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

Plant Yates

Environmental Monitoring Program Report: Fourth Quarter and Annual 1994

(Final)

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Executive Summary

This progress report summarizes activities associated with the environmental monitoring program (EMP) during the fourth calendar quarter and year of 1994 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.

This document discusses progress made in EMP activities during the fourth calendar quarter and year of 1994. With the exception of certain compliance data, results are not presented in detail; instead, results will be reported in more comprehensive periodic reports that focus on discrete test periods.

The remainder of the low-fly ash auxiliary test block was completed during the first three months of 1994, including some of the alternate limestone tests and the alternate (high sulfur) coal tests. The high-fly ash test period began in March and continued through the remainder of the year. A parametric test block, long-term test block, and auxiliary test block were included in this period.

Tests performed during the fourth quarter included the alternate limestone test block, using limestone from Florida Rock's Rome, Georgia, quarry and the plant's Phase I compliance coal (nominally 1.2% sulfur). Most of these tests were conducted at low-ash loading (i.e., with the ESP completely energized) because of the desire to complete the testing program with the scrubber relatively free of ash solids. Following the completion of these tests, the scrubber was transferred to Georgia Power Company (Plant Yates).

Operational-phase groundwater monitoring continued during the year. Also, compliance monitoring was conducted and compliance reports were submitted by Georgia Power Company to the Environmental Protection Division of the Georgia Department of Natural Resources.

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1.0 Introduction

This progress report summarizes activities associated with the environmental monitoring program (EMP) during the fourth calendar quarter and year of 1994 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. The Cooperative Agreement for this project was signed by DOE on April 2, 1990.

The EMP was developed to fulfill the following specific objectives:

- To provide monitoring data to fulfill environmental compliance requirements of local, state, and federal regulatory agencies;
- To define and describe additional supplemental monitoring activities, if needed; and
- To ensure that emissions and environmental impacts are consistent with projections provided in NEPA documents.

This document discusses progress made in EMP activities during the fourth calendar quarter and year of 1994. Results are presented for groundwater monitoring and compliance (air emissions and wastewater) monitoring, but the results of FGD process monitoring will be presented in more comprehensive periodic reports that focus on discrete test phases.

2.0 Project Summary

This section provides a brief description of the plant and process in addition to the demonstration project.

2.1 Plant and Process Description

Plant Yates consists of seven steam turbine electric generating units providing a total nameplate capacity of 1,250,000 kW. Units 1 through 5 (operational since the 1950s) are operated as intermediate load units and are located in one building that features a common 825-foot stack for venting emissions from all five units. Units 6 and 7, operational since 1974, are operated as base load units. A common 800-foot stack is used to vent emissions from Units 6 and

7, which are housed in a separate building. All of Plant Yates' units are equipped with electrostatic precipitators for particulate control.

Plant Yates typically uses coal that is a 50-50 blend of Arch Mineral and Old Ben coals from the Illinois Basin. The target coal sulfur content for the demonstration project is 2.5 percent. Raw water for process needs is drawn from the Chattahoochee River. Solid waste, in the form of bottom ash and fly ash, is sluiced to a series of wet ash disposal ponds.

2.2 Project Description

The CT-121 flue gas desulfurization project was constructed and is operated to treat the entire flue gas stream from Unit 1 (100 MW), which is approximately 12% of the total flue gas generated at Plant Yates. A 258-foot stack was constructed to vent emissions from the CT-121 process.

A simplified process flow diagram of the flue gas desulfurization process is shown in Figure 1. Major process sampling locations are shown in that diagram.

3.0 Project Status

The CT-121 demonstration project at Plant Yates consists of four distinct environmental test periods, including:

- Period 0: Site Preparation, Construction, and Startup of the Demonstration Project;
- Period 1: Testing at Low-Fly Ash Loading—With ESP In Service;
- Period 2: Testing at High-Fly Ash Loading—ESP Detuned or Out of Service; and
- Period 3: Post-Demonstration Groundwater Testing.

Monitoring during Period 0 consisted solely of background (i.e., prior to project operation) groundwater monitoring. Samples were obtained during seven periods between September 6, 1990 and October 14, 1992.

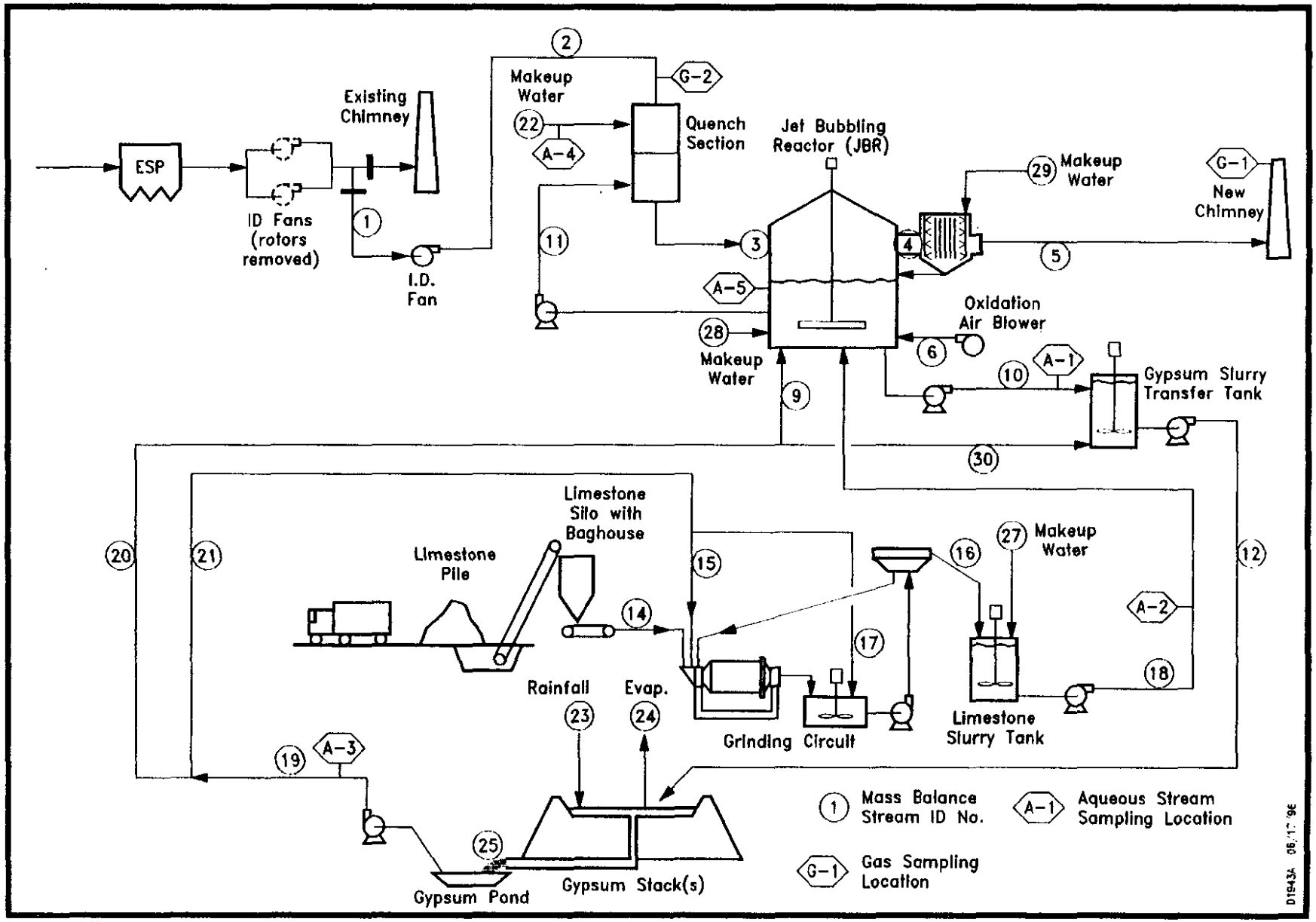

Figure 1. Yates 100 MW CT-121 Process Flow Diagram

On October 26, 1992, the CT-121 wet scrubber became operational for the first time. During the remainder of 1992, shakedown of the process equipment and data collection procedures was conducted.

The majority of the Period 1 (low-fly ash) tests were performed in 1993. These consisted of a parametric test block, long-term test block, and most of the auxiliary test block (i.e., high-SO_2 removal, and most of the alternate limestone tests).

The remainder of the Period 1 auxiliary test block was completed during the first three months of 1994. Additional alternate limestone tests were conducted with the unit in load-following operation to gather additional data on the scrubber's performance and gypsum byproduct dewatering characteristics while operating with Dravo limestone. Following these tests, the Period 1 alternate coal tests were conducted using high-sulfur coal (about 4.3%) to judge the flexibility and performance of the scrubber while operating with higher-than-design inlet SO_2 concentrations. These tests required a number of modifications to the scrubber's limestone feed system and the JBR.

The Period 2 (high-fly ash) test period began in March, 1994, with a parametric test block. Particulate sampling of the JBR inlet flue gas and stack gas streams was conducted during the first nine parametric tests conducted at several different JBR inlet flue gas particulate loadings. The loadings were adjusted by varying upstream ESP operation. Based on the results of these tests, the decision was made not to conduct Period 2 testing with the ESP completely deenergized. Instead, it was decided to partially detune the ESP for these tests to simulate operation with a marginally performing upstream particulate collection device. The parametric test block was completed by the latter part of May.

Following completion of the parametric test block, the long-term test block was conducted during the months of June, July, and August. Because of inhibited limestone dissolution, it was necessary to operate at a lower pH than originally planned for these tests (pH 4.0 instead of 4.5).

The JBR and other process components were cleaned in early September, and the scrubber was then returned to service for the Period 2 high-SO_2 removal test block. Several short tests at fixed loads from 50 to 100 MWe were conducted, followed by load-following operation during the remainder of this test block.

Period 2 alternate coal testing was performed in October. Although 4.3% sulfur coal was requested (the same concentration as was used in the Period 1 alternate coal tests), the actual coal sulfur content, as determined by a daily proximate analysis, was 3.4 percent.

The annual boiler outage for Unit 1 began in late October and continued during most of November. During this outage, the scrubber process equipment was inspected and cleaned, and several process modifications were made.

December was the last month of scheduled Period 2 testing for the Yates CT-121 demonstration project. The tests performed during the month of December were the high-particulate alternate limestone tests. All of the tests were conducted using limestone from Florida Rock's Rome, Georgia, quarry and the plant's Phase I compliance coal (nominally containing 1.2% sulfur). Because it was scheduled after the 1994 annual boiler outage, and because of the desire to complete the testing with the scrubber relatively free of ash solids, most of these tests were actually conducted at low-ash loading (i.e., with the ESP completely energized). Following the completion of the Period 2 tests, operation of the scrubber was transferred to Georgia Power Company (Plant Yates).

Period 3 testing will include only monitoring of the groundwater around the gypsum stacking area and is scheduled to continue through 1996.

4.0 Compliance Monitoring And Reporting

Wastewater samples collected throughout the year for compliance purposes were as follows:

Stream/Parameter	Ash Transport Water	Final Plant Discharge
Total Suspended Solids	✓	
Oil and Grease	✓	
pH		✓

During each quarter, compliance reports were submitted by Georgia Power Company, as required, to the Environmental Protection Division of the Georgia Department of Natural Resources. The reports for the fourth quarter of 1994 are reproduced as Appendices A and B. Appendix A contains excess emission and monitoring system performance reports. Appendix B

contains wastewater data. The compliance reports for the first through third quarters of 1994 have been attached to previously-submitted EMP reports.

During the first quarter of 1995, a semiannual progress report was submitted by GPC to the DNR, in accordance with an amendment (effective December 28, 1990) to the air operating permit for Source 1 (comprising Units 1, 2, and 3) (No. 4911-038-4838-0). This report covered the testing performed during the second semester of 1994.

5.0 Supplemental Monitoring

5.1 Groundwater Monitoring

Operational-phase groundwater monitoring was conducted during each quarter of 1994. Monitoring for the fourth quarter was conducted on December 20-21, 1994. The samples collected, shown in Table 1, were analyzed for the parameters shown in Table 2. Results for these samples will be available in the next quarterly EMP progress report.

A report containing the results of groundwater monitoring conducted during the third quarter of 1994 is provided as Appendix C. The results from previous quarters have been attached to previously-submitted EMP reports.

5.2 FGD Process Monitoring

The monitoring schedules for gaseous, aqueous, and solid streams are shown in Tables 3, 4, and 5, respectively. Tables 6, 7, and 8 are summaries of the EMP monitoring conducted during the quarter.

Table 1. Summary of Groundwater Samples Collected at Plant Yates on December 20-21, 1994

Well ID	Sample ID	Analyses
GWA-1	None	Well dry; no samples collected
GWC-1	GWC-1-16-1	Anions, TOC, TOX, and Metals
GWC-2	GWC-2-16-1	Anions, TOC, TOX, and Metals
GWC-3	GWC-3-16-1 GWC-3-16-2	Anions, TOC, TOX, and Metals Anions, TOC, TOX, and Metals
GWC-4	GWC-4-16-1	Anions, TOC, TOX, and Metals
GWC-5	GWC-5-16-1	Anions, TOC, TOX, and Metals
GWC-6	None	Well dry; no samples collected

Table 2. 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		
TOX		

Table 3. Gaseous Streams: Integrated Monitoring Schedule

Parameter	Stack Gas Stream	Flue Gas Inlet to JBR
Opacity	None	Continuous
SO_2	Continuous	Continuous
O_2	Continuous	Continuous
Moisture Content	9/Parametric Test Period	9/Parametric Test Period
SO_3, H_2SO_4 Mist (contingent upon funding availability)	36/Parametric Test Period	36/Parametric Test Period
Particulate Matter		
Loading	9/Parametric Test Period and Annually	9/Parametric Test Period
Particle Size Distribution (contingent upon funding availability)	9/Parametric Test Period	9/Parametric Test Period

Table 4. Aqueous Stream Monitoring Schedule

Parameter	JBR Overflow		JBR Underflow	
	P	L	P	L
Liquid Phase				
pH	7/M	4/M	7/M	4/M
Chloride	7/M	4/M		
Sulfite	7/M	4/M		
Sulfate	7/M	4/M		
Carbonate	7/M	4/M		
Trace Elements		1/M		
Solid Phase				
Solids Content	7/M	4/M	7/M	4/M
Inert Content	7/M	4/M	7/M	4/M
Calcium	7/M	4/M	7/M	4/M
Magnesium			7/M	4/M
Sulfite			7/M	4/M
Sulfate	7/M	4/M	7/M	4/M
Carbonate	7/M	4/M	7/M	4/M
Trace Elements				1/M
TCLP				1/P

Table 4 (continued)

Parameter	Limestone Slurry Feed		Gypsum Stack Return		Makeup Water	
	P	L	P	L	P	L
Liquid Phase						
pH			7/M	4/M	1/M	1/M
Chloride			7/M	4/M	1/M	1/M
Sulfite					1/M	1/M
Sulfate			7/M	4/M	1/M	1/M
Carbonate			7/M	4/M	1/M	1/M
Trace Elements			1/M	1/M		
Solid Phase						
Solids Content	7/M	4/M				
Inert Content	7/M	4/M				
Calcium	7/M	4/M				
Magnesium	7/M	4/M				
Carbonate	7/M	4/M				

Table 4 (continued)

Abbreviations:

n/D = n times per day;
n/W = n times per week;
n/M = n times per month;
n/Q = n times per quarter;
1/nM = once per n months;
P = Parametric test; and
L = Long-term test. (Each of the two testing periods consists of a parametric test and a long-term test.)

Trace elements are the following:

Aluminum	Copper	Phosphorus
Arsenic	Iron	Lead
Boron	Potassium	Sulfur
Barium	Magnesium	Antimony
Beryllium	Manganese	Selenium
Calcium	Mercury	Silicon
Cadmium	Molybdenum	Titanium
Cobalt	Sodium	Uranium
Chromium	Nickel	Vanadium

Table 5. Solid Stream Monitoring Schedule

Parameter	Coal Feed
Proximate Analysis	Daily
Ultimate Analysis, Cl, and F	Twice Yearly
Trace Elements	Twice Yearly

Note: In addition to the monitoring shown, analysis of coal feed for sulfur, moisture, heating value, and ash content once per week is a regulatory compliance requirement.

Table 6. Gaseous Streams: Numbers of Samples Collected in 1994

Parameter	Stack Gas Stream	Flue Gas Inlet to JBR
Opacity	NA	Continuous
SO_2	Continuous	Continuous
O_2	Continuous	Continuous
Moisture Content	36	34
SO_3, H_2SO_4 Mist	36	36
PM Loading	27	27
PM Size Distribution	9	9

Table 7. Aqueous Streams: Numbers of Samples Collected in 1994

Parameters	JBR Overflow and Underflow	Limestone Slurry Feed	Gypsum Stack Return	Makeup Water
pH	Twice daily when operating	NA	Daily when operating	Monthly
Anions (liquid and solid phases) and solids/inerts/Ca/Mg (solid phase)	47	49	48	11
Metals (liquid and solid phases)	12	NA	10	NA

Table 8. Solid Streams: Number of Samples Collected in 1994

Parameters	Coal Feed
Proximate Analysis	Daily when operating
Ultimate Analysis, Cl, and F	7
Trace Elements	6

6.0 Quality Assurance/quality Control Activities

QA/QC activities for process data consist of calibrations, calibration checks, and related maintenance activities, all of which are recorded in log books. Six log books are used:

1. CEM flow rates and gas concentrations;
2. pH calibrations;
3. ΔP cells;
4. Density measurements;
5. Flow meters; and
6. Level meters.

Radian Corporation personnel were on site on June 14-15, 1994, to perform a quality assurance audit of the Plant Yates laboratory. The audit indicated that all of the quality control procedures established for the laboratory had been implemented and are being complied with, and that an appropriate level of quality control is being practiced. A report presenting the results of this audit was included as an appendix to the EMP quarterly progress report for the third quarter of 1994.

Appendix A

Quarterly Air Emission Report for the Fourth Quarter of 1994

Fuel Analysis Report
for
Lab ID 94009191

P.O. Number		Receiving Plant	Yates Unit 1
Sample Class	Daily Sample	Unit Train No.	
Date Shipped	12/03/94	Number of Cars	0
Date Received	12/07/94	Tonnage	1021.00

Air Dry Loss	Weights	Results	
Pan	807.2 g	Air Dry Loss	6.02%
Pan, Wet Coal & Bag	1986.5 g	Total Moisture	7.54%
Pan, Dry Coal & Bag	1916.5 g		
Pan & Dry Coal	1900.2 g		

MAC-400	Instrument Data		Results	
	Dry	As Det.		
Sample Wt.		1.1590g		
Moisture		1.62%		
Volatile	35.79%	35.21%	Volatile as Rec.	33.09%
Ash	10.39%	10.22%	Ash as Rec.	9.61%
F. Carbon	53.82%	52.95%	F. Carbon as Rec.	49.76%

Sulfur	Instrument Data	Results	
As Determined	1.21%	Dry Basis	1.23%
		As Received	1.14%

BTU Content
Bomb # = 10

Instrument Data		Results	
			Btu/lb
Capsule Weight	11.2491 g	As Determined	13283
Capsule & Coal Wt.	12.2493 g	Dry Basis	13501
Initial Temperature	29.656 deg C	As Received	12483
Final Temperature	41.638 deg C	Moist & Ash Free	15067
Acid Correction	38.00 Btu/lb		
Wire Correction	97.20 Btu/lb	Sulfur MM	0.91%
Water Equivalent	1122	SO2 MM	1.73%

CHN-1000	Results		
	Dry	As Det.	As Rec.
Carbon	76.02%	74.79%	70.29%
Hydrogen	4.98%	5.08%	4.61%
Nitrogen	1.45%	1.43%	1.34%
Oxygen	5.92%	7.27%	5.48%

NOTE: Hydrogen & Oxygen from Moisture NOT included.

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 10/06/1994
CURRENT TIME : 08:33:49

DEMAND FOR DAILY EMISSIONS REPORT FOR
DATE : 10/05/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800	4	61.76		
0800-0900	1	73.82		
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	5	67.79		
LIMITS		40.00		34.00

RLS1536685

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 10/08/1994
CURRENT TIME : 00:00:11

DAILY EMISSIONS REPORT FOR
DATE : 10/07/1994

TIME	OPACITY # OF 6 MIN AVG	OPACITY AVG	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700	1	48.14		
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	48.14		
LIMITS		40.00		34.00

RLS1536686

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 10/13/1994
CURRENT TIME : 00:00:12

DAILY EMISSIONS REPORT FOR
DATE : 10/12/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG	OPACITY INDEX INDEX
0000-0100	3	49.12			
0100-0200	10	65.37			
0200-0300	4	65.11			
0300-0400			1		35.30
0400-0500					
0500-0600					
0600-0700					
0700-0800					
0800-0900					
0900-1000					
1000-1100	1	54.75			
1100-1200					
1200-1300					
1300-1400					
1400-1500					
1500-1600					
1600-1700					
1700-1800					
1800-1900					
1900-2000					
2000-2100					
2100-2200					
2200-2300					
2300-2400					
SUMMARY	18	58.59	1		35.30
LIMITS		40.00			34.00

RLS1536687

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 10/14/1994
CURRENT TIME : 00:00:11

DAILY EMISSIONS REPORT FOR
DATE : 10/13/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000	1	60.22		
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	60.22		
LIMITS		40.00		34.00

RLS1536688

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 10/19/1994
CURRENT TIME : 00:00:11

DAILY EMISSIONS REPORT FOR
DATE : 10/18/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG	OPACITY INDEX INDEX
0000-0100					
0100-0200					
0200-0300					
0300-0400					
0400-0500					
0500-0600					
0600-0700					
0700-0800					
0800-0900					
0900-1000					
1000-1100					
1100-1200					
1200-1300	9	83.82			
1300-1400	10	81.13	1		40.09
1400-1500					
1500-1600					
1600-1700					
1700-1800					
1800-1900					
1900-2000					
2000-2100					
2100-2200					
2200-2300					
2300-2400					
SUMMARY	19	82.50	1		40.09
LIMITS		40.00			34.00

RLS1536689

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 10/20/1994
CURRENT TIME : 00:00:12

DAILY EMISSIONS REPORT FOR
DATE : 10/19/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCURSIONS	OPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700	1	71.51		
0700-0800	6	82.81		
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	7	77.06		
LIMITS		40.00		34.00

RLS1536690

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 11/12/1994
CURRENT TIME : 00:00:15

DAILY EMISSIONS REPORT FOR
DATE : 11/11/1994

TIME	OPACITY # OF 6 MIN HIGH	OPACITY AVG%	(illegible) # OF EXCEEDENCES	(illegible) AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000		10.50		
1000-1100		01.00		
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	0	02.07		
(illegible)		10.00		00.00

PLANT : YATES
UNIT : 1-3
CURRENT DATE : 11/14/1994
CURRENT TIME : 00:00:15

DAILY EMISSIONS REPORT FOR
DATE : 11/13/1994

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 11/28/1994
CURRENT TIME : 11:45:23

DEMAND FOR DAILY EMISSIONS REPORT FOR
DATE : 11/27/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000	3	71.34		
1000-1100	10	72.99		
1100-1200	10	77.07	1	45.48
1200-1300	10	82.60		
1300-1400	5	53.85		
1400-1500				
1500-1600			1	40.11
1600-1700				
1700-1800				
1800-1900				
1900-2000	2	46.60		
2000-2100				
2100-2200				
2200-2300				
2300-2400	1	55.41		
SUMMARY	41	65.69	2	42.79
LIMITS		40.00		34.00

RLS1536693

PLANT: YATEB
UNIT : 1-3
CURRENT DATE : 11/29/1994
CURRENT TIME : 00:00:15

DAILY EMISSIONS REPORT FOR
DATE : 11/28/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVG%	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
0000-0100	1	54.64		
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900				
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	54.64		
LIMITS		40.00		34.00

RLS1536694

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 12/01/1994
CURRENT TIME : 00:00:13

DAILY EMISSIONS REPORT FOR
DATE : 11/30/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVGS	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
0000-0100				
0100-0200				
0200-0300				
0300-0400				
0400-0500				
0500-0600				
0600-0700				
0700-0800				
0800-0900	1	46.16		
0900-1000				
1000-1100				
1100-1200				
1200-1300				
1300-1400				
1400-1500				
1500-1600				
1600-1700				
1700-1800				
1800-1900				
1900-2000				
2000-2100				
2100-2200				
2200-2300				
2300-2400				
SUMMARY	1	46.16		
LIMITS		40.00		34.00

RLS1536695

PLANT: YATES
UNIT : 1-3
CURRENT DATE : 12/17/1994
CURRENT TIME : 00:00:10

DAILY EMISSIONS REPORT FOR
DATE : 12/16/1994

TIME	OPACITY # OF 6 MIN ALM	OPACITY AVGS	OPACITY INDEX # OF EXCESSES	OPACITY INDEX AVG INDEX
00000-01000				
01000-02000				
02000-03000				
03000-04000				
04000-05000				
05000-06000				
06000-07000				
07000-08000				
08000-09000	1	01.63		
09000-10000				
10000-11000				
11000-12000				
12000-13000				
13000-14000				
14000-15000				
15000-16000				
16000-17000				
17000-18000				
18000-19000				
19000-20000				
20000-21000				
21000-22000				
22000-23000				
23000-24000				
SUMMARY	1	01.63		
LIMITS		40.00		34.00

RLS1536696

Appendix B

Quarterly Operational Monitoring Report for the Fourth Quarter of 1994

QUARTERLY OPERATION MONITORING REPORT

Georgia Power Company
Plant Yates
P.O. Box 718
Newnan, Georgia 30264

From 10-01-94
To: 12-31-94

Permit Number: GA0001473

Discharge Location: 01A - Condenser Cooling Water Units 1-5
Frequency of Analysis: 1/wk

Location	Intake	Mixing Zone	N/A	Condenser	Condenser
Type Sample	In. Situ.	In. Situ.	T	Grab	Grab
Frequency	1/Wk	1/Wk	1/Wk		
Parameter	Temp. ^{O}F	Temp. ^{O}F	Temp. ^{O}F	TRC mg/L	Time of TRC Release
PCS Code	*00011*	*00011*	*00018*	*50060*	*81400*
Limits	N/A	Max.90	Max. 5	Inst. Max. 0.2	Max. 120 Min.

DATE				Note	Note
10-06-94	67	68	1		
10-13-94	61	61	0		
10-18-94	63	63	0		
10-24-94	66	67	1		
11-02-94	61	61	0		
11-07-94	65	65	0		
11-14-94	61	61	0		
11-22-94	62	64	2		
11-30-94	54	55	1		
12-06-94	60	60	0		
12-15-94	54	54	0		
12-19-94	54	54	0		
12-28-94	51	52	1		
Note: No chlorination were performed on discharge 01A this quarter.					
Month of: October					
No. of Samples	4	4	4		
Average Value	64	65	.5		
Max. Value	67	68	1		
Min. Value	61	61	0		
Limits Exceeded	0	0	0		
Month of: November					
No. of Samples	5	5	5		
Average Value	61	61	.6		
Max. Value	65	65	2		
Min. Value	54	55	0		
Limits Exceeded	0	0	0		
Month of: December					
No. of Samples	4	4	4		
Average Value	55	55	.25		
Max. Value	60	60	1		
Min. Value	51	52	0		
Limits Exceeded	*0*	*0*	0		

RLS1531769

QUARTERLY OPERATION MONITORING REPORT

Georgia Power Company
Plant Yates
P.O. Box 718
Newnan, Georgia 30264

From: 10-01-94
To: 12-31-94

Permit Number: GA000147

Discharge Location: 01B - Ash Transport Water

Location	Ash Transport Water	Ash Transport Water	Final Discharge
Type Sample	Grab	Grab	Grab
Frequency	2/Month	2/Month	2/Month
Parameter	Suspended Solids (mg/L)	Oil & Grease (mg/L)	PH (PH Units)
PCS Code	00530	00556	00400
Limits	Avg. 30 Max 100	Avg.15 Max 20	Min. 6.0 Max. 9.0
DATE			
10-03-94	3	0	6.87
10-17-94	2	0	7.01
11-07-94	2	0	6.60
11-21-94	10	0	6.74
12-05-94	5	0	6.88
12-19-94	0	0	7.19
Month of: October			
No. of Samples	2	2	2
Average Value	2.5	0	
Max. Value	3	0	7.01
Min. Value	2	0	6.87
Limits Exceeded	0	0	0
Month of: November			
No. of Samples	2	2	2
Average Value	6	0	
Max. Value	10	0	6.74
Min. Value	2	0	6.60
Limits Exceeded	0	0	0
Month of: December			
No. of Samples	2	2	2
Average Value	2.5	0	
Max. Value	5	0	7.19
Min. Value	0	0	6.88
Limits Exceeded	0	0	0

RLS1531772

QUARTERLY OPERATION MONITORING REPORT

Georgia Power Company
Plant Yates
P.O. Box 718
Newnan, Georgia 30264

From: 10-01-94
To: 12-31-94

Permit Number: GA0001473

There were no discharges from the following outfalls during the quarter covered by this report:

01L	Building Sump Overflow
01M	Building Sump Overflow
01N	Building Sump Overflow
02	Ash Pond Emergency Overflow
04	Low Volume Waste Sump
05	Coal Pile Runoff Emergency Overflow

"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 on 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."

M. J. Knowles
Plant Manager

Attachment

RLS1531773

Appendix C

Groundwater Monitoring Report for the Third Quarter of 1994

RCN 218-070-07-20

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

Plant Yates

Environmental Monitoring Program Report: Groundwater Monitoring for the Third Quarter of 1994

(Final)

DOE DE-FC22-90PC89650
SCS C-90-002284

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Cleared by DOE Patent Counsel on September 19, 1995.

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1.0 Introduction

This report summarizes the results of groundwater monitoring performed during the third calendar quarter of 1994 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 environmental 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.

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 areas are lined with synthetic liners to minimize the

potential for adverse impacts on the groundwater. Requirements for the liners, 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, which is performed on a quarterly basis, was initiated in the fourth quarter of 1992. Monitoring is conducted for the suite of parameters shown previously in Table 1. Samples are analyzed each quarter for all parameters shown except for radionuclides, which are monitored semiannually. Beginning in the second quarter of 1994, monitoring is also being performed quarterly for total organic halides (TOX) and annually for volatile organics (VOCs). These parameters have been added at the request of the Environmental Protection Division of the DNR.

1.3 Report Contents

This report presents the results of quarterly operational-phase groundwater monitoring for the third calendar quarter of 1994. The groundwater monitoring wells were sampled on August 31, 1994.

Table 3. Sample Containers, Preservation Method, 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
Total Organic Halogens	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.

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 third-quarter 1994 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.

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 in detail. The representative species selected are those present in appreciable concentrations in the gypsum slurry, including the major cations and anions (i.e., calcium, magnesium, chlorine, 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. Concentrations of several selected species are shown as functions of time in Figures 2 through 4. 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 either the upgradient well, GWA-1 or downgradient well GWC-6. Well GWC-6 has been nonproductive since groundwater monitoring began. Well GWA-1 has been nonproductive for four straight quarters.

For well GWC-2, the measured concentrations for all monitored parameters were generally close to the historically observed concentrations of these species. For well GWC-4, the trend of increasing concentrations of chloride, magnesium, and calcium that began in the 4th quarter of 1993 continued this quarter. The observed increases may be due to the continuing effects of a breach in the gypsum pond dike that occurred on July 24, 1993, in the vicinity of this well. The contaminant levels in the groundwater at this location are still very low. For example, the latest chloride concentration is still less than 1/10th the maximum concentration recommended in the National Secondary Drinking Water Standards (i.e., 20.8 mg/L vs. 250 mg/L).

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
Total Organic Halogens	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; and
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 Material, *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 August 31, 1994 (Third Quarter 1994)

Parameter	GWA-1-15-1[a]	GWC-1-15-1	GWC-2-15-1	GWC-3-15-1	GWC-4-15-1	GWC-5-15-1
pH		6.09	5.63	5.41	5.10	5.53
Conductivity (µS/cm)		68	60	30	108	43
Temperature (°C)		18.0	18.4	19.0	18.1	18.4
Eh (mV)		365	350	305	440	372
Alkalinity (mg/L $CaCO_3$)		25	7	77[d]	5	13
Total Dissolved Solids (mg/L)		64	60	39[c]	93	61
Bromide (mg/L)		<0.0226	<0.0226	<0.0226	<0.0226	<0.0226
Chloride (mg/L)		2.71	3.92	2.91	20.8	2.67
Total Organic Carbon (mg/L)		<0.357	<0.357	<0.357	1.42[c]	<0.357
Total Organic Halogens (µg/L)		<11.7	<11.7	<11.7	12.7[c]	11.9[c]
Fluoride (mg/L)		0.0596[b]	0.0402[b]	0.0424[b]	0.0334[b]	0.0284[b]
Nitrate-Nitrite (mg/L as N)		0.459[b]	0.810[b]	0.366[b]	1.80[b]	0.167[b]
Sulfate (mg/L)		1.64	6.73	<0.0471	4.83	6.68
Radium 226 and 228 (pCi/L)		0.12 ± 0.048 -0.56 ± 0.68	0.14 ± 0.052 -0.83 ± 0.72	0.10 ± 0.046 -0.091 ± 0.70	0.12 ± 0.055 0.92 ± 0.89	0.10 ± 0.046 0.23 ± 0.72
Gross Alpha (pCi/L)		0.64 ± 0.51	-0.13 ± 0.33	0.08 ± 0.30	0.14 ± 0.36	1.9 ± 0.7
Gross Beta (pCi/L)		1.8 ± 0.8	1.5 ±0.7	1.2 ± 0.7	0.67 ± 0.72	3.6 ± 0.9
Gross Gamma (pCi/L)						
Ac-227		NR	NR	NR	NR	NR
Ac-228		NR	NR	NR	NR	NR
Bi-212		<110	<90	<92	<100	<110
Bi-214		57 ± 32	52 ± 28	50 ± 34	77 ± 32	<37
Co-60		<10	<12	<16	<13	<15
Cs-134		<14	<11	<15	<12	<16
Cs-137		<13	<12	<13	<14	<13
K-40		<170	<120	<220	<210	<210

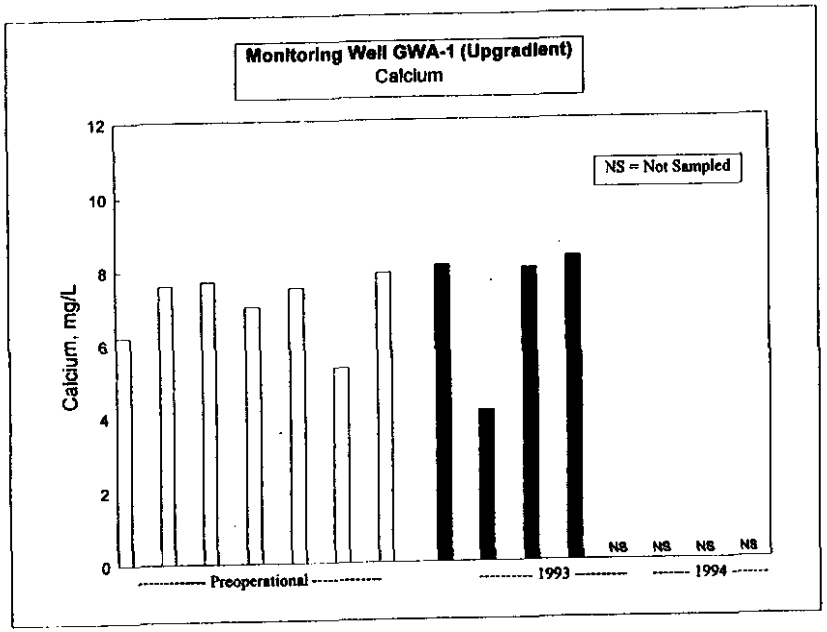
Table 5 (continued)

Parameter	GWA-1-15-1[a]	GWC-1-15-1	GWC-2-15-1	GWC-3-15-1	GWC-4-15-1	GWC-5-15-1
Pb-211		NR	NR	NR	NR	NR
Pb-212		<20	<15	<19	<21	<19
Pb-214		86 ± 27	57 ± 23	33 ± 27	68 ± 30	<33
Ra-223		<62	<54	<61	<67	<64
Ra-226		<290	<230	<280	<270	<290
Rn-219		<81	<63	<87	<83	<77
Th-227		<78	<61	<74	<77	<78
Th-228		<560	<840	<940	<1100	<940
Th-231		<100	<160	<170	<200	<180
Th-234		<390	<400	<480	<460	<430
Tl-208		<35	<38	<35	<47	<44
U-235		<9.9	<13	<16	<16	<18
U-238		NR	NR	NR	NR	NR
Silver (mg/L)		<0.00519	<0.00519	<0.00519	<0.00519	<0.00519
Aluminum (mg/L)		<0.0523	<0.0523	<0.0523	<0.0523	<0.0523
Arsenic (mg/L)		<0.00214	<0.00214	<0.00214	<0.00214	<0.00214
Boron (mg/L)		<0.0176	<0.0176	<0.0176	0.0361[c]	<0.0176
Barium (mg/L)		0.00909	0.00952	0.00693	0.0178	0.00693
Beryllium (mg/L)		<0.00051	<0.00051	<0.00051	<0.00051	<0.00051
Bismuth (mg/L)		<0.0132	<0.0132	<0.0132	<0.0132	<0.0132
Calcium (mg/L)		5.00[b]	2.11[b]	0.328[b]	2.73[b]	1.26[b]
Cadmium (mg/L)		0.00533[c]	<0.00386	<0.00386	<0.00386	<0.00386
Cobalt (mg/L)		<0.00407	<0.00407	<0.00407	<0.00407	<0.00407
Copper (mg/L)		<0.00916	<0.00916	<0.00916	<0.00916	<0.00916
Chromium (mg/L)		<0.00524	0.0102[c]	0.00653[c]	<0.00524	0.00562[c]
Mercury (mg/L)		<0.000033	<0.000033	<0.000033	<0.000033	<0.000033

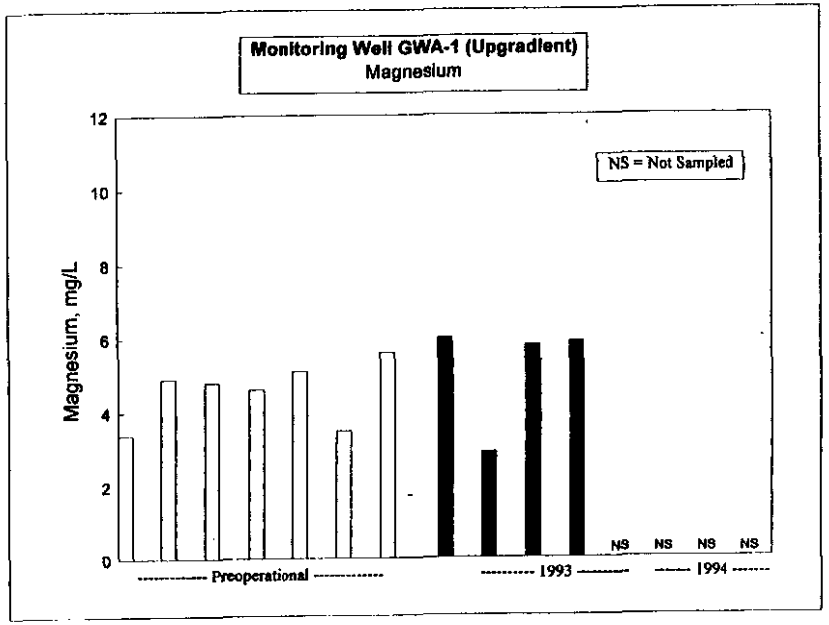
Table 5 (continued)

Parameter	GWA-1-15-1[a]	GWC-1-15-1	GWC-2-15-1	GWC-3-15-1	GWC-4-15-1	GWC-5-15-1
Iron (mg/L)		0.0203[c]	0.0125[c]	<0.00452	0.0126[c]	0.0419
Potassium (mg/L)		<0.822	<0.822	<0.822	<0.822	<0.822
Lithium (mg/L)		<0.00543	<0.00543	<0.00543	<0.00543	<0.00543
Magnesium (mg/L)		3.70	2.03	1.00	7.32	1.46
Manganese (mg/L)		<0.00155	0.0102	0.00289[c]	0.194	0.00436[c]
Molybdenum (mg/L)		<0.00739	<0.00739	<0.00739	<0.00739	<0.00739
Sodium (mg/L)		4.32	7.17	4.17	5.80	5.38
Nickel (mg/L)		<0.0141	0.0455[c]	<0.0141	<0.0141	<0.0141
Phosphorus (mg/L)		<0.0610	<0.0610	<0.0610	<0.0610	<0.0610
Lead (mg/L)		<0.00205	<0.00205	0.0140	<0.00205	<0.00205
Sulfur (mg/L)		0.344[c]	2.18	<0.175	1.38	2.29
Antimony (mg/L)		<0.00146	<0.00146	<0.00146	<0.00146	<0.00146
Selenium (mg/L)		<0.000592	0.00242[c]	<0.000592	0.000930[c]	0.000650[c]
Silicon (mg/L)		11.8	12.9	9.15	9.91	10.5
Tin (mg/L)		<0.0145	0.0146[c]	<0.0145	<0.0145	0.0146[c]
Strontium (mg/L)		0.0157	0.0124	0.00286[c]	0.0210	0.0114
Tellurium (mg/L)		<0.0317	<0.0317	0.0405[c]	<0.0317	<0.0317
Titanium (mg/L)		<0.00159	<0.00159	0.00164[c]	0.00188[c]	<0.00159
Thallium (mg/L)		<0.00185	<0.00185	<0.00185	<0.00185	<0.00185
Uranium (mg/L)		<0.199	<0.199	<0.199	<0.199	<0.199
Vanadium (mg/L)		<0.00454	<0.00454	<0.00454	<0.00454	<0.00454
Tungsten (mg/L)		<0.0408	<0.0408	<0.0408	<0.0408	<0.0408
Zinc (mg/L)		0.0111[c]	0.0137[c]	0.00569[c]	0.0134[c]	0.0138[c]

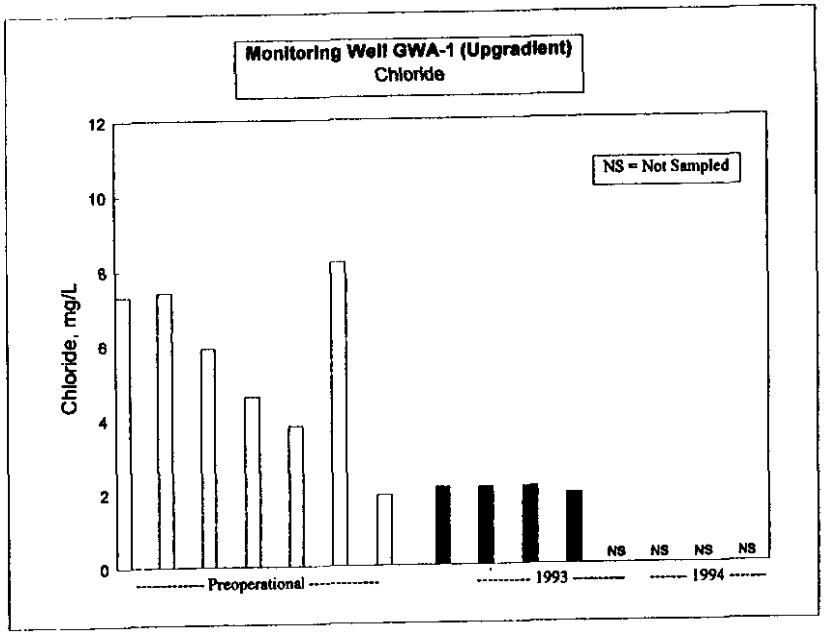
[a] Well was dry; no samples collected.
[b] Detected in the method blank.
[c] Less than five times the detection limit; results are expected to be less accurate as concentrations approach the detection limit.
[d] Result is questionable; concentration of reagent used in titration is unclear.
NR = Not reported.



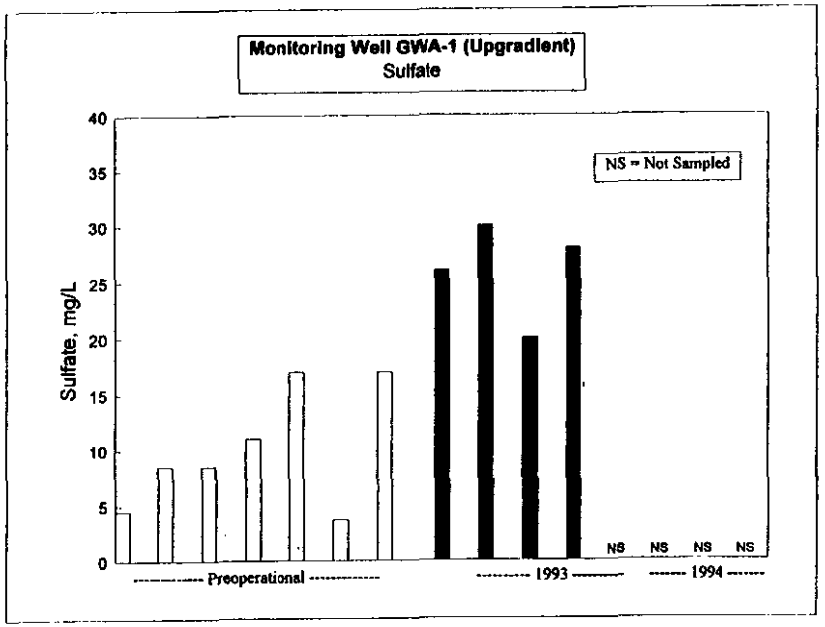
(a) Calcium



(b) Magnesium

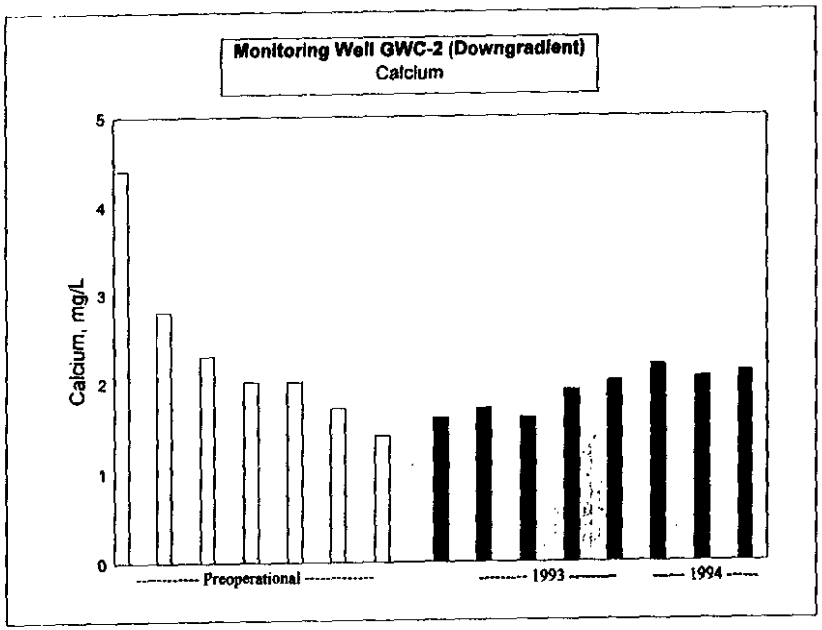


(c) Chloride

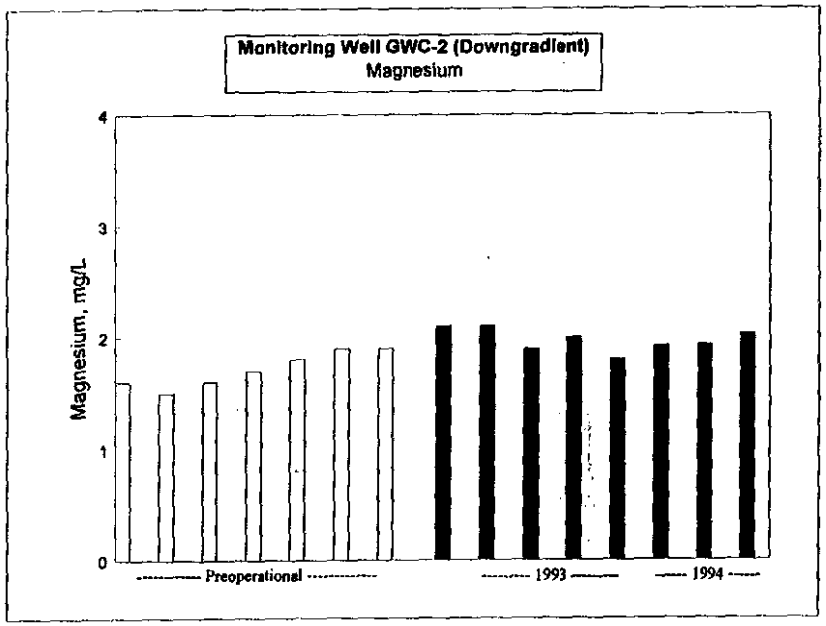


(d) Sulfate

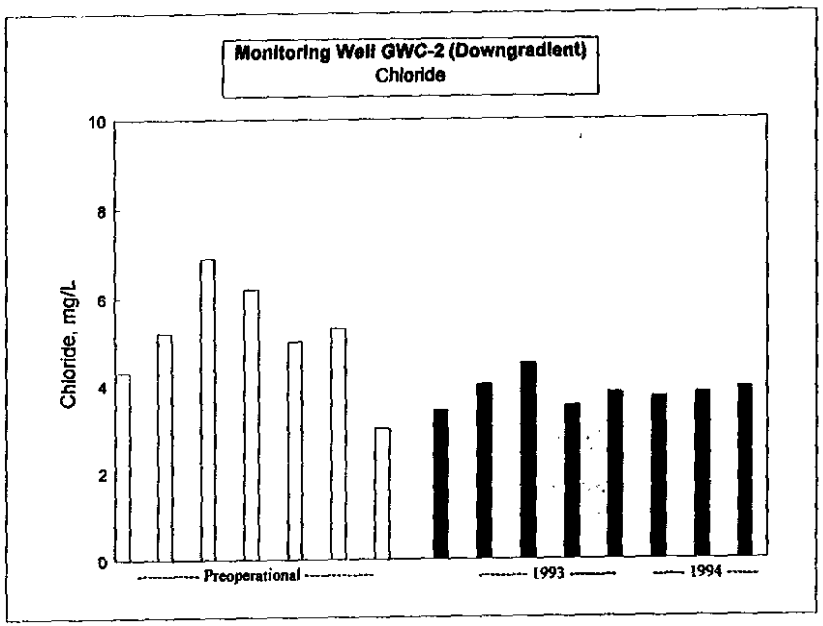
Figure 2. Historical Data for Representative Species from Well GWA-1 (Upgradient)



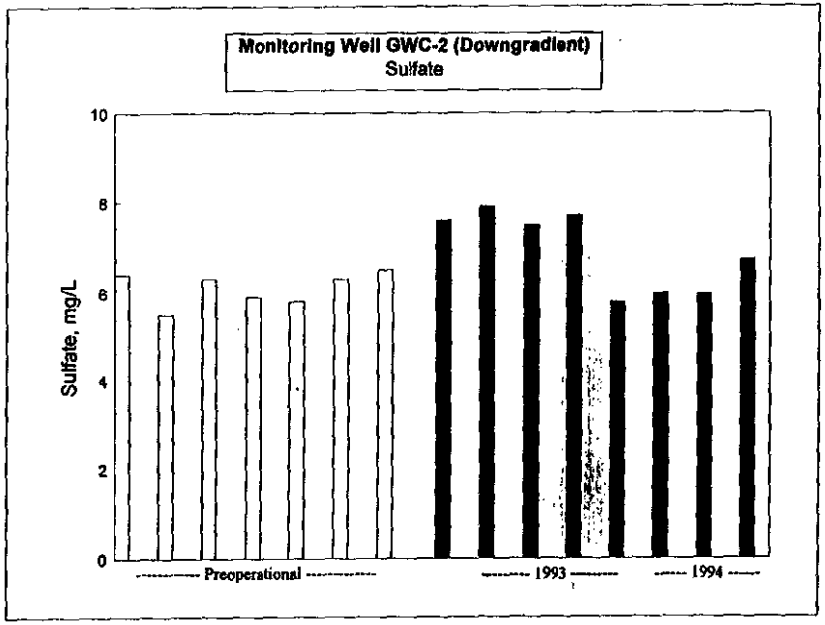
(a) Calcium



(b) Magnesium

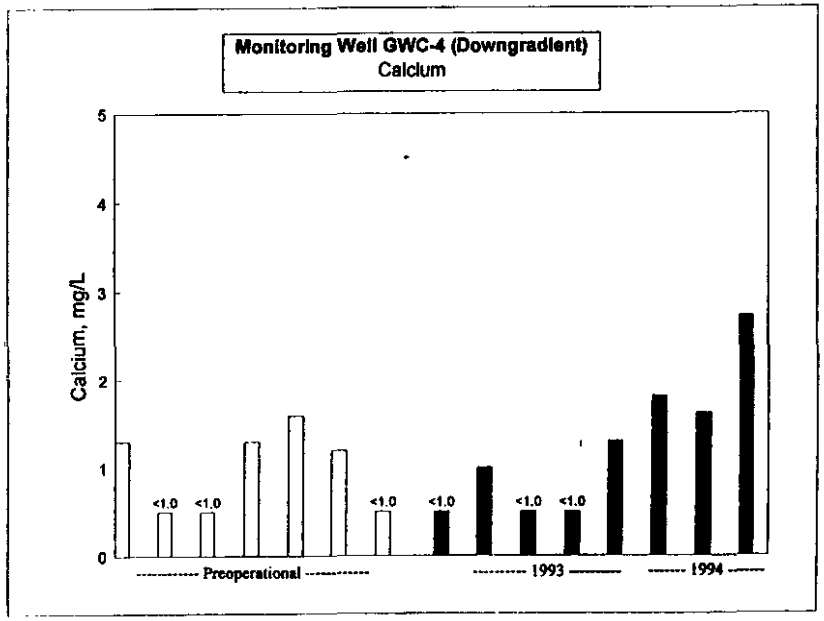


(c) Chloride

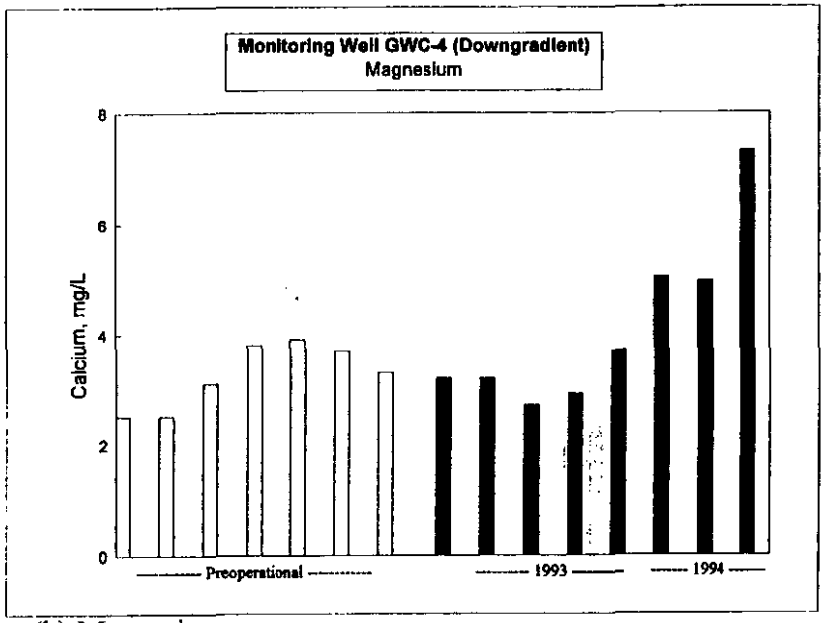


(d) Sulfate

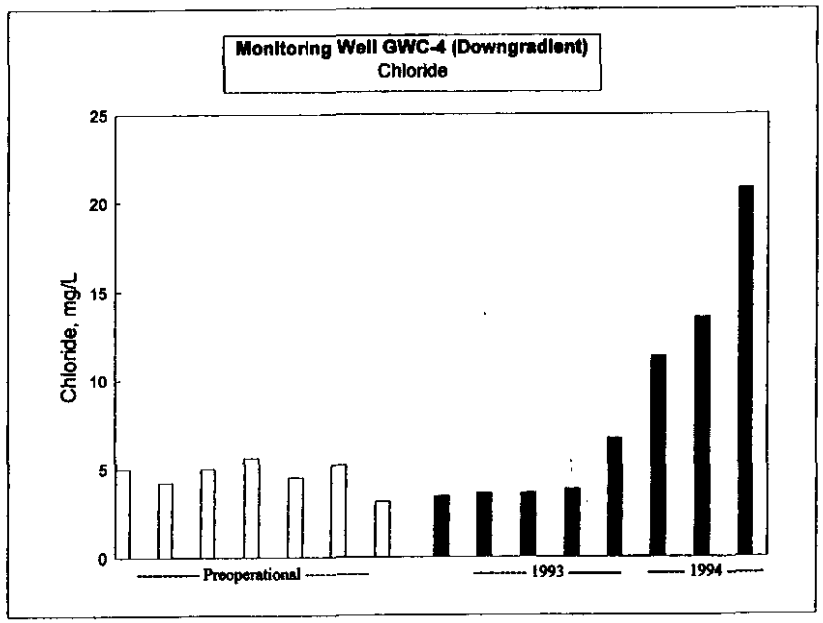
Figure 3. Historical Data for Representative Species from Well GWC-2 (Downgradient)



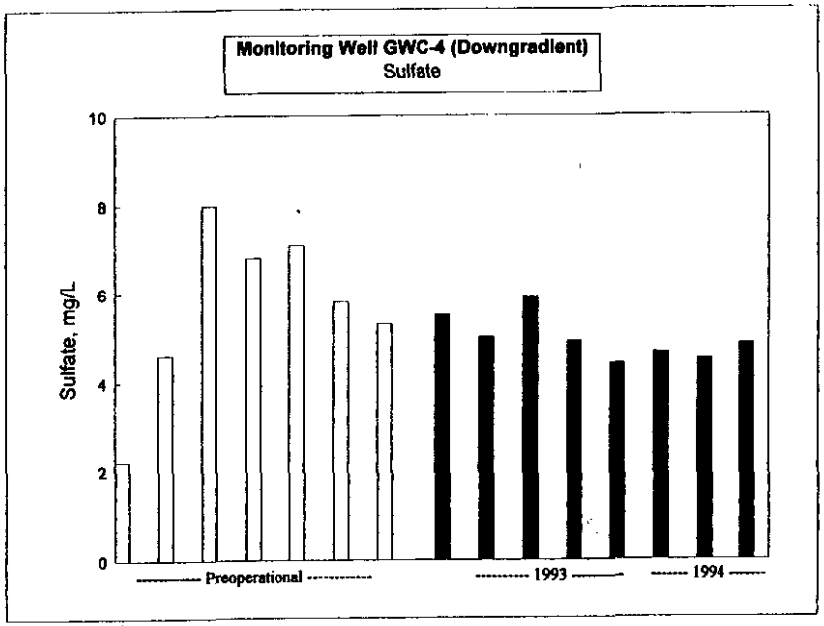
(a) Calcium



(b) Magnesium



(c) Chloride



(d) Sulfate

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

4.0 Summary of QA/QC Activities

A number of QA/QC activities are being performed, as specified in the project's EMP, to ensure that the data collected 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 Section 2. There were no deviations from the specified methods during this quarter's monitoring effort.

- Chain-of-custody procedures established in the test plan for this project 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. Specified recovery limits (typically 80 to 120%) were met for all analytes in the laboratory control samples and matrix spikes.

- 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 duplicate samples are summarized in Table 6 for those parameters measured above the detection limit. Complete results are provided in Appendix B. Differences in the duplicate analyses results were small for most species (i.e., less than 10%). For nitrate-nitrite and calcium, the percentage differences between the sample and the field duplicate were -32% and 64%, respectively, but both analytes were detected in method blanks. For strontium and zinc, the percentage differences between the sample and the field duplicate were 50% and 190%, respectively, but for both analytes the results were less than five times the method detection limit, where less accurate results can be expected. For barium the result for the field duplicate was about an order of magnitude higher than the result for the sample, making the results for this analyte somewhat suspect.

Table 6. Results for Duplicate Samples—3rd Quarter 1994

Parameter	Units	Sample GWC-3-15-1	Field Duplicate GWC-3-15-2	% Diff.[a]	Duplicate Analysis GWC-3-15-2	% RPD[b]	Spec. Limit
Total Dissolved Solids	mg/L	39.0	42.0	7.7	40.0	4.9	15
Chloride	mg/L	2.91	2.82	-3.1	2.82	0.0	20
Fluoride	mg/L	0.0424[c]	0.0390[c]	-8.0			
Nitrate-Nitrite as N	mg/L	0.366[c]	0.249[c]	-32	0.256[c]	2.6	20
Total Organic Halides	µg/L	<11.7	15.1[d]	NC	12.0[d]	23	20
Aluminum	mg/L	<0.0523	0.147[d]	NC			
Barium	mg/L	0.00693	0.0715	930			
Calcium	mg/L	0.328[c]	0.539[c]	64			
Copper	mg/L	<0.00916	<0.00916	NC			
Iron	mg/L	<0.00452	0.227	NC			
Magnesium	mg/L	1.00	1.07	7.0			
Manganese	mg/L	0.00289[d]	0.00300[d]	3.8			
Sodium	mg/L	4.17	4.61	11			
Lead	mg/L	0.0140	<0.00205	NC			
Silicon	mg/L	9.15	9.53	4.2			
Strontium	mg/L	0.00286[d]	0.00429[d]	50			
Tellurium	mg/L	0.0405[d]	<0.0317	NC			
Titanium	mg/L	0.00164[d]	0.00166[d]	1.2			
Zinc	mg/L	0.00569[d]	0.0166[d]	190			

[a] % Difference = (GWC-3-15-2 - GWC-3-15-1)/GWC-3-15-1 x 100%

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

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

[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.

Appendix A

Historical Monitoring Data for Selected Parameters

Table A-1. Historical Monitoring Data for Selected Parameters

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	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
Well: GWA-1 (Formerly CW-1)											
pH	5.86	6.27	5.6	6.7	6.05	5.94	6.4	5.7	6.82	6.1	5.9
Conductivity	98	114	112	121	104	85	116	101	128	100	110
Alkalinity	15.6	22.3	25.8	27.1	25	16.4	35.4	22.7	28	27	24.8
TDS	94	87	86	84	90	77	99	110	110	116	99
Chloride	7.3	7.4	5.9	4.6	3.8	8.2	1.9	2.1	2.1	2.1	1.9
Sulfate	4.5	8.5	8.5	11	17	3.7	17	26	30	20	28
Calcium	6.2	7.6	7.7	7	7.5	5.3	7.9	8.1	4.1	8.0	8.3
Magnesium	3.4	4.9	4.8	4.6	5.1	3.5	5.6	6.0	2.9	5.8	5.9
Sodium	4.2	4.8	4.9	4.3	4.4	3.8	4.1	4.2	4.0	4.4	4.3
Silicon	9.8	11	14	16	17	9.6	15	17	11	18	17

Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94	Round 14 21-22 Jun 94	Round 15 31 Aug 94							
Well: GWA-1 (Formerly CW-1) (Continued)											
pH	NS	NS	NS	NS							
Conductivity	NS	NS	NS	NS							
Alkalinity	NS	NS	NS	NS							
TDS	NS	NS	NS	NS							
Chloride	NS	NS	NS	NS							
Sulfate	NS	NS	NS	NS							
Calcium	NS	NS	NS	NS							
Magnesium	NS	NS	NS	NS							
Sodium	NS	NS	NS	NS							
Silicon	NS	NS	NS	NS							

Table A-1 (continued)

Parameter	Baseline Monitoring							Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
	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: GWC-1 (Formerly CW-2)											
pH	6.09	5.79	5.62	5.93	6.04	5.96	6.1	4.5	5.83	6.0	6.0
Conductivity	81	70	72	63	63	66	78	57	67	57	61
Alkalinity	21.7	22.9	24.4	22.1	20.5	25.8	27.8	23.3	22.5	24.1	27.3
TDS	81	51	59	52	48	64	64	68	43	74	70
Chloride	3.5	2.8	3.1	3.4	2.8	2.5	2.5	2.6	2.6	2.6	2.5
Sulfate	7.6	5	2.8	<0.05	1.2	1.5	3.2	3.3	2.2	<2.5	2.6
Calcium	3.9	3.6	3.8	3.2	3.4	3.6	4.3	4.0	8.8	4.1	4.1
Magnesium	2.3	2.5	2.8	2.2	2.4	2.5	3.2	3.0	6.2	2.9	3.0
Sodium	5.9	5.2	4.3	4.1	4.2	4.1	4.0	4.0	4.2	4.0	3.8
Silicon	9	9	9.2	11	11	11	11	12	16	12	12

Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94	Round 14 21-22 Jun 94	Round 15 31 Aug 94							
Well: GWC-1 (Formerly CW-2) (Continued)											
pH	6.1	5.89	5.91	6.09							
Conductivity	74	61	60	68							
Alkalinity	29.9	25	30.1	25							
TDS	22	66	56	64							
Chloride	3.5	2.43	2.77	2.71							
Sulfate	3.3	1.75	1.77	1.64							
Calcium	5.1	4.72	4.65	5.00							
Magnesium	3.7	3.14	3.39	3.70							
Sodium	4.3	4.12	4.16	4.32							
Silicon	12.7	11.9	11.9	11.8							

Table A-1 (continued)

Parameter	Baseline Monitoring							Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
	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: GWC-2 (Formerly CW-3)											
pH	5.64	5.6	5.04	5.5	4.97	5.65	5.5	4.6	5.29	5.4	5.6
Conductivity	76	69	64	66	33	71	66	56	67	56	49
Alkalinity	23.5	19.3	15.2	16.9	12.2	17.5	18.2	17.3	12.5	14.1	15.9
TDS	76	50	55	55	63	65	79	71	68	77	60
Chloride	4.3	5.2	6.9	6.2	5	5.3	3.0	3.4	4.0	4.5	3.5
Sulfate	6.4	5.5	6.3	5.9	5.8	6.3	6.5	7.6	7.9	7.5	7.7
Calcium	4.4	2.8	2.3	2	2	1.7	1.4	1.6	1.7	1.6	1.9
Magnesium	1.6	1.5	1.6	1.7	1.8	1.9	1.9	2.1	2.1	1.9	2.0
Sodium	7.3	7.4	6.9	7	7.5	7.6	7.5	7.4	7.5	6.7	6.8
Silicon	10	10	9.3	12	11	11	11	13	12.0	11	13
Parameter	**Round 12 5 Jan 94**	**Round 13 22-23 Mar 94**	**Round 14 21-22 Jun 94**	**Round 15 31 Aug 94**							
Well: GWC-2 (Formerly CW-3) (Continued)											
pH	5.75	5.5	5.72	5.63							
Conductivity	53	57	59	60							
Alkalinity	15.7	14	16.2	7.0							
TDS	27	76	58	60							
Chloride	3.8	3.7	3.79	3.92							
Sulfate	5.78	5.97	5.95	6.73							
Calcium	2.0	2.19	2.05	2.11							
Magnesium	1.8	1.92	1.93	2.03							
Sodium	7.0	7.15	7.09	7.17							
Silicon	12.9	13.3	13.0	12.9							

Table A-1 (continued)

Parameter	Baseline Monitoring							Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
	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: GWC-3 (Formerly CW-4)											
pH	5.4	5.15	4.8	4.73	6.19	5.08	5.25	3.8	5.23	5.2	5.3
Conductivity	40	35	30	34	32	35	32	27	33	27	27
Alkalinity	11.5	15.2	9.9	11	7	11.1	10.0	8.9	7.0	8.5	9.1
TDS	50	35	31	34	39	41	28	37	44	52	21
Chloride	3	2.8	3.2	3.4	3.1	3.1	2.0	2.3	2.7	2.9	2.8
Sulfate	2.6	2.1	<0.05	<0.05	0.9	1.5	1.7	2.6	1.6	<2.5	<2.5
Calcium	1	<1.0	<1.0	<1.0	<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	<1.0	<1.0	<1.0
Sodium	4.4	4.5	4.3	4.1	4.6	4.3	4.1	4.0	4.1	3.9	3.8
Silicon	8	7.8	3.9	8.5	8.6	8.3	8.3	9.3	9.0	8.7	9.2

Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94	Round 14 21-22 Jun 94	Round 15 31 Aug 94							
Well: GWC-3 (Formerly CW-4)											
pH	5.5	5.18	5.43	5.41							
Conductivity	22	28	29	30							
Alkalinity	9.3	7.5	8.5	77							
TDS	<8.7	42	36	39							
Chloride	2.8	2.77	2.76	2.91							
Sulfate	<0.06	1.38	1.52	<0.0471							
Calcium	<1.0	0.392	0.321	0.328							
Magnesium	<1.0	0.962	0.935	1.00							
Sodium	4.1	4.35	4.14	4.17							
Silicon	9.7	10.1	9.16	9.15							

Table A-1 (continued)

Parameter	Baseline Monitoring							Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
	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: GWC-4 (Formerly CW-5)											
pH	5.34	4.97	4.8	4.6	5.03	5.4	5.05	3.9	5.04	5.2	5.2
Conductivity	62	62	66	72	54	70	72	58	64	52	54
Alkalinity	12.5	15.3	13.1	15.1	8.6	14.2	11.5	8.0	6.0	6.9	7.0
TDS	61	52	60	51	58	64	61	65	63	55	44
Chloride	5	4.2	5	5.6	4.5	5.2	3.1	3.4	3.6	3.6	3.8
Sulfate	2.2	4.6	8	6.8	7.1	5.8	5.3	5.5	5.0	5.9	4.9
Calcium	1.3	<1.0	<1.0	1.3	1.6	1.2	<1.0	<1.0	1.0	<1.0	<1.0
Magnesium	2.5	2.5	3.1	3.8	3.9	3.7	3.3	3.2	3.2	2.7	2.9
Sodium	5.4	5.8	5.3	5.1	5	5.2	4.8	4.9	4.7	4.4	4.4
Silicon	9.9	9.1	4.7	9.7	9.2	10	8.6	9.5	8.7	8.3	9.3

Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94	Round 14 21-22 Jun 94	Round 15 31 Aug 94							
Well: GWC-4 (Formerly CW-5) (Continued)											
pH	5.2	4.98	5.2	5.10							
Conductivity	63	72	81	108							
Alkalinity	9.2	5.0	10.3	5.0							
TDS	20	64	75	93							
Chloride	6.7	11.3	13.5	20.8							
Sulfate	4.4	4.64	4.50	4.83							
Calcium	1.3	1.81	1.62	2.73							
Magnesium	3.7	5.05	4.98	7.32							
Sodium	5.0	5.33	4.87	5.80							
Silicon	9.8	9.91	9.18	9.91							

Table A-1 (continued)

Parameter	Baseline Monitoring							Round 8 29-30 Dec 92	Round 9 30-31 Mar 93	Round 10 21 Jun 93	Round 11 23-24 Sep 93
	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: GWC-5											
pH							5.6	4.4	6.13	5.4	5.6
Conductivity							61	60	54	41	40
Alkalinity							14.8	13.5	12.5	10.2	11.5
TDS							91	86	67	56	50
Chloride							1.8	2.6	2.7	2.9	2.5
Sulfate							8.8	10	7.4	6.7	5.5
Calcium							2.1	2.7	2.2	1.6	1.4
Magnesium							1.9	2.3	1.8	1.5	1.4
Sodium							6.0	6.2	5.7	5.5	5.2
Silicon							12	14	13	12	12

Parameter	Round 12 5 Jan 94	Round 13 22-23 Mar 94	Round 14 21-22 Jun 94	Round 15 31 Aug 94							
Well: GWC-5 (Continued)											
pH	7.0	5.38	5.42	5.53							
Conductivity	39	43	45	43							
Alkalinity	10.8	8.6	10.8	13.0							
TDS	29	53	61	61							
Chloride	2.6	2.34	2.48	2.67							
Sulfate	5.3	6.56	7.65	6.68							
Calcium	1.3	1.65	1.38	1.26							
Magnesium	1.3	1.6	1.55	1.46							
Sodium	5.5	5.74	5.77	5.38							
Silicon	11.4	11.8	11.3	10.5							

Appendix B

QA/QC Results

Table B-1. Results for Duplicate Samples—3rd Quarter 1994

Parameter	Units	Sample GWC-3-15-1	Field Duplicate GWC-3-15-2	% Diff.[a]	Duplicate Analysis GWC-3-15-2	% RPD[b]	Spec. Limit
Total Dissolved Solids	mg/L	39.0	42.0	7.7	40.0	4.9	15
Bromide	mg/L	<0.0226	<0.0226	NC	<0.0226	NC	
Chloride	mg/L	2.91	2.82	-3.1	2.82	0.0	20
Fluoride	mg/L	0.0424[c]	0.0390[c]	-8.0			
Total Organic Carbon	mg/L	<0.357	<0.357	NC	<0.357	NC	20
Nitrate-Nitrite as N	mg/L	0.366[c]	0.249[c]	-32	0.256[c]	2.6	20
Sulfate	mg/L	<0.0471	<0.0471	NC	<0.0471	NC	20
Total Organic Halides	µg/L	<11.7	15.1[d]	NC	12.0[d]	23	20
Silver	mg/L	<0.00519	<0.00519	NC			
Aluminum	mg/L	<0.0523	0.147[d]	NC			
Arsenic	mg/L	<0.00214	<0.00214	NC			
Boron	mg/L	<0.0176	<0.0176	NC			
Barium	mg/L	*0.00693*	*0.0715*	*930*			
Beryllium	mg/L	<0.00051	<0.00051	NC			
Bismuth	mg/L	<0.0132	<0.0132	NC			
Calcium	mg/L	0.328[c]	0.539[c]	64			
Cadmium	mg/L	<0.00386	<0.00386	NC			
Cobalt	mg/L	<0.00407	<0.00407	NC			
Copper	mg/L	<0.00916	<0.00916	NC			
Chromium	mg/L	0.00653[d]	<0.00524	NC			
Mercury	mg/L	<0.000033	<0.000033	NC			
Iron	mg/L	<0.00452	0.227	NC			
Potassium	mg/L	<0.822	<0.822	NC			
Lithium	mg/L	<0.00543	<0.00543	NC			
Magnesium	mg/L	1.00	1.07	7.0			
Manganese	mg/L	0.00289[d]	0.00300[d]	3.8			
Molybdenum	mg/L	<0.00739	<0.00739	NC			
Sodium	mg/L	4.17	4.61	11			
Nickel	mg/L	<0.0141	<0.0141	NC			
Phosphorus	mg/L	<0.0610	<0.0610	NC			
Lead	mg/L	0.0140	<0.00205	NC			
Sulfur	mg/L	<0.175	<0.175	NC			
Antimony	mg/L	<0.00146	<0.00146	NC			
Selenium	mg/L	<0.000592	<0.000592	NC			

Table B-1 (continued)

Parameter	Units	Sample GWC-3-15-1	Field Duplicate GWC-3-15-2	% Diff.[a]	Duplicate Analysis GWC-3-15-2	% RPD[b]	Spec. Limit
Silicon	mg/L	9.15	9.53	4.2			
Tin	mg/L	<0.0145	<0.0145	NC			
Strontium	mg/L	0.00286[d]	0.00429[d]	50			
Tellurium	mg/L	0.0405[d]	<0.0317	NC			
Titanium	mg/L	0.00164[d]	0.00166[d]	1.2			
Thallium	mg/L	<0.00185	<0.00185	NC			
Uranium	mg/L	<0.199	<0.199	NC			
Vanadium	mg/L	<0.00454	<0.00454	NC			
Tungsten	mg/L	<0.0408	<0.0408	NC			
Zinc	mg/L	0.00569[d]	0.0166[d]	190			

[a] % Difference = (GWC-3-15-2 - GWC-3-15-1)/GWC-3-15-1 x 100%

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

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

[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.