LEE COUNTY
SOUTHWEST FLORIDA

CYCLE 9 UPDATE AND EVALUATION FOR CORKSCREW WATER TREATMENT PLANT AQUIFER STORAGE AND RECOVERY SYSTEM, LEE COUNTY, FLORIDA

April, 2011

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Prepared for:

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April, 2011

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I. INTRODUCTION

The Corkscrew aquifer storage and recovery (ASR) system is located at the Lee County Utilities Corkscrew water treatment plant (WTP) in central Lee County, Florida (Figure 1-1). The system consists of five 12-inch diameter ASR wells (ASR-1 through ASR-5) and five storage zone monitoring wells (MW-A, MW-C, and SZMW-1 through SZMW-3) completed in Mid Hawthorn aquifer Zone I, one overlying zone monitoring well completed in the Sandstone aquifer (MW-LM926), and one underlying zone monitoring well completed in the Mid Hawthorn aquifer Zone II (MW-B). The locations of these wells are shown on the aerial photo provided as Figure 1-2. A hydrostratigraphic column for the Corkscrew area is provided as Figure 1-3.

The Corkscrew ASR system wells are permitted by Florida Department of Environmental Protection (FDEP) underground injection control (UIC) construction permit number 142222-012-016-UC (Appendix A) in conjunction with Administrative Order (AO) number AO-050-SD/UIC09 (Appendix B). The purpose of the AO is to establish a schedule for compliance related to slightly elevated arsenic levels in wells ASR-1 and MW-C. The ASR wells are still operating under the UIC construction permit because arsenic concentrations in the recovered water in some of the ASR wells have slightly exceeded, on rare occasions, the reduced regulatory criteria of 10 micrograms per liter (ug/l) implemented by the FDEP on January 1, 2005.

The purpose of the present investigation is to provide detailed analyses of the operational data for Cycle 9, model the injected water through operational Cycle 9, update the optimal storage volume determination, utilize those analyses to provide operational input, and provide recommendations to operate the Corkscrew ASR system in compliance with FDEP regulations.

An annual evaluation update of the cycle data was recommended in the Assessment Plan (AP) (RMA GeoLogic Consultants, 2010) approved by the FDEP. The AP was required in the AO issued in conjunction with the construction permit for the Corkscrew ASR system. The purpose of the AP, of which the current report is one element, was to set forth a specific approach and timeframe for achieving full regulatory compliance for the Corkscrew ASR system.

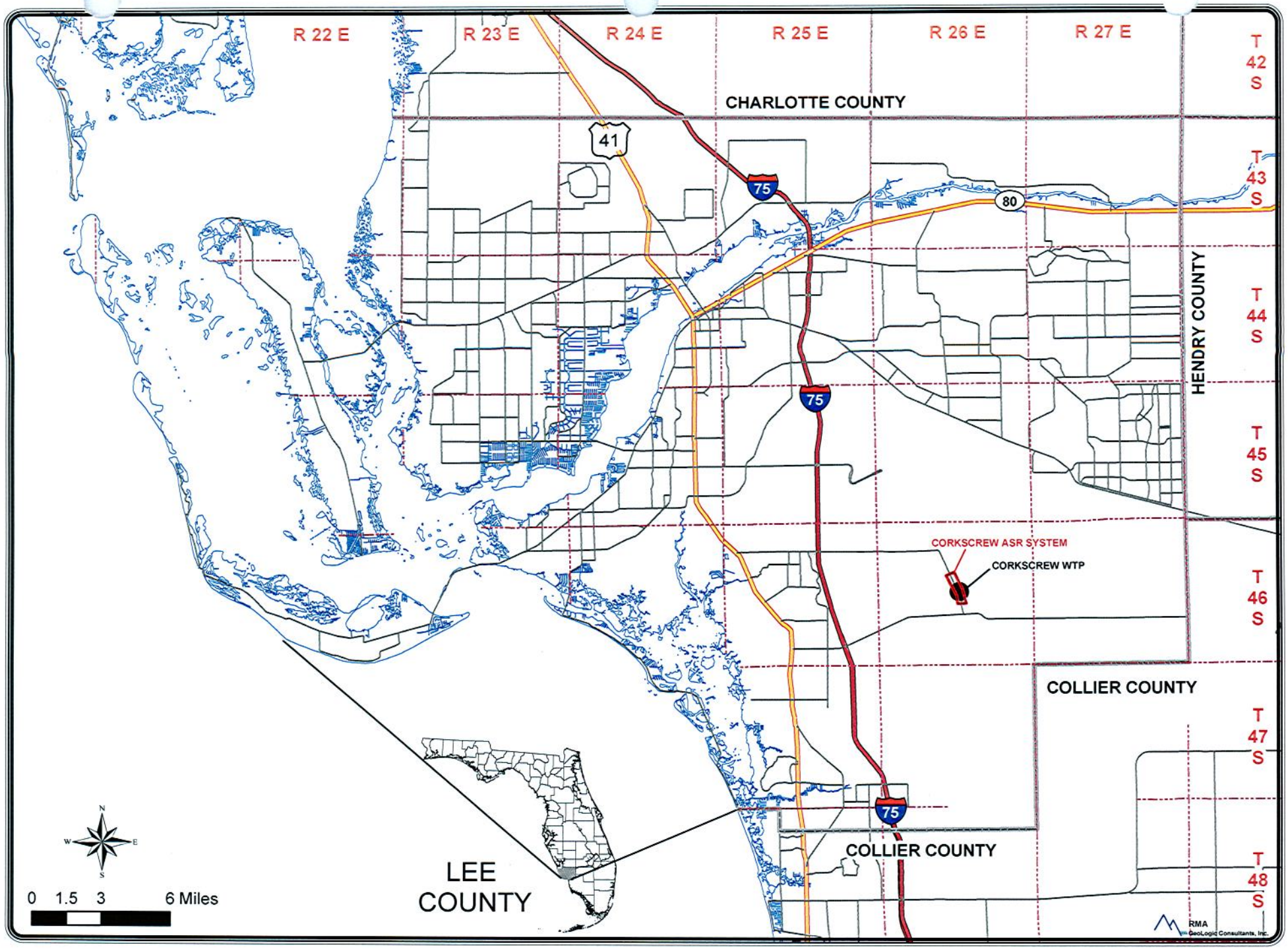
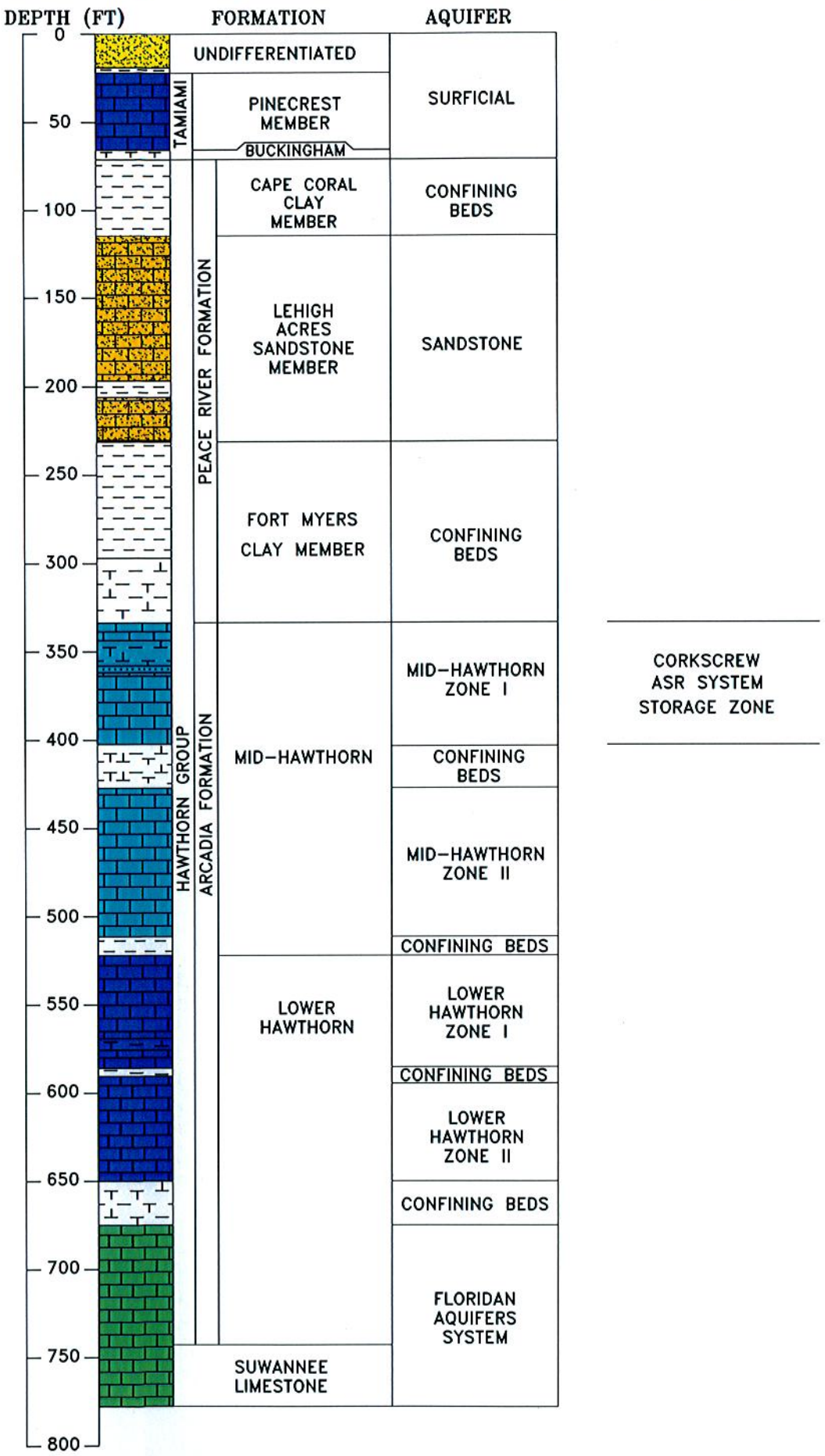


FIGURE 1-1. GENERAL SITE LOCATION MAP.

FIGURE 1-2. AERIAL PHOTO SHOWING LOCATION OF CORKSCREW WTP ASR SYSTEM WELLS.



RMA GeoLogic Consultants, Inc.	PROJECT NAME: CORKSCREW ASR SYSTEM	
	PROJECT NUMBER: 10-546	DATE: 02/11/11

FIGURE 1-3. GENERALIZED HYDROSTRATIGRAPHIC COLUMN FOR CORKSCREW WTP AREA.

II. CORKSCREW ASR SYSTEM CYCLE 9

A. Injection

Cycle 9 injection commenced on August 11, 2009 and continued to December 17, 2009. Approximately 355.8 MG of water was injected. A summary of the Corkscrew ASR system operations for Cycle 9 is provided as Table 2-1.

LCU adjusted and controlled the injection rate into the ASR wells on a daily basis. During Cycle 9 injection the monthly average day per well injection rate varied between 121 and 434 gpm with an average of 356 gpm per well for the entire injection period. The injection rates were influenced by the availability of finished water from the WTP. Plots of the injection rates and volumes into the ASR wells are provided as Figures 2-1 and 2-2.

The injection water quality was monitored on a daily basis (with the exception of specific injectivity and dissolved oxygen, which were measured weekly) by LCU personnel for the parameters shown on Table 2-2. All of the parameters shown on Table 2-2 were field measured, with the exception of dissolved chloride concentrations which were analyzed in the Corkscrew WTP wet lab.

In compliance with the FDEP UIC permit for the system, the injection water quality was sampled on a weekly basis by LCU and the samples were transported to the Lee County Environmental Laboratory (LCEL) for analyses of the additional water quality parameters shown on Table 2-3. Monthly operational reports were provided to the FDEP.

A summary of the range in concentrations for the various injection water quality parameters and a comparison to regulatory criteria is provided on Table 2-4. The injected water met all Primary and Secondary Drinking Water Standards throughout the approximate 4-month injection period with the exception of one value for pH measured in the field (on 10/21/09 a value of 6.37 SU was measured). However, the pH value measured in the laboratory on that day was 7.03 SU which is in compliance with the regulatory criteria.

TABLE 2-1. SUMMARY OF CORKSCREW ASR SYSTEM OPERATIONS FOR CYCLE 9.

ASR #	Injection Begins	Maximum Injection Rate (gpm)	Minimum Injection Rate (gpm)	Average Injection Rate (gpm)	Volume Injected (MG)	Injection Ends	Days of Storage	Recovery Begins	Maximum Recovery Rate (gpd)	Minimum Recovery Rate (gpd)	Average Recovery Rate (gpd)	Volume Recovered (MG)	Recovery Ends	Days of Recovery	Percent of Water Injected Recovered
ASR-1	8/11/2009	445	121	389	72.6	12/16/2009	48	2/2/2010	427	148	370	45.6	4/27/2010	84	63
ASR-2	8/11/2009	500	199	368	66.9	12/16/2009	71	2/25/2010	428	148	336	44.5	5/26/2010	90	67
ASR-3	8/11/2009	457	190	390	72.0	12/16/2009	48	2/2/2010	427	149	354	58.5	5/26/2010	113	81
ASR-4	8/11/2009	500	193	387	71.5	12/16/2009	54	2/8/2010	427	148	372	42.8	4/27/2010	78	59
ASR-5	8/11/2009	500	165	396	72.8	12/16/2009	48	2/2/2010	411	149	354	50.1	5/12/2010	99	69
Total	8/11/2009	500	121	386	355.8	12/16/2009	48-71	2/2/2010	428	148	357	241.4	4/27/2010	113	68

FIGURE 2-1. PLOT OF AVERAGE INJECTION RATES INTO THE ASR WELLS DURING CYCLE 9.

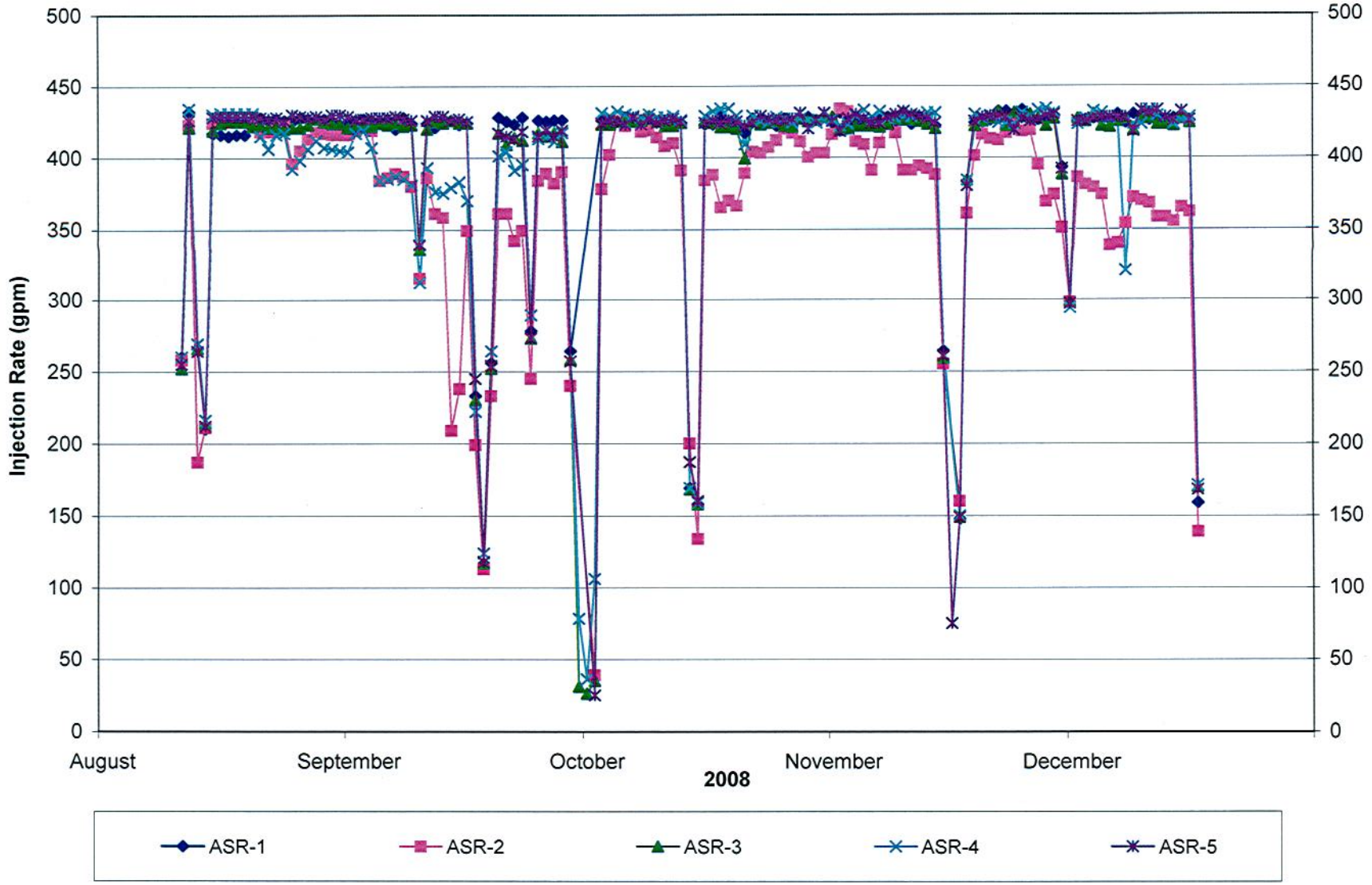


FIGURE 2-2. PLOT OF CUMULATIVE VOLUME INJECTED IN THE ASR WELLS IN CYCLE 9.

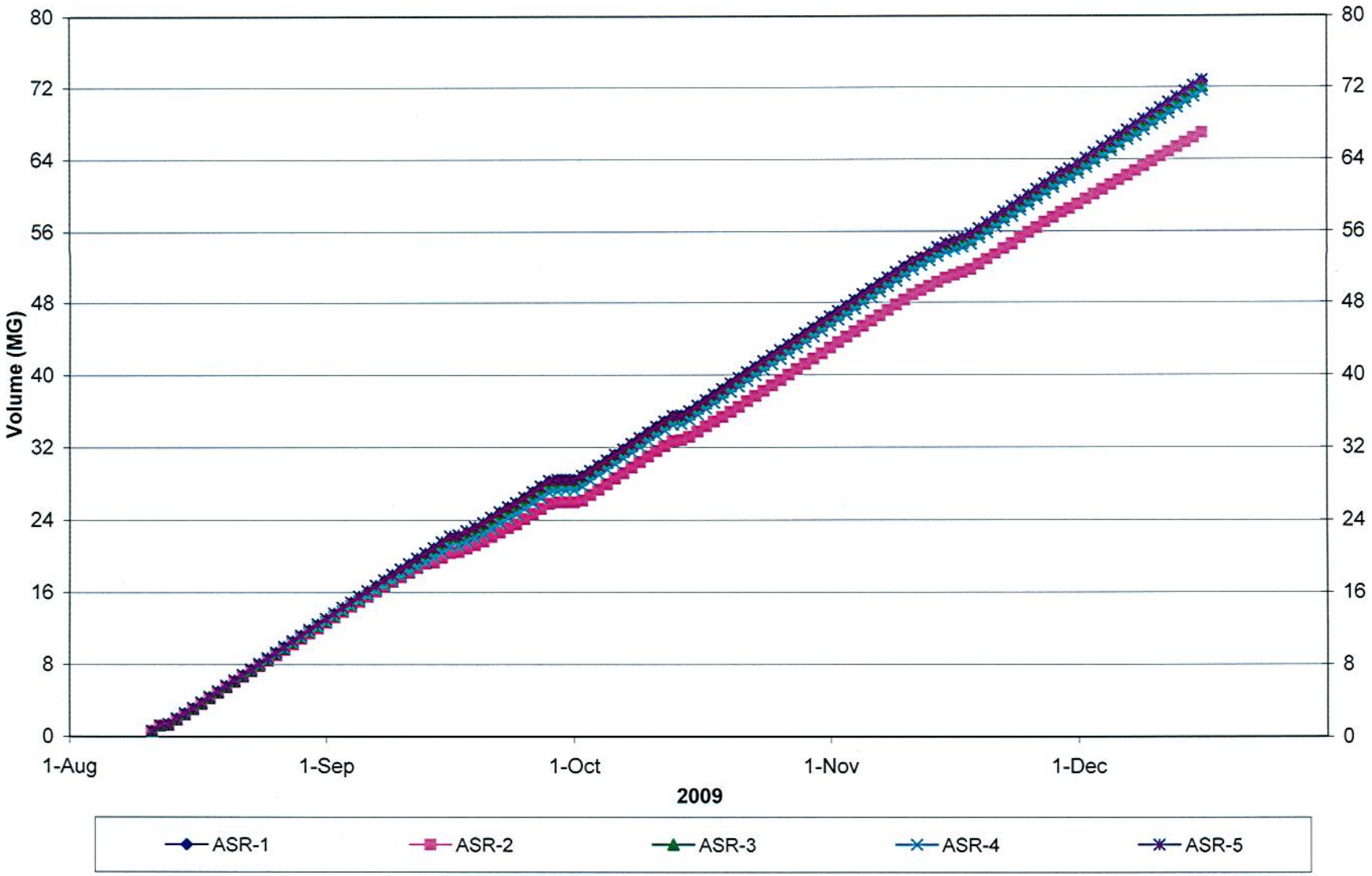


TABLE 2-2

SUMMARY OF FIELD ANALYZED HYDRAULIC AND WATER QUALITY PARAMETERS FOR THE ASR WELLS

Parameter	Analysis Frequency
Injection Pressure (psi)	Daily
Injection/Recovery rate (gpm)	Daily
Total Volume Injected/Recovered (gals)	Daily
Specific Capacity/Injectivity	Weekly
Dissolved Chloride (mg/l)	Daily
Specific Conductance (umhos/cm)	Daily
Temperature (°C)	Daily
Turbidity (NTU)	Daily
Dissolved Oxygen (mg/l)	Weekly
Free Chlorine (mg/l)	Daily
Total Chlorine (mg/l)	Daily
pH (SU)	Daily

TABLE 2-3

SUMMARY OF LABORATORY ANALYZED WATER QUALITY PARAMETERS FOR INJECTED WATER

Parameter	Analysis Frequency
Arsenic (ug/l)	Weekly
Total Iron (mg/l)	Weekly
Total Trihalomethanes (mg/l)	Weekly
Total Dissolved Solids (mg/l)	Weekly
Dissolved Chloride (mg/l)	Weekly
Specific Conductance (umhos/cm)	Weekly
Total Alkalinity (mg/l)	Weekly
Sulfate (mg/l)	Weekly
Total Hardness (mg/l)	Weekly
Calcium Hardness (mg/l)	Weekly
Total Color (CU)	Weekly
Gross Alpha (pC/l)	Monthly

TABLE 2-4. SUMMARY OF INJECTED WATER QUALITY RANGES VERSUS REGULATORY CRITERIA DURING CYCLE 9.

Parameter	Minimum Concentration	Maximum Concentration	Regulatory Criteria	Units
Total Iron	0.04	0.11	0.3	mg/L
Total Arsenic	0.5	1.0	10	ug/L
TDS	252	478	500	mg/L
Dissolved Oxygen (Field)	2.4	3.5	NA	mg/L
Dissolved Oxygen (Lab)	8.1	8.8	NA	mg/L
Sulfate	28	119	250	mg/L
Chloride	59.0	135.0	250	mg/L
PH	6.4	7.9	6.5 - 8.5	SU
Gross Alpha	2.0	4.0	15.0	pCi/L
Total Alkalinity	54	79	NA	mg/L
Specific Conductance	385	809	NA	umhos/cm
Field Temperature	24.6	29.7	NA	°C
Total Trialomethanes	0.1	13.0	80	ug/L

mg/L: Milligrams per Liter
ug/L: Micrograms per Liter
CU: Color Units
SU: PH Standard Units
pCi/L: Picocourier per Liter
NTU: Nephelometric Turbidity Units
BDL: Below Detection Limit
NA: Not Applicable

It should be noted that the injected water quality was not consistent throughout the 4-month injection period, with dissolved chloride concentrations of approximately 125 mg/l and a total alkalinity of about 70 mg/l during the first three months of injection. During the last month of injection, the dissolved chloride concentration was approximately 70 mg/l and the alkalinity was about 60 mg/l. The average field determined dissolved oxygen concentration of the injected water was about 3.0 mg/l. This compares to the laboratory determined dissolved oxygen average of 8.5 mg/l. Plots of the injected water quality are provided as Figures 2-3A and 2-3B.

Potentiometric water levels in the five storage zone observation wells, the overlying zone monitoring well, and the underlying zone monitoring well were monitored on a daily basis. A plot of water level elevations for each monitoring well is provided as Figure 2-4.

Water samples were obtained from the monitoring wells and analyzed for those parameters shown on Tables 2-5 and 2-6. A summary of the range in concentrations for the various water quality parameters in the monitoring wells during injection into the ASR wells and a comparison to regulatory criteria is provided on Table 2-7. The water quality parameters in the monitoring wells met all Primary and Secondary Drinking Water Standards throughout the approximate 4-month injection period with the exception of two isolated anomalous iron concentrations in storage zone monitoring well MW-3 (0.45 mg/l on 8/26/09) and in underlying zone monitoring well MW-B (4.86 mg/l on 11/18/09). Those two isolated anomalous iron concentrations are likely laboratory math errors. Plots of the water quality in the monitoring wells during Cycle 9 are provided as Figures 2-5 through 2-11.

B. Storage

Cycle 9 storage commenced on December 17, 2009 and continued until February 2, 2010. Therefore, the storage duration was for approximately 1.5 months. A summary of the water quality collected during the storage period is provided on Table 2-7. The water quality parameters in the monitoring wells met all Primary and Secondary Drinking Water Standards throughout the storage period with the exception of one isolated anomalous iron concentration in storage zone monitoring well MW-A (2.96 mg/l on 12/22/09). That isolated anomalous iron concentration is likely a laboratory math error. Plots of the water quality in the monitoring wells during Cycle 9 are provided as Figures 2-5 through 2-11.

FIGURE 2-3A. PLOT OF WATER QUALITY INJECTED INTO THE ASR WELLS IN CYCLE 9 (PART 1)

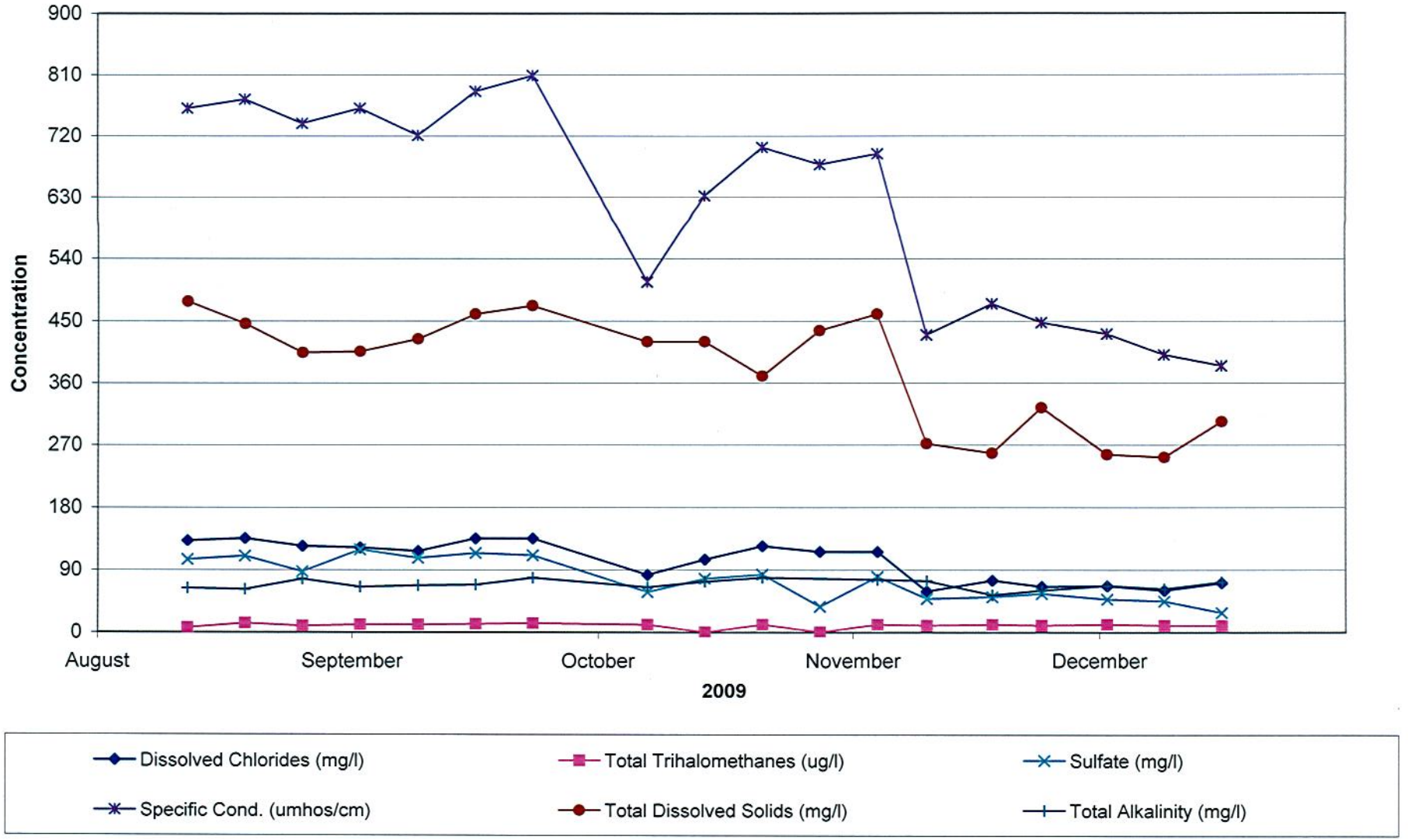


FIGURE 2-3B. PLOT OF WATER QUALITY INJECTED INTO ASR WELLS IN CYCLE 9 (PART 2)

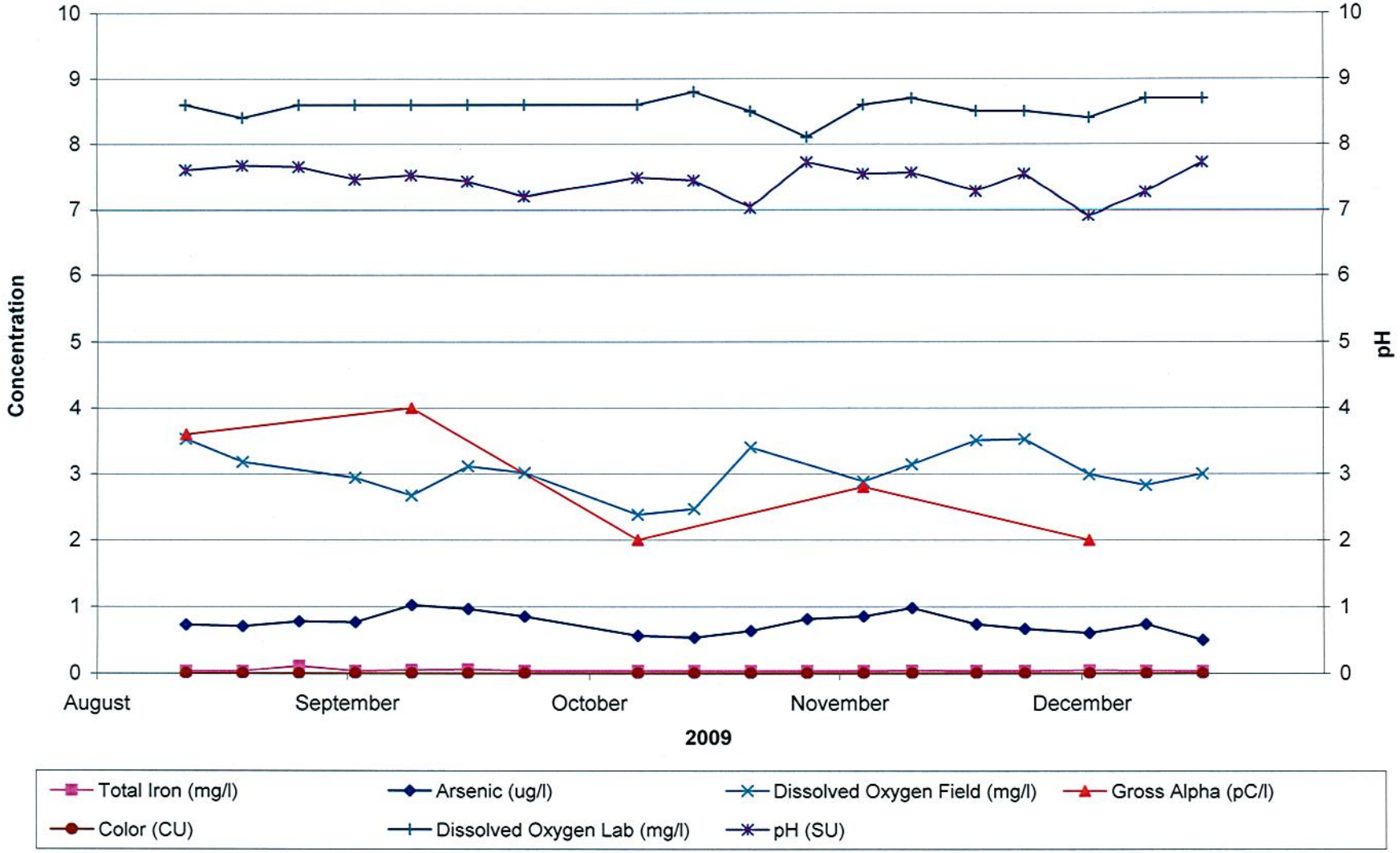


FIGURE 2-4. PLOT OF WATER LEVEL ELEVATIONS IN MONITORING WELLS DURING CYCLE 9.

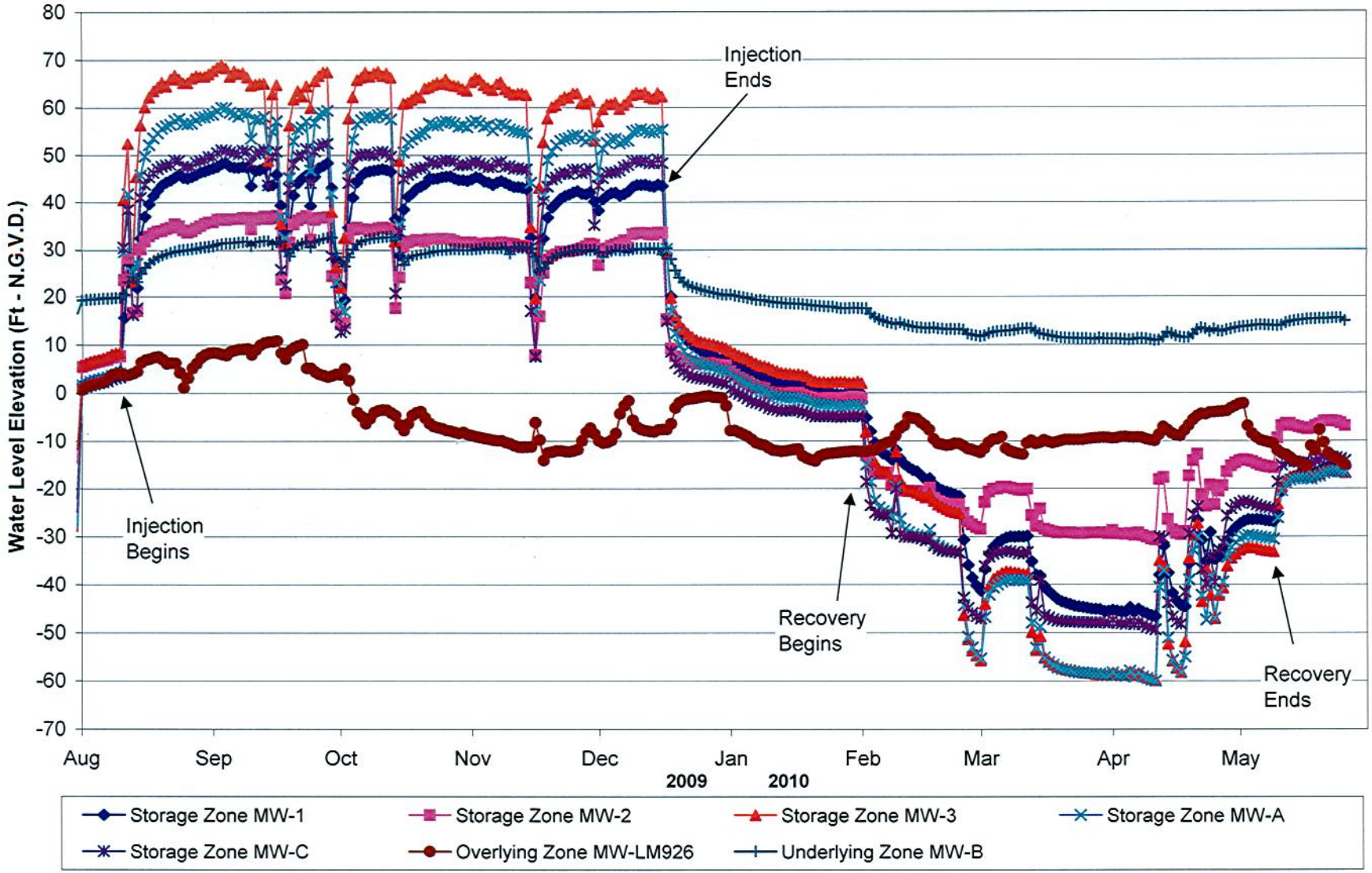


TABLE 2-5

SUMMARY OF FIELD ANALYZED HYDRAULIC AND WATER QUALITY PARAMETERS FOR STORAGE ZONE MONITORING WELLS

Parameter	Analysis Frequency
Potentiometric Water Level (feet NGVD)	Daily
Dissolved Chloride (mg/l)	Weekly
Specific Conductance (umhos/cm)	Weekly
Temperature (°C)	Weekly
Turbidity (NTU)	Weekly
Dissolved Oxygen (mg/l)	Weekly
Free Chlorine (mg/l)	Weekly
Total Chlorine (mg/l)	Weekly
pH (SU)	Weekly

TABLE 2-6

SUMMARY OF LABORATORY ANALYZED WATER QUALITY PARAMETERS FOR MONITORING WELLS

Parameter	Analysis Frequency
Arsenic (ug/l)	Weekly
Total Iron (mg/l)	Weekly
Total Trihalomethanes (mg/l)	Weekly
Total Dissolved Solids (mg/l)	Weekly
Dissolved Chloride (mg/l)	Weekly
Specific Conductance (umhos/cm)	Weekly
Total Alkalinity (mg/l)	Weekly
Sulfate (mg/l)	Weekly
Total Hardness (mg/l)	Weekly
Calcium Hardness (mg/l)	Weekly
Total Color (CU)	Weekly
Gross Alpha (pC/l)	*

* = Beginning and end of each recovery cycle in monitoring wells MW-1, MW-2, and MW-3

TABLE 2-7. SUMMARY OF MONITORING WELLS WATER QUALITY RANGES VERSUS REGULATORY CRITERIA FOR CYCLE 9.

Parameter	STORAGE ZONE MONITORING WELLS										UNDERLYING ZONE MW		OVERLYING ZONE MW		Regulatory Criteria	Units
	MW-1		MW-2		MW-3		MW-A		MW-C		MW-B		MW-LM926			
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN		
INJECTION																
Total Iron	0.12	0.04	0.04	0.04	0.45^	0.04	0.04	0.04	0.04	0.04	4.86^	0.04	0.12	0.04	0.3	mg/L
Total Arsenic	0.5	0.5	1.9	0.5	0.5	0.5	0.5	0.5	4.2	0.1	0.5	0.5	0.5	0.5	10	ug/L
TDS	414	298	386	276	404	260	408	278	424	280	468	388	466	386	500**	mg/L
Dissolved Oxygen Field	2.9	1.6	2.4	1.3	2.4	1.4	2.5	1.2	2.6	1.2	1.9	1.6	2.5	1.2	NA	mg/L
Dissolved Oxygen Lab	0.7	0.1	2.4	0.1	2.8	0.6	0.7	0.1	2.0	1.3	0.4	0.1	0.1	0.1	NA	mg/L
Sulfate	17	10	46	21	59	18	22	14	80	35	45	38	55	28	250	mg/L
Chloride	46	40	67	51	103	47	52	44	105	52	51	44	83	45	250	mg/L
PH	8.1	7.3	8.0	7.4	8.1	7.7	8.1	7.7	8.1	7.6	8.1	7.7	7.8	7.4	6.5 - 8.5	SU
Gross Alpha	2.0	2.0	3.2	3.2	4.0	4.0	NT	NT	2.0	2.0	NT	NT	NT	NT	15.0	pCi/L
Total Alkalinity	255	237	224	167	188	125	234	221	161	108	287	276	271	259	NA	mg/L
Total Trialomethanes	0.2	0.1	0.7	0.1	0.5	0.1	0.1	0.1	10.0	0.1	0.1	0.1	0.2	0.1	80.0	ug/L
STORAGE																
Total Iron	0.04	0.04	0.04	0.04	0.04	0.04	2.96^	0.04	0.04	0.04	0.06	0.04	0.04	0.04	0.3	mg/L
Total Arsenic	0.5	0.5	1.3	0.8	0.5	0.5	0.5	0.5	3.1	1.8	0.5	0.5	0.5	0.5	10	ug/L
TDS	420	308	391	346	404	324	398	294	436	248	436	392	468	384	500**	mg/L
Dissolved Oxygen Field	4.0	1.8	2.6	1.6	4.3	1.1	3.5	2.1	3.3	1.0	2.5	1.7	3.0	1.0	NA	mg/L
Dissolved Oxygen Lab	1.3	0.1	1.8	0.1	5.2	1.1	3.1	0.3	2.6	1.1	1.2	0.1	1.3	0.1	NA	mg/L
Sulfate	19	13	26	17	56	45	20	12	79	76	47	39	30	29	250	mg/L
Chloride	43	41	57	53	96	85	51	43	101	99	46	45	52	49	250	mg/L
PH	8.1	8.0	8.0	8.0	8.2	8.1	8.2	8.1	8.1	8	8.1	8.0	7.9	7.8	6.5 - 8.5	SU
Gross Alpha	2.8	2.8	2.3	2.3	4.0	4.0	NT	NT	NT	NT	NT	NT	NT	NT	15.0	pCi/L
Total Alkalinity	244	237	228	214	153	125	234	219	118	116	276	270	264	280	NA	mg/L
Total Trialomethanes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	80.0	ug/L
RECOVERY																
Total Iron	0.04	0.04	0.04	0.04	0.04	0.01	0.04	0.01	0.04	0.01	0.04	0.01	0.19	0.01	0.3	mg/L
Total Arsenic	0.56	0.5	5.1	0.5	0.5	0.5	0.5	0.5	12.5	1.3	0.5	0.5	0.6	0.5	10	ug/L
TDS	434	284	382	316	348	235	376	284	452	326	493	360	496	368	500**	mg/L
Dissolved Oxygen Field	3.1	1.5	2.5	1.5	3.7	1.6	3.2	1.4	2.3	0.9	2.2	1.0	2.8	0.6	NA	mg/L
Dissolved Oxygen Lab	1.1	0.1	2.8	1.3	4.4	0.8	2.4	0.6	2.7	1.4	1.1	0.1	0.4	0.1	NA	mg/L
Sulfate	20	10	54	26	51	19	20	13	78	50	48	39	37	28	250	mg/L
Chloride	46	39	78	54	86	43	45	41	99	68	48	42	53	47	250	mg/L
PH	8.1	7.6	8.0	7.6	8.2	7.9	8.2	7.8	8.1	7.7	8.1	7.7	7.7	7.4	6.5 - 8.5	SU
Gross Alpha	2.5	2.5	3.6	2.7	2.5	2.5	NT	NT	NT	NT	NT	NT	NT	NT	15.0	pCi/L
Total Alkalinity	242	223	216	158	209	137	234	216	151	112	280	262	265	245	NA	mg/L
Total Trialomethanes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	80.0	ug/L

** May be greater if no other maximum contaminant level is exceeded
mg/L: Milligrams per Liter
SU: PH Standard Units
CU: Color Units
ug/L: Micrograms per Liter
NTU: Nephelometric Turbidity Units
pCi/L: Picocourier per Liter
^ Probable Lab Error

FIGURE 2-5A. PLOT OF WATER QUALITY IN STORAGE ZONE MW-1 DURING CYCLE 9 (PART 1)

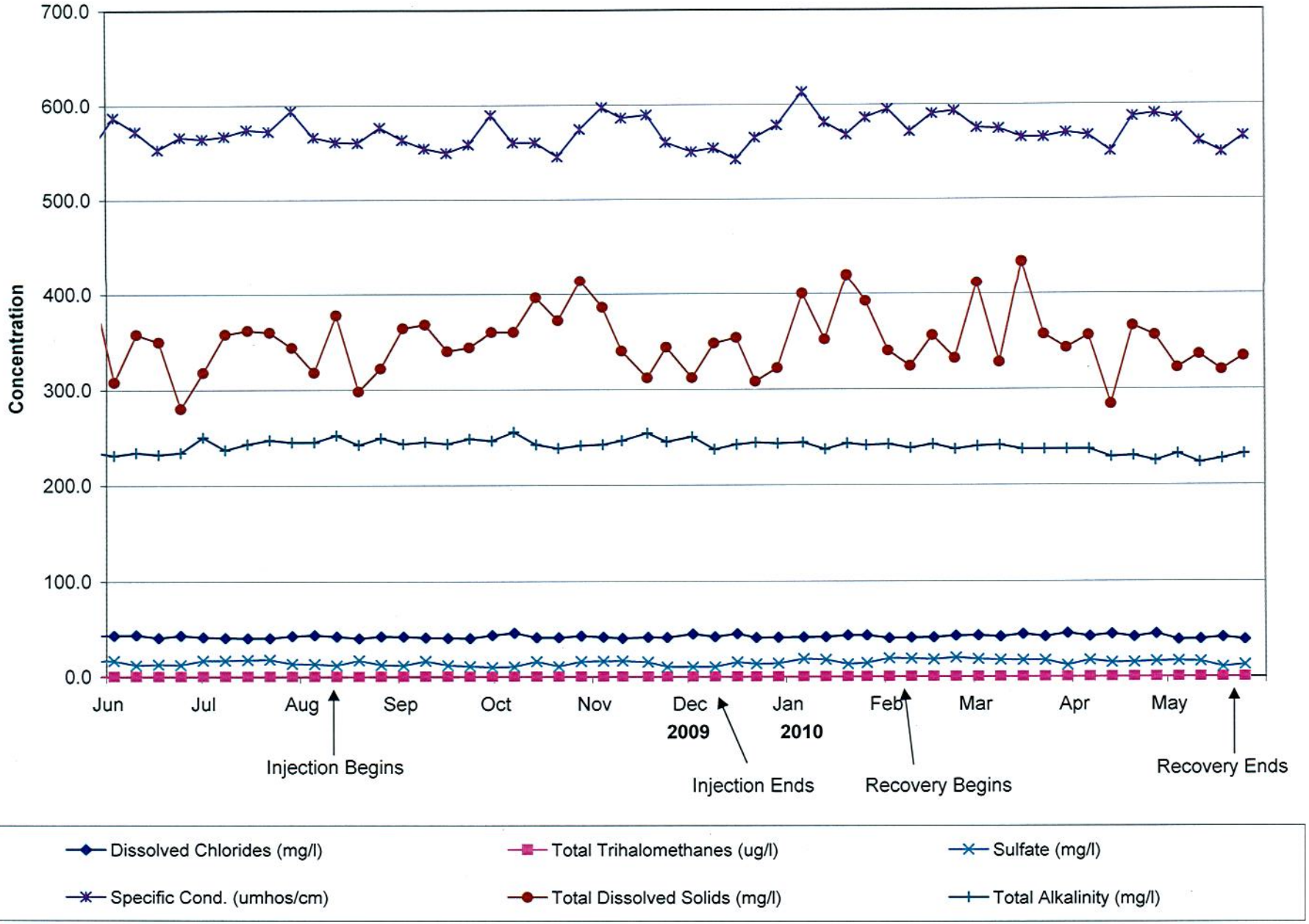


FIGURE 2-5B PLOT OF WATER QUALITY IN STORAGE ZONE MW-1 DURING CYCLE 9 (PART 2)

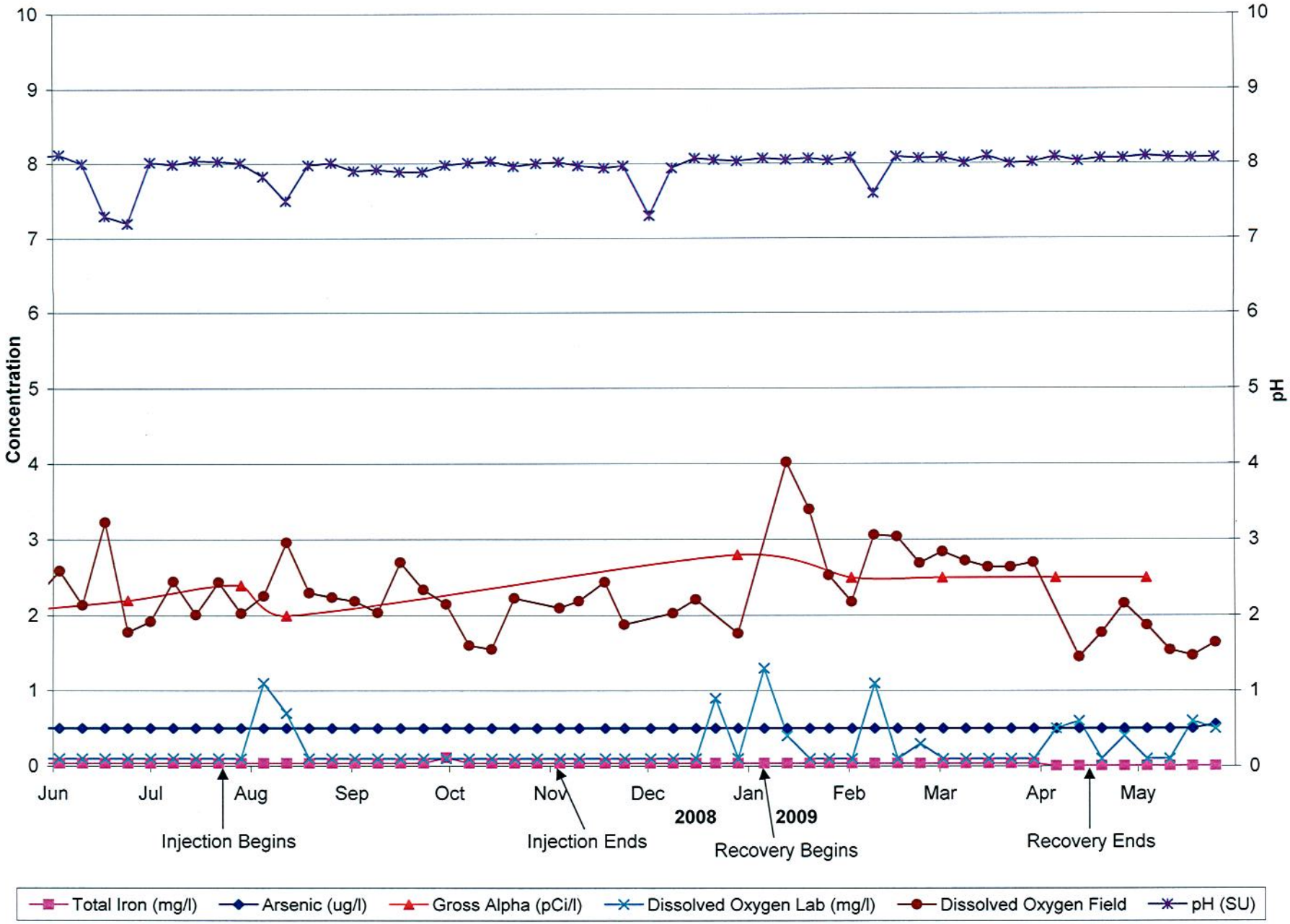


FIGURE 2-6A. PLOT OF WATER QUALITY IN STORAGE ZONE MW-2 DURING CYCLE 9 (PART 1)

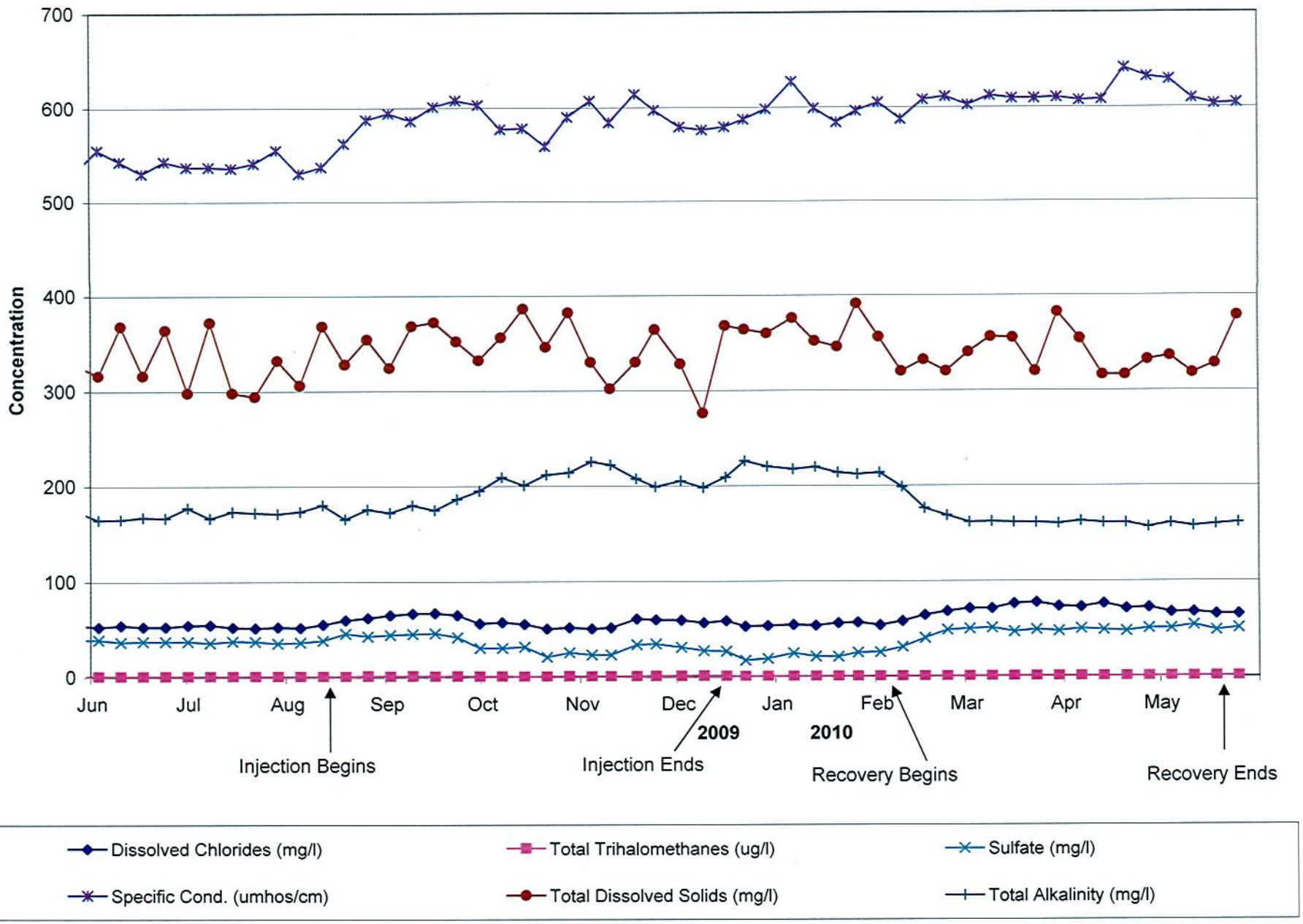


FIGURE 2-6B. PLOT OF WATER QUALITY IN STORAGE ZONE MW-2 DURING CYCLE 9 (PART 2)

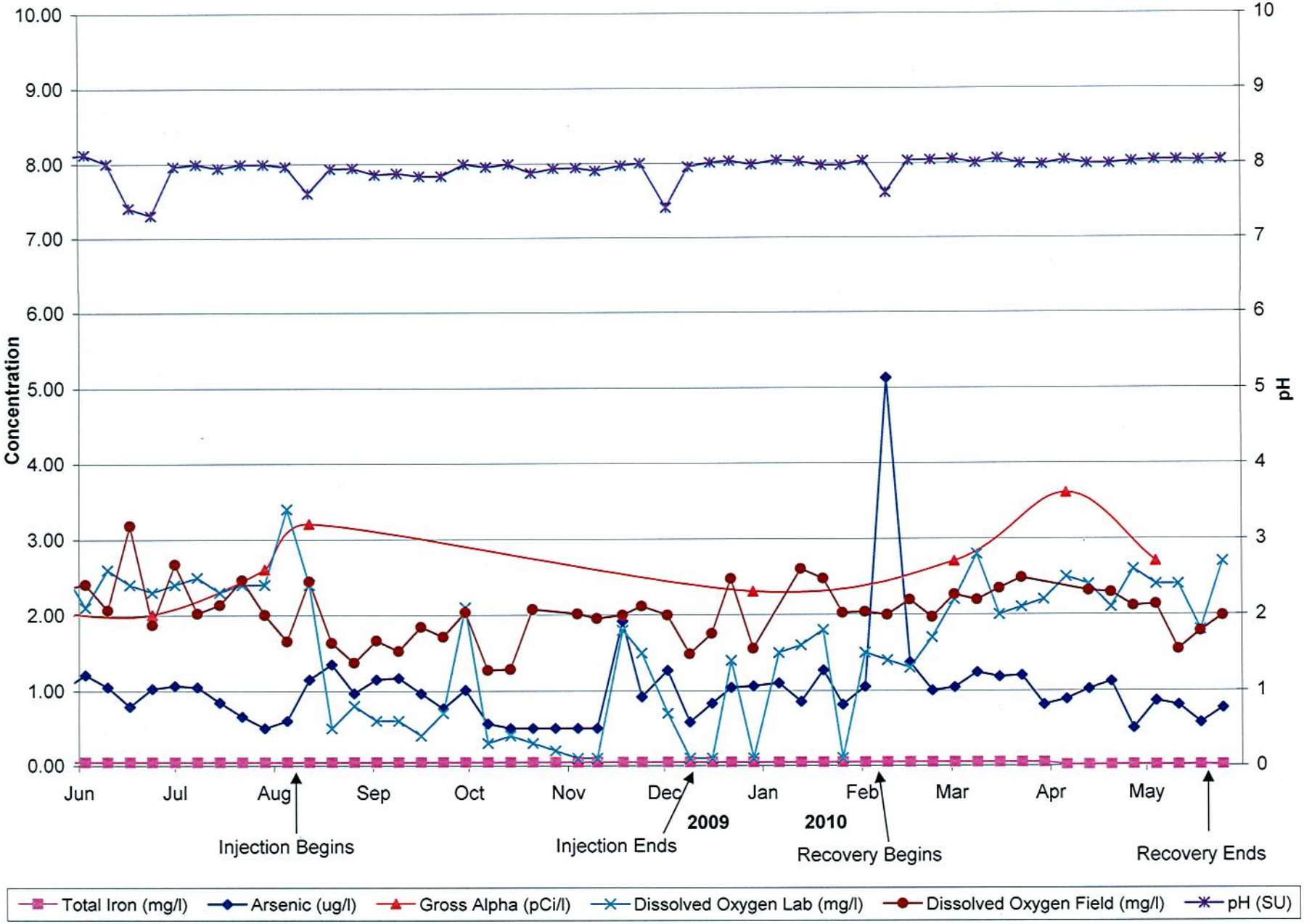


FIGURE 2-7A- PLOT OF WATER QUALITY IN STORAGE ZONE MW-3 DURING CYCLE 9 (PART 1)

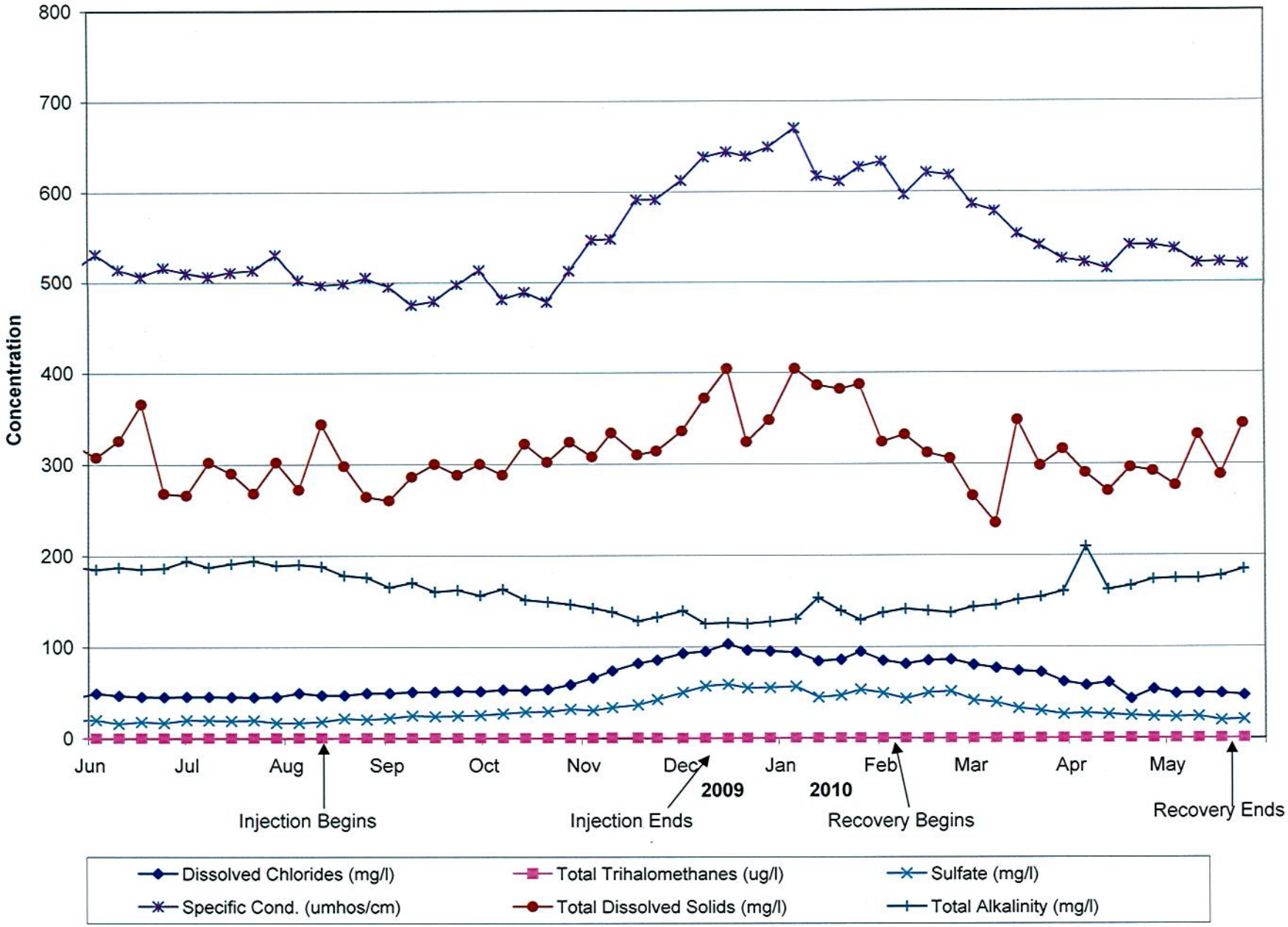


FIGURE 2-7B. PLOT OF WATER QUALITY IN STORAGE ZONE MW-3 DURING CYCLE 9 (PART 2)

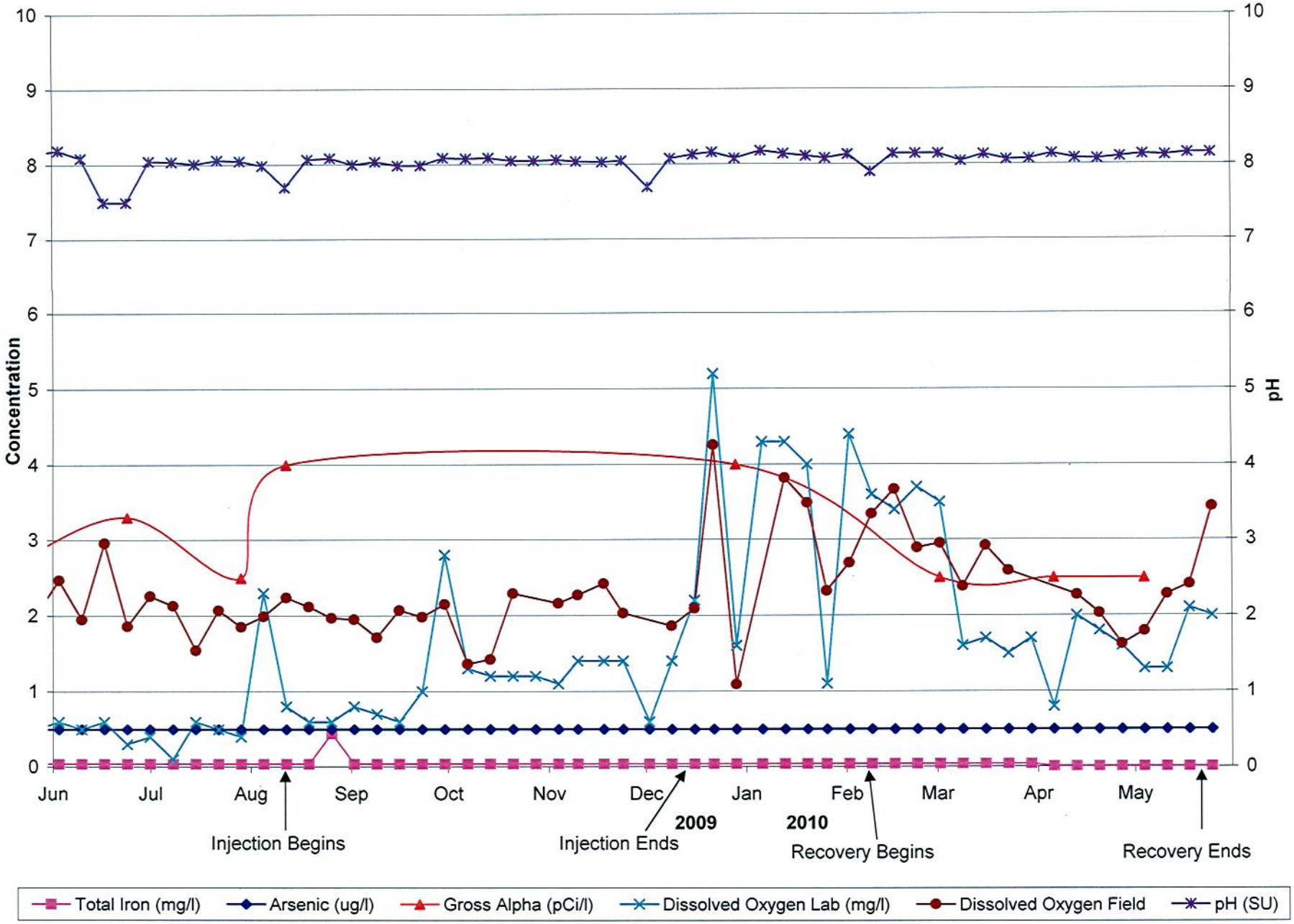


FIGURE 2-8A- PLOT OF WATER QUALITY IN STORAGE ZONE MW-A DURING CYCLE 9 (PART 1)

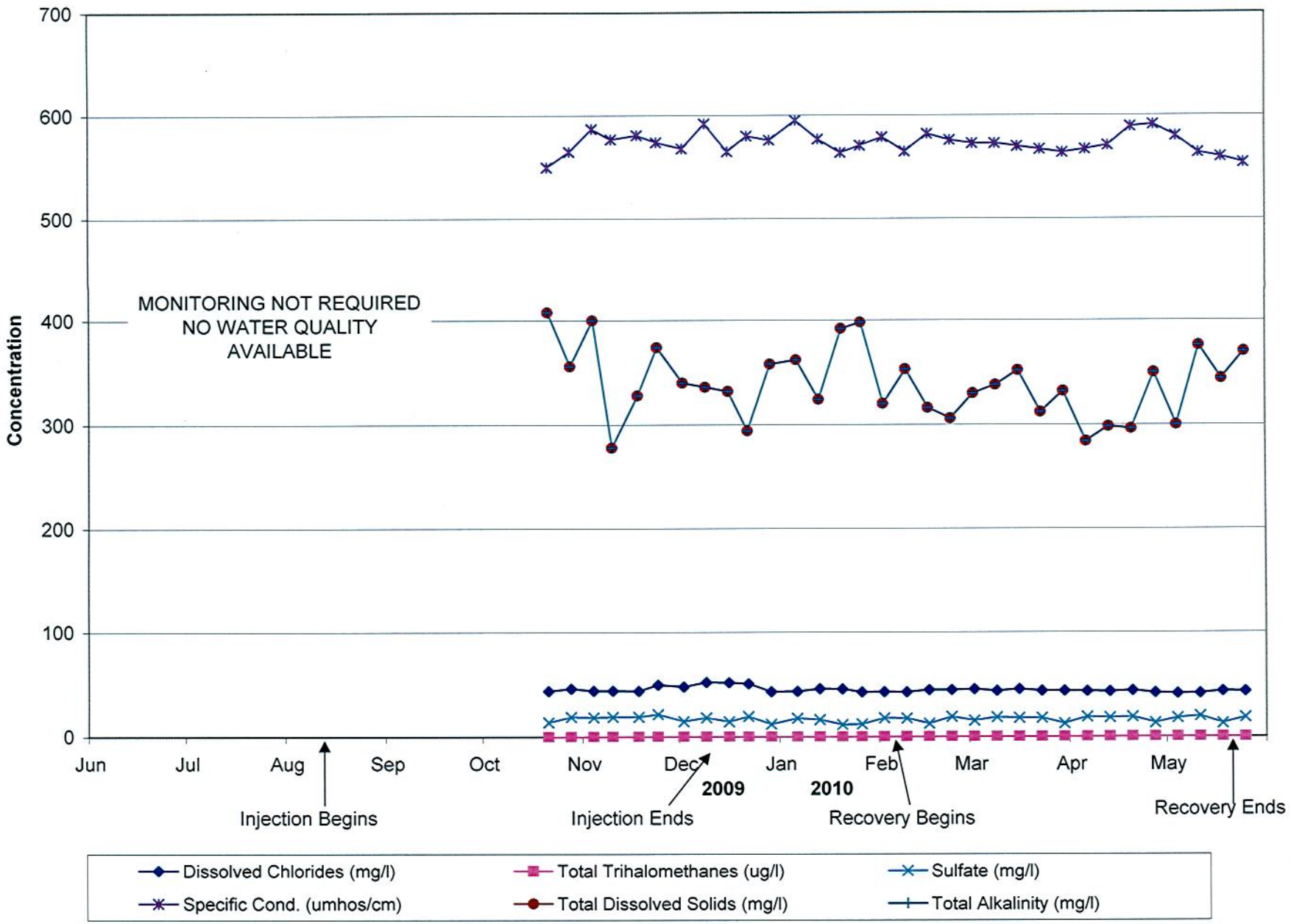


FIGURE 2-8B. PLOT OF WATER QUALITY IN STORAGE ZONE MW-A DURING CYCLE 9 (PART 2)

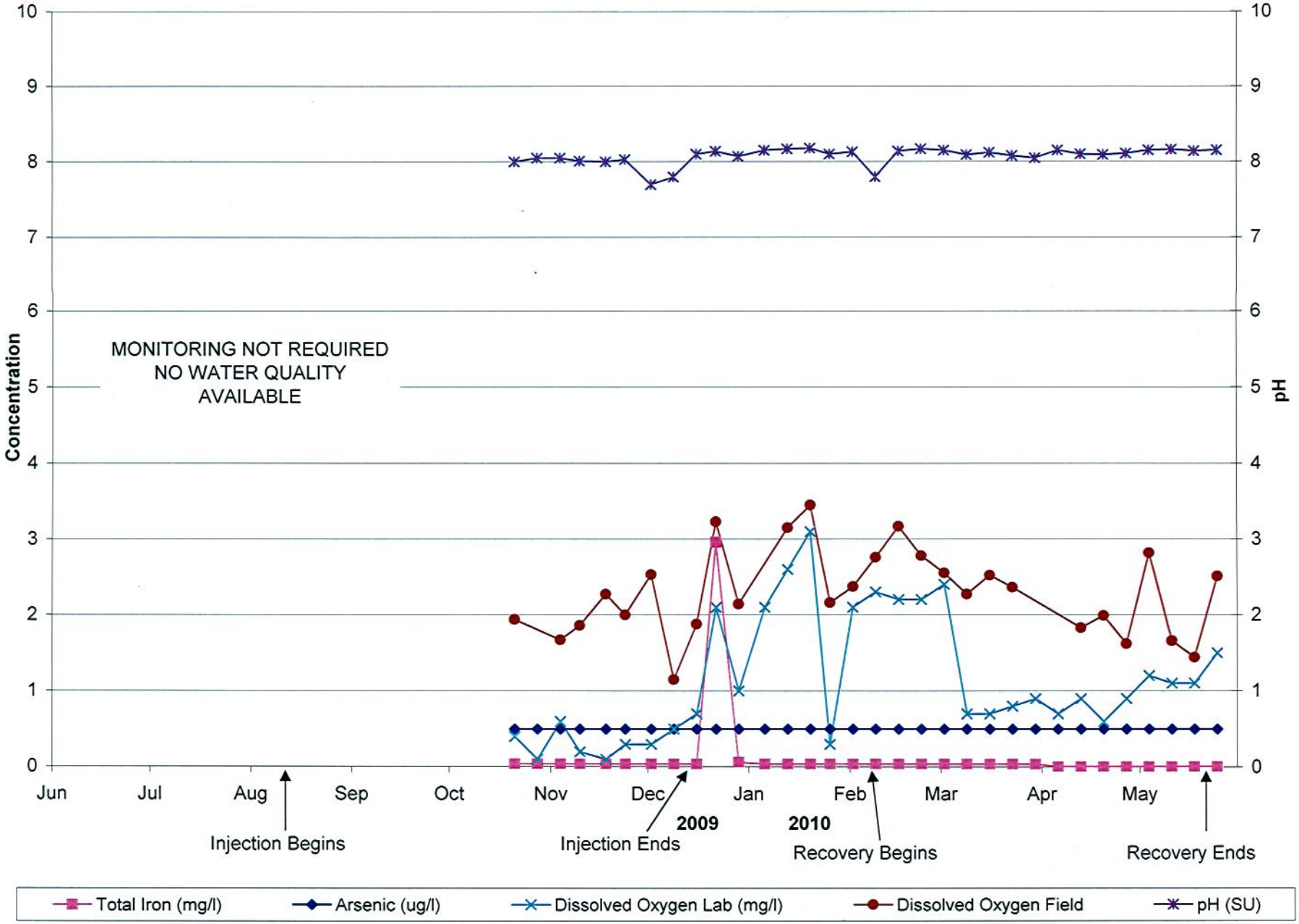


FIGURE 2-9A. PLOT OF WATER QUALITY IN STORAGE ZONE MW-C DURING CYCLE 9 (PART 1)

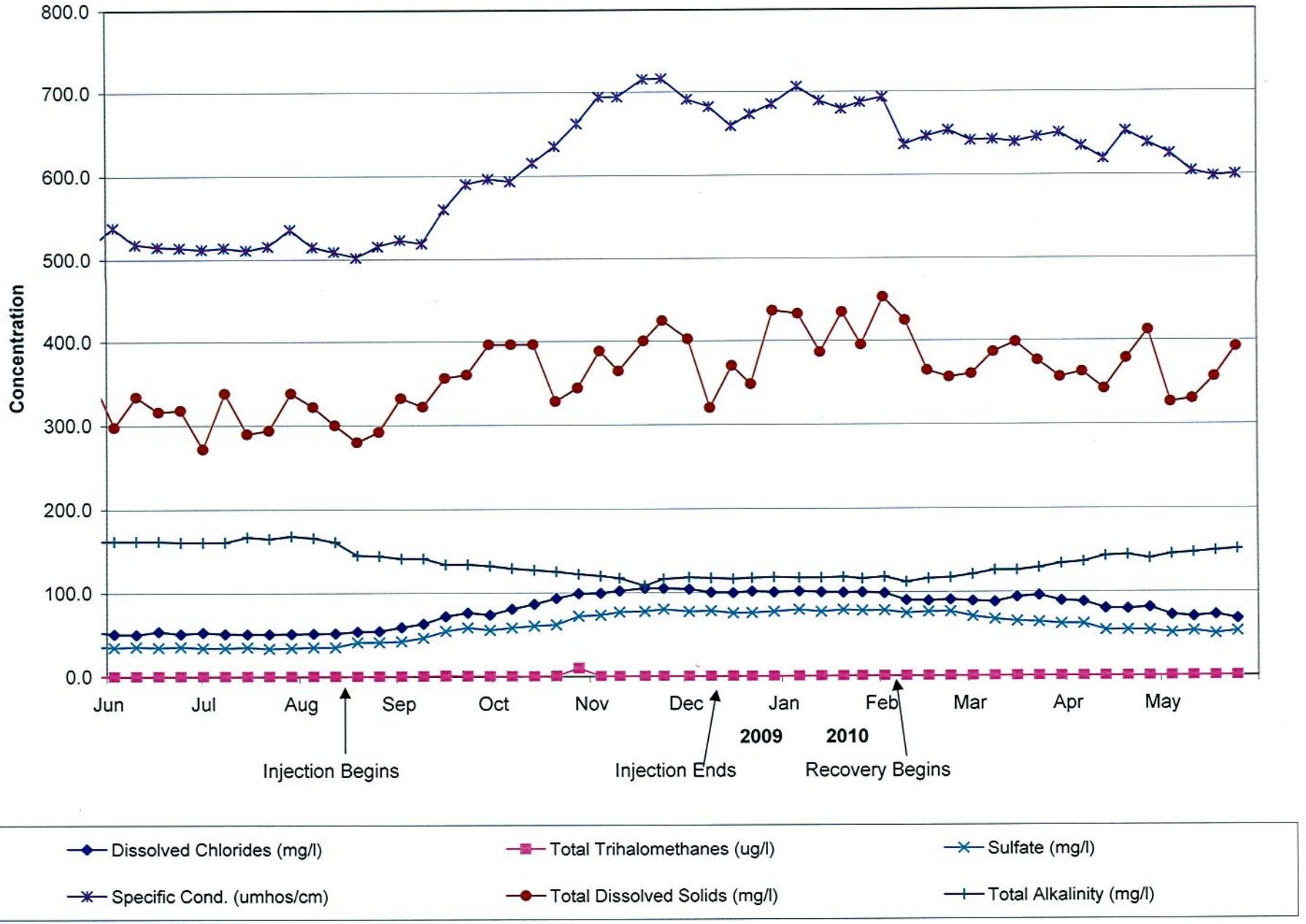


FIGURE 2-9B. PLOT OF WATER QUALITY IN STORAGE ZONE MW-C DURING CYCLE 9 (PART 2)

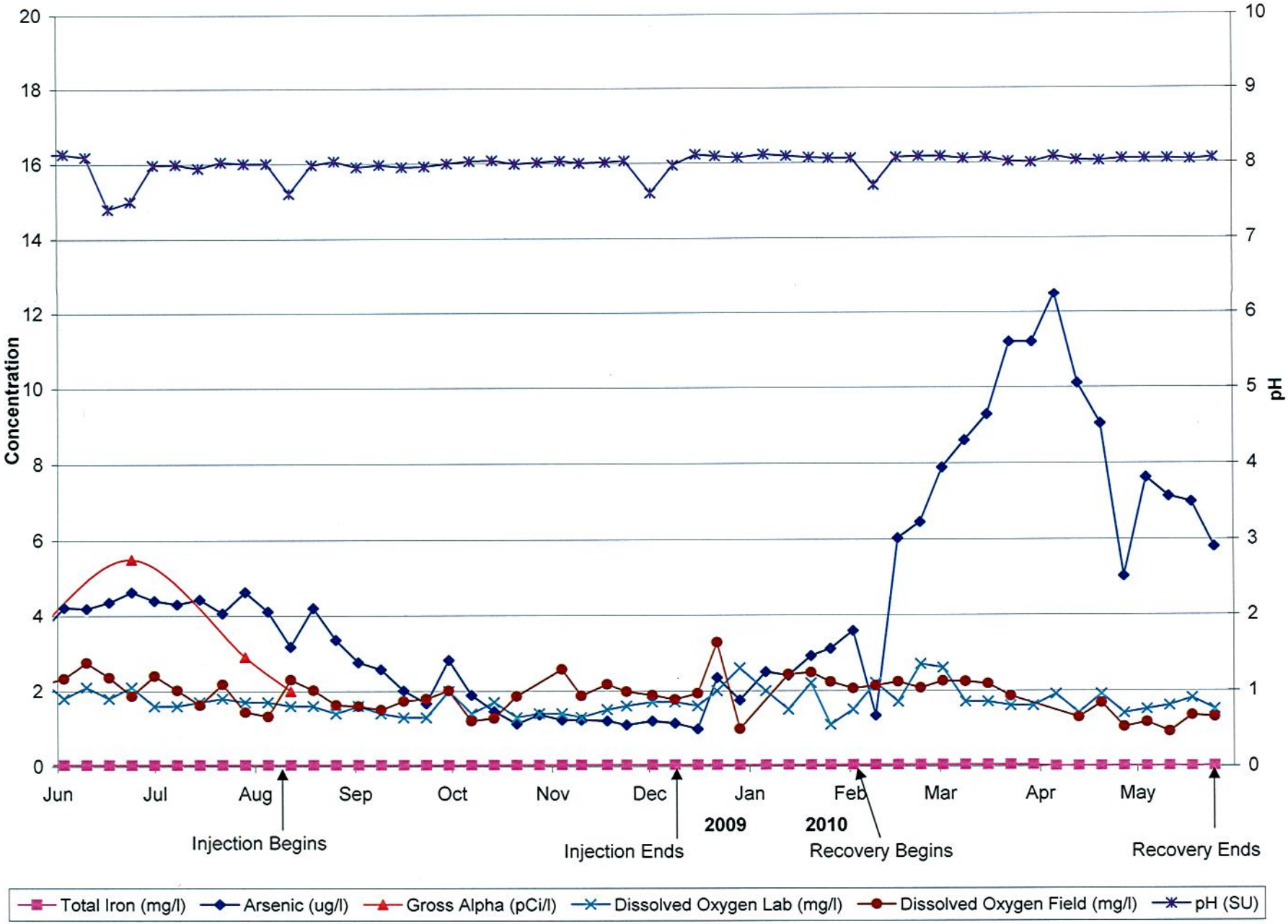


FIGURE 2-10A- PLOT OF WATER QUALITY IN UNDERLYING ZONE MW-B DURING CYCLE 9 (PART 1)

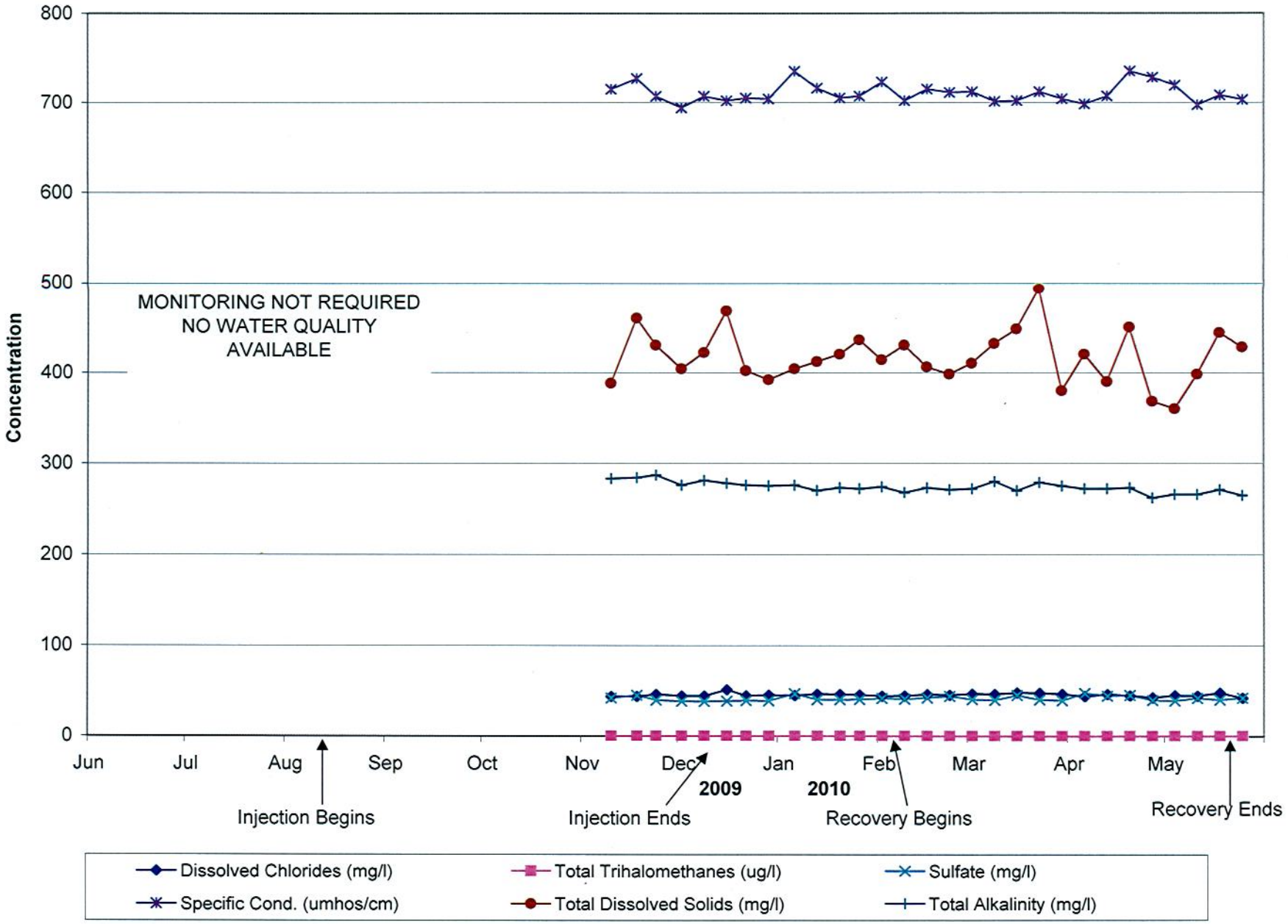


FIGURE 2-10B. PLOT OF WATER QUALITY IN UNDERLYING ZONE MW-B DURING CYCLE 9 (PART 2)

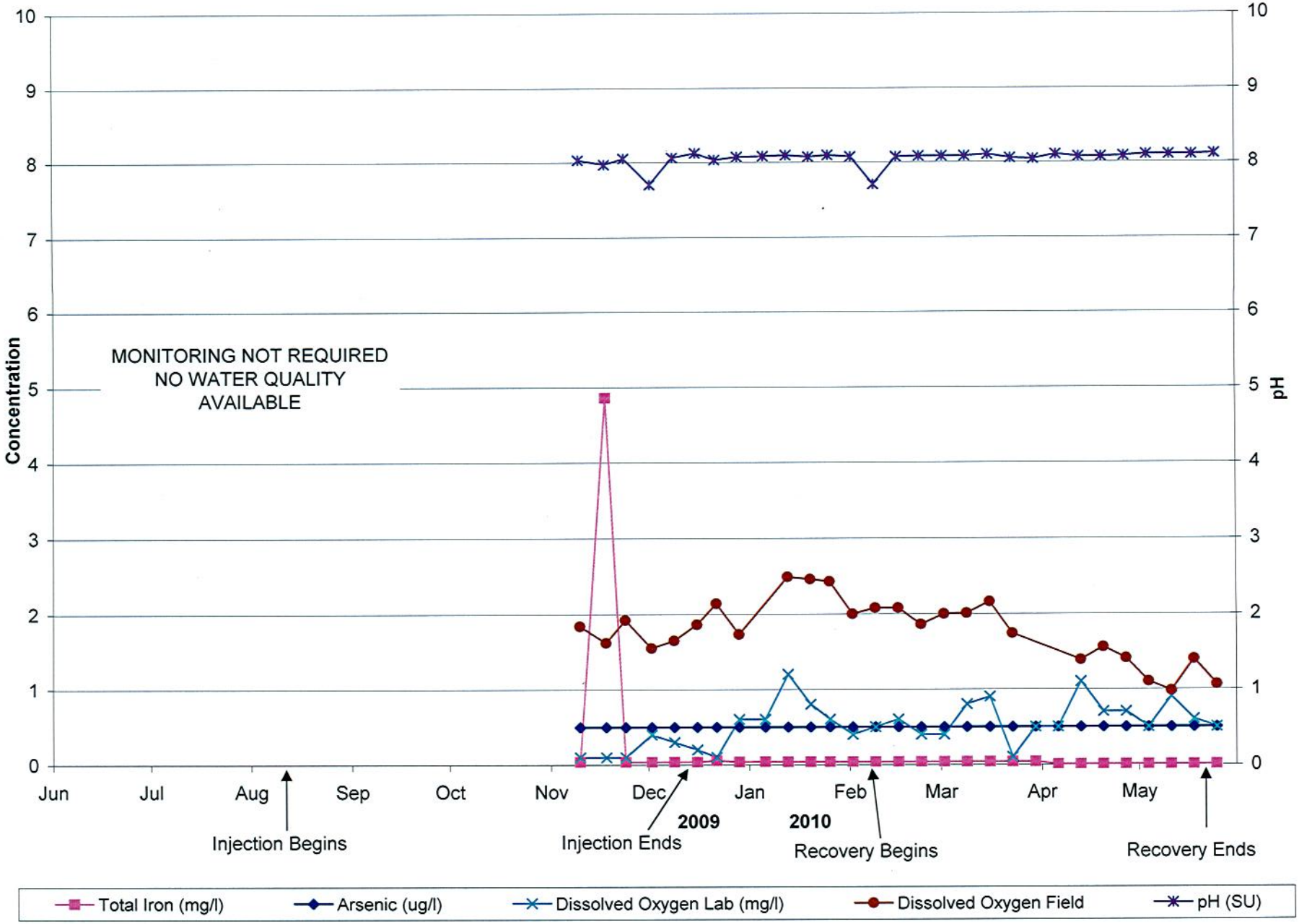


FIGURE 2-11A. PLOT OF WATER QUALITY IN OVERLYING ZONE MW-LM926 DURING CYCLE 9 (PART 1)

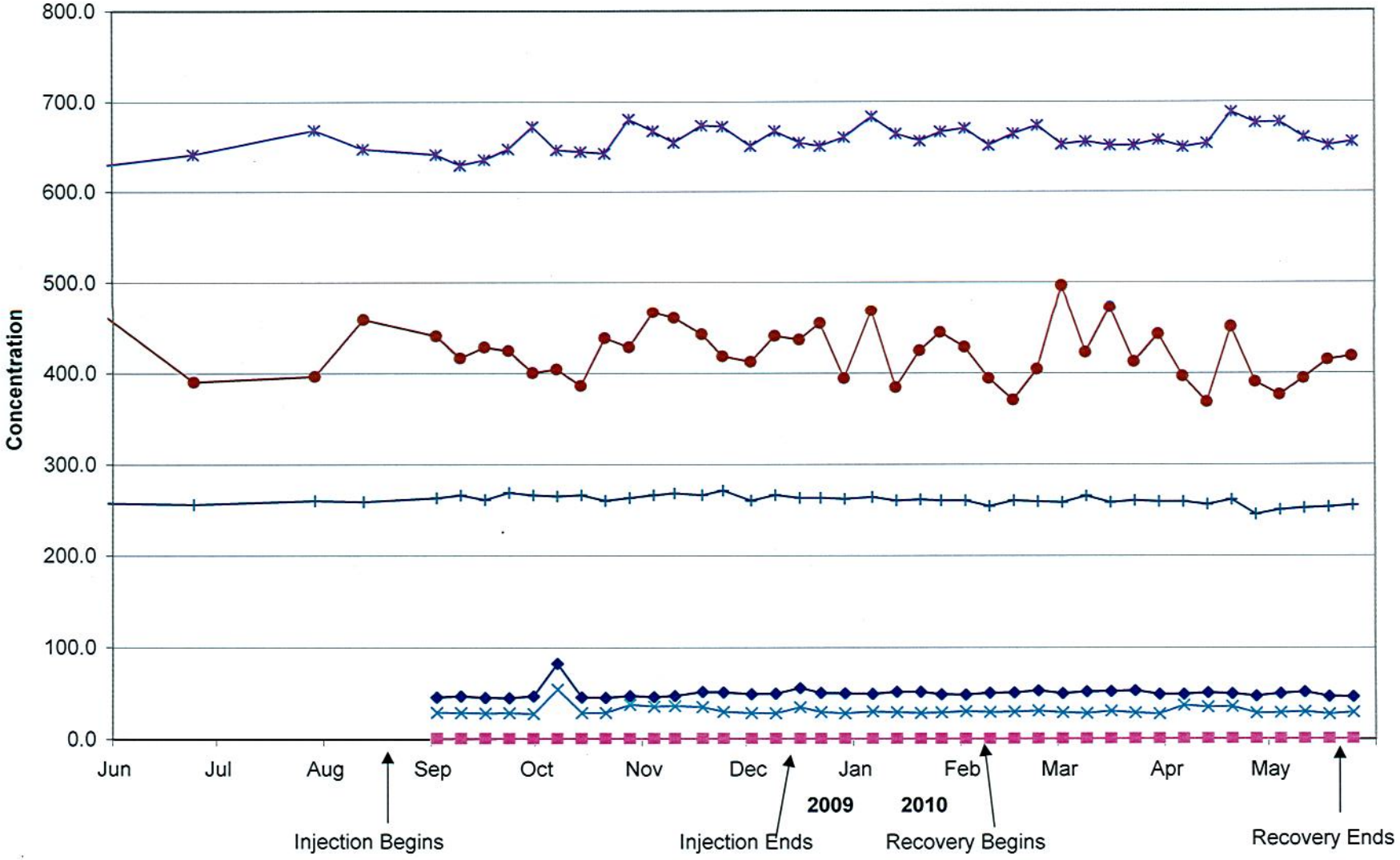
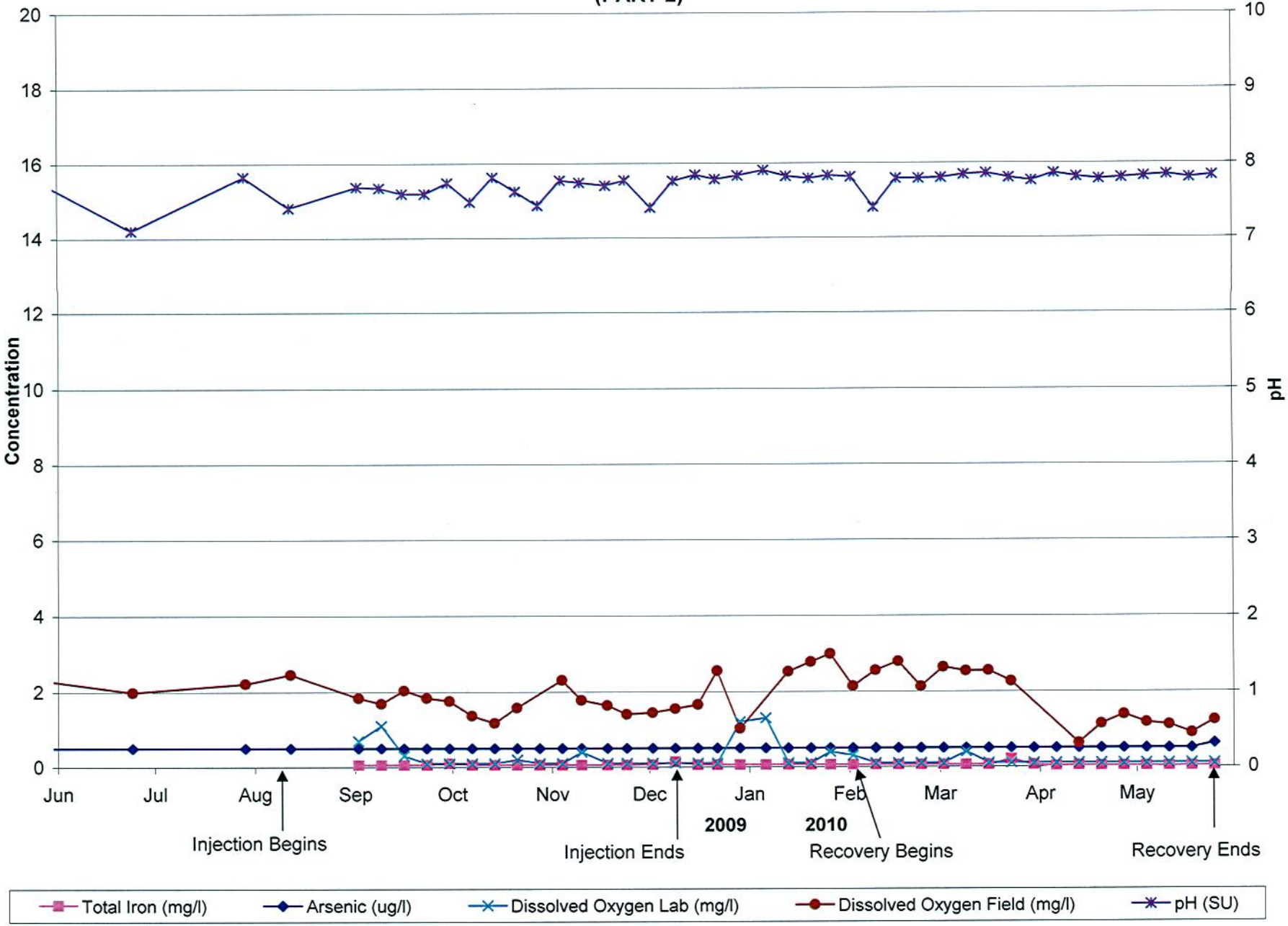


FIGURE 2-11B. PLOT OF WATER QUALITY IN OVERLYING ZONE MW-LM926 DURING CYCLE 9 (PART 2)



C. Recovery

Cycle 9 recovery commenced from the Corkscrew ASR system on February 2, 2010. Recovery continued until May 26, 2010 from wells ASR-2 and ASR-3. Recovery operations from wells ASR-1 and ASR-4 were stopped on April 27, 2010 and from well ASR-5 on May 12, 2010. At the end of recovery, the alkalinity concentrations for wells ASR-1, ASR-2, ASR-3, ASR-4, and ASR-5 were 134, 119, 142, 144, and 130 mg/l, respectively. The maximum arsenic concentration recorded during recovery in wells ASR-1, ASR-2, ASR-3, ASR-4, and ASR-5 occurred during the last sampling event of recovery with values of 11.5 (on 4/21/10), 5.1 (on 5/26/10), 7.2 (on 5/26/10), 8.0 (on 4/21/10), and 8.0 ug/l (on 5/5/10), respectively.

A total of 241.4 MG of water was recovered during Cycle 9. This represents approximately 68% of the injected volume. The recovery water quality data indicates that additional volumes of injected water could have been recovered from wells ASR-2 through ASR-5 without exceeding the arsenic concentration of 10 ug/l. A summary of the Corkscrew ASR system operations during recovery for Cycle 9 is provided as Table 2-1.

The recovered water quality was monitored on a daily basis by Corkscrew WTP personnel for the same parameters as shown on Table 2-2. The recovered water quality was sampled on a weekly basis by Corkscrew WTP personnel and the samples were transported to the Lee County Environmental Laboratory (LCEL) for analyses of the additional water quality parameters shown on Table 2-3.

A summary of the range in concentrations for the various recovered water quality parameters and a comparison to regulatory criteria is provided on Table 2-8. The water quality parameters in the recovered water from the ASR wells met all Primary and Secondary Drinking Water Standards throughout the approximate 3.5-month recovery period with the exception of one arsenic concentration in well ASR-1 at the end of the recovery period. That arsenic concentration (11.5 ug/l) slightly exceeded the maximum contaminant limit of 10 ug/l. Plots of recovered water quality from the ASR wells are provided as Figures 2-12 through 2-16.

The monthly average daily recovery rate per well varied between 148 and 428 gpm. The average recovery rate during Cycle 9 was 357 gpm per well. Plots of recovery rates and cumulative volumes recovered versus time are provided as Figures 2-17 and 2-18.

TABLE 2-8. SUMMARY OF RECOVERED WATER QUALITY RANGES VERSUS REGULATORY CRITERIA DURING CYCLE 9.

Parameter	ASR-1		ASR-2		ASR-3		ASR-4		ASR-5		Regulatory Criteria	Units
	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN	MAX	MIN		
Total Iron	0.12	0.07	0.13	0.09	0.12	0.08	0.20	0.11	0.16	0.10	0.3	mg/L
Total Arsenic	11.5	3.8	5.7	2.5	7.6	4.5	8.0	4.8	8.0	4.2	10	ug/L
TDS	430	308	396	288	428	304	382	300	420	312	500*	mg/L
Total Color	8.0	5.5	8.0	6.2	10.3	6.9	9.2	7.0	8.5	7.0	15	CU
Sulfate	71	48	73	57	66	41	59	48	74	33	250	mg/L
Chloride	90	68	99	67	86	62	80	65	95	68	250	mg/L
PH	8.1	7.4	8.1	7.9	8.0	7.5	8.0	7.5	8.0	7.5	6.5 - 8.5	SU
Gross Alpha	4.7	3.1	5.7	2.9	6.7	2.5	4.5	2.5	7.7	2.5	15	pCi/L
Turbidity	1.1	0.0	1.4	0.0	1.7	0.0	1.5	0.1	1.1	0.1	NA	NTU
Total Alkalinity	134	110	119	108	156	124	144	132	130	111	NA	mg/L
Total Hardness	180	160	178	144	197	162	190	160	221	158	NA	mg/L
Total Trialomethanes	2.4	0.1	0.3	0.1	0.4	0.1	0.2	0.1	2.5	1.3	80	ug/L

* May be greater if no other maximum contaminant level is exceeded
mg/L: Milligrams per Liter
ug/L: Micrograms per Liter
CU: Color Units
SU: PH Standard Units
pCi/L: Picocourier per Liter
NTU: Nephelometric Turbidity Units

FIGURE 2-12A. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-1 DURING CYCLE 9 (PART 1)

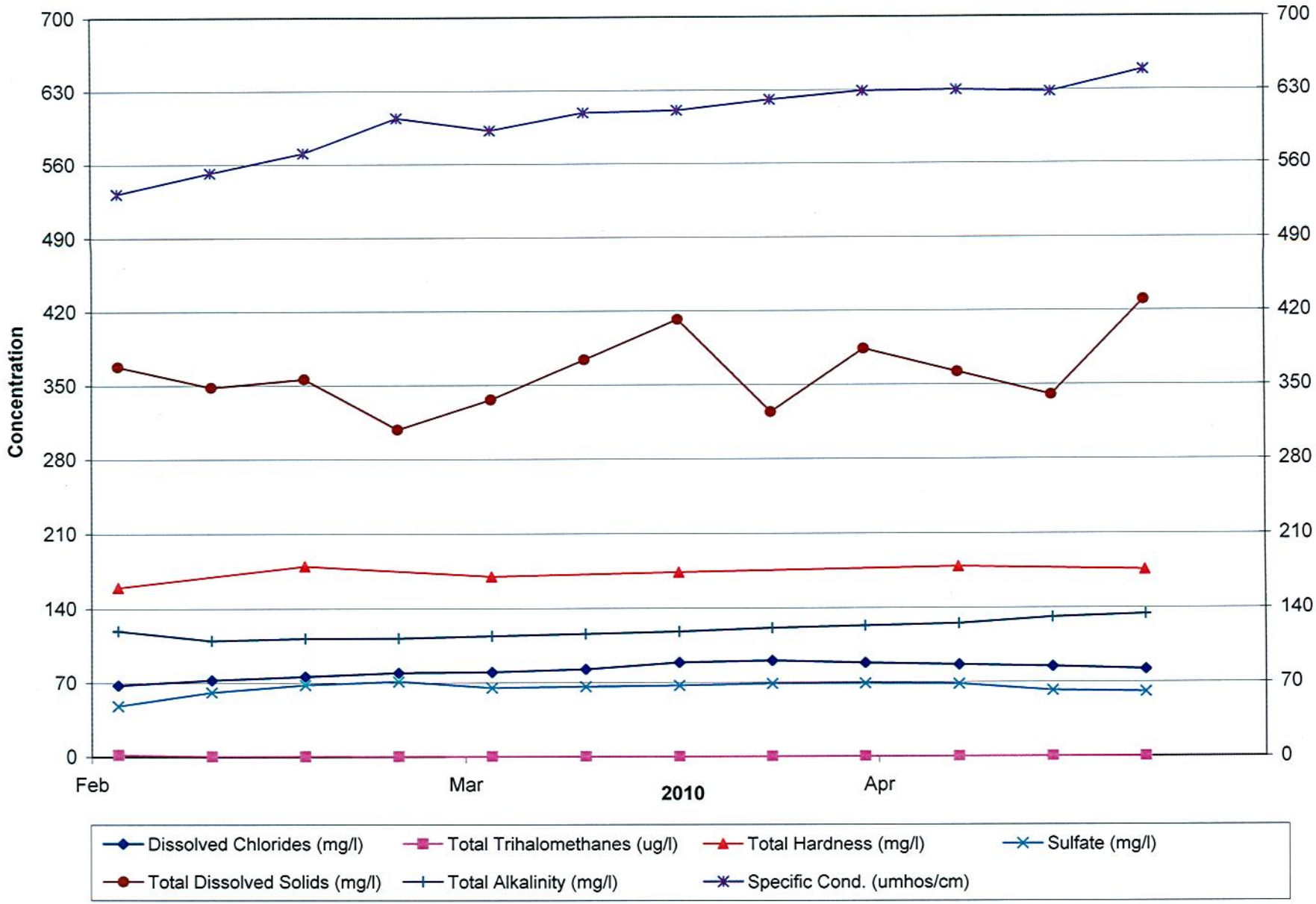


FIGURE 2-12B. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-1 DURING CYCLE 9 (PART 2)

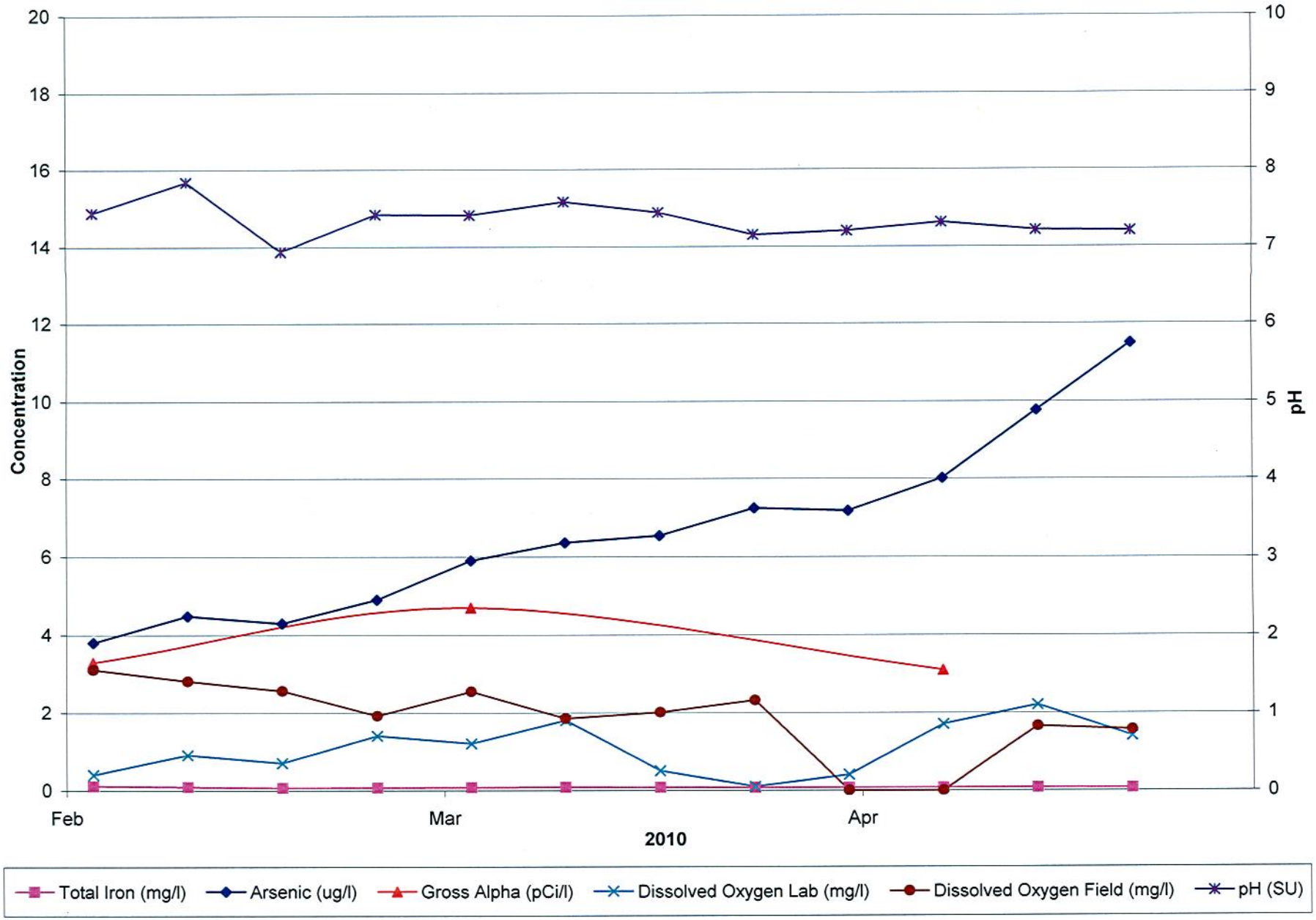


FIGURE 2-13A. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-2 DURING CYCLE 9 (PART 1)

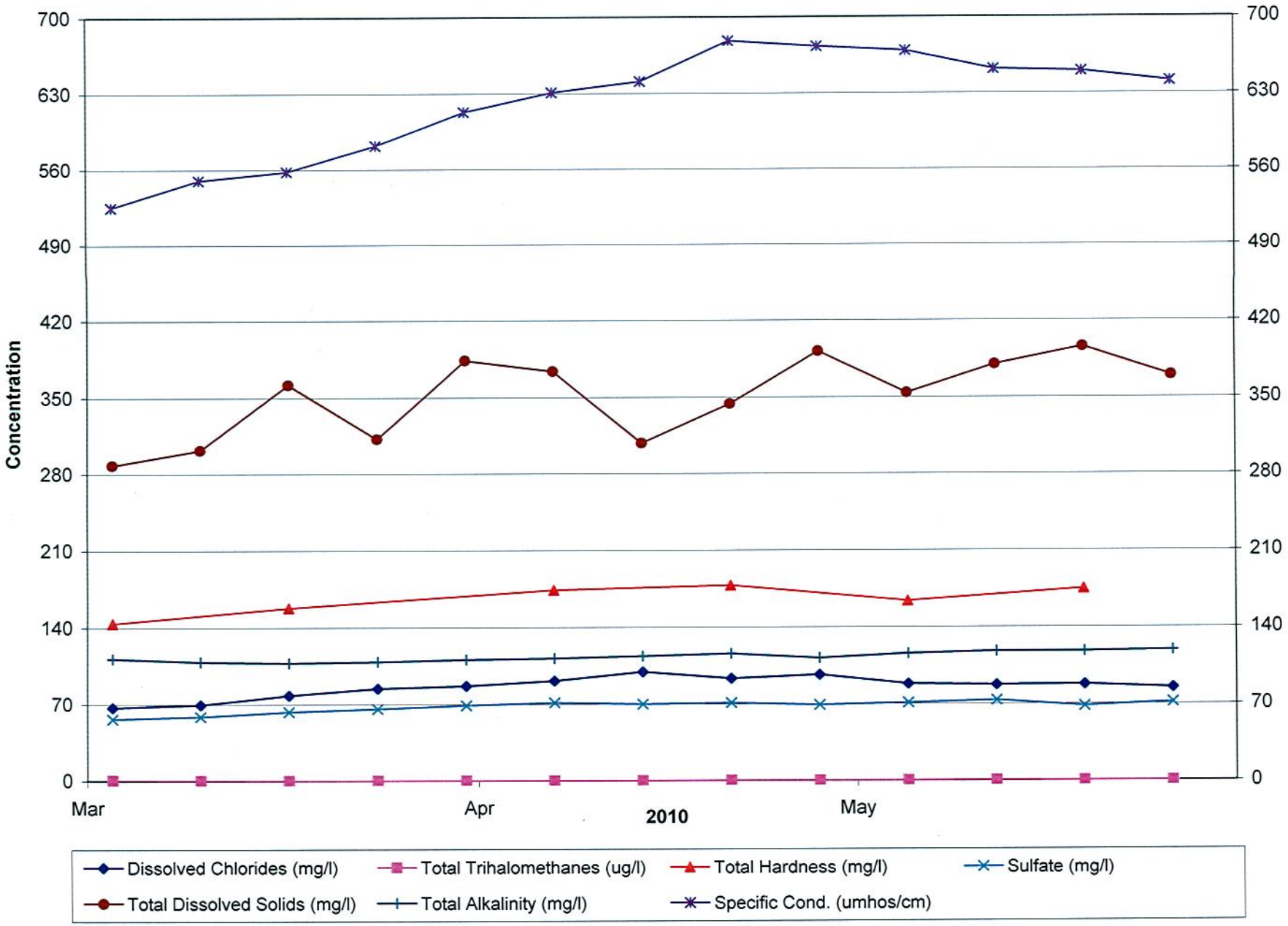


FIGURE 2-13B. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-2 DURING CYCLE 9 (PART 2)

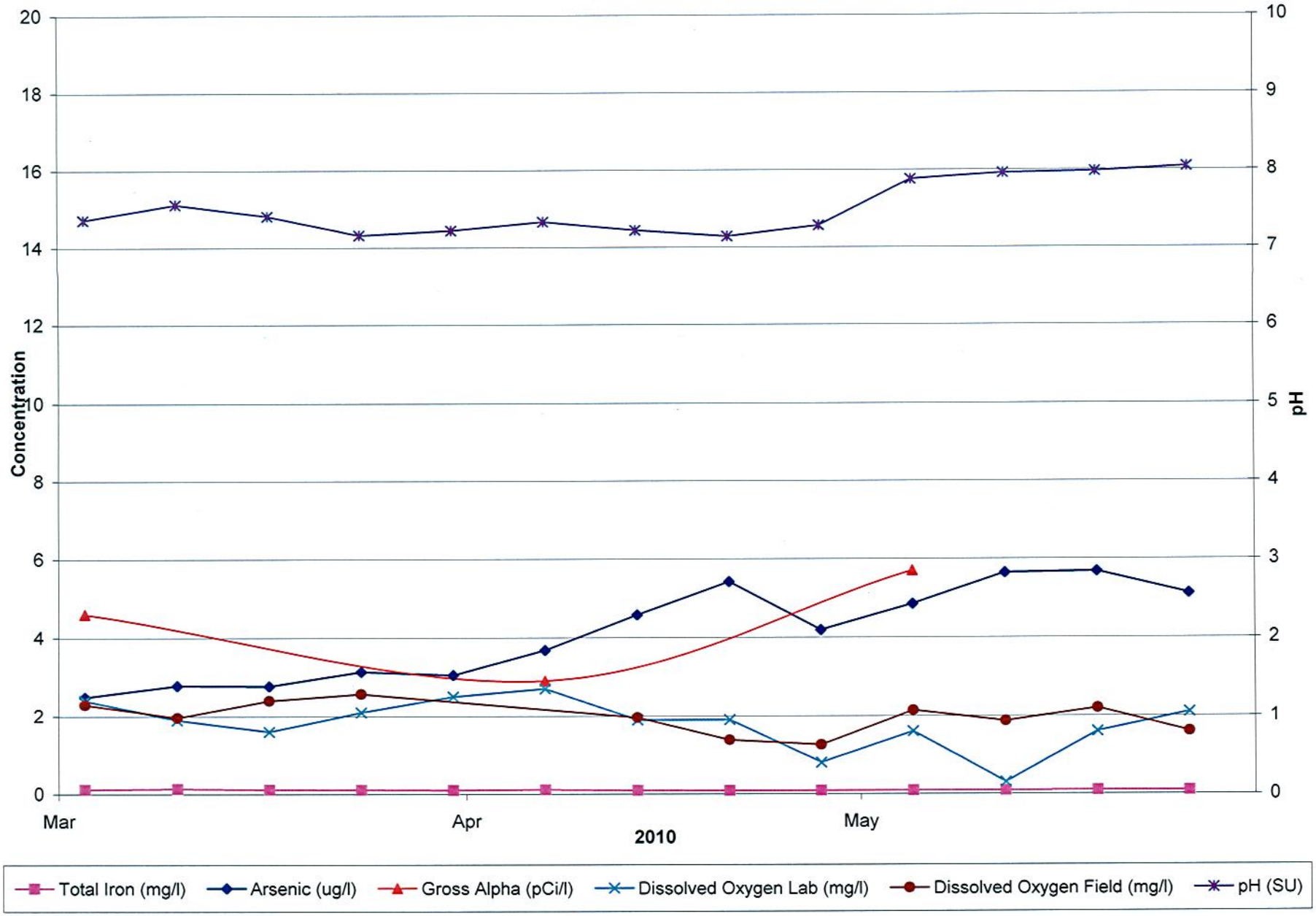


FIGURE 2-14A. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-3 DURING CYCLE 9 (PART 1)

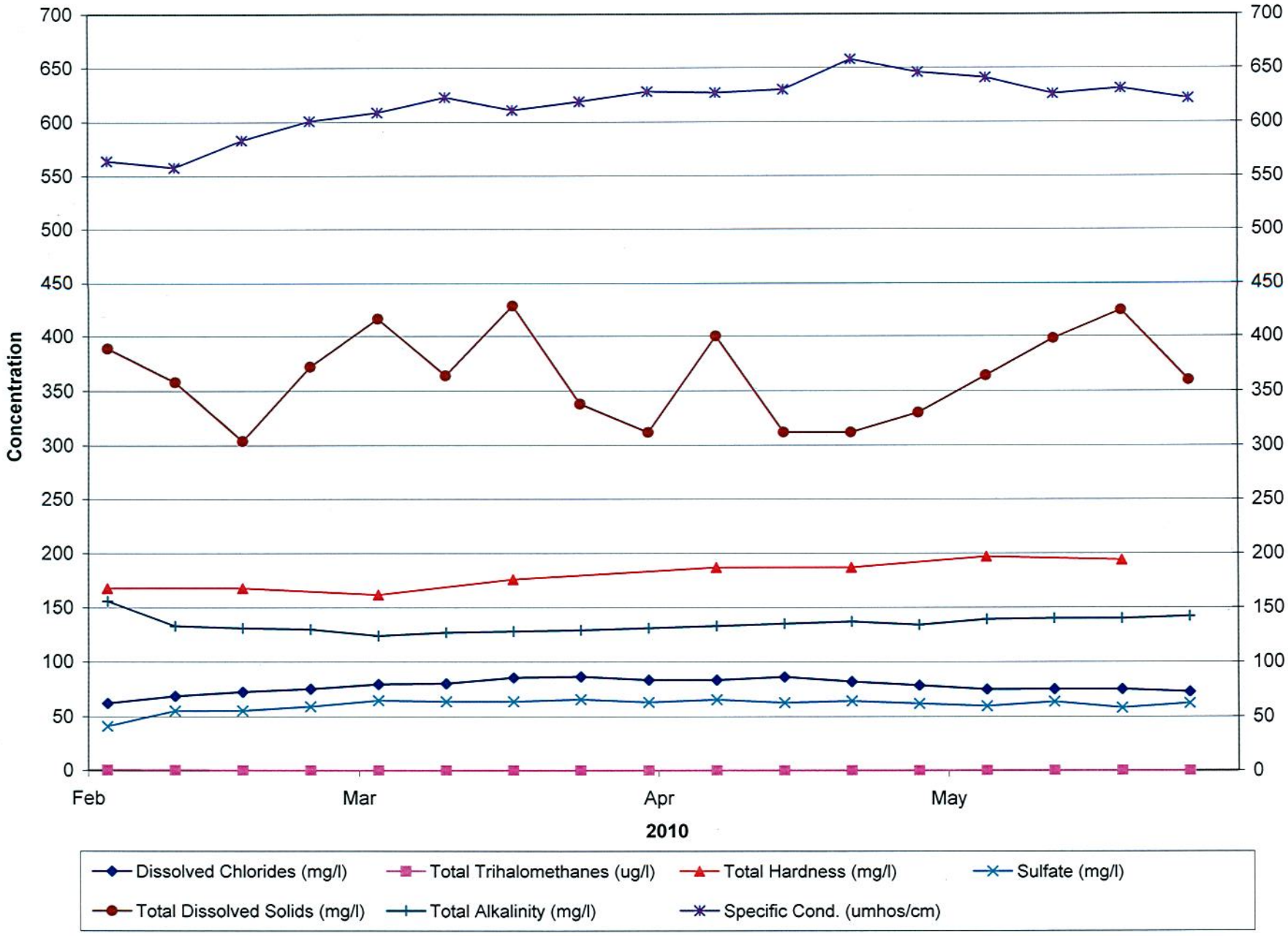


FIGURE 2-14B. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-3 DURING CYCLE 9 (PART 2)

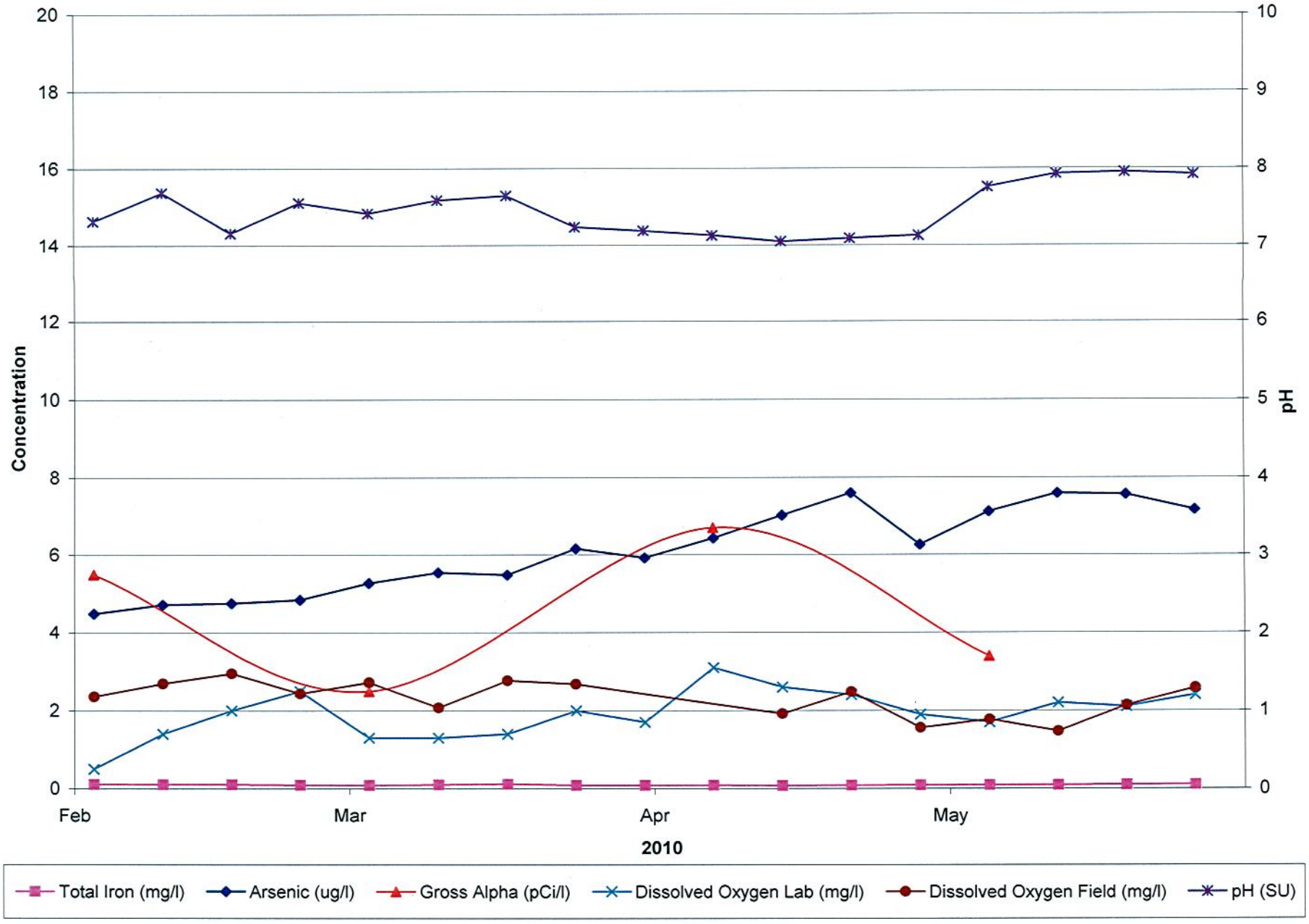


FIGURE 2-15A. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-4 DURING CYCLE 9 (PART 1)

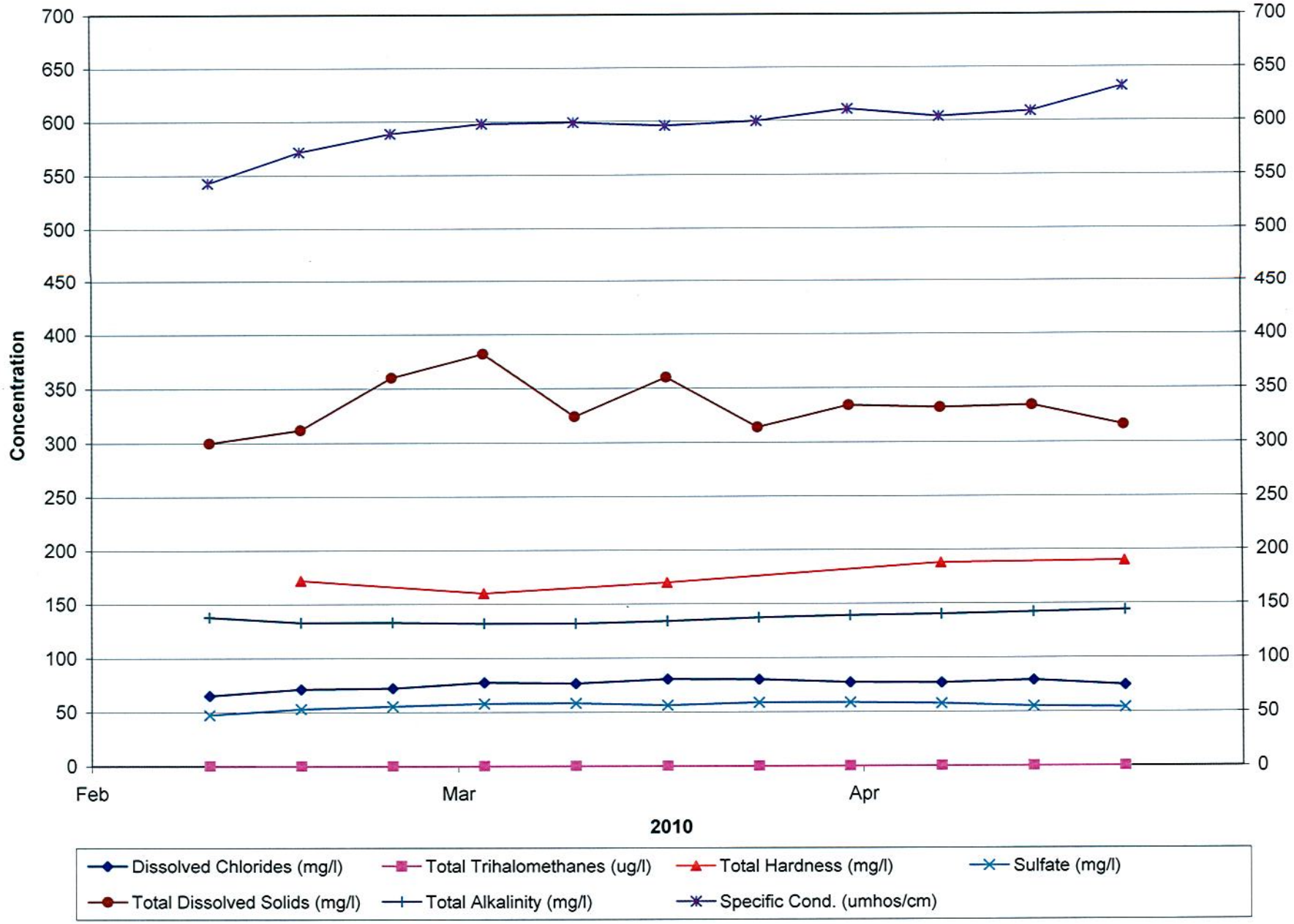


FIGURE 2-15B. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-4 DURING CYCLE 9 (PART 2)

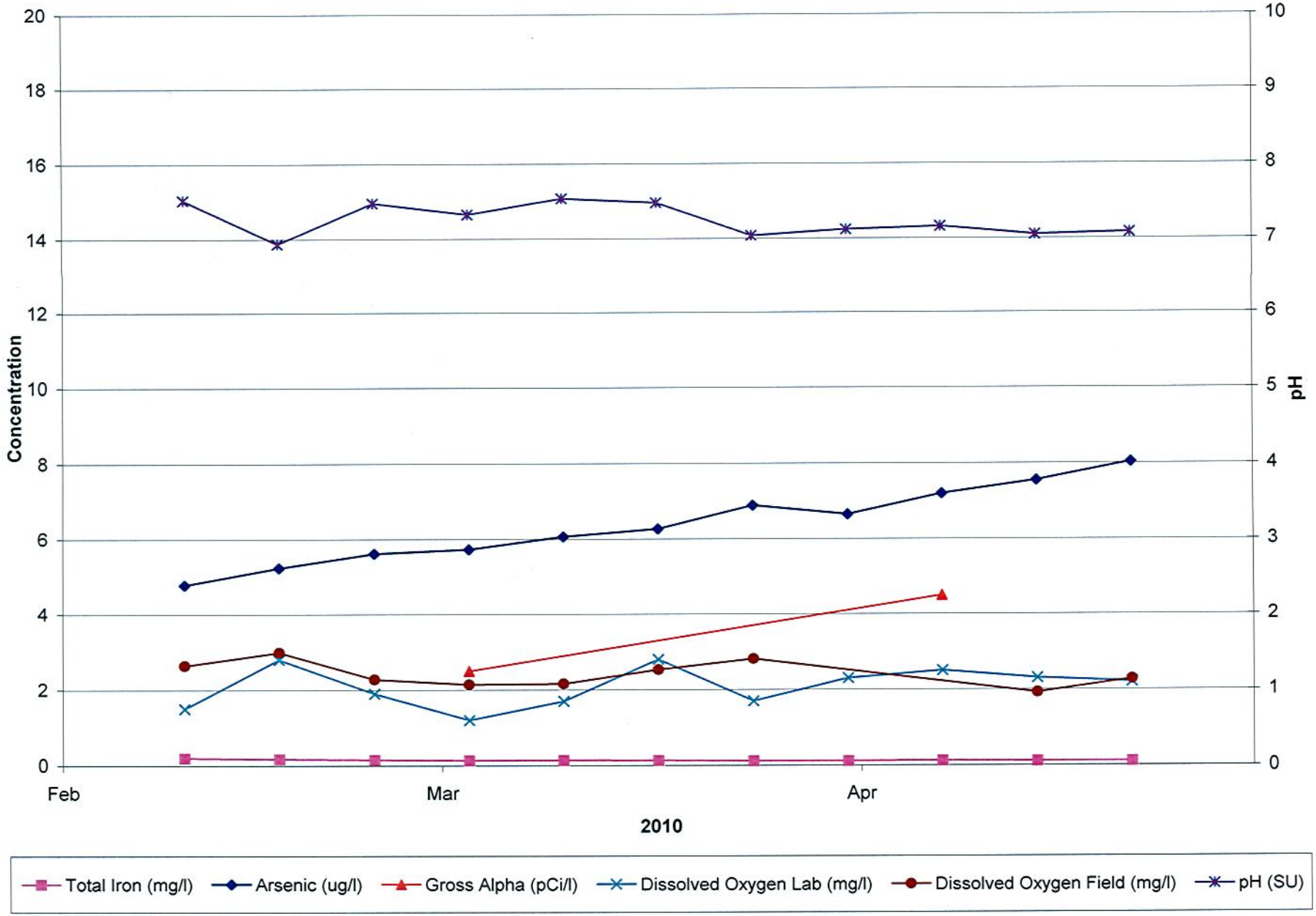


FIGURE 2-16A. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-5 DURING CYCLE 9 (PART 1)

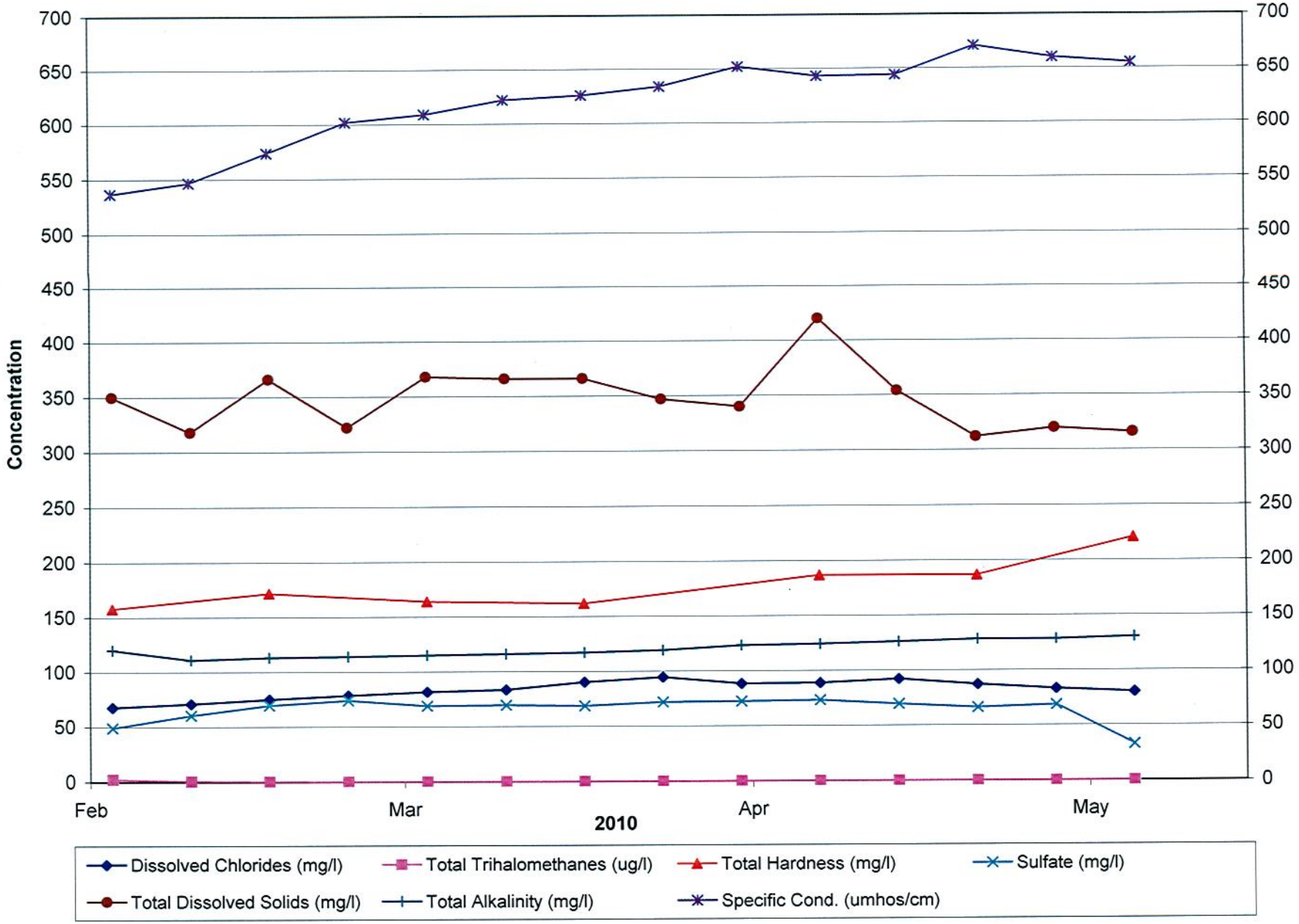


FIGURE 2-16B. PLOT OF RECOVERED WATER QUALITY FROM WELL ASR-5 DURING CYCLE 9 (PART 2)

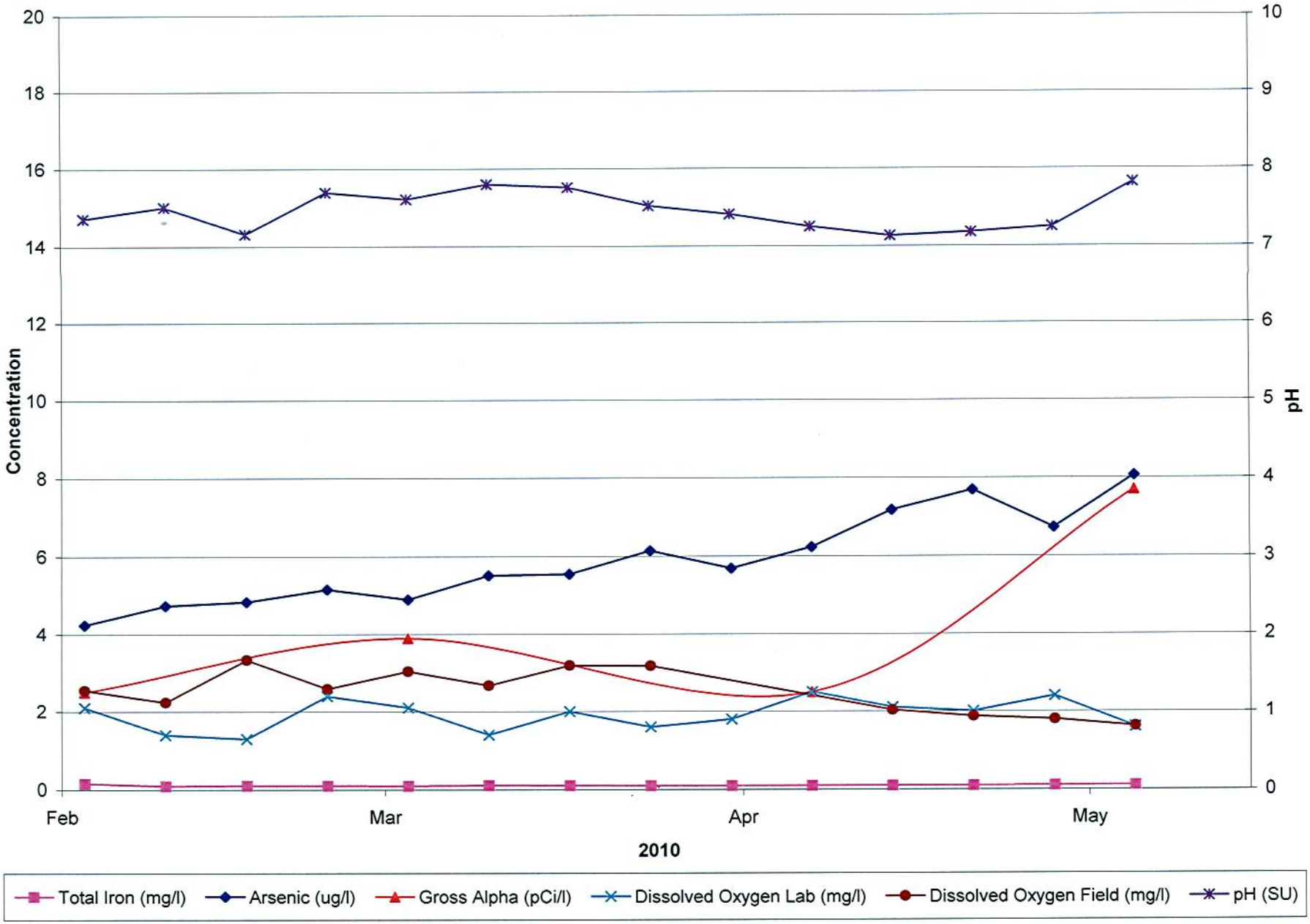


FIGURE 2-17. PLOT OF AVERAGE RECOVERY RATES IN THE ASR WELLS DURING CYCLE 9.

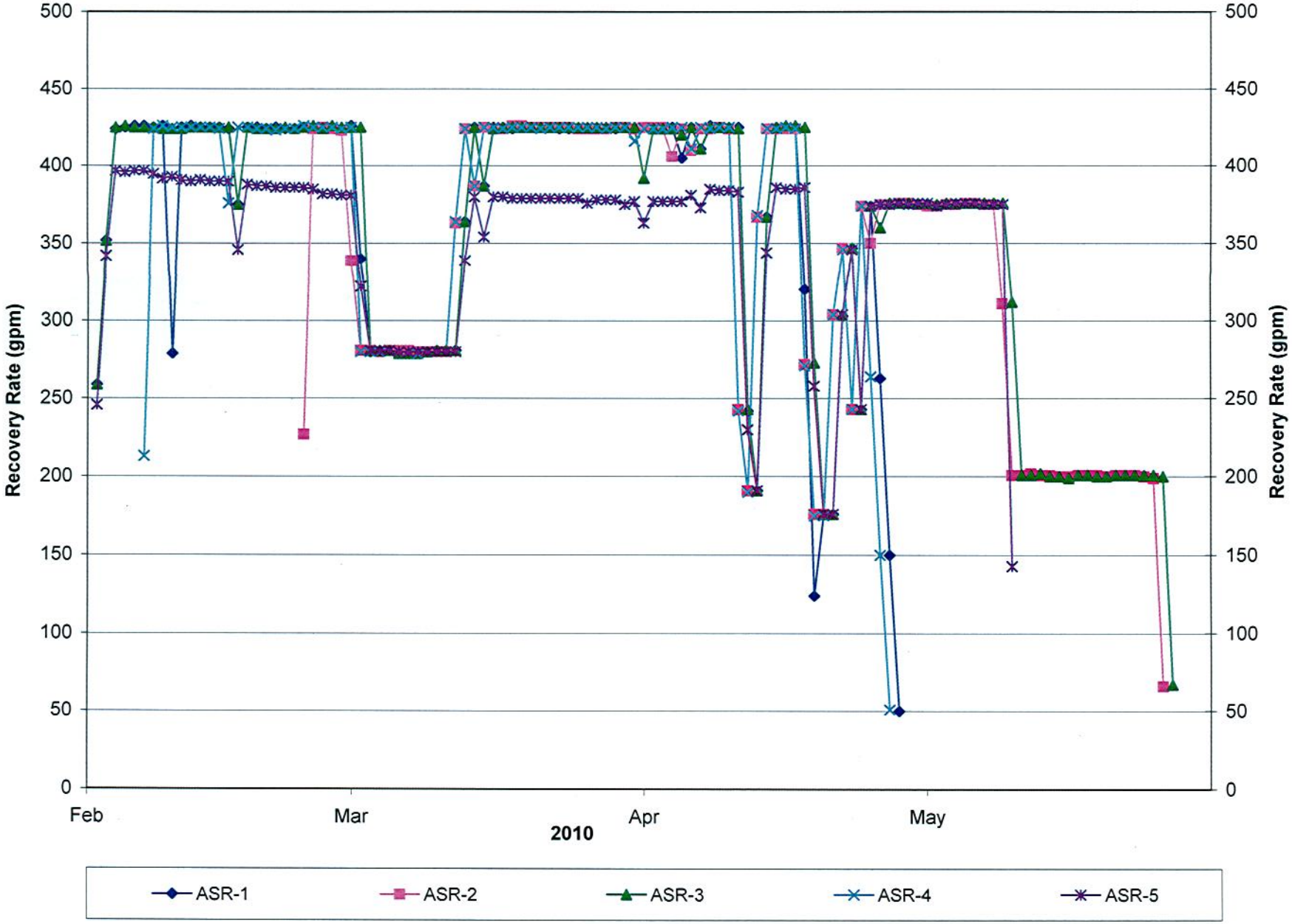
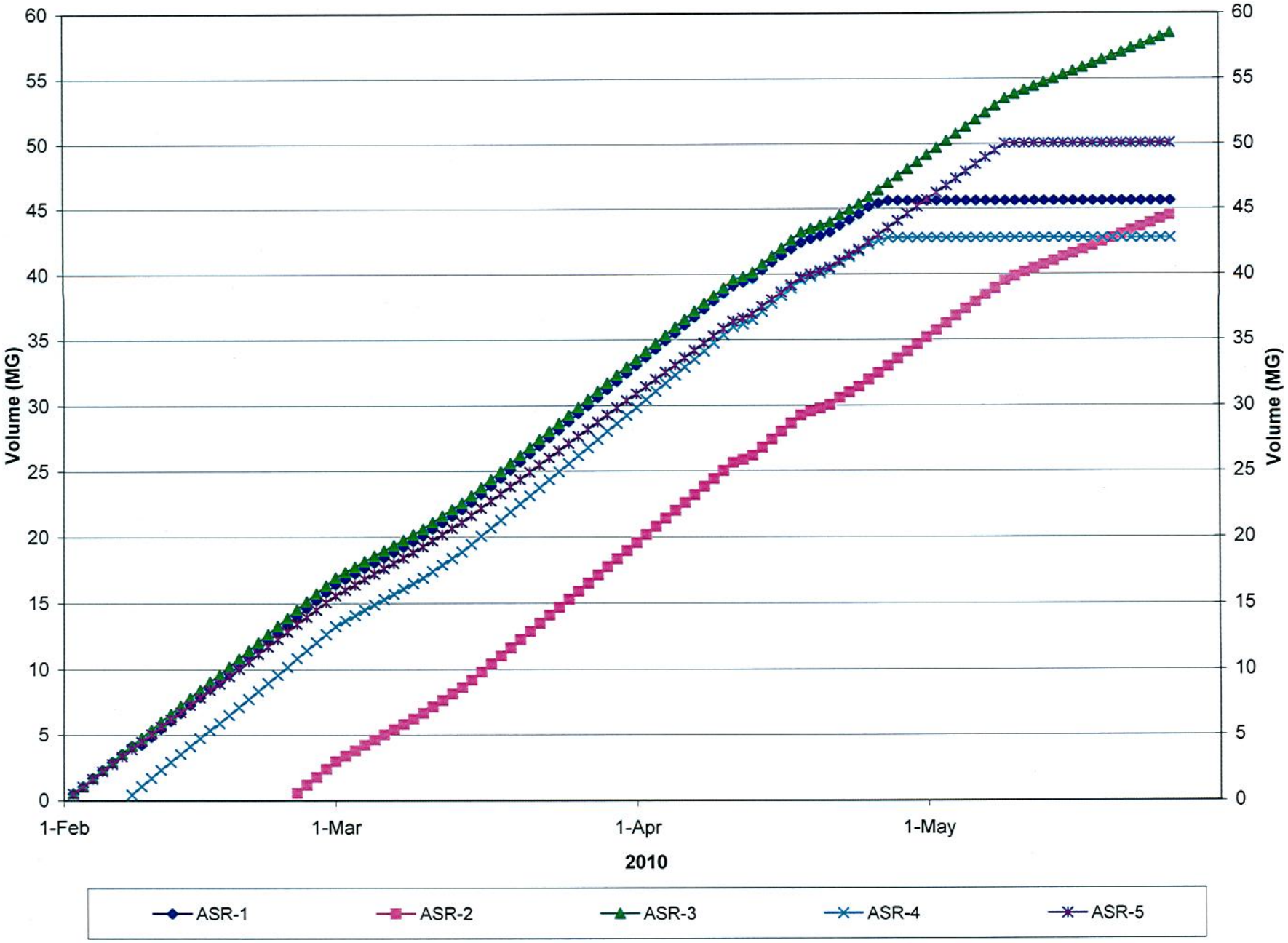


FIGURE 2-18. PLOT OF CUMULATIVE VOLUME RECOVERED IN THE ASR WELLS DURING CYCLE 9.



Potentiometric water levels in the five storage zone observation wells (MW-1, MW-2, MW-3, MW-A, and MW-C), the overlying zone monitoring well, and the underlying zone monitoring well were monitored on a daily basis during recovery in Cycle 9. An annotated plot of potentiometric water levels for the monitoring wells for the entire Cycle 9 injection/storage/recovery period is provided as Figure 2-4.

Water samples were obtained from the monitoring wells during recovery operations from the ASR wells and analyzed for those parameters shown on Table 2-6. A summary of the range in concentrations for the various water quality parameters in the monitoring wells and a comparison to regulatory criteria is provided on Table 2-7. The water quality parameters in the monitoring wells met all Primary and Secondary Drinking Water Standards throughout the approximate 3.5-month recovery period with the exception of arsenic on four occasions in storage zone monitoring well MW-C (11.2 ug/l on 3/23/10, 11.2 ug/l on 3/30/10, 12.5 ug/l on 4/6/10, and 10.1 ug/l on 4/13/10). Plots of the water quality in the monitoring wells during Cycle 9 are provided as Figures 2-5 through 2-11.

III. REVIEW OF CORKSCREW ASR SYSTEM PERFORMANCE AFTER NINE COMPLETE CYCLES

The Corkscrew WTP ASR system has undergone nine complete operational cycles of injection, storage, and recovery for all five ASR wells. The only noncompliance issues related to the operational testing of the Corkscrew ASR system have been slightly elevated arsenic concentrations in the recovered water from well ASR-1 and in the nearby storage zone monitoring well MW-C. The water quality data collected from the five ASR wells, five storage zone observation wells, one overlying zone observation well, and one underlying zone monitoring well indicates that arsenic mobilization is restricted to the area proximal to the borehole of well ASR-1 within a radius not exceeding 350 feet. This area is within the 500 foot institutional control protection zone provided by the Lee County Wellfield Protection Ordinance.

The recovered water quality data indicate that a general progressive decline in arsenic concentration in the recovered water has occurred with each successive cycle (Figure 3-1). Arsenic concentrations in recovered water during each recovery period are very low at the start and gradually increase as each recovery period proceeds. For each successive cycle, the percentage of injected water recovered has increased at which arsenic levels approach or reach a specific concentration.

Arsenic concentrations during recovery in wells ASR-2, ASR-3, ASR-4, and ASR-5 have been detected below 10 ug/l during the last five cycles. Arsenic concentrations in well ASR-1 have been detected slightly over the maximum contaminant limit (MCL) of 10 ug/l on rare occasions at the end of a recovery period. Plots of cumulative volume of water in storage versus arsenic concentrations for the ASR wells (Figures 3-2 through 3-6) confirm a general progressive decline in arsenic concentrations in the recovered water with each successive cycle.

Analyses of the dissolved oxygen concentrations in the injected water (Figures 3-7A and 3-7B) indicate a significant discrepancy between the field and the laboratory data. Dissolved oxygen values obtained in the field during Cycle 9 were approximately 3 mg/l while values obtained at the laboratory were at about 8 mg/l.

FIGURE 3-1. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS IN COMBINED RECOVERED WATER FROM CORKSCREW ASR SYSTEM.

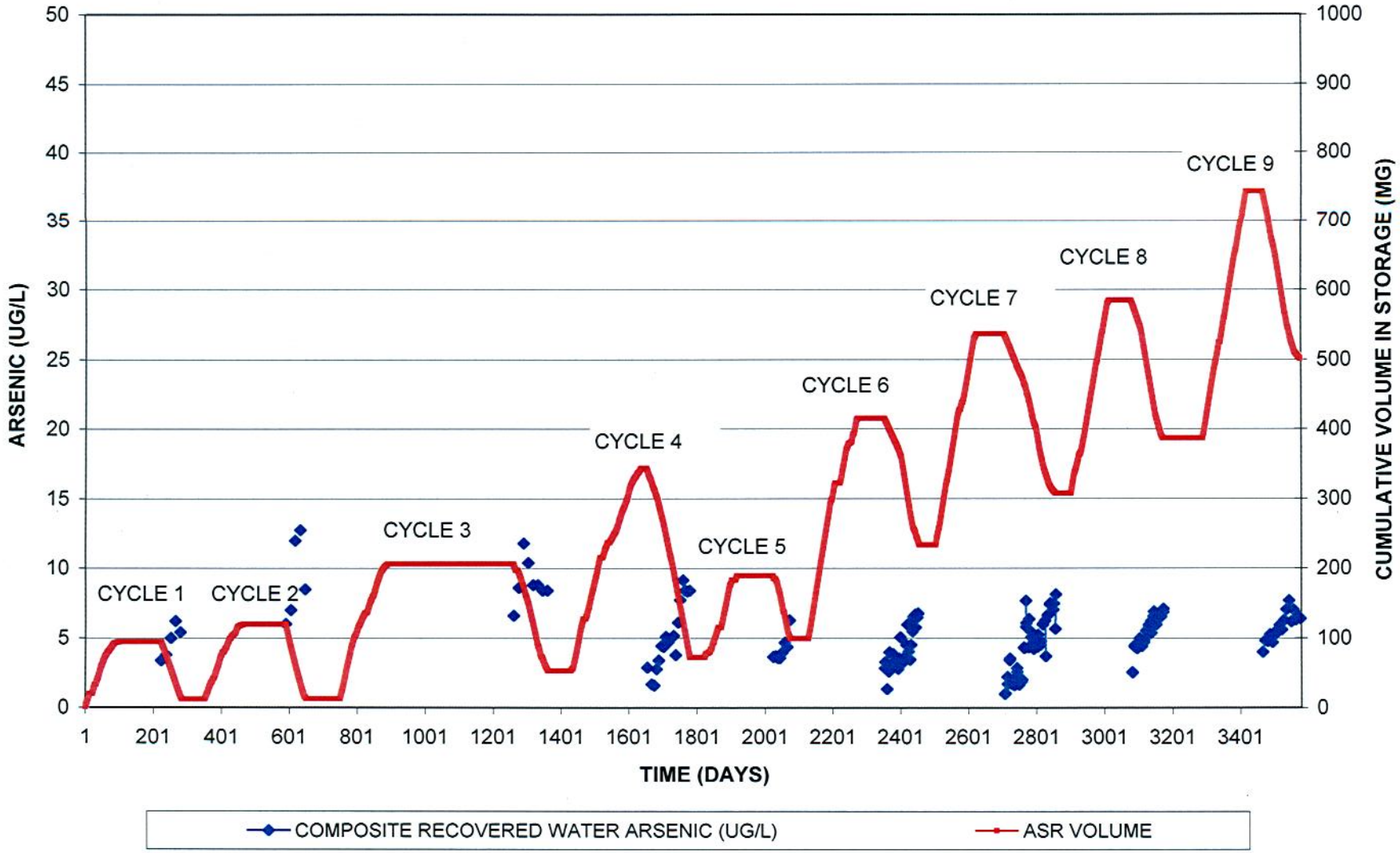


FIGURE 3-2. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS FOR WELL ASR-1

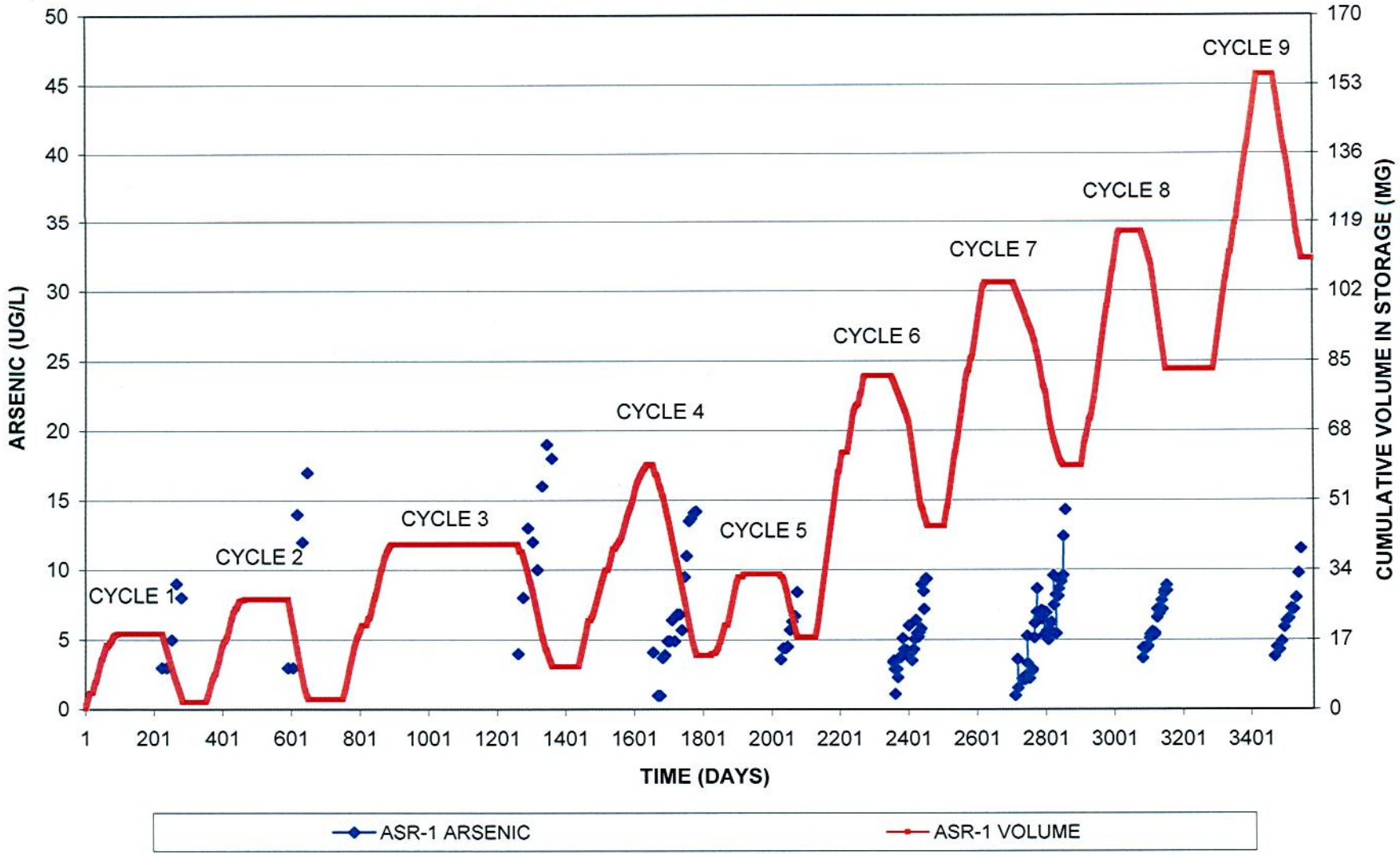


FIGURE 3-3. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS FOR WELL ASR-2.

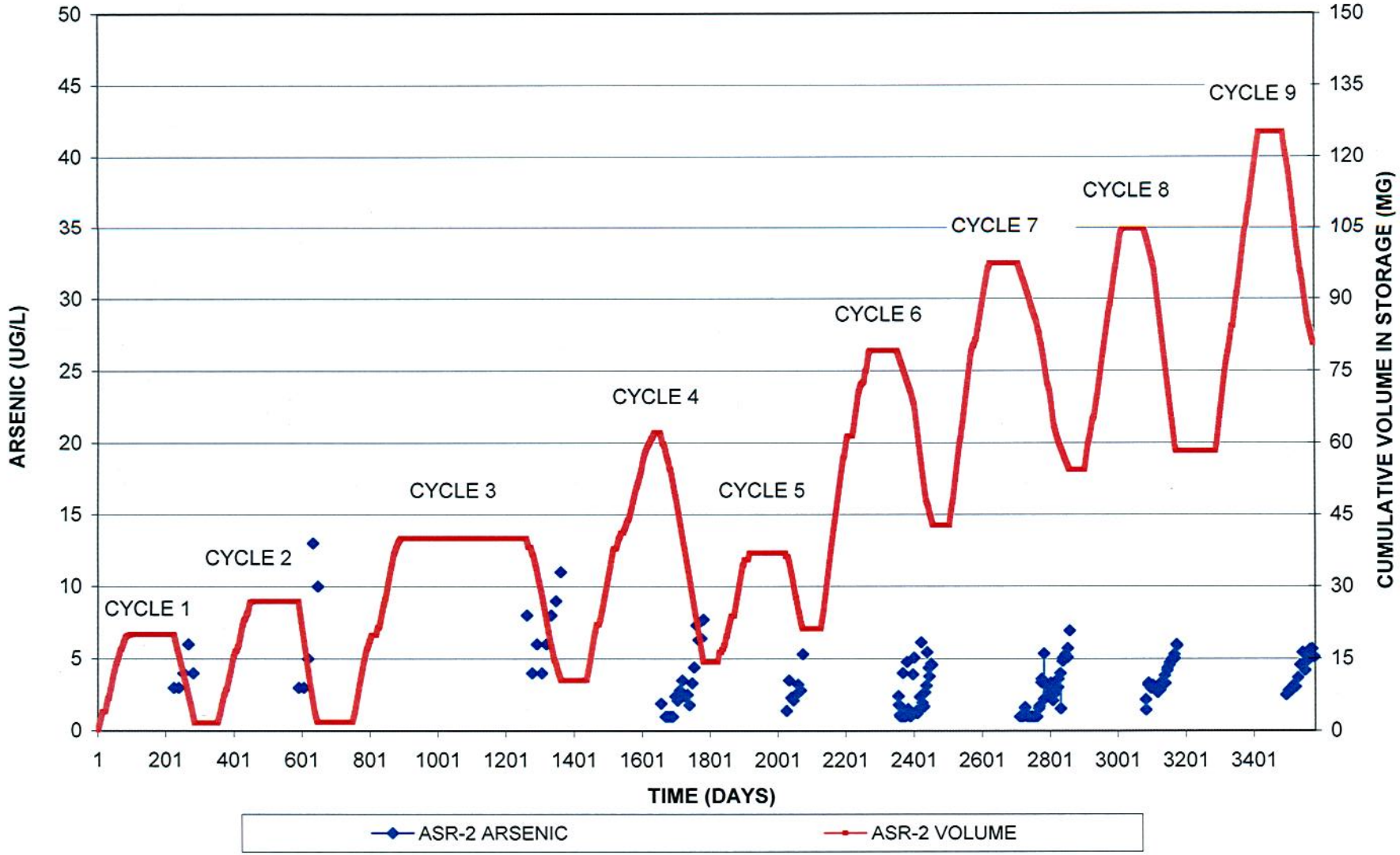


FIGURE 3-4. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS FOR WELL ASR-3

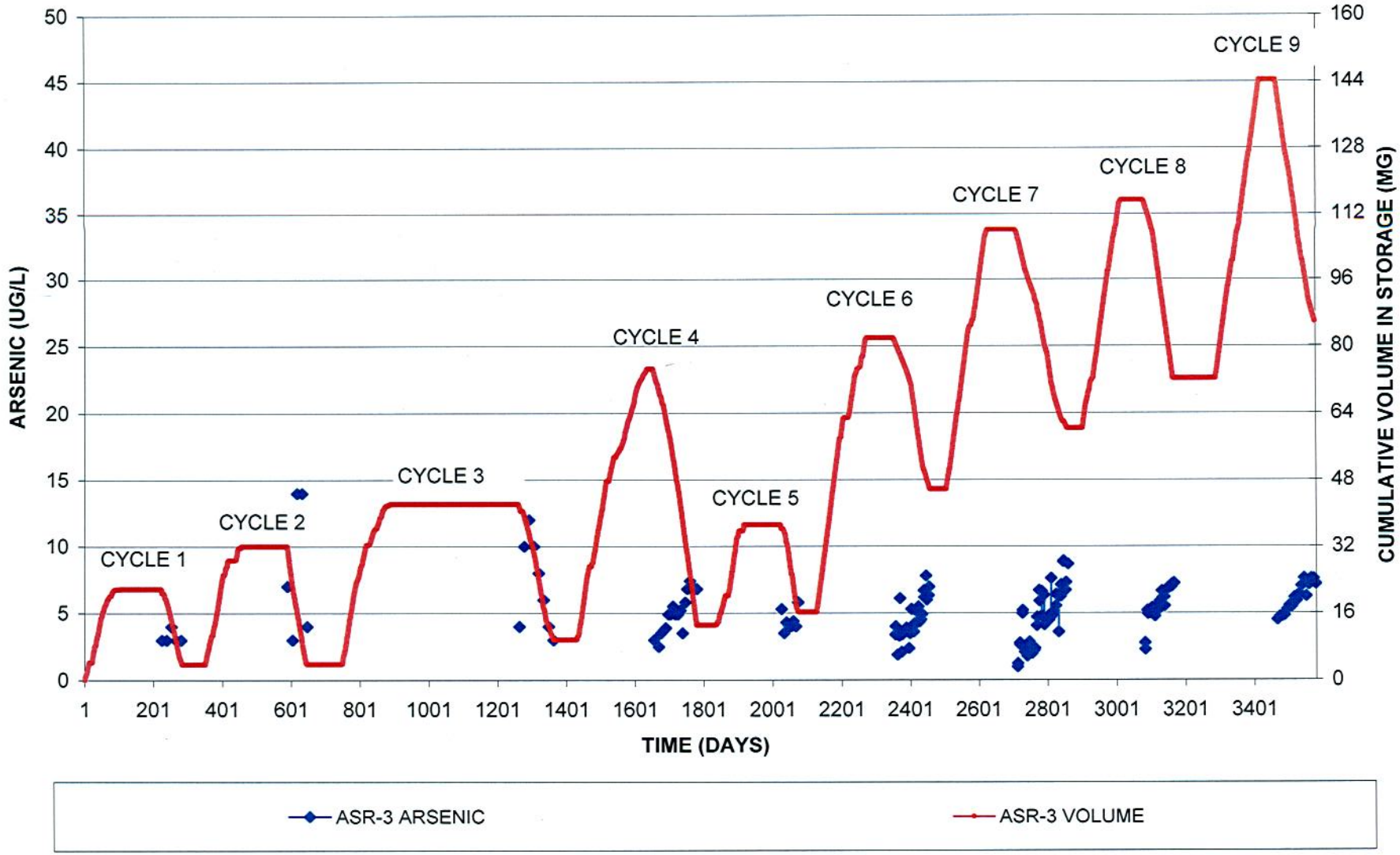


FIGURE 3-5. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS FOR WELL ASR-4

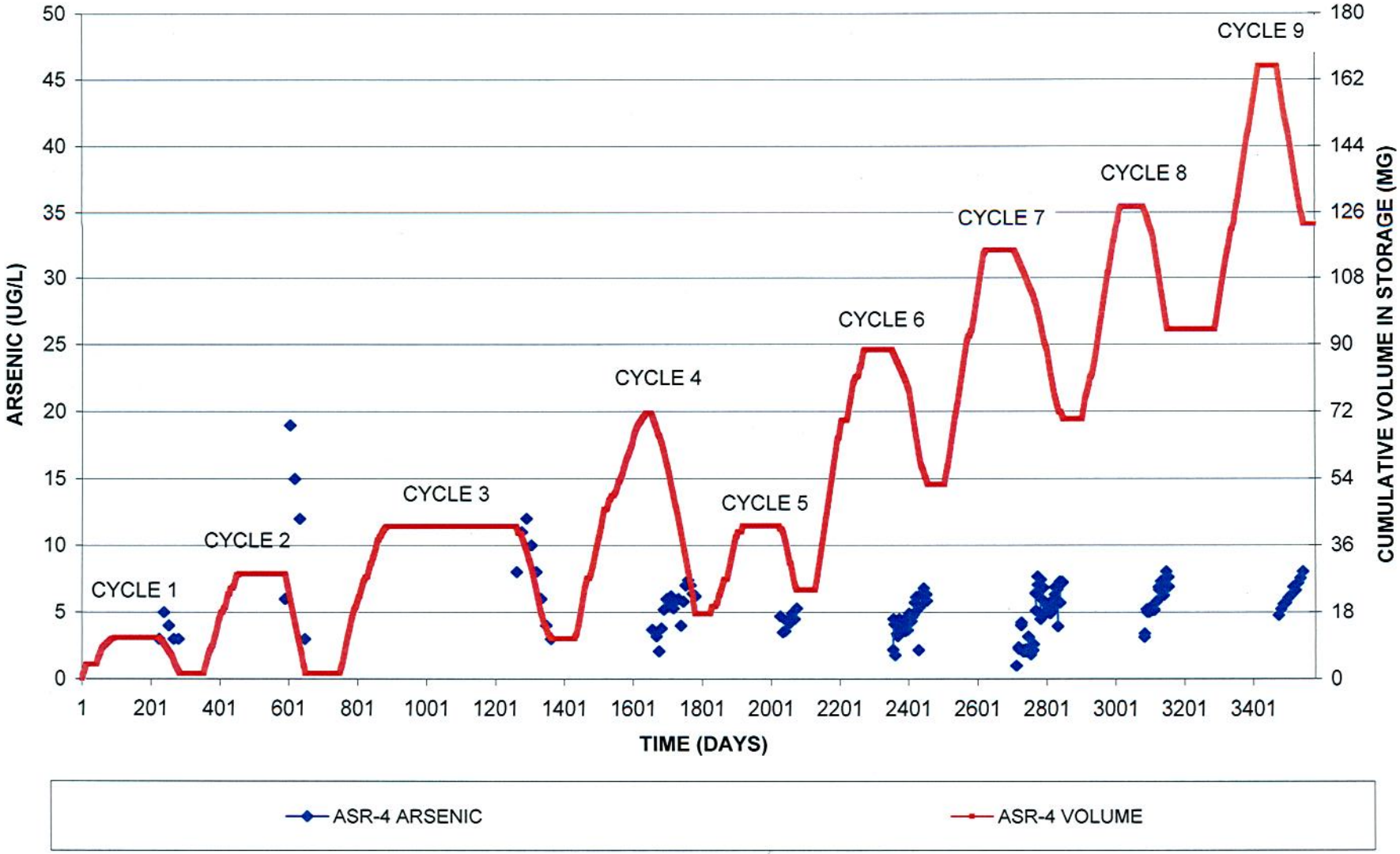


FIGURE 3-6. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS FOR WELL ASR-5

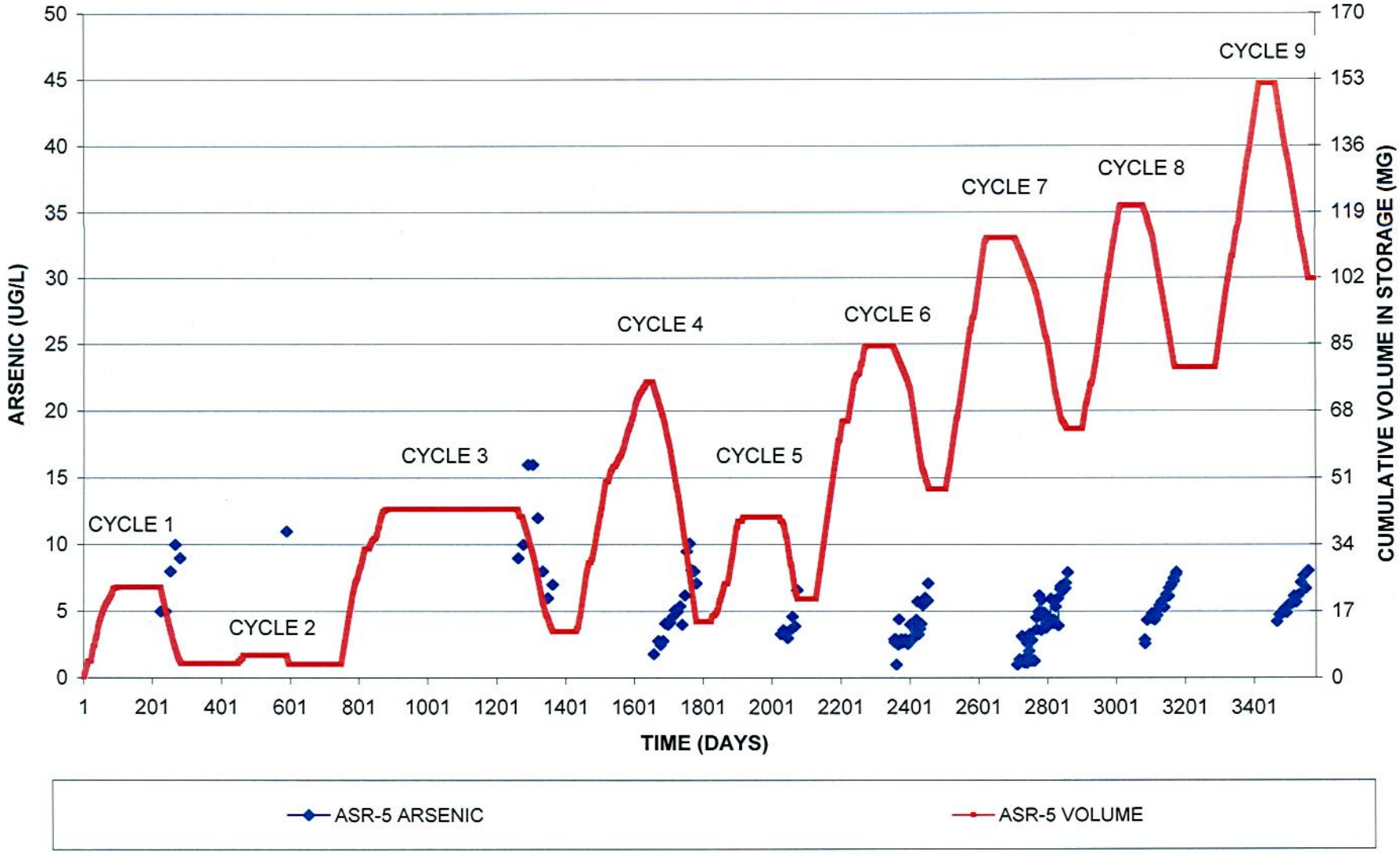


FIGURE 3-7A. PLOT OF DISSOLVED OXYGEN CONCENTRATIONS IN INJECTED WATER OBTAINED IN THE FIELD .

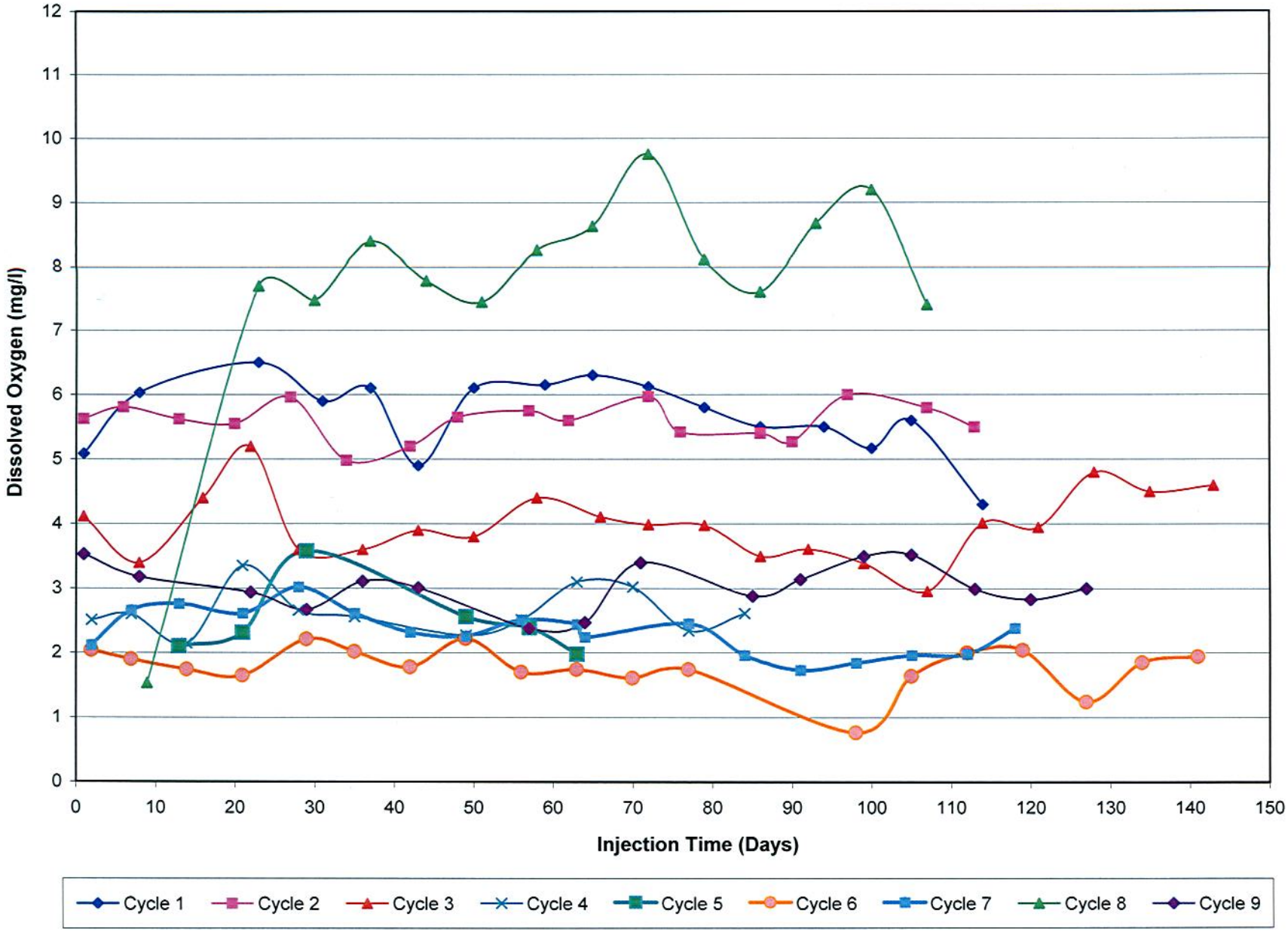
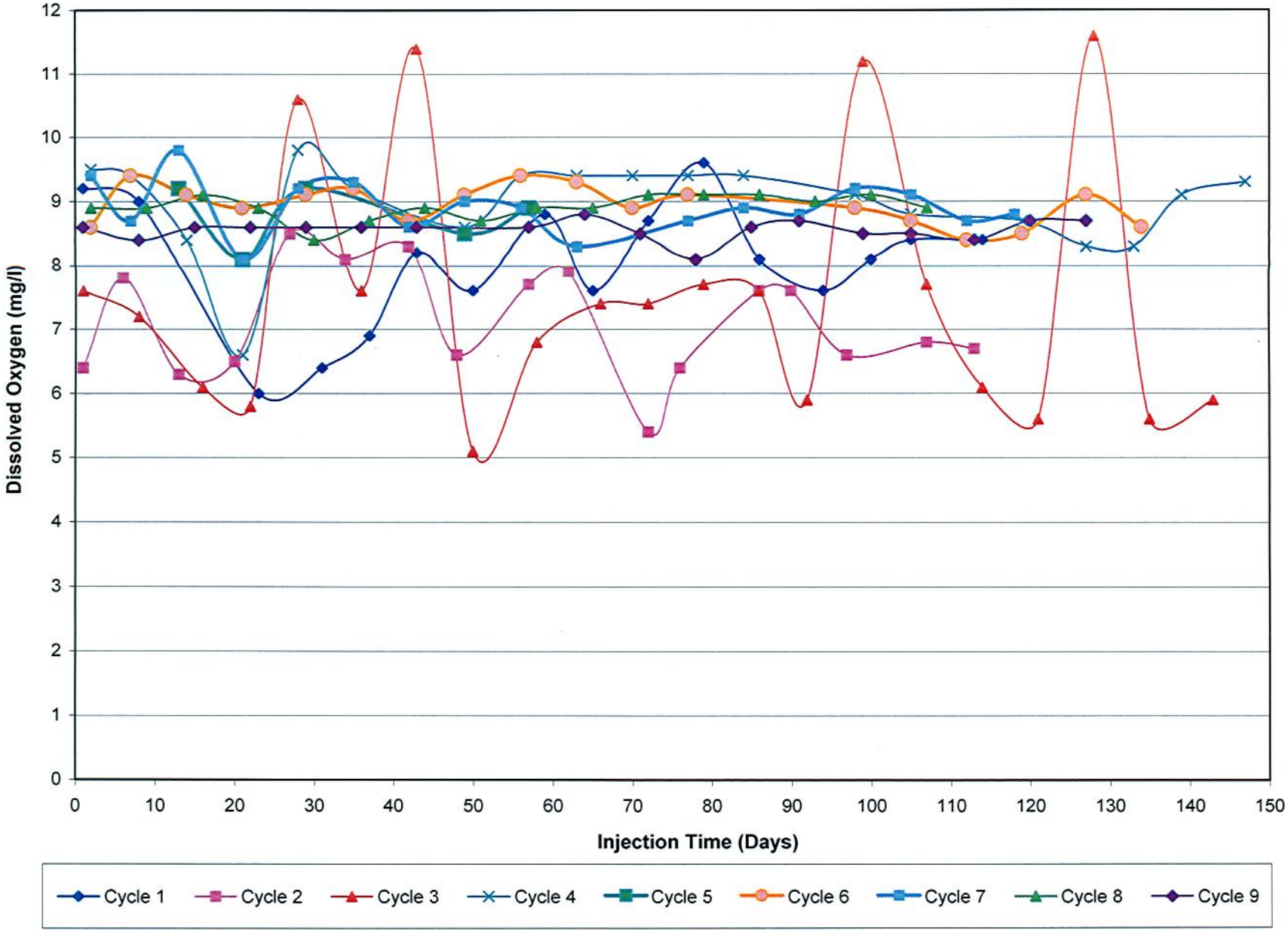
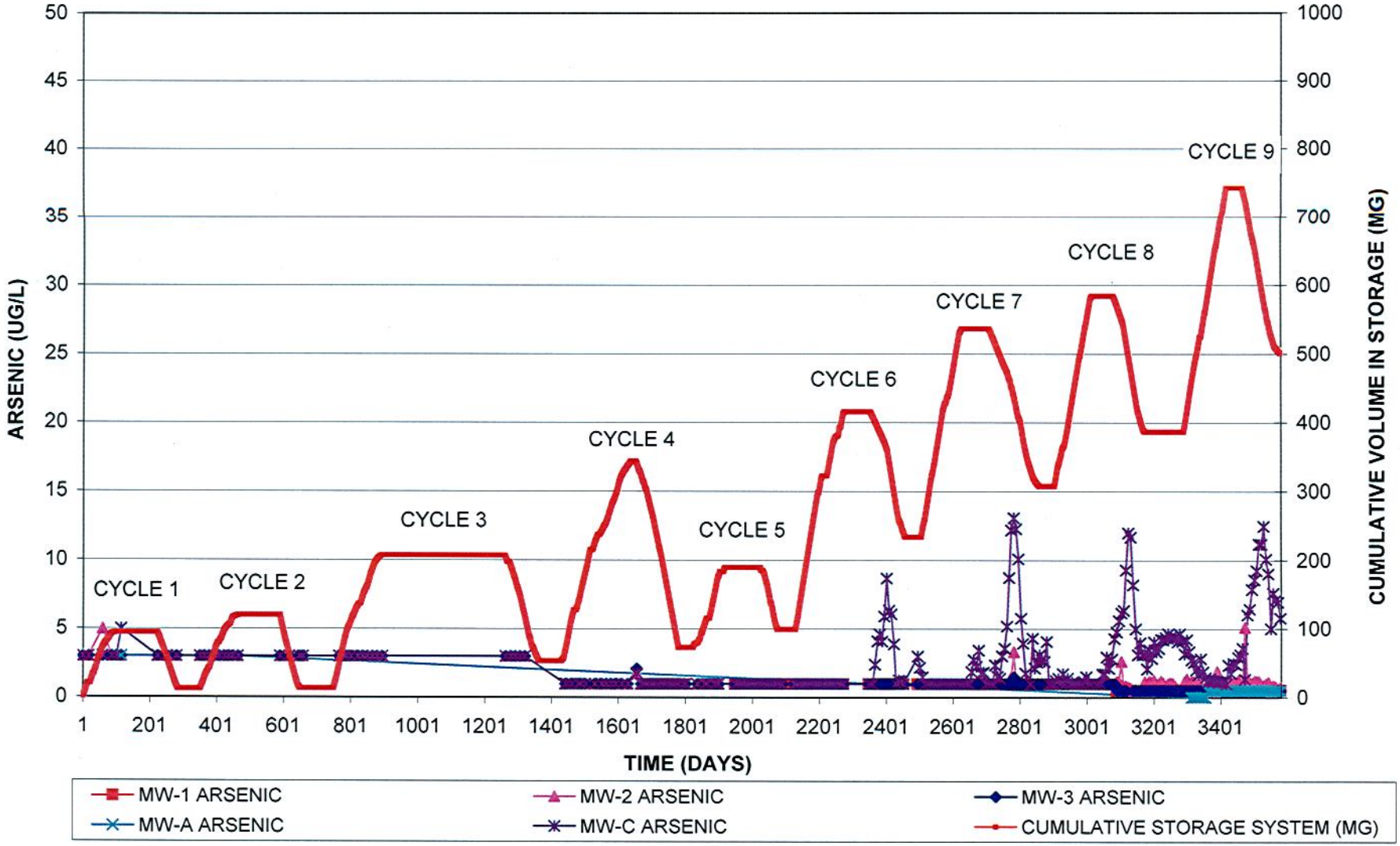


FIGURE 3-7B. PLOT OF DISSOLVED OXYGEN CONCENTRATIONS IN INJECTED WATER OBTAINED AT THE LABORATORY.



No exceedances of arsenic concentrations occurred in any of the monitoring wells with the exception of well MW-C for a small period of time during the middle portion of recovery in Cycle 9. Thereafter, arsenic concentrations remained below the MCL. Well MW-C is located approximately 300 feet west of well ASR-1 and 750 feet north of well ASR-2. A plot of cumulative volumes in storage versus arsenic concentrations in the observations wells is provided as Figure 3-8.

FIGURE 3-8. PLOT OF CUMULATIVE VOLUME IN STORAGE AND ARSENIC CONCENTRATIONS IN STORAGE ZONE MONITORING WELLS.



IV. HYDRAULIC AND SOLUTE TRANSPORT COMPUTER MODELING

As part of the present investigation, the numerical groundwater flow and solute transport model developed for the Corkscrew ASR system Assessment Plan (AP) (RMA GeoLogic Consultants, 2010) was updated with the Cycle 9 data. The model was updated with the potentiometric water level, water usage, water volume injection and recovery, and water quality from the ASR and monitoring wells data for the Corkscrew ASR system area. The model was calibrated to the operational data and then used to determine extent of the injected water for Cycle 9 at the end of injection and at the end of recovery. In addition, the model was used to predict future performance of the system (i.e. recovery efficiencies and water extent).

The model was developed using the U.S. Geological Survey (USGS) Modular Three-Dimensional Finite-Difference Groundwater Flow Model (MODFLOW-2000). MODFLOW-2000 was released by the USGS in 2000 (Harbaugh, Banta, Hill, and McDonald, 2000). The solute transport model was developed using the modular three-dimensional multi-species transport model MT3DMS (Zheng and Wang, 1999). This code integrates the flow results obtained with MODFLOW. The Visual MODFLOW Pro v. 2009.1 software package developed by Waterloo Hydrogeologic, Inc. was used for the groundwater flow simulations.

A. Model Update

For the model calibration update, water levels from seven observation wells were used. The calibration simulation period of was for 3,591 days, which represents 118 stress periods (118 complete months from August, 2000 through May, 2010). The operational water level, pumpage, and water quality (alkalinity concentrations) data were integrated into the model. Thereafter, the model was run for a one hundred eighteen month period (i.e. the operational period). Water quality from well MW-A was available during Cycle 9 (i.e. FDEP did not require monitoring from that well during prior cycles with the exception of Cycle 1). Water quality data from that well indicates a limited influence from the ASR operations, a review of the drilling and testing of the Corkscrew ASR system expansion (Water Resource Solutions, 1999) indicates the presence of a restricted flow boundary just east of well MW-A. In order to represent that type of feature, a MODFLOW wall boundary condition was assigned east of well MW-A. The groundwater flow

and solute transport computer model was then calibrated. Final calibration statistics of observed water level and water quality data indicate that the model is well calibrated. A summary of the calibration statistics for the water level data is provided as Figure 4-1. A summary of the calibration statistics for the water quality calibration for the entire model is provided as Figure 4-2. The calibrated hydraulic and solute transport model input and output files are provided in Appendix C.

B. Model Simulations and Results

After the model was calibrated with the operational data through Cycle 9, the extent of the injected water for the two extreme periods of the operation of the ASR system during Cycle 9 was evaluated. These two periods are the end of the injection period and the end of the recovery period.

Analyses of the extent of the injected water at the end of the injection and recovery periods for Cycle 9 (Figures 4-3 through 4-4) indicates that injected water during Cycle 9 extended to a maximum of approximately 1,500 feet west of well ASR-1 at the end of the injection of Cycle 9. The water quality data collected from the five storage zone observation wells during injection and recovery indicates arsenic concentration below 10 ug/l with the exception of a very small period of time during recovery in well MW-C. The water quality from the ASR wells during recovery indicates arsenic concentrations below 10 ug/l with the exception of well ASR-1 which slightly exceeded 10 ug/l at the end of recovery period. Therefore, arsenic mobilization appears to be restricted to the area proximal to well ASR-1. Based on the recovered water quality, additional volumes could have been recovered during Cycle 9 in wells ASR-2 through ASR-5 without reaching the arsenic concentration of 10 ug/l.

After the model was calibrated with the operational data through Cycle 9, predictions for the system performance and extent of the injected water during Cycle 10 were generated using alkalinity concentrations as a pseudomorph for arsenic concentrations. The selection of alkalinity as a pseudomorph was based on statistical analyses of historic data, as detailed in the AP report (RMA GeoLogic Consultants, 2010). For Cycle 10 an injection volume of 60 MG per well (total of 300 MG), an average injected water alkalinity of 60 mg/l, and a storage time of 120 days were assumed.

FIGURE 4-1. SUMMARY OF CALIBRATION STATISTICS FOR WATER LEVEL DATA.

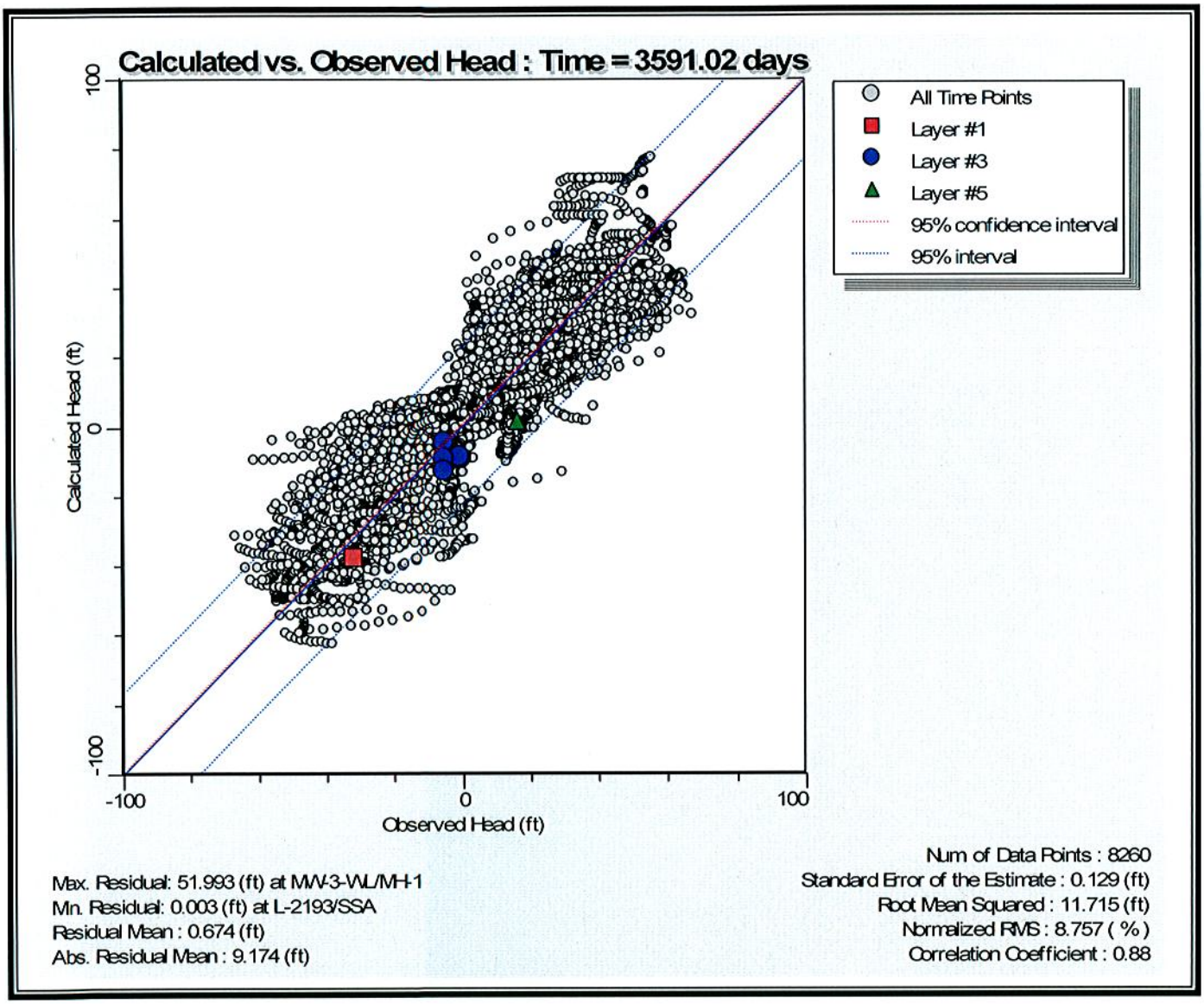
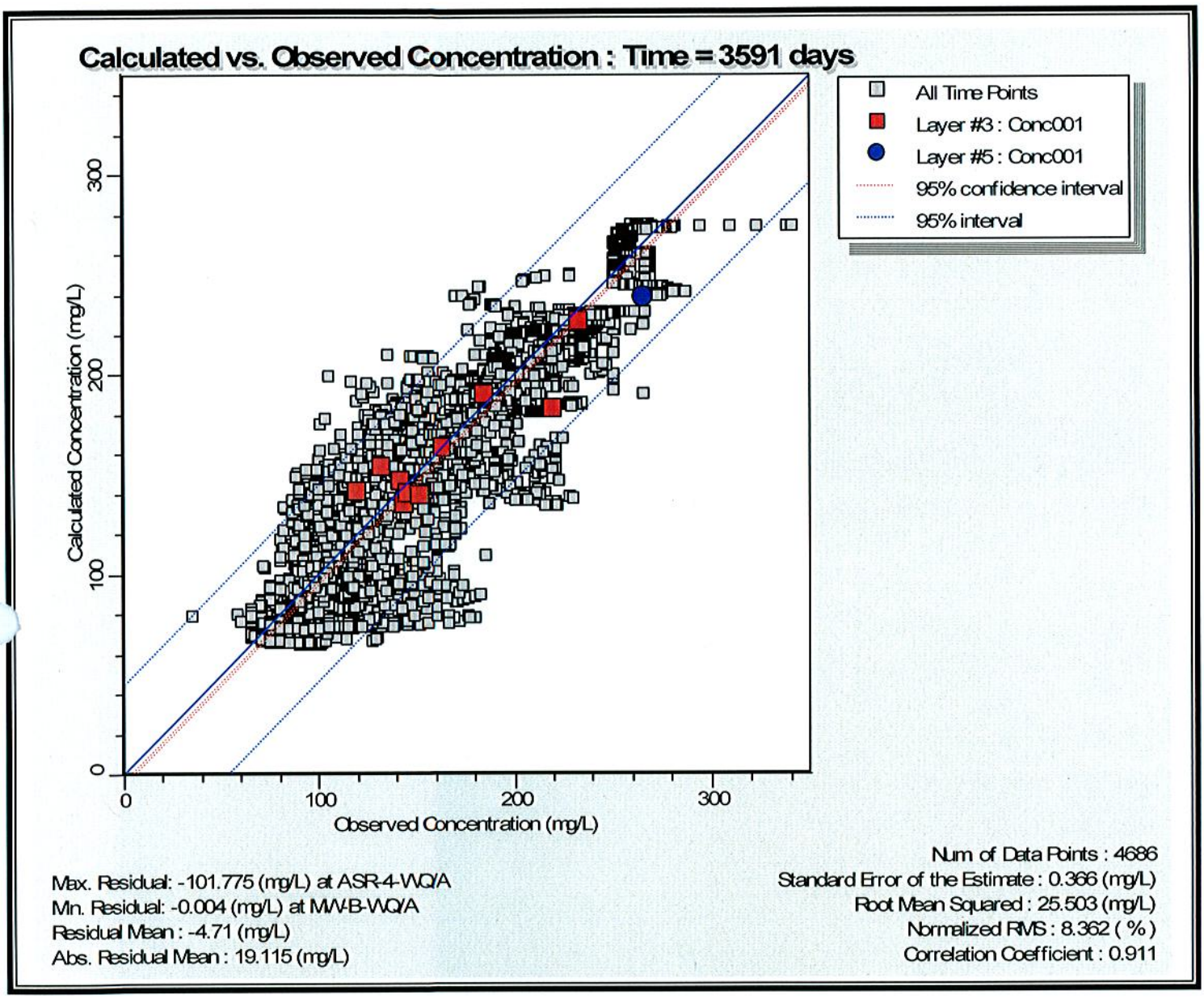


FIGURE 4-2. SUMMARY OF CALIBRATION STATISTICS FOR WATER QUALITY DATA.



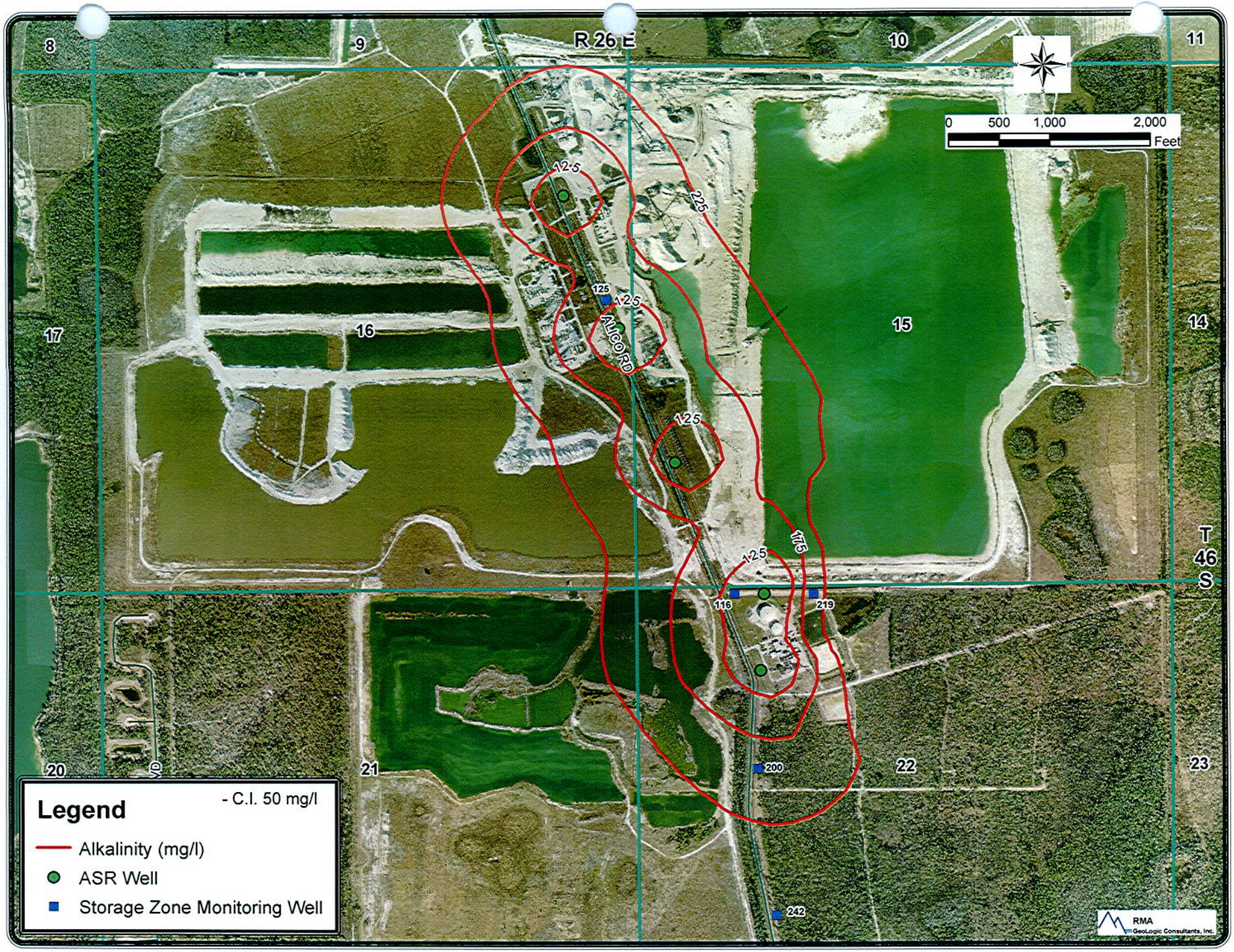


FIGURE 4-3. MAP SHOWING LOCATION OF ASR INJECTED WATER AT THE END OF INJECTION IN CYCLE 9.

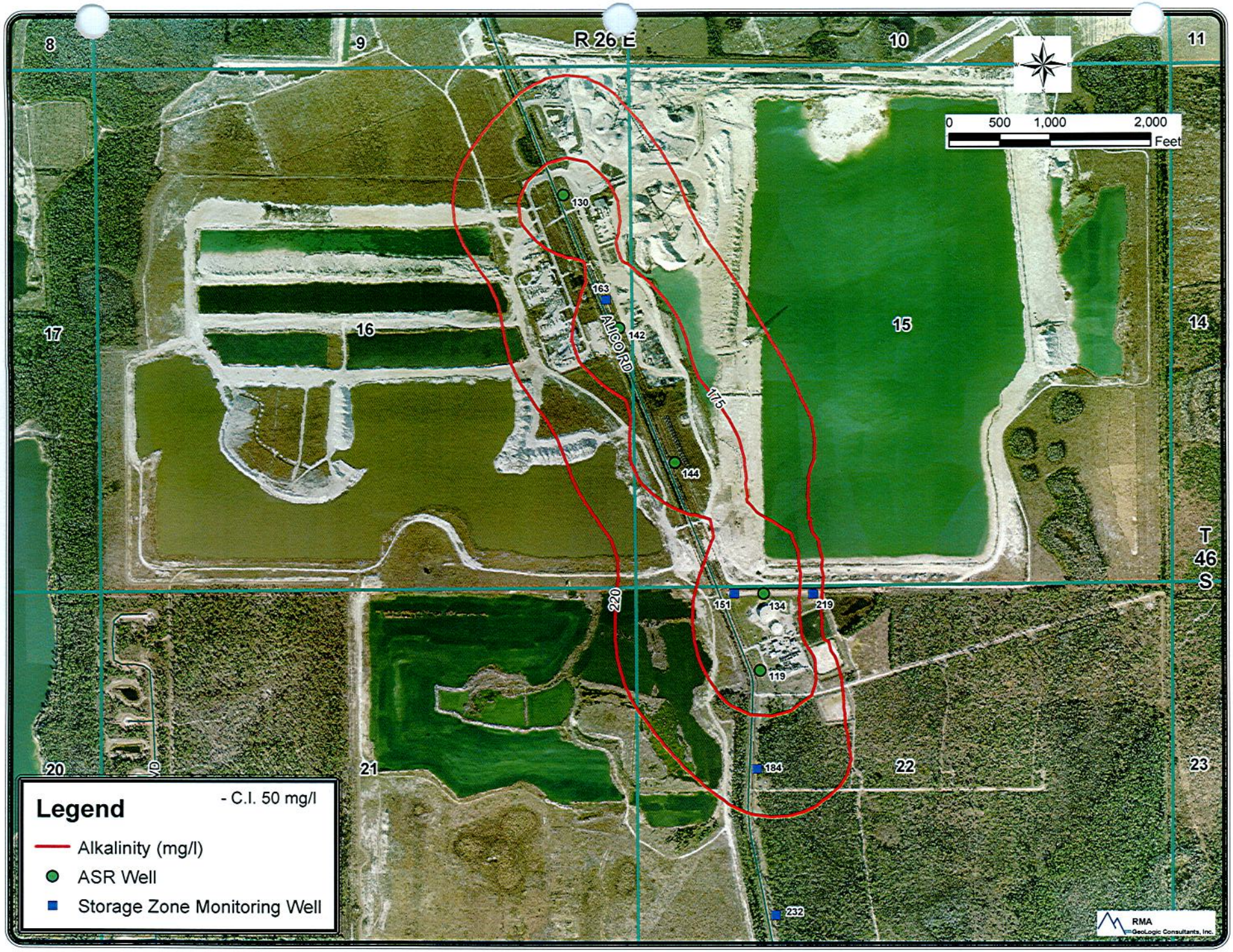


FIGURE 4-4. MAP SHOWING LOCATION OF ASR INJECTED WATER AT THE END OF RECOVERY IN CYCLE 9.

The model was used to predict recovered volumes per well and total for the system, until the arsenic limit (10 ug/l) is reached. The recovered volume to the 10 ug/l limit for arsenic was predicted based on past performance during the nine operational cycles of the system. A summary of the computer model simulations and output for Cycle 10 is provided as Table 4-1.

As indicated on Table 4-1, using alkalinity concentrations as an indicator or pseudomorph for reaching the arsenic MCL, the anticipated recovery factor ranges from 97% for well ASR-2 to about 83% for well ASR-4. Wells ASR-2, ASR-3, ASR-4, and ASR-5 have not shown any arsenic problems during the last five cycles. Recovery efficiency for well ASR-1 is anticipated to be about 65% for Cycle 10. In addition, the model indicated that the injected water will extend a maximum of approximately 1,600 feet west of well ASR-1 (Figure 4-5) at the end of the injection period.

C. Optimum Storage Volume Update

The optimum storage volume previously calculated during the Assessment Plan (RMA GeoLogic Consultants, 2010) was updated based on the results of Cycle 9. Based on the computer modeling, injecting a total of 300 MG per cycle (i.e. 60 MG per ASR well), an optimum storage volume for the Corkscrew ASR system, utilizing the five existing ASR wells is approximately 700 MG. During the Assessment Plan evaluation, the optimum storage volume was anticipated to be reached in operational Cycle 10. As part of the current update, the model anticipates that the optimum storage volume will also be reached during Cycle 10.

After Cycle 10 volumes of injected water will continue to be lost during each cycle around the periphery of the mixing zone. Based on modeling, an adjusted factor of 40 MG was previously calculated. However, due to injection of water with slightly higher salinity (i.e. due to blending fresh water from the shallow wellfields with brackish water from the Lower Hawthorn aquifer), the model calculated adjusted loss factor for future cycles is 45 MG. Thus, the Adjusted Volume in storage at the end of each cycle will be calculated as:

Adjusted Volume in Storage	=	Volume in Storage at Beginning of Cycle	+	Volume Injected	-	Volume Recovered	-	C

Where C is a constant and represents the volume lost at the edge of the mixing zone each year, determined by modeling to be approximately 45 MGY.

TABLE 4-1. SUMMARY OF COMPUTER MODEL SIMULATIONS AND OUTPUT FOR CYCLE 10

Cycle	Year	Well	Assumed Injectate Parameters		Equivalent Alkalinity (mg/) to Arsenic of 10 ug/l	Source of Equivalency	Average Distance of Injected Water (Feet)	Predicted Recovery Volume (MG)	Predicted Recovery Percentage
			Volume (MG)	Avg Alkalinity (mg/l)					
10	2010-2011	ASR-1	60	60	130	Highest Recorded Arsenic Value in Cycle 9	1,500	39.0	65
		ASR-2	60	60	150	Highest Recorded Arsenic Value in Cycle 4	1,350	58.0	97
		ASR-3	60	60	150	Highest Recorded Arsenic Value in Cycle 4	1,350	54.0	90
		ASR-4	60	60	150	Highest Recorded Arsenic Value in Cycle 4	1,350	50.0	83
		ASR-5	60	60	145	Highest Recorded Arsenic Value in Cycle 4	1,300	53.0	88
		TOTALS:	**300**					**254**	**85**

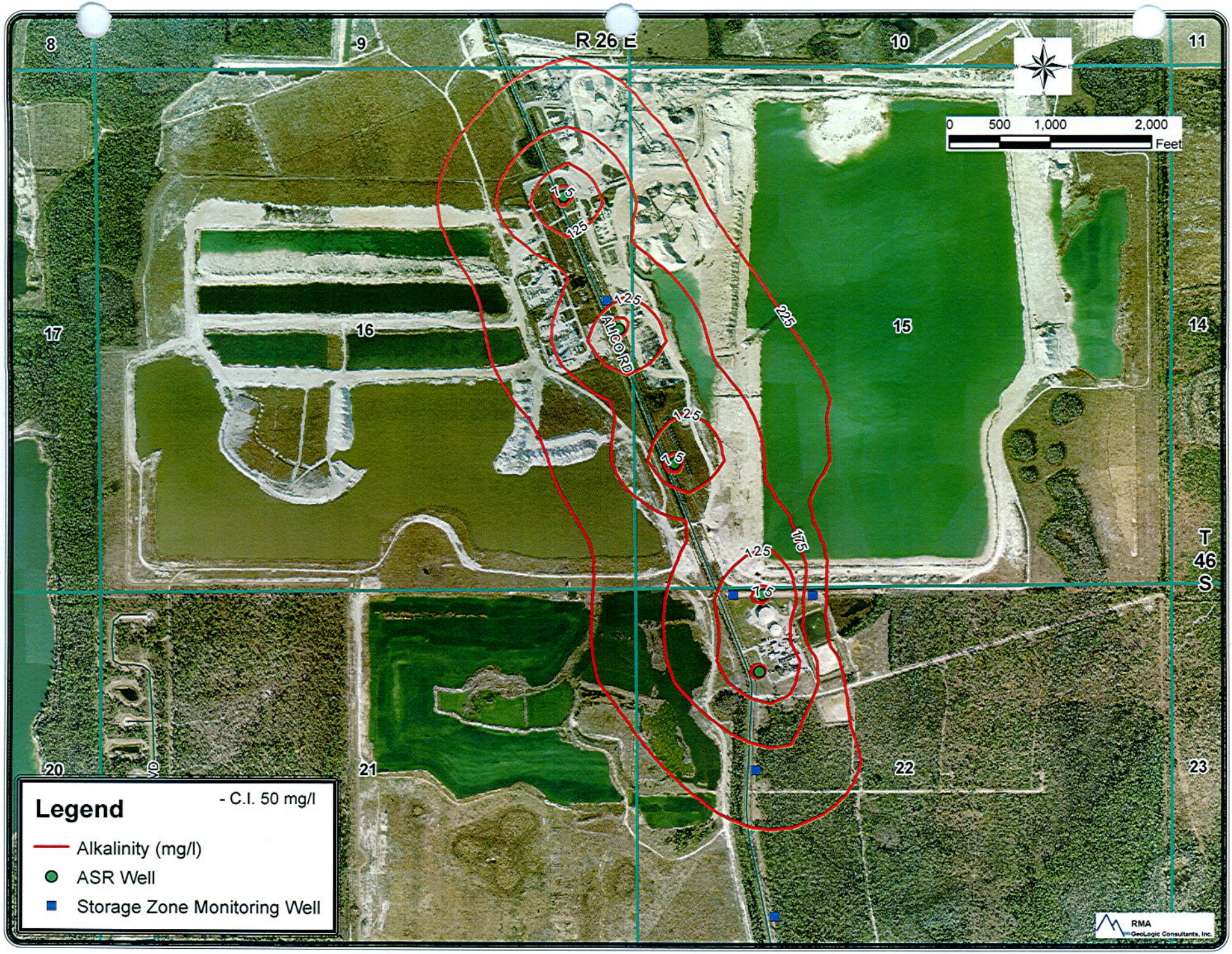


FIGURE 4-5. MAP SHOWING LOCATION OF SIMULATED ASR INJECTED WATER AT THE END OF INJECTION OF CYCLE 10.

V. FUTURE OPERATION SYSTEM CONSIDERATIONS

The Corkscrew ASR system has completed nine operational cycles of injection, storage, and recovery using five ASR wells. The only noncompliance issues related to the operational testing have been arsenic concentrations in the recovered water that have slightly exceeded regulatory criteria during a very short period of time in well ASR-1 and storage zone observation well MW-C which is located proximal to well ASR-1. Because the recovered water is blended with treated water from the WTP before it enters the Corkscrew distribution system, there are no issues with arsenic concentrations in the finished water pumped to LCU customers. Noncompliance is strictly due to the minor amounts of mobilized arsenic in the storage zone caused by leaching of arsenic from the rock matrix. This is believed to be related to higher dissolved oxygen concentrations in the injected water than in the native groundwater.

A. Institutional Control Evaluation

The Lee County Wellfield Protection Ordinance (07-35) provides a 500 foot radial zone of protection around each ASR well in Lee County. This protection zone prohibits installation of a water supply well within 500 feet of an existing or permitted ASR well unless confinement exists between the production zone of the water supply well and the storage zone of the ASR well.

The solute transport computer model indicates that the leading edge of injected fresh water extends more than 500 feet from the ASR well. However, the water quality data collected from the ASR wells and the storage monitoring wells indicates that mobilization of arsenic is restricted to the area proximal to well ASR-1 within an approximate radial distance of 400 feet from well ASR-1. Therefore, The Lee County Wellfield Protection Ordinance provides sufficient institutional control over the area where arsenic mobilization has occurred.

B. Evaluation of Current Monitoring Program

The construction permit for Corkscrew ASR system includes five storage zone observation wells (MW-1, MW-2, MW-3, MW-A, and MW-C), one overlying zone monitoring well (MW-LM926), and one underlying zone monitoring well (MW-B). Monitoring requirements include

weekly sampling during injection and recovery periods from all the wells. During storage periods greater than one month, monitoring is required monthly.

Based on the AP investigation and the solute transport computer modeling, some modifications to the monitoring program were recommended. Those recommendations included the installation of three new storage zone monitoring wells located as shown on Figure 5-1 and discontinuance of water quality monitoring from overlying zone monitoring well MW-LM926 and underlying monitoring well MW-B. The FDEP approved the recommended changes to the monitoring program with the exception of the discontinuance of monitoring from the overlying zone monitoring well.

C. Recommendations for Future Near-Term Operation for Corkscrew ASR System

It is recommended that LCU continue operational testing cycles using the existing five ASR wells. Recovery operations from the ASR wells should cease when alkalinity concentrations approach the following concentrations: 130 mg/l in well ASR-1, 145 mg/l in well ASR-5, and 150 mg/l in wells ASR-2 through ASR-4. Based on the evaluation of the operational data collected through nine cycles, these alkalinity concentrations are equivalent to arsenic concentrations approaching 10 ug/l. It should be noted that alkalinity concentrations in monitoring well MW-C can be used as a good indicator to determine the approach of injected water with elevated arsenic concentrations to well ASR-1.

The results of the nine operational cycles indicate a direct relationship between dissolved oxygen in the injected water to arsenic concentrations in the recovered water from the ASR wells. Analyses of the injected water indicate that the dissolved oxygen in the injected water obtained in the field ranged from approximately 8 mg/l during Cycle 8 to below 2 mg/l in Cycle 6 (Figure 3-7A). During Cycle 9, the field obtained dissolved oxygen concentrations in the injected water ranged from 2.3 to 3.5 mg/l. The laboratory reported dissolved oxygen concentrations in the injected water ranged from about 6 to 10 mg/l during the 9 operational cycles with an average concentration of about 8.5 mg/l during Cycle 9 (Figure 3-7B). The significant difference between the reported dissolved oxygen concentrations from the laboratory to those obtained in the field was not observed for the samples obtained from the recovered water and from the monitoring

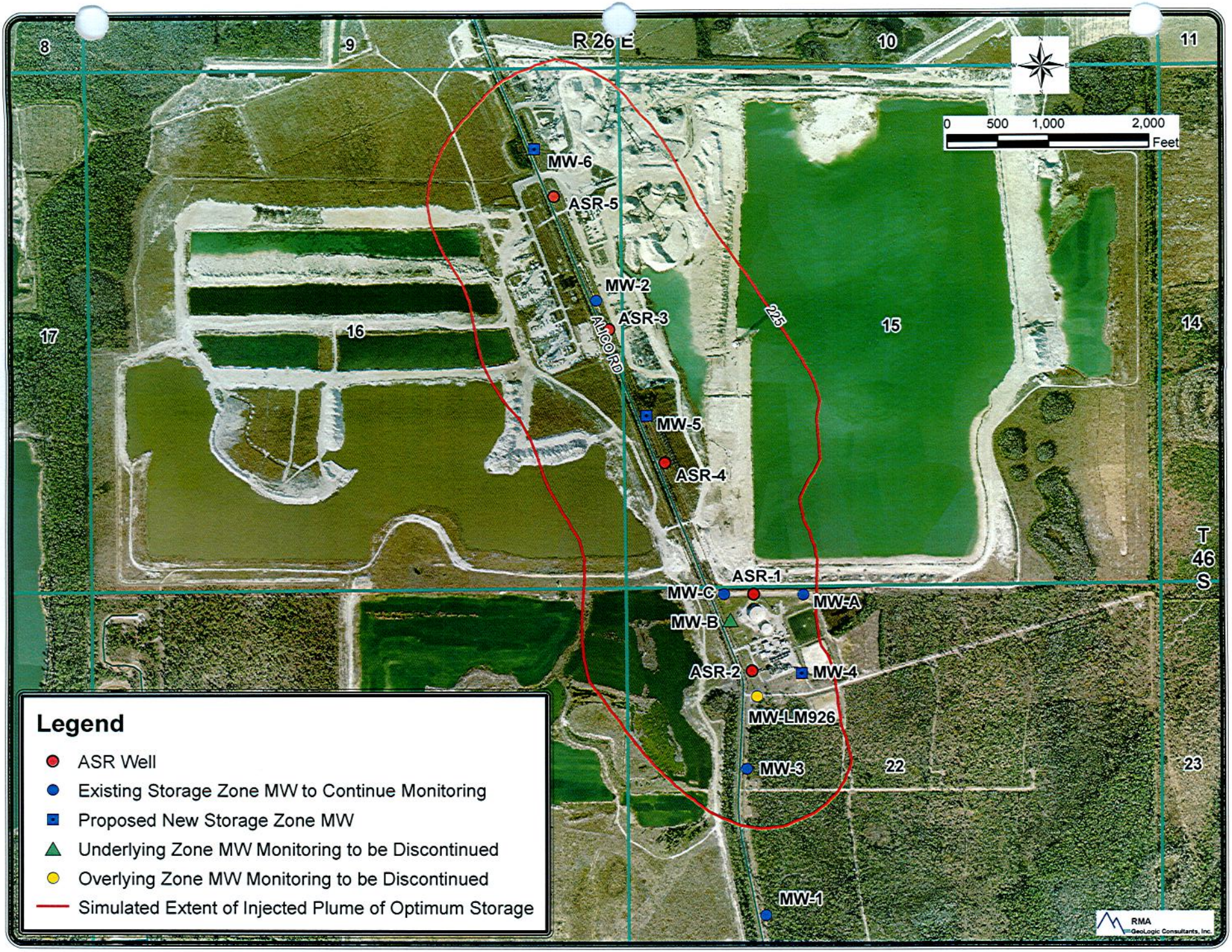
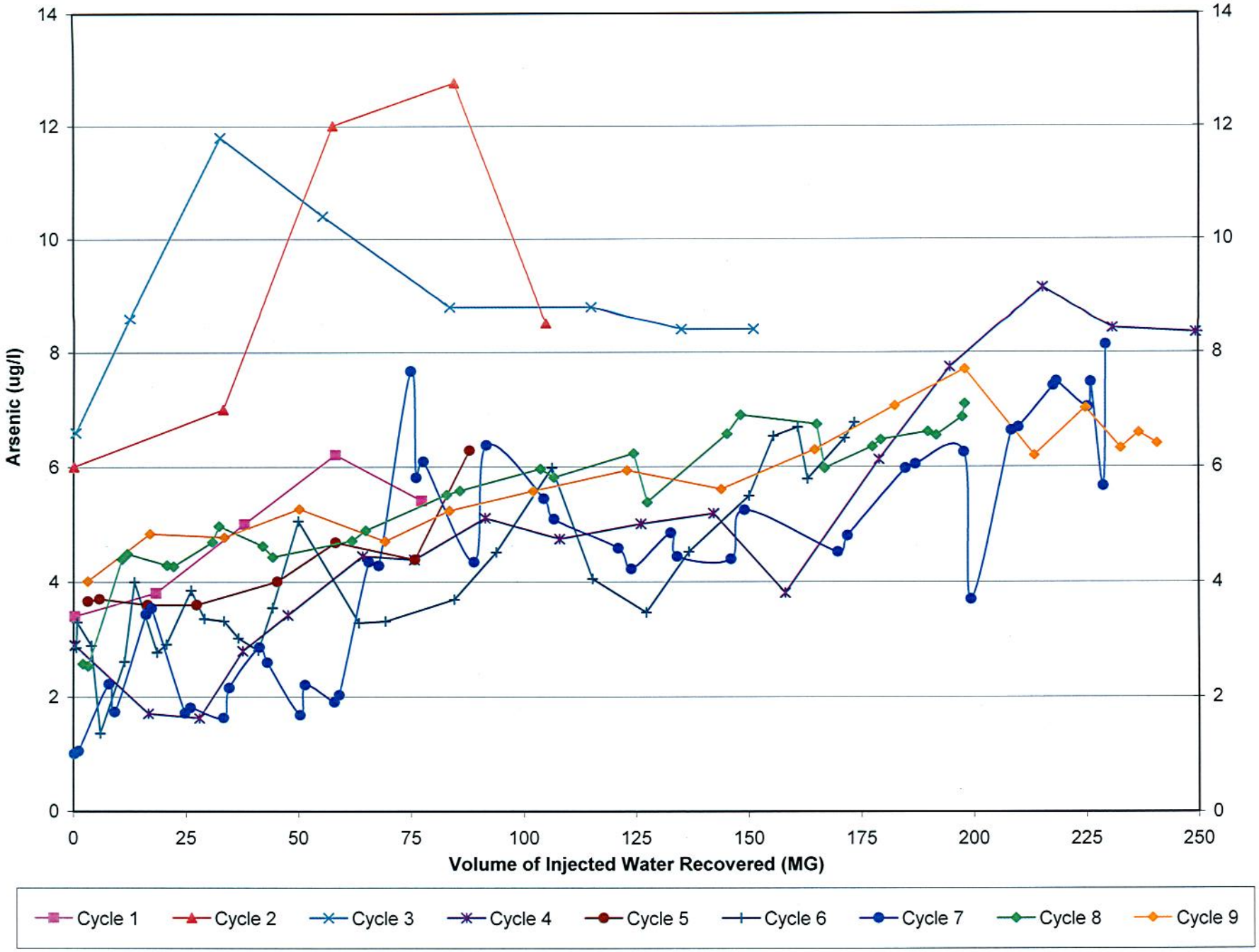


FIGURE 5-1. MAP SHOWING LOCATION OF EXISTING AND PROPOSED MONITORING WELLS FOR CORKSCREW ASR SYSTEM.

wells (see figures provided in Section 2 of this report).

The arsenic concentrations in the recovered water for Cycle 9 were similar to those of Cycle 8 and slightly higher than those of Cycle 7 (Figure 5-2) which indicates that the dissolved oxygen concentrations in the injected water were likely similar or slightly higher than to those during Cycle 8. It is believed that as the result of the recharge of injected water with a high dissolved oxygen content, oxidation of pyrite contained in the limestone matrix proximal to an ASR well causes a release of arsenic into the groundwater. During recovery, arsenic transport is believe to occur due to reductive dissolution of iron oxyhydroxides, with subsequent release of sorbed arsenic occurring under sulfate-reducing conditions. Therefore, it is strongly recommended that, in the future, the dissolved oxygen in the injected water be maintained at levels similar to those of Cycles 4 through 7 (i.e. about 2 mg/l), and should never at any time be above 5.0 mg/l.

FIGURE 5-2. PLOT OF ARSENIC CONCENTRATIONS IN RECOVERED WATER FOR EACH OPERATIONAL CYCLE.



VI. CONCLUSIONS AND RECOMMENDATIONS

A. Conclusions

The following conclusions are made as a result of this study:

(1-) A total of 355.8 MG of water from the Corkscrew WTP were injected during Cycle 9. The injected water was stored for 1.5 months. A total of 241.4 MG of water were recovered during Cycle 9. This represents approximately 68% of the injected water.

(2-) The recovered water quality indicates that additional volumes of injected water could have been recovered for wells ASR-2 through ASR-5 during Cycle 9 without exceeding the arsenic concentration of 10 ug/l.

(3-) A very strong discrepancy between field and laboratory reported dissolved oxygen concentrations in the injected water was noted during Cycle 9. No significant difference between field and laboratory reported dissolved oxygen concentrations in the recovered water and in the monitoring wells was observed. Due to the direct relationship between dissolved oxygen in the injected water and arsenic mobilization, it is important to accurately determine concentrations of dissolved oxygen in the injected water.

(4-) The recovered water quality met all Primary and Secondary Drinking Water Standards throughout the approximate 3.5-month recovery period with the exception of one arsenic concentration in well ASR-1 at the end of the recovery period.

(5-) The water quality parameters in the monitoring wells met all Primary and Secondary Drinking Water Standards during Cycle 9 with the exception of arsenic concentrations in storage zone monitoring well MW-C during a short period of time during the middle portion of recovery operations.

(6-) The groundwater flow and solute transport model for the Corkscrew ASR system was updated and calibrated with the data collected during Cycle 9. Based on the model, the injected water extended to a maximum of 1,500 feet west of ASR-1 during Cycle 9. Model projections for Cycle 10 indicate that if a total of 300 MG is injected (i.e. 60 MG

per ASR well), the injected water will extend a maximum of approximately 1,600 feet west of well ASR-1 and a recovery efficiency of 85% is anticipated for the entire system.

(7-) The model update indicates that the calculated optimum storage volume of approximately 700 MG should be reached in Cycle 10 with approximately 45 MG lost during each successive cycle due to mixing at the periphery. Therefore, by injecting 300 MG into the ASR system, a total of 255 MG is anticipated to be recovered during each cycle.

B. Recommendations

The following recommendations are made as a result of this study:

(1-) Based on the solute transport model predictions, recovery operations in Cycle 10 should cease when alkalinity reach 130 mg/l in well ASR-1, 145 mg/l in well ASR-5, and 150 mg/l in wells ASR-2 through ASR-4.

VII. REFERENCES

Harbaugh, A.W., Banta, E.R., Hill, M.C., and McDonald, M.G., 2000, MODFLOW-2000, the U.S. Geological Survey modular ground-water model-user guide to modularization concepts and the ground-water flow process, United States Geological Survey, Open-File Report 00-92, 130 p.

RMA GeoLogic Consultants, 2010, Assessment, Evaluation, Computer Modeling, and Operation and Management Plan for Lee County Utilities' Corkscrew Water Treatment Plant Aquifer Storage and Recovery System, 206 p.

Water Resource Solutions, 1999, Corkscrew Expansion Project: Well Completion Report Prepared for Lee County, 40 p.

Zheng, C. and Wang, P., 1999, MT3DMS, A Modular Three-Dimensional Multispecies Transport Model for Simulation of Advection, Dispersion, and Chemical Reactions of Contaminants in Groundwater Systems: Documentation and User's Guide, United States Army Corps of Engineers, U.S. Army Engineer Research and Development Center, Vicksburg, Mississippi, SERDP-99-1.

APPENDIX A
COPY OF CONSTRUCTION PERMIT
FOR CORKSCREW ASR SYSTEM

Florida Department of Environmental Protection

Charlie Crist
Governor

Jeff Kottkamp
Lt. Governor

Michael W. Sole
Secretary

SENT VIA ELECTRONIC MAIL

August 17, 2009

In the Matter of an
Application for Permit by:

Mr. Douglas Meurer, P.E., Director,
Lee County Utilities
1500 Monroe Street, 3rd Floor
Fort Myers, FL 339901
Email: meurerDL@leegov.com

Lee County - UIC
File Number: 142222-012-016-UC and
AO-050-SD/UIC09
Lee County Utilities Corkscrew WTP ASR
Class V, Group 7, ASR Wells ASR-1 through ASR-5

PERMIT

Enclosed are Administrative Order, AO-050-SD-UIC09, and Permit Numbers 142222-012-UC/5X through 142222-016-UC to renew construction permits for four (4) Class V, Group Seven, Aquifer Storage and Recovery, (ASR), injection wells and associated monitor wells, issued pursuant to Section(s) 403.087, Florida Statutes.

Any party to this Order (permit) has the right to seek judicial review of the permit pursuant to Section 120.68, Florida Statutes, by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000; and by filing a copy of the Notice of appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this Notice is filed with the Clerk of the Department.

Executed in Lee County, Florida

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

Vijaya Sakyal for

Jon M. Iglehart
Director of
District Management

CERTIFICATE OF SERVICE

The undersigned duly designated deputy clerk hereby certifies that this PERMIT and all copies were mailed before the close of business on August 17, 2009 to the listed persons.

Clerk Stamp

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to Section 120.52, Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Julie D. La Mear

Clerk

8/17/09

Date

JMI/DR/mac

Enclosures

cc

Dan Aquaviva, P.G. (Daquaviva@rma-geologic.com)
Nancy Marsh, EPA (marsh.nancy@epa.gov)
Joe Haberfeld, P.G., FDEP (joe.haberfeld@dep.state.fl.us)
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Scott Coovert, Lee County, (scoovert@leegov.com)

Florida Department of Environmental Protection

SENT VIA ELECTRONIC MAIL

July 13, 2009

PERMIT

PERMITTEE:
Mr. Douglas Meurer, P.E., Director,
Lee County Utilities
1500 Monroe Street, 3rd Floor
Ft Myers, FL 33901
Email: MeurerDL@leegov.com

Permit/Cert. No:142222-012-016-UC/5X
Date of Issue: **August 17, 2009**
Expiration Date: **August 16, 2014**
County: Lee
Latitude: Various N
Longitude: - Various W
Lee County Utilities Corkscrew WTP ASR
Class V, Group 7 Injection Wells ASR-1 through ASR-5

This permit is issued under the provisions of Chapter 403 of the Florida Statutes (F.S.) and rules 62-4, 62-520, 62-528, and 62-550 of the Florida Administrative Code. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents, attached hereto or on file with the Department and made a part hereof and specifically described as follows:

Continue operational testing, in accordance with this permit and associated Administrative Order, AO-050-SD-UIC09, of five (5) Class V, Group 7, Aquifer Storage and Recovery (ASR) injection wells with five (5) existing storage zone monitoring wells, one, (1), existing overlying zone monitor well completed into the Sandstone Aquifer and one, (1) underlying zone monitor well completed into the Mid-Hawthorn Zone II Aquifer. The purpose is to store, in the Mid - Hawthorn, Zone 1, aquifer, water from the Corkscrew Water Treatment Plant (WTP) treated to meet potable standards to meet the seasonal demands of a potable water system. The ASR wells are designed to inject a maximum of 450 gpm (0.65 million gallons per day). This project is depicted on the Lee County Utilities Corkscrew WTP ASR applications and associated documents submitted in support of this project. The location for this project is at the Lee County Utilities Corkscrew WTP, 16101 Alico Road, Ft Myers, Lee County, Florida.

Subject to Specific Conditions 1-14.

1. General Criteria:

   a. The terms, conditions, requirements, limitations and restrictions set forth in this permit are "permit conditions" and are binding and enforceable pursuant to section 403.141, F.S.

   b. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action.

   c. As provided in subsection 403.087(7), F.S., the issuance of this permit does not convey any vested rights or exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor infringement of federal, state, or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in this permit.

   d. This permit conveys no title to land, water, does not constitute State recognition or acknowledgment of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

   e. This permit does not relieve the permittee from liability for harm to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefrom; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by an order from the Department.

   f. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, or are required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

   g. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credentials or other documents as may be required by law and at reasonable times, access to the premises where the permitted activity is located or conducted to:

      (1) Have access to and copy any records that must be kept under conditions of this permit;

      (2) Inspect the facility, equipment, practices, or operations regulated or required under this permit; and

(3) Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

(4) Reasonable time will depend on the nature of the concern being investigated.

h. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee should immediately provide the Department with the following information:

(1) A description of and cause of noncompliance; and

(2) The period of noncompliance, including dates and times; or, if not corrected the anticipated time the noncompliance is expected to continue, and steps being taken to reduce, eliminate, and prevent the recurrence of the noncompliance. The permittee shall be responsible for any and all damages that may result and may be subject to enforcement action by the Department for penalties or for revocation of this permit.

i. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source which are submitted to the Department may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is proscribed by sections 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

j. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance; provided, however, the permittee does not waive any other rights granted by Florida Statutes or Department rules.

k. This permit is transferable only upon Department approval in accordance with rules 62-4.120 and 62-528.350, F.A.C. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

l. This permit or a copy thereof shall be kept at the work site of the permitted activity.

m. The permittee shall comply with the following;

(1) Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records shall be extended automatically unless the Department determines that the records are no longer required.

(2) The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation) required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three

years from the date of the sample, measurement, report, or application unless otherwise specified by Department rule.

(3) Records of monitoring information shall include:

(a) the date, exact place, and time of sampling or measurements;

(b) the person responsible for performing the sampling or measurements;

(c) the dates analyses were performed;

(d) the person responsible for performing the analyses;

(e) the analytical techniques or methods used;

(f) the results of such analyses.

(4) The permittee shall furnish to the Department, within the time requested in writing, any information which the Department requests to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit.

(5) If the permittee becomes aware that relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

n. All applications, reports, or information required by the Department shall be certified as being true, accurate, and complete

o. Reports of compliance or noncompliance with, or any progress reports on, requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each scheduled date

p. Any permit noncompliance constitutes a violation of the Safe Drinking Water Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application

q. It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit

r. The permittee shall take all reasonable steps to minimize or correct any adverse impact on the environment resulting from noncompliance with this permit.

s. This permit may be modified, revoked and reissued, or terminated for cause, as provided in 40 C.F.R. sections 144.39(a), 144.40(a), and 144.41 (1998). The filing of a request by the permittee for a permit modification, revocation or reissuance, or termination, or a

notification of planned changes or anticipated noncompliance, does not stay any permit condition

t. The permittee shall retain all records of all monitoring information concerning the nature and composition of injected fluid until five years after completion of any plugging and abandonment procedures specified under rule 62-528.435, F.A.C. The permittee shall deliver the records to the Department office that issued the permit at the conclusion of the retention period unless the permittee elects to continue retention of the records.

u. The permittee shall notify the Department as soon as possible of any planned physical alterations or additions to the permitted facility. In addition, prior approval is required for activities described in rule 62-528.410(1)(h).

v. The permittee shall give advance notice to the Department of any planned changes in the permitted facility or injection activity that may result in noncompliance with permit requirements.

w. The permittee shall report any noncompliance which may endanger health or the environment including:
   (1) Any monitoring or other information which indicates that any contaminant may cause an endangerment to an underground source of drinking water; or

   (2) Any noncompliance with a permit condition or malfunction of the injection system that may cause fluid migration into or between underground sources of drinking water.

   (3) Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause, the period of noncompliance, including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and the steps taken or planned to reduce, eliminate, and prevent reoccurrence of the noncompliance.

x. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

y. No underground injection is allowed that causes or allows movement of fluid into an underground source of drinking water if such fluid movement may cause a violation of any primary drinking water standard or may otherwise adversely affect the health of persons.

2. Signatories and Certification Requirements.

All reports and other submittals required to comply with this permit shall be signed by a person authorized under Rules 62-528.340(1) or (2), F.A.C. In accordance with Rule 62-528.340(4), F.A.C., all reports shall contain the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based upon my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

3. Drawings, plans, documents or specifications submitted by the Permittee, not attached hereto, but retained on file at the South Florida District Office, are made a part hereof. Any changes, except as provided elsewhere in this permit, must be approved by the Department before implementation.

4. The injection and monitor wells at the site shall be abandoned when posing a potential threat to the quality of the waters of the State. In the event a well must be plugged or abandoned, the permittee shall obtain a permit from the Department as required by Chapter 62-528, F.A.C. The permittee shall notify the Department and obtain approval prior to any well work or modification.

5. The permittee shall notify the Department in the event that any of the conditions of the permit cannot be met, including an emergency discharge, due to breakdown of equipment, power outages or damages by hazard of fires, wind or other causes in accordance with the following:

   a. Notification shall be made in person, email, or by telephone within 24 hours of the event.

   b. A written report shall be submitted within 5 days which describes the nature and cause of the breakdown or malfunction, the steps being taken to correct the problem and prevent its recurrence, emergency procedures in use pending correction of the problem and the time when the facility will again be operating in compliance with permit conditions.

6. Prior to the commencement of any work, the name of the Florida-registered driller(s) supervising the drilling operations and the driller's registration number shall be submitted to the Department. The permittee or the engineer of record shall provide the Department with copies of all required federal, state or local permits prior to spudding the wells.

7. The permittee shall retain the engineer of record or obtain the services of any professional engineer registered in the State of Florida for the inspection of the construction of this project. Upon completion the engineer shall inspect for conformity to construction permit applications and associated documents. The Department shall be notified immediately of any change of engineer.

8. The specifications for a temporary containment structure around the borehole during the drilling of the ASR well shall be submitted to and approved by the Department prior to the ASR well construction.

9. Pumping fluids other than the potable water from the Corkscrew WTP into the injection well will constitute a violation of this permit and shall constitute cause for revocation.

10. Operational Testing

a. The following table lists the major milestones for facility improvements required by AO-050-SD/UIC09, the administrative order, accompanying this permit.

Milestones	TimeFrame
Submit Assessment Plan, (AP)	Within 90 days of issuance of the permits
FDEP review of submittal and written response	Within 30 days of receipt
County's submittal of written response to FDEP inquiries	Within 30 days of receipt of FDEP responses
Implement AP	Upon FDEP approval
Based on findings of AP submit Corrective Action Plan, CAP	Within 30 days of completion of AP activities
FDEP review of submittal and written response	Within 30 days of receipt
County's submittal of written response to FDEP inquiries	Within 30 days of receipt of FDEP responses
If necessary, implement Corrective Action Plan to remove Arsenic Contamination from the USDW	Within 30 days of FDEP approval
Submit Corrective Action Report	Within 90 days of completion of FDEP approved AP, CAP, and Remdial activities

b. Operational Testing Conditions – ASR Wells

Class V Injection Wells

Well Number	Casing Diameter (OD)	Depth Cased	Open Hole (bls)
ASR-1	12" OD Sch 80 PVC	328'	328' to 397'
ASR-2	12" OD Sch 80 PVC	337'	337' to 397'
ASR 3	12" OD Sch 80 PVC	285'	285' to 347'
ASR 4	12" OD Sch 80 PVC	310'	310' to 368'
ASR-5	12" OD Sch 80 PVC	253'	253' to 291'

The injection well system shall be monitored in accordance with rule 62-528.615, F.A.C. The following injection well performance data shall be recorded and reported from the injection well instrumentation in the Monthly Operating Report as indicated below during each recharge and recovery cycle. Sampling of ASR wells during storage cycles is not required. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

ASR-1 through ASR-5

Reporting	
Parameter	Frequency
Maximum Injection Pressure (psi)	Daily/Monthly

Minimum Injection Pressure (psi)	Daily/Monthly
Average Injection Pressure (psi)	Daily/Monthly
Maximum Flow Rate	Daily/Monthly
Minimum Flow Rate	Daily/Monthly
Average Flow Rate	Daily/Monthly
Total Volume Recharged (Gals)	Daily/Monthly
Total Volume Recovered (Gals)	Daily/Monthly
Net Storage (MG)	Monthly
Gross Alpha (pCi/L)	Monthly
Total Trihalomethanes (mg/L)	Weekly
Dissolved Oxygen (mg/L)	Weekly
Total Dissolved Iron (mg/L)	Weekly
Total Dissolved Sulfide (mg/L)	Weekly
Arsenic (µg/L)	Weekly
Total Dissolved Solids (mg/L)	Weekly
Specific Conductivity (µmhos/cm)	Weekly
Total Alkalinity (mg/L)	Weekly
pH (SU)	Weekly
Chloride (mg/L)	Weekly
Sulfate (mg/L)	Weekly
Field Temperature (°C)	Weekly
Oxidation-Reduction Potential (ORP)	Weekly
Primary and Secondary Drinking Water Standards (Recharge Water Only)	Annually***

*** Asbestos, acrylamide, epichlorohydrin, and dioxin are excluded.

c. Operational Testing Conditions - Monitor Well System Monitor Wells

Well Number	Casing Diameter (OD)	Depth (bls) Cased/Total	Group or Formation	Monitoring Interval (bls)
MW-A	8" Sch 40 PVC	340'	Mid-Hawthorn Zone I	340'-402'
MW-B	4" Sch 40 PVC	452'	Mid-Hawthorn Zone II	452'-504'
MW-C	4" Sch 40 PVC	330'	Mid-Hawthorn Zone I	330'400'
MW-1	6" Sch 40 PVC	358'	Mid-Hawthorn Zone I	358'-410'
MW-2	6" Sch 40 PVC	283'	Mid-Hawthorn Zone I	283'-354'
MW-3	6" Sch 40 PVC	355'	Mid-Hawthorn Zone I	355'-411'
LM-926	4" Sch 40 PVC	155'	Sandstone	155'-195'

All monitor wells shall be monitored in accordance with Rule 62-528.615, F.A.C. The following monitor well performance data shall be recorded and reported from the monitor well instrumentation in the Monthly Operating Report as indicated below during all recharge, storage

and recovery cycles of the injection/production wells. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

During extended storage periods (greater than 30 days), the monitor well water quality parameters listed below may be sampled and analyzed monthly.

MW-A through MW-C, and MW-1 through MW-3, and LM-926

Parameter	Reporting Frequency
Maximum Water Level or Pressure (feet NVGD or psi)	Daily/Monthly
Minimum Water Level or Pressure (feet NVGD or psi)	Daily/Monthly
Average Water Level or Pressure (feet NVGD or psi)	Monthly
Gross Alpha (pCi/L)	(SZMW-1R, 2 and 3 only)*
Total Trihalomethanes (mg/L)	Weekly
Dissolved Oxygen (mg/L)	Weekly
Total Iron (mg/L)	Weekly
Total Dissolved Sulfide (mg/L)	Weekly
Arsenic (µg/L)	Weekly
Total Dissolved Solids (mg/L)	Weekly
Specific Conductivity (µmhos/cm)	Weekly
Total Alkalinity (mg/L)	Weekly
pH (SU)	Weekly
Chloride (mg/L)	Weekly
Sulfate (mg/L)	Weekly
Field Temperature (°C)	Weekly
Oxidation-Reduction Potential (ORP)	Weekly

*Beginning and end of each recovery cycle.

11. The permittee shall calibrate all pressure gauge(s), flow meter(s), chart recorder(s), and other related equipment associated with the injection well system on a semi-annual basis. The permittee shall maintain all monitoring equipment and shall ensure that the monitoring equipment is calibrated and in proper operating condition at all times. Laboratory equipment, methods, and quality control will follow EPA guidelines as expressed in Standard Methods for the Examination of Water and Wastewater. The pressure gauge(s), flow meter(s), and chart recorder(s) shall be calibrated using standard engineering methods.

12. The permittee shall submit monthly to the Department the results of all injection well and monitor well data required by this permit no later than the last day of the month immediately following the month of record. The results shall be sent to the Department of Environmental Protection, P.O. Box 2549, Fort Myers, Florida 33902-A copy of this report shall also be sent to the Department of Environmental Protection, Underground Injection Control Program, MS 3530, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400.

13. If injection is to continue beyond the expiration date of this permit, the permittee shall apply for and obtain a construction or operation permit. If necessary to complete the operational testing period, the permittee shall apply for renewal of the construction permit at least 60 days prior to the expiration date of this permit.

14. The permittee is reminded of the necessity to comply with the pertinent regulations of any other regulatory agency, as well as any county, municipal, and federal regulations applicable to the project. These regulations may include, but are not limited to, those of the Federal Emergency Management Agency in implementing flood control measures. This permit should not be construed to imply compliance with the rules and regulations of other regulatory agencies.

Note: In the event of an emergency the permittee shall contact the Department by calling Ph. (800) 320-0519. During normal business hours, the permittee shall call (239) 332-6975.

Issued this _17th_ day of August 2009.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION

for

Jon M. Iglehart
Director of
District Management

JMI/DR/mac

APPENDIX B
COPY OF ADMINISTRATIVE ORDER
FOR CORKSCREW ASR SYSTEM

BEFORE THE STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION

IN THE MATTER OF:	IN THE OFFICE OF THE SOUTH DISTRICT
Lee County Board Of County Commissioners C/O Mr. Douglas Muerer, P.E., Director, Lee County Utilities Department, 1500 Monroe Street, Ft Myers, Florida 33902	Order No.: AO-050-SD/UIC09 Lee County Utilities Injection Well Facility DEP Permit No. 142222-012-016-UC/5X

ADMINISTRATIVE ORDER ESTABLISHING COMPLIANCE SCHEDULE UNDER SECTION 403.088(2)(f), F.S.

STATUTORY AUTHORITY

The Department of Environmental Protection (Department) issues this order under the authority of section 403.088(2)(f) of the Florida Statutes in conjunction with Department permit Nos. 142222-012-UC/5X, 142222-013-UC/5X, 142222-014-UC/5X, 142222-015-UC/5X and 142222-016-UC/5X. The Secretary of the Department has delegated this authority to the Director of District Management, who issues this order and makes the following findings of fact.

I. FINDINGS OF FACT

1. The Lee County Board of County Commissioners is a person under Section 403.031 of the Florida Statutes. The Lee County Board of County Commissioners owns and operates a potable water production facility, located at the Corkscrew WTP ASR Wellfield, a 15 MGD potable Water Treatment and Production facility ("Facility") with a Groundwater Type aquifer storage and recovery ("ASR") system. The WTP Facility is located at 26° 27′ 42″ N. Latitude and -81° 42′ 15″ W Longitude 16101 Alico Road, Ft Myers, Florida 33913. The ASR system is located at: 26° 27.861′ N. Latitude and -81° 42.272′ W Longitude ASR Well-1, 26° 27.738′ N. Latitude and -81° 42.274′ W Longitude ASR Well-2, 26° 28.302′ N. Latitude and -81° 42.533′ W Longitude ASR Well-3, 26° 28.078′ N. Latitude and -81° 42.432′ W Longitude ASR Well-4, and 26° 28.525′ N. Latitude and -81° 42.633′ W Longitude ASR Well-5.

2. A part of that system currently consists of Aquifer Storage and Recovery, (ASR), wells which inject potable water into waters of the state, (via the ASR wells), as defined in Section 403.031 of the Florida Statutes.

3. The County has applied for a renewal of five construction permits under Section 403.088(2) of the Florida Statutes to continue operational testing of ASR well nos. 1, 2, 3, 4, and 5.

4. The County has filed an application for the renewal of the construction permits to continue operational testing of five injection wells with the Department; Permit Application Nos. 142222-012-UC/5X through 142222-016-UC/5X. The Department and the County acknowledge that the water quality data from the recovered water and the monitor wells provide specific data trends indicating the possibility of Arsenic migration within the USDW as a result of the operation of this system.

5. The Facility constructed and conducted operational testing of its ASR system under Permit Nos. 142222-012 - 016-UC/5X. These permits were issued prior to January 26, 2006, the date the federal primary drinking water standard for arsenic decreased from 50 µg/L to 10 µg/L. During operational testing the facility complied with the applicable arsenic standard of 50 µg/L. However, the facility continues to measure arsenic values greater than 10 µg/L in the recovered water and monitoring wells.

6. Section 403.088(2)(e) and (f) of the Florida Statutes and Rule 62-528.300(e)(7), of the Florida Administrative Code, (F.A.C.), authorize the Department to issue permits, for the injection of potable water into waters of the state for the specific period of time necessary to conduct additional cycle testing, an assessment of the groundwater for potential Arsenic contamination, an assessment of the system operational model for determination of improvements to prevent potential groundwater contamination, and determine the necessity of any additional technological treatment additions to the system, said permits being accompanied by an order establishing a schedule for achieving compliance with all permit conditions if the specified criteria are met.

7. The Department finds that:

   (a) Presently, there are monitoring well and recovered water quality data trends that indicate Arsenic mobilization may be occurring as a result of injection activities related to the operational testing of the ASR wellfield. Accordingly, the Department and the County acknowledge that certain steps are necessary to resolve this issue. The Department and the County agree that implementing specific changes as set forth in this document would be the most beneficial and cost effective approach to resolution of the issue of Arsenic mobilization.

(b) The granting of the permits to continue operational testing with this attached Administrative Order will be in the best public interest; and

(c) The permittee should be allowed a specified period of time to develop and implement the necessary changes proposed as resolution to this issue.

II ORDER

Based on the foregoing findings of fact,

IT IS ORDERED,

1. The County shall operationally test the injection well system under the conditions of this Administrative Order and under the conditions of the attached Construction Permit Nos. 142222-012-016-UC/5X for up to 5 years from the effective date of this Administrative Order and Permit issuance. The County shall apply for or, modify, or renew any permits necessary for any ASR wells in this system in the event that it becomes necessary to prevent offsite mobilization of any contaminant plume or to facilitate remediation of any contaminant plume that may be migrating offsite or outside an area of institutional control.

2. Within ninety, (90), days of issuance of these permits and this order: Respondent shall submit to the Department, an assessment plan, (AP), under sign and seal of the appropriate Professional Engineer and/or Professional Geologist registered within the State of Florida that recommends methods/tasks (along with reasonable time schedule) to achieve the following objectives:

   A. Objectives shall be:

      (1) Reduce potential for injectate to generate arsenic exceedances,
      (2) Reduce arsenic levels for ground water within the storage zone, and
      (3) Identify the adequacy of the County's current Wellhead Protection Ordinance relative to the ASR protection zone contained in the Ordinance or recommend changes to the Ordinance.
      (4) Ensure contaminated groundwater does not migrate outside the area of institutional control.
      (5) Remediate water which may have migrated outside the area of institutional control or institute risk-based corrective action under Chapter 62-780, Fla. Admin. Code.

B. Methods/Tasks to achieve objectives shall include but not be limited to:

(1) An evaluation/recommendation as to whether additional cycle testing would decrease ASR arsenic levels;
(2) An evaluation of the Facility's monitor plan adequacy including recommendations for additional monitoring wells, a revised parameter list or data set, and an increase in monitoring frequency and reporting;
(3) An evaluation of the Facility's treatment system and any proposed technical modifications that will ensure the ASR system will function in full and consistent compliance with the arsenic standard of 10 µg/L;
(4) An estimate of the vertical and lateral extent of arsenic concentration exceeding 10 µg/L; and
(5) A field-verified inventory of all water wells within the area determined by best professional judgment to include the area potentially affected by the discharge plus a safety factor of 50%, or a one-mile radius, whichever is larger (area of review).

3. The Department will review any assessment plan, (AP), submitted pursuant to this Administrative Order. In the event additional information, modifications or specifications are necessary to evaluate the AP, the Department shall issue a written request for additional information. The County shall submit all required additional information within 30 days after receipt of each request. The option to request additional information notwithstanding, the Department reserves all legal rights to enforce compliance with the terms of this Administrative Order, or to file suit to recover civil penalties and damages separate and apart from the terms of this Administrative Order.

4. The Department shall review the AP and provide Respondent with written responses. Any action taken by the Respondent with regard to implementation of the AP prior to receiving Department approval shall be at Respondent's own risk.

5. If the Department determines upon review of the AP that it adequately addresses the objectives set forth in paragraph 2, then the Department shall approve the AP for implementation.

6. Upon approval of the AP, (assessment plan), by the Department, the terms, conditions, and timeframes contained in the approved report become a part of this Administrative Order and are enforceable as such.

7. Upon Department approval of the AP, the County shall begin any required assessment plan activities in accordance with the time frames specified in the approved AP. Within 90 days of the completion of tasks contained in the AP, the County shall submit a plan for corrective action (corrective action plan or CAP), based on a public health risk assessment, to address any public health concerns identified in the AP. Upon Department approval of the CAP the County shall begin any required corrective actions in accordance with the time frames specified in the approved CAP.

8. This report may include, as necessary corrective actions, proposals to perform pumpage from the ASR wells as a part of the contamination cleanup. The report shall be prepared by a Florida licensed Professional Engineer or Professional Geologist, as applicable. The report shall describe and summarize all corrective actions planned and/or completed and provide conclusions and recommendations.

9. The Department will review the CAP submitted pursuant to this Administrative Order. In the event additional information, modifications or specifications are necessary to evaluate the report, the Department shall issue a written request for additional information. The County shall revise the report and submit the revised version in writing to the Department within 30 days after receipt of the request.

10. Upon Department approval of the CAP, the County shall begin any required assessment plan activities in accordance with the time frames specified in the approved CAP. Upon approval of the CAP the terms, conditions, and timeframes contained in the approved plan become a part of this Administrative Order and are enforceable as such.

11. The Department and TAC members will review any permit application(s) and supporting documentation submitted pursuant to this Administrative Order. In the event additional information, modifications or specifications are necessary to process the application(s), the Department shall issue a written request for additional information. The County shall submit all required additional information within 30 days after receipt of each request.

12. The Lee County Wellfield Protection Ordinance currently provides for an ASR protection zone consisting of a 500-foot radius around an ASR well, and prohibiting installation of water wells in the ASR storage zone aquifer. This Ordinance may require modification based upon information and water quality data obtained during the assessment performed pursuant to paragraph 2 previously which may/or may not show the 500-foot radius to be sufficient. In the event that information obtained during the assessment indicates the need for modification to the referenced Ordinance the County shall prepare a

draft County Wellhead Protection Ordinance within 30 days and a schedule for obtaining passage of the revised Ordinance via the administrative processes within County government.

13. The Department will review the draft modifications to the County Wellhead Protection Ordinance submitted pursuant to this Administrative Order. In the event additional information, modifications or specifications are necessary to evaluate the report, the Department shall issue a written request for additional information. The County shall revise the report and submit the revised version in writing to the Department within 30 days after receipt of the request. Once the County and the Department agree on draft language, the County shall pursue the changes to the Ordinance through the County's administrative process as quickly as possible. However, if the agreed upon draft is not approved by the County, any off-site arsenic exceedances over the 10 mg/L standard will have to be remediated in a Department-approved manner, or using institutional controls described in the Department's Division of Waste Management's Institutional Controls Procedures Guidance, November 2004, as adopted under Chapter 62-780, F.A.C .

14. The County shall achieve compliance with all applicable state statutes and Department Rules including but not limited to Underground Injection Control Program statutes, rules, and permits within the time frame specified in Permit, but no more than 5 years from the effective date of this Administrative Order and issuance of these Permits. Otherwise the County shall request renewal of and any necessary modifications to, this Administrative Order and associated permits.

III. NOTICE OF RIGHTS

A person whose substantial interests are affected by this Order may petition for an administrative proceeding (hearing) under Sections 120.569 and 120.57, Florida Statutes. The petition must contain the information set forth below and must be filed (received by the clerk) in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000.

Under Rule 62-110.106(4), Florida Administrative Code, a person may request enlargement of the time for filing a petition for an administrative hearing. The request must be filed (received by the clerk) in the Office of General Counsel before the end of the time period for filing a petition for an administrative hearing.

Petitions by the applicant or any of the persons listed below must be filed within fourteen days of receipt of this written notice. Petitions filed by any

persons other than those entitled to written notice under Section 120.60(3), Florida Statutes, must be filed within fourteen days of publication of the notice or within fourteen days of receipt of the written notice, whichever occurs first. Under Section 120.60(3), Florida Statutes, however, any person who has asked the Department for notice of agency action may file a petition within fourteen days of receipt of such notice, regardless of the date of publication.

The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition within fourteen days of receipt of notice shall constitute a waiver of that person's right to request an administrative determination (hearing) under Sections 120.569 and 120.57, Florida Statutes. Any subsequent intervention (in a proceeding initiated by another party) will be only at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, Florida Administrative Code.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

(a) The name, address, and telephone number of each petitioner; the name, address, and telephone number of the petitioner's representative, if any; the Department permit identification number and the county in which the subject matter or activity is located;
(b) A statement of how and when each petitioner received notice of the Department action;
(c) A statement of how each petitioner's substantial interests are affected by the Department action;
(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
(e) A statement of facts that the petitioner contends warrant reversal or modification of the Department action;
(f) A concise statement of the ultimate facts alleged, as well as the rules and statutes which entitle the petitioner to relief and
(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department's final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under Section 120.573, Florida Statutes, is not available for this

proceeding.

This Order is final and effective on the date filed with the clerk of the Department unless a petition is filed in accordance with the above. Upon the timely filing of a petition this Order will not be effective until further order of the Department.

Any party to the permit has the right to seek judicial review of the Order under Section 120.68, Florida Statutes, by the filing of a notice of appeal under Rules 9.110 and 9.190, Florida Rules of Appellate Procedure, with the clerk of the Department in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000; and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice of appeal must be filed within 30 days from the date when this Order is filed with the clerk of the Department.

DONE AND ORDERED on this 17th day of August, 2009 in Ft Myers, Florida.

STATE OF FLORIDA DEPARTMENT
OF
ENVIRONMENTAL PROTECTION

for

Jon M. Iglehart
Director of
District Management

FILED AND ACKNOWLEDGED on this date, under section 120.52(11) of the Florida Statutes, with the designated Department Clerk, receipt of which is acknowledged.

Julie D. La Mere

8/17/09

Clerk

Date

JMI/DR/mac

Copies furnished to:
Technical Advisory Committee

CERTIFICATE OF SERVICE

The undersigned hereby certifies that this Order and all copies were mailed before the close of business on August 17, 2009 to the listed persons.

APPENDIX C
SUMMARY OF COMPUTER MODEL FILES

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                                  MODFLOW-2000
      U.S. GEOLOGICAL SURVEY MODULAR FINITE-DIFFERENCE GROUND-WATER FLOW MODEL
                  VERSION 1.18.00 08/23/2007   +OpenMI+SLB

 This model run combines GLOBAL and LIST output into this single file.

 GLOBAL LISTING FILE: C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.LST
                         UNIT    6

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.WHS
 FILE TYPE:WHS   UNIT   53   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.BAS
 FILE TYPE:BAS6   UNIT   10   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.LPF
 FILE TYPE:LPF   UNIT   33   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.WEL
 FILE TYPE:WEL   UNIT   12   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.OC
 FILE TYPE:OC   UNIT   22   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.CHD
 FILE TYPE:CHD   UNIT   30   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.HFB
 FILE TYPE:HFB6   UNIT   31   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.DIS
 FILE TYPE:DIS   UNIT   34   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.CLB
 FILE TYPE:CLB   UNIT   54   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.LMT
 FILE TYPE:LMT6   UNIT  333   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.FLO
 FILE TYPE:DATA(BINARY)   UNIT  175   STATUS:UNKNOWN
 FORMAT:UNFORMATTED            ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.NDC
 FILE TYPE:NDC   UNIT   57   STATUS:OLD
 FORMAT:FORMATTED              ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.HDS
 FILE TYPE:DATA(BINARY)   UNIT  150   STATUS:UNKNOWN
 FORMAT:UNFORMATTED            ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.DDN
 FILE TYPE:DATA(BINARY)   UNIT  151   STATUS:UNKNOWN
 FORMAT:UNFORMATTED            ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.BGT
 FILE TYPE:DATA(BINARY)   UNIT  154   STATUS:UNKNOWN
 FORMAT:UNFORMATTED            ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.sig
 FILE TYPE:DATA(BINARY)   UNIT  152   STATUS:UNKNOWN
 FORMAT:UNFORMATTED            ACCESS:SEQUENTIAL

 OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.HVT
 FILE TYPE:DATA(BINARY)   UNIT  153   STATUS:UNKNOWN
 FORMAT:UNFORMATTED            ACCESS:SEQUENTIAL


 DISCRETIZATION INPUT DATA READ FROM UNIT   34
 #Discretization Package translator - (c) 2001 Waterloo Hydrogeologic Software
 #PREDICTIONS-0311-MODIFIED.DIS Fri Mar 18 11:19:19 2011
    5 LAYERS       118 ROWS       104 COLUMNS
  121 STRESS PERIOD(S) IN SIMULATION
 MODEL TIME UNIT IS DAYS
 MODEL LENGTH UNIT IS FEET
  --- GUI Regime ---
 THE GROUND-WATER TRANSPORT PROCESS IS INACTIVE

 THE OBSERVATION PROCESS IS INACTIVE
 THE SENSITIVITY PROCESS IS INACTIVE
 THE PARAMETER-ESTIMATION PROCESS IS INACTIVE

 MODE: FORWARD
```

Confining bed flag for each layer:
0 0 0 0 0

552462 ELEMENTS OF GX ARRAY USED OUT OF 552462
61360 ELEMENTS OF GZ ARRAY USED OUT OF 61360
61360 ELEMENTS OF IG ARRAY USED OUT OF 61360

DELR
READING ON UNIT 34 WITH FORMAT: (10E16.9)

DELC
READING ON UNIT 34 WITH FORMAT: (10E16.9)

TOP ELEVATION OF LAYER 1
READING ON UNIT 34 WITH FORMAT: (10E14.7)

MODEL LAYER BOTTOM EL. FOR LAYER 1
READING ON UNIT 34 WITH FORMAT: (10E14.7)

MODEL LAYER BOTTOM EL. FOR LAYER 2
READING ON UNIT 34 WITH FORMAT: (10E14.7)

MODEL LAYER BOTTOM EL. FOR LAYER 3
READING ON UNIT 34 WITH FORMAT: (10E14.7)

MODEL LAYER BOTTOM EL. FOR LAYER 4
READING ON UNIT 34 WITH FORMAT: (10E14.7)

MODEL LAYER BOTTOM EL. FOR LAYER 5
READING ON UNIT 34 WITH FORMAT: (10E14.7)

STRESS PERIOD	LENGTH	TIME STEPS	MULTIPLIER FOR DELT	SS FLAG
1	31.00000	10	1.000	TR
2	30.00000	10	1.000	TR
3	31.00000	10	1.000	TR
4	30.00000	10	1.000	TR
5	31.00000	10	1.000	TR
6	31.00000	10	1.000	TR
7	28.00000	10	1.000	TR
8	31.00000	10	1.000	TR
9	30.00000	10	1.000	TR
10	31.00000	10	1.000	TR
11	30.00000	10	1.000	TR
12	31.00000	10	1.000	TR
13	31.00000	10	1.000	TR
14	30.00000	10	1.000	TR
15	31.00000	10	1.000	TR
16	30.00000	10	1.000	TR
17	31.00000	10	1.000	TR
18	31.00000	10	1.000	TR
19	28.00000	10	1.000	TR
20	31.00000	10	1.000	TR
21	30.00000	10	1.000	TR
22	31.00000	10	1.000	TR
23	30.00000	10	1.000	TR
24	31.00000	10	1.000	TR
25	31.00000	10	1.000	TR
26	30.00000	10	1.000	TR
27	31.00000	10	1.000	TR
28	30.00000	10	1.000	TR
29	31.00000	10	1.000	TR
30	31.00000	10	1.000	TR
31	28.00000	10	1.000	TR
32	31.00000	10	1.000	TR
33	30.00000	10	1.000	TR
34	31.00000	10	1.000	TR
35	30.00000	10	1.000	TR
36	31.00000	10	1.000	TR
37	31.00000	10	1.000	TR
38	30.00000	10	1.000	TR
39	31.00000	10	1.000	TR
40	30.00000	10	1.000	TR
41	31.00000	10	1.000	TR
42	31.00000	10	1.000	TR
43	29.00000	10	1.000	TR
44	31.00000	10	1.000	TR
45	30.00000	10	1.000	TR
46	31.00000	10	1.000	TR
47	30.00000	10	1.000	TR
48	31.00000	10	1.000	TR
49	31.00000	10	1.000	TR
50	30.00000	10	1.000	TR
51	31.00000	10	1.000	TR
52	30.00000	10	1.000	TR
53	31.00000	10	1.000	TR

54	31.00000	10	1.000	TR
55	28.00000	10	1.000	TR
56	31.00000	10	1.000	TR
57	30.00000	10	1.000	TR
58	31.00000	10	1.000	TR
59	30.00000	10	1.000	TR
60	31.00000	10	1.000	TR
61	31.00000	10	1.000	TR
62	30.00000	10	1.000	TR
63	31.00000	10	1.000	TR
64	30.00000	10	1.000	TR
65	31.00000	10	1.000	TR
66	31.00000	10	1.000	TR
67	28.00000	10	1.000	TR
68	31.00000	10	1.000	TR
69	30.00000	10	1.000	TR
70	31.00000	10	1.000	TR
71	30.00000	10	1.000	TR
72	31.00000	10	1.000	TR
73	31.00000	10	1.000	TR
74	30.00000	10	1.000	TR
75	31.00000	10	1.000	TR
76	30.00000	10	1.000	TR
77	31.00000	10	1.000	TR
78	31.00000	10	1.000	TR
79	28.00000	10	1.000	TR
80	31.00000	10	1.000	TR
81	30.00000	10	1.000	TR
82	31.00000	10	1.000	TR
83	30.00000	10	1.000	TR
84	31.00000	10	1.000	TR
85	31.00000	10	1.000	TR
86	30.00000	10	1.000	TR
87	31.00000	10	1.000	TR
88	30.00000	10	1.000	TR
89	31.00000	10	1.000	TR
90	31.00000	10	1.000	TR
91	29.00000	10	1.000	TR
92	31.00000	10	1.000	TR
93	30.00000	10	1.000	TR
94	31.00000	10	1.000	TR
95	30.00000	10	1.000	TR
96	31.00000	10	1.000	TR
97	31.00000	10	1.000	TR
98	30.00000	10	1.000	TR
99	31.00000	10	1.000	TR
100	30.00000	10	1.000	TR
101	31.00000	10	1.000	TR
102	31.00000	10	1.000	TR
103	28.00000	10	1.000	TR
104	31.00000	10	1.000	TR
105	30.00000	10	1.200	TR
106	31.00000	10	1.200	TR
107	30.00000	10	1.200	TR
108	31.00000	10	1.200	TR
109	31.00000	10	1.200	TR
110	30.00000	10	1.200	TR
111	31.00000	10	1.200	TR
112	30.00000	10	1.200	TR
113	31.00000	10	1.200	TR
114	31.00000	10	1.200	TR
115	28.00000	10	1.200	TR
116	31.00000	10	1.200	TR
117	30.00000	10	1.200	TR
118	31.00000	10	1.200	TR
119	120.0000	10	1.200	TR
120	120.0000	10	1.200	TR
121	120.0000	10	1.200	TR

TRANSIENT SIMULATION

LPF1 -- LAYER PROPERTY FLOW PACKAGE, VERSION 1, 1/11/2000
INPUT READ FROM UNIT 33
#Layer Property Flow Package translator - (c) 2001 Waterloo Hydrogeologic Software
#PREDICTIONS-0311-MODIFIED.LPF Fri Mar 18 11:19:19 2011
CELL-BY-CELL FLOWS WILL BE SAVED ON UNIT 154
HEAD AT CELLS THAT CONVERT TO DRY= -1.00000E+30
No named parameters

LAYER FLAGS:

LAYER	LAYTYP	LAYAVG	CHANI	LAYVKA	LAYWET
1	0	0	1.000E+00	0	0
2	0	0	1.000E+00	0	0
3	0	0	1.000E+00	0	0
4	0	0	1.000E+00	0	0
5	0	0	1.000E+00	0	0

```
 INTERPRETATION OF LAYER FLAGS:
                      INTERBLOCK     HORIZONTAL    DATA IN
       LAYER TYPE   TRANSMISSIVITY   ANISOTROPY   ARRAY VKA   WETTABILITY
LAYER     (LAYTYP)      (LAYAVG)       (CHANI)     (LAYVKA)     (LAYWET)
-------------------------------------------------------------------------
   1      CONFINED      HARMONIC     1.000E+00    VERTICAL K  NON-WETTABLE
   2      CONFINED      HARMONIC     1.000E+00    VERTICAL K  NON-WETTABLE
   3      CONFINED      HARMONIC     1.000E+00    VERTICAL K  NON-WETTABLE
   4      CONFINED      HARMONIC     1.000E+00    VERTICAL K  NON-WETTABLE
   5      CONFINED      HARMONIC     1.000E+00    VERTICAL K  NON-WETTABLE

    184080 ELEMENTS IN X ARRAY ARE USED BY LPF
        30 ELEMENTS IN IX ARRAY ARE USED BY LPF
0WHS1  - CGSTAB-P PROCEDURE SOLUTION PACKAGE, VERSION 1, 8/4/95 INPUT READ FROM UNIT  1
   2577120 ELEMENTS IN X ARRAY ARE USED BY CGSTAB-P
0CAL2 -- W.H.S. CALIBRATION PACKAGE INPUT READ FROM UNIT 54
 icalin:         152
 passport%m_data_field_count:           1
 passport%m_passport_reccount:           7
 Success
 # OF CAL POINTS :    7

         7 ELEMENTS IN X ARRAY ARE USED FOR CALIBRATION POINTS

   2761207  ELEMENTS OF X ARRAY USED OUT OF    2761207
         0  ELEMENTS OF Z ARRAY USED OUT OF          1
        30  ELEMENTS OF IX ARRAY USED OUT OF         30
         0  ELEMENTS OF XHS ARRAY USED OUT OF         1
0


                                                  SOLUTION BY CGSTAB-P
                                                  --------------------
0                                          MAXIMUM ITERATIONS ALLOWED FOR CLOSURE =       50
0                                          MAXIMUM INNER ITERATIONS ALLOWED =       25
                                                        DAMPING FACTOR =     1.0000
                                              HEAD CHANGE CRITERION FOR CLOSURE =    0.10000E-01
 MAXIMUM RESIDUAL FOR LINEAR ITERATION    0.10000E-01
 MAXIMUM RELATIVE RESIDUAL FOR LINEAR ITERATION     0.00000E+00
 CALIBRATION POINTS
 ------------------
       1       1      61      76 0.32751422D+05 0.23249929D+05
       2       3      56      59 0.29273478D+05 0.24298441D+05
       3       3      27      51 0.27682345D+05 0.30111050D+05
       4       3      50      58 0.29106709D+05 0.25517610D+05
       5       3      41      59 0.29390181D+05 0.27327579D+05
       6       5      43      57 0.28914147D+05 0.26941805D+05
       7       3      41      57 0.28914747D+05 0.27287377D+05

 WETTING CAPABILITY IS NOT ACTIVE IN ANY LAYER

    HYD. COND. ALONG ROWS =   28.0000     FOR LAYER   1

      VERTICAL HYD. COND. =  0.900000     FOR LAYER   1

         SPECIFIC STORAGE =  1.500000E-05 FOR LAYER   1

    HYD. COND. ALONG ROWS =  0.500000     FOR LAYER   2

      VERTICAL HYD. COND. =  8.000000E-04 FOR LAYER   2

         SPECIFIC STORAGE =  1.000000E-07 FOR LAYER   2


             HYD. COND. ALONG ROWS FOR LAYER   3
 READING ON UNIT   33 WITH FORMAT:  (10G11.4)


               VERTICAL HYD. COND. FOR LAYER   3
 READING ON UNIT   33 WITH FORMAT:  (10G11.4)


                  SPECIFIC STORAGE FOR LAYER   3
 READING ON UNIT   33 WITH FORMAT:  (10G11.4)

    HYD. COND. ALONG ROWS =  4.000000E-02 FOR LAYER   4

      VERTICAL HYD. COND. =  1.000000E-03 FOR LAYER   4

         SPECIFIC STORAGE =  1.000000E-07 FOR LAYER   4

    HYD. COND. ALONG ROWS =   20.0000     FOR LAYER   5

      VERTICAL HYD. COND. =  0.670000     FOR LAYER   5

         SPECIFIC STORAGE =  1.500000E-06 FOR LAYER   5

#Basic Package translator - (c) 2001 Waterloo Hydrogeologic Software
#PREDICTIONS-0311-MODIFIED.BAS Fri Mar 18 11:19:09 2011
```

```
    5 LAYERS       118 ROWS       104 COLUMNS
  121 STRESS PERIOD(S) IN SIMULATION

 BAS6 -- BASIC PACKAGE, VERSION 6, 1/11/2000 INPUT READ FROM UNIT   10
         25 ELEMENTS IN IR ARRAY ARE USED BY BAS

 WEL6 -- WELL PACKAGE, VERSION 6, 1/11/2000 INPUT READ FROM UNIT   12
 No named parameters
 MAXIMUM OF     26 ACTIVE WELLS AT ONE TIME
 CELL-BY-CELL FLOWS WILL BE SAVED ON UNIT  154
        104 ELEMENTS IN RX ARRAY ARE USED BY WEL

 CHD6 -- TIME-VARIANT SPECIFIED-HEAD PACKAGE, VERSION 6, 1/11/2000
 INPUT READ FROM UNIT   30
 No named parameters
 MAXIMUM OF   1320 TIME-VARIANT SPECIFIED-HEAD CELLS AT ONE TIME
       6600 ELEMENTS IN RX ARRAY ARE USED BY CHD
 HFB6 -- HORIZONTAL FLOW BARRIER PACKAGE, VERSION 6, 1/11/1000.
   INPUT READ FROM UNIT   31
     0 PARAMETERS DEFINE A MAXIMUM OF      0 HORIZONTAL FLOW BARRIERS
     14 HORIZONTAL FLOW BARRIERS NOT DEFINED BY PARAMETERS
         98 ELEMENTS IN RX ARRAY ARE USED FOR
           HORIZONTAL FLOW BARRIER PACKAGE

       6802  ELEMENTS OF RX ARRAY USED OUT OF       6802
          0  ELEMENTS OF RZ ARRAY USED OUT OF          1
         25  ELEMENTS OF IR ARRAY USED OUT OF         25
1
 #Basic Package translator - (c) 2001 Waterloo Hydrogeologic Software
 #PREDICTIONS-0311-MODIFIED.BAS Fri Mar 18 11:19:09 2011


                      BOUNDARY ARRAY FOR LAYER   1
 READING ON UNIT   10 WITH FORMAT: (40I2)



                      BOUNDARY ARRAY FOR LAYER   2
 READING ON UNIT   10 WITH FORMAT: (40I2)



                      BOUNDARY ARRAY FOR LAYER   3
 READING ON UNIT   10 WITH FORMAT: (40I2)



                      BOUNDARY ARRAY FOR LAYER   4
 READING ON UNIT   10 WITH FORMAT: (40I2)


                      BOUNDARY ARRAY FOR LAYER   5
 READING ON UNIT   10 WITH FORMAT: (40I2)

 AQUIFER HEAD WILL BE SET TO 1.00000E+30 AT ALL NO-FLOW NODES (IBOUND=0).

              INITIAL HEAD =   4.00000      FOR LAYER   1

              INITIAL HEAD =   4.00000      FOR LAYER   2

              INITIAL HEAD =   6.00000      FOR LAYER   3

              INITIAL HEAD =   6.00000      FOR LAYER   4

              INITIAL HEAD =   25.0000      FOR LAYER   5

 OUTPUT CONTROL IS SPECIFIED EVERY TIME STEP
 HEAD PRINT FORMAT CODE IS   0    DRAWDOWN PRINT FORMAT CODE IS   0
 HEADS WILL BE SAVED ON UNIT  150    DRAWDOWNS WILL BE SAVED ON UNIT  151


     0 Well parameters


     0 TIME-VARIANT SPECIFIED-HEAD PARAMETERS


     0 HFB parameters

    14 BARRIERS NOT DEFINED BY PARAMETERS
 BARRIER  LAYER  IROW1  ICOL1  IROW2  ICOL2    HYDCHR
      1      3     48     60     48     59  0.69850E-05
      2      3     47     60     47     59  0.69850E-05
      3      3     46     60     46     59  0.69850E-05
      4      3     45     60     45     59  0.69850E-05
      5      3     44     60     44     59  0.69850E-05
      6      3     43     60     43     59  0.69850E-05
      7      3     42     60     42     59  0.69850E-05
      8      3     41     60     41     59  0.69850E-05
      9      3     40     60     40     59  0.69850E-05
     10      3     39     60     39     59  0.69850E-05
     11      3     38     60     38     59  0.69850E-05
     12      3     37     60     37     59  0.69850E-05
     13      3     36     60     36     59  0.69850E-05
```

```
     14      3     35     60     35     59   0.69850E-05

     14 HFB BARRIERS
1

 HEAD WILL BE SAVED ON UNIT  150 AT END OF TIME STEP  10, STRESS PERIOD  121

 DRAWDOWN WILL BE SAVED ON UNIT  151 AT END OF TIME STEP  10, STRESS PERIOD  121
1
  VOLUMETRIC BUDGET FOR ENTIRE MODEL AT END OF TIME STEP 10 IN STRESS PERIOD 121
  ---------------------------------------------------------------------------

     CUMULATIVE VOLUMES      L**3       RATES FOR THIS TIME STEP      L**3/T
     ------------------                 ------------------------

          IN:                                   IN:
          ---                                   ---
            STORAGE =   289923264.0000            STORAGE =       29907.1367
     CONSTANT HEAD =  4935339008.0000     CONSTANT HEAD =     1195520.2500
              WELLS =   314769728.0000             WELLS =           0.0000

         TOTAL IN =  5540032000.0000          TOTAL IN =     1225427.3750

         OUT:                                  OUT:
         ----                                  ----
            STORAGE =   286434848.0000            STORAGE =           0.0000
     CONSTANT HEAD =  3727315968.0000     CONSTANT HEAD =      891295.3125
              WELLS =  1526281344.0000             WELLS =      334145.0000

         TOTAL OUT =  5540032000.0000          TOTAL OUT =     1225440.2500

          IN - OUT =           0.0000           IN - OUT =         -12.8750

PERCENT DISCREPANCY =           0.00     PERCENT DISCREPANCY =           0.00



          TIME SUMMARY AT END OF TIME STEP  10 IN STRESS PERIOD  121
                     SECONDS      MINUTES      HOURS       DAYS        YEARS
                     -----------------------------------------------------------
  TIME STEP LENGTH 2.06084E+06  34347.       572.45      23.852     6.53040E-02
STRESS PERIOD TIME 1.03680E+07 1.72800E+05  2880.0      120.00      0.32854
        TOTAL TIME 3.41368E+08 5.68946E+06  94824.      3951.0       10.817
1
```

```
LISTING FILE: C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.OT
                         UNIT  16

OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.BT3
FILE TYPE:BTN   UNIT   1

OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.AD3
FILE TYPE:ADV   UNIT   2

OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.DP3
FILE TYPE:DSP   UNIT   3

OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.SS3
FILE TYPE:SSM   UNIT   4

OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.GCG
FILE TYPE:GCG   UNIT   9

OPENING C:\Projects\LCU\Corkscrew ASR\Model\Predictions-0311-Modified.FLO
FILE TYPE:FTL   UNIT  10

                              ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
                              +                                                                    +
                              +                                                                    +
                              +                              MT3DMS                                +
                              +              A Modular 3D Multi-Species Transport Model            +
                              +     For Simulation of Advection, Dispersion and Chemical Reactions +
                              +                  of Contaminants in Groundwater Systems            +
                              +                                                                    +
                              +                                                                    +
                              ++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++

 -----
| M T | MT3DMS dataset
| 3 D | Translated by Visual MODFLOW
 -----
THE TRANSPORT MODEL CONSISTS OF     5 LAYER(S)  118 ROW(S)  104 COLUMN(S)
NUMBER OF STRESS PERIOD(S) FOR TRANSPORT SIMULATION =  121
NUMBER OF ALL COMPONENTS INCLUDED IN SIMULATION =    1
NUMBER OF MOBILE COMPONENTS INCLUDED IN SIMULATION =    1
UNIT FOR TIME IS day ;  UNIT FOR LENGTH IS ft  ;  UNIT FOR MASS IS lb
OPTIONAL PACKAGES INCLUDED IN CURRENT SIMULATION:
 o ADV   ON UNIT  2
 o DSP   ON UNIT  3
 o SSM   ON UNIT  4
 o GCG   ON UNIT  9

BTN5 -- BASIC TRANSPORT PACKAGE, VERSION 5, OCTOBER 2006, INPUT READ FROM UNIT  1
    933116 ELEMENTS OF THE  X ARRAY USED BY THE BTN PACKAGE
     61365 ELEMENTS OF THE IX ARRAY USED BY THE BTN PACKAGE

FMI5 -- FLOW MODEL INTERFACE PACKAGE, VERSION 5, FEBRUARY 2005, INPUT READ FROM UNIT 10
FLOW MODEL IS TRANSIENT
FLOW MODEL CONTAINS CONSTANT-HEAD CELLS

ADV5 -- ADVECTION PACKAGE, VERSION 5, FEBRUARY 2005, INPUT READ FROM UNIT  2
ADVECTION IS SOLVED WITH THE UPSTREAM FINITE DIFFERENCE SCHEME
COURANT NUMBER ALLOWED IN SOLVING THE ADVECTION TERM = 0.750
         0 ELEMENTS OF THE  X ARRAY USED BY THE ADV PACKAGE
         0 ELEMENTS OF THE IX ARRAY USED BY THE ADV PACKAGE

DSP5 -- DISPERSION PACKAGE, VERSION 5, OCTOBER 2006, INPUT READ FROM UNIT  3
    674970 ELEMENTS OF THE  X ARRAY USED BY THE DSP PACKAGE
         0 ELEMENTS OF THE IX ARRAY USED BY THE DSP PACKAGE

SSM5 -- SINK & SOURCE MIXING PACKAGE, VERSION 5, OCTOBER 2006, INPUT READ FROM UNIT  4
HEADER LINE OF THE SSM PACKAGE INPUT FILE:
 T F F F F F F FWEL,FDRN,FRCH,FEVT,FRIV,FGHB,FSTR
MAJOR STRESS COMPONENTS PRESENT IN THE FLOW MODEL:
 o WELL
MAXIMUM NUMBER OF POINT SINKS/SOURCES =    1346
     17498 ELEMENTS OF THE  X ARRAY USED BY THE SSM PACKAGE
         0 ELEMENTS OF THE IX ARRAY BY THE SSM PACKAGE

GCG5 -- GENERALIZED CONJUGATE GRADIENT SOLVER PACKAGE, VERSION 5, FEBRUARY 2005 INPUT READ FROM UNIT  9
MAXIMUM OF    1 OUTER ITERATIONS
      AND   50 INNER ITERATIONS ALLOWED FOR CLOSURE
THE PRECONDITIONING TYPE SELECTED IS JACOBI.
DISPERSION CROSS TERMS LUMPED INTO RIGHT-HAND-SIDE
    920450 ELEMENTS OF THE  X ARRAY USED BY THE GCG PACKAGE
       150 ELEMENTS OF THE IX ARRAY USED BY THE GCG PACKAGE

.....................................
ELEMENTS OF THE  X ARRAY USED =   2546035
ELEMENTS OF THE IX ARRAY USED =     61516
.....................................

LAYER NUMBER  AQUIFER TYPE
------------  ------------
     1            0
     2            0
     3            0
     4            0
     5            0
```

```
WIDTH ALONG ROWS (DELR)  READ ON UNIT  1 USING FORMAT: "(10G11.4)          "

                    WIDTH ALONG COLS (DELC)  READ ON UNIT  1 USING FORMAT: "(10G11.4)          "

                                TOP ELEV. OF 1ST LAYER   =  -100.0000
                                CELL THICKNESS (DZ)      =   130.0000     FOR LAYER  1
                                CELL THICKNESS (DZ)      =   80.15000     FOR LAYER  2
                                CELL THICKNESS (DZ)      =   69.85000     FOR LAYER  3
                                CELL THICKNESS (DZ)      =   20.00000     FOR LAYER  4
                                CELL THICKNESS (DZ)      =   100.0000     FOR LAYER  5
                                POROSITY                 =  0.2000000     FOR LAYER  1
                                POROSITY                 =  0.5000000E-01 FOR LAYER  2
                                POROSITY                 =  0.2000000     FOR LAYER  3
                                POROSITY                 =  0.5000000E-01 FOR LAYER  4
                                POROSITY                 =  0.2000000     FOR LAYER  5

              CONCN. BOUNDARY ARRAY    FOR LAYER  1 READ ON UNIT  1 USING FORMAT: "(40I2)              "

              CONCN. BOUNDARY ARRAY    FOR LAYER  2 READ ON UNIT  1 USING FORMAT: "(40I2)              "

              CONCN. BOUNDARY ARRAY    FOR LAYER  3 READ ON UNIT  1 USING FORMAT: "(40I2)              "

              CONCN. BOUNDARY ARRAY    FOR LAYER  4 READ ON UNIT  1 USING FORMAT: "(40I2)              "

              CONCN. BOUNDARY ARRAY    FOR LAYER  5 READ ON UNIT  1 USING FORMAT: "(40I2)              "

                              INITIAL CONC.: COMP.  01 =  0.1561000E-01 FOR LAYER  1
                              INITIAL CONC.: COMP.  01 =  0.1561000E-01 FOR LAYER  2

              INITIAL CONC.: COMP.  01 FOR LAYER  3 READ ON UNIT  1 USING FORMAT: " (10G11.4)          "
```

1	2	3	4	5	6	7	8	9	10	11
12	13	14	15	16	17	18	19	20	21	22
23	24	25	26	27	28	29	30	31	32	33
34	35	36	37	38	39	40	41	42	43	44
45	46	47	48	49	50	51	52	53	54	55
56	57	58	59	60	61	62	63	64	65	66
67	68	69	70	71	72	73	74	75	76	77
78	79	80	81	82	83	84	85	86	87	88
89	90	91	92	93	94	95	96	97	98	99
100	101	102	103	104						

```
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>FOR COMPONENT NO.
01<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

                              TRANSPORT STEP NO.    1

TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION =    3931.000     day

             CUMMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP     1, TIME STEP    10, STRESS PERIOD  121

                                             IN                         OUT
           CONSTANT CONCENTRATION:     0.000000                  0.000000
                    CONSTANT HEAD:     0.000000                 -0.5231385E+08
                            WELLS:     1115551.                 -0.2149611E+08
            MASS STORAGE (SOLUTE):    0.1279654E+09             -0.5537834E+08

                          [TOTAL]:    0.1335551E+09 lb          -0.1336036E+09 lb

                                     NET (IN - OUT):    -48536.00
                              DISCREPANCY (PERCENT):    -0.3633495E-01
   1 CALLS TO GCG PACKAGE FOR TRANSPORT TIME STEP   2 IN FLOW TIME STEP  10 STRESS PERIOD 121
   4 TOTAL ITERATIONS

>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>FOR COMPONENT NO.
01<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<

                              TRANSPORT STEP NO.    2

TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION =    3936.000     day

             CUMMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP     2, TIME STEP    10, STRESS PERIOD  121
```

```
                                                                 IN                           OUT
                                                          ----------------             ----------------
                        CONSTANT CONCENTRATION:           0.000000                     0.000000
                                 CONSTANT HEAD:           0.000000                    -0.5237563E+08
                                         WELLS:           1115551.                    -0.2151067E+08
                          MASS STORAGE (SOLUTE):          0.1280745E+09               -0.5541424E+08
                       ----------------------------------------------------------------------------
                                       [TOTAL]:           0.1336665E+09 lb            -0.1337159E+09 lb

                                                        NET (IN - OUT):   -49392.00
                                                 DISCREPANCY (PERCENT):   -0.3694485E-01
 1 CALLS TO GCG PACKAGE FOR TRANSPORT TIME STEP   3 IN FLOW TIME STEP  10 STRESS PERIOD 121
 6 TOTAL ITERATIONS


>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>FOR COMPONENT NO.
01<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<


                                            ----------------------------------------
                                                  TRANSPORT STEP NO.     3
                                            ----------------------------------------

TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION =    3941.000     day
.......................................................................

                     CUMMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP     3, TIME STEP   10, STRESS PERIOD  121
                     ------------------------------------------------------------------------------------------

                                                                 IN                           OUT
                                                          ----------------             ----------------
                        CONSTANT CONCENTRATION:           0.000000                     0.000000
                                 CONSTANT HEAD:           0.000000                    -0.5243740E+08
                                         WELLS:           1115551.                    -0.2152537E+08
                          MASS STORAGE (SOLUTE):          0.1281846E+09               -0.5545021E+08
                       ----------------------------------------------------------------------------
                                       [TOTAL]:           0.1337789E+09 lb            -0.1338283E+09 lb

                                                        NET (IN - OUT):   -49408.00
                                                 DISCREPANCY (PERCENT):   -0.3692576E-01
 1 CALLS TO GCG PACKAGE FOR TRANSPORT TIME STEP   4 IN FLOW TIME STEP  10 STRESS PERIOD 121
 6 TOTAL ITERATIONS


>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>FOR COMPONENT NO.
01<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<


                                            ----------------------------------------
                                                  TRANSPORT STEP NO.     4
                                            ----------------------------------------

TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION =    3946.000     day
.......................................................................

                     CUMMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP     4, TIME STEP   10, STRESS PERIOD  121
                     ------------------------------------------------------------------------------------------

                                                                 IN                           OUT
                                                          ----------------             ----------------
                        CONSTANT CONCENTRATION:           0.000000                     0.000000
                                 CONSTANT HEAD:           0.000000                    -0.5249916E+08
                                         WELLS:           1115551.                    -0.2154023E+08
                          MASS STORAGE (SOLUTE):          0.1282947E+09               -0.5548594E+08
                       ----------------------------------------------------------------------------
                                       [TOTAL]:           0.1338913E+09 lb            -0.1339407E+09 lb

                                                        NET (IN - OUT):   -49416.00
                                                 DISCREPANCY (PERCENT):   -0.3690076E-01
 1 CALLS TO GCG PACKAGE FOR TRANSPORT TIME STEP   5 IN FLOW TIME STEP  10 STRESS PERIOD 121
 6 TOTAL ITERATIONS


>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>FOR COMPONENT NO.
01<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<


                                            ----------------------------------------
                                                  TRANSPORT STEP NO.     5
                                            ----------------------------------------

TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION =    3951.000     day
.......................................................................

                     CUMMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP     5, TIME STEP   10, STRESS PERIOD  121
                     ------------------------------------------------------------------------------------------

                                                                 IN                           OUT
                                                          ----------------             ----------------
                        CONSTANT CONCENTRATION:           0.000000                     0.000000
```

```
                              CONSTANT HEAD:    0.000000                      -0.5256092E+08
                                      WELLS:    1115551.                      -0.2155523E+08
                      MASS STORAGE (SOLUTE):    0.1284046E+09                 -0.5552146E+08
               ------------------------------------------------------------------------------
                                    [TOTAL]:    0.1340035E+09 lb              -0.1340529E+09 lb

                                              NET (IN - OUT):    -49440.00
                                       DISCREPANCY (PERCENT):   -0.3688775E-01
  1 CALLS TO GCG PACKAGE FOR TRANSPORT TIME STEP   6 IN FLOW TIME STEP  10 STRESS PERIOD 121
  1 TOTAL ITERATIONS
 MAXIMUM CONCENTRATION CHANGES FOR EACH ITERATION:
 MAX. CHANGE LAYER,ROW,COL MAX. CHANGE LAYER,ROW,COL MAX. CHANGE LAYER,ROW,COL MAX. CHANGE LAYER,ROW,COL MAX. CHANGE
LAYER,ROW,COL
-------------------------------------------------------------------------------------------------------------------------
-----
   0.000     (  1,   1,   1)


 >>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>FOR COMPONENT NO.
01<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<


                                      --------------------------------------------
                                                TRANSPORT STEP NO.     6
                                      --------------------------------------------

 TOTAL ELAPSED TIME SINCE BEGINNING OF SIMULATION =   3951.017    day
 .................................................................

                  CUMMULATIVE MASS BUDGETS AT END OF TRANSPORT STEP     6, TIME STEP   10, STRESS PERIOD  121
                  -------------------------------------------------------------------------------------------

                                                    IN                             OUT
                                             ----------------               ----------------
                     CONSTANT CONCENTRATION:    0.000000                       0.000000
                              CONSTANT HEAD:    0.000000                     -0.5256113E+08
                                      WELLS:    1115551.                     -0.2155528E+08
                      MASS STORAGE (SOLUTE):    0.1284046E+09                -0.5552146E+08
              ------------------------------------------------------------------------------
                                    [TOTAL]:    0.1340035E+09 lb             -0.1340532E+09 lb

                                              NET (IN - OUT):    -49688.00
                                       DISCREPANCY (PERCENT):   -0.3707275E-01
  -----
 | M T |
 | 3 D |  END OF MODEL OUTPUT
  -----
```