure

Figure 1 Proposed Location for the MW-71 Replacement Well MW-71R 11

Appendix

Deviation-Survey Log of MW-71

REPORT

INTRODUCTION

Well MW-71 is one of the two wells monitoring the Deep Flow Zone (DFZ) that underlies the "4800-foot clay unit", a clay layer that was encountered in MW-71 and other deep wells drilled in the vicinity of the Sparton Technology Inc. (Sparton) former Coors Road Plant site. Soon after its installation as a 4-inch monitoring well in July 1998, the well was found to be leaking contaminated water from the shallow horizons of the aquifer through a breach in its casing. In an attempt to correct the problem, the well was recompleted in October 1998 by installing, sand-packing, and cementing a 2-inch liner and screen assembly within the original 4-inch casing. Samples collected after the recompletion of the well, however, indicated that leakage of contaminated water from shallower zones was continuing. Early this year, Sparton proposed to prevent the continuing leakage by plugging and abandoning the well. The United States Environmental Protection Agency (USEPA) and the New Mexico Environment Department (NMED) agreed to the abandonment of the well but requested that it be replaced by another DFZ well at the same or at a nearby location.

Sparton agreed to the replacement of the well but proposed that investigations, consisting of a purging test and a deviation survey, be conducted (1) to confirm that the source of the contaminants detected in this well is indeed leakage from shallower zones, and (2) to determine the feasibility of replacing this well by overdrilling it and completing a new well at the same location. A Work Plan for Testing and Replacing Monitoring Well MW-71 (Work Plan)[1] was prepared to describe the proposed investigations and submitted to the agencies on May 24, 2001. The Work Plan was approved by the agencies on June 12, 2001. Some minor revisions to the Work Plan, primarily concerning sampling methodology, were agreed upon later in June and documented on July 5, 2001[2].

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[1] S. S. Papadopulos & Associates, Inc. and Metric Corporation, 2001, *Sparton Technology, Inc., Former Coors Road Plant Remedial Program, Work Plan for Testing and Replacing Monitoring Well MW-71*, May 24, 2001.
[2] Hurst Engineering Services, 2001, *Letter from Tony Hurst to Michael Hebert of USEPA, James Bearzi and others of the NMED, and R. Jan Appel of Sparton*, July 5, 2001.

The investigations, and all data collection activities associated with them, were conducted under the direct supervision of Mr. Gary L. Richardson of Metric Corporation (Metric). Dr. Stavros S. Papadopulos of S. S. Papadopulos & Associates, Inc. (SSP&A) maintained close contact with Mr. Richardson throughout the investigations, and assisted in the interpretation of the purging test data.

PURGING TEST

A 13-day purging test was conducted on the well in July 2001. The test started in the morning of July 10, 2001 by pumping (air-lifting) 1,700 gallons of water from the well over a period of about 8 hours. After stopping the pumping, an additional 3 casing volumes were purged from the well using a submersible pump, followed by the removal of one gallon of water by bailer and the sampling of the well for chemical analysis. The well was left to rest overnight, and another sample was obtained from the well on the morning of July 11 after purging approximately 1.1 casing volumes. The well was then pumped again for about 8 hours to remove 1,800 gallons of water and sampled at the end of the pumping period. The process of pumping 1,800 gallons of water from the well over a period of about 8 hours, and sampling it before and after the pumping period was continued until July 22, 2001, except that the volume of the pumped water was increased from 1,800 gallons to 2,500 gallons on July 21 and to 3,150 gallons on July 22. Sampling of the well continued after the end of the purging test, daily between July 24 and 27, and on July 30, August 1, and August 3. To obtain samples that are more representative of the water leaking from shallower formations rather than of water from the DFZ, only the discharge tubing was purged prior to obtaining these latter, post-test samples. Finally, the well was again sampled on August 28 during the regular quarterly sampling event for the site.

The results of the chemical analysis of the samples collected from MW-71 during and after the purging test, and other data pertinent to the test, are summarized in Table 1. Also included on Table 1 are the results of the last quarterly sample collected prior to the test, and of the quarterly sample collected after the test. As shown on this table, the last quarterly sample prior to the test contained 340 μg/l of TCE, 12 μg/l of 1,1-DCE and 32.1 μg/l of chromium. During the purging test, the concentration of contaminants declined significantly. For example, the concentration of TCE declined from 160 μg/l at the end of the first day of pumping to 81 μg/l after the 11^{th} day of pumping 1,800 gallons each day. When the pumping volume was increased during the next two days, the TCE concentration declined to 56 μg/l.

TABLE 1

MONITORING WELL MW-71 PURGE TEST DATA

Date	Sampling Time	Pumped Volume, in gallons	Volume Purged Prior to Sampling		Concentration, in µg/l			
			in gallons	in casing volumes	TCE	1,1-DCE	1,1,1-TCA	Cr
5/24/01	-	NA[a]	4.9	3[b]	340	12	<5.0	32.1
7/10/01	-	1700	-	-	NS[c]	NS	NS	NS
	7:17 PM		91	3	160	3.7	<1.0	21
7/11/01	8:35 AM	1800	36	1.1	140	3.4	<1.0	21.9
	4:02 PM		91	3	150	3.4	<1.0	20
7/12/01	8:23 AM	1800	36	1.1	140	3.3	<1.0	20.6
	5:38 PM		91	3	130	3.1	<1.0	20.1
7/13/01	8:01 AM	1800	36	1.1	150	3.6	<1.0	20.8
	5:20 PM		91	3	100	2.3	<1.0	19.6
7/14/01	8:03 AM	1800	36	1.1	120	3	<1.0	19.8
	5:18 PM		91	3	100	2.5	<1.0	18.8
7/15/01	7:28 AM	1800	36	1.1	130	3	<1.0	18.1
	4:34 PM		91	3	110	2.4	<1.0	16.8
7/16/01	7:38 AM	1800	36	1.1	130	2.9	<1.0	17.7
	4:47 PM		91	3	100	2.6	<1.0	18.3
7/17/01	7:47 AM	1800	36	1.1	120	2.8	<1.0	19.2
	4:58 PM		91	3	99	2.3	<1.0	20.2
7/18/01	7:47 AM	1800	36	1.1	120	2.7	<1.0	18.7
	4:56 PM		91	3	96	2.2	<1.0	17.9
7/19/01	7:40 AM	1800	36	1.1	110	2	<1.0	18.8
	4:50 PM		91	3	110	2.1	<1.0	18.7
7/20/01	7:41 AM	1800	36	1.1	95	1.7	<1.0	18
	4:50 PM		91	3	81	1.6	<1.0	17
7/21/01	8:00 AM	2500	91	3	110	2	<1.0	18.8
	5:16 PM		91	3	79	1.5	<1.0	17.3
7/22/01	7:53 AM	3150	91	3	94	1.7	<1.0	20.2
	5:19 PM		91	3	56	<1.0	<1.0	17.7
7/24/01	12:00 PM	NA	2.5	*	130	1.3	<1.0	NA
7/25/01	11:00 AM	NA	2.5	*	220	4.3	<1.0	NA
7/26/01	11:18 AM	NA	2.5	*	200	4.1	<1.0	NA
7/27/01	8:00 AM	NA	2.5	*	230	4.9	<1.0	NA
7/30/01	7:45 AM	NA	2.5	*	270	7.5	<1.0	NA
8/1/01	8:15 AM	NA	2.5	*	270	7.3	<1.0	NA
8/3/01	8:10 AM	NA	2.5	*	280	7.4	<1.0	NA
8/28/01	-	NA	7.7	3[b]	200	10	<1.0	33.2

[a] Not applicable.

[b] The volume purged during these quarterly sampling events is at least 3 times the casing volume below the packer that isolates the permanent sampling pump from the rest of the well.

[c] Not sampled.

* Only the pump discharge tubing was purged.

Also note that, in general, contaminant concentrations in the morning samples, that is, in the samples taken after the overnight rest of the well and prior to the beginning of pumping, were higher than those in the samples taken at the end of the previous day's pumping period. After the end of the purging test, contaminant concentrations in the samples collected after purging only the pump tubing began increasing with TCE concentrations approaching about 300 μg/l. Finally, the regular quarterly sample collected a few weeks later, following standard sampling procedures, had a TCE concentration of 200 μg/l.

These data confirm that the source of the contaminants detected in samples from MW-71 was contaminated groundwater from the shallower zones of the aquifer leaking into the DFZ through the wellbore. If the source of the contaminants detected in the well were a plume originating upgradient from the well and moving laterally within the DFZ[3], then the concentration of contaminants during and after the purging test would have remained fairly constant.

Leakage through the wellbore has been continuing for the last several years; the leaking water moved primarily downgradient from the well but also a short distance upgradient. The amount of water purged before quarterly sampling events was relatively small (see Table 1); thus, the quarterly samples collected prior to the test represented the quality of the leaking water (a mixture of water that was leaking during the sampling event with water that had leaked for some time prior to sampling and had penetrated the DFZ). Most of the water pumped during the purging test was contributed by the DFZ, primarily from areas upgradient from the well. Therefore, the changes in concentration observed in the samples collected at the end of the daily pumping periods reflected the mixing of the contaminated water leaking through the wellbore with upgradient water from the DFZ. During the first few days of the test, the upgradient water contributed by the DFZ had

[3] The hypothesis of a plume in the DFZ is also inconsistent with the vertical rates of groundwater flow observed at the site and its vicinity. The rate of vertical groundwater flow in the area of the site, as reflected by the rate of water-table decline, is about 0.65 feet per year. At this rate, the time required for contaminated groundwater to traverse the more than 100 feet that separates the DFZ from the deepest level of contamination on the site is about 150 years.

residual contamination due to leakage prior to the test. As the test progressed, the quality of the upgradient DFZ water improved (may even have become free of contaminants); therefore, the concentration of contaminants in the samples collected at the end of each daily pumping period declined. The generally higher concentrations detected in the morning samples reflected the effects of the continuing leakage overnight. The increased pumping rates that were implemented during the last two days of the test caused an increase in the amount of upgradient water contributed by the DFZ but did not affect significantly the rate of leakage through the wellbore. This resulted in greater dilution and, therefore, in lower contaminant concentrations in the pumped water. After the test was terminated, the samples collected after purging only the pump tubing represented the quality of the water accumulated in the well; as leakage of contaminated water through the wellbore continued, the quality of the water in the well deteriorated, and contaminant concentrations began approaching those in the leaking water. Finally, when standard sampling procedures were followed a few weeks later to obtain a quarterly sample from the well, the sample consisted of a mixture of the leaking water and DFZ water of better quality.

DEVIATION SURVEY

A deviation survey was conducted on MW-71 on September 13, 2001. Southwest Geophysical Services, Inc. conducted the survey under the supervision of Mr. Gary L. Richardson of Metric. The survey consisted of lowering a probe in the well at 10-foot depth increments (as measured along the well casing) and measuring the inclination and the bearing of the probe at each "probe station". The horizontal distance between the wellhead at the surface and a probe station, that is, the deviation of the well between the surface and that probe station, is calculated from the inclination data; the north-south and east-west components of the deviation are calculated from the bearing data.

A copy of the deviation-survey log of the well is presented in the Appendix, and the results of the survey are summarized in Table 2. As these results indicate, the bottom of the well is about 7.3 feet southeast (about 6.8 feet south and 2.6 feet east) of its location at the land surface. This corresponds to an average inclination of about 1.2^{o} between the top and the bottom of the well, but as shown on Table 2, inclinations of as much as 1.88^{o} were measured along the well casing. Although these data indicate that the well would be considered reasonably straight for most purposes, the measured deviation of more than 7 feet between the top and bottom of the well would make it difficult to maintain the same alignment during any attempt to overdrill the well.

TABLE 2

MONITORING WELL MW-71 DEVIATION SURVEY DATA

Depth[a], in feet	Inclination[b], in degrees	Bearing[c], in degrees	True Depth[d], in feet	Northing[e], in feet	Easting[f], in feet	Distance[g], in feet
0	0.51	151.16	0.00	0.00	0.00	0.00
10	0.97	135.53	10.00	-0.12	0.12	0.17
20	1.22	141.87	20.00	-0.29	0.25	0.38
30	1.21	152.75	29.99	-0.48	0.34	0.59
40	0.84	145.75	39.99	-0.60	0.43	0.74
50	0.96	139.33	49.99	-0.73	0.54	0.90
60	1.03	144.56	59.99	-0.87	0.64	1.08
70	1.10	145.33	69.99	-1.03	0.75	1.27
80	0.92	154.16	79.99	-1.18	0.82	1.43
90	0.93	159.30	89.99	-1.33	0.88	1.59
100	1.07	166.40	99.98	-1.51	0.92	1.77
110	1.10	152.49	109.98	-1.68	1.01	1.96
120	1.15	143.92	119.98	-1.84	1.13	2.16
130	1.23	142.95	129.98	-2.01	1.26	2.37
140	1.14	145.25	139.98	-2.18	1.37	2.57
150	1.10	137.98	149.97	-2.32	1.50	2.76
160	1.05	141.14	159.97	-2.46	1.61	2.94
170	1.05	170.33	169.97	-2.64	1.64	3.11
180	1.30	160.01	179.97	-2.86	1.72	3.33
190	1.21	145.42	189.97	-3.03	1.84	3.55
200	0.85	163.83	199.96	-3.17	1.88	3.69
210	0.91	167.18	209.96	-3.33	1.92	3.84
220	0.98	168.81	219.96	-3.49	1.95	4.00
230	0.97	170.41	229.96	-3.56	1.98	4.16
240	1.17	173.42	239.96	-3.86	2.00	4.33
250	1.28	176.89	249.96	-4.09	2.02	4.56
260	1.38	176.96	259.95	-4.33	2.03	4.78
270	1.73	165.56	269.95	-4.62	2.10	5.08
280	1.65	165.99	279.94	-4.90	2.17	5.36
290	1.58	165.37	289.94	-5.17	2.24	5.63
300	1.43	168.86	299.94	-5.41	2.29	5.88
310	1.53	166.95	309.93	-5.67	2.35	6.14
320	1.53	155.60	319.93	-5.91	2.46	6.41
330	1.88	158.63	329.92	-6.22	2.58	6.73
340	1.46	170.80	339.92	-6.47	2.62	6.98
350	1.81	182.34	349.92	-6.79	2.61	7.27

[a] Distance between surface and probe station.
[b] Angle from vertical.
[c] Angle from magnetic North.
[d] Vertical depth to probe station.
[e] North/South component of horizontal distance from wellhead to probe station (negative = South).
[f] East/West component of horizontal distance from wellhead to probe station (negative = West).
[g] Horizontal distance from wellhead to probe station.

PLUGGING OF MW-71

After the conduct of the deviation survey, well MW-71 was plugged by perforating and pressure grouting the well. The well was perforated on September 17, 2001 using 1-11/16-inch Link Jet charges with 4 shots per foot at 90° phasing. The following four 10-foot depth intervals were perforated:

1. The interval between a depth of 195 and 205-feet;
2. The interval between a depth of 245 and 255-feet;
3. The interval between a depth of 295 and 305-feet; and
4. The interval between a depth of 339 and 349-feet.

Note that the deepest perforated interval straddled the 4,800-foot clay that was encountered between the depths of 343 and 345 feet in this well.

About five gallons of fractured 2-inch and 4-inch PVC casing fragments and fractured grout pieces were cleaned out of the well after it was shot-perforated. On October 2, 2001, the perforated well bore was pressure grouted with cement grout consisting of Type III cement mixed with 7 gallons of water per bag of cement. After displacing the water from the well with grout, the well was pressure grouted at a pressure of at least 300 psi. About 125 gallons of grout, which is 2.2 times the volume of the 2-inch casing, was accepted by the well. The materials removed from the well after perforation and the volume of the injected grout indicate that the perforation was successful in penetrating through both casings and into the formation, and that a good grout seal was placed through the 10-foot perforated intervals.

PROPOSED LOCATION FOR THE REPLACEMENT WELL

As discussed earlier, the measured deviation of more than 7 feet between the wellhead and the bottom of well MW-71 may present difficulties in attempting to overdrill the grouted borehole. Given these potential difficulties, well MW-71 will be replaced by a new well at a nearby location. The proposed location for the replacement well MW-71R is about 40 feet south of MW-71 (see Figure 1). In late November 2001, this location was discussed with Mr. Michael Hebert of the USEPA, Project Coordinator for the Sparton Site, and verbal approval for the installation of MW-71R at this location was obtained[4]. Easements for installing well MW-71R have been obtained from the City of Albuquerque, and installation of the well is scheduled for the week of January 14, 2002.

[4] Telephone communication between Michael Hebert of USEPA and Stavros S. Papadopulos of SSP&A, November 26, 2001.

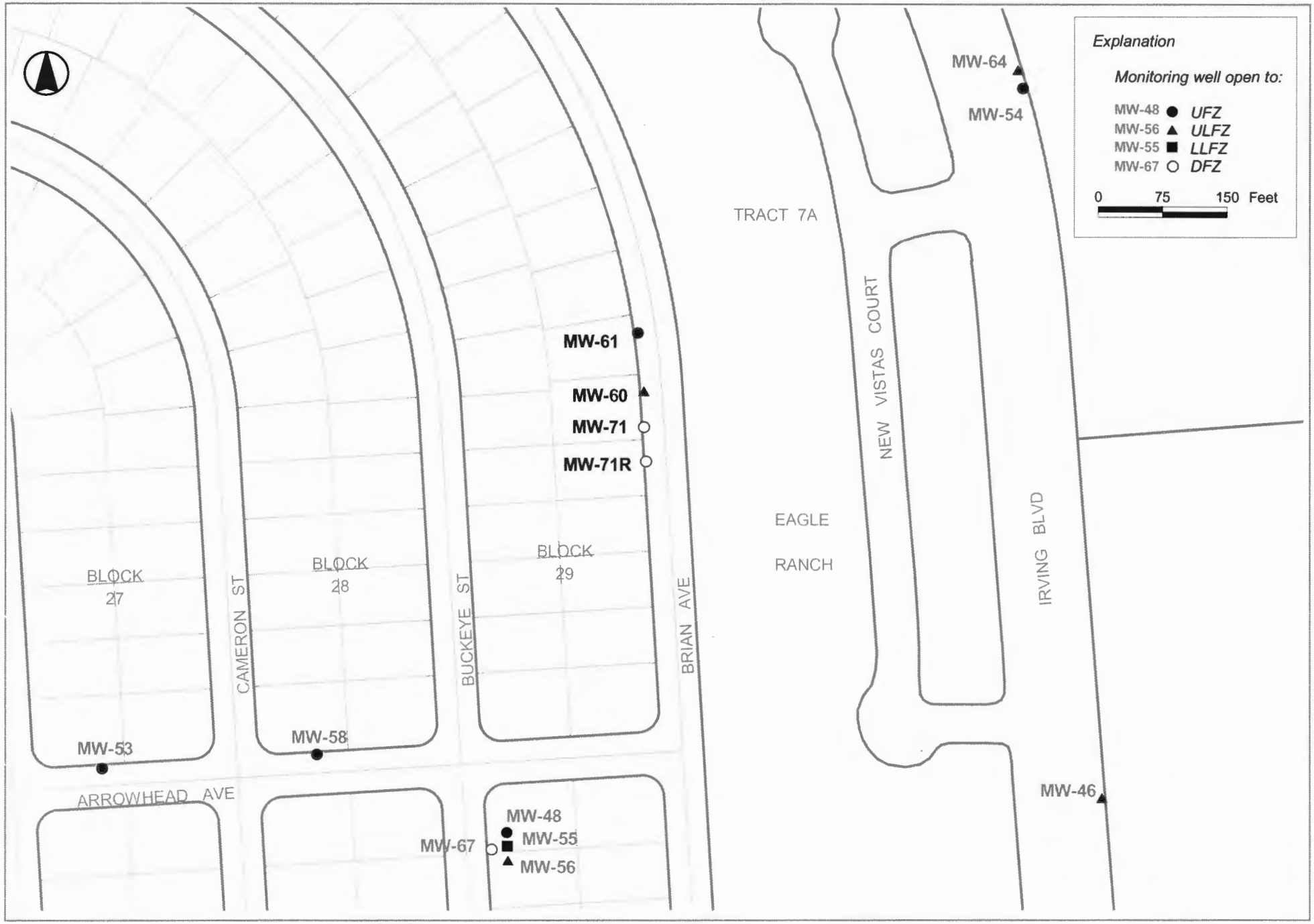

Figure 1 Proposed Location for the MW-71 Replacement Well MW-71R

APPENDIX

Appendix

Deviation-Survey Log of MW-71

TO VIEW THE MAP AND/OR MAPS WITH THIS DOCUMENT, PLEASE CALL THE HAZARDOUS WASTE BUREAU AT 505-476-6000 TO MAKE AN APPOINTMENT