RCN 218-070-07-20

DEMONSTRATION OF INNOVATIVE APPLICATIONS OF TECHNOLOGY FOR THE CT-121 FGD PROCESS

Plant Yates

Environmental Monitoring Program Report:
Second Quarter 1996
(Final)

DOE DE-FC22-90PC89650
SCS C-90-00284

Prepared for:

Southern Company Services, Inc.
P.O. Box 2625
600 North 18th Street
Birmingham, Alabama 35291-1195

Prepared by:

Radian International LLC
8501 North Mopac Boulevard
P.O. Box 201088
Austin, Texas 78720-1088

Cleared by DOE Patent Counsel.

Legal Notice

This report was prepared by Radian International LLC for Southern Company Services, Inc. pursuant to a cooperative agreement partially funded by the U.S. Department of Energy and neither Southern Company Services, Inc., nor any of its subcontractors, nor the U.S. Department of Energy, nor any person acting on behalf of either:

1. Makes any warranty or representation, express or implied with respect to the accuracy, completeness, or usefulness of the information contained in this report or that the process disclosed in this report may not infringe privately-owned rights; or

2. Assumes any liabilities with respect to the use of or for damages resulting from the use of any information, apparatus, method, or process disclosed in this report.

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Department of Energy. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Department of Energy.

Demonstration of Innovative Applications of Technology for the CT-121 FGD Process

Plant Yates

Environmental Monitoring Program Report: Second Quarter 1996

This progress report summarizes activities associated with the environmental monitoring program (EMP) during the second calendar quarter of 1996 for the U.S. Department of Energy's Innovative Clean Coal Technology project entitled "Demonstration of Innovative Applications of Technology for the CT-121 FGD Process." This demonstration project was conducted at Georgia Power Company's Plant Yates Unit 1, located near Newnan, Georgia, until January 1995, when operational responsibility was permanently transferred to Georgia Power Company from Southern Company Services, Inc., manager of the demonstration project.

No further operational testing is planned, and monitoring under the EMP is now limited to groundwater monitoring.

Post-operational-phase groundwater monitoring is being conducted. A report of monitoring results for the previous quarter (first quarter of 1996) is attached.

Attachment

Groundwater Monitoring Report for the First Quarter of 1996

Table of Contents

List of Figures

List of Tables

1.0 Introduction

This report summarizes the results of groundwater monitoring performed during the first calendar quarter of 1996 as part of the environmental monitoring program (EMP) for the U.S. Department of Energy's Innovative Clean Coal Technology project entitled "Demonstration of Innovative Applications of Technology for the CT-121 FGD Process." This demonstration project is being conducted at Georgia Power Company's Plant Yates Unit 1, located near Newnan, Georgia.

1.1 Project Summary

The purpose of this ICCT project is to demonstrate the use of the Chiyoda Thoroughbred-121 flue gas desulfurization process as a means of reducing SO_2 and particulate emissions from pulverized-coal utility boilers that use medium-sulfur coal. This project is also designed to demonstrate the lower cost and higher reliability of the CT-121 process compared to conventional wet limestone FGD processes.

The demonstration project at Plant Yates consists of four distinct test periods:

- Period 0: Site Preparation, Construction, and Startup of the Demonstration Project (including background groundwater monitoring [29 months]);
- Period 1: Baseline Testing at Low Particulate Loading—ESP In Service (12 months);
- Period 2: Testing at High Particulate Loading—ESP Detuned or Out of Service (12 months); and
- Period 3: Post Demonstration Groundwater Testing and Gypsum Byproduct Evaluation.

Period 2 ended in December 1994. Groundwater monitoring was initiated in Period 0 and will continue through Period 3.

1.2 Purpose and Scope of Groundwater Monitoring

The CT-121 process produces gypsum, which is being disposed of in an on-site stacking area where the solids are concentrated as they are allowed to settle, dewater, and dry. The gypsum and gypsum/fly ash stacking area is lined with a synthetic liner to minimize the potential for adverse impacts on the groundwater. Requirements for the liner, leachate collection system, and groundwater monitoring are specified in the permit issued by the Georgia Department of Natural Resources (DNR). One requirement is the regular monitoring of groundwater before, during, and for two years after the demonstration program. The purpose of this monitoring is to demonstrate that the gypsum stacking area can be operated in an environmentally benign and acceptable manner.

In 1990, five groundwater monitoring wells were installed in the vicinity of the proposed gypsum stacking area. These wells were used to monitor baseline groundwater quality prior to construction of the stacking area. Monitoring was conducted every two months from September 1990 through July 1991. Table 1 is a summary of the parameters that were monitored during this period. The results of this monitoring activity were summarized in the report "Environmental Monitoring Program Report of Preconstruction Monitoring: 1990-1991 Background Water Quality."

Following the preconstruction monitoring period, and as a DNR permit requirement, two additional monitoring wells were installed in 1992. The locations of all seven monitoring wells are shown in Figure 1. Because of a delay in the commencement of Phase 1 testing, an additional round of preoperational groundwater monitoring was conducted on September 3-4 and October 14, 1992. The results from this monitoring effort were presented in the report "Interim Data Report of Preoperational Groundwater Monitoring: September 3-4 and October 14, 1992."

Operational-phase groundwater monitoring, performed on a quarterly basis, was initiated in the fourth quarter of 1992. Monitoring was conducted for the suite of parameters shown previously in Table 1. Samples were analyzed each quarter for all parameters shown except for radionuclides, which are monitored semiannually.

Beginning in the second quarter of 1994, quarterly monitoring was initiated for total organic halides (TOX) and annual monitoring was initiated for volatile organic compounds (VOCs). These parameters were added to comply with requirements of the permit issued by the Environmental Protection Division of the Georgia DNR.

Table 1. EMP Groundwater Monitoring Parameters

pH	Conductivity	Temperature
Eh	Alkalinity	Total Dissolved Solids
Bromide	Chloride	Total Organic Carbon
Fluoride	Nitrate-Nitrite	Sulfate
Trace Elements (Dissolved)		
Silver	Aluminum	Arsenic
Boron	Barium	Beryllium
Bismuth	Calcium	Cadmium
Cobalt	Copper	Chromium
Mercury	Iron	Potassium
Lithium	Magnesium	Manganese
Molybdenum	Sodium	Nickel
Phosphorus	Lead	Sulfur
Antimony	Selenium	Silicon
Tin	Strontium	Tellurium
Titanium	Thallium	Uranium
Vanadium	Tungsten	Zinc
Other		
Radionuclides		

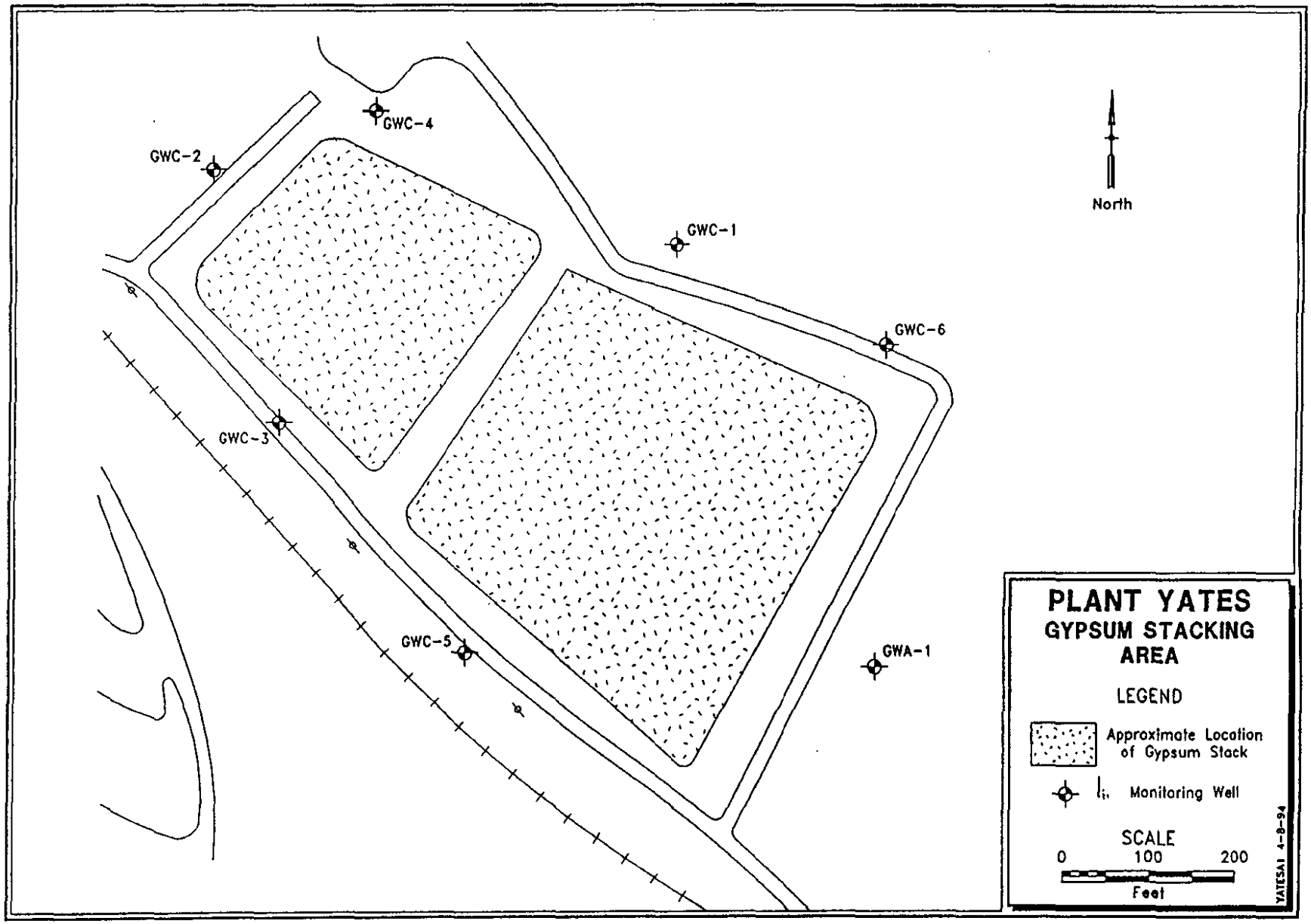


Figure 1. Locations of Groundwater Monitoring Wells

The post-demonstration groundwater monitoring period began in the first quarter of 1995 and will be conducted over a period of two years (i.e., through the end of 1996) for the same parameters and at the same frequency as during the operational phase.

1.3 Report Contents

This report presents the results of quarterly post-demonstration-phase groundwater monitoring for the first calendar quarter of 1996. The groundwater monitoring wells were sampled on March 18-19, 1996.

Section 2 is a brief summary of the sampling and analytical methods used to conduct the monitoring. Results of the monitoring are presented in Section 3. Results of quality assurance/ quality control (QA/QC) activities associated with sample analyses are summarized in Section 4. Tables of historical trends for selected parameters, and the results for field and laboratory duplicates, are given in the appendices.

2.0 Sampling and Analytical Methods

This section describes the methods used to obtain and analyze groundwater samples. These methods were specified in Radian's "Test Plan for Groundwater Monitoring Around the Plant Yates Gypsum Stacking Area," August 30, 1990, as amended.

2.1 Sampling Methods

The QED Well Wizard dedicated sampling system was used to purge the monitoring wells and collect samples. The Well Wizard system utilizes a dedicated Teflon® bladder pump and portable air compressor to extract groundwater samples.

To ensure the collection of a representative sample, standing water was removed from each well by purging a minimum of three wetted casing volumes. Conductivity, pH, redox potential, and temperature were monitored and recorded on field sampling forms during purging. Samples were collected after these indicator parameters stabilized and (1) after at least three wetted casing volumes of water were removed or (2) immediately following recovery if a well was purged dry.

Samples were obtained from the upgradient well (GWA-1) and five of the six down-gradient wells (GWC-1, GWC-2, GWC-3, GWC-4, and GWC-5). Only a small amount of

groundwater was present in the upgradient well GWA-1 and a complete set of samples could not be collected from this well. As has been the case during all previous rounds of monitoring, well GWC-6 could not be sampled since it was unproductive and contained no water. Table 2 summarizes the groundwater samples collected during this monitoring period.

Table 2. Summary of Groundwater Samples Collected at Plant Yates on March 18-19, 1996

Well ID	Sample ID	Analyses
GWA-1	GWA-1-21-1	Anions and Metals [a]
GWC-1	GWC-1-21-1	Anions, TOC, TOX, Metals, and Radionuclides
GWC-2	GWC-2-21-1	Anions, TOC, TOX, Metals, and Radionuclides
GWC-3	GWC-3-21-1 GWC-3-21-2	Anions, TOC, TOX, Metals, and Radionuclides Anions, TOC, TOX, Metals, and Radionuclides
GWC-4	GWC-4-21-1	Anions, TOC, TOX, Metals, and Radionuclides
GWC-5	GWC-5-21-1	Anions, TOC, TOX, Metals, and Radionuclides
GWC-6	None	Well dry; no samples collected

[a] A complete set of samples could not be obtained because only a small amount of groundwater was present in the well.

To preserve the integrity of the groundwater samples before analyses, proper sample containment, preservation, holding time duration, shipment, and chain-of-custody procedures were followed. Sample bottles, preservation methods, and maximum holding times are summarized in Table 3.

2.2 Analytical Procedures

The analytical methods used in this program are listed in Table 4. There were no deviations from these methods.

3.0 Summary of Results

The results of the first-quarter 1996 groundwater monitoring are presented in Table 5. The concentrations of all of the monitored dissolved constituents in the groundwater near the gypsum stacking area continue to be low.

Table 3. Sample Containers, Preservation Methods, and Maximum Holding Times

Bottle Label	Containers [a]	Parameter	Preservation Method	Maximum Holding Time (days)
Total Organic Carbon	500-mL Amber Glass	Total Organic Carbon	H_2SO_4 pH<2	28
Anions/TDS	1-L Plastic	Bromide	4 °C	28
		Chloride	4 °C	28
		Fluoride	4 °C	28
		Nitrate-Nitrite	4 °C	28
		Sulfate	4 °C	28
		Total Dissolved Solids	4 °C	7
TOX	250-mL Amber Glass, no headspace	Total Organic Halogens	H_2SO_4 pH<2	28
VOCs	(2) 40-mL VOA Vials	Volatile Organics	HCl pH<2	14
Metals	1-L Plastic	Trace Metals	Filtered On Site Ultrex II HNO_3 pH<2	180
Radioactivity	(3) 1-L Plastic	Radium 226, Radium 228, Gross Alpha, Gross Beta, Gross Gamma	Filtered On Site Ultrex II HNO_3 pH<2	180

[a] Sample containers supplied by either I-Chem or Eagle Picher.

Table 4. Analytical Methods

Parameter	Technique	Reference
pH	Potentiometry	EPA 150.1
Conductivity	Specific Conductance	EPA 120.1
Temperature	Temperature Probe	EPA 170.1
Eh	Electrometry	ASTM D1498
Alkalinity	Titrimetric or Colorimetric	EPA 310.1 or 310.2
Bromide	Ion Chromatography	EPA 300
Chloride	Ion Chromatography	EPA 300
Total Organic Carbon	Combustion/IR	EPA 415.1
TOX	Carbon Adsorption/Combustion/ Electrolytic Titration	SW-846 Method 9020A
VOCs	GC/MS	SW-846 Method 8260
Fluoride	SIE	EPA 340.2
Nitrate/Nitrite	Colorimetry	EPA 353.1
Sulfate	Ion Chromatography	EPA 300
Total Dissolved Solids	Filtration/Evaporation/Gravimetry	EPA 160.2
Mercury	On-site Filtration/Cold Vapor AA	EPA 245.1
Trace Elements	On-site Filtration/AA and ICP-AES	EPA 200.7, 7421 (Cr), 7060 (As), 7421 (Pb), 7041 (Sb), 7740 (Se), and 7841 (Tl)
Radium 226 and 228	Proportional Counter	ASTM D2460
Gross Alpha	Proportional Counter	ASTM D1943
Gross Beta	Proportional Counter	ASTM D1890
Gross Gamma	Gamma Ray Spectrometer	ASTM D2459

Legend:

AA = Atomic absorption spectrophotometry
SIE = Specific ion electrode
ICP-AES = Inductively coupled plasma-atomic emission spectrometry
IR = Infrared detection
GC/MS = Gas chromatography/mass spectroscopy

References:

EPA "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-79-020, revised March 1983.
ASTM = American Society for Testing and Materials, *Annual Book of ASTM Standards.*
SW-846 "Test Methods for Evaluating Solid Waste," SW-846, 3rd Ed., November 1986.

Table 5. Results of Groundwater Monitoring Conducted March 18-19, 1996 (1st Quarter 1996)

Parameter	GWA-1-21-1	GWC-1-21-1	GWC-2-21-1	GWC-3-21-1 [a]	GWC-4-21-1	GWC-5-21-1
pH	NM	6.04	5.79	5.25	4.98	5.54
Conductivity (µS/cm)	NM	86	66	42	288	67
Temperature (°C)	NM	15.7	16.5	17.9	16.5	17.5
Eh (mV)	NM	153	167	177	189	196
Alkalinity (mg/L $CaCO_3$)	NM	24.2	NM	7.4	5.6	4.7
Total Dissolved Solids (mg/L)	113	71.0	69.0	49.0	175	72.0
Bromide (mg/L)	<0.0181	<0.0181	<0.0181	<0.0181	0.616	<0.0181
Chloride (mg/L)	2.26	2.20	3.79	3.46	66.0	2.78
Total Organic Carbon (mg/L)	NM	<0.117 [b]	1.12 [b]	0.176 [b,c]	0.118 [b,c]	<0.117 [b]
Total Organic Halogens (µg/L)	NM	<20.9	<20.9	<20.9	<20.9	<20.9
Fluoride (mg/L)	0.0767 [b]	0.0517 [b]	0.0339 [b]	0.0365 [b]	0.0368 [b]	0.0311 [b]
Nitrate-Nitrite (mg/L as N)	NM	0.226 [b]	0.922 [b]	0.259 [b]	16.7 [b]	0.126 [b]
Sulfate (mg/L)	32.7	1.06	4.11	<0.0491	4.18	13.3
Radium 226 (pCi/L)	NM	1.23 ± 0.409	1.00 ± 0.354	0.840 ± 0.409	-0.290 ± 0.701	-0.180 ± 0.690
Radium 228 (pCi/L)	NM	0.470 ± 0.572	0.680 ± 0.495	0.780 ± 0.526	0.240 ±1.40	-0.320 ± 1.40
Gross Alpha (pCi/L)	NM	<0.63	<0.59	<0.46	<0.73	<0.53
Gross Beta (pCi/L)	NM	<1.4	<1.4	<1.3	<1.5	<1.4
Gamma Scan (pCi/L)						
Ac-228	NM	3.64 ± 25.2	2.13 ± 14.8	-6.56 ± 21.8	0.294 ± 24.4	-0.770 ± 20.5
Bi-214	NM	38.4 ± 15.9	16.0 ± 13.9	11.8 ± 12.9	14.4 ± 5.36	12.0 ± 12.6
Pb-214	NM	54.0 ± 7.37	12.9 ± 11.6	9.66 ± 10.1	13.0 ± 4.32	16.7 ± 10.2
K-40	NM	39.1 ± 100	-44.3 ± 80.6	-71.1 ± 85.1	-67.9 ± 99.1	21.0 ± 70.3
Silver (mg/L)	0.000700 [c]	<0.000501	<0.000501	<0.000501	<0.000501	<0.000501
Aluminum (mg/L)	0.0402 [b,c]	0.0574 [b,c]	0.0510 [b,c]	0.0228 [b,c]	0.160 [b]	0.105 [b]
Arsenic (mg/L)	<0.00392	<0.00392	<0.00392	<0.00392	<0.00392	<0.00392
Boron (mg/L)	<0.0479	<0.0479	<0.0479	<0.0479	0.608	<0.0479
Barium (mg/L)	0.0469 [b]	0.0134 [b]	0.0117 [b]	0.0102 [b]	0.0448 [b]	0.0495 [b]
Beryllium (mg/L)	0.00150 [b]	0.00026 [b,c]	0.00020 [b,c]	<0.000162 [b]	0.00379 [b]	0.00048 [b,c]

Table 5 (continued)

Parameter	GWA-1-21-1	GWC-1-21-1	GWC-2-21-1	GWC-3-21-1 [a]	GWC-4-21-1	GWC-5-21-1
Bismuth (mg/L)	0.00320 [c]	<0.00271	<0.00271	<0.00271	<0.00271	<0.00271
Calcium (mg/L)	10.4	5.91	2.37	0.361	7.10	2.28
Cadmium (mg/L)	0.000200 [c]	<0.000156	<0.000156	<0.000156	<0.000156	<0.000156
Cobalt (mg/L)	0.00180 [c]	<0.000580	<0.000580	<0.000580	0.00585	<0.000580
Copper (mg/L)	0.00400 [b,c]	<0.00136 [b]	<0.00136 [b]	<0.00136 [b]	<0.00136 [b]	0.00226 [b,c]
Chromium (mg/L)	0.0186	0.000630 [c]	0.00274	0.00188	0.00155 [c]	0.00587
Mercury (mg/L)	<0.000039	<0.000039	<0.000039	<0.000039	<0.000039	<0.000039
Iron (mg/L)	0.0560 [b,c]	0.0510 [b,c]	0.0501 [b,c]	0.0150 [b,c]	0.158 [b]	0.261 [b]
Potassium (mg/L)	2.72	0.730	0.372	0.128	0.659	0.361
Lithium (mg/L)	NM	NM	NM	NM	NM	NM
Magnesium (mg/L)	6.87	4.11	1.92	1.11	19.1	2.65
Manganese (mg/L)	0.00650	0.00121 [c]	0.00181 [c]	0.00274	0.0371	0.00745
Molybdenum (mg/L)	0.00270 [c]	<0.000705	<0.000705	<0.000705	0.00358	<0.000705
Sodium (mg/L)	4.65	4.38	7.04	5.14	9.36	6.43
Nickel (mg/L)	0.0147 [b]	0.00110 [b,c]	0.0129 [b]	0.00292 [b,c]	0.0217 [b,c]	0.00873 [b]
Phosphorus (mg/L)	0.0215 [c]	0.0224 [c]	<0.00471	<0.00471	0.188	0.00854 [c]
Lead (mg/L)	<0.00126	<0.00126	<0.00126	<0.00126	<0.00126	<0.00126
Sulfur (mg/L)	12.4	0.104	1.37	0.0569	1.42	4.96
Antimony (mg/L)	0.00398 [c]	<0.000919	<0.000919	<0.000919	<0.000919	<0.000919
Selenium (mg/L)	0.00148 [b,c]	<0.00821 [b]	0.00119 [b,c]	0.00104 [b,c]	<0.00821 [b]	<0.00821 [b]
Silicon (mg/L)	14.3	11.6	13.7	9.48	10.8	11.3
Tin (mg/L)	0.00230 [c]	<0.00111	<0.00111	<0.00111	0.00346 [c]	<0.00111
Strontium (mg/L)	0.0315 [b]	0.0183 [b]	0.0126 [b]	0.00387 [b]	0.0580 [b]	0.0197 [b]
Tellurium (mg/L)	0.00220 [c]	<0.00170	<0.00170	<0.00170	0.00300 [c]	<0.00170
Titanium (mg/L)	0.00230 [b]	0.00541 [b]	0.00432 [b]	0.000420 [b]	0.0140 [b]	0.00742 [b]
Thallium (mg/L)	<0.00125	<0.00125	<0.00125	<0.00125	<0.00125	<0.00125
Uranium (mg/L)	<0.0132	<0.0132	<0.0132	<0.0132	0.0377 [c]	0.0956

Table 5 (continued)

Parameter	GWA-1-21-1	GWC-1-21-1	GWC-2-21-1	GWC-3-21-1 [a]	GWC-4-21-1	GWC-5-21-1
Vanadium (mg/L)	0.00100 [c]	0.00100 [c]	<0.000681	<0.000681	<0.000681	<0.000681
Tungsten (mg/L)	0.00510 [c]	<0.00183	<0.00183	<0.00183	0.00570 [c]	<0.00183
Zinc (mg/L)	0.00189 [b]	<0.00309 [b]	<0.00309 [b]	<0.00309 [b]	0.00462 [b]	0.685 [b]

[a] A duplicate sample (GWC-3-21-2) was collected from this well.

[b] Detected in the method blank.

[c] Less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.

NM = Not measured due to insufficient sample.

To help determine whether the material in the gypsum stacking area is having an impact on groundwater quality, the monitoring data for a selected number of representative species from all of the monitoring rounds conducted to date were tabulated and examined. The representative species selected are those present in appreciable concentrations in the gypsum slurry, including the major cations and anions (i.e., calcium, magnesium, chloride, and sulfate), as well as several other indicator parameters such as pH, TDS, conductivity, and alkalinity. The complete set of historical data for these species is provided in Appendix A. In Figures 2 through 4 the measured concentrations of some example species are shown as functions of chronologically-ordered sampling periods. Data are presented for the upgradient well, GWA-1, and two downgradient wells, GWC-2 and GWC-4. The locations of these wells were shown previously in Figure 1. Samples were not obtained this quarter from downgradient well GWC-6.

Concentrations of calcium, magnesium, chloride, and sulfate all increased slightly in the samples from the upgradient well, GWA-1, relative to last quarter's results. For well GWC-2, the measured concentrations of all monitored parameters were close to the historically-observed concentrations of these species. The concentrations of chloride, magnesium, and calcium in the water from downgradient well GWC-4 were significantly higher than previously-measured levels. The current monitoring results continue to show a generally upward trend in the concentrations of these gypsum constituents in well GWC-4. This trend was first noticed in the fourth quarter of 1993. There have been no significant increases in the levels of these species in either the upgradient well or the other downgradient wells.

The source(s) of the higher levels of gypsum constituents in well GWC-4 is (are) are not clearly apparent. However, there are several potential sources, and three of the more plausible are briefly described below:

- A breach of the dike surrounding the gypsum pond occurred on July 24, 1993. This breach happened in the vicinity of GWC-4. Since the rise in the levels of chloride, magnesium, and calcium in GWC-4 was first noticed in the fourth quarter of 1993, it seemed likely that the increase was a result of the dike breach. The validity of this assumption appeared to be reinforced in the first quarter of 1995, when the levels of the three species declined in GWC-4. Such a decline would be expected as the amount of spilled material remaining in the soil diminished due to gradual downward migration. However, no further decrease in the GWC-4 concentrations occurred over the following three quarters of 1995. As mentioned earlier, further increases in the levels of chloride, magnesium, and calcium have been noted in this quarter (first quarter of 1996). Although this

behavior could still be due to the 1993 breach (changes in rainfall patterns and/or acidity of the rain could cause higher migration rates and/or increased leaching of the soil), other factors could be contributing to or causing higher levels of gypsum constituents in the groundwater in the vicinity of GWC-4.

- The groundwater sampling team has noticed that there appear to have been periodic leaks from a slurry pump and associated valves/fittings that are situated in close proximity (30-40 feet) to GWC-4. Slurry has periodically leaked onto the ground and flowed across the soil surface to form small pools near (10-15 feet) GWC-4. This material could be the source of at least some of the increased levels of chloride, calcium, and magnesium observed in the first quarter of 1996.

- The possibility that the increased levels of the slurry constituents in GWC-4 could be caused by a leak in the liner under the gypsum stacking area cannot be discounted. There is no indication of leakage in any of the other groundwater monitoring wells, but this does not preclude the presence of a liner leak at a location immediately upgradient from GWC-4.

- At this time, it is not possible to determine which, if any, of the above possible causes is contributing the bulk of the chloride, etc., being seen in GWC-4. Some clarification may be forthcoming as more results of the continuing groundwater monitoring activities become available.

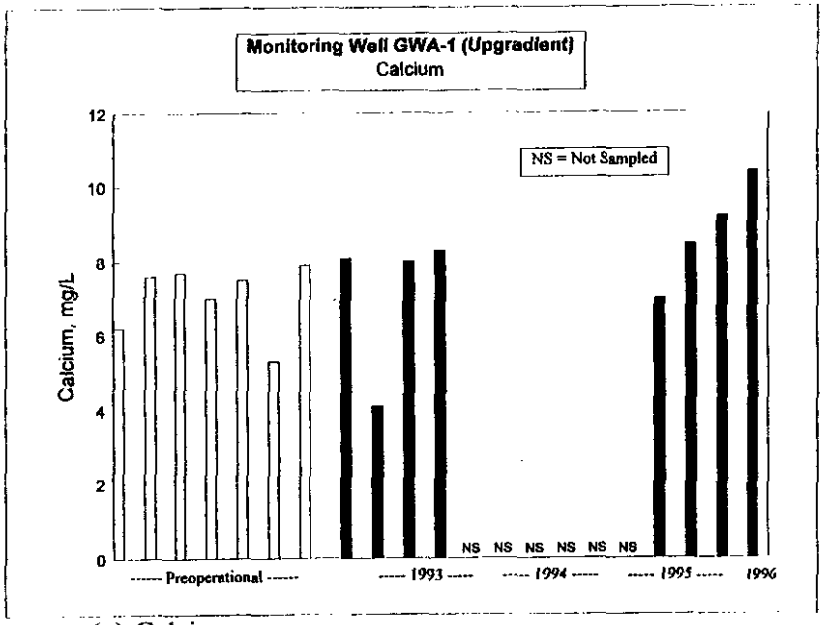
Although the contaminant levels in the groundwater at this location continue to be higher than they were prior to the time of the gypsum pond leak, they are still quite low. For example, the latest chloride concentration is only 26% of the maximum concentration recommended in the National Secondary Drinking Water Standards (i.e., 66 mg/L versus 250 mg/L).

4.0 Summary of QA/QC Activities

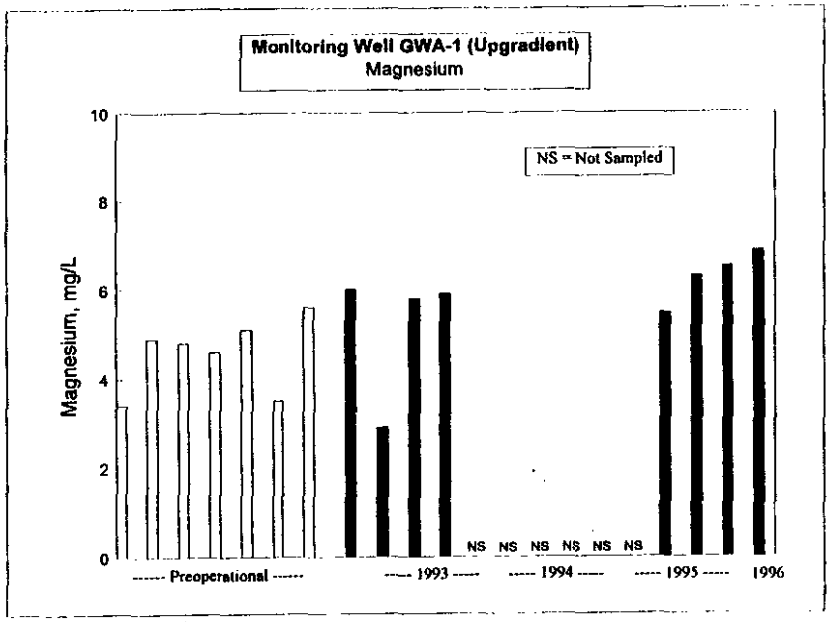
A number of QA/QC activities are being performed, as specified in the project's EMP, to assure that the data obtained meet project objectives. These include the following:

- Groundwater samples were split for independent analysis by a laboratory selected by SCS.

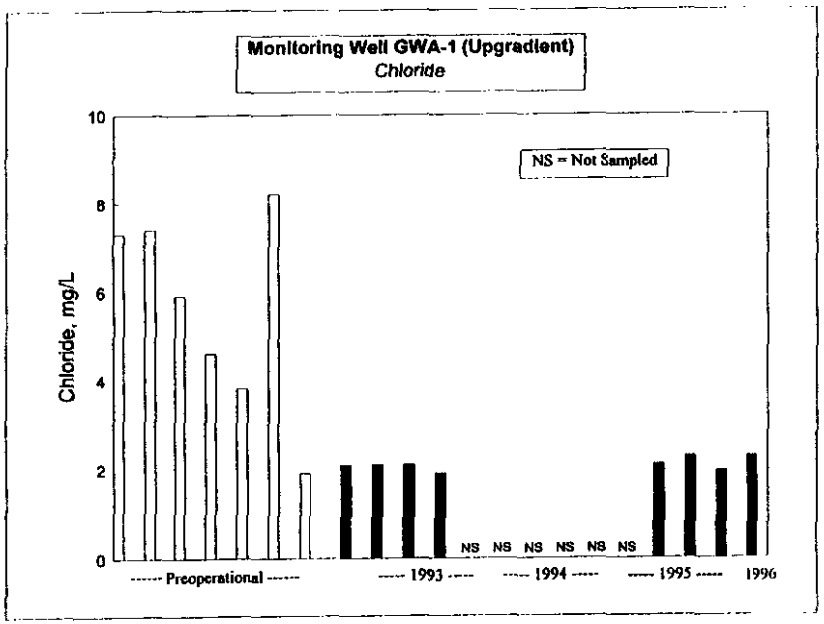
- Established sampling and analytical methods were specified and used. All samples were analyzed within the specified holding times, as outlined in



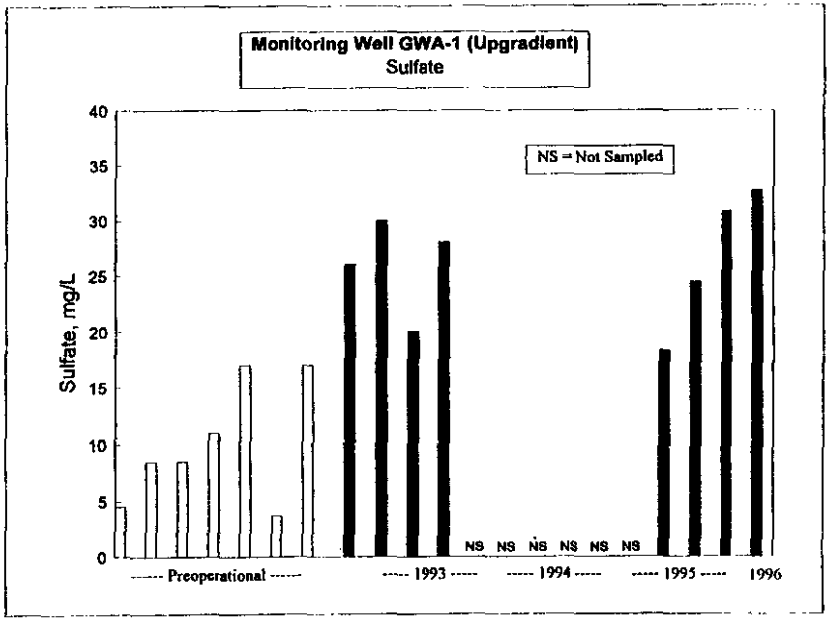
(a) Calcium



(b) Magnesium

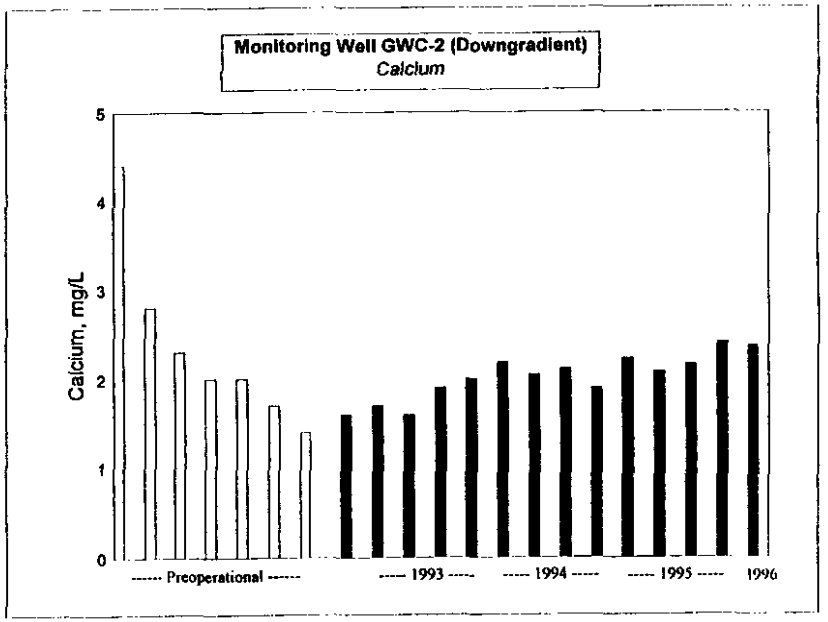


(c) Chloride

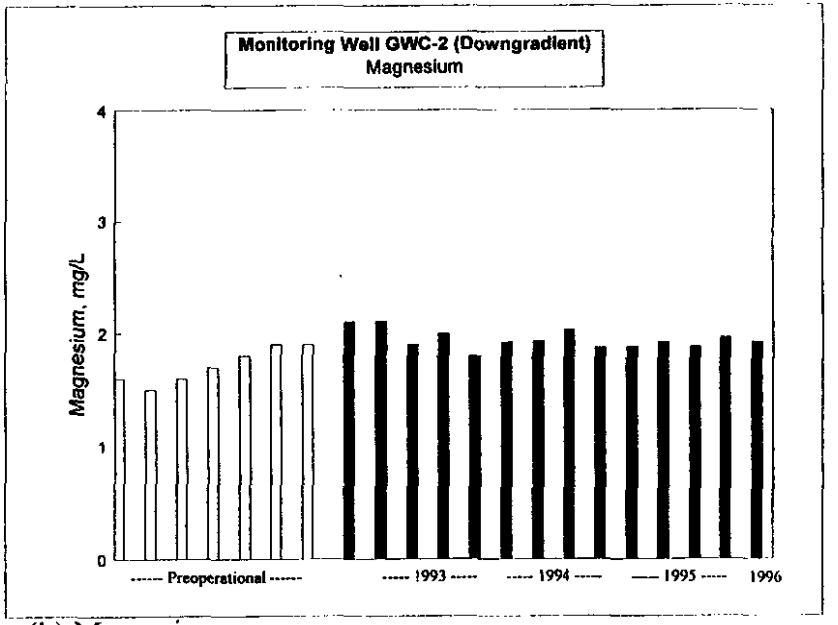


(d) Sulfate

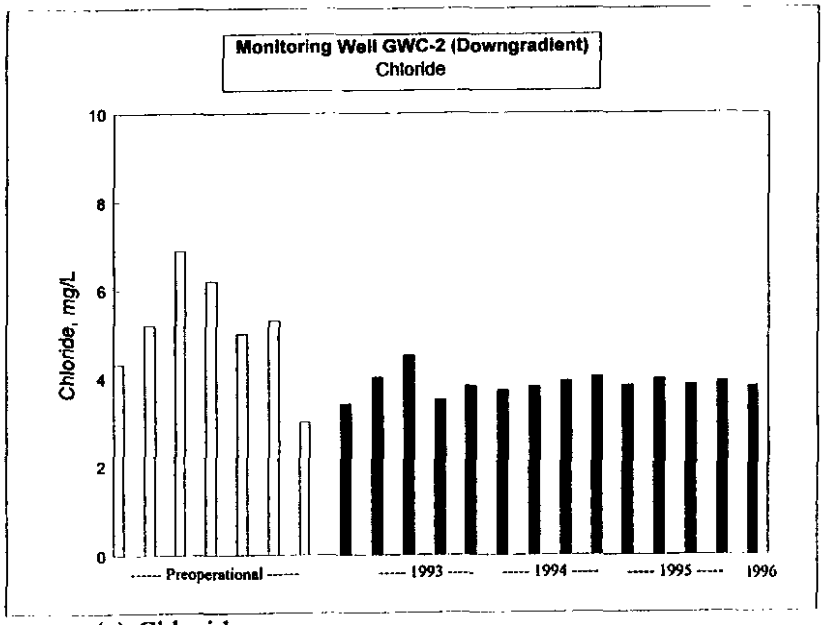
Figure 2. Historical Data for Representative Species from Well GWA-1 (Upgradient)



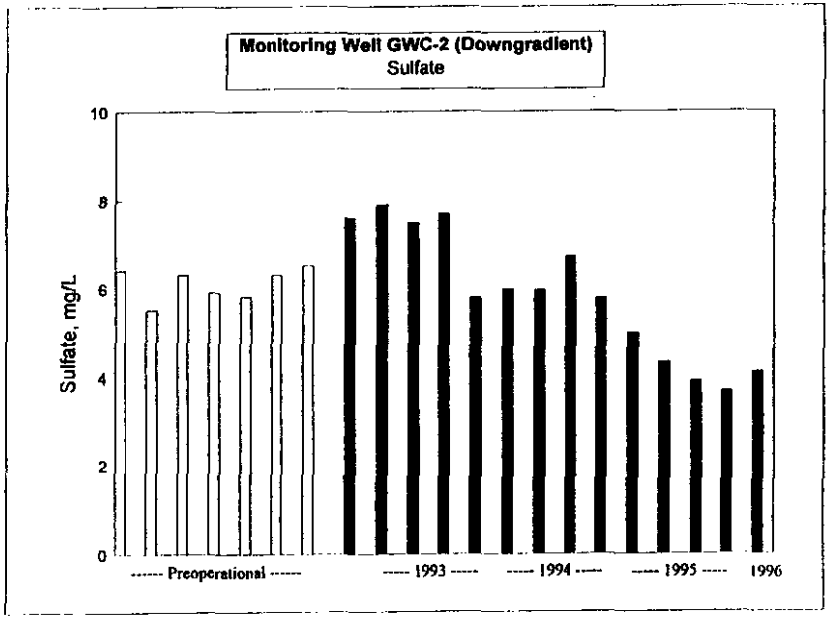
(a) Calcium



(b) Magnesium

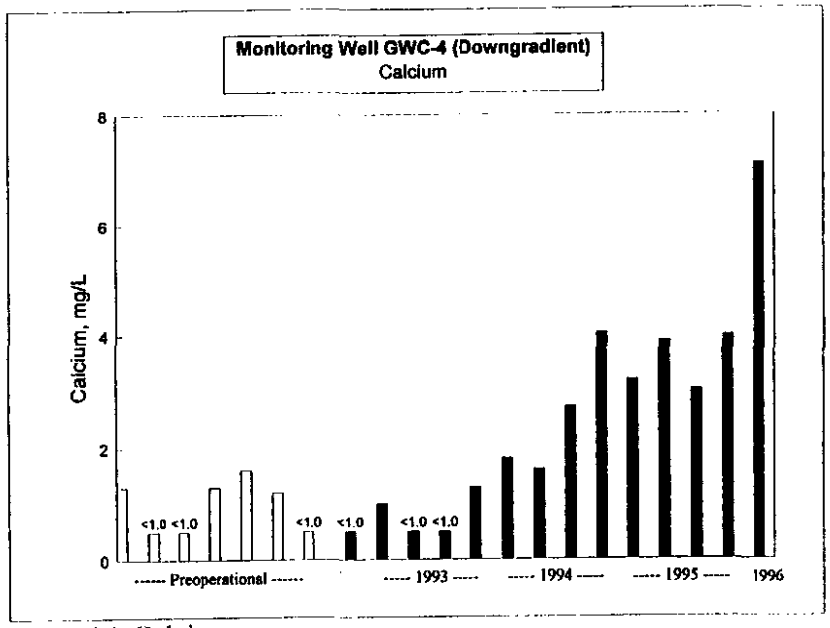


(c) Chloride

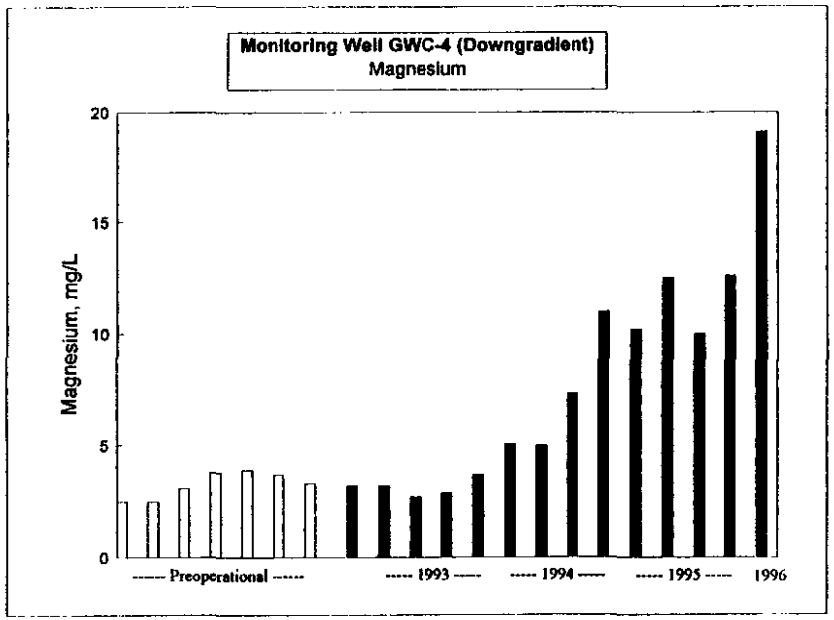


(d) Sulfate

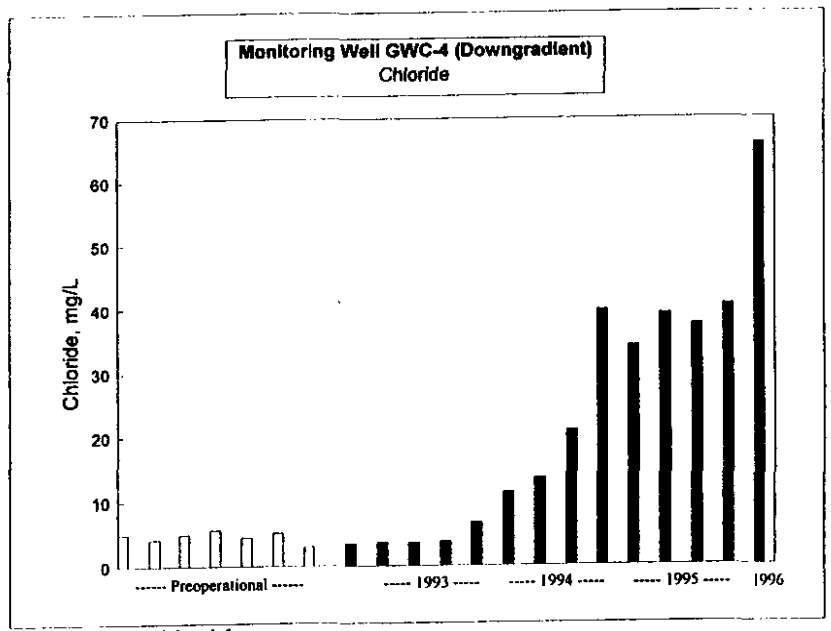
Figure 3. Historical Data for Representative Species from Well GWC-2 (Downgradient)



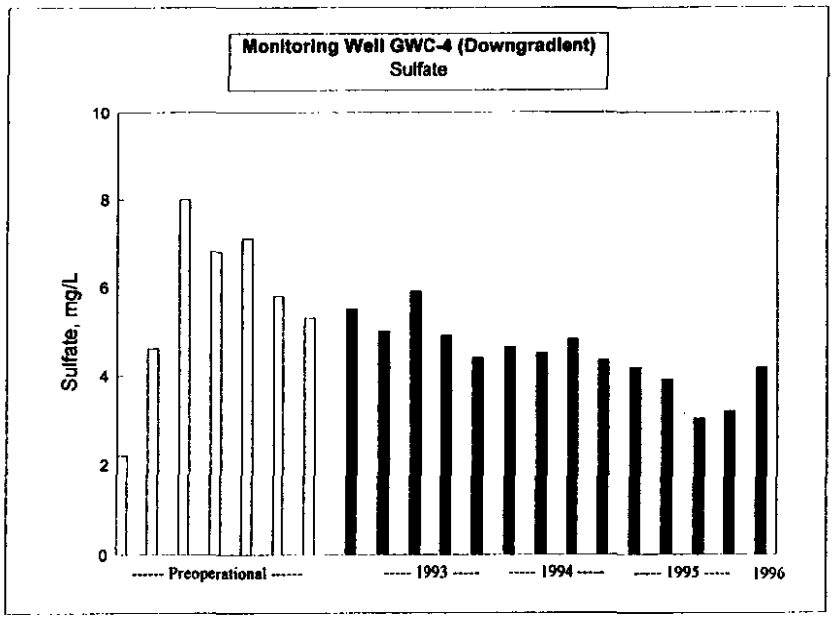
(a) Calcium



(b) Magnesium



(c) Chloride



(d) Sulfate

Figure 4. Historical Data for Representative Species from Well GWC-4 (Downgradient)

Section 2. There were no deviations from the specified methods during this quarter's monitoring effort.

- Chain-of-custody procedures established in the project test plan were observed.
- In the laboratory, method blanks, control samples, and matrix spikes were analyzed in conjunction with the sample analyses, following recognized good laboratory practice. Daily calibration verification and analytical spikes were also used to evaluate the quality of results. Specified recovery limits (typically 80 to 120%) were met for all analytes.
- Duplicate samples were obtained in the field and analyzed for all parameters. Replicate analyses were performed for a smaller number of parameters.

The results of the analysis of field and laboratory duplicates are summarized in Table 6 for those parameters measured above the detection limit in at least one sample. Complete results are provided in Appendix B. Differences in the duplicate analyses results were small for most species (i.e., less than about ±10%). Larger differences between sample duplicates were obtained for TOC, aluminum, barium, chromium, iron, and titanium. For the most part, the measured concentrations for these analytes were less than five times the detection limit (where results can be expected to be less accurate) or the analyte was found in the method blanks.

Table 6. Results for Duplicate Samples—First Quarter 1996

Parameter	Units	Sample GWC-3-21-1	Field Duplicate GWC-3-21-2	% Diff. [a]	Duplicate Analysis GWC-3-21-2	% RPD [b]	Spec. Limit
Total Dissolved Solids	mg/L	49.0	44.0	-11	51.0	15	15
Chloride	mg/L	3.46	3.49	1			
Fluoride	mg/L	0.0365[c]	0.0361[c]	-1			
Sulfate	mg/L	<0.0491	1.17	NC			
Total Organic Carbon	mg/L	0.176[c,d]	1.41[c]	88			
Nitrate-Nitrite as N	mg/L	0.259[c]	0.291[c]	11			
Aluminum	mg/L	0.0228 [c,d]	0.0392 [c,d]	42			
Barium	mg/L	0.0102[c]	0.0122[c]	16			
Calcium	mg/L	0.361	.0378	4			
Chromium	mg/L	0.00188	0.00268	30			
Iron	mg/L	0.0150[c,d]	0.0335[c,d]	55			
Magnesium	mg/L	1.11	1.18	6			
Manganese	mg/L	0.00274	0.00303	10			
Nickel	mg/L	0.00292[c]	0.00321[c]	9			
Potassium	mg/L	0.128	0.136	6			
Sodium	mg/L	5.14	5.30	3			
Sulfur	mg/L	0.0569	0.0627	9			
Selenium	mg/L	0.001040[c,d]	0.00112[c,d]	7			
Silicon	mg/L	9.48	9.88	4			
Strontium	mg/L	0.00387[c]	0.00408[c]	5			
Titanium	mg/L	0.00042[c,d]	0.00174[c]	76			

[a] % Difference = ([GWC-3-21-2] - [GWC-3-21-1]) x 100/[GWC-3-21-1].

[b] RPD = Relative Percent Difference, defined as follows:

$$\text{RPD} = \frac{\text{(Larger Value - Smaller Value)}}{\text{(Larger Value + Smaller Value)/2}} \times 100\%.$$

[c] Detected in the method blank.

[d] Value is less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.

NC = Not computed.

Appendix A

Historical Monitoring Data for Selected Parameters

Table A-1. Historical Monitoring Data for Selected Parameters

Parameter	Baseline Monitoring							Round 8 29-30 Dec 92
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	
Well: GWA-1 (Formerly CW-1)								
pH	5.86	6.27	5.6	6.7	6.05	5.94	6.4	5.7
Conductivity	98	114	112	121	104	85	116	101
Alkalinity	15.6	22.3	25.8	27.1	25	16.4	35.4	22.7
TDS	94	87	86	84	90	77	99	110
Chloride	7.3	7.4	5.9	4.6	3.8	8.2	1.9	2.1
Sulfate	4.5	8.5	8.5	11	17	3.7	17	26
Calcium	6.2	7.6	7.7	7	7.5	5.3	7.9	8.1
Magnesium	3.4	4.9	4.8	4.6	5.1	3.5	5.6	6.0
Sodium	4.2	4.8	4.9	4.3	4.4	3.8	4.1	4.2
Silicon	9.8	11	14	16	17	9.6	15	17

Parameter	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93	Round 12 5 Jan 94	Round 13 22-23 Mar 94	Round 14 21-22 Jun 94	Round 15 31 Aug 94	Round 16 20-21 Dec 94
Well: GWA-1 (Formerly CW-1) (Continued)								
pH	6.82	6.1	5.9	NS	NS	NS	NS	NS
Conductivity	128	100	110	NS	NS	NS	NS	NS
Alkalinity	28	27	24.8	NS	NS	NS	NS	NS
TDS	110	116	99	NS	NS	NS	NS	NS
Chloride	2.1	2.1	1.9	NS	NS	NS	NS	NS
Sulfate	30	20	28	NS	NS	NS	NS	NS
Calcium	4.1	8.0	8.3	NS	NS	NS	NS	NS
Magnesium	2.9	5.8	5.9	NS	NS	NS	NS	NS
Sodium	4.0	4.4	4.3	NS	NS	NS	NS	NS
Silicon	11	18	17	NS	NS	NS	NS	NS

Parameter	Round 17 28-29 Mar 95	Round 18 13-14 Jun 95	Round 19 11-12 Sep 95	Round 20 12-13 Dec 95	Round 21 18-19 Mar 96			
Well: GWA-1 (Formerly CW-1) (Continued)								
pH	NS	6.31	6.38	6.08	NM			
Conductivity	NS	116	165	118	NM			
Alkalinity	NS	28.6	23	NM	NM			
TDS	NS	108	114	93	113			
Chloride	NS	2.10	2.27	1.94	2.26			
Sulfate	NS	18.3	24.4	30.8	32.7			
Calcium	NS	6.98	8.47	9.21	10.4			
Magnesium	NS	5.47	6.30	6.51	6.87			
Sodium	NS	4.29	4.53	3.50	4.65			
Silicon	NS	16.6	17.6	13.2	14.3			

Table A-1 (Continued)

Parameter	Baseline Monitoring							
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92
Well: GWC-1 (Formerly CW-2)								
pH	6.09	5.79	5.62	5.93	6.04	5.96	6.1	4.5
Conductivity	81	70	72	63	63	66	78	57
Alkalinity	21.7	22.9	24.4	22.1	20.5	25.8	27.8	23.3
TDS	81	51	59	52	48	64	64	68
Chloride	3.5	2.8	3.1	3.4	2.8	2.5	2.5	2.6
Sulfate	7.6	5	2.8	<0.05	1.2	1.5	3.2	3.3
Calcium	3.9	3.6	3.8	3.2	3.4	3.6	4.3	4.0
Magnesium	2.3	2.5	2.8	2.2	2.4	2.5	3.2	3.0
Sodium	5.9	5.2	4.3	4.1	4.2	4.1	4.0	4.0
Silicon	9	9	9.2	11	11	11	11	12
Parameter	**Round 9 30-31 Mar 93**	**Round 10 21 Jun 93**	**Round 11 23-24 Sep 93**	**Round 12 5 Jan 94**	**Round 13 22-23 Mar 94**	**Round 14 21-22 Jun 94**	**Round 15 31 Aug 94**	**Round 16 20-21 Dec 94**
Well: GWC-1 (Formerly CW-2) (Continued)								
pH	5.83	6.0	6.0	6.1	5.89	5.91	6.09	6.09
Conductivity	67	57	61	74	61	60	68	76
Alkalinity	22.5	24.1	27.3	29.9	25	30.1	25	22
TDS	43	74	70	22	66	56	64	46
Chloride	2.6	2.6	2.5	3.5	2.43	2.77	2.71	2.68
Sulfate	2.2	<2.5	2.6	3.3	1.75	1.77	1.64	1.19
Calcium	8.8	4.1	4.1	5.1	4.72	4.65	5.00	4.50
Magnesium	6.2	2.9	3.0	3.7	3.14	3.39	3.70	3.33
Sodium	4.2	4.0	3.8	4.3	4.12	4.16	4.32	4.10
Silicon	16	12	12	12.7	11.9	11.9	11.8	10.9
Parameter	**Round 17 28-29 Mar 95**	**Round 18 13-14 Jun 95**	**Round 19 11-12 Sep 95**	**Round 20 12-13 Dec 95**	**Round 21 18-19 Mar 96**			
Well: GWC-1 (Formerly CW-2) (Continued)								
pH	6.05	5.70	6.00	5.92	6.04			
Conductivity	77	66	79	82	86			
Alkalinity	29.1	31.0	31	31.2	24.2			
TDS	63	72	58	49	71			
Chloride	2.64	2.76	2.77	2.45	2.20			
Sulfate	1.23	1.10	1.06	<0.0491	1.06			
Calcium	5.30	5.12	5.12	5.86	5.91			
Magnesium	3.65	3.83	3.80	4.23	4.11			
Sodium	4.21	4.15	4.28	4.44	4.38			
Silicon	10.9	11.8	12.3	10.0	11.6			

Table A-1 (Continued)

Parameter	Baseline Monitoring							
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92
Well: GWC-2 (Formerly CW-3)								
pH	5.64	5.6	5.04	5.5	4.97	5.65	5.5	4.6
Conductivity	76	69	64	66	33	71	66	56
Alkalinity	23.5	19.3	15.2	16.9	12.2	17.5	18.2	17.3
TDS	76	50	55	55	63	65	79	71
Chloride	4.3	5.2	6.9	6.2	5	5.3	3.0	3.4
Sulfate	6.4	5.5	6.3	5.9	5.8	6.3	6.5	7.6
Calcium	4.4	2.8	2.3	2	2	1.7	1.4	1.6
Magnesium	1.6	1.5	1.6	1.7	1.8	1.9	1.9	2.1
Sodium	7.3	7.4	6.9	7	7.5	7.6	7.5	7.4
Silicon	10	10	9.3	12	11	11	11	13
Parameter	**Round 9 30-31 Mar 93**	**Round 10 21 Jun 93**	**Round 11 23-24 Sep 93**	**Round 12 5 Jan 94**	**Round 13 22-23 Mar 94**	**Round 14 21-22 Jun 94**	**Round 15 31 Aug 94**	**Round 16 20-21 Dec 94**
Well: GWC-2 (Formerly CW-3) (Continued)								
pH	5.29	5.4	5.6	5.75	5.5	5.72	5.63	5.34
Conductivity	67	56	49	53	57	59	60	66
Alkalinity	12.5	14.1	15.9	15.7	14	16.2	7.0	6.9
TDS	68	77	60	27	76	58	60	65
Chloride	4.0	4.5	3.5	3.8	3.7	3.79	3.92	4.00
Sulfate	7.9	7.5	7.7	5.78	5.97	5.95	6.73	5.78
Calcium	1.7	1.6	1.9	2.0	2.19	2.05	2.11	1.89
Magnesium	2.1	1.9	2.0	1.8	1.92	1.93	2.03	1.87
Sodium	7.5	6.7	6.8	7.0	7.15	7.09	7.17	6.96
Silicon	12.0	11	13	12.9	13.3	13.0	12.9	12.2
Parameter	**Round 17 28-29 Mar 95**	**Round 18 13-14 Jun 95**	**Round 19 11-12 Sep 95**	**Round 20 12-13 Dec 95**	**Round 21 18-19 Mar 96**			
Well: GWC-2 (Formerly CW-3) (Continued)								
pH	5.53	5.39	5.41	5.45	5.79			
Conductivity	65	65	67.5	67	66			
Alkalinity	13.3	14.5	13.5	13.0	NM			
TDS	63	64	54	53	69			
Chloride	3.81	3.97	3.83	3.91	3.79			
Sulfate	4.98	4.33	3.90	3.68	4.11			
Calcium	2.23	2.08	2.16	2.41	2.37			
Magnesium	1.88	1.92	1.88	1.96	1.92			
Sodium	6.79	6.85	6.94	7.11	7.04			
Silicon	12.2	13.4	13.5	12.9	13.7			

Table A-1 (Continued)

Parameter	Baseline Monitoring							
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92
Well: GWC-3 (Formerly CW-4)								
pH	5.4	5.15	4.8	4.73	6.19	5.08	5.25	3.8
Conductivity	40	35	30	34	32	35	32	27
Alkalinity	11.5	15.2	9.9	11	7	11.1	10.0	8.9
TDS	50	35	31	34	39	41	28	37
Chloride	3	2.8	3.2	3.4	3.1	3.1	2.0	2.3
Sulfate	2.6	2.1	<0.05	<0.05	0.9	1.5	1.7	2.6
Calcium	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Magnesium	1	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Sodium	4.4	4.5	4.3	4.1	4.6	4.3	4.1	4.0
Silicon	8	7.8	3.9	8.5	8.6	8.3	8.3	9.3
Parameter	**Round 9 30-31 Mar 93**	**Round 10 21 Jun 93**	**Round 11 23-24 Sep 93**	**Round 12 5 Jan 94**	**Round 13 22-23 Mar 94**	**Round 14 21-22 Jun 94**	**Round 15 31 Aug 94**	**Round 16 20-21 Dec 94**
Well: GWC-3 (Formerly CW-4) (Continued)								
pH	5.23	5.2	5.3	5.5	5.18	5.43	5.41	5.06
Conductivity	33	27	27	22	28	29	30	36
Alkalinity	7.0	8.5	9.1	9.3	7.5	8.5	77	4.8
TDS	44	52	21	<8.7	42	36	39	30
Chloride	2.7	2.9	2.8	2.8	2.77	2.76	2.91	3.02
Sulfate	1.6	<2.5	<2.5	<0.06	1.38	1.52	<0.0471	1.01
Calcium	<1.0	<1.0	<1.0	<1.0	0.392	0.321	0.328	0.335
Magnesium	<1.0	<1.0	<1.0	<1.0	0.962	0.935	1.00	1.02
Sodium	4.1	3.9	3.8	4.1	4.35	4.14	4.17	4.34
Silicon	9.0	8.7	9.2	9.7	10.1	9.16	9.15	8.94
Parameter	**Round 17 28-29 Mar 95**	**Round 18 13-14 Jun 95**	**Round 19 11-12 Sep 95**	**Round 20 12-13 Dec 95**	**Round 21 18-19 Mar 96**			
Well: GWC-3 (Formerly CW-4) (Continued)								
pH	5.10	5.10	5.02	5.27	5.25			
Conductivity	36	37	45	39	42			
Alkalinity	8.6	8.5	9.0	9.1	7.4			
TDS	44	52	37	36	49			
Chloride	3.15	3.13	3.64	3.52	3.46			
Sulfate	<0.0471	0.968	0.595	0.233	<0.0491			
Calcium	0.441	0.314	0.389	0.436	0.361			
Magnesium	1.10	1.08	1.21	1.26	1.11			
Sodium	4.39	4.47	4.83	5.14	5.14			
Silicon	8.97	8.90	9.94	5.18	9.48			

Table A-1 (Continued)

Parameter	Baseline Monitoring							
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92
Well: GWC-4 (Formerly CW-5)								
pH	5.34	4.97	4.8	4.6	5.03	5.4	5.05	3.9
Conductivity	62	62	66	72	54	70	72	58
Alkalinity	12.5	15.3	13.1	15.1	8.6	14.2	11.5	8.0
TDS	61	52	60	51	58	64	61	65
Chloride	5	4.2	5	5.6	4.5	5.2	3.1	3.4
Sulfate	2.2	4.6	8	6.8	7.1	5.8	5.3	5.5
Calcium	1.3	<1.0	<1.0	1.3	1.6	1.2	<1.0	<1.0
Magnesium	2.5	2.5	3.1	3.8	3.9	3.7	3.3	3.2
Sodium	5.4	5.8	5.3	5.1	5	5.2	4.8	4.9
Silicon	9.9	9.1	4.7	9.7	9.2	10	8.6	9.5
Parameter	**Round 9 30-31 Mar 93**	**Round 10 21 Jun 93**	**Round 11 23-24 Sep 93**	**Round 12 5 Jan 94**	**Round 13 22-23 Mar 94**	**Round 14 21-22 Jun 94**	**Round 15 31 Aug 94**	**Round 16 20-21 Dec 94**
Well: GWC-4 (Formerly CW-5) (Continued)								
pH	5.04	5.2	5.2	5.2	4.98	5.2	5.10	4.92
Conductivity	64	52	54	63	72	81	108	188
Alkalinity	6.0	6.9	7.0	9.2	5.0	10.3	5.0	3.8
TDS	63	55	44	20	64	75	93	110
Chloride	3.6	3.6	3.8	6.7	11.3	13.5	20.8	39.7
Sulfate	5.0	5.9	4.9	4.4	4.64	4.50	4.83	4.34
Calcium	1.0	<1.0	<1.0	1.3	1.81	1.62	2.73	4.04
Magnesium	3.2	2.7	2.9	3.7	5.05	4.98	7.32	11.0
Sodium	4.7	4.4	4.4	5.0	5.33	4.87	5.80	7.86
Silicon	8.7	8.3	9.3	9.8	9.91	9.18	9.91	10.1
Parameter	**Round 17 28-29 Mar 95**	**Round 18 13-14 Jun 95**	**Round 19 11-12 Sep 95**	**Round 20 12-13 Dec 95**	**Round 21 18-19 Mar 96**			
Well: GWC-4 (Formerly CW-5) (Continued)								
pH	5.10	4.98	4.79	4.89	4.98			
Conductivity	163	148	180	196	288			
Alkalinity	9.0	4.6	4.5	4.2	5.6			
TDS	113	132	123	107	175			
Chloride	34.1	39.1	37.5	40.5	66			
Sulfate	4.18	3.91	3.03	3.21	4.18			
Calcium	3.21	3.89	3.03	3.99	7.10			
Magnesium	10.2	12.5	10.0	12.6	19.1			
Sodium	7.63	8.61	8.42	8.00	9.36			
Silicon	9.36	10.0	10.4	11.4	10.8			

Table A-1 (Continued)

Parameter	Baseline Monitoring							
	Round 1 6 Sep 90	Round 2 2 Nov 90	Round 3 8-9 Jan 91	Round 4 11 Mar 91	Round 5 8 May 91	Round 6 1-2 Jul 91	Round 7 3-4 Sep 92	Round 8 29-30 Dec 92
Well: GWC-5								
pH							5.6	4.4
Conductivity							61	60
Alkalinity							14.8	13.5
TDS							91	86
Chloride							1.8	2.6
Sulfate							8.8	10
Calcium							2.1	2.7
Magnesium							1.9	2.3
Sodium							6.0	6.2
Silicon							12	14
Parameter	**Round 9 30-31 Mar 93**	**Round 10 21 Jun 93**	**Round 11 23-24 Sep 93**	**Round 12 5 Jan 94**	**Round 13 22-23 Mar 94**	**Round 14 21-22 Jun 94**	**Round 15 31 Aug 94**	**Round 16 20-21 Dec 94**
Well: GWC-5 (Continued)								
pH	6.13	5.4	5.6	7.0	5.38	5.42	5.53	5.57
Conductivity	54	41	40	39	43	45	43	47
Alkalinity	12.5	10.2	11.5	10.8	8.6	10.8	13.0	11.2
TDS	67	56	50	29	53	61	61	45
Chloride	2.7	2.9	2.5	2.6	2.34	2.48	2.67	2.70
Sulfate	7.4	6.7	5.5	5.3	6.56	7.65	6.68	5.75
Calcium	2.2	1.6	1.4	1.3	1.65	1.38	1.26	1.20
Magnesium	1.8	1.5	1.4	1.3	1.6	1.55	1.46	1.32
Sodium	5.7	5.5	5.2	5.5	5.74	5.77	5.38	5.43
Silicon	13	12	12	11.4	11.8	11.3	10.5	10.3
Parameter	**Round 17 28-29 Mar 95**	**Round 18 13-14 Jun 95**	**Round 19 11-12 Sep 95**	**Round 20 12-13 Dec 95**	**Round 21 18-19 Mar 96**			
Well: GWC-5 (Continued)								
pH	5.52	5.60	5.20	5.28	5.54			
Conductivity	50	52	60	53	67			
Alkalinity	9.5	8.5	11.0	9.1	4.7			
TDS	50	64	64	45	72			
Chloride	2.54	2.62	2.70	2.93	2.78			
Sulfate	6.45	6.64	6.80	7.20	13.3			
Calcium	1.51	1.31	1.48	1.97	2.28			
Magnesium	1.59	1.73	1.78	6.02	2.65			
Sodium	5.34	5.54	6.12	5.82	6.43			
Silicon	10.3	11.1	11.5	16.2	11.3			

Appendix B

QA/QC Results

Table B-1. Results for Duplicate Samples—First Quarter 1996

Parameter	Units	Sample GWC-3-21-1	Field Duplicate GWC-3-21-2	% % Diff. [a]	Duplicate Analysis GWC-3-21-2	% RPD [b]	Spec. Limit
Total Dissolved Solids	mg/L	49.0	44.0	-11	51.0	15	15
Bromide	mg/L	<0.0181	<0.0181	NC			
Chloride	mg/L	3.46	3.49	1			
Fluoride	mg/L	0.0365 [c]	0.0361 [c]	-1			
Sulfate	mg/L	<0.0491	1.17	NC			
Total Organic Carbon	mg/L	0.176 [c,d]	1.41 [c]	88			
Nitrate-Nitrite as N	mg/L	0.259 [c]	0.291 [c]	11			
Total Organic Halides	µg/L	<20.9	<20.9	NC			
Ra-226	pCi/L	0.840 ± 0.409	-0.350 ± 0.841	NC			
Ra-228	pCi/L	0.780 ± 0.526	0.190 ± 1.33	NC			
Gross Alpha	pCi/L	<0.46	<0.47	NC			
Gross Beta	pCi/L	<1.3	<1.3	NC			
Ac-228	pCi/L	-6.56 ± 21.8	9.34 ± 13.9	NC			
Pb-214	pCi/L	9.66 ± 10.1	19.9 ± 4.42	NC			
Bi-214	pCi/L	11.8 ± 12.9	16.5 ± 5.21	NC			
K-40	pCi/L	-71.1 ± 85.1	23.6 ± 71.0	NC			
Silver	mg/L	<0.000501	<0.000501	NC			
Aluminum	mg/L	0.0228 [c,d]	0.0392 [c,d]	42			
Arsenic	mg/L	<0.00392	<0.00392	NC			
Boron	mg/L	<0.0479	<0.0479	NC			
Barium	mg/L	0.0102 [c]	0.0122 [c]	16			
Beryllium	mg/L	<0.000162 [c]	0.00017 [c,d]	NC			
Bismuth	mg/L	<0.00271	<0.00271	NC			
Calcium	mg/L	0.361	0.378	4			
Cadmium	mg/L	<0.000156	<0.000156	NC			
Cobalt	mg/L	<0.000580	<0.000580	NC			
Copper	mg/L	<0.00136 [c]	<0.00136 [c]	NC			
Chromium	mg/L	0.00188	0.00268	30			
Mercury	mg/L	<0.000039	<0.000039	NC			
Iron	mg/L	0.0150 [c,d]	0.0335 [c,d]	55			
Potassium	mg/L	0.128	0.136	6			
Lithium	mg/L						
Magnesium	mg/L	1.11	1.18	6			
Manganese	mg/L	0.00274	0.00303	10			
Molybdenum	mg/L	<0.000705	<0.000705	NC			
Sodium	mg/L	5.14	5.30	3			
Nickel	mg/L	0.00292 [c]	0.00321 [c]	9			
Phosphorus	mg/L	<0.00471	<0.00471	NC			
Lead	mg/L	<0.00126	<0.00126	NC			

Table B-1 (continued)

Parameter	Units	Sample GWC-3-21-1	Field Duplicate GWC-3-21-2	% % Diff. [a]	Duplicate Analysis GWC-3-21-2	% RPD [b]	Spec. Limit
Sulfur	mg/L	0.0569	0.0627	9			
Antimony	mg/L	<0.000919	<0.000919	NC			
Selenium	mg/L	0.00104 [c,d]	0.00112 [c,d]	7			
Silicon	mg/L	9.48	9.88	4			
Tin	mg/L	<0.00111	<0.00111	NC			
Strontium	mg/L	0.00387 [c]	0.00408 [c]	5			
Tellurium	mg/L	<0.00170	<0.00170	NC			
Titanium	mg/L	0.00042 [c,d]	0.00174 [c]	76			
Thallium	mg/L	<0.00125	<0.00125	NC			
Uranium	mg/L	<0.0132	<0.0132	NC			
Vanadium	mg/L	<0.000681	<0.000681	NC			
Tungsten	mg/L	<0.00183	<0.00183	NC			
Zinc	mg/L	<0.00309 [c]	<0.00309 [c]	NC			

[a] % Difference = (GWC-3-21-2 - GWC-3-21-1)/GWC-3-21-1 x 100%.

[b] RPD = Relative Percent Difference, defined as follows:

$$\text{RPD} = \frac{\text{(Larger Value - Smaller Value)}}{\text{(Larger Value + Smaller Value)/2}} \times 100\%.$$

[c] Detected in the method blank.

[d] Value is less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.

NC = Not computed.