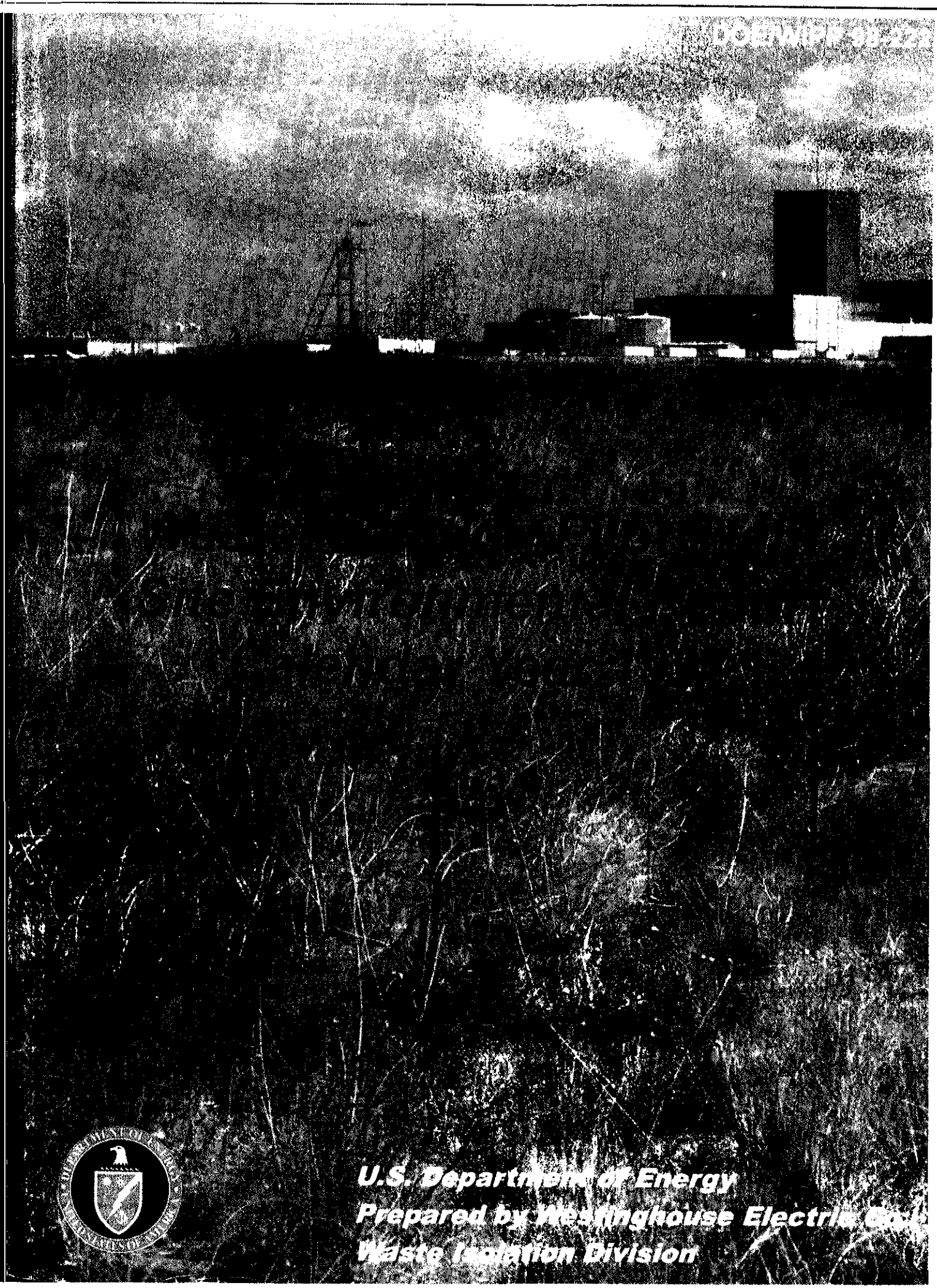


U.S. Department of Energy

Prepared by Westinghouse Electric Corp.

Waste Isolation Division

Printed on Recycled Paper

RECEIVED
NOV 20 1998

PROPERTY OF WIPP LIBRARY

Waste Isolation Pilot Plant

Annual

Site Environmental Report

Calendar Year 1997

DOE/WIPP 98-2225

Issue Date: September 29, 1998

This document has been reproduced directly from the best possible copy. It is available to DOE and DOE contractors at the following addresses:

Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Prices available from (615) 576-8401

Available to the public from the
National Technical Information Services
U.S. Department of Commerce
5285 Port Royal Road
Springfield, Virginia 22161

Processing and final preparation of this report was performed by the Waste Isolation Pilot Plant Management and Operating Contractor for the U.S. Department of Energy under Contract No. DE-AC04-86AL31950.

PREFACE

The 1997 Annual Site Environmental Report (ASER) documents the progress of environmental programs at the U.S. Department of Energy's (DOE) Waste Isolation Pilot Plant (WIPP), which is operated by Westinghouse Electric Company's Waste Isolation Division (WID). Elements of this report were compiled through the cooperative efforts of Environmental Monitoring, Environmental Compliance and Support, RCRA [Resource Conservation and Recovery Act] Permitting, the WIPP laboratory, Quality and Regulatory Assurance, and Document Services personnel. Thanks are due to the Environmental Evaluation Group for their review of the report and constructive comments.

This ASER provides a compilation and summarization of environmental data collected at the WIPP site during calendar year 1997. Comments concerning this report may be made on the enclosed Reader Comment Form. If further information is desired, please write the U.S. Department of Energy, Manager of the Environment, Safety and Health Department, at P.O. Box 3090, Carlsbad, NM 88221-3090.

TABLE OF CONTENTS

LIST OF TABLES iii

LIST OF FIGURES iv

ACRONYMS AND ABBREVIATIONS xi

CHAPTER 1 EXECUTIVE SUMMARY 1-1
1.1 Compliance Summary 1-2
1.1.1 National Environmental Policy Act Annual Mitigation Report 1-2
1.1.2 Superfund Amendments and Reauthorization Act Title III Emergency and Hazardous Chemical Inventory 1-2
1.1.3 New Mexico Air Quality 1-2
1.1.4 Environmental Compliance Assessments 1-3
1.1.5 ISO 14001 Environmental Management Systems 1-3
1.1.6 Voluntary Release Assessment Program at Selected Solid Waste Management Units at WIPP 1-3
1.1.7 Federal Acquisition, Recycling, and Waste Prevention 1-3
1.2 Environmental Monitoring Program Information 1-4
1.2.1 Environmental Monitoring Plan 1-4
1.3 Environmental Radiological Program Information 1-4
1.3.1 Airborne Particulate Sampling 1-5
1.3.2 Soil Sampling 1-5
1.3.3 Groundwater 1-6
1.3.4 Surface Water and Sediment Sampling 1-6
1.3.5 Biotic Sampling 1-7
1.4 Nonradiological Environmental Monitoring Information 1-7
1.4.1 Land Management 1-8
1.4.2 Meteorology 1-8
1.4.3 Wildlife Population Monitoring 1-8
1.4.4 Reclamation of Disturbed Lands 1-9
1.5 Quality Assurance 1-10

CHAPTER 2 INTRODUCTION 2-1
2.1 Description of the WIPP Project 2-1
2.1.1 WIPP Property Areas 2-2
2.1.2 Demographics Within the Affected Environment 2-3

CHAPTER 3 COMPLIANCE SUMMARY 3-1
3.1 Compliance Overview 3-1
3.2 Statutes and Regulations Applicable to WIPP 3-1
3.3 Compliance Status 3-2
3.3.1 Comprehensive Environmental Response, Compensation, and Liability Act 3-2
3.3.2 Federal Acquisition, Recycling, and Pollution Prevention 3-3
3.3.3 Resource Conservation and Recovery Act 3-3
3.3.4 National Environmental Policy Act 3-5
3.3.5 Clean Air Act 3-6
3.3.6 Clean Water Act 3-8
3.3.7 Safe Drinking Water Act 3-9
3.3.8 National Historic Preservation Act 3-10
3.3.9 Hazardous Materials Transportation Act 3-12
3.3.10 Packaging and Transportation of Radioactive Materials 3-13

3.4 Other Significant Accomplishments and Ongoing Compliance Activities . . . 3-14
3.4.1 Environmental Compliance Assessment Program 3-14
3.4.2 Site Environmental Management Program 3-15
3.4.3 ISO 14000 – Standards for Environmental Management 3-15
3.4.4 Pollution Prevention Committee 3-16
3.4.5 Environmental Training 3-17

CHAPTER 4 ENVIRONMENTAL PROGRAM INFORMATION 4-1
4.1 Environmental Monitoring Plan 4-1
4.2 Baseline Data 4-1
4.3 Land Management Programs 4-2
4.3.1 Land Management and Environmental Compliance 4-3
4.3.2 Wildlife Population Monitoring 4-3
4.3.3 Reclamation of Disturbed Lands 4-6
4.3.4 Oil and Gas Surveillance 4-7

CHAPTER 5 ENVIRONMENTAL RADIOLOGICAL ASSESSMENT 5-1
5.1 Airborne Gross Alpha/Beta 5-1
5.2 Airborne Particulate 5-18
5.3 Soil Samples 5-32
5.4 Surface Water 5-43
5.5 Ground Water 5-56
5.6 Sediments 5-56
5.7 Biota 5-68
5.8 Trend Analyses 5-77

CHAPTER 6 ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION 6-1
6.1 Principal Functions of Nonradiological Sampling 6-1
6.2 Meteorology 6-1
6.2.1 Climatic Data 6-1
6.2.2 Wind Direction and Wind Speed 6-2
6.3 Volatile Organic Compounds Monitoring 6-2
6.4 Seismic Activity 6-7
6.5 Liquid Effluent Monitoring 6-7

CHAPTER 7 GROUNDWATER PROTECTION 7-1

CHAPTER 8 QUALITY ASSURANCE 8-1
8.1 Sample Collection Methodologies 8-1
8.2 Revision of Procedures 8-2
8.3 Interlaboratory Comparisons 8-2
8.4 Analytical Laboratory Quality Assurance and Quality Control 8-7
8.5 Data Handling 8-7
8.6 Records Management 8-7

CHAPTER 9 REFERENCES 9-1

APPENDIX A - LOCATION CODES A-1

APPENDIX B - CONCENTRATIONS OF ALPHA AND BETA ACTIVITIES IN AIR PARTICULATE B-1

LIST OF TABLES

TABLE	TITLE	PAGE
3.1	Compliance Status with Major Environmental Regulations Applicable to the WIPP Project	3-18
3.2	DOE Orders Affecting the WIPP Environmental Program	3-20
3.3	Summary of Agreements Between the DOE and the State of New Mexico That Affect the WIPP Environmental Program	3-22
3.4	Active Environmental Permits for the Waste Isolation Pilot Plant	3-24
4.1	Environmental Monitoring Plan Sampling Schedule	4-9
5.1.1	Summary of Gross Alpha and Beta Activities Found in Air Particulate Samples Collected Weekly at Various Locations	5-2
5.1.2	Weight of Air Particulates and Volume of Air - 1st Quarter 1997	5-14
5.1.3	Weight of Air Particulates and Volume of Air - 2nd Quarter 1997	5-15
5.1.4	Weight of Air Particulates and Volume of Air - 3rd Quarter 1997	5-16
5.1.5	Weight of Air Particulates and Volume of Air - 4th Quarter 1997	5-17
5.2.1	Measurement of Radionuclides in Air Particulate	5-22
5.2.2	Measurement of Radionuclides on Duplicate Air Particulate Samples	5-25
5.3.1	Concentration of Radionuclides in Soil (Bq/g)	5-35
5.4.1	Concentration of Radionuclides in Surface Water	5-46
5.4.2	Measurement of Radionuclides in Duplicate Samples of Red Tank Surface Water	5-49
5.6.1	Concentrations of Various Radionuclides in Sediment	5-59
5.7.1	Concentrations of Radionuclides in Biota	5-70
5.8.1	Mean Concentrations (Bq/m^3) of Gross Alpha and Beta Activities for 1996 and 1997	5-78
6.1	VOC Monitoring Program Data - Station VOC-A	6-3
6.2	VOC Monitoring Program Data - Station VOC-B	6-5
7.1	Indicator Parameters Analyzed in Addition to Appendix IX During Calendar Year 1997	7-10

LIST OF FIGURES

FIGURE	TITLE	PAGE
2.1	Location of the WIPP Site	2-4
5.1.1	Air Sampling Locations	5-4
5.1.2	Gross Alpha Activity in Air Particulate Samples - Carlsbad (CBD)	5-5
5.1.3	Gross Alpha Activity in Air Particulate Samples - WIPP South (WSS)	5-5
5.1.4	Gross Alpha Activity in Air Particulate Samples - Smith Ranch (SMR)	5-6
5.1.5	Gross Alpha Activity in Air Particulate Samples - WIPP Far Field (WFF)	5-6
5.1.6	Gross Alpha Activity in Air Particulate Samples - Mills Ranch (MLR)	5-7
5.1.7	Gross Alpha Activity in Air Particulate Samples - WIPP East (WEE)	5-7
5.1.8	Gross Alpha Activity in Air Particulate Samples - South East Control (SEC)	5-8
5.1.9	Gross Alpha Activity in Air Particulate Samples - WIPP Air Blank (WAB)	5-8
5.1.10	Gross Beta Activity in Air Particulate Samples - Carlsbad (CBD)	5-9
5.1.11	Gross Beta Activity in Air Particulate Samples - WIPP South (WSS)	5-9
5.1.12	Gross Beta Activity in Air Particulate Samples - Smith Ranch (SMR)	5-10
5.1.13	Gross Beta Activity in Air Particulate Samples - WIPP Far Field (WFF)	5-10
5.1.14	Gross Beta Activity in Air Particulate Samples - Mills Ranch (MLR)	5-11
5.1.15	Gross Beta Activity in Air Particulate Samples - WIPP East (WEE)	5-11
5.1.16	Gross Beta Activity in Air Particulate Samples - South East Control (SEC)	5-12
5.1.17	Gross Beta Activity in Air Particulate Samples - WIPP Air Blank (WAB)	5-12
5.1.18	Duplicate Sample Results - Gross Alpha	5-13
5.1.19	Duplicate Sample Results - Gross Beta	5-13
5.2.1	Composite Air Filters by Quarter/Location - Potassium-40	5-27
5.2.2	Composite Air Filters by Quarter/Location - Cobalt-60	5-27
5.2.3	Composite Air Filters by Quarter/Location - Strontium-90	5-28
5.2.4	Composite Air Filters by Quarter/Location - Cesium-137	5-28

5.2.5 Composite Air Filters by Quarter/Location - Uranium-234 5-29

5.2.6 Composite Air Filters by Quarter/Location - Uranium-235 5-29

5.2.7 Composite Air Filters by Quarter/Location - Uranium-238 5-30

5.2.8 Composite Air Filters by Quarter/Location - Plutonium-238 5-30

5.2.9 Composite Air Filters by Quarter/Location - Plutonium-239+240 5-31

5.2.10 Composite Air Filters by Quarter/Location - Americium-241 5-31

5.3.1 Soil Sampling Locations 5-34

5.3.2 Potassium-40 in Soil 5-38

5.3.3 Cobalt-60 in Soil 5-38

5.3.4 Strontium-90 in Soil 5-39

5.3.5 Cesium-137 in Soil 5-39

5.3.6 Uranium-234 in Soil 5-40

5.3.7 Uranium-235 in Soil 5-40

5.3.8 Uranium-238 in Soil 5-41

5.3.9 Plutonium-238 in Soil 5-41

5.3.10 Plutonium-239+240 in Soil 5-42

5.3.11 Americium-241 in Soil 5-42

5.4.1 Environmental Sampling Locations 5-45

5.4.2 Potassium-40 in Surface Water 5-50

5.4.3 Cobalt-60 in Surface Water 5-50

5.4.4 Strontium-90 in Surface Water 5-51

5.4.5 Cesium-137 in Surface Water 5-51

5.4.6 Uranium-234 in Surface Water 5-52

5.4.7 Uranium-235 in Surface Water 5-52

5.4.8 Uranium-238 in Surface Water 5-53

5.4.9 Plutonium-238 in Surface Water 5-53

5.4.10 Plutonium-239+240 in Surface Water 5-54

5.4.11 Americium-241 in Surface Water 5-54

5.4.12 Comparison Between the Concentrations of Uranium-234 and Uranium-238 5-55

5.6.1 Potassium-40 in Sediment 5-63

5.6.2 Cobalt-60 in Sediment 5-63

5.6.3 Strontium-90 in Sediment 5-64

5.6.4 Cesium-137 in Sediment 5-64

5.6.5 Uranium-234 in Sediment 5-65

5.6.6 Uranium 235 in Sediment 5-65

5.6.7 Uranium-238 in Sediment 5-66

5.6.8 Plutonium-238 in Sediment 5-66

5.6.9 Plutonium-239+240 in Sediment 5-67

5.6.10 Americium-241 in Sediment 5-67

5.7.1 Potassium-40 in Vegetation 5-72

5.7.2 Cobalt-60 in Vegetation 5-72

5.7.3 Strontium-90 in Vegetation 5-73

5.7.4 Cesium-137 in Vegetation 5-73

5.7.5 Uranium-234 in Vegetation 5-74

5.7.6 Uranium-235 in Vegetation 5-74

5.7.7 Uranium-238 in Vegetation 5-75

5.7.8 Plutonium-238 in Vegetation 5-75

5.7.9 Plutonium-239+240 in Vegetation 5-76

5.7.10 Americium-241 in Vegetation 5-76

5.8.1 Comparison Gross Alpha 1996-1997 - Carlsbad (CBD) 5-79

5.8.2 Comparison Gross Beta 1996-1997 - Carlsbad (CBD) 5-79

5.8.3 Comparison Gross Alpha 1996-1997- WIPP South (WSS) 5-80

5.8.4 Comparison Gross Beta 1996-1997 - WIPP South (WSS) 5-80

5.8.5 Comparison Gross Alpha 1996-1997 - Smith Ranch (SMR) 5-81

5.8.6 Comparison Gross Beta 1996-1997 - Smith Ranch (SMR) 5-81

5.8.7 Comparison Gross Alpha 1996-1997 - WIPP Far Field (WFF) 5-82

5.8.8 Comparison Gross Beta 1996-1997 - WIPP Far Field (WFF) 5-82

5.8.9 Comparison Gross Alpha 1996-1997 - Mills Ranch (MLR) 5-83

5.8.10 Comparison Gross Beta 1996-1997 - Mills Ranch (MLR) 5-83

5.8.11 Comparison Gross Alpha 1996-1997 - WIPP East (WEE) 5-84

5.8.12 Comparison Gross Beta 1996-1997 - WIPP East (WEE) 5-84

5.8.13 Comparison Gross Alpha 1996-1997 - Southeast Control (SEC) 5-85

5.8.14 Comparison Gross Beta 1996-1997 - Southeast Control (SEC) 5-85

6.1 1997 Precipitation 6-9

6.2 WIPP Site Temperature Graph for the Year 1997 - Elevation: 2m 6-10

6.3 WIPP Site Temperature Graph for the Year 1997 - Elevation: 10m 6-11

6.4 WIPP Site Temperature Graph for the Year 1997 - Elevation: 50m 6-12

6.5 WIPP Site Wind Rose for the Period January 1, 1997, through December 31, 1997 - Elevation: 2m 6-13

6.6 WIPP Site Wind Rose for the Period January 1, 1997, through December 31, 1997 - Elevation: 10m 6-14

6.7 WIPP Site Wind Rose for the Period January 1, 1997, through December 31, 1997 - Elevation: 50m 6-15

6.8 WIPP Seismograph Station Locations 6-16

7.1 Water Quality Sampling Program Sample Wells - 1997 7-6

7.2 Groundwater Level Surveillance Wells 7-7

7.3 Potentiometric Surface of the Culebra Dolomite Member of the Rustler Formation Near the WIPP Site as of December 1997 7-8

7.4 Potentiometric Surface of the Magenta Dolomite Member of the Rustler Formation Near the WIPP Site as of December 1977 7-9

7.5 As-Built Configuration of Well WQSP-1 7-11

7.6 As-Built Configuration of Well WQSP-2 7-12

7.7 As-Built Configuration of Well WQSP-3 7-13

7.8 As-Built Configuration of Well WQSP-4 7-14

7.9 As-Built Configuration of Well WQSP-5 7-15

7.10 As-Built Configuration of Well WQSP-6 7-16

7.11 As-Built Configuration of Well WQSP-6A 7-17

7.12 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-1 7-18

7.13 Time Trend Plot for Potassium and Sodium at WQSP-1 7-19

7.14 Time Trend Plot for Calcium and Magnesium at WQSP-1 7-20

7.15 Time Trend Plot for Chloride and Sulfate at WQSP-1 7-21

7.16 Time Trend Plot for Alkalinity and pH at WQSP-1 7-22

7.17 Time Trend Plot for Boron and Bromide at WQSP-1 7-23

7.18 Time Trend Plot for Lithium and Silica at WQSP-1 7-24

7.19 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-1 7-25

7.20 Time Trend Plot for Fluoride at WQSP-1 7-26

7.21 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-2 7-27

7.22 Time Trend Plot for Potassium and Sodium at WQSP-2 7-28

7.23 Time Trend Plot for Calcium and Magnesium at WQSP-2 7-29

7.24 Time Trend Plot for Chloride and Sulfate at WQSP-2 7-30

7.25 Time Trend Plot for Alkalinity and pH at WQSP-2 7-31

7.26 Time Trend Plot for Boron and Bromide at WQSP-2 7-32

7.27 Time Trend Plot for Lithium and Silica at WQSP-2 7-33

7.28 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-2 7-34

7.29 Time Trend Plot for Fluoride at WQSP-2 7-35

7.30 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-3 7-36

7.31 Time Trend Plot for Potassium and Sodium at WQSP-3 7-37

7.32 Time Trend Plot for Calcium and Magnesium at WQSP-3 7-38

7.33 Time Trend Plot for Chloride and Sulfate at WQSP-3 7-39

7.34 Time Trend Plot for Alkalinity and pH at WQSP-3 7-40

7.35 Time Trend Plot for Boron and Bromide at WQSP-3 7-41

7.36 Time Trend Plot for Lithium and Silica at WQSP-3 7-42

7.37 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-3 7-43

7.38 Time Trend Plot for Fluoride at WQSP-3 7-44

7.39 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-4 7-45

7.40 Time Trend Plot for Potassium and Sodium at WQSP-4 7-46

7.41 Time Trend Plot for Calcium and Magnesium at WQSP-4 7-47

7.42 Time Trend Plot for Chloride and Sulfate at WQSP-4 7-48

7.43 Time Trend Plot for Alkalinity and pH at WQSP-4 7-49

7.44 Time Trend Plot for Boron and Bromide at WQSP-4 7-50

7.45 Time Trend Plot for Lithium and Silica at WQSP-4 7-51

7.46 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-4 7-52

7.47 Time Trend Plot for Fluoride at WQSP-4 7-53

7.48 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-5 7-54

7.49 Time Trend Plot for Potassium and Sodium at WQSP-5 7-55

7.50 Time Trend Plot for Calcium and Magnesium at WQSP-5 7-56

7.51 Time Trend Plot for Chloride and Sulfate at WQSP-5 7-57

7.52 Time Trend Plot for Alkalinity and pH at WQSP-5 7-58

7.53 Time Trend Plot for Boron and Bromide at WQSP-5 7-59

7.54 Time Trend Plot for Lithium and Silica at WQSP-5 7-60

7.55 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-5 7-61

7.56 Time Trend for Fluoride at WQSP-5 7-62

7.57 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-6 7-63

7.58 Time Trend Plot for Potassium and Sodium at WQSP-6 7-64

7.59 Time Trend Plot for Calcium and Magnesium at WQSP-6 7-65

7.60 Time Trend Plot for Chloride and Sulfate at WQSP-6 7-66

7.61 Time Trend Plot for Alkalinity and pH at WQSP-6 7-67

7.62 Time Trend Plot for Boron and Bromide at WQSP-6 7-68

7.63 Time Trend Plot for Lithium and Silica at WQSP-6 7-69

7.64 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-6 7-70

7.65 Time Trend Plot for Fluoride at WQSP-6 7-71

7.66 Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-6A 7-72

7.67 Time Trend Plot for Potassium and Sodium at WQSP-6A 7-73

7.68 Time Trend Plot for Calcium and Magnesium at WQSP-6A 7-74

7.69 Time Trend Plot for Chloride and Sulfate at WQSP-6A 7-75

7.70 Time Trend Plot for Alkalinity and pH at WQSP-6A 7-76

7.71 Time Trend Plot for Boron and Bromide at WQSP-6A 7-77

7.72 Time Trend Plot for Lithium and Silica at WQSP-6A 7-78

7.73 Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-6A 7-79

7.74 Time Trend Plot for Fluoride at WQSP-6A 7-80

ACRONYMS AND ABBREVIATIONS

ACA	Agency for Conservation Archaeology
ALARA	as low as reasonably achievable
ANOVA	analysis of variance
ANSI	American National Standards Institute
ASER	Annual Site Environmental Report
ASME	American Society of Mechanical Engineers
bgs	below ground surface
BLM	Bureau of Land Management
C	Celsius
C of C	Certificate of Compliance
CAO	Carlsbad Area Office
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	*Code of Federal Regulations*
CH	contact-handled
cm	centimeter
CY	calendar year
DOE	United States Department of Energy
DOI	United States Department of the Interior
DOT	United States Department of Transportation
DP	Discharge Plan
EA	environmental assessments
EC&S	Environmental Compliance and Support (Section)
ECAP	Environmental Compliance Assessment Program
EEG	Environmental Evaluation Group
EIS	Environmental Impact Statement
EML	Environmental Measurements Laboratory
EMP	WIPP Environmental Monitoring Plan
EMS	Environmental Management System
EPA	United States Environmental Protection Agency
ERDA	United States Energy Research and Development Administration
F	Fahrenheit
FEIS	Final Environmental Impact Statement
FR	*Federal Register*
GOCO	government-owned, contractor-operated
HAP	hazardous air pollutant
HMTA	Hazardous Materials Transportation Act
in	inch
ISO	International Standards Organization
K-S	Kolmogorov-Smirnov

lbs	pounds
LEPC	Local Emergency Planning Committee
LMC	Land Management Council
LMP	Land Management Plan
LUR	Land Use Request
LWA	Land Withdrawal Act
MDA	minimum detectable activity
MDC	minimum detectable concentration
MDL	method detection limit
mg	milligram
ml	milliliter
MOU	memorandum of understanding
mps	meters per second
NCRP	National Council of Radiation Protection
NEPA	National Environmental Policy Act
NES	Nonradiological Environmental Surveillance
NESHAPs	National Emissions Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NMD	No-Migration Determination
NMED	New Mexico Environment Department
NMIMT	New Mexico Institute of Mining Technology
NMVP	No-Migration Variance Petition
NPDES	National Pollutant Discharge Elimination System
NQA	Nuclear Quality Assurance
NRC	Nuclear Regulatory Commission
NRIP	National Institute of Standards and Technology Radiochemistry Inter-comparison Program
P.L.	Public Law
ppbv	parts per billion by volume
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SARP	Safety Analysis Report for Packaging
SD	standard deviation; soil deep
SDWA	Safe Drinking Water Act
SEIS	Supplemental Environmental Impact Statement
SERC	State Emergency Response Commission
SI	soil intermediate
SMA	Special Management Areas
SNL	Sandia National Laboratories
SPDV	site and preliminary design validation
SS	soil surface
SWMU	solid waste management unit

TDS	total dissolved solid
TRU	transuranic waste
TRUPACT-II	Transuranic Package Transporter Model II
U.S.C	*United States Code*
USF&WS	United States Department of the Interior, Fish and Wildlife Service
USGS	United States Geological Survey
VOC	volatile organic compound
WID	Waste Isolation Division
WIPP	Waste Isolation Pilot Plant
WQSP	WIPP Groundwater Quality Surveillance Program
WRP	WIPP Raptor Program

CHAPTER 1 EXECUTIVE SUMMARY

This 1997 Annual Site Environmental Report (ASER) was prepared in accordance with DOE Order 5400.1, "General Environmental Protection Program"; the Environmental Protection Implementation Plan (DOE/WIPP 96-2199); and Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T). The above Orders and guidance documents require that DOE facilities submit an ASER to DOE Headquarters, Office of the Assistant Secretary for Environment, Safety and Health. The purpose of the ASER is to provide a comprehensive description of operational environmental monitoring activities, an abstract of environmental activities conducted to characterize site environmental management performance, to confirm compliance with environmental standards and requirements, and to highlight significant programs and efforts of environmental merit at WIPP during CY 1997. The content of this ASER is not restricted to a synopsis of the required data. In addition, information pertaining to new and continued monitoring and compliance activities during CY 1997 are also included.

Data contained in Chapter 5, "Environmental Radiological Assessment," of this report were derived from the monitoring programs directed by the WIPP Environmental Monitoring Plan (EMP) (DOE/WIPP 96-2194). The plan provides inclusive guidelines implemented to detect potential impacts to the environment and establish baseline measurements for future environmental evaluations. Surface water, sediment, groundwater, air, soil, and biotic matrices are monitored for an array of radiological factors.

This report also discusses the quality assurance (QA) and quality control (QC) programs that provide the oversight necessary to maintain sample integrity, including:

- Proceduralized (to industry standards) sample collection methodology
- Personnel training
- Scrutiny of analytical data

These criteria ensure that data derived from environmental samples provide an accurate representation of environmental conditions at the WIPP site. The requirements and goals driving these activities are more fully described in the EMP.

The EMP was drafted in accordance with the guidelines in DOE Order 5400.1. The EMP defines the scope and extent of the WIPP environmental monitoring programs and ensures that all appropriate sampling efforts are in place to determine the following: (1) the amount and type of naturally occurring radioactivity in the WIPP area prior to operational status (these quantitative data will support comparisons between preoperational and operational environmental conditions, once WIPP is operating as a waste repository for transuranic [TRU] waste); and (2) a comparison between preoperational and operational radiological emissions, once the WIPP site is operating as a waste repository for TRU waste.

The EMP is reviewed annually and updated every three years, as required by DOE Order 5400.1. The revisions/updates address the general changes, improvements, and enhancements to be implemented based on the data generated from the monitoring programs.

To date, WIPP remains in a preoperational phase; accordingly, certain operational requirements specified in DOE Order 5400.1 do not apply. This report does not address program modifications, new program implementation, or activities that will be developed to meet future (operational) requirements such as radionuclide emissions and effluents and respective impacts upon the public and the environment.

1.1 Compliance Summary

A summary of significant compliance-related activities at WIPP during CY 1997 is presented in this chapter. Chapter 3 will address environmental statutes and executive orders comprehensively in terms of compliance status, significant issues, actions, and accomplishments specific to WIPP.

During 1997, WIPP issued Revisions 6.3, 6.4, and 6.5 of the Resource Conservation and Recovery Act (RCRA) Part B Permit Application to the New Mexico Environment Department (NMED). Revision 6.3 covered changes to the facility. Revision 6.4 was an update to the Groundwater Monitoring Plan, and Revision 6.5 contained an update to Chapter I containing financial assurance responsibilities. Revision 6.5 also contained a recertification statement from the DOE Carlsbad Area Office (CAO) and WID.

On September 26, 1997, the NMED rescinded its completeness determination for the RCRA Part B Permit Application previously issued on July 27, 1996. The NMED based this decision on its opinion that some of the information provided to the NMED was new and not simply to "modify, clarify, or supplement previously submitted materials."

The NMED is continuing to process the draft permit which is anticipated in early CY 1998.

Section 8 of the Land Withdrawal Act (LWA) (P.L. 102-579) requires the DOE to submit to the U.S. Environmental Protection Agency (EPA) an application for certification of compliance with the EPA's final disposal regulations. In February 1996, the EPA issued the criteria for the certification of WIPP's compliance with the disposal regulations (Title 40 *Code of Federal Regulations* (CFR) § 194). In response to the WIPP Compliance Certification Application (DOE/CAO 1996-2184), which was submitted to the EPA in October 1996, the EPA issued a proposed rule certifying that the DOE complies with the disposal regulations in 40 CFR § 191 on October 30, 1997. The EPA will conduct hearings and is anticipated to issue a final determination in CY 1998.

1.1.1 National Environmental Policy Act Annual Mitigation Report

The 1997 Annual Mitigation Report for the Waste Isolation Pilot Plant (NEPA [National Environmental Policy Act] ID# WIP:97:0001) was issued June 26, 1997, in accordance with the requirement of DOE Order 451.1A, "National Environmental Policy Act Compliance Program." This Order requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action nonsignificant or that is made in the Record of Decision (ROD).

1.1.2 Superfund Amendments and Reauthorization Act Title III Emergency and Hazardous Chemical Inventory

WIPP submitted the Emergency and Hazardous Chemical Inventory Report for CY 1997 to the CAO for distribution to the New Mexico State Emergency Response Commission, the Eddy County Local Emergency Planning Committee, and the local fire department with jurisdiction over the WIPP site, as required by Section 312 of the Superfund Amendments and Reauthorization Act [SARA] Title III (also known as the Emergency Planning and Community Right-to-Know Act).

1.1.3 New Mexico Air Quality

WIPP completed all requirements for emissions monitoring and sampling in New Mexico Air Quality Permit 310-M-2. During calendar year 1997 the backup diesel generators were operated for approximately 47 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit.

1.1.4 Environmental Compliance Assessments

During 1997, twelve environmental compliance assessments were conducted. Forty-five improvements were identified and implemented as a result of these assessments. The assessed areas included Underground Storage Tank Requirements; Oil and Gas Surveillance Requirements; Drinking Water Quality Regulations; Environmental Management Systems (EMS)/International Standards Organization (ISO) 14000; Federal Insecticide, Fungicide, and Rodenticide Act; Special Waste - Infectious, Contaminated Soils, and Manifest Regulations; Cross-Connection Control Plan; Contingency Plan/Emergency Procedures; WIPP National Pollutant Discharge Elimination System Permit Compliance; Hazardous Chemical Reporting Requirements; Material Safety Data Sheet Requirements; and Chlorofluorocarbons.

1.1.5 ISO 14001 Environmental Management Systems

The ISO 14000 standards establish a new environmental management systems philosophy that goes beyond regulatory compliance. ISO 14000 is the series of international environmental management standards designed to give a common management approach for parties trading products or services having impacts on the environment. The criteria for environmental management systems are contained in Section 14001-1996 of the ISO standard. While these standards are voluntary, many companies and countries are adopting the standards as a model for their environmental management systems. WID views ISO 14001 compliance as an important step towards becoming an industry leader at implementing a formal EMS. On August 5, 1997, the WID EMS received third-party registration under the ISO 14001 Standard.

WIPP has developed and implemented the EMS in accordance with the ISO 14001 standard. The EMS established the necessary organizational structure, planning activities, procedures, and resources to develop, implement, achieve, and maintain WID's environmental management policy, MP 1.14. A description of the EMS can be found in the Environmental Management Implementation Document (WP 02-EC.0).

1.1.6 Voluntary Release Assessment Program at Selected Solid Waste Management Units at WIPP

The CAO completed a voluntary release assessment sampling program at eleven selected solid waste management units (SWMUs) at WIPP. Soil samples were analyzed for total constituent concentrations and leachable constituent concentrations according to the EPA toxicity characteristic leaching procedure. The results of the voluntary release assessment sampling and proposed corrective actions at the SWMU sites are described in the Final Voluntary Release Assessment/Corrective Action Report (DOE/WIPP 96-2209).

Based on the results of voluntary release assessment sampling, the CAO has formally requested that a determination of "no further action" be granted for each of the eleven SWMUs. If the "no further action" determination is approved, each of the eleven sites will be replanted with native vegetation in accordance with the guidelines provided in the WIPP Land Management Plan (LMP) (DOE/WIPP 93-004).

1.1.7 Federal Acquisition, Recycling, and Waste Prevention

WIPP adopted a systematic and cost-effective Affirmative Procurement Plan for the promotion and procurement of certain products containing recovered materials in July 1995. Affirmative procurement is designed to "close a loop" in the waste minimization recycling process by supporting the market for materials collected through recycling and salvage operations.

Affirmative procurement programs are mandated by RCRA Section 6002(I), which requires federal agencies and their procuring agencies to establish material preference programs targeted to purchase recycled materials. Executive Order 12873 and the EPA guidelines in 40 CFR §§ 248-250 and 252-253 provide additional guidance for implementing affirmative procurement programs at federal facilities.

Affirmative procurement programs must include four elements: (1) a preference program; (2) a promotion program; (3) estimation, certification, and verification procedures; and (4) procedures for annual review and monitoring. The purchase and use of recycled products at WIPP will help foster markets for recovered materials and reduce the amount of solid waste requiring disposal through the purchase and use of products containing recovered materials.

1.2 Environmental Monitoring Program Information

Site characterization and environmental baseline measurements at WIPP were initiated during 1975. Many of these elements continue to be maintained on radiological and nonradiological databases. When WIPP becomes operational, baseline measurements will be transitioned to the "operational phase" and will be monitored constantly throughout the life of the project.

1.2.1 Environmental Monitoring Plan

WIPP's EMP provides schedules and guidelines for monitoring a comprehensive set of parameters to detect and quantify present or potential environmental impacts, both nonradiologically and radiologically. Radiological surveillance covers a broader geographic area that includes nearby ranches, villages, and cities. Sampling activities conducted during CY 1997 were performed at locations identified in the EMP. Monitoring protocol is dynamic and requires modifications from time to time to sustain a contemporary and technically sound program. Environmental monitoring will continue at the WIPP site during project operations and throughout decommissioning activities.

1.3 Environmental Radiological Program Information

DOE Order 5400.1 requires the measurements of radionuclides of interest in environmental and biological samples to establish the radiological baseline during the preoperational phase. Accordingly, six subprograms are being conducted to document the background levels of radionuclides around the WIPP site. These subprograms are consistent with the guidance provided in DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. Once a radiological baseline has been established, applicable radiological sampling programs can be maintained or modified to improve sampling efficiency. As radiological sampling protocol evolves to reflect program requirements (e.g., DOE Orders, EPA directives), the continuation of baseline sampling is necessary to provide adequate and timely measurements prior to waste receipt.

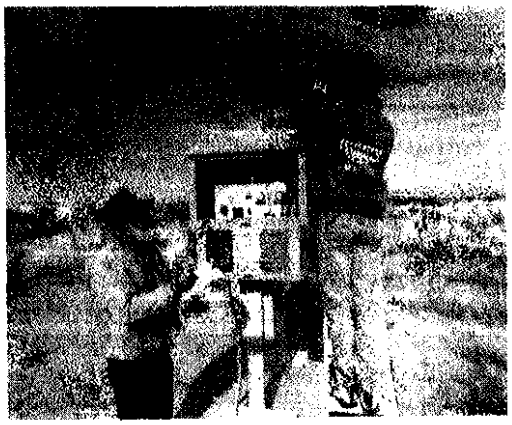
Inhalation and ingestion are the two main pathways for the intake of radionuclides by humans in the general population, whereas workers may acquire these radionuclides through puncture wounds also while at work. Therefore, the six subprograms conducted at the WIPP site include sampling and measurements of radionuclides in air particulate, soil, surface water, groundwater, sediments, and biota, which are discussed in the Statistical Summary of the Radiological Baseline Program for the Waste Isolation Pilot Plant (DOE/WIPP 92-037).

Isotopes of plutonium (Pu) and americium (Am)-241 constitute the majority of radioactivity in the contact-handled (CH) waste, and cesium (Cs)-137 and strontium (Sr)-90 are additional constituents of remote-handled waste to be received at the WIPP site. It is therefore

appropriate to measure these radionuclides in environmental and biological samples to establish the radiological baseline during the pre-operational phase. The measurements of naturally occurring radionuclides such as isotopes of uranium (U) and potassium (K)-40 also have been included as natural precursors. Cobalt-60 has been also included in these measurements. Discussions pertaining to radiological conditions are contained in Chapter 5, "Environmental Radiological Assessment."

1.3.1 Airborne Particulate Sampling

Inhalation is the major pathway for the intake of radionuclides if released from the WIPP site; therefore, sampling of air particulate and measurements of the radionuclides in these samples are very important. Accordingly, air particulate samples were collected at seven different locations around the WIPP site during 1997; three within 1,000 meters of the facility boundary; three at local ranches and communities; and one at a sample control site. Samples were collected by using low-volume continuous air samplers and Whatman micro fiber glass filters (4.7 cm). These filters were changed weekly, and after decay of radon progeny (three to five days), they were counted for gross alpha and beta.



Continuous air samplers are stationed at various locations in the vicinity of WIPP. Environmental Monitoring personnel exchange filters weekly.

The highest mean gross alpha activity was 0.029 ± 0.062 mBq/m^3 and the highest mean gross beta activity was 0.641 ± 0.457 mBq/m^3. Thirteen weekly samples collected during each quarter were composited for the quantitative determinations of individual radionuclides. The results for the radioisotopes in air particulate are mostly below detection limits and with high total propagated uncertainty. Some scattered false positive and/or false negative results were reported, but were found to be analytical artifacts. The detailed results and discussion are presented in Section 5.2.

1.3.2 Soil Sampling

Soil samples were collected from six different locations around the site in accordance with applicable guidance (e.g., DOE/EH-0173T) and sampling procedures. Samples were collected in three depth profiles: soil surface (SS) (0-2 cm), soil intermediate (SI) (2-5 cm), and soil deep (SD) (5-10 cm), and analyzed separately. The mean concentration of K-40 was found to be 368 ± 756 mBq/g of soil at the WIPP site, whereas the mean concentration of K-40 is 400 mBq/g in the United States and ~ 600 mBq/g around Albuquerque. The mean concentration of U-234 was 16.3 ± 6.7 mBq/g of soil and the mean concentration of U-238 was 16.7 ± 8.1 mBq/g. These results indicate that the parent U-238 and the progeny U-234 are in equilibrium. However, the U-238 concentration around WIPP was found to be much lower than national average of 66 mBq/g. The results are given in detail in Section 5.3.

Environmental Monitoring personnel collecting soil media for radiological analysis.

1.3.3 Groundwater

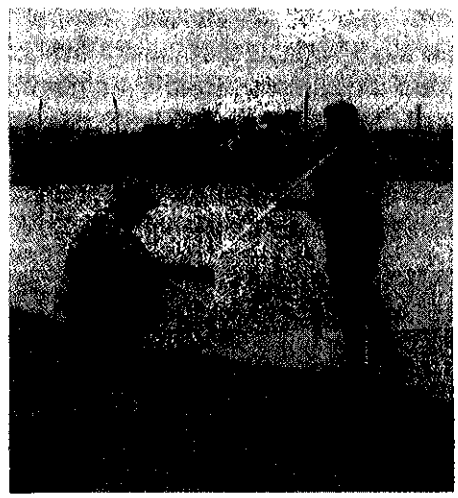
Groundwater samples were collected from six wells at a depth of 617 to 879 feet containing brine water (Culebra formation) and one from one well at a depth of 225 feet containing fresh water (Dewey Lake). These samples were analyzed for nonradiological and radiological constitution.

Wells were sampled for nonradiological parameters. Samples were analyzed for major cations/anions, metals and constituents in the environmental monitoring list contained in 40 CFR § 264, Appendix IX. Sodium appears to be the dominant cation followed by calcium and magnesium. Chloride appears to be the dominant anion. Appendix IX criteria constituents do not appear to be present in the sampling matrix.

The results of the QA and QC samples analyzed along with these water samples did not meet the verification and validation criteria for sampling and the radiological analyses. Therefore, all the radiological results became questionable and have been submitted for re-analyses to the contract laboratory. These results shall be published in a supplementary report at a later date.

1.3.4 Surface Water and Sediment Sampling

Surface water and sediment samples were collected from 14 different locations. The surface water samples and the sediment samples were analyzed for radiological constitution. The results and discussions pertaining to surface water and sediment are given in Section 5.4. Potassium-40, a naturally occurring radionuclide, was found in most of the surface water samples. The concentration ranged 1.07 ± 1.08 Bq/L to 6.42 ± 2.38 Bq/L with a mean of 3.38 ± 3.12 Bq/L. The concentration of K-40 was highest in the Upper Pecos River (UPR) samples due to large amount of sediments in this location. The uranium concentration show a significant variation in the degree of disequilibrium in these sampling locations. The activity ratio of U-234 to U-238 ranged from 1.14 to 3.12, as shown in Figure 5.4.12.

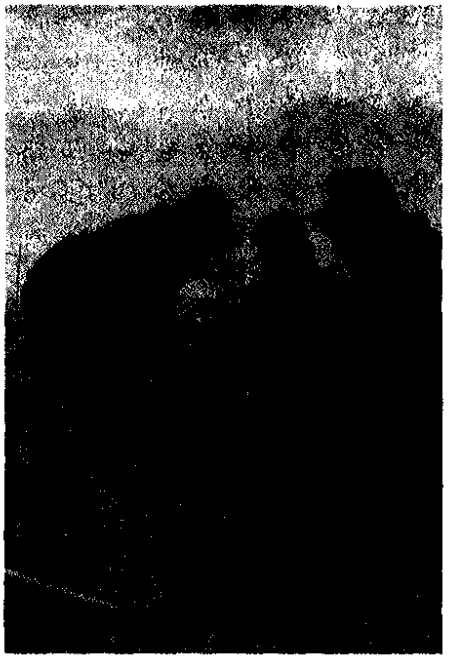


Samples are collected from local catchment ponds for radiological analysis. This picture illustrates Environmental Monitoring personnel collecting a surface water sample.

Environmental Monitoring personnel collect bottom sediments from area ponds for radiological analysis.

1.3.5 Biotic Sampling

Vegetation samples were collected from six different locations around the WIPP site. Vegetation sites are co-located with air and soil sampling locations. Catfish samples were also collected. Potassium-40, U-234, U-238, and Sr-90 were detected in vegetation samples. The concentrations of these radionuclides were quite low. Potassium-40 was detected in fish samples also. Other radionuclides were either not detected or very low. The results and discussions pertaining to biota samples are given in Section 5.7.



Vegetation, as a sample media, is collected for radiological analysis.

1.4 Nonradiological Environmental Monitoring Information

Nonradiological environmental surveillance was also conducted in accordance with the EMP. This program was preceded by the WIPP Biology Program (1975-1982). An extensive baseline of information describing the major ecological components of the Los Medaños region, prior to the initiation of the WIPP site construction activities, was developed. Six universities participated in the initiation of the characterization and baseline surveillance programs.

A significant portion of the nonradiological surveillance investigated effects of fugitive salt dust, generated by the surface stockpiling activities, on the surrounding environment (e.g., Reith, et al., 1985). This study is described in the Summary of the Salt Impact Studies at the Waste Isolation Pilot Plant, 1984 to 1990 (DOE/WIPP 92-038).

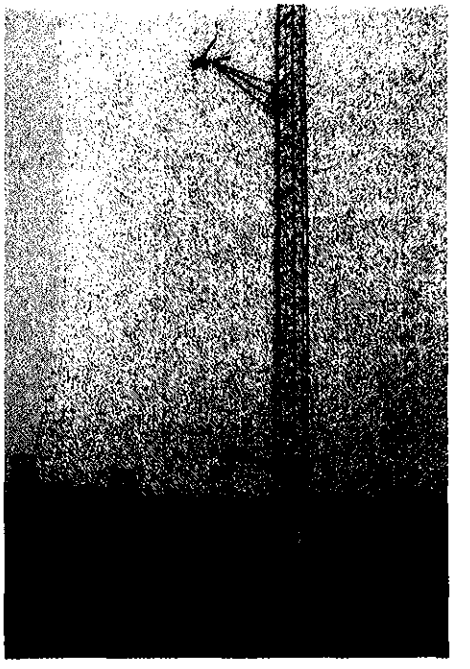
1.4.1 Land Management

The DOE prepared the LMP as required by Section 4 of the LWA. The development of this plan was in collaboration with the U.S. Department of the Interior's (DOI) Bureau of Land Management (BLM) and the state of New Mexico. Changes or amendments to the LMP are done in consultation with the BLM, the state of New Mexico, and affected stakeholders, as appropriate.

The LMP, as required by the LWA, was prepared to identify resource values, promote the concept of multiple-use management, and identify long-term goals for the management of DOE/WIPP lands until the culmination of the decommissioning phase. The plan also provides the opportunity for participation in the land use planning process by the public and local, state, and federal agencies.

1.4.2 Meteorology

The WIPP nonradiological environmental surveillance includes a primary meteorological station that provides support for various programs at WIPP. The primary function of the station is to generate data to model atmospheric conditions for radiological environmental surveillance. The station records meteorological measurements for wind speed, wind direction, and temperature at elevations of 2, 10, and 50 meters (6.6, 33, and 164 feet respectively). Relative humidity, barometric pressure, precipitation, and solar radiation are monitored at ground level. These parameters are measured continuously, and the data are logged at 15-minute intervals in the Central Monitoring System.



Meteorological data is collected from the primary meteorological tower (pictured here) located northeast of the site.

Discussions pertaining to meteorological monitoring are contained in Chapter 6, "Environmental Nonradiological Program Information."

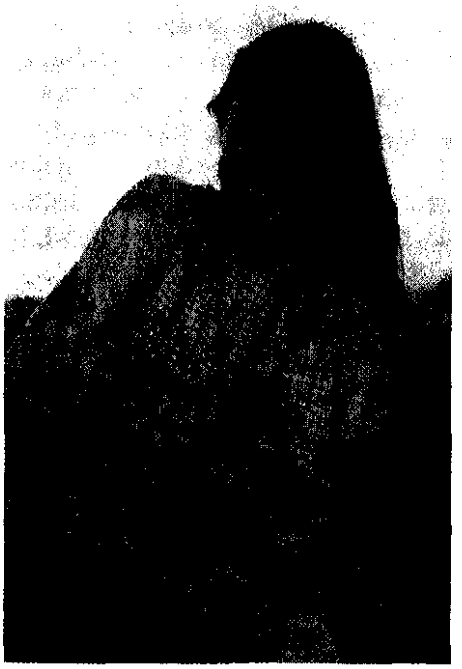
1.4.3 Wildlife Population Monitoring

Observations of various species of wildlife are conducted to assess the effects of WIPP's activities on transient and resident wildlife populations (e.g., raptors, small mammals). Results are published in the Waste Isolation Pilot Plant Raptor Program 1997 Annual Report.

WIPP Raptor Program

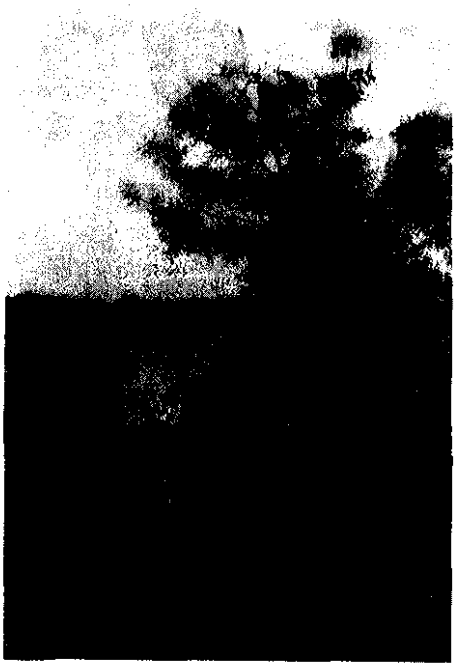
During CY 1997, data were collected on resident birds of prey within an area of approximately 870 square miles in the vicinity of WIPP, with the WIPP site as the center of the study area. Most of this sector is managed under the authority of the DOI's BLM Carlsbad Resource Area office with WIPP lands comprising the nucleus of the research area. This cooperative enterprise between the BLM and

the DOE was commissioned through the bilateral development of an interagency agreement. The agreement defines commitments on behalf of each respective agency to include deliverables and itemized time lines for the completion of each element.



The vicinity of WIPP supports one of the largest and most diverse raptor populations in recorded literature.

The CY 1997 field research and public educational activities, collectively referred to as the WIPP Raptor Program (WRP), were done in relation to raptors (eagles, hawks, falcons, and owls) in the same area. The CY 1997 survey period suggested that raptor populations are starting to recover from drought conditions that have characterized the past several years. Among priority species, 17 Harris hawk (*Parabuteo unicinctus harrisi*) nests and 15 Swainson's hawk (*Buteo swainsoni*) nests were located. Research done at each nest included productivity assessments, vegetation measurements, morphological measurements, and nesting behavior.

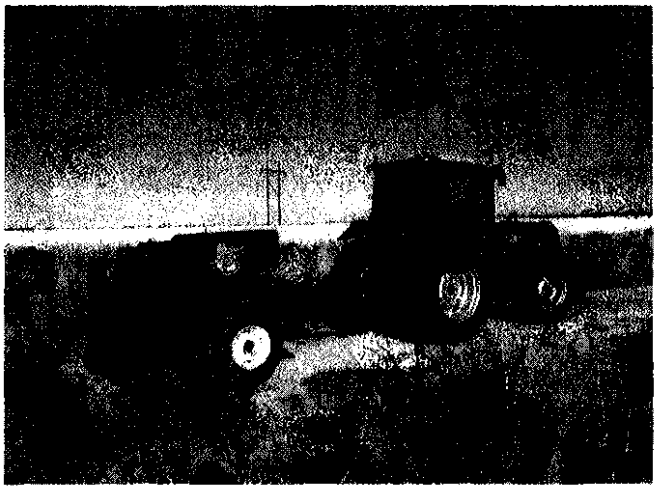


Nesting raptors in the vicinity of WIPP are regarded as a valuable resource and are considered during all project planning phases.

An educational presentation using live animals, interactive graphics, and upbeat lecture material was developed and implemented to teach children about local wildlife and the WRP. Presentations were made to over 2,200 students in 67 classrooms throughout Carlsbad, Jal, Santa Fe, Albuquerque, Las Vegas, and Los Alamos, New Mexico, in CY 1997. Talks and presentations were also given to other local groups and organizations.

1.4.4 Reclamation of Disturbed Lands

Reclamation activities during CY 1997 consisted of the periodic inspections, supplemental seedings, exclosure maintenance, and erosion mitigation on several sites. The H-19 hydropad, for example, exhibited severe erosion along a 20- to 30-meter interval on the west elevation. Contour lines were cut perpendicular to the erosion pattern, gullies were filled in, and the area was planted. Eventually, the majority of the pad will be reclaimed in this manner with access points, well heads, and the evaporation pond as the only exclusions.



Land management and reclamation is an integral part of the environmental programs at WIPP.

1.5 Quality Assurance

The purpose of the QA/QC program is to ensure that processes, activities, and products that potentially impact health, safety, and the environment are appropriately planned, implemented, and assessed. The goal of the QA/QC program is twofold: (1) to provide confidence that the data used in demonstrating regulatory compliance are adequate, and (2) to promote continuous improvement in WIPP's operations. The QA program is successful when risks and environmental impacts are identified and minimized, and when safety, reliability, and performance are maximized.

Programs described in this document adhere to policies set forth by QA guidance criteria, including American Society of Mechanical Engineers [ASME] [Nuclear Quality Assurance] NQA-1, "Quality Assurance Program Requirements for Nuclear Facilities" (ASME, 1989) and the EPA [Quality Assurance Management Staff] QAMS-005/80, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans" (EPA, 1980), and the requirements of "Nuclear Safety Management, Quality Assurance" (10 CFR § 830.120), and fulfill the requirements of the QA plans specified in DOE Orders 5400.1 (DOE, 1988d), 5400.3 (DOE, 1988e), and DOE/EH-0173T.

A comprehensive QA program was implemented to ensure that the data collected reflect selected parameters of the environment. Data have been obtained prior to commencement of operations, providing a sound baseline for comparison with operational phase data. The data will be evaluated to determine future impacts of WIPP on the environment.

The focus of this program includes the following areas:

- Sample collection at specified locations in accordance with approved procedures. These procedures are based on established and accepted practices.
- Procedure review and revision to minimize uncertainties introduced through sampling and analysis, while maintaining comparability and continuity between past and future data.
- Verification of data through a continuing program of analytical laboratory QC, including the performance of interlaboratory cross-checks, duplicate and split sample radiological analyses, and sample splits provided to the Environmental Evaluation Group (EEG).

CHAPTER 2 INTRODUCTION

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 2.1). The site is 26 miles east of Carlsbad in a region known as Los Medaños, which represents the initial intergradation between the Llano Estacado and the Chihuahuan desert. This region displays an exceptional diversity of plant and animal inhabitants. Geographically, the region is regarded as a relatively flat, sparsely inhabited plateau with little surface water. The region is popular for recreation, providing opportunities for hunting, camping, hiking, and bird watching.

The majority of the lands outside the WIPP site boundary are managed under the jurisdiction of the DOI's BLM Carlsbad Resource Area office. Land uses in the surrounding area include livestock grazing, potash mining, oil and gas exploration and production (including support services), and recreational uses.

The WIPP site boundary extends at least 1.6 kilometers (one mile) beyond any of the WIPP underground developments and is defined on the surface by the 16-section (4,146 hectares) WIPP Land Withdrawal Area. On October 30, 1992, the LWA was signed into law, transferring the land from the DOI to the DOE. In accordance with edicts contained in the LWA, the WIPP LMP was prepared and submitted to Congress.

Consisting of 16 sections of federal land, the WIPP site is located in Eddy County, New Mexico, in Township 22 South, Range 31 East. With the exception of properties located within the boundaries of the posted 1,454-acre (589 hectares) Off-Limits Area, the surface land uses remain largely unchanged and are managed in accordance with accepted practices for multiple land use. Mining and drilling for purposes other than those which support the WIPP Project are prohibited within the 16-section area.

2.1 Description of the WIPP Project

The WIPP Project is authorized by the DOE, National Security, and Military Applications of Nuclear Energy Authorization Act of 1980 (i.e., P.L. 96-164). The legislative mandate is to demonstrate the safe disposal of TRU wastes resulting from national defense activities and programs. To fulfill this mandate, WIPP has been designed to (1) scientifically investigate the behavior of bedded salt and the interactions between the salt and radioactive wastes, and (2) demonstrate safe and efficient handling, transport, and emplacement of TRU waste in a fully operational disposal site.

The first radioactive wastes will be emplaced once permitting activities are completed. Subsequent to successful permit completion, the WIPP site will be designated as an operational facility. TRU wastes will then be transported from generator/storage sites throughout the United States to the WIPP site.

The TRU waste received from the generator sites will be transported to the WIPP site via tractor-trailer trucks. Each truck can carry up to three Transuranic Package Transporter Model IIs (TRUPACT-II), and each transporter may contain fourteen 55-gallon drums or two standard waste boxes. The TRUPACT-II is a durable, reusable container that has been certified by the Nuclear Regulatory Commission (NRC) to transport contact-handled (waste containers that can be handled without additional shielding) TRU waste to WIPP.

Once TRU wastes have arrived at WIPP, they will be transported into the Waste Handling Building. The waste containers will be removed from the TRUPACT-IIs, placed on the waste hoist, and lowered to the repository level of 655 m (2,150 feet) below the surface. During the disposal phase, waste drums will be removed from the hoist and emplaced in excavated storage rooms in the Salado formation,

a thick sequence of salt beds deposited approximately 250 million years ago in the Permian Age. After the disposal areas have been filled, specially designed closures will be placed in the excavated disposal rooms and seals will be placed in the shafts. The self-healing nature of the salt formation will aid in gradual closure, causing encapsulation and isolation of the waste within the Salado formation.

During site operations, the underground area will be ventilated with ambient air that enters the Air Intake Shaft, the Salt Handling Shaft, and the Waste Handling Shaft. The air exits through the Exhaust Shaft. In the event of an underground accident involving radioactivity, exhaust air can be circulated at a reduced flow rate through the Exhaust Filter Building. This building contains banks of high-efficiency particulate air filters that remove contaminated particulate.

2.1.1 WIPP Property Areas

The WIPP site is divided into defined areas as represented in Figure 2.1. Descriptions of these areas are as follows:

Property Protection Area

The interior core area of the facility is approximately 34.16 surface acres surrounded by a chain link fence. This sector, formerly identified as "Zone I," is designated as the "Property Protection Area." All access control features are maintained with uniformed security personnel on duty 24 hours a day.

Exclusive Use Area

The Exclusive Use Area is approximately 277.14 acres within Sections 20, 21, 28, and 29 of Township 22 South, Range 31 East. It is surrounded by a five-strand barbed wire fence and is restricted exclusively for the use of the DOE and its contractors and subcontractors in support of the project. In addition, this area is defined as the point of closest public access for the purposes of performing accident consequences to the general public in the WIPP Safety Analysis Report. This area is marked by DOE no trespassing signs and is patrolled by WIPP security personnel to prevent unauthorized activities or uses.

Off-Limits Area

The Off-Limits Area is 1453.9 acres (approximately 2.2 square miles) within Sections 20, 21, 28, and 29 of Township 22 South, Range 31 East. This sector is managed as an area wherein unauthorized entry and introduction of weapons and/or dangerous materials (as provided in 10 CFR §§ 860.3 and 860.4) are prohibited. Pertinent prohibitions and subsequent penalties (10 CFR § 860.5) are posted at consistent intervals along the perimeter as directed in 10 CFR § 860.6. Grazing and public thoroughfare continue until such time that these activities present a threat to the security, safety, and/or environmental quality of WIPP. This sector is patrolled by WIPP security personnel to prevent unauthorized activity or use. While the subject sector is posted, the area is not fenced.

WIPP Land Withdrawal Area

The WIPP site boundary distinguishes the perimeter of the 16-section WIPP Land Withdrawal Area. This tract includes properties outlying the Property Protection Area, the Exclusive Use Area, and the Off-Limits Area. This sector is designated at points of ingress and egress as a Multiple Land Use Area, and is managed accordingly. Certain restrictions, however, do apply. Information regarding land use restrictions is available from the DOE on request.

Special Management Areas

Certain property sectors used in the operation of WIPP (e.g., reclamation sites, well pads, roads) are (and may be) identified as Special Management Areas (SMA). An SMA designation is made due to values, resources, and/or circumstances that meet criteria for protection

and management under special management designations. Unique resources of value that are in danger of being lost or damaged, sectors wherein ongoing construction is occurring, fragile plant and/or animal communities, sites of archaeological significance, sectors containing imminent risks (safety hazards), or a sector(s) that may receive an unanticipated elevated security status would be suitable for designation as an SMA. Accordingly, the subject sector would receive special management emphasis under this stipulation. SMAs will be posted against trespass and will be safeguarded commensurate with applicable laws governing property protection. WIPP security personnel will patrol these areas to prevent unauthorized access or use.

The first two aforementioned sectors are posted against trespass under the authority of Section 229 of the Atomic Energy Act of 1954, 42 *United States Code* (U.S.C.) § 2278a, and pursuant to the regulations set forth in 10 CFR § 860 and DOE Order 5632.1c, "Protection and Control of Safeguards and Security Interests." These sectors are patrolled by the WIPP security and regulations are enforced commensurate with laws pertaining to property protection. The WIPP site boundary (4 miles x 4 miles) provides a functional barrier of intact salt between the underground region defined by the Off-Limits Area and the accessible environment.

2.1.2 Demographics Within the Affected Environment

Approximately 26 residents live in various locations within 10 miles of the WIPP site. The majority of the local population within 50 miles of WIPP are concentrated in and around the communities of Carlsbad, Hobbs, Eunice, Jal, and Artesia. The nearest community is the village of Loving, 18 miles west-southwest of WIPP. The population of Loving increased from an estimated 1,240 in 1990 to a current population estimate of 1,977. The nearest major populated area is Carlsbad, 26 miles west of WIPP. The population of Carlsbad was estimated at 24,952 in 1990, with a current estimated population of 26,974. (Population estimates are calculated by subtracting the number of deaths from the number of births and adding net migration.) The transient population within 10 miles of WIPP is associated with ranching, oil and gas exploration/production, and potash mining.

The two nearby ranch residences (Smith Ranch [SMR] and Mills Ranch [MLR]) are continuously monitored as part of the Environmental Monitoring Program.

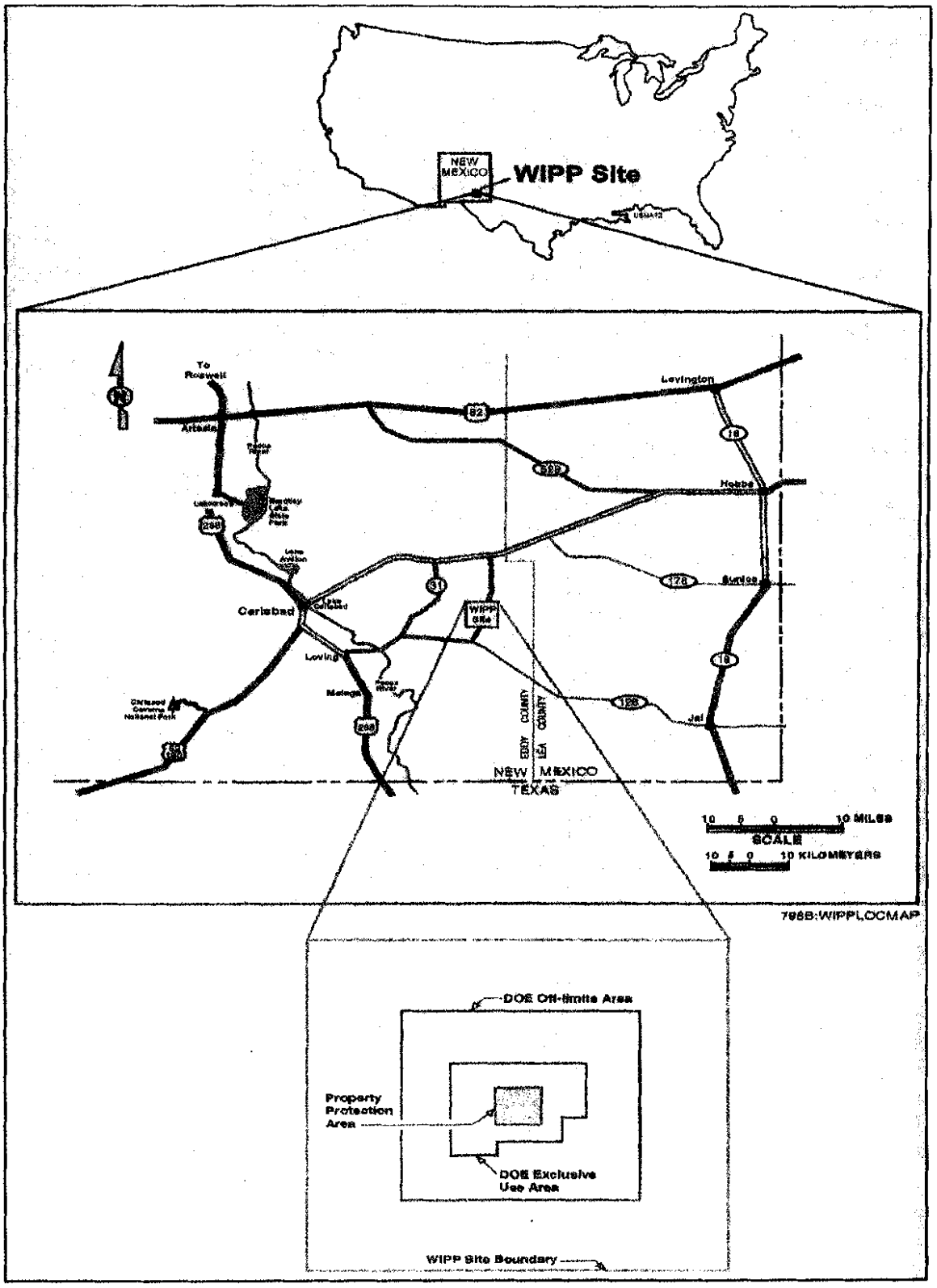


Figure 2.1 - Location of the WIPP Site

CHAPTER 3 COMPLIANCE SUMMARY

WIPP is required to comply with all applicable federal and state laws and DOE Orders. Documentation of requisite federal and state permits, notifications, and applications for approval is maintained by the WID Environment, Safety, and Health Department. Regulatory requirements are incorporated in facility plans and implementing procedures. The Standards/Requirements Identification Document establishes the environmental, safety, and health requirements that apply to WID and documents the status of WID's compliance with those requirements.

3.1 Compliance Overview

In CY 1997 WIPP maintained compliance with applicable federal and state environmental regulations. Section 3.2 contains a listing of environmental statutes/regulations applicable to WIPP. Section 3.3 describes significant accomplishments and ongoing compliance activities relative to these regulations most relevant to WIPP's development and eventual opening of the facility. A detailed breakdown of WIPP's compliance with all environmental regulations is available in the WIPP Biennial Environmental Compliance Report (DOE/WIPP 96-2171). Section 3.4 lists other significant accomplishments achieved in CY 1997 towards environmental excellence.

3.2 Statutes and Regulations Applicable to WIPP

This section documents compliance with the following regulatory requirements at WIPP:

- Atomic Energy Act of 1954
- Bald and Golden Eagle Protection Act
- Clean Air Act
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (includes the Superfund Amendments and Reauthorization Act of 1986)
- Emergency Planning and Community Right-to-Know Act
- Endangered Species Act
- Federal Facilities Compliance Act
- Federal Insecticide, Fungicide, and Rodenticide Act
- Federal Land Policy and Management Act
- Federal Water Pollution Control Act of 1972 ("Clean Water Act")
- Hazardous Materials Transportation Act (HMTA)
- Implementation of the Federal Land Policy and Management Act
- Materials Act of 1947
- Migratory Bird Treaty Act
- National Environmental Policy Act
- National Historic Preservation Act (NHPA)
- New Mexico Air Quality Control Act
- New Mexico Drinking Water Regulations
- New Mexico Emergency Management Act
- New Mexico Environmental Improvement Act
- New Mexico Ground Water Protection Act
- New Mexico Hazardous Chemicals Information Act

- New Mexico Hazardous Waste Act
- New Mexico Pesticide Control Act
- New Mexico Prehistoric and Historic Sites Preservation Act
- New Mexico Solid Waste Act
- New Mexico State Implementation of the Bald and Golden Eagle Protection Act
- New Mexico Water Quality Act
- New Mexico Wildlife Conservation Act, Implementing the Endangered Species Act
- Noise Control Act of 1972
- Public Rangelands Improvement Act
- Resource Conservation and Recovery Act
- Safe Drinking Water Act (SDWA)
- Taylor Grazing Act
- Toxic Substances Control Act

3.3 Compliance Status

3.3.1 Comprehensive Environmental Response, Compensation, and Liability Act

The CERCLA establishes a comprehensive federal strategy for responding to, and establishing liability for, releases of hazardous substances from a facility to the environment. Hazardous substance cleanup procedures are specified in the National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR § 300). No release sites have been identified at WIPP that would require cleanup under the provisions of the CERCLA. Any spill of hazardous substances that exceeds a reportable quantity must be reported to the National Response Center under the provisions of Section 103 of CERCLA and 40 CFR § 302.

Accidental Releases of Reportable Quantities of Hazardous Substances

During 1997, no releases of hazardous substances exceeded the reportable quantity limits. The WIPP facility is required to report such releases to the State Emergency Response Commission (SERC) and the Local Emergency Planning Committee (LEPC). In accordance with Section 312 of the Emergency Planning and Community Right to Know Act, WIPP submits an Emergency and Hazardous Chemical Inventory to the SERC and the LEPC and to local fire departments with which the CAO maintains a memorandum of understanding (MOU). The Tier II Emergency and Hazardous Chemical Inventory lists hazardous chemicals that exceed a Threshold Planning Quantity during the reporting year for the facility. This information is provided to inform the public as well as to inform external responders about potential chemical hazards in the event of an emergency.

Waste Minimization and Pollution Prevention Programs

Waste Minimization and Pollution Prevention activities that took place in 1997 were as follows:

CRC Lectra Motive containing 1,1,1 trichloroethane, perchloreoethylene, and 1,3 dioxalane was replaced with Super Electrosafe Solvent Degreaser. Some of the accomplishments of this change are:

- Use of hazardous solvent containing a carcinogen was eliminated
- A hazardous waste stream was eliminated
- Satellite Accumulation Area 12A was eliminated

- Cost savings of $600
- ISO 14000 goals for benchmarking and solvent substitution were satisfied
- Commitments to the CAO to eliminate use of carcinogens from the site were supported

Carcinogens were removed from the Environment, Safety, and Health Analytical Laboratory. Removal of these carcinogens resulted in the elimination of Satellite Accumulation Area 24 and a cost savings of $360.

Satellite Accumulation Area 3, Waste Paint, was eliminated. The paint is now being reused to paint strips on the roadways, sidewalks, and crosswalks on site.

Waste reduction of Atlas-Copco condensate was accomplished by adding a Wilsa S510 Filter. The condensate can now be discharged into the waste water system per the NMED Discharge Plan (DP-831). There was a waste reduction of seven barrels per week at $110/bbl. This resulted in a cost savings of $33,600 per year.

WIPP continued sending excess property to local auctions to be sold for reuse.

WIPP sold 425 scrap batteries for recycling.

Scrap metal was sold for recycling as follows:

- 69,600 lbs of No. 2 steel
- 24,920 lbs of unprepared steel
- 17,220 lbs of long iron
- 15,480 lbs of tin

3.3.2 Federal Acquisition, Recycling, and Pollution Prevention

WIPP adopted a systematic and cost-effective Affirmative Procurement Plan for the promotion and procurement of certain products containing recovered materials in July 1995. Affirmative procurement is designed to "close a loop" in the waste minimization recycling process by supporting the market for materials collected through recycling and salvage operations.

Affirmative procurement programs are mandated by RCRA Section 6002(I), which requires federal agencies and their procuring agencies to establish material preference programs targeted to purchase recycled materials. Executive Order 12873 and the EPA guidelines in 40 CFR §§ 248-250 and 252-253 provide additional guidance for implementing affirmative procurement programs at federal facilities.

Affirmative procurement programs must include four elements: (1) a preference program; (2) a promotion program; (3) estimation, certification, and verification procedures; and (4) procedures for annual review and monitoring. The purchase and use of recycled products at WIPP will help foster markets for recovered materials and reduce the amount of solid waste requiring disposal through the purchase and use of products containing recovered materials.

During 1997 the contract for recycling printer toner cartridges was changed. Under the previous contract, cartridges were refilled three times and then destroyed. Under the new contract, the spent cartridges are sent off to be completely remanufactured as many times as practicable. With this new contract placed, the electronic office supply system has also been modified. Employees can no longer order new toner cartridges (except those that are not recyclable); they will receive only remanufactured toner cartridges that have been placed on the supply system.

3.3.3 Resource Conservation and Recovery Act

The RCRA (42 U.S.C. § 3251 et seq.) was enacted in 1976, and implementing regulations were promulgated in May 1980. This body of regulations ensures that hazardous wastes are

managed and disposed of in an environmentally safe manner. Facilities that store, treat, or dispose of hazardous waste also must protect human health and the environment. The Hazardous and Solid Waste Amendments of 1984 prohibit land disposal of hazardous wastes unless certain treatment standards are met. The amendments also place increased emphasis on waste minimization activities and serve as a mechanism to enforce the RCRA cleanup requirements. The WIPP facility is subject to the permitting requirements under the RCRA and the New Mexico Hazardous Waste Act. Title 40 CFR § 264 outlines the technical standards for treatment, storage, and disposal facilities that must be addressed in a permit application (as applicable). Title 40 CFR § 270 outlines the requirements of the RCRA permitting program with respect to general format and content for applications, and the administrative aspects of the permitting and modification processes. The WIPP RCRA Part B Permit Application addresses TRU mixed waste management activities for surface facilities and in the repository as required for disposal operations. This application was submitted to the NMED in May 1995 to address compliance during the disposal phase. In general, programmatic changes reflected in this application center on the DOE decision to forego test phase activities at WIPP. The permit application was subsequently revised in response to a Notice of Deficiency in April 1996, and the DOE expects a final RCRA permit to be issued during CY 1999.

During 1997, WIPP issued Revisions 6.3, 6.4, and 6.5 of the RCRA Part B Permit Application to the NMED. Revision 6.3 covered changes to the facility. Revision 6.4 was an update to the Groundwater Monitoring Plan, and Revision 6.5 contained an update to Chapter I containing financial assurance responsibilities. Revision 6.5 also contained a recertification statement from the CAO and WID.

On September 26, 1997, the NMED rescinded its completeness determination for the RCRA Part B Permit Application previously issued on July 27, 1996. The NMED based this decision on its opinion that some of the information provided to the NMED was new and not simply to "modify, clarify, or supplement previously submitted materials."

The NMED is continuing to process the draft permit which is anticipated in early CY 1999.

Hazardous Waste Generator Compliance

Nonradioactive hazardous waste is currently generated through normal facility operations, and is managed in Satellite Accumulation Areas and "less-than-90-day" storage areas. In addition, hazardous waste generated at WIPP is characterized, packaged, labeled, and manifested prior to shipment to an off-site treatment, storage, and disposal facility in accordance with the requirements codified in 40 CFR § 262.

Voluntary Release Assessment Program at Selected SWMUs at WIPP

The CAO has completed a voluntary release assessment sampling program at eleven selected SWMUs at WIPP. The CAO made the decision to complete a voluntary release assessment/corrective action program at selected SWMUs described in Chapter J of the RCRA Part B Permit Application because the proposed rules provide incentives for facilities willing to complete voluntary corrective actions. The proposed Subpart S rule states:

> The Agency intends to remove regulatory disincentives to independent action by facility owner/operators, and will encourage voluntary cleanups. EPA recognizes that it is important to allow willing and responsible owner/operators to begin corrective action promptly without unnecessary procedural delay.

The Voluntary Release Assessment/Corrective Action Program is intended to be the first phase in implementing the RCRA facility investigation corrective action process at

WIPP. The results of voluntary facility investigations will be used to focus on plausible concerns and expedite cleanup decisions as defined in the preamble of the proposed Subpart S rule.

Data generated by the release assessment sampling program are being used to document voluntary release assessment/corrective action commitments contained in the Voluntary Release Assessment/Corrective Action Work Plan (DOE/WIPP Draft 2115) submitted to the EPA and the NMED in August 1995. These data are also intended to update the 1994 RCRA Facility Assessment for WIPP (Assessment of Solid Waste Management Units at the Waste Isolation Pilot Plant), NMED/DOE/AIP 94/1.

Soil samples were collected from areas of suspected release at the eleven SWMUs. Release assessment sampling data and proposed corrective actions were compiled into the Final Voluntary Release Assessment Corrective Action Report (DOE/WIPP 96-2209), which was submitted to the EPA Region VI Hazardous Waste Mana Division; and the NMED Hazardous and Radioactive Materials Bureau.

Using the criteria provided in proposed 40 CFR § 264.514; *Federal Register* (FR) Vol. 55, No. 145, VI(D), p. 30813; and the October 1995 EPA Region III Risk-Based Concentration Table, January-June 1996, the analytical data collected at each of the eleven SWMUs demonstrates that no release of hazardous constituents has occurred. All metal concentrations within the SWMUs are well below the applicable proposed subpart's rule action levels. Thus, there is no potential for impacts to human health or the environment.

Based on these analytical results, the CAO has formally requested that a determination of "no further action" be granted for each of the eleven SWMUs. Because it is the EPA's intent to encourage voluntary corrective actions, the CAO has requested that the "no further action" determination be granted prior to the issuance of the RCRA Part B permit for WIPP. If this "no further action" determination is approved by the agencies, each of the eleven sites will be replanted with native vegetation in accordance with the guidelines provided in the LMP.

3.3.4 National Environmental Policy Act

The NEPA requires the federal government to use all practicable means to consider potential environmental impacts of proposed projects as part of the decision-making process. The NEPA dictates that the public shall be allowed to review and comment on proposed projects that have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs, and resources relating to human health and the environment.

NEPA procedural objectives and public involvement requirements are detailed in the Council on Environmental Quality regulations implementing the NEPA in 40 CFR §§ 1500-1508. The DOE codified its requirements for implementing the council's regulations in 10 CFR § 1021. Further procedural NEPA compliance guidance is provided in DOE Order 451.1A.

Title 10 CFR § 1021.331 requires that, following completion of each environmental impact statement (EIS) and its associated ROD, the DOE shall prepare a mitigation action plan that addresses mitigation commitments expressed in the ROD.

DOE Order 451.1A further requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action not significant or that is made in a ROD. The 1996 Annual Mitigation Report for the Waste Isolation Pilot Plant (NEPA ID# WIP:97:0001) was issued June 26, 1997.

In 1980, the DOE prepared the Final Environmental Impact Statement (FEIS) (DOE/EIS-0026). The objective of the FEIS was to assess the potential impacts of developing WIPP in addition to the alternatives for the disposal and management of TRU waste. By 1990, following construction of the WIPP facilities, the DOE decided to prepare the Final Supplement Environmental Impact Statement (SEIS-I) (DOE/EIS-0026-FS) to update the environmental record established in the FEIS (DOE, 1990).

Since the SEIS-I was issued, the DOE has published three environmental assessments (EA) and two supplement analyses related to WIPP. Environmental assessments were prepared for the WIPP-related test programs at Los Alamos, the construction and operation of the Carlsbad Environmental Monitoring and Research Center, and the DOE acted as a cooperating agency for the construction and operation of the Ochoa power line to provide a secondary source of electrical power to WIPP.

Supplemental analyses were prepared for proposed waste characterization and packaging activities at the Idaho National Engineering and Environmental Laboratory for the WIPP test program. The second supplement analysis evaluated proposed transportation routes to WIPP and a deviated gas well at WIPP.

In October 1993, the DOE decided not to conduct the full range of Test Phase experiments at WIPP, and moved toward the implementation of waste disposal operations. This was based on a determination that TRU waste experiments could be adequately performed at a lower cost in above ground laboratories as part of the ongoing experimental program. However, a commitment was made in the SEIS-I ROD to prepare a second SEIS (SEIS-II) prior to beginning disposal operations at WIPP. In addition to the DOE's 1990 ROD commitment to prepare the SEIS-II, regulatory and statutory changes as well as changes in the TRU waste inventory and waste acceptance criteria have occurred since the SEIS-I was issued. New hydrologic and geologic information was used in the development of the WIPP performance assessment and the evaluation of the facilities' ability to isolate waste.

On November 29, 1996, the DOE issued a Notice of Availability (61 FR 60690) on the Waste Isolation Pilot Plant Disposal Phase Draft Supplement Environmental Impact Statement (SEIS II - Draft) (DOE/EIS-0026-DS) that included a brief description of the contents of the document and alternatives analyzed; a list of reading rooms where the full document is available to the public; information on how to obtain additional copies of the document and submit public comments; and a schedule of public hearings. Some of the changes that have occurred since the issuance of the 1990 SEIS-I include the identification of additional TRU waste generator sites, changes in TRU waste volumes and waste forms, and changes in the compliance status of previously disposed of TRU wastes. Other major changes discussed in the SEIS-II include the passage of the amended WIPP LWA, the acquisition of new data from experimental programs, the issuance of the DOE's Final Waste Management Programmatic Environmental Impact Statement, Changes in the Planning Basis Waste Acceptance Criteria, and changes in regulations applicable to WIPP.

In September 1997 the DOE published the SEIS-II (DOE/EIS-0026-S-2). The SEIS II takes into account all of the changing circumstances since 1990 that might result in potential environmental impacts from WIPP disposal and closures operations. WID anticipates that the DOE will issue the ROD for the SEIS-II in January 1998.

3.3.5 Clean Air Act

The Clean Air Act (42 U.S.C. § 7401 et seq.) provides for the preservation, protection, and enhancement of air quality, particularly at locations of special interest such as areas of natural, recreational, scenic, or historic value.

Under Section 109 of the Clean Air Act, the EPA established the National Ambient Air Quality Standards for six "criteria" pollutants: sulfur dioxide, total suspended particulate, carbon monoxide, ozone, nitrogen oxide, and lead. These standards establish primary and secondary standards for ambient air quality that the EPA considers necessary to protect public health and welfare.

In 1993, WID completed the WIPP Hazardous Air Pollutant (HAP) Emission Inventory for CY 1992. The inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria pollutants. The HAPs inventory was conducted again in 1995 and 1997 for CYs 1994 and 1996, respectively, and compared to the baseline data. The current inventory is used as a comparison to the previous inventories to identify trends and potential emissions problems. Emission estimates are used to determine if WIPP is required to obtain an air permit as specified in the following regulations:

- Clean Air Act, § 112, "National Emissions Standards for Hazardous Air Pollutants" (NESHAPs)
- Clean Air Act, Part C (Prevention of Significant Deterioration - Criteria Pollutants)
- New Mexico Administrative Code Title 20, Chapter 2, Air Quality

WIPP's normal operations do not involve or entail any planned or expected releases of airborne radioactive materials to the workplace or the environment. Waste containers accepted for disposal at WIPP are required to meet the 10 CFR § 835 external contamination limits. To ensure compliance, the containers are surveyed both prior to release from the generator sites and as the TRUPACT-II containers are opened at WIPP. Since radioactive material remains in the waste containers unless an accident occurs, there will be no emissions of radionuclides to the ambient air from DOE facilities during normal WIPP waste handling, and the public will not be subjected to direct radiation. Therefore, the public is expected to receive a negligible dose during normal operations. As a result of the above arguments, it may be concluded that WIPP will be operated in compliance with the release standards of 40 CFR § 191, Subpart A, and 40 CFR § 61, Subpart H.

Based on an MOU with the EPA, the DOE committed to compliance with the requirements of 40 CFR § 61, Subpart H, through the disposal phase of operations at WIPP. A revised standard for radionuclide emissions was promulgated by the EPA in a final ruling published in the *Federal Register*, effective December 15, 1989 (54 FR 51654).

The 1995 Safety Analysis Report establishes the adequacy of the WIPP safety bases regarding plant response to conditions considered to be "extremely unlikely." External doses to workers from the handling of contact-handled waste containers were estimated to be well within DOE ALARA (as low as reasonably achievable) goals. Moreover, consequences to the public and worker as a result of the release of volatile organic compounds (VOC) during disposal phase normal operations were shown to be many orders of magnitude below health-based limits.

An emissions monitoring system was installed to comply with the periodic confirmatory monitoring compliance requirements established in the NESHAPs. On November 21, 1994, the EPA approved the use of a single-point source shrouded probe for compliance sampling. The shrouded probe will be used to conduct periodic confirmatory monitoring at WIPP.

Based on the current HAPs inventory, WIPP operations do not exceed the 10-ton-per-year emission limit for any individual HAP or the 25-ton-per-year limit for any combination of HAPs emissions established in Subpart A.

WIPP does not have any NESHAPs Subpart A permitting or reporting requirement at this time. However, 40 CFR § 61, Subpart A, Section 61.09(a)(1), requires that the WIPP facility notify the EPA of its anticipated date of initial start-up (i.e., receipt of wastes) not more than 60 days and not less than 30 days before actual start-up date. In addition, the EPA required that notification of the actual date of initial start-up must be made within 15 days after start-up.

Based on emission estimates generated in the HAPs inventory, the WIPP site is not required to obtain federal Clean Air Act permits. WIPP, in consultation with the NMED Air Quality Bureau, working in concert with data provided in the first HAPs inventory, was required to obtain a New Mexico Air Quality Control Regulation 702, Operating Permits (recodified in 1997 as Title 20, Chapter 2, Part 72, Construction Permits) for two primary backup diesel generators at the site. The only emission points where the WIPP site exceeds state threshold criteria is with the backup diesel generators. WIPP completed all necessary requirements for emissions monitoring and sampling required by New Mexico Air Quality Permit 310-M-2. During CY 1997 the backup diesel generators were operated for approximately 47 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit.

3.3.6 Clean Water Act

Section 402 of the Clean Water Act establishes provisions for the issuance of permits for discharges into waters of the United States. Regulations promulgated to define this permitting process are contained in 40 CFR § 122, Subpart A, Section (b)(1), and state that "...National Pollutant Discharge Elimination System (NPDES) program requires permits for the discharge of 'pollutants' from any 'point source' into waters of the United States." WIPP has no pollutant discharges from point sources and is currently exempted from obtaining a standard NPDES permit.

On September 9, 1992, the EPA issued the final requirements for NPDES General Permits for Storm Water Discharges Associated with Industrial Activity. The storm water regulations establish requirements for managing industrial storm water runoff that has the potential to discharge into waters of the United States. WIPP submitted a Notice of Intent to the EPA to obtain a NPDES Storm Water General Permit on December 31, 1992. The Notice of Intent described how the WIPP site mitigates the discharge of contaminated storm water through the use of best management practices. These practices include engineering controls such as storm water retention basins, the covering of materials storage areas, and the reclamation of disturbed areas. The EPA issued a New Mexico NPDES Storm Water General Permit (NMR00A021) on January 31, 1992. As part of the Nationwide General Permit Program, WIPP is included in the New Mexico General Permit. This national permit program expired September 9, 1997.

On August 29, 1997, WIPP submitted to the EPA a Notice of Intent for Storm Water Discharges Associated with Industrial Activity under a NPDES Multi-Sector General Permit. On December 2, 1997, WIPP received a request for additional information necessary to process the Notice of Intent. The information will be submitted in January of 1998.

No sampling is required to demonstrate compliance with the WIPP Storm Water Permit unless a release occurs. Operational permit compliance activities are limited to quarterly inspections of retention basins, spill containment devices, reclamation sites, and site housekeeping practices.

The NPDES sewage sludge regulations promulgated in 40 CFR § 122.21 require all facilities that generate or dispose of sewage sludge to submit an information package describing sewage sludge management and

disposal practices. This information is reviewed by the EPA to determine if a NPDES permit will be required for the disposal of sewage sludge at a facility.

On February 14, 1994, the DOE submitted an information package to the EPA Water Management Division and requested a written determination of whether a NPDES permit would be required for sewage sludge generated at WIPP. On March 31, 1994, the EPA Region VI Permits Issuance Section notified the DOE that they had received the information package. The agency determined that the information package was complete and stated they would notify the DOE if a full and complete sewage sludge permit application would be required at a future date.

On January 16, 1992, the NMED issued the Sewage System Discharge Plan (DP-831) for the WIPP sewage facility. The approved discharge plan superseded an Emergency Discharge Permit issued on September 18, 1991. In addition to sewage effluent, DP-831 allows for the disposal of a maximum of 1,500 gallons a day of nonhazardous brines generated by seepage into shaft sumps and from pumping of observation wells at the site. (Exceptions to the classification of "nonhazardous" are brine waters with lead concentrations exceeding regulatory levels, collected in the waste shaft sump, exhaust shaft sump, and boreholes OH 224, 225, and 226, located between the waste shaft and the exhaust shaft. Subject waters were disposed of as RCRA hazardous waste in an approved and permitted treatment, storage, and disposal facility.) Brine waters are collected in portable tanks and transported to the north sewage system evaporation basin. Characterization samples were collected to appropriately disposition brines. On August 28, 1995, WID submitted a request to the NMED requesting a minor amendment to DP-831, increasing the amount of nonhazardous brine for disposal to 2,000 gallons per day. On October 4, 1995, the NMED approved the amendment to DP-831. The increase was required, not because additional brine was being generated, but because on days the observation wells were pumped more than 1,500 gallons were produced, necessitating that the brine be disposed of over two days' time.

In December 1996, an application for renewal of DP-831 was submitted to the NMED. The application consisted of renewal of the existing permit conditions and the addition of the H-19 Evaporation Pond. This pond was constructed by Sandia National Laboratories for use during the Culebra Transport Test Program. The discharge plan renewal and modification was approved by the NMED on July 3, 1997. The permit approves the discharge of up to 8,000 gallons per day of nonhazardous waters generated by mine dewatering activities, pumping of groundwater observation wells, and from miscellaneous nonhazardous sources to the H-19 Evaporation Pond.

The DOE submits quarterly discharge monitoring reports to the NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan.

Water quality analysis as specified by DP-831 was modified with the issuance of the July 3, 1997, permit. The permit requires quarterly sampling and analysis of the sewage system influent for nitrate; total Kjeldahl nitrogen; total dissolved solids; Pu-238 and Pu-239+240; Am-241; U-234, 235, and 238; and Sr-90. There are no numeric limitations specified by the permit.

3.3.7 Safe Drinking Water Act

The SDWA (42 U.S.C. § 300f et seq.) of 1974 provides the regulatory strategy for protecting public water supply systems and underground sources of drinking water. The NMED notified WIPP in a September 9, 1992, letter that the WIPP public water supply was categorized as a nontransient, noncommunity system for reporting and testing requirements. At that time, the NMED determined that WIPP was

required to sample drinking water for total coliform bacteria, lead, copper, nitrate and nitrite. In a March 11, 1994, letter the NMED again modified compliance sampling requirements, stating that only lead, copper, and bacteriological samples are required. The modification was based upon New Mexico water supply regulations, which mandate that when a public water supply system supplements other systems, that water system is treated as a single system for compliance sampling purposes.

The Carlsbad municipal water supply system is contracted to provide raw water to WIPP from city-owned wells 31 miles north of the site. Because of this contractual agreement, the city of Carlsbad completes the source, or point-of-entry, samples for the various chemical constituents at each well field source.

On August 19, 1996, the results of the lead and copper compliance samples collected on July 16, 1996, were sent to the NMED. The sample numbers and frequency were based on the previous year's approval for reduced monitoring status. In a letter dated August 28, 1996, the NMED acknowledged receipt of the sample results and again reduced the sampling frequency from ten samples every year to ten samples every three years. The next required sampling period will be in July of 1999. This reduction was based on Drinking Water Program Guidance No. 8 issued by the NMED Field Operations Division on May 2, 1996.

Bacterial samples were collected and reported monthly throughout 1997. All bacteriological/ analytical results were below the SDWA regulatory limits.

3.3.8 National Historic Preservation Act

The NHPA (16 U.S.C. § 470 et seq.) was enacted to protect the nation's cultural resources and establish the National Register of Historic Places. Federal agencies are required to coordinate NEPA compliance with the responsibilities of the NHPA to ensure that historic and cultural properties are given proper consideration in the preparation of environmental assessments and EISs. Agency obligations under the NHPA, however, are independent from the NEPA and must be complied with even when no EAs or EIS is required (i.e., for proposed projects not classified as major federal actions with significant environmental impacts, the DOE must still consider impacts to historic properties and sites). Where both the NEPA and the NHPA are applicable, draft EISs must integrate NHPA considerations along with other environmental impact analyses and studies (see 40 CFR § 1502.25).

Summary

From man's first arrival in the Southwest about 10,000 B.C. to the late 1800s, southeastern New Mexico was inhabited by aboriginal hunters and gatherers who subsisted on various wild plants and animals. These people would have found a number of edible plants throughout the region, including mesquite beans, hackberries, walnuts, acorns, seed-producing grasses, agave, and a variety of other succulents. Big and small game, including bison, deer, antelope, rabbits, reptiles, birds, and various invertebrates, could have been hunted or collected in the region.

From approximately 600 A..D. onward, as trade networks were established with Puebloans to the west, domesticated plant foods and materials, including corn (or maize), beans, squash, and cotton, were exchanged for dried meat, hides, and other goods from the Pecos Valley and plains. The indigenous population may also have practiced horticulture at favorable locales in the area, but only on an intermittent basis, since water for crops would have been scarce and unpredictable much of the time.

In the mid-1500s, the Spanish conquistadors encountered Jumano and Apachean peoples in the region hunting, gathering crops, and engaging in trade with Puebloans. Later, as the natives acquired horses, and as Europeans began settling the land, this traditional way of

life evolved into specialized bison hunting on the Llano Estacado and raiding both Spanish and Puebloan settlements to the west. The region was settled by ranchers and farmers in the late 1800s.

The WIPP Land Withdrawal Area is situated in dune-covered, rolling-plains terrain in the eastern part of the BLM's Carlsbad Resource Area. Known archaeological sites within the area are primarily the remains of prehistoric camps and short-term settlements. These localities are generally marked by hearth features, scattered burned rock, flaked stone projectile points, cutting and scraping tools, pottery fragments, and ground stone implements. Locations generally represent short-term, seasonal occupations by small, nomadic groups of hunters and gatherers who used the plants and animals in the dune lands east of the Pecos River. In a few cases within the WIPP Land Withdrawal Area, sites with evidence of structures have been reported. These sites probably hosted occupations of perhaps several weeks or months.

Many known historical sites in southeastern New Mexico consist primarily of early twentieth century homesteads that failed, or isolated features from late nineteenth and early twentieth century cattle or sheep ranching and military activities. Although the region was part of the Spanish and Mexican colonial empires, no related conquest or settlement sites have yet been identified.

Historic components (more than 50 years old) are rare, but are occasionally noted within the WIPP Land Withdrawal Area. They include features and debris related to ranching in the early years of the twentieth century. In addition, more modern ranching debris and facilities such as fence lines are present in the area, including some which are likely still in use. Ranch-related sites that date to the 1940s and 1950s are common in parts of the WIPP Land Withdrawal Area. These will be considered historical properties within the next several years and, under current law, will have to be treated as such. Most of the sites recorded in the area typically include elements that can contribute to their eligibility for the National Register of Historic Places. With few exceptions, cultural properties known or anticipated for the WIPP Land Withdrawal Area are significant; they must be identified, recorded, assessed through inventory, and considered in any plan of development for the area.

Compared with most other parts of southeastern New Mexico, the locations and nature of cultural resources within the WIPP Land Withdrawal Area can be described relatively well, based on intensive inventory of portions of the area, along with limited excavation and some other work on some sites.

In 1976, four sections comprising the WIPP core area (Sections 20, 21, 28, and 29), along with associated rights-of-way and drilling pads within and outside the WIPP Land Withdrawal Area (Nielson 1976), were inventoried by the Agency for Conservation Archaeology (ACA) of Eastern New Mexico University. Additional rights-of-way within and outside the WIPP Land Withdrawal Area were inventoried in 1978 and 1979 by the ACA (Schermer, 1978; MacLennan and Schermer, 1979). Sites identified in the core area were relocated and evaluated in 1980 by the ACA, and management recommendations for those sites were prepared (Schermer, 1980). Subsequently, in accordance with the ACA's recommendations, a number of sites within the WIPP core area were tested for eligibility and/or were excavated as mitigation (Lord and Reynolds, 1985).

In 1987, Mariah Associates conducted an intensive study of portions of 45 sections surrounding the WIPP facility. Mariah's study included an inventory of 2,460 acres in 15 quarter-section units. Inventoried units were selected so as to be representative of the area as a whole. Within each of the sample units, all cultural resource sites encountered were recorded, certain selected sites were tested,

and management recommendations were prepared (Mariah Associates, 1987).

Between 1989 and 1992, several seismic projects associated with oil and gas development provided cultural resource clearances within the WIPP Land Withdrawal Area. Numerous inventories have been conducted outside the withdrawal area, primarily for oil and gas exploration and ranching.

Inventories conducted to date within the withdrawal area have located 60 archaeological sites, along with 91 isolated occurrences (single or few artifacts, or isolated features that can be fully recorded in the field). Sites and isolates identified are almost exclusively prehistoric. Only one site with both prehistoric and historic components has been noted.

Of a total of 10,240 acres in the WIPP Land Withdrawal Area, 3,380 acres (37 percent) have been inventoried for cultural resources. The results were the discovery of one site for every 65 acres surveyed, and one isolate in every 42 acres. Based on this information, and assuming environmental homogeneity and a fairly even distribution of sites, the remaining 6,410 uninventoried acres could contain approximately 99 sites and 153 isolates. The combined results of the several inventories conducted within the WIPP Land Withdrawal Area compare well with those from Mariah's 1987 inventory of selected units over a much larger area. Mariah's results show only a slightly higher frequency of cultural resources per acre. In 2,460 acres, 40 sites and 75 isolates were recorded, or one site for every 62 acres and one isolate in every 33 acres.

Of the 40 sites identified and evaluated on the Mariah inventory, 14 are eligible for the National Register of Historic Places, 24 are potentially eligible, and two are not eligible (a determination of eligibility can be made only after the site has been archaeologically tested). None of the 75 isolates are considered eligible. While the data from the various researchers cited above are not always consistent with Mariah's explicit data on site significance, it appears that within the WIPP Land Withdrawal Area, the majority of sites either are or have the potential to be eligible for the National Register of Historic Places and will require consideration in future land disturbing activities.

Site significance is contingent on the number of manifestations encountered, their diversity in composition, the total number of each type of manifestation, and existing evidence suggesting whether or not a given site is datable. Previous limited cultural inventories indicate that WIPP represents a potentially significant cultural resource contributor to the discipline of archaeology and shall be regarded as such when deliberating land management decisions.

The objectives of the DOE are to protect and preserve representatives of the full array of cultural resources within the WIPP Land Withdrawal Area for the benefit of scientific and sociocultural use by present and future generations. This guidance will ensure that cultural resources are given full consideration in land use planning and management decisions.

On June 21, 1995, an investigation was conducted of a previously known site as several previously buried artifacts emerged at the surface. No regulatory actions were required following the investigation, since no surface disturbing activities are planned for the area in question.

During 1997, no new archaeological sites were discovered. Avoidance remains to be WIPP's primary mitigation measure for archaeological sites.

3.3.9 Hazardous Materials Transportation Act

The HMTA (49 App. U.S.C. § 1801 et seq.; 49 CFR §§ 106-179) is one of the major transportation-related statutes that affect the DOE at WIPP. It provides for safe intra- and

interstate transportation of hazardous materials (including radioactive materials). In the second modification to the Agreement for Consultation and Cooperation, dated August 4, 1987, the DOE agreed to comply with all applicable DOT regulations and corresponding NRC regulations, and has issued DOE Orders to ensure compliance. DOE Order 460.1A, Packaging & Transportation Safety establishes safety requirements for the proper packaging and transportation of DOE offsite shipments and onsite transfers of hazardous materials and for modal transport. (Offsite is any area within or outside a DOE site to which the public has free and uncontrolled access; onsite is any area within the boundaries of a DOE site or facility to which access is controlled.)

DOE Order 460.2 establishes DOE policies and requirements to supplement applicable laws, rules, regulations, and other DOE Orders for materials transportation and packaging operations. The Order requires that DOE Field Elements conduct their operations in compliance with all applicable international, federal, state, local, and tribal laws, rules, and regulations governing materials transportation which are not inconsistent with federal regulations, unless exemptions or alternatives are approved in accordance with DOE O 460.1. The Order contains requirements for development of a Transportation Plan; use of the DOE Transportation Tracking and Communications (TRANSCOM) System shall for tracking and monitoring shipments; inspection of shipments upon receipt for damage or loss, and evidence of leakage and inspection for external surface contamination for radioactive material shipments; Shipment Notifications to States and Tribes; Consignee Notifications - For each shipment of fissile or more than Type A quantities of radioactive material the shipper shall notify the consignee of the dates of the shipment, the expected date of arrival, and any special loading or unloading instructions; conduct of compliance assessments of transportation and packaging operations.

The following federal regulations are applicable to WIPP.

The DOT regulations for hazardous/radioactive materials are contained in 49 CFR §§ 171-178. Specifications for the kinds and designs of packages and packagings to be used for the transport of various types of radioactive materials are contained in 49 CFR §§ 173 and 178. Nuclear Regulatory Commission regulations in 10 CFR § 71 establish requirements for packaging, preparation for shipment, and transportation of licensed material and procedures and standards for NRC approval of packaging and shipping procedures for fissile material and for a quantity of other licensed material in excess of a Type A quantity. The DOT regulations in 49 CFR § 174, Subparts A through D and K, address the shipment of radioactive material by rail. Title 49 CFR § 177 provides routing and training requirements for highway shipments of nuclear material. Motor carrier safety regulations are contained in 49 CFR. All vehicles and drivers must meet the requirements.

The WID Waste Operations Section implements applicable DOT and EPA regulations, and DOE Orders for the transport of hazardous waste and hazardous materials from WIPP, including radioactive and nonradioactive materials.

The shipping sites implement applicable DOT and EPA regulations, and DOE Orders for the transport of transuranic waste to WIPP.

3.3.10 Packaging and Transportation of Radioactive Materials

Regulations for transportation of radioactive materials, under the authority of the DOT, are found in 49 CFR Subpart I, "Class 7 (Radioactive) Materials." If the quantity of radioactive material exceeds A_2, as determined by 49 CFR § 173.433, a Type B shipping container (packaging) must be used. Requirements for shipment of Type A quantities of radioactive materials, and

requirements applicable to the Type B packages to be used to transport waste to the WIPP facility, are detailed in the DOT regulations. Regulations for Type B packaging, under the authority of the NRC, are found in 10 CFR § 71, "Packaging and Transportation of Radioactive Materials." The WIPP LWA requires that TRU waste containers shipped to WIPP shall be transported using packages which have had the design certified by the NRC and which have been determined by the NRC to satisfy its QA requirements.

Transportation requirements for shipments of hazardous radioactive wastes (i.e., TRU mixed wastes) are detailed in 40 CFR § 262, Subpart B. The Part 262 appendix provides an example of a hazardous waste manifest and Instructions to waste generators and shippers of hazardous wastes.

Contact-handled TRU waste will be shipped in the TRUPACT-II and HALFPACT. The NRC certified the TRUPACT-II container on August 30, 1989. Since 1989, expansion of the TRUPACT-II payload envelope has been accomplished through applications to the NRC for revisions of the TRUPACT-II Safety Analysis Report for Packaging (SARP) and the Certificate of Compliance (C of C), when applicable. The HalfPACT is a shorter version of the TRUPACT-II; it was designed to transport heavier CH-TRU waste payloads. Recently, a HalfPACT certification test unit was subjected to destructive testing in accordance with test methods described in 10 CFR § 71, Subpart F. The test results will be included in a HalfPACT SARP to be submitted to the NRC for approval in August 1998.

The current revision of the TRUPACT-II C of C, No. 8, expires June 30, 1999. The NRC is reviewing an application for a revision to the TRUPACT-II C of C, submitted in August 1997, which includes a request for timely (five-year) renewal.

Today there are 15 certified TRUPACT-IIs. It is estimated that approximately 45 additional packagings (TRUPACT-II plus HalfPACT) will be required for full-throughput disposal of contact-handled TRU waste at WIPP.

Remote-handled TRU waste will be shipped to the WIPP in a shielded packaging known as the RH-TRU 72-B cask. A SARP for the 72-B cask, submitted December 1996, is being reviewed by the NRC. After NRC approval, a fleet of approximately fifteen 72B casks will be fabricated for full-throughput disposal of remote-handled TRU waste at WIPP.

3.4 Other Significant Accomplishments and Ongoing Compliance Activities

3.4.1 Environmental Compliance Assessment Program

The Environmental Compliance Assessment Program (ECAP) plays a major role in the overall program for environmental protection activities at WIPP. The ECAP was developed to determine if impactive or potentially impactive facility activities protect human health and the environment and if these activities are in compliance with applicable federal, state, and local requirements; with permit conditions/ requirements; and with best management practices.

During 1997, twelve environmental compliance assessments were conducted, which resulted in the identification and implementation of forty-five improvements. The assessed areas included: Underground Storage Tank Requirements; Oil and Gas Surveillance Requirements; Drinking Water Quality Regulations; EMS/ISO 14000; Federal Insecticide, Fungicide, and Rodenticide Act; Special Waste - Infectious, Contaminated Soils, and Manifest Regulations; Cross-Connection Control Plan; Contingency Plan/Emergency Procedures; WIPP National Pollutant Discharge Elimination System Permit Compliance; Hazardous Chemical Reporting Requirements; Material Safety Data Sheet Requirements; and Chlorofluorocarbons.

3.4.2 Site Environmental Management Program

In December 1995, the Site Environmental Management Program was initiated to increase employee awareness of environmental issues. The program consists of a three-phased approach and is aimed at WID managers; however, many program elements target all WID employees. The first phase, the Environmental Awareness Campaign, was completed in 1996. The second and third phases are ongoing awareness programs. The three phases are described below.

Manager's Environmental Handbook

The purpose of the Manager's Environmental Handbook is to provide a brief overview of corporate charters and policies; WIPP policies and procedures; DOE Orders; and the major environmental laws and regulations that directly apply to WIPP. The handbook also contains information on how the ISO 14000 Standards are implemented at WIPP.

Management Environmental Accountability Program

The purpose of the Management Environmental Accountability Program is to educate employees and managers about current environmental issues and to encourage individual and line-management accountability. The program consists of training elements on a variety of environmental subjects. A manager's training packet ensures that current environmental information is conveyed correctly and consistently. The packet will contain an attendance sheet, a pretest, educational text, review questions, exercises, handouts, and a test. The program:

- Establishes WIPP as a proactive, environmentally responsible citizen
- Promotes individual responsibility
- Aligns with the Westinghouse and CAO mission to protect human health and the environment
- Enhances the WID's application to one of the EPA's environmental management programs

3.4.3 ISO 14000 – Standards for Environmental Management

The WID EMS received third-party registration on August 5, 1997. Much of FY 1997 was used to implement the EMS and expand employee understanding of the ISO 14000 Standard.

The Environmental Management System Implementation Document (WP 02-EC.0) was developed to define the roles of WID departments and subcontractors and to implement the EMS and the environmental management policy. WP 02-EC.0 applies to all WID operations and designated WID subcontractors at the WIPP site.

The WID environmental aspects tables were developed, and the aspect and impact tables identify the significant environmental objectives and targets, and the date for implementing each of the significant objectives. The goal for this activity is to ensure a system of continuous environmental improvements and pollution prevention at WIPP. Additionally, EMS training has been provided to the entire WIPP work-force and integrated into sitewide training programs.

In addition, the following actions have been taken in implementing the ISO 14001 program at WIPP.

WID formed an ISO 14001 Integration Team at WIPP. This team includes members from all WID departments. Each member was tasked with providing their department's environmental objectives and targets leading to overall improvement under WIPP's EMS.

Integration of WIPP's ISO 14001 program with other Westinghouse government-owned, contractor-operated (GOCO) programs has been initiated. Westinghouse corporate officials and GOCO ISO 14001 coordinators met on numerous occasions to discuss mutual assistance possibilities. Information sharing has already occurred with benefits to all Westinghouse GOCOs.

Articles on ISO 14001 requirements are being published periodically in issues of the Westinghouse employee newsletter, *TRU-News*. The WID General Manager has spoken of the ISO 14001 program in both all-managers and all-employee meetings. The Environmental Compliance and Support Section (EC&S) of the WID Environment, Safety, and Health Department is responsible for reviewing the EMS Implementation Document, the Environmental Policy, and the Aspects, Impacts, Objectives, and Target Tables annually to ensure that the EMS process remains effective.

3.4.4 Pollution Prevention Committee

The Pollution Prevention Committee was formed in 1993 with representatives from groups generating or working with hazardous and/or large volumes of waste. The committee prepared a waste minimization charter, which outlines the committee's responsibilities.

The Pollution Prevention Committee was formed in 1993 with representatives from groups generating or working with hazardous and/or large volumes of waste. The committee prepared a waste minimization charter, which outlines the committee's responsibilities.

During 1997 the Pollution Prevention Committee accomplished several activities on employee and community awareness of pollution prevention. Those activities are as follows:

On July 19, 1997, the Pollution Prevention Committee participated in Community Day at the WIPP site. The committee set up a booth and talked to approximately 900 visitors from all over New Mexico and Texas about pollution prevention opportunities. The committee also handed out literature about pollution prevention.

During September 1997, the Pollution Prevention Committee participated in the New Mexico State Fair held in Albuquerque New Mexico. Approximately 300 handouts on pollution prevention information were distributed to the public along with a collage of information about pollution prevention and WIPP's role in the activity was on display for fair goers to view.

In April 1997, Earth Day activities took place in conjunction with the Earth Day nation wide celebration. The Pollution Prevention Committee presented ideas to reuse items around the house to make children's crafts. The committee also handed out seedlings and seeds that are native to New Mexico. The seeds were of two species that formerly grew wild in New Mexico, but were killed out by overgrazing and mans intervention.

During 1997 several articles were published in the *TRU-News* (which is a newsletter for WID employees); these articles included the following subjects:

- A wheel of fortune contest about recycling
- Earth Day activities and how to participate
- New toner cartridge contract and recycling process
- Monthly recycling information placed in the TRUPACT-II display at the front gate
- Cigarette butts thrown out of automobiles

The Pollution Prevention Committee made a suggestion to the Picnic Committee of using two- and three-liter soda bottles and decorating them as aliens for center pieces to be used on the tables at the WIPP picnic. The committee

also made a suggestion to the Christmas Committee to make snowflakes out of six pack rings to hang up at the WIPP Christmas party. Both suggestions were implemented and was not only a pollution prevention activity, but also a cost savings to both activities.

3.4.5 Environmental Training

Environmental training was provided to personnel associated with environmental operations at WIPP. Training courses ranged from technical topics (e.g., RCRA sampling); EMS; basic environmental, safety, and health training; and general sitewide training such as the required General Employee Training module. These courses were conducted both on site by WIPP personnel and off site by various contractors.

Table 3.1 - Compliance Status with Major Environmental Regulations Applicable to the WIPP Project	
Statute/Regulation	**Status**
Atomic Energy Act	No radioactive waste was received during CY 1997.
Clean Air Act	No monitoring/reporting required until after receipt of waste.
Clean Water Act	Quarterly inspections of best management practices to comply with (stormwater retention basins) NPDES stormwater general permit (NMR00A021).
Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act	No Land Disposal Units exist at the site. No CERCLA site cleanup required. Reports filed as required under SARA for hazardous substances are maintained on site.
Endangered Species Act	In November 1996, WIPP completed the draft 1996 Threatened and Endangered Species Survey. The survey is part of the analysis required for the SEIS-II. There were no threatened or endangered species located on WIPP land. Individual permits to collect biological samples and to band nonendangered species of raptors are maintained. No threatened and endangered species have been identified. Consultation with federal and state agencies is not required.
Federal Land Policy and Management Act	An MOU between the DOE and the BLM was issued in July 1994. This MOU outlines the responsibilities the BLM and the DOE have with regard to land use management for the withdrawal area.
Federal Insecticide, Fungicide, and Rodenticide Act	All use of pesticides is approved by Industrial Safety and is performed by subcontractors.
Hazardous Materials Transportation Act	Appropriate shipping papers accompany hazardous materials and hazardous wastes shipped off-site to ensure compliance with the HMTA.
National Environmental Policy Act (as supplemented by DOE Order 451.1A, and 10 CFR § 1021)	The 1997 Annual Mitigation Report for the Waste Isolation Pilot Plant (NEPA ID# WIP:97:0001) was issued June 26, 1997, in accordance with the requirement of DOE Order 451.1E, "National Environmental Policy Act Compliance Program." This Order requires DOE facilities to track and annually report progress in implementing a commitment for environmental impact mitigation that is essential to render the impacts of a proposed action nonsignificant or that is made in the ROD.

Table 3.1 - Compliance Status with Major Environmental Regulations Applicable to the WIPP Project	
Statute/Regulation	**Status**
National Historic Preservation Act	Activities requiring excavation in previously undisturbed areas are surveyed by licensed, permitted archaeologists. Required reports are submitted to the New Mexico State Historic Preservation Officer.
New Mexico Air Quality Control Act	During CY 1997 the backup diesel generators were operated for approximately 47 of the 480 hours allowed by the permit. There were no malfunctions or abnormal conditions of operation that would cause a violation of the permit.
New Mexico Radioactive Materials Act	No radioactive wastes had been received at WIPP in CY 1997.
New Mexico Water Quality Act	The DOE submits quarterly discharge monitoring reports to the NMED Groundwater Quality Bureau to comply with the requirements of DP-831.
New Mexico Wildlife Conservation Act	See "Endangered Species Act."
Resource Conservation and Recovery Act	*Hazardous-waste generator compliance:* All site-generated hazardous wastes were transported off site within the 90-day accumulation period. NMED issued a declaration of completeness against Revision 6 of the RCRA Part B Permit Application on June 27, 1996, and is currently drafting the RCRA permit. *Underground Storage Tanks:* Annual registration fee paid.
Toxic Substances Control Act	Procurement of asbestos-/PCB-containing materials not allowed. Other portions of the Toxic Substances Control Act are not applicable.

Table 3.2 - DOE Orders Affecting the WIPP Environmental Program

Order No.	Date	Title	Annotation
DOE 5400.1 Paragraphs 2B, 4B, and 4C of Chapter II, and 2D and 3B of Chapter III are canceled by DOE O 231.1	11/09/88 Change 1 6/29/90	General Environmental Protection Program	Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with federal and state environmental protection laws and regulations, federal executive orders, and internal department policies.
DOE 5400.5 Paragraph 1A(3)(A) of Chapter II is canceled by DOE O 231.1	2/8/90 Change 2 1/7/93	Radiation Protection of the Public and the Environment	Establishes standards and requirements for operations of the DOE and DOE contractors with respect to protection of the public and the environment against undue risk from radiation.
DOE O 451.1A	9/11/95 Change 1 10/26/95	National Environmental Policy Act Compliance Program	Establishes DOE policy for implementation of the National Environmental Policy Act of 1969 (P.L. 91-190).
DOE O 460.1A	10/2/96	Packaging and Transportation Safety	Establishes safety requirements for the proper packaging and transportation of DOE off-site shipments and on-site transfers of hazardous materials and for model transportation.
DOE 5484.1 Paragraphs 1-5, 6a(1)-(10), 6f(1)-(8), and the second misnumbered 6f, and Chapter I and Chapter II are canceled and replaced by DOE O 231.1	2/24/87	Environmental Protection, Safety, and Health Protection Information Reporting Requirements	Establishes the requirements and procedures for the investigation of occurrences that have environment, safety, or health protection significance, and for efficient and environmental monitoring of DOE operations.
AL 5484.1	8/23/82 Change 1 10/24/86	Environmental Protection, Safety and Health Protection Information Reporting Requirements	Albuquerque Operations Office implementation of 5484.1.1E
DOE 5480.23	04/10/92 Change 1 03/10/94	Nuclear Safety Analysis Reports	To establish uniform requirements for the preparation and review of safety analyses of DOE operations that include the following: identification of hazards, their elimination or control, assessment of the risk, and documented management authorization of their operation

Table 3.2 - DOE Orders Affecting the WIPP Environmental Program

Order No.	Date	Title	Annotation
DOE 5482.1B	09/23/86 Change 5 05/10/93	Environmental, Safety and Health Appraisal Program	To establish the Environmental Protection, Safety, and Health appraisal program for the DOE.
DOE O 151.1	9/25/95 Change 1 10/26/95	Comprehensive Emergency Management System	Establishes requirements for comprehensive planning, preparedness, response, and recovery activities of emergency management programs for the DOE or for programs requiring DOE assistance.
DOE 5700.6C	8/21/91 Change 1 5/10/96	Quality Assurance	To provide DOE policy, set forth principles, and assign responsibilities for establishing, implementing, and maintaining programs of plans and actions to ensure quality achievement in DOE programs.
DOE 5820.2A	9/26/88	Radioactive Waste Management	Establishes policies and guidelines by which the DOE manages radioactive waste, waste byproducts, and radioactively contaminated surplus facilities
DOE O 430.1	8/24/95 Change 1 10/26/95	Life-Cycle Assessment Management	To plan, acquire, operate, maintain, and dispose of physical assets as valuable national resources.

Table 3.3
Summary of Agreements Between the DOE and the State of New Mexico That Affect the WIPP Environmental Program

Stipulated Agreement on Civil Action No. 81-0363 JB - This agreement, approved by the U.S. District Court proceedings, held in abeyance in the lawsuit against the DOE by the state of New Mexico, was executed on July 1, 1981. The eight-page agreement assures that a binding, enforceable "consultation and cooperation" agreement will be entered into by the DOE and the state, and that the DOE will make a "good faith effort" to resolve certain state off-site concerns (which are covered in the Supplemental Stipulated Agreement). The Stipulated Agreement also addresses a number of additional studies and experiments to be conducted by the DOE for the Site and Preliminary Design Validation (SPDV) phase of the WIPP facility. This agreement was signed by Jeff Bingaman (Attorney General, State of New Mexico) and Myles Flint (Attorney, U.S. Department of Justice), and was issued July 1, 1981, by Juan G. Burciaga (U.S. District Judge, District of New Mexico).

Agreement for Consultation and Cooperation - Usually referred to as the "C&C Agreement," this agreement is contained in Appendix A to the Stipulated Agreement. It affirms the intent of the Secretary of Energy to consult and cooperate with New Mexico with respect to state public health and safety concerns. It was signed in July 1981 by Bruce King (Governor, State of New Mexico) and James B. Edwards (Secretary, DOE).

Working Agreement for Consultation and Cooperation, Appendix B, Article IV, Revision I - This agreement, Appendix B to the Stipulated Agreement, identifies in Article IV over 60 "key events" and "milestones" in the construction and operation of the WIPP facility that must be reviewed by the state before they are commenced. Many environmental items are included. It was signed in March 1983 by Robert McNeill (Chairman, Radioactive Waste Task Force), and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. DOE). (Article IV of the Working Agreement was revised on April 8, 1983.)

Supplemental Stipulated Agreement Resolving Certain State Off-Site Concerns Over WIPP - This agreement dated December 27, 1982, addresses five state concerns, including the need for state "verification" of the WIPP Environmental Monitoring Program. The concerns addressed are: state liability for a nuclear incident, emergency response preparedness, transportation monitoring of the WIPP facility waste, the WIPP facility environmental monitoring by the state, and upgrading of state highways. It was signed in December 1982 by Bruce King (Governor, State of New Mexico) et al., and R. G. Romotowski (Manager, DOE Albuquerque Operations Office).

First Modification to the July 1, 1981, Agreement for Consultation and Cooperation on WIPP by the State of New Mexico and the U.S. Department of Energy - This modification was signed November 30, 1984, wherein the DOE and the state agree to address certain concerns of the state regarding: (1) the specific mission of the WIPP Project, (2) a demonstration of retrievableness prior to waste emplacement, (3) postclosure control and responsibility, (4) completion of certain additional scientific testing and reports, (5) compliance with applicable federal regulatory standards for waste repositories, and (6) a program for encouraging and reporting on the hiring of New Mexico residents at the WIPP Project. It was signed in November 1984 by Joseph Goldberg (Secretary, Health and Environment Department, State of New Mexico), and R. G. Romotowski (Manager, DOE Albuquerque Operations Office).

Second Modification to the July 1, 1981, Agreement for Consultation and Cooperation on the WIPP by the State of New Mexico and the U.S. Department of Energy - Signed August 4, 1987, wherein the DOE and the state agree to address certain concerns of the state regarding: (1) surface and subsurface mining and drilling after closure of the WIPP site, (2) the disposal of salt tailings at the WIPP site, and (3) compliance with U.S. EPA, U.S. DOT, and U.S. NRC regulations. It was signed in August 1987 by Garrey Carruthers (Governor, State of New Mexico) et al., and R. G. Romotowski (Manager, DOE Albuquerque Operations Office).

1988 Modification to the Working Agreement of the Consultation and Cooperation Agreement Between the U.S. Department of Energy and the State of New Mexico on the Waste Isolation Pilot Plant - This modification deleted the sorbing tracer test from the list of required reports and substituted additional tests. In addition, the state is allowed to operate a fixed-air sampler in the mine ventilation effluent air stream. It was signed in March 1988 by Kirkland Jones Deputy Director, New Mexico Environmental Improvement Division, State of New Mexico) et al., and R. G. Romotowski (Manager, DOE Albuquerque Operations Office).

Environmental Oversight and Monitoring Agreement - This agreement states that the DOE will provide additional technical and financial support for state activities in environmental oversight, monitoring, access, and emergency response to ensure compliance with applicable federal, state, and local laws at several DOE facilities, including the WIPP facility. It was signed in October 1990 by Garrey Carruthers (Governor, State of New Mexico; Dennis Boyd, Secretary, Health and Environment Department; and Bruce G. Twining, Manager, DOE Albuquerque Operations Office).

Site-Specific Protocol for Implementation of the Environmental Oversight and Monitoring Agreement - Signed October 23, 1992, this protocol describes the site-specific protocol for day-to-day activities involving the NMED and the DOE contract personnel stationed at WIPP. This protocol is a result of the "Environmental Oversight and Monitoring Agreement of 1990" between the state of New Mexico and the DOE. It is designed within the context of the unique nature and purpose of WIPP.

Table 3.4 - Active Environmental Permits for the Waste Isolation Pilot Plant
(Does Not Include RCRA Permits)

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WID Owner	Signed By Title/Date	Signed For
Department of the Interior, Bureau of Land Management	Right-of-Way for Water Pipeline	NM53809	08/17/1983	None	Active (in perpetuity)	Engineering	Issued by BLM - WIPP signature not required 08/17/83	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for the North Access Road	NM55676	08/24/1983	None	Active (in perpetuity)	Facility Operations	Issued by BLM - WIPP signature not required 08/24/83	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for Railroad	NM55699	09/27/1983	None	Active (in perpetuity)	Facility Operations	Issued by BLM - WIPP signature not required 09/27/83	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for Dosimetry and Aerosol Sampling Sites	NM63136	07/31/1986	07/31/2111	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required 07/31/86	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for Seven Subsidence Monuments	NM65801	11/07/1986	None	Active	Mine Engineering	Issued by BLM - WIPP signature not required 11/07/86	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for Aerosol Sampling Site	NM77921	08/18/1989	08/18/2019	Active	Environmental Monitoring	Issued by BLM - WIPP signature not required 09/18/89	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for Ten Raptor Nesting Platforms	NM82212	09/12/1989	12/13/2019	Active	Environmental Monitoring	N/A - Raptor platforms are inside WIPP 16 sections, therefore Right-of-Way does not apply	DOE-CAO
Department of the Interior, Bureau of Land Management	Right-of-Way for Survey Monument Installation	NM82245	12/13/1989	12/13/2019	Active	Mine Engineering	Issued by BLM - WIPP signature not required 12/13/89	DOE-CAO
New Mexico State Engineer Office	H-14 and H-15 test wells	NM1469 & NM1470	10/18/1986	None	Active	Environmental Monitoring (SNL/DOE)	J. W. Mercer, SNL Engineering Products Div. 7133 10/12/86 (Permit application not dated. Application received at State Eng. Office 10/12/86)	DOE-CAO

Table 3.4 - Active Environmental Permits for the Waste Isolation Pilot Plant
(Does Not Include RCRA Permits)

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WID Owner	Signed By Title/Date	Signed For
Department of the Interior, Bureau of Land Management	Free Use Permit for Caliche	NM96943	01/09/1997	01/09/2000	Active	Environmental Monitoring	D. C. Lynn, WIPP Land Use Coordinator 06/06/1995	DOE-CAO
New Mexico Environment Department Groundwater Bureau	Discharge Permit	DP-831	07/03/1997	07/03/2002	Active	EC&S and Facility Operations	G. E. Dials, Manager 12/16/1996	DOE-CAO
New Mexico Environment Department	Operating Permit for two backup diesel generators	310-M-2	12/07/1993	None	Active	EC&S and Facility Operations	A. E. Hunt Project Manager 06/18/1993	DOE-CAO
New Mexico Department of Game and Fish	Individual Banding	#1961	04/01/1997	12/31/1999	Active	Environmental Monitoring	Permit - for use by WIPP	DOE
New Mexico Department of Game and Fish	Master Collecting	#1894	06/05/1996	12/31/1998	Active	Environmental Monitoring	Permit - for use by WIPP	DOE
New Mexico Department of Game and Fish	Concurrence that WIPP construction activities will have no significant impact on state-listed threatened or endangered species	None 07/25/1983 None Active	05/26/1989	None	Active	Environmental Monitoring	N/A	N/A
Department of the Interior, Fish and Wildlife Service	Master Personal Banding	#22478	05/19/1993	Auto. renewed every 3 years	Active	Environmental Monitoring	Permit - for use by WIPP	DOE
Department of the Interior, Fish and Wildlife Service	Concurrence that WIPP construction activities will have no significant impact on federally-listed threatened or endangered species	None	05/29/1980	None	Active	Environmental Monitoring	N/A	N/A
New Mexico State Engineer Office	Exploratory: Exhaust Shaft Exploratory Boreholes	C-2527-Expl. C-2528-Expl.	05/09/1997	05/31/1998	Active	EC&S and Geotechnical Engineering	E. K. Hunter, Asst. Manager ONTWO 05/06/1997	DOE-CAO

Table 3.4 - Active Environmental Permits for the Waste Isolation Pilot Plant
(Does Not Include RCRA Permits)

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Current Permit Status	WID Owner	Signed By Title/Date	Signed For
New Mexico State Engineer Office	Appropriation: Exhaust Shaft Exploratory Borehole	C-2505 C-2506 C-2507	12/06/1996	12/31/2000	Active	EC&S and Geotechnical Engineering	E. K. Hunter, Asst. Manager ONTWO 09/10/1997	DOE-CAO
New Mexico State Engineer Office	Appropriation: WQSP Wells 1 through 6a	C-2413 through C-2419	10/21/1996	None	Active	EC&S and Environmental Monitoring	E. K. Hunter, Asst. Manager ONTWO 07/03/1996	DOE-CAO
New Mexico State Engineer Office	Appropriation: H-19 Wells H-19b0 through H-19b7-19 b1 abandoned, not permitted	C-2420 through C-2426	1/25/1995	1/31/1998	Active	EC&S and Environmental Monitoring	Harold F. Klaus, Jr. 11/09/1994	DOE-CAO
New Mexico Environment Department-UST Bureau	Registration of 2 Underground Storage Tanks	NM 04881 (Number changes annually)	07/01/1997	06/30/1998	Active	EC&S and Facility Operations	V. Daub, Deputy Project Site Manager 06/18/1992	DOE-CAO
Environmental Protection Agency	New Mexico NPDES Storm Water General Permit (Submitted Notice of Intent for Storm Water Discharges Associated with Industrial Activity under a NPDES General Permit, Multi-Sector Group Permit on 08/29/1997, submitted additional information 01/08/1998)	NMR00A021 (NMR05A225 pending)	12/31/1992 (Submitted 8/29/1997)	09/09/1997	Active (Pending)	EC&S	A. E. Hunt, Project Manager (as Operator) A. L. Trego, General Manager (as Co-Operator) 09/25/1992 *[Permit renewal due 09/09/1997 Permit renewal application will be signed by DOE-CAO only]*	DOE-CAO
New Mexico Commissioner of Public Lands	Right-of-Way for High Volume Air Sampler	RW-22789	10/03/1985	10/03/2020	Active	Environmental Monitoring	Permit - for use by WIPP	DOE

CHAPTER 4 ENVIRONMENTAL PROGRAM INFORMATION

WIPP's policy is to conduct its operations in a manner commensurate with all applicable environmental laws and regulations.

4.1 Environmental Monitoring Plan

WIPP's EMP outlines programs that monitor a comprehensive set of parameters to detect and quantify present and future environmental impacts. Nonradiological portions of the plan focus on the immediate area surrounding the site.

The purpose of the EMP is to prescribe programs that evaluate WIPP's effect on the local ecosystem. Evaluation of the severity, geographic extent, and environmental significance are important to the mission of the facility. The EMP sampling schedule is provided in Table 4.1.

The EMP describes the monitoring of naturally occurring and specific anthropogenic radionuclides. This surveillance has included the monitoring of worldwide fallout. The geographic scope of radiological sampling is based on projections of potential release pathways from the stored waste at WIPP. Surrounding population centers are also monitored.

Results and discussions pertaining to respective monitoring programs prescribed by the EMP are provided in Chapter 5, "Environmental Radiological Program Information," and Chapter 6, "Environmental Nonradiological Program Information."

DOE Order 5400.1 requires the EMP to be reviewed internally every year and updated every three years. The most recent EMP update was in September 1996. Under the NEPA regulations and DOE Orders 5400.1 and 5400.5, WID is required to monitor the environment annually as a part of the ongoing mission to protect the public and the environment.

4.2 Baseline Data

Four programs are currently in place within the WIPP Environmental Monitoring Section: (1) Land Management Programs (includes the WIPP Raptor Program) (Section 4.3), (2) Environmental Radiological Assessment (Chapter 5), (3) Nonradiological Program Information (Chapter 6), and (4) WIPP Groundwater Surveillance Programs (Chapter 7). The purpose of these programs is to collect the data needed to detect and quantify possible impacts that construction and operational activities at WIPP may have on the surrounding ecosystem. Also, when necessary, provide technical support for issues that require technical expertise in the disciplines of environmental science or land management. The data are used to assess impacts of WIPP operations on the environment and to demonstrate compliance with applicable standards for radiological and nonradiological programs.

Preoperational studies must be considered during environmental evaluations. These assessments have contributed to baseline data gathered during the construction phase and provided much of the foundation for long-term monitoring programs. Examples of such investigations include the following:

- WIPP Site Characterization Program - instituted in 1976 by Sandia National Laboratories to monitor air quality, background radiation levels, and groundwater quality (Pocalujka et al., 1979; 1980a, b, c; 1981a, b; Powers et al., 1978; Lappin, 1989).
- WIPP Biology Program - began in 1975 with site characterization studies of climate, soils, vegetation, arthropods, and vertebrates (Best, 1980).
- Investigations of the Site Geohydrology - conducted by the U.S. Geological Survey (USGS) at the request of the DOE. In

addition, the NRC issued a contract to Columbia University to perform a study of radionuclide mobility in the highly saline groundwaters of the Delaware Basin (USGS, 1983).

- Radiological Monitoring of Air, Water, and Biological Media - conducted by the U.S. Atomic Energy Commission before and after the Project Gnome nuclear detonation (U.S. Atomic Energy Commission, 1962a, b, c, d).

4.3 Land Management Programs

On October 30, 1992, the LWA became law. This act transferred the responsibility for the management of the WIPP Land Withdrawal Area from the Secretary of the Interior to the Secretary of Energy. In accordance with Sections 3(a)(1) and (3) of the act, these lands:

> . . . are withdrawn from all forms of entry, appropriation, and disposal under the public land laws . . . and are reserved for the use of the Secretary of Energy . . . for the construction, experimentation, operation, repair and maintenance, disposal, shutdown, monitoring, decommissioning, and other activities associated with the purposes of WIPP as set forth in Section 213 of the DOE National Security and Military Application of the Nuclear Energy Act of 1980 (P.L. 96-164; 93 Stat. 1259, 1265) and this Act.

The DOE developed the LMP as required by Section 4 of the WIPP Land Withdrawal Act. The development of this plan was in consultation and cooperation with the DOI's BLM and the state of New Mexico. Changes or amendments to the plan require the involvement of the BLM, the state of New Mexico, and affected stakeholders, as appropriate.

The LMP, as required by the LWA, was developed to identify resource values, promote the concept of multiple-use management, and identify long-term goals for the management of WIPP lands until the culmination of the decommissioning phase. The plan also provides the opportunity for participation in the land use planning process by the public and local, state, and federal agencies.

The LMP was prepared through the integration of the LWA, BLM planning regulations (43 CFR § 1600) issued under the authority of the Federal Land Policy and Management Act of 1976, the NEPA, as amended, and existing MOUs among the DOE and local, state, and/or federal agencies. The LMP is designed to provide a comprehensive framework for the management and coordination of WIPP land uses during the life of the project. The LMP, and any subsequent amendments, will continue through the decommissioning phase.

Guidelines in the LMP provide for the management and oversight of WIPP lands under the jurisdiction of the DOE in addition to lands outside the WIPP boundary used in the operation of WIPP (e.g., groundwater surveillance well pads outside the withdrawn area). Furthermore, the plan provides for multiagency involvement in the administration of DOE land management actions. The LMP, in addition to any documents referenced therein, is available to person(s) and/or organization(s) desiring to conduct activities on lands under the jurisdiction of WIPP in addition to those involved in development and/or amending existing land management actions. These documents can be obtained from the U.S. Department of Energy, Carlsbad Area Office, P.O. Box 3090, Carlsbad, New Mexico 88221-3090.

The LMP envisions and encourages direct communication among stakeholders, including federal and state agencies involved in managing the resources within, or activities impacting the areas adjacent to, the WIPP Land Withdrawal Area. It sets forth cooperative arrangements and protocols for addressing WIPP-related land management actions. The DOE recognizes the guidelines for

contemporary land management practices that pertain to rational adherence with edicts in the WIPP Land Withdrawal Area and all applicable regulatory requirements contained therein. Commitments contained in current permits, agreements, or concurrent MOUs with other agencies (e.g., state of New Mexico, DOI), will be adhered to when addressing/evaluating land use management activities and future amendments that affect the management of WIPP lands.

The LMP is reviewed on a biennial basis to assess the adequacy and effectiveness of the document, or as may be necessary to address emerging issues potentially affecting WIPP lands. Affected agencies, groups, and/or individuals may be involved in the review process. Components of the LMP emphasize management protocols for the following issues: administration of the plan, environmental compliance, wildlife, cultural resources, grazing, recreation, energy and mineral resources, lands/realty, reclamation, security, industrial safety, emergency management, maintenance, and work control. Each issue and its complementary planning/management criteria are described in respective chapters of the document.

4.3.1 Land Management and Environmental Compliance

Parties who desire to conduct activities that impact lands under the jurisdiction of WIPP, outside the inner core of the facility designated as the Property Protection Area, are required to prepare a Land Use Request (LUR). An LUR consists of a narrative description of the project, a completed environmental review, and a map depicting the location of the proposed activity. The LUR is used to determine if applicable regulatory requirements have been met prior to the approval of a proposed project. An LUR is submitted to the land use coordinator by any WIPP organization or outside entity wishing to complete any construction, rights-of-way, pipeline easements, or similar actions within the WIPP site boundary and on lands used in the operation of WIPP, under the jurisdiction of the DOE.

4.3.2 Wildlife Population Monitoring

WIPP is involved in the planning of wildlife investigation and management projects. Recommendations for approaches, potential prospectuses, and proposed investigational plans are evaluated. Tools, techniques, and personnel available for conducting investigations and achieving management objectives are examined. These criteria are essential to wildlife objectives for effective planning related to choices between alternatives, establishment of realistic constraints (e.g., time, funding, manpower), practicality, or expediency in the development of efficient research methodology.

The LUR process provides consideration to wildlife within the WIPP Land Withdrawal Area during planning stages of projects involving the disturbance or encroachment of wildlife habitat inside DOE lands. Monitoring and research of specific wildlife populations occur in accordance with applicable laws, agreements, and regulations subject to funding and personnel constraints.

WIPP conducts a number of general wildlife management activities. Each activity is mandated and/or supported by state and federal guidelines or by way of commitments created through interagency agreements (e.g., Raptor Research and Monitoring Interagency Agreement) and/or MOUs.

Examination of wildlife species in the area reveals significant diversity and complexity. Management of indigenous wildlife incorporates the development of a logical sequence when programming activities. Solutions for problems (e.g., home-range, territoriality) serve the implementation of conservation and resource management objectives as they pertain to the management and operation of the WIPP site.

Affected Biological and Wildlife Environment

The wildlife habitat around WIPP is categorized in accordance with the BLM's standardized habitat sites subsequent to a detailed integrated habitat inventory classification system. WIPP lands comprise a small part of those lands grouped into major habitat types as described in Appendix L-2 of the East Roswell Grazing EIS. Moreover, habitat types and species inventories were conducted for the DOE during initial site characterization studies as described in the WIPP Biology Program, the FEIS, the SPDV studies, and the EMP (DOE/WIPP 92-040). Wildlife in the vicinity of WIPP is characterized by a wide variety of insects, amphibians, reptiles, birds, and mammals.

The Chihuahuan desert has long been regarded for its extraordinary diversity of plant and animal communities. The location of WIPP, situated in the Los Medaños region of the Chihuahuan desert, exemplifies this unusual array of biotic factors. Los Medaños is in an area of intergradation between the northern region of the Chihuahuan desert and the Llano Estacado (Staked Plains). The region is characterized by aeolian and alluvial sedimentation on upland plains that form hummocks, dunes, sand ridges, and swales with the presence of Havard shinnery oak as a prominent foliar factor. Although the abundance of shinnery oak has aided in the stabilization of the dunes, a number of them remain unstable and exhibit distinct signs of shifting. An additional predominant shrub is honey mesquite, which has invaded what at one time was a short-grass, shinnery oak-dominated landscape.

As with many areas, the shinnery oak community has shifted from a dominant bluestem/grama grassland with varying amounts of shinnery oak, sand sage, and yucca to a composition dominated by dropseeds, three-awns, and gramas, with high densities of plains yucca, annual forbs, and mesquite.

According to the BLM's Resource Management Plan, 15 percent of the wildlife species identified in the resource area use the shinnery oak habitat, with 30 percent occupying areas consisting primarily of grass compositions with greater than 75 percent grasses in the description of the potential plant community.

The subtle blend of plant communities with shinnery oak/dune habitat that somewhat dominates grassland affords a composition of factors that results in the diverse wildlife population of the Los Medaños region.

Wildlife populations are characterized by numerous species of arthropods, amphibians, reptiles, birds, and mammals. Now and then, aquatic mollusks, inhabitants of local stock ponds and livestock drinking units, are observed. Jerusalem crickets (*Stenopelmatus fuscus*) are an example of one order of insects that occupy the locality of WIPP.

Red-spotted toads (*Bufo punctatus)* and New Mexico spadefoot toads (*Spea hammondi)* are two examples of no fewer than ten different species of indigenous amphibians. Their significance is seldom recognized until spring or summer rains, at which time they appear in extraordinary numbers.

Reptiles comprise more conspicuous inhabitants due to the diurnal nature of numerous species. Ornate box turtles (*Terrapene ornata),* desert side-blotched lizards (*Uta stansburiana),* and Texas horned lizards (*Phrynosoma cornutum),* a federal notice-of-review species listed under the Endangered Species Act, represent three of approximately 35 distinct species of indigenous reptiles. Moreover, three species of rattlesnake can be encountered in the area.

Bird densities vary according to preferable food and habitat availability. The habitat heterogeneity of the Los Medaños region accounts for a wide assortment of bird species that inhabit the area either as seasonal transients or permanent residents. Large numbers of

mourning dove (*Zenaida macroura*), pyrrhuloxias (*Cardinalis sinuata*), and black-throated sparrows (*Amphispiza bilineata*) are frequently observed. A unique desert subspecies of the northern bobwhite (*Colinus virginianus*), scaled quail (*Callipepla squamata*), and an occasional lesser prairie chicken (*Typanuchus pallidicinctus*) depict the gallinaceous inhabitants. Due to a scarcity of surface waters in the immediate vicinity of WIPP, migrating or breeding waterfowl are not considered common.

The area supports a particularly abundant and diverse population of raptors, or birds of prey. Harris hawks (*Parabuteo unicinctus*), Swainson's hawks (*Buteo swainsoni*), and great horned owls (*Bubo virginianus*) illustrate species commonly found nesting in the area. The density of large avian-predator nests is generally regarded as a predominant raptor breeding population.

As is common in desert biomes, black-tailed jackrabbits (*Lepus californicus*) and desert cottontails (*Sylvilagus audoboni*) are the most conspicuous mammals. Three species of ground squirrel (*Spermophilus spp.*) and numerous other rodents such as kangaroo rats (*Dipodomys spp.*) and cactus mice (*Peromyscus eremicus*) also occupy the area. Large piles of debris, which may consist of aluminum cans, cow dung and other rubbish (sometimes to a height of nearly five feet), clustered at the base of cactus or large mesquites, characterize the houses (or "middens") of the southern plains woodrat (*Neotoma micropus*). Although specimens rarely exceed weights of 300 grams, several woodrats that weighed nearly 500 grams have been captured by WIPP biologists near WIPP. Big-game species, such as desert mule deer (*Odocoileus hemionus*), and carnivores such as coyotes (*Canis latrans*) and badgers (*Taxidea taxis*), also frequent the area.

The DOE consulted with the United States Fish and Wildlife Service (USF&WS) in 1979 to determine the presence of threatened or endangered species at or near the WIPP site. At that time, the USF&WS listed the Lee pincushion cactus (*Coryphantha sneedi* var. *leei*), the black-footed ferret (*Mustela nigripes*), the American peregrine falcon (*Falco peregrinus anatum*), and the bald eagle (*Haliaeetus leucocephalus*) as threatened or endangered that could occur on lands within or outlying the WIPP site. However, no critical habitat for endangered species was identified at WIPP.

In 1989, the DOE again consulted with the USF&WS to update the list of threatened and endangered species. The agency advised the DOE that the list of species provided in 1979 was still valid.

During 1989, the DOE consulted with the NMDG&F regarding the state-listed endangered species in the vicinity of WIPP. NMDG&F Regulation 657, dated January 9, 1988, listed seven birds and one reptile in one of two endangerment categories that occur or are likely to occur at the site.

During 1995, the USF&WS transmitted the April 24, 1995, updated list of threatened and endangered species (including a Notice of Review) for Eddy and Lea Counties, New Mexico. Inclusive were approximately 18 species that occur or are likely to occur on WIPP lands. Accordingly, the list was disseminated to pertinent WID departments for consideration and incorporation into applicable documents. A comprehensive evaluation in support of the SEIS-II was conducted during CY 1996 to determine the presence/absence of threatened and/or endangered species in the vicinity of WIPP. Results indicated that activities associated with the operation of WIPP have no impact on any threatened or endangered species. Considerations pertaining to protected species are implemented in accordance with pertinent management plan(s) during the deliberation and administration of projects conducted on WIPP lands.

Population density measurements of birds and small nocturnal mammals, initiated in 1985,

were performed annually to assess the effects of WIPP surface activities (e.g., construction, salt piles) on wildlife populations. Customary protocol involved comparative data analyses between two outlying or "control" plots and two experimental plots situated in proximity to WIPP operations. A Hantavirus investigation during CY 1994 prompted the temporary postponement of small nocturnal mammal surveys. As previous years' investigations revealed no detectable detrimental impacts from salt encroachment on the peripheral environment, annual appraisals of small mammal populations have been discontinued indefinitely.

WIPP Raptor Program

During CY 1997, the WRP enhanced both the field research and the wildlife education components of the program. Data were collected on resident raptors (eagles, hawks, falcons, and owls) within an area of approximately 870 square miles in the vicinity of WIPP, with WIPP as the center of the area. The majority of the area is managed by the DOI's BLM Carlsbad Resource Area office. The WRP is a cooperative effort between the BLM and DOE that was commissioned through the bilateral development of an interagency agreement. The agreement defines commitments of behalf of each respective agency, including deliverables and itemized time lines for the completion of each element.

In CY 1997, research was continued on long-term studies of productivity and population demographics of the raptor community in and around WIPP. Other studies that specifically targeted the behavioral ecology of the Harris hawk were started. The WRP was invited to join in an international effort to study the Swainson's hawk and initiated deeper studies on the species.

The CY 1997 survey period indicated that raptor populations are starting to recover from drought conditions that characterized the past several years. Seventeen Harris hawk active nests were located and studied, and 15 Swainson's hawk nests were located. Great-horned owls, burrowing owls, and Chihuahuan ravens were also examined as part of the program.

The mean group size for 25 Harris hawk groups was 2.12 hawks per group and helpers were uncommon. In a sample of 25 breeding groups of Harris hawks, fledging success was 1.520 young per nest (for all nests) and 2.235 young per nest (for successful nests). Productivity among Swainson's hawk pairs (n=22) was 1.910 young per nest (all nests) and 2.333 young per nest (successful nests). Eight nest failures were recorded among Harris hawks.

The education program, designed to promote a deeper understanding of natural history, raptors, and the WRP among local school children, was greatly enhanced in CY 1997. A presentation format using live animals was developed and implemented for use in the intimate environment of the classroom. Although this format is more time-intensive than presenting to large groups, it was decided that the benefits of affording children a close look at native wildlife outweighed any disadvantages. Classroom presentations were made in 67 classrooms throughout Carlsbad, Jal, Santa Fe, Albuquerque, Las Vegas, and Los Alamos, New Mexico (an estimated 2,200 students attended the presentations). Other presentations were given to senior citizen groups and special interest groups in the Carlsbad area. Personnel from the WRP also participated in presentations held at the WIPP site and were active in the Shadowing Program.

4.3.3 Reclamation of Disturbed Lands

The DOE recognizes responsibilities pursuant to applicable federal, state, and local environmental regulations to enhance and restore areas affected by WIPP activities, including areas disturbed prior to WIPP activities that were accepted as part of the land transfer from the BLM to the DOE. These obligations

include protocols designed to be revised as needed and are no way limited, except by law, to revisions based on new techniques for reclamation and new plans that WIPP may incorporate in the future. WIPP reclamation activities are conducted in accordance with the Environmental Protection Implementation Plan (DOE/WIPP 90-050); DOE Order 5400.1; the DOE Organization Act (42 U.S.C. § 7112); the Federal Land Policy and Management Act of 1976 (P.L. 94-579); the SEIS-I; the FEIS; and all applicable reclamation requirements by federal laws and regulations, Executive Orders, MOUs, DOE Orders, and state and local laws. These commitments encompass any unforeseeable future mandates or amendments to existing regulations.

In accordance with the LMP, WIPP implements a contemporary reclamation program and corresponding long-range reclamation plans. As locations are identified for reclamation, WIPP personnel reclaim these areas by using the best acceptable reclamation practices. Seed mixes used reflect those species indigenous to the vicinity with priority given to those plant species which are conducive to soil stabilization, wildlife, and livestock needs.

Without an active reclamation program, the establishment of stable ecological conditions in arid environments may require decades or centuries to achieve, depending on natural and unnatural disturbances and environmental conditions present during the entirety of the reclamation process. Reclamation activities are intended to reduce soil erosion, increase the rate of plant colonization and succession, and provide habitat for wildlife in disturbed areas. In addition to maintaining the compliance posture of WIPP with respective external entities, reclamation ultimately serves to mitigate the effects of WIPP-related activities on affected plant and animal communities. The objective of the DOE reclamation program is to return lands used in the operation of WIPP that are no longer commissioned for WIPP operations to a stable ecological condition. Plant species and topography of the reclaimed area are indicative of the vicinity. It is the intent of the DOE to establish reclamation guidelines for land use requestors.

Reclamation activities during CY 1997 consisted of working in problem areas (e.g., drainages, eroded slopes, etc.) on existing reclamation sites where additional stabilization measures were employed. Existing fences left in place were repaired as necessary.

4.3.4 Oil and Gas Surveillance

Surveillance of oil and gas activities within one mile of the WIPP boundary were conducted throughout CY 1997 in accordance with the BLM/DOE MOU. Oil and gas activities within the defined land sectors are monitored twice monthly to identify new activities associated with oil and gas exploration/production, including:

- Drilling
- Survey staking
- Geophysical exploration
- Pipeline construction
- Work-overs
- Changes in well status
- Anomalous occurrences (e.g., leaks, spills, accidents, etc.)

The oil and gas industry is well established in the Los Medaños region of New Mexico (the vicinity of WIPP), with producing oil and gas fields, support services, and compressor stations. Nearly all phases of oil and gas activities have occurred in the locality. These phases include seismic exploration, exploratory drilling, field development (comprised of production and injection wells), and sundry other activities associated with hydrocarbon extraction.

As identified in the BLM's Oil and Gas Potential Occurrence Zones, the Los Medaños region is located in a region designated as having a "high potential for oil and gas occurrence." This region, part of the Delaware Basin, is bordered by the Capitan Reef. Most hydrocarbon extraction has occurred outside the

basin, within the reef. Although the Delaware Basin accounts for approximately 32 percent of lands in Eddy County, only 17 percent of the oil and gas wells are located within its boundaries.

During 1995, oil and gas reserves in the immediate vicinity of the WIPP Land Withdrawal Area were evaluated by the New Mexico Bureau of Mines and Mineral Resources. Results from this evaluation were compiled in a report, Evaluation of Mineral Resources at the Waste Isolation Pilot Plant Site, March 31, 1996.

During CY 1997, WIPP surveillance teams conducted 24 routine surveillances, with cursory inspections and additional surveillances as required. One well, for example, designated as Apache 25 Fed. #6, was drilled by Mitchell Energy within 330 feet of the WIPP site boundary. In addition to land management personnel conducting on-site visits to the well location, customary stipulations for approval were requested on behalf of the DOE. Accordingly, Mitchell Energy provided daily drilling records to the WIPP Office of Land Management. These records included all of the elements required to drill the subject well (e.g., date of well spudding, drilling rates, depths, degree of deviation, perforation horizons, initial production rates, etc.). These records were used as a means of correlating the horizontal displacement of the well bore with the WIPP site boundary. The subject well was drilled to a depth of 7,870 feet with a total maximum deviation from vertical of 145.18 feet.

To date, no wells drilled in the vicinity have exceeded the interval between bottom hole location and the WIPP site boundary. Routine oil and gas surveillance activities continue on a bimonthly basis with supplementary oversight conducted as conditions warrant.

Table 4.1 - Environmental Monitoring Plan Sampling Schedule		
Type of Sample	Sampling Locations	Sampling Frequency
Liquid Effluent	1	Semiannual (oversight)
Liquid Effluent	1	Quarterly (DP 831 permit)
Meteorology	2	Continuous
Atmospheric Particulate @ CBD (Carlsbad) MLR (Mills Ranch) SMR (Smith Ranch) WEE (WIPP East) WFF (WIPP Far Field) SEC (South East Control) WSS (WIPP South)	7	Weekly
Vegetation	6	Annual
Beef/Deer/Game Birds/Rabbits	As available	Annual
Soil	6	Annual
Surface Water	13	Annual
Groundwater	7	Twice a year
Fish	3	Annual
Sediment	10	Annual
Aerial Photography	1	Annual

THIS PAGE LEFT INTENTIONALLY BLANK

CHAPTER 5 ENVIRONMENTAL RADIOLOGICAL ASSESSMENT

5.1 Airborne Gross Alpha/Beta

Inhalation and ingestion are the two main routes of intake of radionuclides in humans from the environment. Measurements of gross alpha and beta activities in airborne particulates provide instant information on the radiological conditions of the area being monitored. Therefore, gross alpha and beta measurements were performed on the air particulate samples collected around the WIPP site.

Airborne particulate samples were collected from seven different locations around the WIPP site: South East Control (SEC), Carlsbad (CBD), Mills Ranch (MLR), Smith Ranch (SMR), WIPP East (WEE), WIPP Far Field (WFF), and WIPP South (WSS). These locations are shown in Figure 5.1.1. Samples were collected every week (~600 m^3) on Whatman micro fiberglass filters (4.7 cm) using low-volume continuous air samplers. The samples were collected at sample heights to closely match the air inhaled by humans. Filters were counted for gross alpha and beta after five to seven days to ensure that the short-lived radon daughters had appropriately decayed.

Blank air filters were also analyzed to measure the gross alpha and beta activities so that the background corrections (activity present in blank filter papers) could be made in the gross alpha and beta measurements of the air samples.

Gross alpha and beta counts were measured in blank filter paper weekly along with the samples. Counts obtained for blank filter paper were then subtracted from the counts obtained for the samples to get the net gross alpha and beta counts for the sample. The net gross alpha and beta activities/m^3 of air were then determined by dividing the net total activity of gross alpha and beta found in each weekly sample by the amount of air pulled through each sample. The results are given in Appendix B.

The results on gross alpha activities found for weekly samples ranged from -0.034 ± 0.025 to 0.113 ± 0.049 mBq/m^3 at CBD, from -0.064 ± 0.042 to 0.118 ± 0.050 mBq/m^3 at SMR, from -0.046 ± 0.041 to 0.081 ± 0.046 mBq/m^3 at WFF, from -0.052 ± 0.044 to 0.084 ± 0.039 mBq/m^3 at WSS, from -0.043 ± 0.043 to 0.090 ± 0.039 mBq/m^3 at MLR, -0.035 ± 0.043 to 0.096 ± 0.040 mBq/m^3 at SEC, and from -0.041 ± 0.045 to 0.080 ± 0.040 mBq/m^3 at WEE. The maximum alpha activities found at these locations ranged from 0.08 ± 0.04 mBq/m^3 (at WEE) to 0.12 mBq/m^3 of air (at SMR). In other words the highest gross alpha activities found in the vicinity of WIPP is 0.12 ± 0.05 mBq/m^3 of air. The mean gross alpha activities (± 2 SD) found at all locations ranged from 0.019 ± 0.050 mBq/m^3 (at WFF) to 0.029 ± 0.062 mBq/m^3 of air (at SMR). The overall mean concentration of gross alpha activities measured in 345 air filter samples collected weekly at all locations was 0.024 ± 0.055 (± 2 SD) mBq/m^3 of air. The results are summarized in Table 5.1.1.

Similarly, the results on the measurements of gross beta activities on weekly air filter samples varied from week to week, ranging from -0.222 ± 0.056 to 1.05 ± 0.126 mBq/m^3 at CBD, from -0.047 ± 0.111 to 1.10 ± 0.136 mBq/m^3 at SMR, from -0.143 ± 0.106 to 1.38 ± 0.149 mBq/m^3 at WFF, from -0.140 ± 0.107 to 1.14 ± 0.125 mBq/m^3 at WSS, from -.165 ± 0.108 to 1.19 ± 0.141 mBq/m^3 at MLR, from -0.139 ± 0.110 to 1.25 ± 0.138 mBq/m^3 at SEC, and from -0.106 ± 0.109 to 1.13 ± 0.138 mBq/m^3 at WEE. The maximum gross beta activities found at these locations ranged from 1.05 ± 0.13 mBq/m^3 (at CBD) to 1.38 ± 0.15 mBq/m^3 (at WFF). These results suggest that the maximum gross beta activities found in the vicinity of WIPP is 1.38 ± 0.15 mBq/m^3 of air. The mean gross beta activities (± 2 SD) found at all these locations ranged from 0.604

± 0.406 mBq/m^3 (at SMR) to 0.641 ± 0.452 mBq/m^3 (at MLR). The overall mean concentration of gross beta activities measured in the 345 air filter samples collected in CY 1997 was 0.627 ± 0.445 mBq/m^3 of air. These results are summarized in Table 5.1.1.

Table 5.1.1
Summary of Gross Alpha and Beta Activities Found in Air Particulate Samples Collected Weekly at Various Locations

Location	Gross Alpha Activity (mBq/m^3)			Gross Beta Activity (mBq/m^3)		
	Min. ± TPU (2σ)	Max. ± TPU (2σ)	Mean ± 2 SD	Min. ± TPU (2σ)	Max. ± TPU (2σ)	Mean ± 2 SD
CBD	-0.034 ± 0.025	0.113 ± 0.049	0.027 ± 0.061	-0.222 ± 0.056	1.05 ± 0.126	0.640 ± 0.456
SMR	-0.064 ± 0.042	0.118 ± 0.050	0.029 ± 0.062	-0.047 ± 0.111	1.10 ± 0.136	0.604 ± 0.406
WFF	-0.046 ± 0.041	0.081 ± 0.046	0.019 ± 0.050	-0.143 ± 0.106	1.38 ± 0.149	0.639 ± 0.469
WSS	-0.052 ± 0.044	0.084 ± 0.039	0.023 ± 0.060	-0.140 ± 0.107	1.14 ± 0.125	0.606 ± 0.426
MLR	-0.043 ± 0.043	0.090 ± 0.039	0.023 ± 0.047	-0.165 ± 0.108	1.19 ± 0.141	0.641 ± 0.457
SEC	-0.035 ± 0.043	0.096 ± 0.040	0.026 ± 0.051	-0.139 ± 0.110	1.25 ± 0.138	0.631 ± 0.476
WEE	-0.041 ± 0.045	0.080 ± 0.040	0.022 ± 0.055	-0.106 ± 0.109	1.13 ± 0.138	0.621 ± 0.443

The graphical presentation of the gross alpha activities found in weekly air particulate samples of all the seven locations and blank filter paper are given in Figures 5.1.2 through 5.1.8, and 5.1.9, respectively. The one-sample Kolmogorov-Smirnov (K-S) test was employed to test the data for a normal distribution. By applying the K-S test for the combined gross alpha activities found in weekly air particulate samples from all seven locations, it was found that the distribution of the data was not significantly different from a normal distribution (2-tailed asymptotic significance = 0.883). Thus it may be quite reasonable to state that the data as a whole are distributed normally and, therefore, a standard parametric test (ANOVA) may be employed to test whether the gross alpha activities found at different sampling locations are different from each other. Analysis of variance, or ANOVA, is a method of testing the null hypothesis that the means of several groups are equal in the population by comparing the sample variance estimated from the means of the groups to that estimated within the groups. Using a one-factor ANOVA test for the combined (normally distributed) data on gross alpha activities, it was found that with a high P value (P = 0.54), and an F-statistic (F = 0.84) that is below the critical F statistic (critical F = 2.13), the concentration of gross alpha activity is not significantly different among all seven sampling locations.

The results for gross beta measurements of air particulate samples collected weekly from these seven locations are given in Figures 5.1.10 through 5.1.16, and blank filter in Figure 5.1.17. The combined beta activities

found at all these locations were also tested for the normality test using K-S test. The results (2-tailed asymptotic significance = 0.014) clearly indicated that the distribution of the data was significantly different from a normal distribution. Therefore, the assumption must be made that the data as a whole are not distributed normally; therefore, a non-parametric test (Kruskal-Wallis) was used to test the variation in concentrations of beta activity among all the locations.

The Kruskal-Wallis test is a non-parametric equivalent to one-way ANOVA that tests whether several independent samples are from the same population. The combined results obtained for all the samples collected from various locations were tested. Given that the computed chi-square value (chi-square value found for this set of data = 2.478) was between the critical chi-square values of 1.237 and 14.449 at six degrees of freedom (from the chi-square table on pages 816-817 of Basic Econometrics by Damodar Gujarati) it failed to reject the null hypothesis that all of the means are equal. Thus there is no significant differences in concentration of beta activities found at various locations.

The weekly volumes of air pulled through each sampler installed at various locations are given in Tables 5.1.2 through 5.1.5. The particulate weights collected on the filter paper each week at all locations are given in the same table. Even though the air volumes pulled through all the samplers were quite similar, the particulate weight collected on these filter papers differed from location to location, and from week to week at each location. These results clearly suggest that the concentrations of gross alpha and beta activities may vary to some extent from location to location, and from week to week, simply because of the variation in the weight of air particulate collected.

Duplicate samples were collected and analyzed for the QC of (1) air sampling technique, (2) determination of gross alpha and beta activities, and (3) analyses of the individual radionuclides in airborne particulate. One duplicate sample per week was collected every quarter by rotating the sampler from one location to another every quarter: MLR in the first quarter, WSS in the second quarter, WEE in the third quarter, and WFF in the fourth quarter. The samples were collected by both samplers in identical conditions at all these four locations.

The results of gross alpha and beta activities for the duplicate samples of all the four locations are presented in Figures 5.1.18 and 5.1.19. By applying the K-S test, it was found that the data points (gross alpha measurements) for duplicate samples were normally distributed. Because of the normal distribution and the large number of data points, a one way ANOVA was used to test for differences between the means of the original and the duplicate results. Since the p value found (0.35) was very high and the F statistic (0.88) was well below the critical F value (3.94), the null hypothesis that there are no differences between the two groups can not be rejected. Similarly, the data points for gross beta measurements were also found to be normally distributed. The ANOVA analysis of these data points also gave a high p value (p = 0.73) and much lower F statistic (0.12) as compared to critical F value (3.94). These results clearly suggest that the null hypothesis that there are no differences between the original and duplicate measurements can not be rejected.

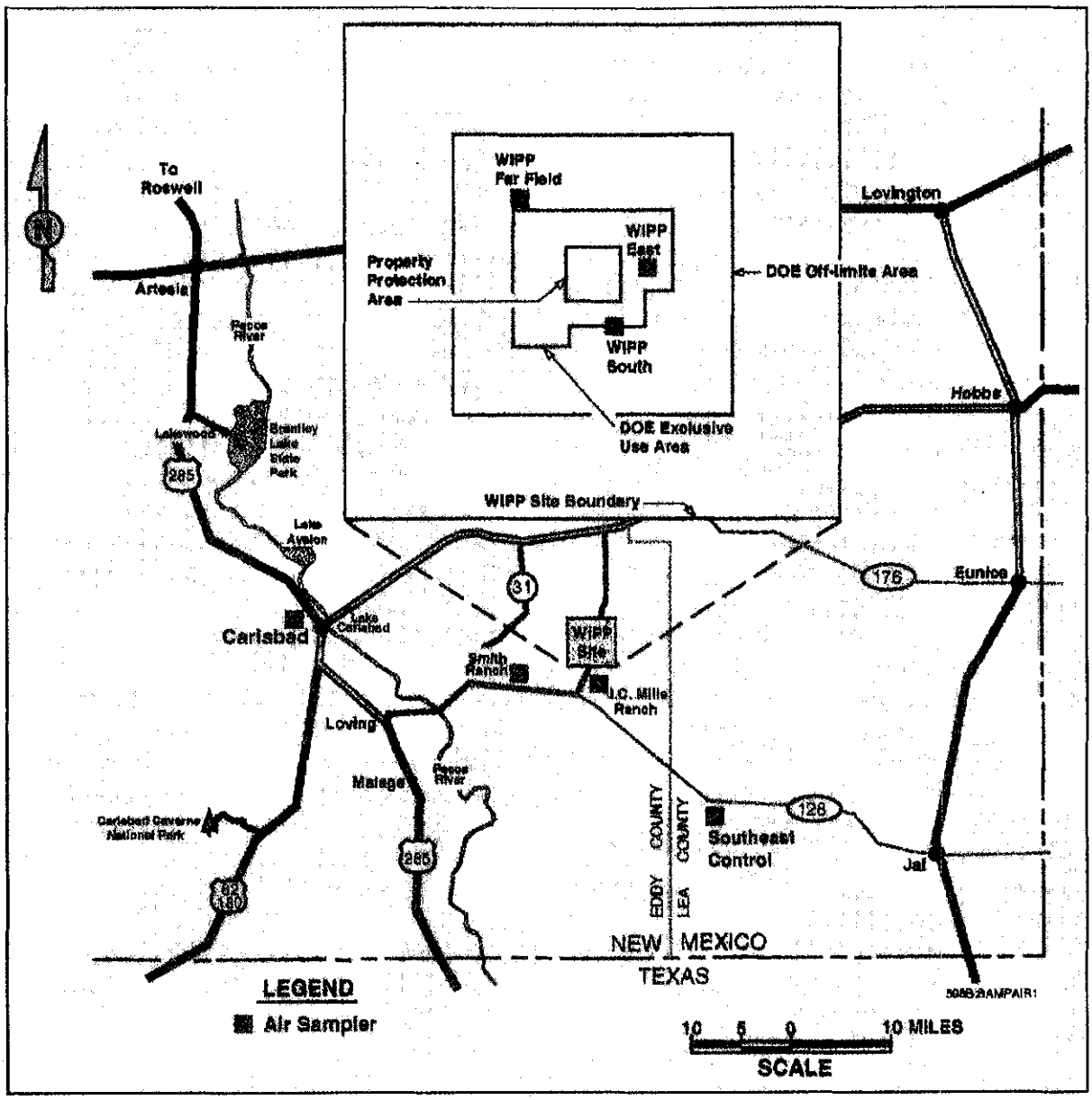


Figure 5.1.1 - Air Sampling Locations

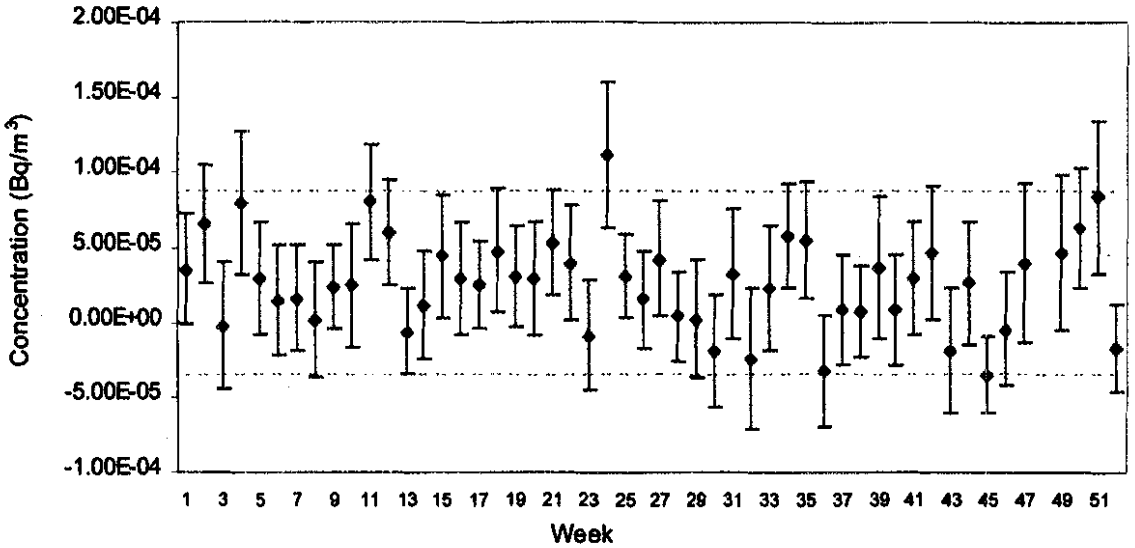


Figure 5.1.2 - Gross Alpha Activity in Air Particulate Samples - Carlsbad (CBD)

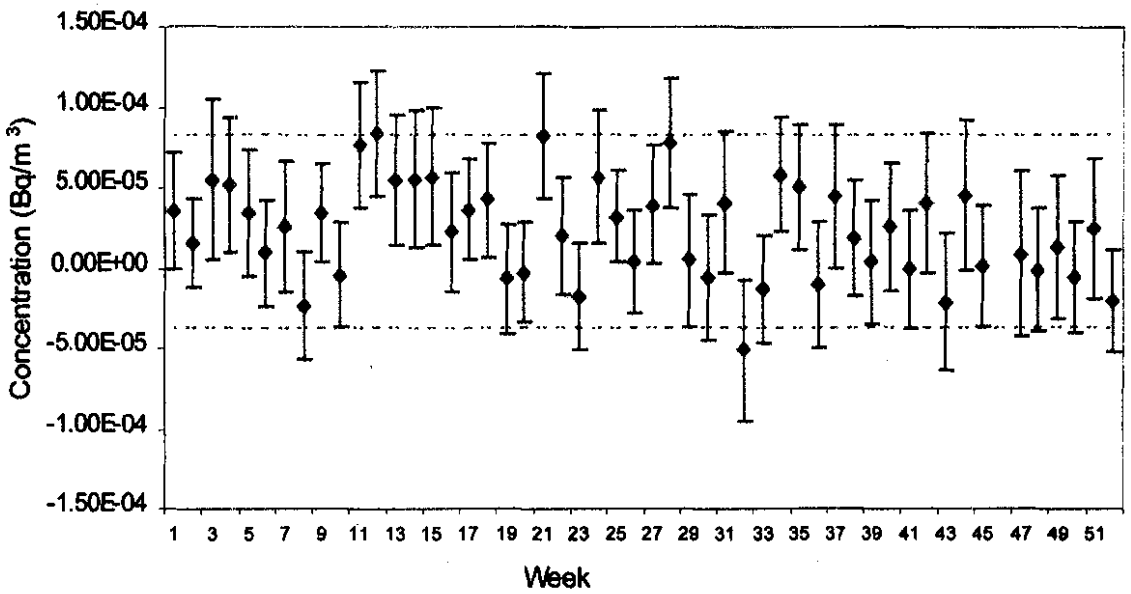


Figure 5.1.3 - Gross Alpha Activity in Air Particulate Samples - WIPP South (WSS)

● Alpha Activity - - - - - - - - - ± 2 Sigma

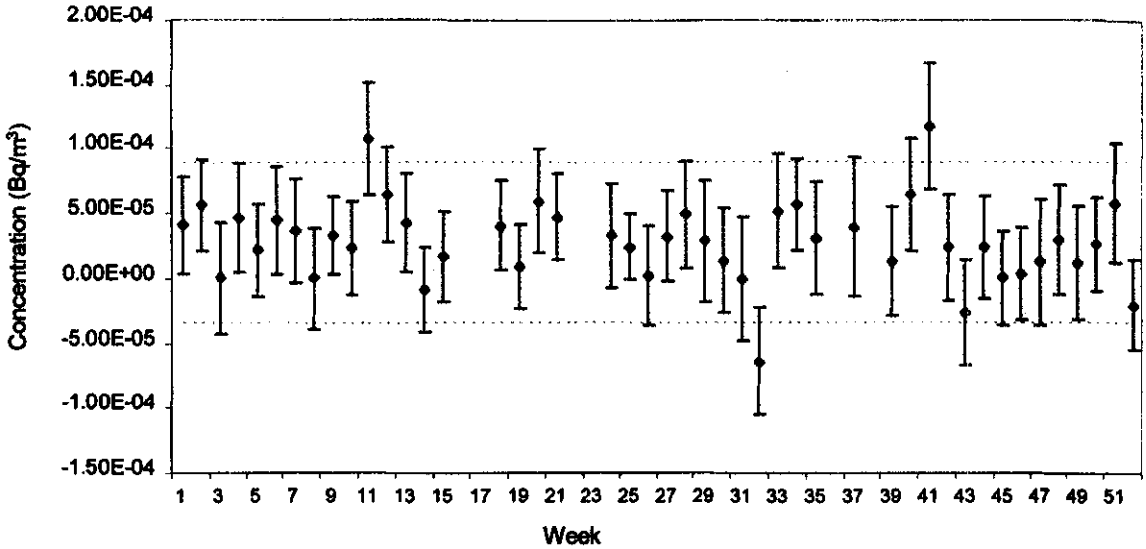


Figure 5.1.4 - Gross Alpha Activity in Air Particulate Samples - Smith Ranch (SMR)

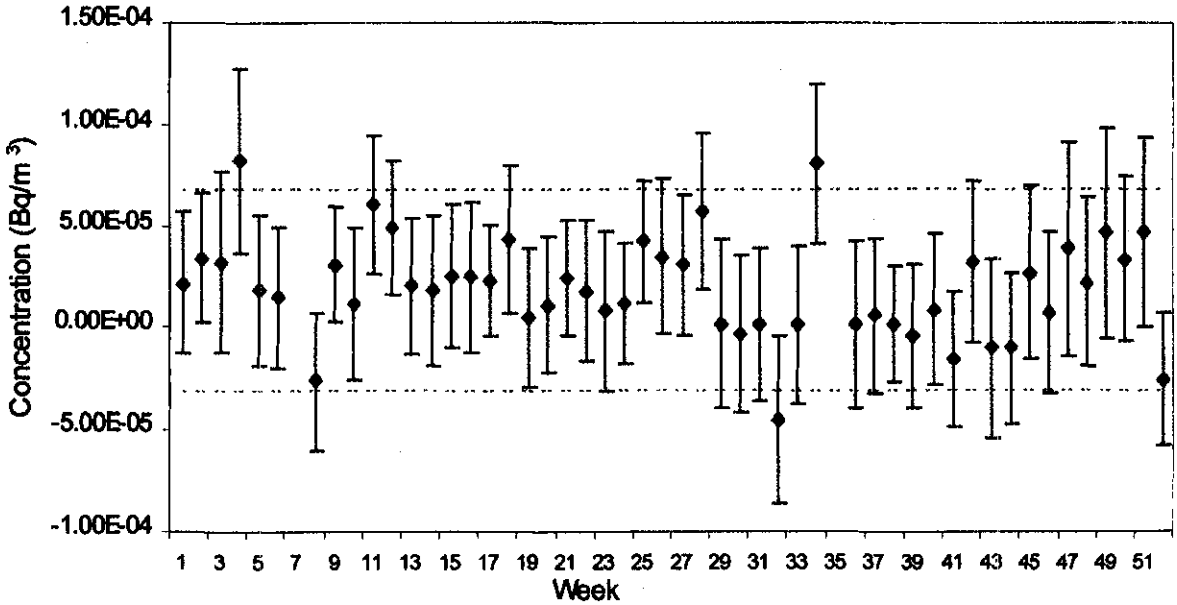


Figure 5.1.5 - Gross Alpha Activity in Air Particulate Samples - WIPP Far Field (WFF)

◆ Alpha Activity - - - - - - - - - ± 2 Sigma

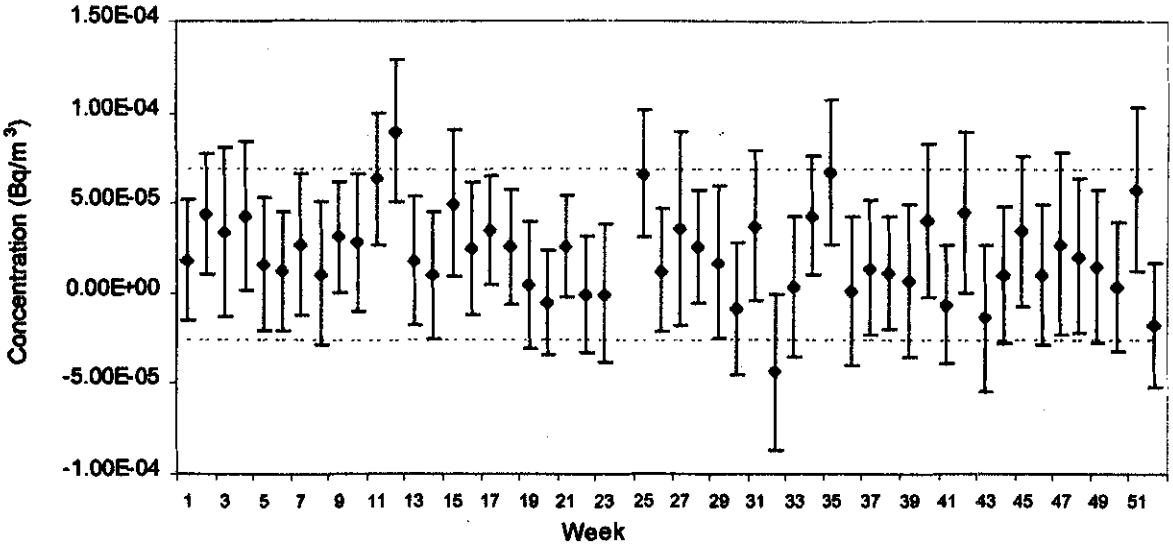


Figure 5.1.6 - Gross Alpha Activity in Air Particulate Samples - Mills Ranch (MLR)

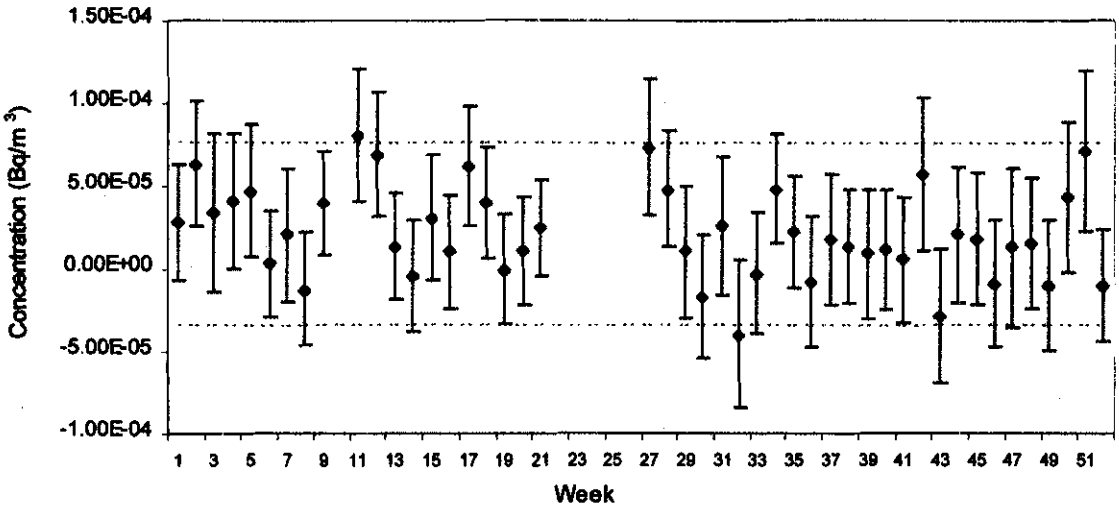


Figure 5.1.7 - Gross Alpha Activity in Air Particulate Samples - WIPP East (WEE)

◆ Alpha Activity - - - - - - - - - ± 2 Sigma

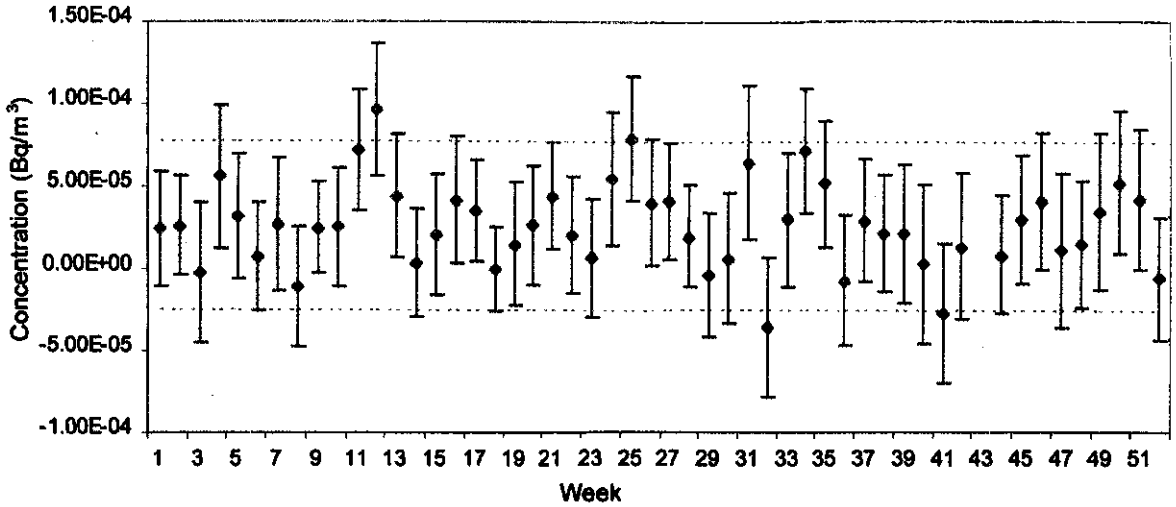


Figure 5.1.8 - Gross Alpha Activity in Air Particulate Samples - South East Control (SEC)

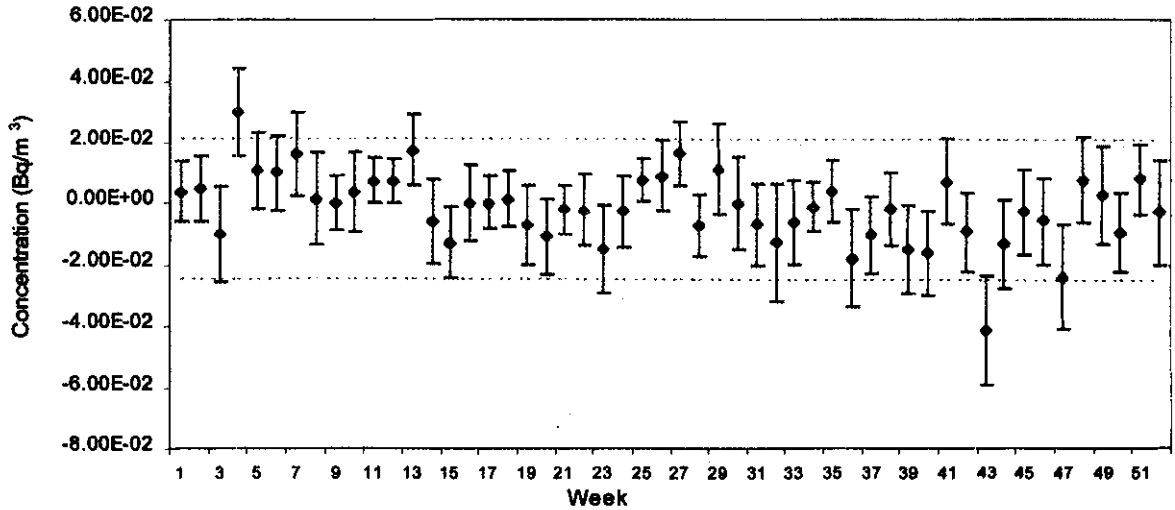


Figure 5.1.9 - Gross Alpha Activity in Air Particulate Samples - WIPP Air Blank (WAB)

◆ Alpha Activity - - - - - - - - - ± 2 Sigma

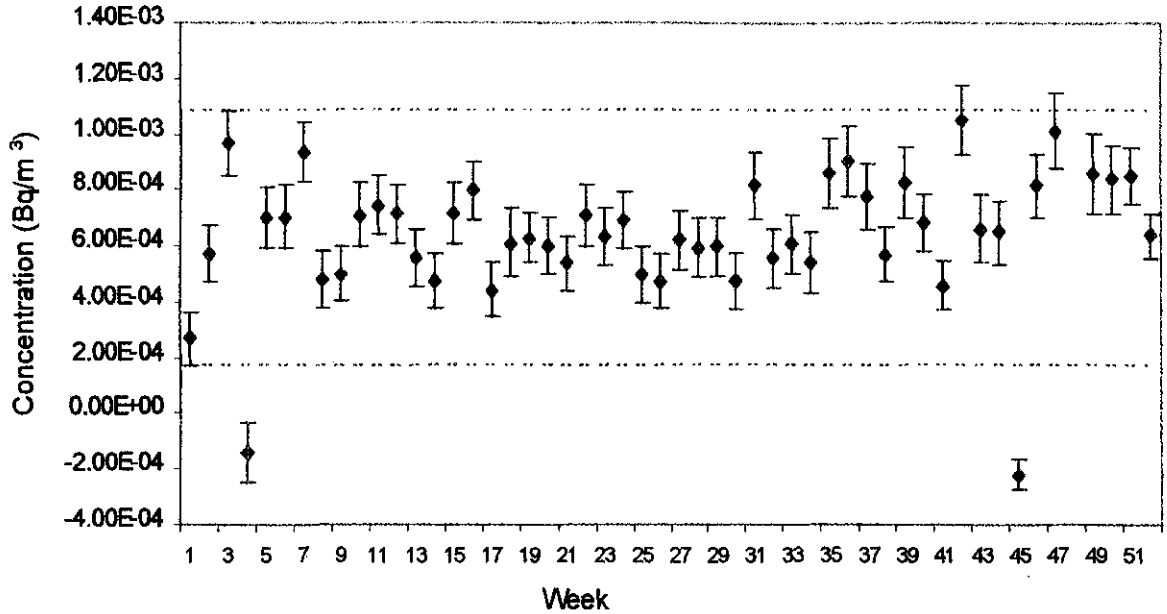


Figure 5.1.10 - Gross Beta Activity in Air Particulate Samples - Carlsbad (CBD)

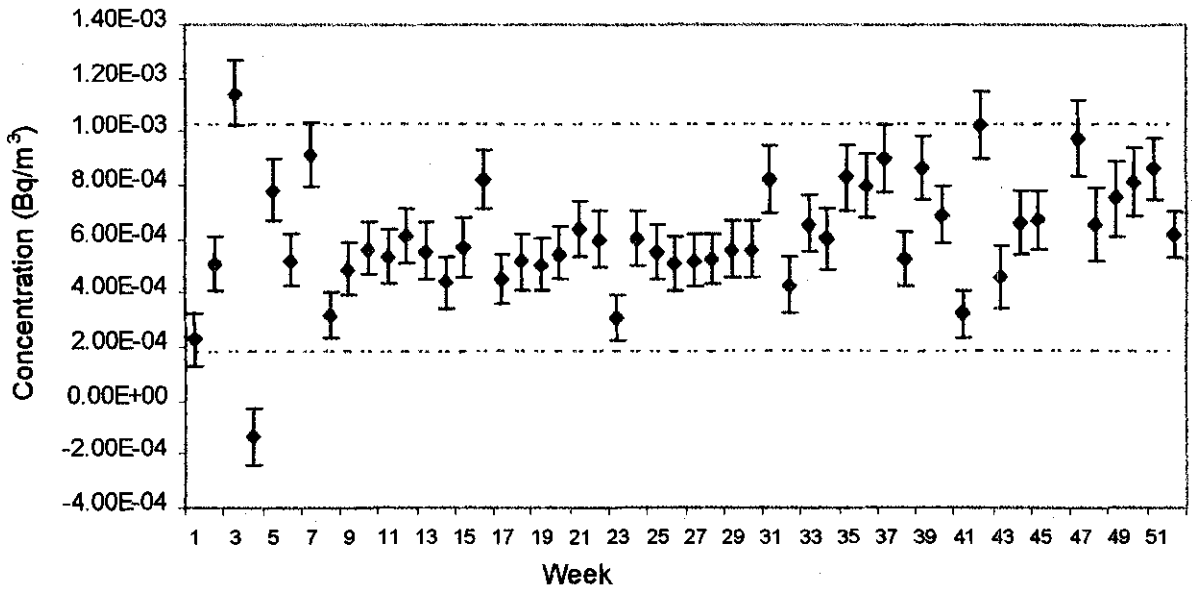


Figure 5.1.11 - Gross Beta Activity in Air Particulate Samples - WIPP South (WSS)

● Beta Activity - - - - - - - - - ± 2 Sigma

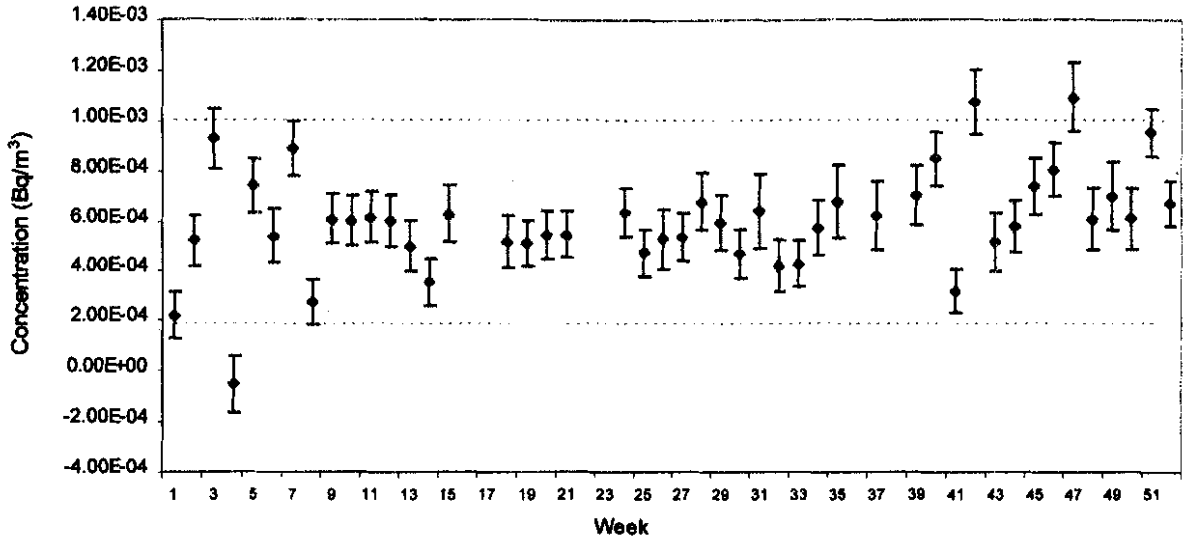


Figure 5.1.12 - Gross Beta Activity in Air Particulate Samples - Smith Ranch (SMR)

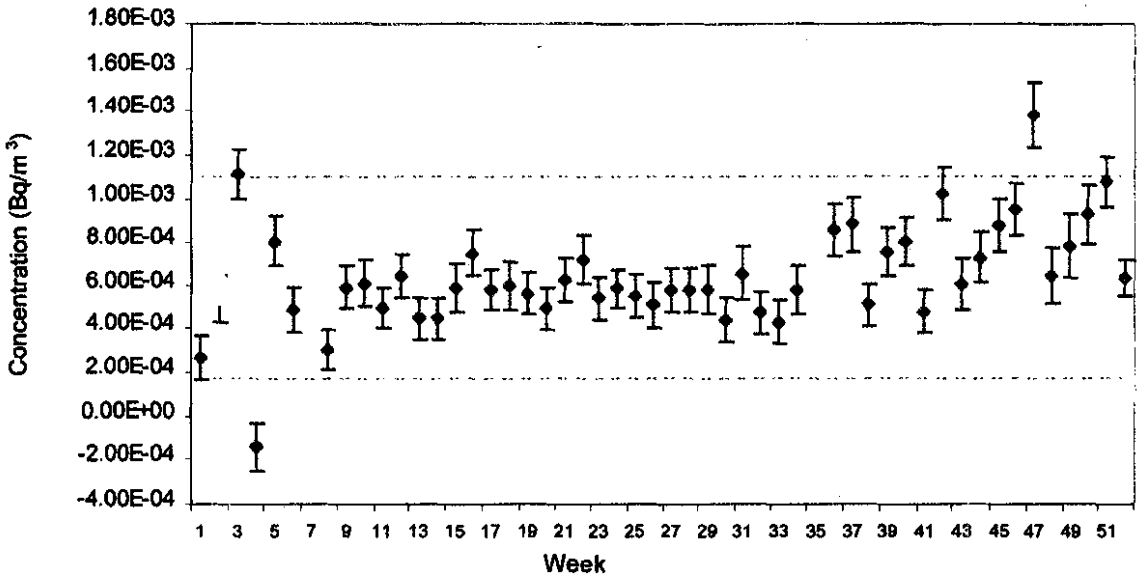


Figure 5.1.13 - Gross Beta Activity in Air Particulate Samples - WIPP Far Field (WFF)

◆ Beta Activity - - - - - - - - - ± 2 Sigma

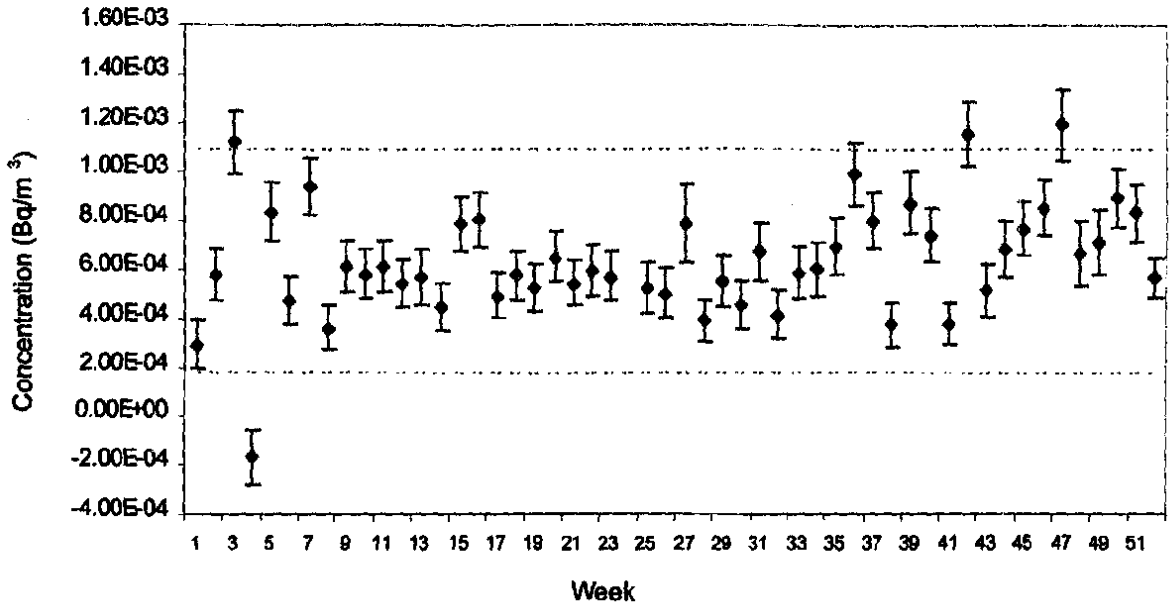


Figure 5.1.14 - Gross Beta Activity in Air Particulate Samples - Mills Ranch (MLR)

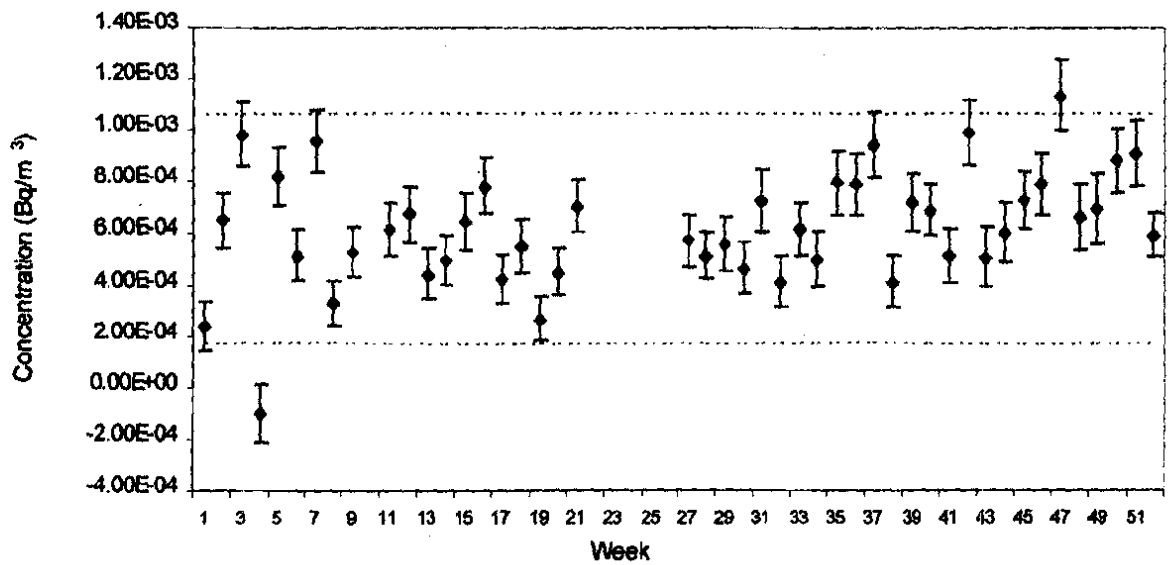


Figure 5.1.15 - Gross Beta Activity in Air Particulate Samples - WIPP East (WEE)

◆ Beta Activity - - - - - - - - - ± 2 Sigma

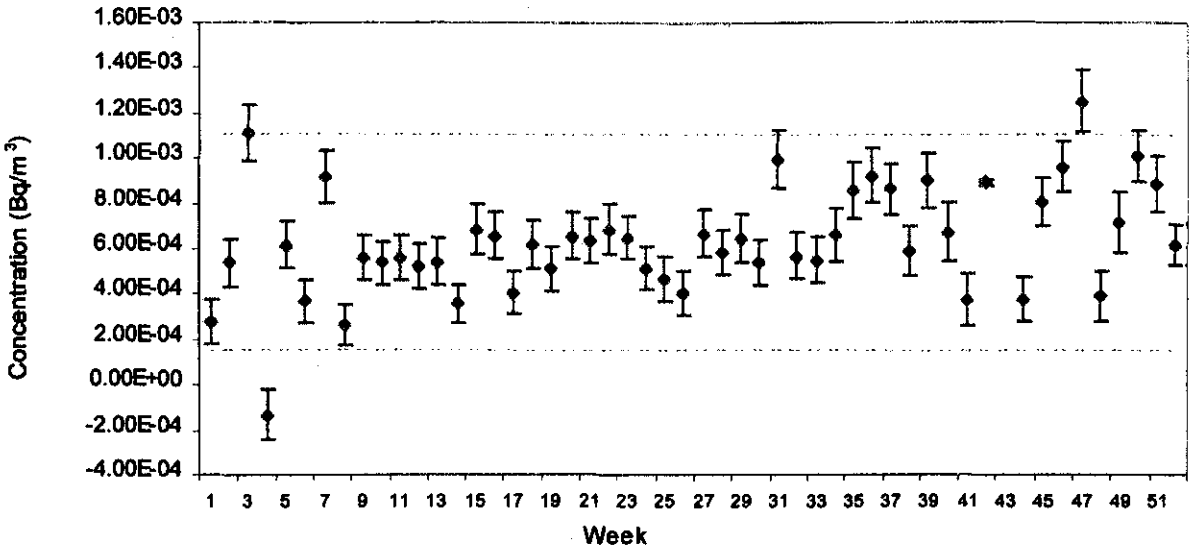


Figure 5.1.16 - Gross Beta Activity in Air Particulate Samples - South East Control (SEC)

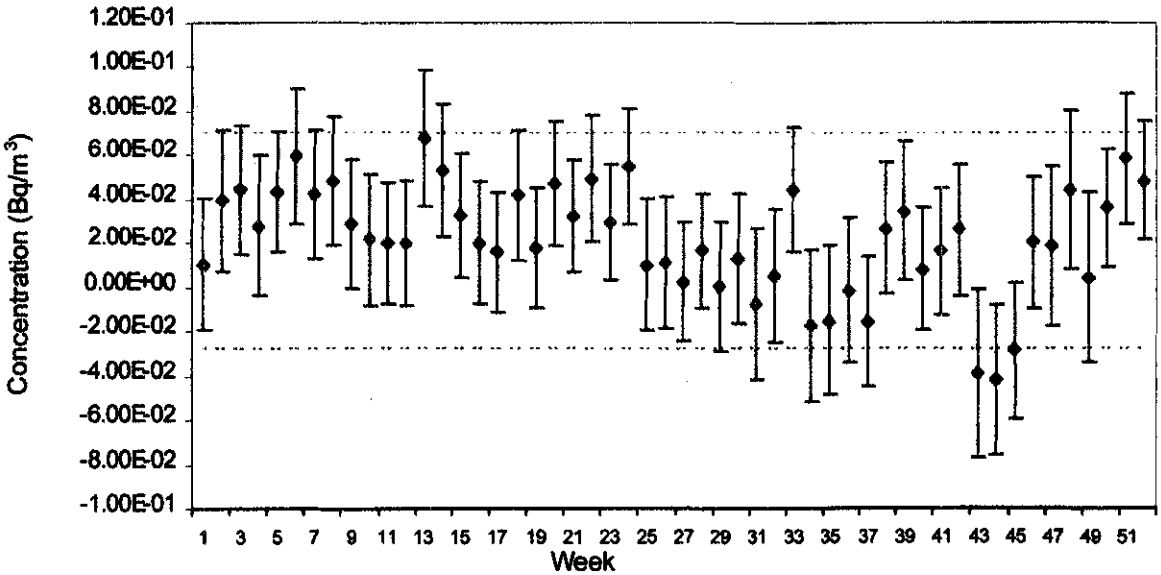


Figure 5.1.17 - Gross Beta Activity in Air Particulate Samples - WIPP Air Blank (WAB)

◆ Beta Activity - - - - - - - - - ± 2 Sigma

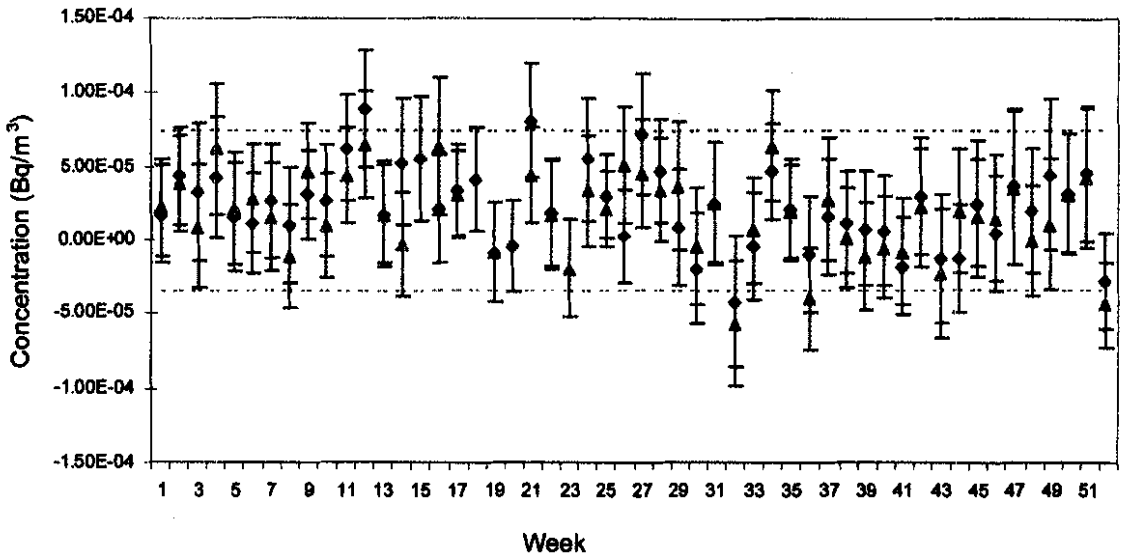


Figure 5.1.18 - Duplicate Sample Results - Gross Alpha

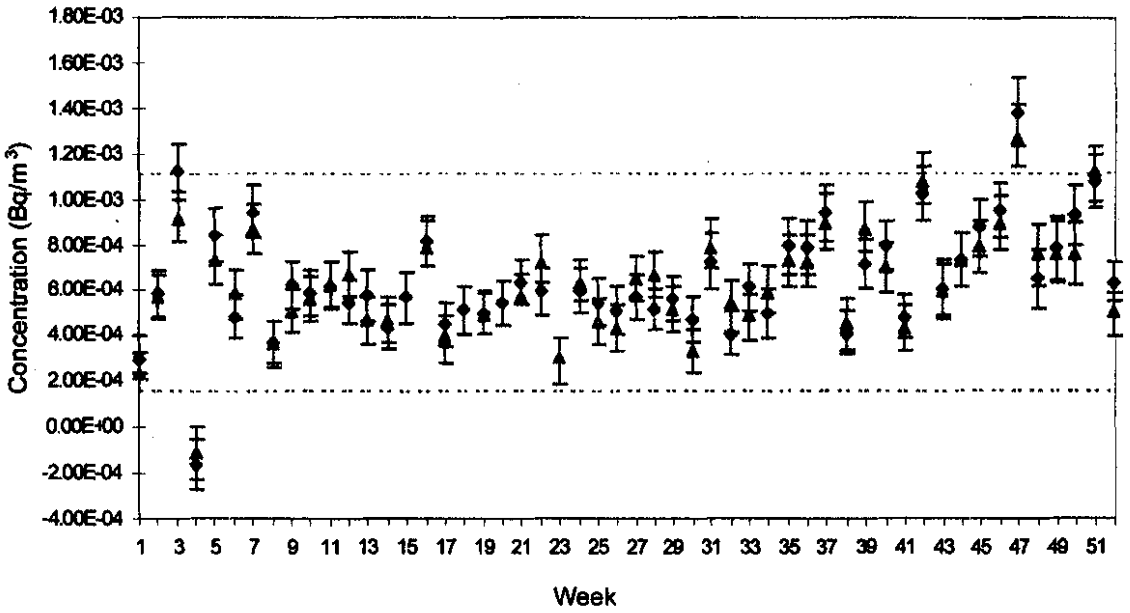


Figure 5.1.19 - Duplicate Sample Results - Gross Beta

◆ Original ▲ Duplicate

Locations Sampled:	MLR	-	Weeks 1 through 13
	WSS	-	Weeks 14 through 26
	WEE	-	Weeks 27 through 39
	WFF	-	Weeks 40 through 51

Table 5.1.2 - Weight of Air Particulates and Volume of Air - 1st Quarter 1997

	Carlsbad (CBD)		Smith Ranch (SMR)		Far Field (WFF)		WIPP East (WEE)	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #1	11.7	524.053	13.4	520.292	5.9	495.432	8.6	517.193
Week #2	7.4	625.84	5.3	597.973	4.1	583.668	4.3	589.086
Week #3	13.5	576.916	19.3	564.483	8.1	618.650	9.3	572.352
Week #4	12.5	573.718	26.6	586.180	6.5	592.190	7.9	583.742
Week #5	16.7	579.772	23.6	593.699	7.5	558.285	9.5	586.529
Week #6	9.7	563.952	5.3	560.109	6.1	581.534	5.3	603.944
Week #7	13.8	643.554	5.6	611.951	N/A	566.684	4.5	579.542
Week #8	6.5	586.94	6.1	572.694	3.3	579.082	3.1	605.277
Week #9	13.1	626.584	8.9	600.834	5.7	625.468	8.8	585.484
Week #10	17.8	556.261	18.2	618.281	7.7	565.155	N/A	N/A
Week #11	21.2	609.734	19.1	584.439	11.3	610.019	12.8	561.632
Week #12	31.9	599.394	27.3	567.510	15.5	587.574	18.3	573.718
Week #13	18.6	595.133	14.7	586.240	8.4	589.390	10.6	587.990
Total	194.40	7661.851	193.4	7564.685	90.1	7553.131	103.0	6946.499

	WIPP South (WSS)		Mills Ranch (MLR) #1		Mills Ranch (MLR) #2		South East (SEC)	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #1	6.9	512.609	9.4	518.584	8.6	531.128	20.5	503.584
Week #2	4.2	595.466	4.2	606.557	4.3	606.917	6.2	597.980
Week #3	9.3	589.437	9.4	586.940	8.6	615.432	37.8	584.337
Week #4	8.3	587.574	8.1	576.109	7.8	578.975	34.6	570.864
Week #5	10.6	557.782	11.5	557.782	11.3	544.526	36.6	576.916
Week #6	4.6	604.640	4.0	609.078	7.0	589.315	9.1	586.877
Week #7	19.0	567.984	6.0	610.661	4.6	613.857	2.6	588.031
Week #8	5.2	601.903	3.0	584.091	4.6	595.133	5.8	579.427
Week #9	7.6	589.040	6.3	586.180	5.8	595.112	25.0	619.387
Week #10	9.6	608.332	10.8	596.553	14.1	596.553	18.2	621.385
Week #11	13.9	558.713	13.3	578.737	14.2	604.395	41.1	605.371
Week #12	19.1	593.306	20.8	599.039	17.7	573.243	47.6	588.619
Week #13	10.4	569.505	10.0	549.124	9.6	591.937	33.4	603.315
Total	128.7	7536.291	116.8	7559.435	118.2	7636.523	318.5	7626.093

N/A = Not available

Table 5.1.3 - Weight of Air Particulates and Volume of Air - 2nd Quarter 1997

	Carlsbad (CBD)		Smith Ranch (SMR)		Far Field (WFF)		WIPP East (WEE)	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #14	15.0	607.189	12.1	601.514	8.1	598.993	9.7	597.601
Week #15	16.5	556.261	13.1	580.895	7.1	578.537	7.5	561.287
Week #16	16.6	602.978	4.5	83.912	8.5	582.974	9.9	598.694
Week #17	12.7	563.305	N/A	N/A	8.2	607.608	8.1	561.147
Week #18	20.4	469.913	13.7	562.449	9.0	532.847	12.1	569.529
Week #19	18.7	703.272	7.9	632.291	5.7	587.225	6.4	573.616
Week #20	12.8	571.669	11.1	599.752	3.8	574.401	5.0	588.690
Week #21	13.9	562.970	10.1	565.492	6.7	570.524	7.9	579.082
Week #22	16.4	581.935	N/A	N/A	7.9	560.113	N/A	N/A
Week #23	13.4	556.592	N/A	N/A	6.8	553.514	N/A	N/A
Week #24	14.4	571.204	11.0	619.756	5.6	652.938	N/A	N/A
Week #25	19.1	586.940	12.7	615.065	7.4	582.628	N/A	N/A
Week #26	13.6	583.668	8.1	459.546	7.9	545.824	N/A	N/A
Total	203.5	7517.896	104.3	5320.673	92.7	7528.126	66.6	4050.564

	WIPP South (WSS) #1		WIPP South (WSS) #2		Mills Ranch (MLR)		South East (SEC)	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #14	10.4	593.357	11.1	579.855	10.9	607.970	25.4	625.923
Week #15	7.7	551.998	N/A	N/A	9.8	582.349	13.4	559.447
Week #16	10.8	586.180	9.0	527.421	10.0	586.529	26.4	609.438
Week #17	8.8	564.819	6.4	582.281	9.3	593.345	27.9	573.827
Week #18	12.2	550.456	N/A	N/A	11.7	572.556	35.4	581.573
Week #19	5.8	562.369	7.4	562.709	6.5	574.310	26.7	565.934
Week #20	5.2	564.819	N/A	N/A	10.1	602.262	33.2	588.690
Week #21	8.2	582.281	7.7	582.281	8.1	593.699	37.7	583.742
Week #22	8.8	551.431	9.4	526.488	7.9	553.738	27.9	563.473
Week #23	N/A	N/A	3.8	572.797	6.6	548.588	12.5	610.141
Week #24	7.1	558.580	6.8	569.700	N/A	N/A	47.5	580.548
Week #25	10.4	582.628	9.6	607.970	8.6	576.229	30.9	568.010
Week #26	9.8	566.501	8.6	569.024	8.3	558.249	15.7	562.301
Total	105.2	6815.419	79.8	5680.526	107.8	6949.824	360.6	7573.047

N/A = Not available

Table 5.1.4 - Weight of Air Particulates and Volume of Air - 3rd Quarter 1997

	Carlsbad (CBD)		Smith Ranch (SMR)		Far Field (WFF)		WIPP East (WEE) #1	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #27	17.2	544.526	17.3	575.543	11.6	559.958	14.0	567.984
Week #28	15.9	545.500	8.1	490.051	7.2	565.155	8.1	594.052
Week #29	23.4	565.155	15.3	519.486	11.5	537.570	12.8	585.747
Week #30	16.8	554.819	13.1	582.628	8.8	554.068	9.2	550.228
Week #31	19.5	545.965	10.0	416.994	8.9	532.140	13.2	540.957
Week #32	11.8	547.377	8.7	549.572	6.6	582.995	5.8	552.175
Week #33	14.7	542.644	9.1	557.586	6.9	515.648	7.9	551.212
Week #34	16.4	589.315	12.8	569.700	8.0	567.333	8.6	576.229
Week #35	21.5	566.107	8.8	421.539	N/A	N/A	11.2	549.900
Week #36	14.0	560.293	N/A	N/A	10.9	581.588	9.3	575.543
Week #37	15.0	542.035	5.3	395.240	6.5	515.205	7.4	529.143
Week #38	17.3	627.203	N/A	N/A	8.9	636.513	6.8	550.048
Week #39	17.1	520.506	12.8	542.484	8.8	599.067	9.9	579.843
Total	220.6	7256.445	121.3	5620.823	104.6	6747.24	124.2	7303.061

	WIPP East (WEE) #2		WIPP South (WSS)		Mills Ranch (MLR)		South East (SEC)	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #27	12.8	570.728	9.8	545.746	8.6	343.889	16.6	587.990
Week #28	7.8	562.636	9.0	582.974	8.6	590.961	11.3	578.392
Week #29	12.4	591.140	13.8	544.903	15.7	552.851	14.1	586.877
Week #30	6.9	549.124	16.6	560.446	13.0	576.257	18.4	570.986
Week #31	12.7	555.118	10.0	544.115	11.4	562.502	16.9	557.782
Week #32	7.0	563.219	5.4	538.247	5.7	561.632	22.8	586.624
Week #33	7.5	579.427	9.0	569.024	8.6	534.711	23.0	561.445
Week #34	8.4	553.408	9.4	562.636	8.5	567.510	18.2	569.700
Week #35	11.4	589.437	13.2	561.297	11.6	568.146	12.1	568.146
Week #36	8.2	575.200	9.5	575.543	13.2	577.702	19.7	580.895
Week #37	7.0	526.444	7.7	513.778	7.1	553.507	15.4	599.353
Week #38	4.4	528.144	7.1	553.408	5.8	604.756	13.6	577.702
Week #39	10.1	570.769	11.5	576.301	9.7	534.380	20.7	567.672
Total	116.6	7314.794	132.0	7228.418	127.5	7128.804	222.8	7493.564

N/A = Not available

Table 5.1.5 - Weight of Air Particulates and Volume of Air - 4th Quarter 1997

	Carlsbad (CBD)		Smith Ranch (SMR)		Far Field (WFF) #1		Far Field (WFF) #2	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #40	13.9	586.325	10.1	619.187	7.3	577.796	5.5	586.846
Week #41	12.1	640.853	7.0	621.003	6.3	585.706	5.0	552.474
Week #42	16.8	555.802	14.0	550.639	10.5	591.031	11.0	559.059
Week #43	12.6	592.638	9.6	577.602	7.0	575.978	8.7	553.611
Week #44	19.7	593.699	19.2	612.948	8.3	569.566	8.1	566.487
Week #45	20.4	611.915	14.1	599.407	9.2	556.027	9.2	571.921
Week #46	9.2	560.568	9.1	628.168	5.8	569.211	5.3	536.194
Week #47	17.4	542.158	23.3	564.068	7.2	548.916	6.9	548.916
Week #48	N/A	N/A	17.1	607.277	6.0	582.876	6.4	585.401
Week #49	11.0	585.217	7.7	593.357	4.3	565.869	4.5	576.284
Week #50	13.5	661.808	12.3	614.044	4.4	570.103	4.2	570.103
Week #51	14.7	500.039	11.0	526.836	3.5	497.686	6.6	482.642
Week #52	20.8	837.892	7.4	694.813	5.1	712.907	5.4	725.313
Week #53	16.7	430.015	4.4	575.200	4.8	591.225	4.6	605.437
Total	198.8	7698.929	166.3	8384.549	89.7	8094.897	91.4	8020.688

	WIPP East (WEE)		WIPP South (WSS)		Mills Ranch (MLR)		South East (SEC)	
	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)	Weight (mg)	Volume (m^3)
Week #40	6.6	610.390	5.8	586.272	4.3	568.485	6.6	432.679
Week #41	5.6	565.305	5.6	565.305	5.1	613.230	5.0	431.400
Week #42	10.4	541.976	10.6	542.616	10.3	552.090	8.7	474.887
Week #43	7.2	582.186	6.9	569.845	7.6	610.879	N/A	N/A
Week #44	9.0	571.578	8.5	544.699	9.6	604.035	19.3	612.218
Week #45	9.1	572.767	9.6	564.085	10.9	582.628	15.1	629.446
Week #46	5.6	540.041	2.2	N/A	6.4	583.668	8.8	624.464
Week #47	7.2	560.628	6.5	511.943	10.5	554.605	7.6	583.790
Week #48	7.3	609.438	5.8	557.364	7.3	574.262	3.7	605.488
Week #49	6.1	577.881	9.2	569.639	5.4	611.487	5.6	594.777
Week #50	4.9	516.493	5.4	560.677	5.0	580.117	2.4	577.702
Week #51	6.4	507.493	4.3	482.976	7.4	526.109	6.0	533.595
Week #52	5.4	736.462	8.8	736.462	5.3	689.400	4.7	677.452
Week #53	4.2	591.225	4.0	602.234	4.0	608.643	4.7	589.437
Total	95.0	8083.863	93.2	7394.117	99.1	8259.629	98.2	7367.335

N/A = Not available

5.2 Airborne Particulate

Plutonium is the main constituent of the transuranic wastes to be received by WIPP. The two major intake routes of plutonium in the human body are ingestion and inhalation. The uptake of plutonium through ingestion is very low; therefore, inhalation becomes the major route of intake. Obviously, it is very important to measure plutonium and other radionuclides of interest in air particulate to estimate the intake of these radionuclides in the general population. Therefore, all the weekly air filter samples collected for gross alpha and beta measurements were composited together quarterly for the determination of individual radionuclides.

Sample Preparation: The quarterly composited air filter samples were transferred into a Pyrex beaker. The samples were spiked with appropriate tracers and placed in a muffle oven at a temperature of 250°C for two hours, followed by two hours at 375°C and six hours at 525°C. The ashed filters were cooled, quantitatively transferred to a Teflon beaker by rinsing with concentrated nitric acid, and treated with hydrofluoric acid for complete dissolution of the ash. Hydrofluoric acid was evaporated to dryness. Twenty-five milliliters of concentrated nitric acid and approximately one gram of boric acid were added and finally evaporated to dryness. The residue was dissolved in 8M HNO_3 for gamma spectrometry and sequential determinations of Sr-90 and alpha-emitting radionuclides.

Determination of Individual Radionuclides: The solution obtained after sample preparation was counted by gamma spectrometry for the quantitative determination of gamma-emitting radionuclides such as K-40, Co-60, and Cs-137. After the gamma spectrometry was completed, the total sample solution was used for the sequential determination of strontium and alpha-emitting radionuclides, including the isotopes of uranium, plutonium, and Am-241. The procedure for the determination of actinides basically involved coprecipitation, ion exchange column chromatography, source preparation, and alpha spectrometry.

Results and Discussions: The concentrations of various radionuclides including K-40, Co-60, Sr-90, Cs-137, alpha-emitting isotopes of uranium such as U-234, U-235, and U-238, plutonium isotopes such as Pu-238 and Pu-239+240, and Am-241 were measured in the air particulate samples composited every quarter from each of the seven locations. The results are given in Table 5.2.1. Most of these radionuclides were below their minimum detection level. Concentrations of the individual radionuclides in quarterly air filter samples for all the locations are graphically presented in Figures 5.2.1 through 5.2.10.

The statistical analyses of the data were performed to test whether or not there is a significant variation in the concentrations of any individual radionuclide in (1) samples collected in different quarters of a sampling site and (2) samples collected at different sites in the same quarter.

The concentration of K-40, a naturally occurring gamma-emitting radionuclide, ranged from below detection level to 0.58 ± 0.36 mBq/m^3 with a mean of 0.18 ± 0.36 (± 2 SD) mBq/m^3 in air particulate samples collected from these seven locations (Figure 5.2.1). The highest concentration was found in the sample collected in the first quarter at sampling location SMR. However, the variations in the concentrations of K-40 found in these samples were within 2 sigma of the mean.

A statistical analysis of the data was performed using the K-S test for all 28 data points (four data points for each of the seven locations), which suggested that the data points were normally distributed (asymptotic significance = 0.903). These data points were further tested to check the quarterly variations among the concentrations of K-40 for these seven locations. Using the Kruskal-Wallis test, it was found that the chi-squared value (16.351) fell outside the critical values of 0.351 and 7.815.

The null hypothesis, which assumes that there is no significant variation between locations is rejected. This means that there are significant differences between the concentrations of K-40 found in various quarters. However, all the data points (Figure 5.2.1) were found to be within ± 2 sigma, which suggests that there are no significant differences in the concentrations of K-40 found in various quarters of each location.

The differences in K-40 concentrations found at various sampling sites were tested. Using the same test, a chi-squared value of 1.71 was found, which is between the critical values of 1.63 and 12.59. This suggests that the null hypothesis that there is no variation among the concentrations of K-40 found in air particulate samples collected from various sampling sites can not be rejected.

The results on the concentrations of Co-60 found in each quarter of composite air filters for each sampling site are given in Figure 5.2.2. Most of the results were below its minimum detectable activity (MDA) (~0.02 mBq/m^3). Measurements of Sr-90 in all 28 of the composited air filter samples did not show any detectable amount of Sr-90 (Figure 5.2.3). Most of the results were either negative or associated with large analytical uncertainty. Obviously, the statistical analyses of the data did not show any differences between the quarters and the sampling locations.

The results for the concentration of Cs-137 in air particulate are graphically presented in Figure 5.2.4. These results clearly suggested that no Cs-137 was detected in the air particulate samples (the results were either negative or associated with larger errors). Also, most of the results on the concentration of Cs-137 were below its MDA (~0.02 mBq/m^3). The statistical analyses of the data obviously did not show statistically significant variations either between the quarters or among the sampling sites.

The results on the concentrations of U-234, U-235 and U-238 in air particulate samples collected from these seven locations are graphically presented in Figures 5.2.5, 5.2.6, and 5.2.7 respectively.

The mean concentration of U-234 was 0.0031 ± 0.0008 mBq/m^3; U-235 was 0.0002 ± 0.0001 mBq/m^3; and U-238 was 0.0031 ± 0.0010 mBq/m^3. These results show a normal distribution of the data for U-234 (asymptotic significance = 0.443), U-235 (asymptotic significance = 0.990), and U-238 (asymptotic significance = 0.475). These data were further tested for the variations between quarters of all the sampling sites by using Kruskal-Wallis test. The chi-squared value of 11.70 for U-234 fell outside of the critical values of 0.35 and 7.82, which suggested that there are statistically significant differences between the concentrations of U-234 in various quarters. However, when the same statistical test was applied for U-235 and U-238, the chi-squared value of 3.47 for U-235 fell within the critical values of 0.35 and 7.82, and the chi-squared value of 6.91 for U-238 fell within the critical values of 0.35 and 7.82, suggesting that the concentrations of U-235 and U-238 did not vary significantly from quarter to quarter. The Kruskal-Wallis test was employed to check the differences between the concentrations of U-234 and U-238 in each quarter, it was found that there is no statistically significant variation between the concentrations of these two isotopes for any of the four quarters.

The data for uranium concentrations were further tested for variation among sites. Again, using the Kruskal-Wallis test, it was found that the chi-squared value of 3.58 for U-234, 8.64 for U-235, and 6.70 for U-238 fell within the critical values of 1.63 and 12.59. These results suggested that the null hypothesis that there is no variation among the sites can not be rejected.

The concentrations of Pu-238 and Pu-239+240 are given in Figures 5.2.8 and 5.2.9 respectively. Plutonium-238 found in the sample

collected in the third quarter at location WEE is an outlier (above 3 sigma of the mean). This is most probably an analytical artifact due to the contamination from a radionuclide of similar alpha energy. This possibility is supported by the fact that the concentration of Pu-238 in duplicate air particulate samples collected at WEE in the same quarter was much lower . In fact, it was in the range of Pu-238 found for all other locations in all four quarters. Plutonium-238 and Pu-239+240 in all the remaining samples were either negative or were associated with large errors. Also, they were below their minimum detection level (~5E-08 Bq/m^3). This is quite reasonable because the concentrations of Pu-238 and Pu-239+240 in the environment are very low. The weight of the air particulate collected on filter paper in a quarter generally ranged between 100 and 300 mg only. Plutonium content of this small amount of particulate is too low to be detected by alpha-spectrometry. Since the concentrations of plutonium isotopes were nondetectable in air particulate samples the statistical analyses of the data obviously did not show any variation either among the quarters or among the sampling sites.

The results on the concentration of Am-241 in air particulate samples collected from all locations are graphically presented in Figure 5.2.10. The results were within ± 2 sigma of the mean except for the one collected at SEC in the last quarter. The concentrations of Am-241 were either below its minimum detection level or close to MDA (~4E-08 Bq/m^3) in all the samples.

Results on the concentrations of individual radionuclides in original and duplicate air particulate samples are given in Table 5.2.2. Duplicate samples were collected weekly. The duplicate sampler was rotated quarterly: MLR in the first quarter, WSS in the second quarter, WEE in the third quarter, and WFF in the fourth quarter. The samples were collected by both samplers in identical conditions at these four locations. The duplicate samples were composited together and processed through sample preparation for individual radionuclides analyses.

The statistical analyses of the data showed that the results obtained for original and duplicate samples were not statistically significant from each other. This is based on the fact that chi-squared values found for each radionuclide in original and duplicate samples fell between their critical values.

$$TPU_{1\sigma} = \sigma_{ACT} = \frac{\sqrt{\sigma^2_{NCR} + (NCR)^2 * (RE^2_{EFF} + RE^2_{ALI} + RE^2_R + \Sigma\ RE^2_{CF})}}{2.22\ * EFF\ * ALI\ * R\ * ABN_s\ * e^{-\lambda t}\ * CF}$$

Where: EFF = Detector efficiency
ALI = Sample aliquot volume or mass
R = Sample tracer/carrier recovery
ABN_s = Abundance fraction of the emissions used for identification/quantification
σ^2_{NCR} = Variance of the net sample count rate
$(NCR)^2$ = Net sample count rate
RE^2_{EFF} = Square of the relative error of the efficiency term
RE^2_{ALI} = Square of the relative error of the aliquot
RE^2_R = Square of the relative error of the sample recovery
RE^2_{CF} = Square of the relative error of the other correction factor
λ = Analyte decay constant - ln 2/(half-life) [same units as the half-life use to compute λ]
t = Time from sample collection to radionuclide separation or midpoint of count time (same units as half-life)
CF = Other correction factors as appropriate (i.e., ingrowth factor, self-absorption factor, etc.)

The minimum detectable concentration (MDC) was calculated by using the following equation:

$$MDC = \frac{3.29\ * (S_{BLK})_i}{K} + \frac{2.71}{T\ * K}$$

Where: K = A correction factor that includes such things as units conversion, sample volume/weight, decay correction, detector efficiency, chemical recovery and abundance correction, etc.;

T = The counting time of the sample;

$(S_{BLK})_i$ = The calculated standard deviation for the method blank assuming it had been counted in the ith chamber for the same length of time as the ith sample and that the blank tracer/chemical recovery was equal to that of the ith sample.

Table 5.2.1 - Measurement of Radionuclides in Air Particulate

	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma
Carlsbad (CBD)								
Potassium-40	2.64E-04	1.80E-04	3.48E-04	2.36E-04	2.05E-05	1.77E-04	2.29E-04	1.58E-04
Cobalt-60	2.07E-05	1.47E-05	1.64E-05	1.42E-05	9.80E-06	1.21E-05	-2.16E-06	1.28E-05
Strontium-90	-2.64E-08	1.56E-05	8.67E-07	1.58E-05	-2.71E-05	2.13E-05	-8.57E-06	1.69E-05
Cesium-137	1.67E-05	1.27E-05	-1.17E-06	1.92E-05	1.00E-05	1.11E-05	1.13E-05	1.30E-05
Uranium-234	3.00E-06	4.76E-07	NA	NA	3.74E-06	5.39E-07	2.84E-06	4.40E-07
Uranium-235	1.98E-07	1.09E-07	NA	NA	2.96E-07	1.35E-07	2.48E-07	1.16E-07
Uranium-238	3.10E-06	4.56E-07	NA	NA	4.07E-06	5.32E-07	2.77E-06	4.03E-07
Plutonium-238	-1.36E-08	3.06E-08	-3.35E-08	7.08E-08	-2.16E-08	5.41E-08	2.62E-08	3.64E-08
Plutonium-239+240	1.38E-08	2.70E-08	2.04E-08	3.83E-08	1.64E-09	1.02E-08	1.30E-09	5.58E-08
Americium-241	-5.43E-09	7.73E-08	-3.13E-08	9.78E-08	-7.73E-08	1.21E-07	-3.00E-08	8.80E-08
Mills Ranch (MLR)								
Potassium-40	2.32E-04	1.61E-04	3.08E-04	1.51E-04	-2.10E-05	2.05E-04	1.16E-04	2.15E-04
Cobalt-60	1.23E-06	1.46E-05	-3.33E-06	1.62E-05	-6.32E-06	1.17E-05	6.71E-06	1.44E-05
Strontium-90	-1.23E-08	1.46E-05	-1.81E-07	1.59E-05	-1.84E-06	2.01E-05	-3.71E-05	1.35E-05
Cesium-137	5.58E-06	1.36E-05	1.33E-05	1.63E-05	9.98E-06	1.10E-05	9.54E-06	1.07E-05
Uranium-234	NA	NA	2.39E-06	4.20E-07	3.65E-06	5.97E-07	2.58E-06	4.20E-07
Uranium-235	NA	NA	7.47E-08	6.51E-08	1.75E-07	1.15E-07	1.81E-07	9.93E-08
Uranium-238	NA	NA	2.64E-06	4.05E-07	3.56E-06	5.55E-07	3.05E-06	4.34E-07
Plutonium-238	6.04E-08	1.15E-07	1.73E-08	1.02E-07	-5.46E-08	5.41E-08	3.00E-08	5.88E-08
Plutonium-239+240	-1.50E-14	9.77E-08	2.42E-08	4.20E-08	1.56E-09	9.69E-09	1.49E-09	5.23E-08
Americium-241	-4.70E-08	6.22E-08	-1.25E-08	1.15E-07	2.45E-08	1.61E-07	-5.68E-08	8.27E-08
South East Control (SEC)								
Potassium-40	3.46E-04	2.17E-04	2.37E-04	1.50E-04	3.02E-05	1.71E-04	4.41E-05	2.35E-04
Cobalt-60	3.68E-08	1.03E-05	-1.31E-05	1.69E-05	8.64E-06	8.66E-06	9.78E-06	8.91E-06
Strontium-90	-9.31E-06	1.83E-05	-1.18E-05	1.60E-05	-4.44E-05	2.09E-05	-3.02E-05	1.44E-05
Cesium-137	8.98E-06	9.32E-06	-3.02E-06	1.37E-05	2.74E-07	9.16E-06	-9.99E-07	1.45E-05
Uranium-234	NA	NA	2.66E-06	4.49E-07	3.16E-06	5.03E-07	3.02E-06	4.54E-07
Uranium-235	NA	NA	2.47E-07	1.30E-07	2.10E-07	1.15E-07	2.22E-07	1.10E-07
Uranium-238	NA	NA	3.78E-06	5.16E-07	3.48E-06	4.98E-07	3.04E-06	4.22E-07
Plutonium-238	1.75E-09	4.42E-08	1.62E-08	9.43E-08	-5.64E-08	5.71E-08	1.77E-09	1.10E-08
Plutonium-239+240	1.66E-09	1.03E-08	3.62E-08	5.04E-08	1.95E-09	1.21E-08	1.77E-08	8.32E-08
Americium-241	5.26E-08	1.02E-07	3.90E-08	1.21E-07	-6.23E-08	1.19E-07	2.37E-07	1.59E-07

N/A = Not Available

Table 5.2.1 - Measurement of Radionuclides in Air Particulate

	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma
Smith Ranch (SMR)								
Potassium-40	5.76E-04	3.56E-04	2.76E-04	2.26E-04	8.63E-05	2.62E-04	-2.18E-05	1.42E-04
Cobalt-60	2.64E-05	1.71E-05	5.12E-06	2.38E-05	-2.44E-06	1.71E-05	5.50E-07	8.92E-06
Strontium-90	3.22E-06	1.60E-05	-2.48E-06	2.08E-05	-1.99E-05	2.50E-05	5.01E-06	1.64E-05
Cesium-137	-4.92E-06	1.57E-05	4.89E-06	1.93E-05	1.51E-06	1.33E-05	3.77E-06	7.77E-06
Uranium-234	3.05E-06	4.62E-07	NA	NA	3.67E-06	6.17E-07	2.54E-06	4.28E-07
Uranium-235	2.68E-07	1.22E-07	NA	NA	3.17E-07	1.72E-07	1.31E-07	8.63E-08
Uranium-238	2.62E-06	4.05E-07	NA	NA	3.76E-06	5.75E-07	2.76E-06	4.21E-07
Plutonium-238	-1.52E-08	7.81E-08	-2.74E-08	1.02E-07	-1.60E-08	8.56E-08	-1.84E-14	4.10E-08
Plutonium-239+240	-1.82E-08	3.58E-08	5.77E-08	6.83E-08	-3.28E-08	6.45E-08	0.00E+00	7.68E-08
Americium-241	-5.72E-08	9.15E-08	-5.31E-08	1.27E-07	-5.31E-08	1.68E-07	-4.04E-08	8.76E-08
WIPP East (WEE)								
Potassium-40	4.60E-04	1.56E-04	3.25E-04	3.25E-04	8.58E-05	2.02E-04	-1.19E-04	2.52E-04
Cobalt-60	-7.44E-06	1.45E-05	2.35E-05	1.99E-05	1.25E-06	1.09E-05	1.21E-05	9.52E-06
Strontium-90	9.33E-06	1.65E-05	-1.07E-05	2.33E-05	9.38E-06	2.10E-05	1.73E-06	1.55E-05
Cesium-137	1.06E-05	1.34E-05	4.42E-05	3.84E-05	1.62E-05	1.70E-05	1.10E-05	1.49E-05
Uranium-234	NA	NA	NA	NA	3.74E-06	5.75E-07	2.97E-06	4.71E-07
Uranium-235	NA	NA	NA	NA	2.43E-07	1.38E-07	2.27E-07	1.16E-07
Uranium-238	NA	NA	NA	NA	3.78E-06	5.50E-07	3.13E-06	4.51E-07
Plutonium-238	-1.54E-08	3.32E-08	-2.94E-08	1.06E-07	5.87E-07	2.26E-07	2.52E-09	1.56E-08
Plutonium-239+240	1.12E-08	2.20E-08	3.23E-08	6.12E-08	3.76E-08	5.23E-08	2.50E-09	6.34E-08
Americium-241	-3.76E-08	6.58E-08	-1.02E-07	1.32E-07	-9.06E-08	1.17E-07	7.08E-08	1.35E-07
WIPP Far Field (WFF)								
Potassium-40	2.95E-04	1.43E-04	-7.45E-05	1.76E-04	2.27E-05	1.74E-04	1.18E-04	1.36E-04
Cobalt-60	1.26E-05	9.10E-06	-9.28E-07	1.85E-05	1.91E-05	2.02E-05	-5.33E-06	1.18E-05
Strontium-90	-1.10E-05	1.77E-05	-1.87E-06	1.56E-05	-3.65E-05	2.01E-05	-2.39E-05	1.95E-05
Cesium-137	-4.39E-06	9.79E-06	-1.40E-06	1.30E-05	1.16E-05	1.39E-05	1.29E-06	1.33E-05
Uranium-234	NA	NA	NA	NA	2.78E-06	4.73E-07	2.79E-06	4.45E-07
Uranium-235	NA	NA	NA	NA	1.62E-07	1.01E-07	1.71E-07	9.78E-08
Uranium-238	NA	NA	NA	NA	2.76E-06	4.32E-07	2.73E-06	4.13E-07
Plutonium-238	2.39E-08	6.46E-08	-4.25E-08	7.97E-08	-2.30E-08	5.18E-08	1.45E-09	8.96E-09
Plutonium-239+240	1.99E-09	1.24E-08	-4.35E-09	5.88E-08	1.46E-08	2.87E-08	1.44E-09	5.33E-08
Americium-241	-8.39E-09	7.64E-08	-2.50E-08	8.89E-08	-1.11E-08	1.36E-07	-4.13E-08	9.15E-08

N/A = Not Available

Table 5.2.1 - Measurement of Radionuclides in Air Particulate								
	1st Quarter		2nd Quarter		3rd Quarter		4th Quarter	
	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma
WIPP South (WSS)								
Potassium-40	4.11E-04	3.71E-04	3.51E-04	2.37E-04	-1.85E-05	2.68E-04	1.36E-04	1.85E-04
Cobalt-60	1.04E-05	1.18E-05	-6.68E-06	1.60E-05	7.26E-06	5.78E-06	9.22E-06	6.80E-06
Strontium-90	3.62E-07	1.59E-05	-7.54E-06	1.67E-05	-4.29E-05	2.30E-05	-1.32E-05	1.37E-05
Cesium-137	-3.08E-06	9.02E-06	9.01E-06	1.20E-05	4.80E-07	1.52E-05	-5.80E-06	1.01E-05
Uranium-234	NA	NA	2.58E-06	4.46E-07	3.05E-06	5.29E-07	2.97E-06	4.51E-07
Uranium-235	NA	NA	7.79E-08	6.85E-08	2.23E-07	1.27E-07	1.38E-07	8.63E-08
Uranium-238	NA	NA	2.61E-06	4.10E-07	3.38E-06	5.26E-07	2.50E-06	3.78E-07
Plutonium-238	-2.65E-08	3.72E-08	1.32E-08	8.59E-08	-4.05E-08	4.62E-08	1.52E-08	2.99E-08
Plutonium-239+240	2.23E-08	3.09E-08	2.26E-08	4.24E-08	-1.34E-14	5.06E-08	1.52E-08	6.47E-08
Americium-241	-1.45E-08	7.10E-08	-8.97E-08	8.74E-08	-9.07E-08	1.19E-07	-2.91E-08	9.31E-08

N/A = Not Available

Table 5.2.2
Measurement of Radionuclides on Duplicate Air Particulate Samples

	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma
1st Quarter				
Mills Ranch				
Potassium-40	2.32E-04	1.61E-04	1.40E-04	1.77E-04
Cobalt-60	1.23E-06	1.46E-05	4.11E-06	1.31E-05
Strontium-90	-1.23E-08	1.46E-05	-2.46E-06	1.54E-05
Cesium-137	5.58E-06	1.36E-05	1.41E-05	1.29E-05
Uranium-234	N/A	N/A	N/A	N/A
Uranium-235	N/A	N/A	N/A	N/A
Uranium-238	N/A	N/A	N/A	N/A
Plutonium-238	6.04E-08	1.15E-07	-1.50E-08	4.62E-08
Plutonium-239+240	-1.50E-14	9.77E-08	1.27E-08	2.49E-08
Americium-241	-4.70E-08	6.22E-08	-1.01E-08	7.00E-08
2nd Quarter				
WIPP South				
Potassium-40	3.51E-04	2.37E-04	3.07E-04	2.11E-04
Cobalt-60	-6.68E-06	1.60E-05	3.07E-05	1.97E-05
Strontium-90	-7.54E-06	1.67E-05	1.26E-06	2.32E-05
Cesium-137	9.01E-06	1.20E-05	2.69E-05	2.45E-05
Uranium-234	2.58E-06	4.46E-07	2.83E-06	5.34E-07
Uranium-235	7.79E-08	6.85E-08	2.26E-07	1.34E-07
Uranium-238	2.61E-06	4.10E-07	2.86E-06	4.80E-07
Plutonium-238	1.32E-08	8.59E-08	-6.58E-08	1.03E-07
Plutonium-239+240	2.26E-08	4.24E-08	2.51E-08	4.93E-08
Americium-241	-8.97E-08	8.74E-08	-8.58E-08	1.28E-07
3rd Quarter				
WIPP East				
Potassium-40	8.58E-05	2.02E-04	6.28E-05	1.99E-04
Cobalt-60	1.25E-06	1.09E-05	-2.82E-06	1.41E-05
Strontium-90	9.38E-06	2.10E-05	3.44E-06	1.99E-05
Cesium-137	1.62E-05	1.70E-05	-2.01E-06	9.49E-06
Uranium-234	3.74E-06	5.75E-07	2.96E-06	5.07E-07
Uranium-235	2.43E-07	1.38E-07	2.49E-07	1.32E-07
Uranium-238	3.78E-06	5.50E-07	3.84E-06	5.50E-07
Plutonium-238	5.87E-07	2.26E-07	-3.79E-08	4.34E-08
Plutonium-239+240	3.76E-08	5.23E-08	9.54E-15	4.98E-11
Americium-241	-9.06E-08	1.17E-07	-4.58E-08	1.27E-07

Table 5.2.2
Measurement of Radionuclides on Duplicate Air Particulate Samples

	Bq/m³	TPU 2 Sigma	Bq/m³	TPU 2 Sigma
4th Quarter				
WIPP Far Field				
Potassium-40	1.18E-04	1.36E-04	1.91E-04	1.36E-04
Cobalt-60	-5.33E-06	1.18E-05	8.28E-06	1.35E-05
Strontium-90	-2.39E-05	1.95E-05	-2.64E-05	1.45E-05
Cesium-137	1.29E-06	1.33E-05	1.27E-05	6.18E-06
Uranium-234	2.79E-06	4.45E-07	2.51E-06	3.94E-07
Uranium-235	1.71E-07	9.78E-08	2.39E-07	1.09E-07
Uranium-238	2.73E-06	4.13E-07	2.63E-06	5.70E-07
Plutonium-238	1.45E-09	8.96E-09	1.53E-09	9.46E-09
Plutonium-239+240	1.44E-09	5.33E-08	1.52E-08	6.08E-08
Americium-241	-4.13E-08	9.15E-08	2.39E-07	1.58E-07

N/A = Not available

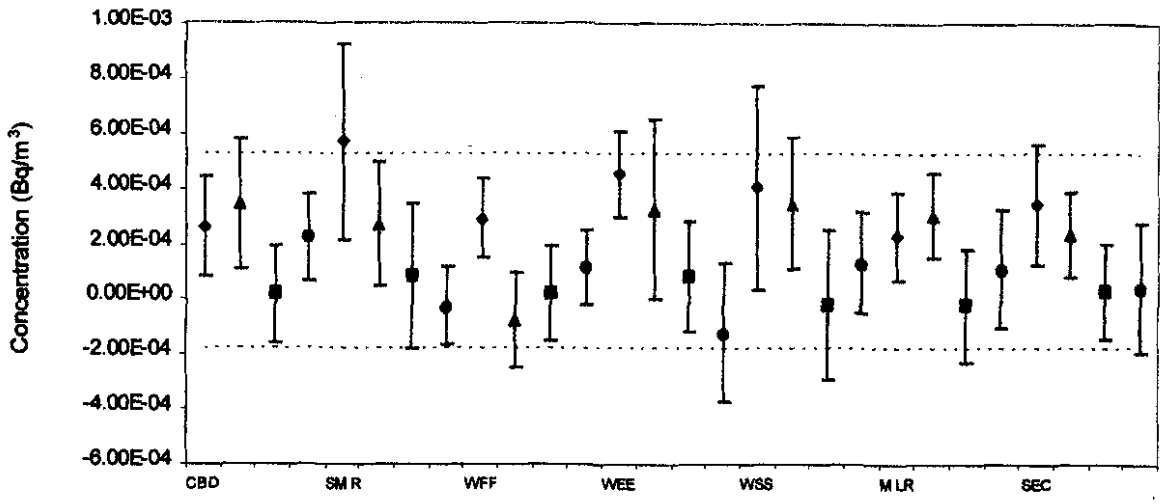


Figure 5.2.1 - Composite Air Filters by Quarter/Location - Potassium-40

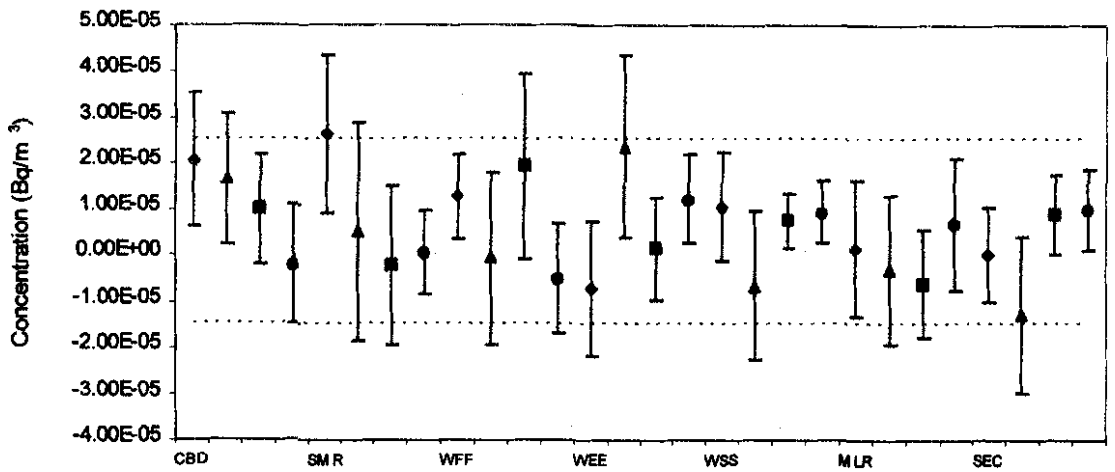


Figure 5.2.2 - Composite Air Filters by Quarter/Location - Cobalt-60

◆ 1st QTR ▲ 2nd QTR ■ 3rd QTR ● 4th QTR - - - - - - - - ± 2 Sigma

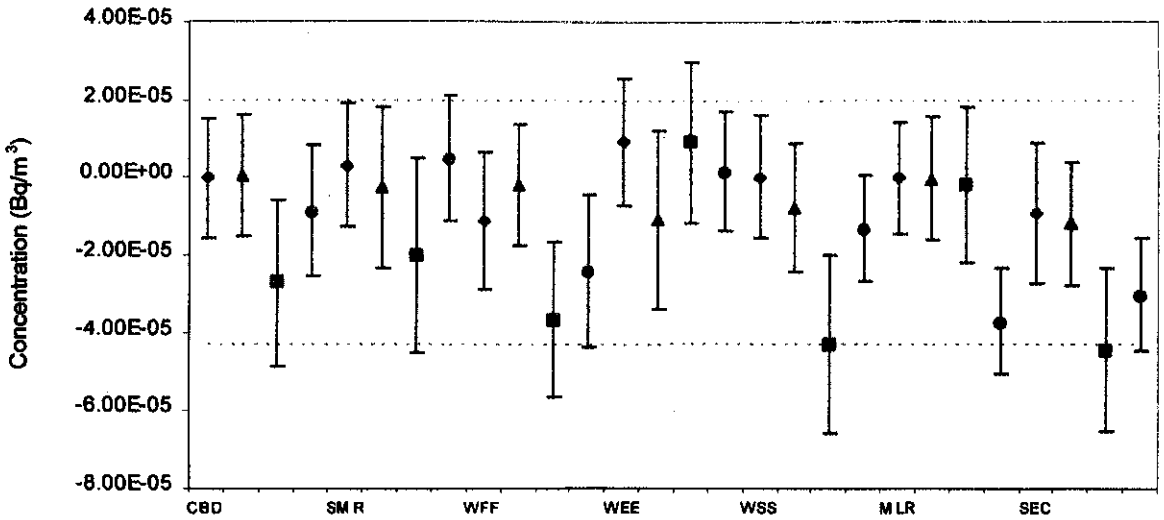


Figure 5.2.3 - Composite Air Filters by Quarter/Location - Strontium-90

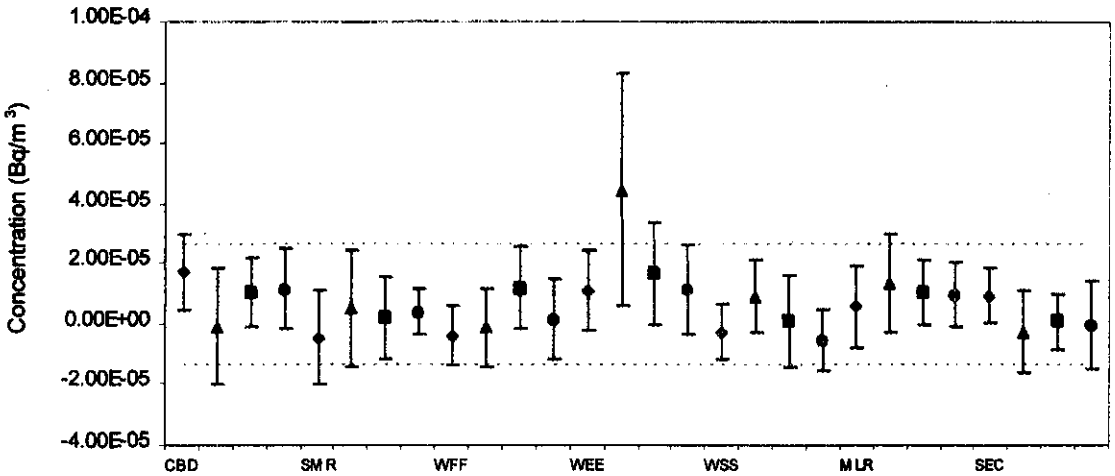


Figure 5.2.4 - Composite Air Filters by Quarter/Location - Cesium-137

◆ 1st QTR ▲ 2nd QTR ■ 3rd QTR ● 4th QTR - - - - - - - - ± 2 Sigma

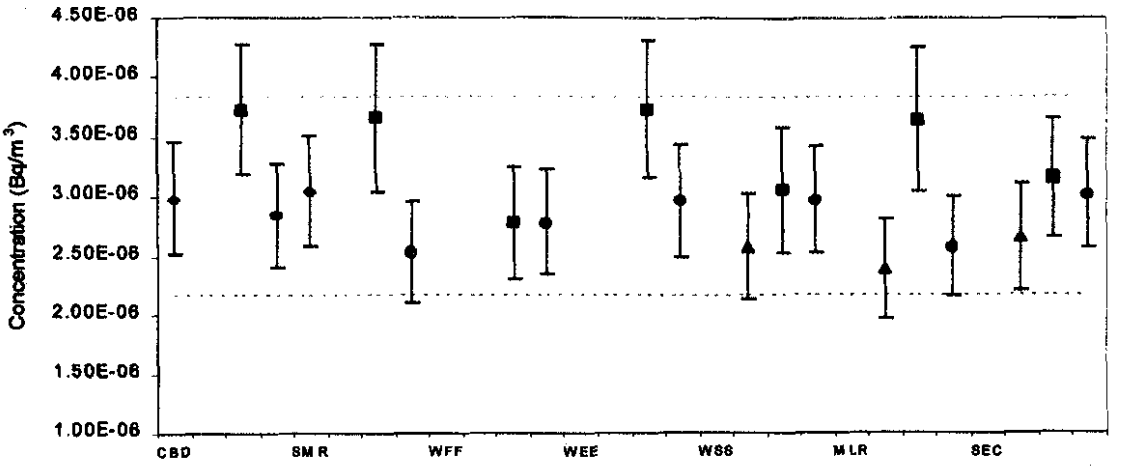


Figure 5.2.5 - Composite Air Filters by Quarter/Location - Uranium-234

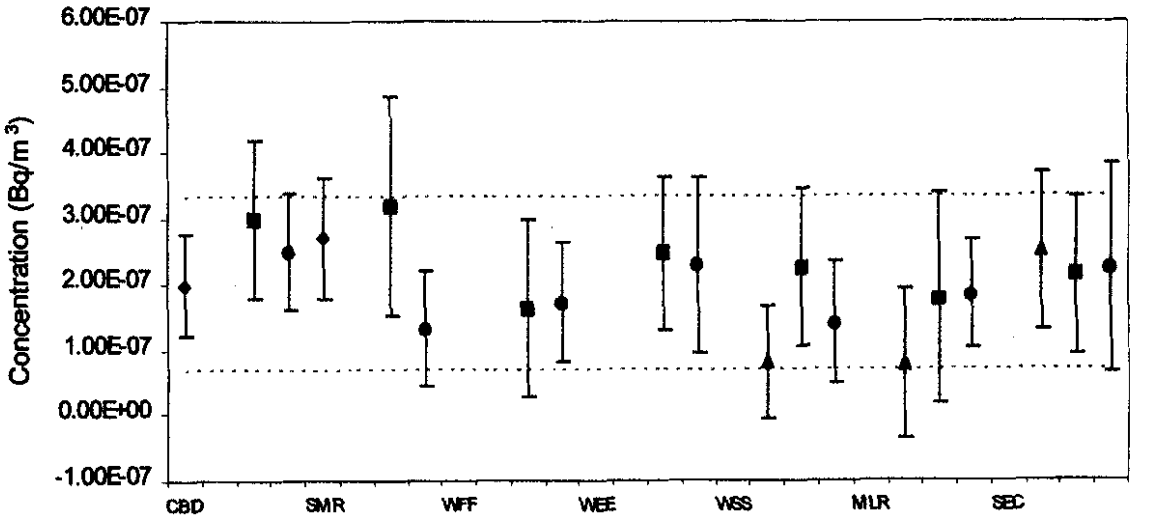


Figure 5.2.6 - Composite Air Filters by Quarter/Location - Uranium-235

◆ 1st QTR ▲ 2nd QTR ■ 3rd QTR ● 4th QTR - - - - - - - - ± 2 Sigma

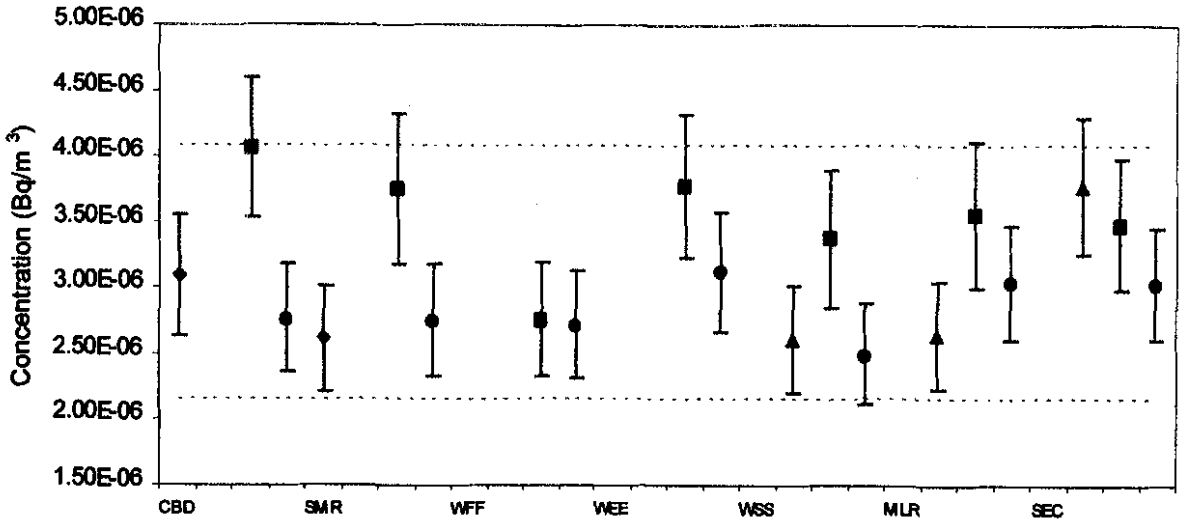


Figure 5.2.7 - Composite Air Filters by Quarter/Location - Uranium-238

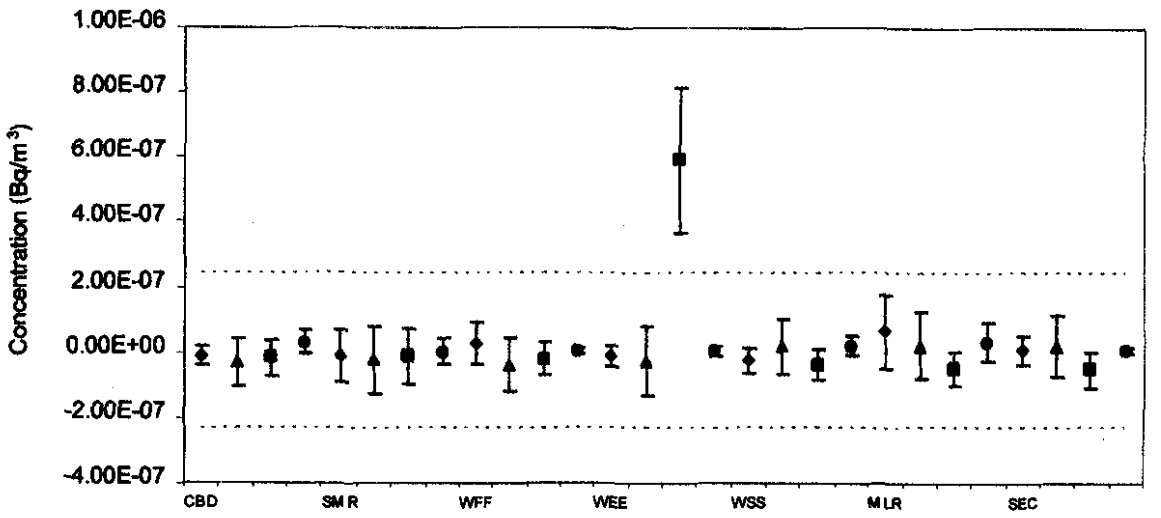


Figure 5.2.8 - Composite Air Filters by Quarter/Location - Plutonium-238

◆ 1st QTR ▲ 2nd QTR ■ 3rd QTR ● 4th QTR - - - - - - - - ± 2 Sigma

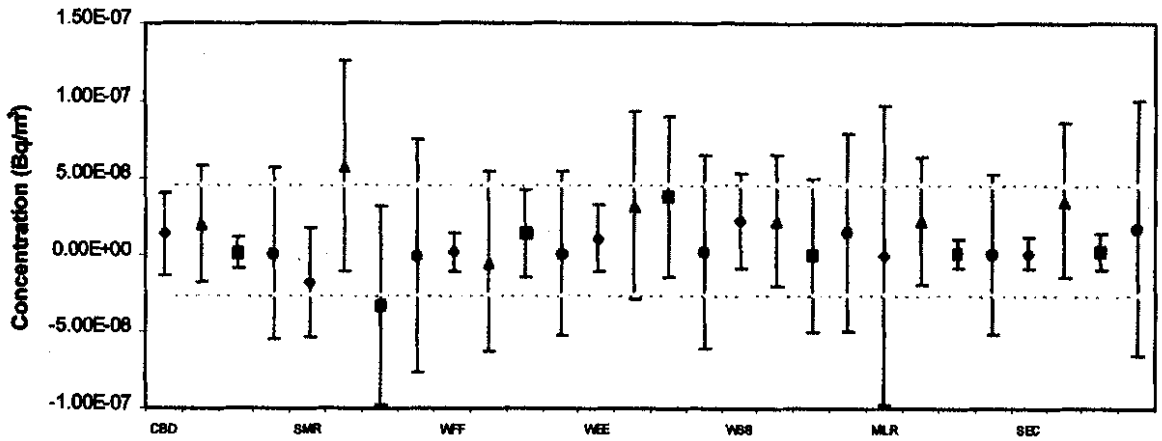


Figure 5.2.9 - Composite Air Filters by Quarter/Location - Plutonium-239+240

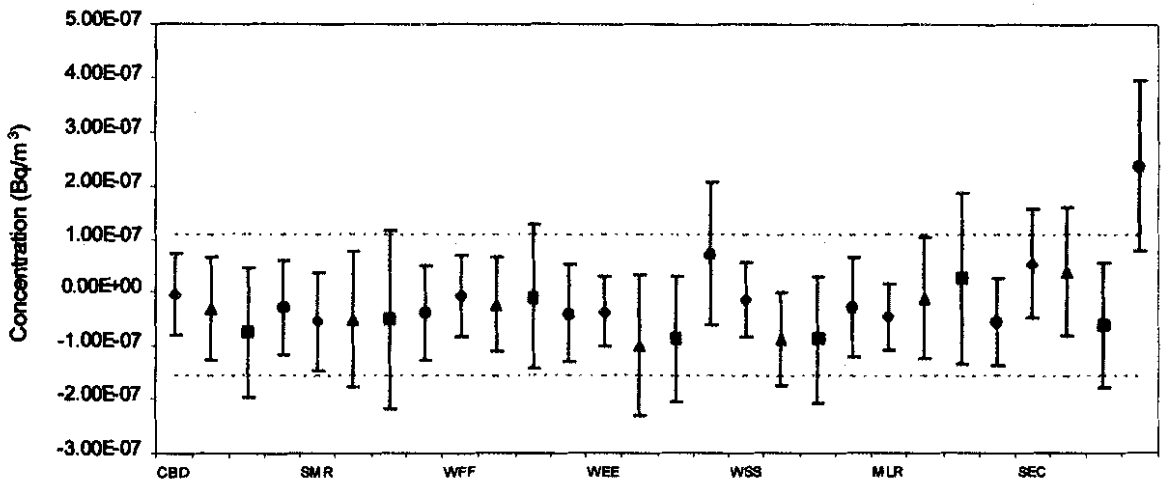


Figure 5.2.10 - Composite Air Filters by Quarter/Location - Americium-241

◆ 1st QTR ▲ 2nd QTR ■ 3rd QTR ● 4th QTR - - - - - - - - ± 2 Sigma

5.3 Soil Samples

Sampling: Soil samples were collected from six different locations. These locations are shown in Figure 5.3.1 and are identified as SMR, WSS, WFF, WEE, MLR, and SEC. Soil samples were collected in three depth profiles: 0-2 cm (surface), 2-5 cm (intermediate), and 5-10 cm (deep) from each location. Determinations of the radionuclides in three depth profiles may provide their vertical migration in soil which is an important factor in assessing the radiation dose to the general public.

Sample Preparation: Soil samples were dried at 110°C for four to ten hours and homogenized by grinding to approximately 100 mesh. Approximately 5 grams of soil (dry weight) were dissolved by heating with nitric and hydrofluoric acids. Finally, hydrofluoric acid was totally removed by heating with nitric and boric acids. The residue was dissolved in hydrochloric acid to perform the gamma spectrometry at the WIPP laboratory. A portion of the soil samples were shipped to the contract laboratory for the quantitative determinations of Sr-90, U-234, U-235 and U-238, Pu-238 and Pu-239+240, and Am-241.

Determination of Individual Radionuclides: The procedures for the determinations of individual radionuclides in soil samples were similar to the methods applied for their determinations in air particulate samples.

Results and Discussions: The concentrations of all the radionuclides of interest in soil samples are given in Table 5.3.1. The results are summarized for each sampling location. Also, the graphical presentations of the data for individual radionuclides are given in Figures 5.3.2 through 5.3.11.

The results on the concentration of K-40 for all the six sampling locations are given in Figure 5.3.2. The data points are within ± 2 sigma of the mean suggesting that there were no significant variations among the concentrations of K-40 at various locations. These results did not show any variation among the three depth profiles of sampling either. The mean concentration of K-40 was found to be 368 ± 756 mBq/g of soil (± 2 SD). For comparison, the average concentration of K-40 in U.S. soil has been reported to be 400 mBq/g. The K-40 content of soil around Albuquerque is ~600 mBq/g (DOE/NV 10384-23, Reproduced by U.S. Department of Energy, Office of Scientific & Technical Information, P.O. Box 62, Oak Ridge, TN 37831).

The results on the concentration of Co-60 is given in Figure 5.3.3. The concentrations of Co-60 at all locations were within ± 2 sigma of the mean. These results suggest that the concentration of Co-60 did not vary either from location to location or between the three sampling depth profiles of all the locations. The mean concentration of Co-60 in soil was 7.8 ± 35 mBq/g. The important point to be noted was that all the results obtained were either below or almost equal to MDA. The MDA for Co-60 was ~40 mBq/g of soil. Similarly, the concentrations of Sr-90 (Figure 5.3.4) and Cs-137 (Figure 5.3.5) were either below or equal to their MDA. The MDA for Sr-90 and Cs-137 were ~30 mBq/g of soil. The mean concentrations of Sr-90 and Cs-137 were 5.8 ± 26 and 17 ± 20 mBq/g of soil, respectively. All but one data point (SMR, Intermediate) for the concentrations of Sr-90 and all data points for Cs-137 were within ± 2 sigma of the mean. These results indicate that there were no significant variations among the sites and the three sampling depths for the concentrations of Sr-90 and Cs-137.

The concentrations of U-234, U-235 and U-238 are given in Figures 5.3.6, 5.3.7 and 5.3.8 respectively. The concentrations of U-234 and U-238 found at all these locations and in all three depth profiles were mostly within ± 2 sigma of the mean. These results therefore suggest that there were no significant variations among the uranium concentrations of various sampling locations and the three depth profiles of each locations. The mean concentration of U-234 from the measurements of all 18 samples (three samples per location)

was 16.3 ± 6.70 (± 2 SD) mBq/g of soil and the mean concentration of U-238 was 16.7 ± 8.1 mBq/g. As expected, the mean concentration of U-235 was much lower (0.79 ± 1.02 mBq/g). These results clearly indicate that the parent U-238 and the daughter U-234 were in equilibrium. The mean concentration of uranium in these soil samples was almost half of the uranium concentration reported in the soil samples of Albuquerque (DOE/NV10384-23, reproduced by the U.S. Department of Energy, Office of Scientific & Technical Information, P.O. Box 62, Oak Ridge, TN 37831) and much lower than the average concentration of 66 mBq/g reported for U-238 in the soil samples of the United States (NCRP Report No. 94).

The concentrations of Pu-238 and Pu-239+240 are given in Figures 5.3.9 and 5.3.10, respectively. These figures show that most of the data points for plutonium isotopes are within ± 2 sigma of the mean, suggesting that their concentrations did not vary significantly among sampling locations and three depth profiles of sampling. The mean concentration of Pu-238 was 0.11 ± 0.52 and Pu-239+240 was 0.36 ± 0.76 mBq/g of soil. These results clearly indicate that the concentrations of Pu-238 and Pu-239+240 in all these samples were below their MDA (~1.1 mBq/g). The concentrations of Am-241 also in these samples were below or close to its MDA (0.74 mBq/g). The mean concentration of Am-241 was 0.42 ± 0.70 mBq/g of soil. As given in Figure 5.3.11, the concentrations of Am-241 at all locations and the three depth profiles of sampling for each locations were within ± 2 sigma of the mean. These results suggest that the concentration of Am-241 did not vary significantly either from location to location or between the samples collected from three depth profiles of each location.

In summary, it can be said that the two naturally occurring radioactive elements measured (K-40 and isotopes of uranium) did not show any significant variations either among the sampling locations or among the three sampling depth profiles. The concentrations of all other radionuclides were below their MDA; therefore, no definite conclusions can be made about their variability from one sampling location to another, and also among three depth profiles.

Duplicate soil samples were collected from the location WEE as a part of QC of the data. The site was selected randomly. The results are summarized in Table 5.3.2. The concentrations of U-234 and U-238 in both samples were almost same (within the errors of the measurements), suggesting that the results were reproducible. The concentrations of all other radionuclides in both samples were very low (lower or equal to their MDA); therefore, a meaningful comparison could not be possibly made.

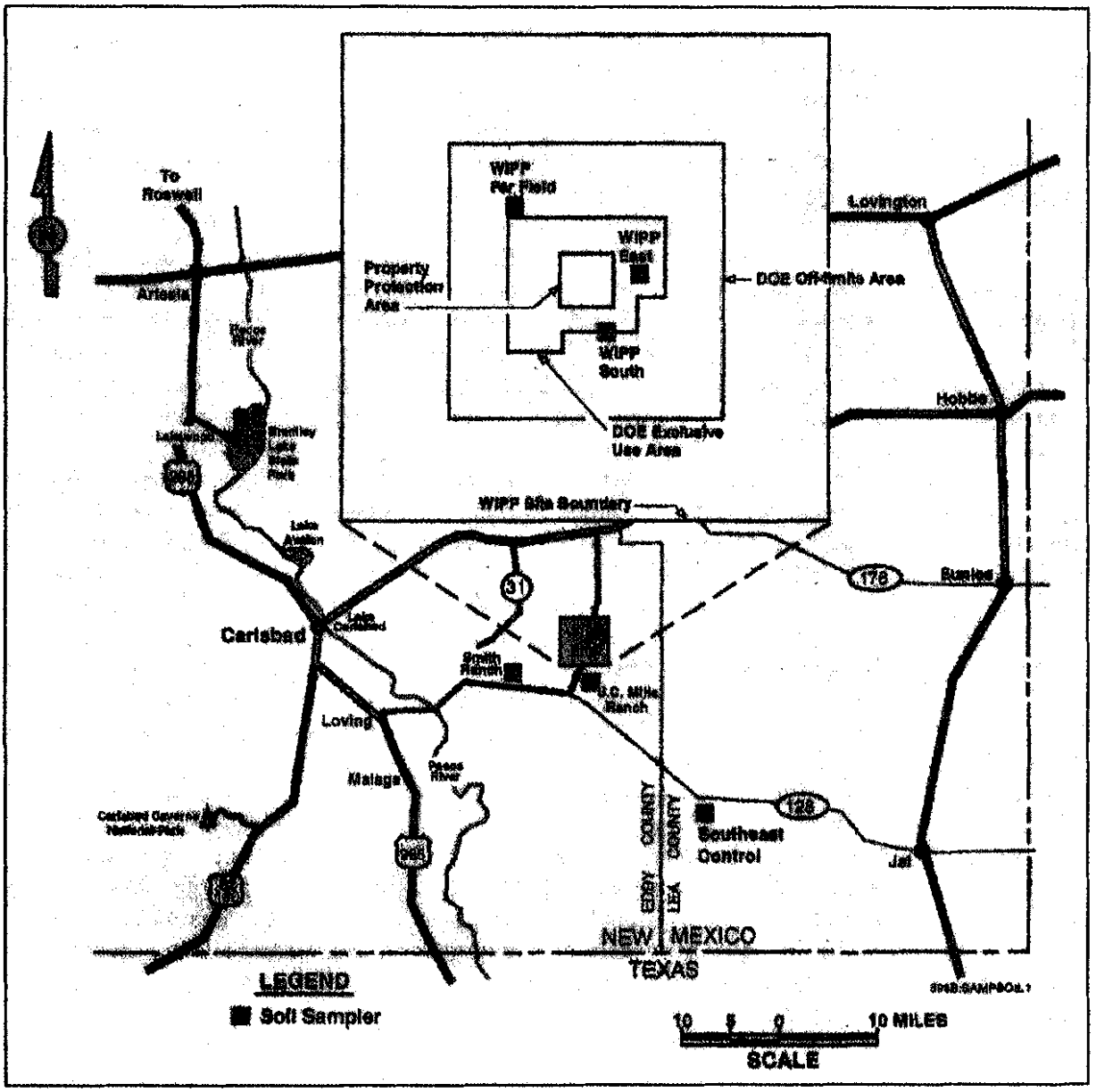


Figure 5.3.1 - Soil Sampling Locations

Table 5.3.1 - Concentration of Radionuclides in Soil (Bq/g)

		SS (0-2 cm)	TPU 2 Sigma	SI (2-5 cm)	TPU 2 Sigma	SD (5-10 cm)	TPU 2 Sigma
Mills Ranch (MLR)	Potassium-40	4.79E-01	2.21E-01	4.52E-01	3.42E-01	5.89E-01	1.98E-01
	Cobalt-60	-1.44E-03	1.51E-02	-4.70E-03	1.61E-02	3.07E-04	1.49E-02
	Strontium-90	4.07E-03	2.78E-02	-1.11E-02	2.66E-02	1.44E-02	2.85E-02
	Cesium-137	2.45E-02	1.62E-02	1.14E-02	1.25E-02	1.70E-02	1.87E-02
	Uranium-234	1.78E-02	9.62E-04	2.15E-02	1.37E-03	2.37E-02	1.55E-03
	Uranium-235	8.88E-04	1.85E-04	2.59E-04	1.18E-03	6.66E-04	9.25E-04
	Uranium-238	1.81E-02	8.88E-04	2.41E-02	6.66E-04	2.59E-02	7.77E-04
	Plutonium-238	1.85E-04	7.03E-04	1.11E-04	7.77E-04	1.11E-04	6.66E-04
	Plutonium-239+240	7.77E-04	1.85E-04	4.81E-04	1.48E-04	2.96E-04	4.81E-04
	Americium-241	5.18E-04	1.85E-04	5.92E-04	4.07E-04	5.92E-04	6.29E-04
South East Control (SEC)	Potassium-40	-4.59E-02	2.82E-01	2.66E-01	2.37E-01	-1.98E-01	3.87E-01
	Cobalt-60	-3.37E-03	1.42E-02	-1.11E-02	2.11E-02	3.27E-02	2.25E-02
	Strontium-90	-3.33E-04	1.78E-02	-2.41E-03	2.41E-02	1.89E-03	2.48E-02
	Cesium-137	1.64E-02	1.26E-02	2.14E-02	2.18E-02	2.83E-02	2.34E-02
	Uranium-234	1.63E-02	1.15E-03	1.33E-02	8.88E-04	9.25E-03	1.04E-03
	Uranium-235	1.07E-03	1.85E-04	7.77E-04	4.44E-04	5.18E-04	6.66E-04
	Uranium-238	1.74E-02	1.85E-04	1.59E-02	6.29E-04	1.11E-02	7.77E-04
	Plutonium-238	4.44E-04	7.77E-04	-4.44E-04	1.52E-03	3.33E-04	1.33E-03
	Plutonium-239+240	7.03E-04	4.81E-04	9.99E-04	6.66E-04	1.33E-03	8.14E-04
	Americium-241	1.07E-03	5.92E-04	4.81E-04	9.25E-04	6.66E-04	8.88E-04
Smith Ranch (SMR)	Potassium-40	5.20E-01	2.19E-01	7.89E-01	4.71E-01	9.34E-01	7.41E-01
	Cobalt-60	1.49E-02	1.65E-02	3.74E-02	3.19E-02	5.43E-02	3.99E-02
	Strontium-90	-6.66E-04	2.48E-02	5.55E-02	3.07E-02	2.04E-02	3.59E-02
	Cesium-137	1.70E-02	1.40E-02	1.94E-02	1.94E-02	2.05E-02	1.84E-02
	Uranium-234	1.70E-02	1.04E-03	1.70E-02	6.66E-04	1.92E-02	7.40E-04
	Uranium-235	7.77E-04	1.85E-04	6.29E-04	7.77E-04	8.14E-04	4.81E-04
	Uranium-238	1.85E-02	4.81E-04	1.96E-02	7.77E-04	2.00E-02	6.29E-04
	Plutonium-238	1.85E-04	8.14E-04	1.11E-04	8.14E-04	-7.40E-05	8.88E-04
	Plutonium-239+240	5.18E-04	7.03E-04	1.11E-04	7.40E-04	7.40E-05	7.40E-04
	Americium-241	7.40E-05	8.88E-04	3.33E-04	8.14E-04	-7.40E-05	7.77E-04

Table 5.3.1 - Concentration of Radionuclides in Soil (Bq/g)

		SS (0-2 cm)	TPU 2 Sigma	SI (2-5 cm)	TPU 2 Sigma	SD (5-10 cm)	TPU 2 Sigma
WIPP East (WEE)	Potassium-40	-2.00E-01	6.80E-01	-7.58E-02	2.86E-01	1.10E+00	7.69E-01
	Cobalt-60	-1.60E-02	2.97E-02	8.01E-03	1.54E-02	1.66E-02	2.10E-02
	Strontium-90	1.22E-03	3.11E-02	2.52E-03	1.96E-02	3.11E-03	2.55E-02
	Cesium-137	9.43E-03	3.11E-02	8.45E-03	1.23E-02	6.14E-03	2.97E-02
	Uranium-234	1.59E-02	1.22E-03	1.63E-02	1.63E-03	1.74E-02	1.15E-03
	Uranium-235	2.52E-03	7.03E-04	4.44E-04	1.07E-03	1.30E-03	2.22E-04
	Uranium-238	1.78E-02	9.99E-04	1.44E-02	9.62E-04	1.48E-02	5.55E-04
	Plutonium-238	-3.70E-04	1.44E-03	3.33E-04	2.04E-03	1.48E-04	8.51E-04
	Plutonium-239+240	3.70E-04	6.66E-04	-1.85E-04	1.26E-03	2.22E-04	5.92E-04
	Americium-241	0.00E+00	9.25E-04	1.48E-04	1.55E-03	6.66E-04	6.29E-04
WIPP Far Field (WFF)	Potassium-40	6.76E-01	2.02E-01	8.50E-02	7.02E-01	7.76E-01	4.06E-01
	Cobalt-60	2.90E-03	1.71E-02	1.38E-02	3.46E-02	1.63E-02	2.53E-02
	Strontium-90	-2.85E-03	2.26E-02	8.51E-03	2.29E-02	4.81E-03	2.11E-02
	Cesium-137	3.81E-03	1.35E-02	2.21E-02	3.86E-02	2.88E-02	1.73E-02
	Uranium-234	1.37E-02	1.11E-03	1.52E-02	1.22E-03	1.52E-02	7.77E-04
	Uranium-235	1.48E-04	8.51E-04	5.92E-04	2.22E-04	5.18E-04	1.48E-04
	Uranium-238	1.26E-02	8.51E-04	1.52E-02	8.14E-04	1.48E-02	3.70E-04
	Plutonium-238	0.00E+00	8.51E-04	2.96E-04	2.59E-04	1.48E-04	7.03E-04
	Plutonium-239+240	1.85E-04	4.81E-04	1.85E-04	7.03E-04	2.96E-04	7.03E-04
	Americium-241	2.22E-04	8.14E-04	2.96E-04	7.40E-04	1.26E-03	1.70E-03
WIPP South (WSS)	Potassium-40	1.91E-01	4.06E-01	4.18E-01	1.75E-01	1.20E-01	1.29E-01
	Cobalt-60	1.85E-02	1.58E-02	3.10E-03	3.25E-02	-4.22E-03	2.03E-02
	Strontium-90	4.44E-03	1.70E-02	8.51E-03	1.74E-02	-9.62E-04	2.33E-02
	Cesium-137	-6.07E-03	1.99E-02	2.48E-03	1.65E-02	2.10E-02	2.28E-02
	Uranium-234	1.33E-02	1.55E-03	1.30E-02	1.59E-03	1.92E-02	1.33E-03
	Uranium-235	8.88E-04	1.04E-03	4.44E-04	1.22E-03	8.88E-04	1.04E-03
	Uranium-238	1.15E-02	7.03E-04	1.22E-02	1.04E-03	1.59E-02	2.96E-04
	Plutonium-238	-3.33E-04	2.26E-03	-1.48E-04	8.88E-04	3.33E-04	1.22E-03
	Plutonium-239+240	7.03E-04	4.81E-04	0.00E+00	6.29E-04	-7.40E-05	7.77E-04
	Americium-241	1.11E-04	1.22E-03	7.77E-04	1.18E-03	5.18E-04	9.25E-04

Table 5.3.1 - Concentration of Radionuclides in Soil (Bq/g)

		SS (0-2 cm)	TPU 2 Sigma	SI (2-5 cm)	TPU 2 Sigma	SD (5-10 cm)	TPU 2 Sigma
WIPP Dup of WEE	Potassium-40	4.97E-01	2.64E-01	4.70E-01	1.91E-01	-1.23E-01	7.27E-01
	Cobalt-60	1.34E-02	2.25E-02	-5.67E-03	1.65E-02	-5.53E-03	3.14E-02
	Strontium-90	1.44E-02	2.96E-02	3.00E-03	2.63E-02	-5.92E-03	2.55E-02
	Cesium-137	2.81E-02	2.45E-02	2.29E-02	1.92E-02	3.64E-02	2.94E-02
	Uranium-234	1.18E-02	1.22E-03	1.52E-02	1.85E-03	1.22E-02	1.26E-03
	Uranium-235	8.51E-04	7.03E-04	8.51E-04	1.04E-03	3.70E-04	7.03E-04
	Uranium-238	1.55E-02	8.51E-04	1.37E-02	1.04E-03	1.44E-02	5.55E-04
	Plutonium-238	3.33E-04	9.25E-04	4.44E-04	8.51E-04	2.22E-04	1.04E-03
	Plutonium-239+240	1.48E-04	8.51E-04	4.44E-04	7.03E-04	-1.11E-04	1.59E-03
	Americium-241	0.00E+00	1.37E-03	2.59E-04	9.25E-04	3.33E-04	1.48E-03

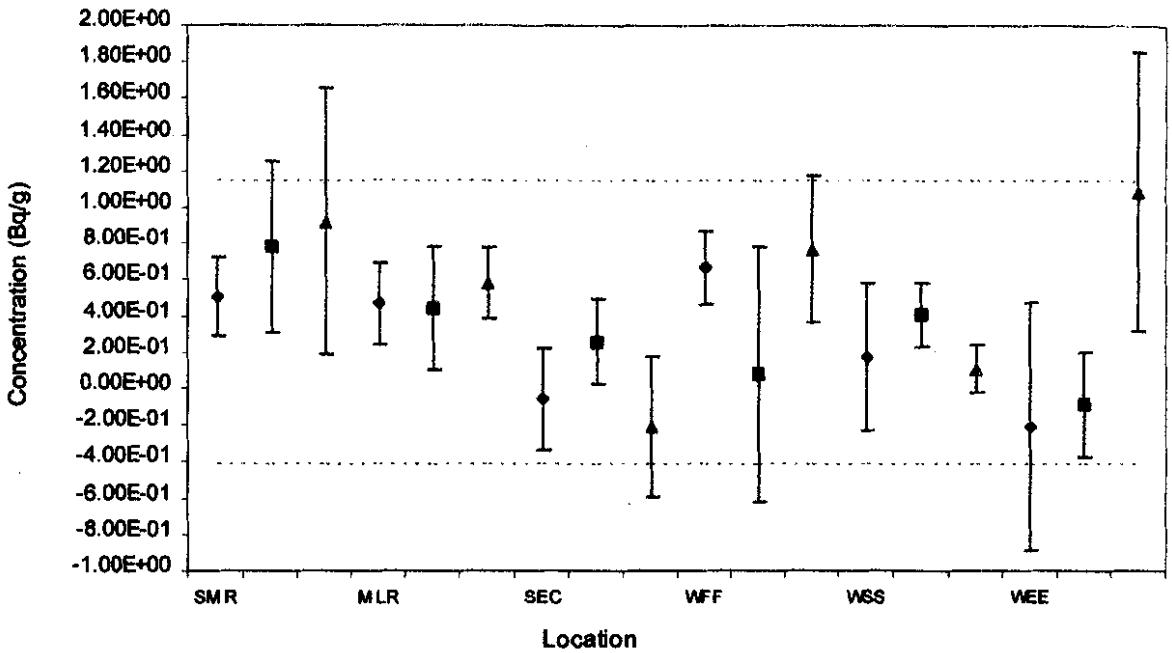


Figure 5.3.2 - Potassium-40 in Soil

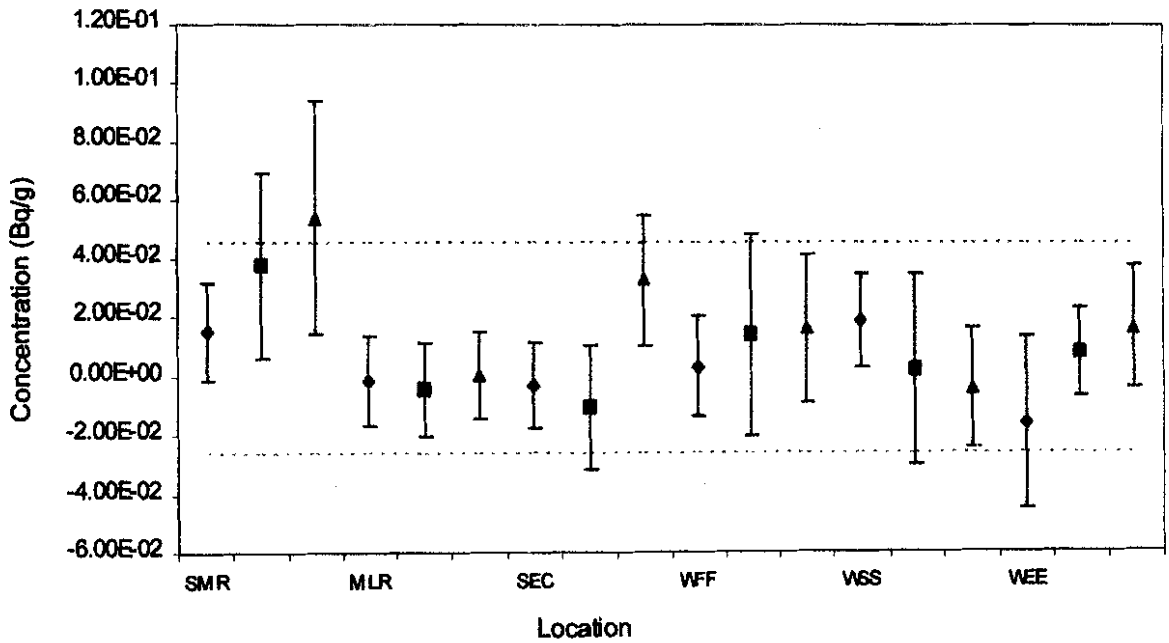


Figure 5.3.3 - Cobalt-60 in Soil

◆ Surface ■ Intermediate ▲ Deep - - - - - ± 2 Sigma

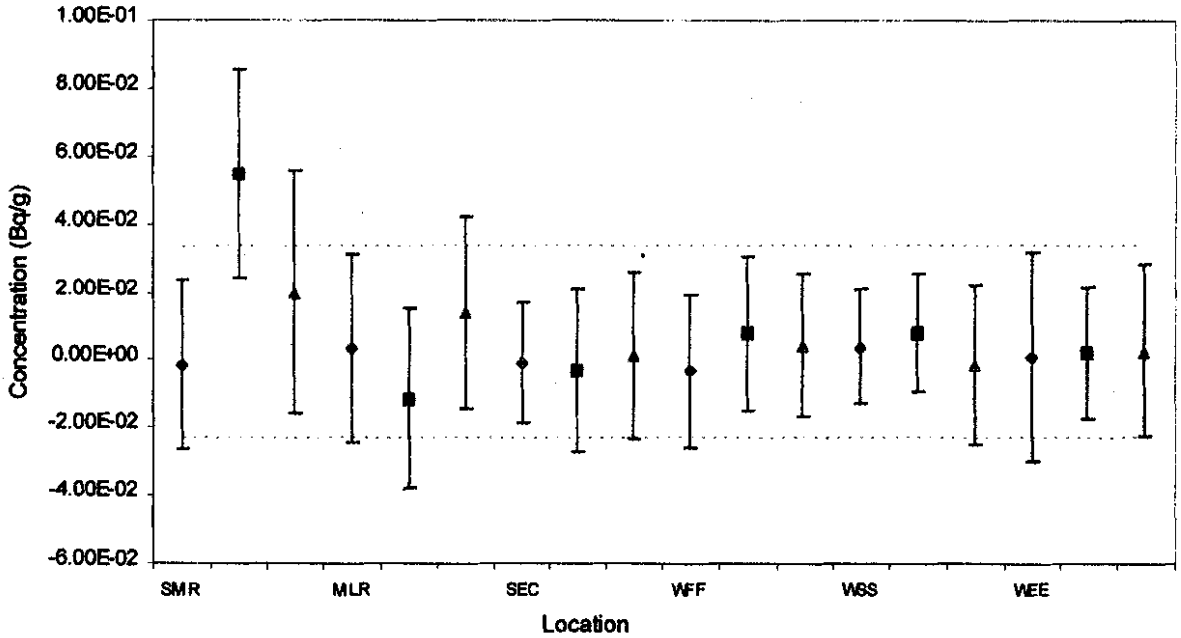


Figure 5.3.4 - Strontium-90 in Soil

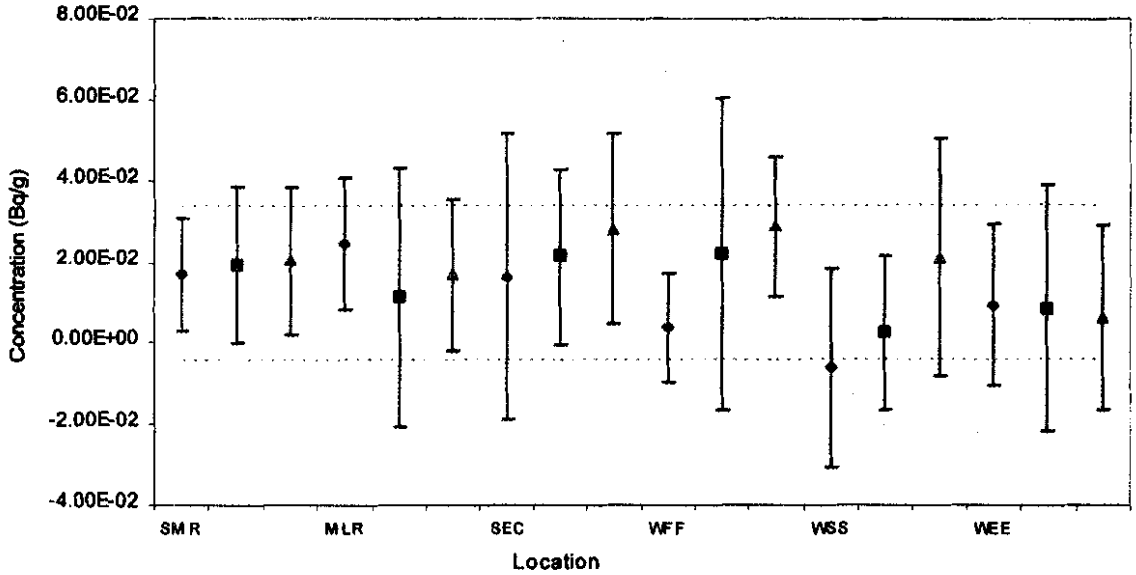


Figure 5.3.5 - Cesium-137 in Soil

◆ Surface ■ Intermediate ▲ Deep - - - - - ± 2 Sigma

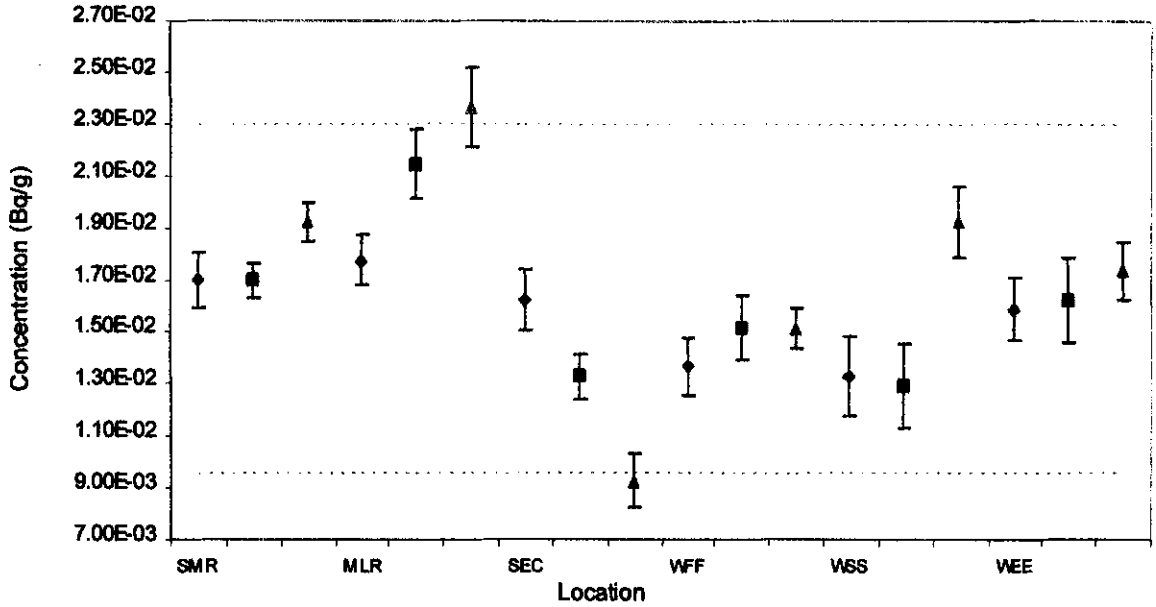


Figure 5.3.6 - Uranium-234 in Soil

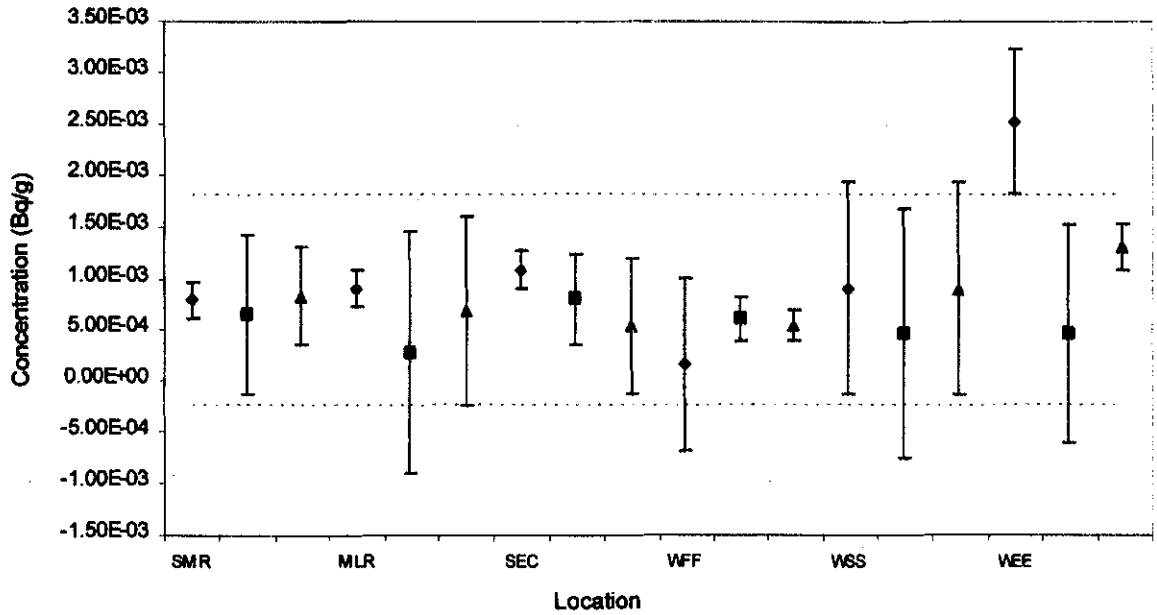


Figure 5.3.7 - Uranium-235 in Soil

● Surface ■ Intermediate ▲ Deep - - - - - ± 2 Sigma

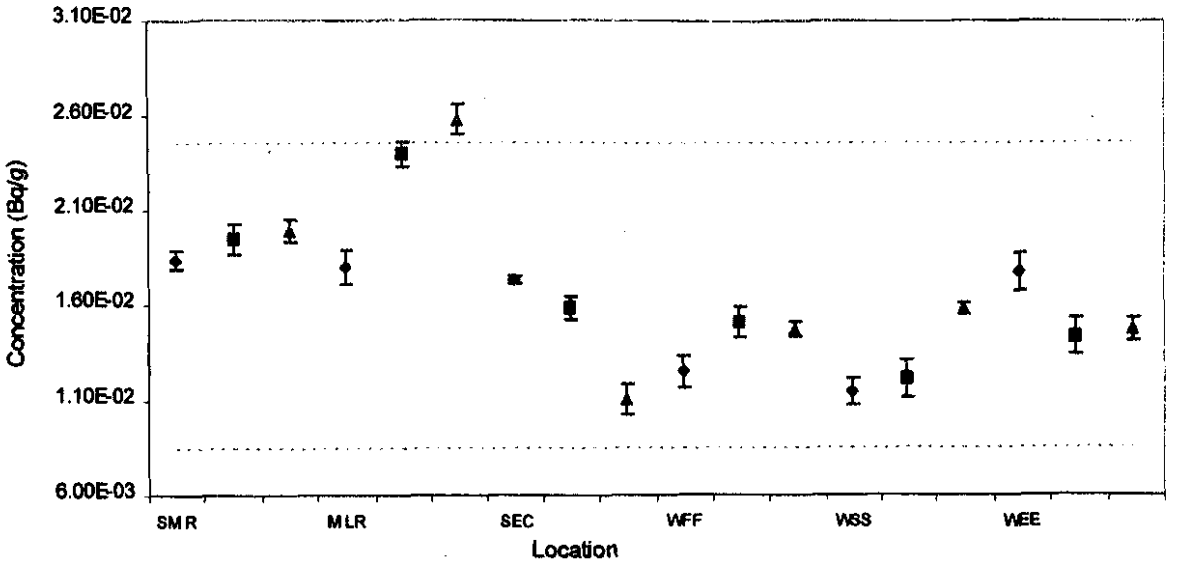


Figure 5.3.8 - Uranium-238 in Soil

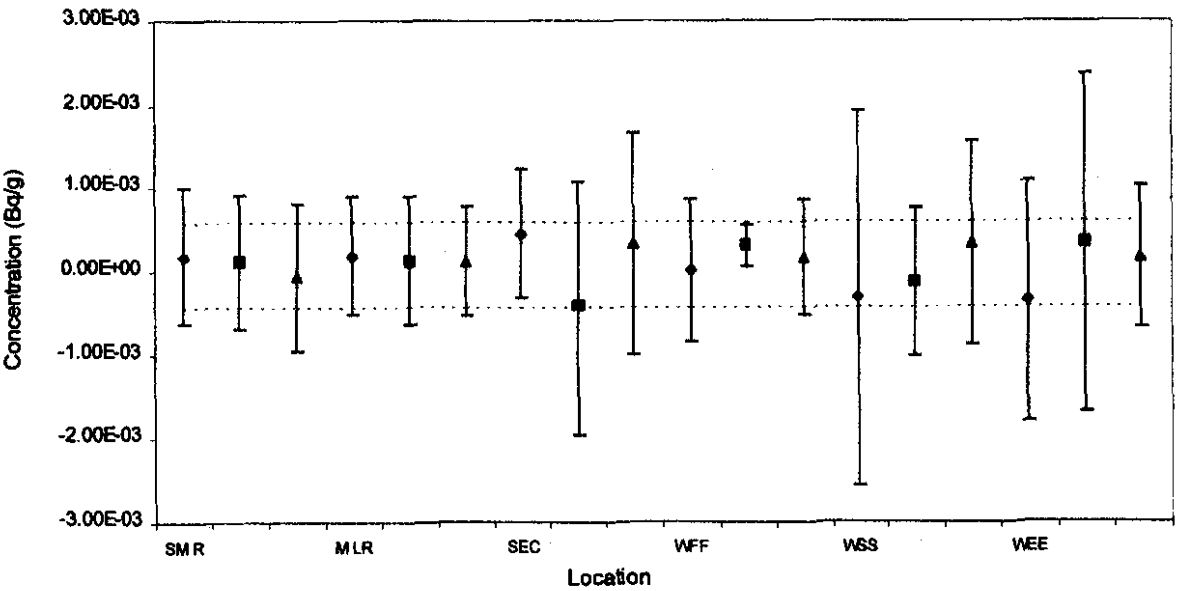


Figure 5.3.9 - Plutonium-238 in Soil

● Surface ■ Intermediate ▲ Deep - - - - - ± 2 Sigma

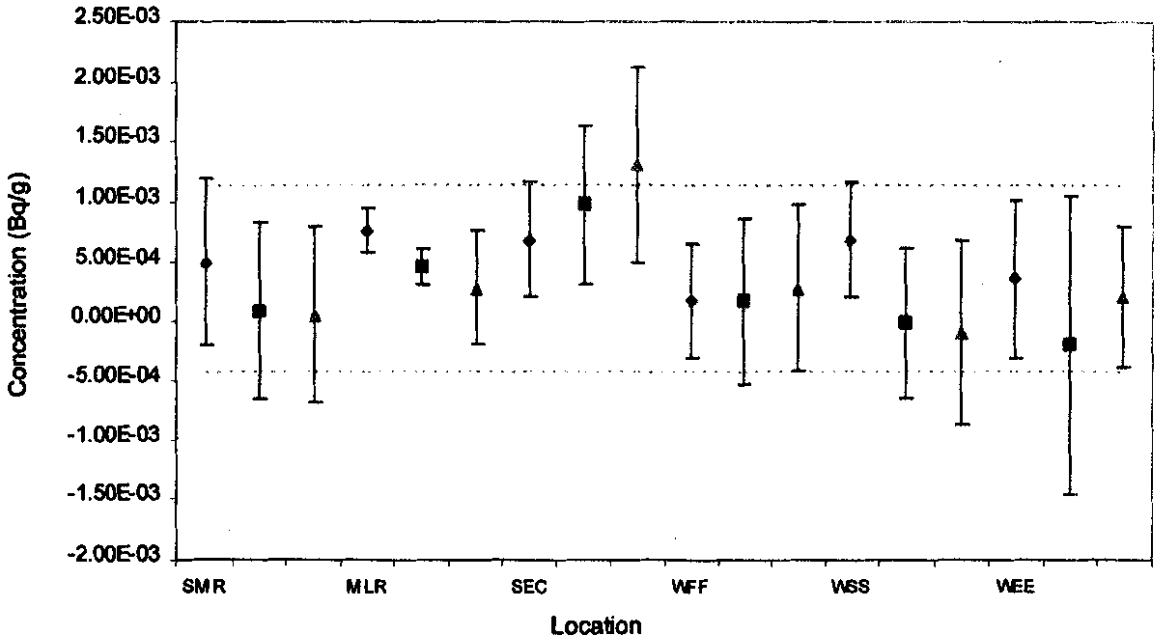


Figure 5.3.10 - Plutonium-239+240 in Soil

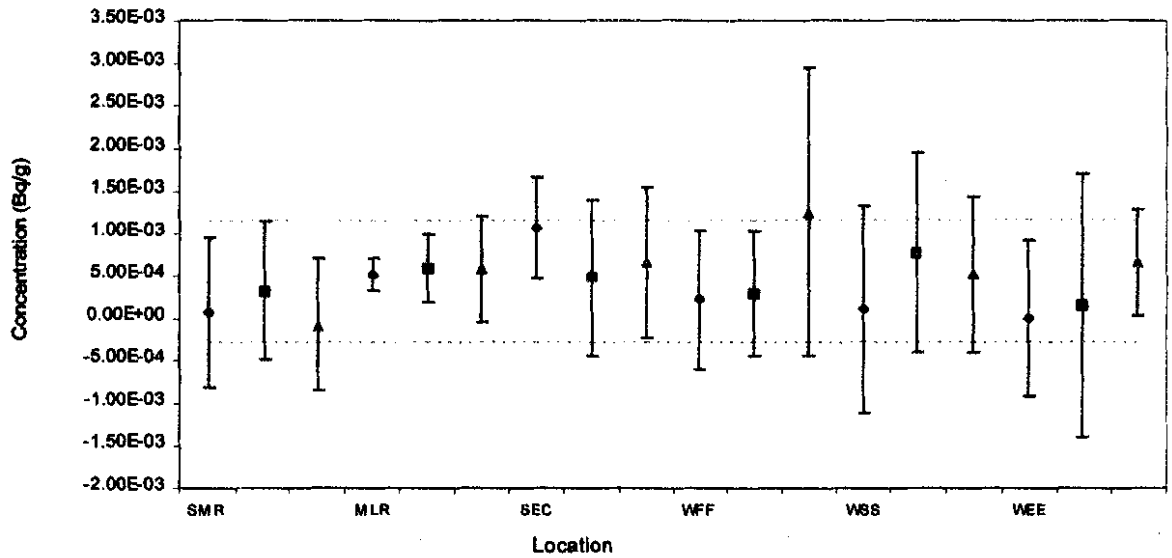


Figure 5.3.11 - Americium-241 in Soil

◆ Surface ■ Intermediate ▲ Deep - - - - - ± 2 Sigma

5.4 Surface Water

Sampling: Thirteen different locations around WIPP site were identified for the collection of surface water samples. These locations are shown in Figure 5.4.1. According to the sampling protocol, the samples are collected only once a year. One gallon polyethylene containers were first rinsed thoroughly (at least three times) with the water from the sampling locations before collecting approximately one gallon of water samples. These water samples were acidified with concentrated nitric acid to pH < 2 at each sampling site. The samples were then transferred to the WIPP laboratory for the radiochemical analyses.

Determination of Individual Radionuclides: The acidified water samples were used for gamma spectrometry for the determination of gamma-emitting radionuclides such as K-40, Co-60 and Cs-137. Strontium was determined in an aliquot of acidified water (500 ml) by using a standard procedure. Appropriate amounts of tracers and iron carrier were added to another aliquot of acidified water samples (500 ml) for the determination of actinides by alpha-spectrometry. The technique involved coprecipitation of actinides, their separation from the bulk of inorganic materials present in the samples and from each other by ion exchange chromatography, source preparation, and alpha spectrometry.

Results and Discussions: The results on the concentrations of all the radionuclides of interest are given by location in Table 5.4.1. The concentrations of individual radionuclides for all the locations are graphically presented in Figures 5.4.2 to 5.4.11. Except for K-40 and the isotopes of uranium, the concentrations of all other radionuclides were below their MDA.

Potassium-40, a naturally occurring radionuclide, was found in most of the water samples. The results are given in Figure 5.4.2. The concentration ranged from 1.07 ± 1.08 Bq/L to 6.42 ± 2.38 Bq/L with a mean of 3.38 ± 3.12 Bq/L (± 2 SD). All the data points were within ± 2 sigma of the mean, suggesting that the concentration of K-40 did not vary significantly from location to location. The concentration of K-40 in the water sample collected at Upper Pecos River (UPR) was highest, which may simply be due to the fact that this water sample contained large amounts of sediment. (It had a lot of total suspended particles). The point to be noted, however, is that the concentration of K-40 in most samples was close to its MDA. The MDA ranged from 2.30 to 3.7 Bq/L in these analyses.

The results on the concentrations of Co-60, Sr-90 and Cs-137 in these water samples are given in Figures 5.4.3, 5.4.4, and 5.4.5 respectively. The concentrations of Co-60, Sr-90, and Cs-137 did not differ significantly from one location to another. This is evident from the fact that the concentrations of each of these three radionuclides at all locations ranged between ± 2 sigma of their mean concentrations. The highest concentration of Co-60 (218 ± 269 mBq/L) was below its MDA (MDA ranged from 217 to 397 in these analyses) and had large analytical uncertainty, suggesting that the concentration of Co-60 in these water samples was below detection level. Concentrations of Sr-90 and Cs-137 were also below detection levels. The concentration of Sr-90 ranged from -134 ± 56 to 67 ± 32 mBq/L, with a mean of -14 ± 128 mBq/L (± 2 SD) and the concentration of Cs-137 ranged from -97 ± 151 to 215 ± 239 mBq/L with a mean of 79 ± 178 mBq/L (± 2 SD). The MDA for Sr-90 was around 75 mBq/L and for Cs-137 was around 290 mBq/L.

The concentrations of U-234, U-235, and U-238 are given in Figures 5.4.6, 5.4.7, and 5.4.8 respectively. The concentration of U-234 ranged from 2.1 ± 1.0 (HIL) to 152 ± 15 mBq/L (UPR) with a mean of 43 ± 105 mBq/L (± 2 SD) and the concentration of U-238 ranged from 1.2 ± 0.85 to 134 ± 14 mBq/L with a mean of 27 ± 78 mBq/L (± 2 SD). As expected, the concentration of U-235 was much lower than the concentrations of U-234 and U-238 and ranged from -0.28 ± 0.69 to 11 ± 3.1 mBq/L with a mean of 2.0 ± 6.4 mBq/L (± 2 SD). Concentrations of all three naturally occurring

isotopes of uranium were highest in the water sample collected from UPR. In fact, concentrations of these radionuclides were significantly higher (data points are above + 2 sigma levels as shown in Figures 5.4.6 through 5.4.8) in the water sample collected from UPR as compared to all other water samples. This is because the water sample from UPR contained large amounts of suspended sediments, which contain much higher concentrations of these radionuclides than water. Therefore, it should not be concluded that the water from UPR contains higher concentrations of uranium isotopes.

Uranium-238 and U-234 in soil and sediments are generally in equilibrium. Certain degrees of disequilibrium between parent U-238 and daughter U-234 are common in water bodies. Generally, the activity of U-234 is approximately 20 percent to 30 percent higher than the activity of U-238. A review of the data on uranium concentrations in these surface water samples revealed disequilibrium between U-238 and U-234, as shown in Figure 5.4.12. The activity ratio of U-234 to U-238 ranged from 1.14 to 3.12 showing, a significant variation in the degree of disequilibrium between water samples.

Concentrations of Pu-238 and Pu-239+240 in water samples of all sampling locations are given in Figures 5.4.9 and 5.4.10, respectively. The results were mostly below their MDA. The MDA for Pu-238 and Pu-239+240 generally ranged between 0.30 to 1.46 mBq/L. Furthermore, the results were either negative numbers or were associated with large analytical uncertainties. These results clearly indicate that the concentrations of Pu-238 and Pu-239+240 in these water samples were below their detection levels.

Concentrations of Am-241 are given in Figure 5.4.11. The results for all water samples except the one collected from UPR were either negative or were associated with large analytical uncertainties. These results clearly indicate that the concentrations of Am-241 in these water samples were below detection level. The MDA for Am-241 mostly ranged between 0.38 and 2.21 mBq/L. The concentration of Am-241 in water sample collected from UPR was 2.56 ± 2.20 mBq/L. This barely detectable concentration of Am-241 may have been due to the large amounts of suspended sediments present in this water sample.

In conclusion, among all the radionuclides measured, only naturally occurring radionuclides such as K-40 and alpha-emitting isotopes of uranium were detected in these water samples. A disequilibrium between parent U-238 and daughter U-234 was observed.

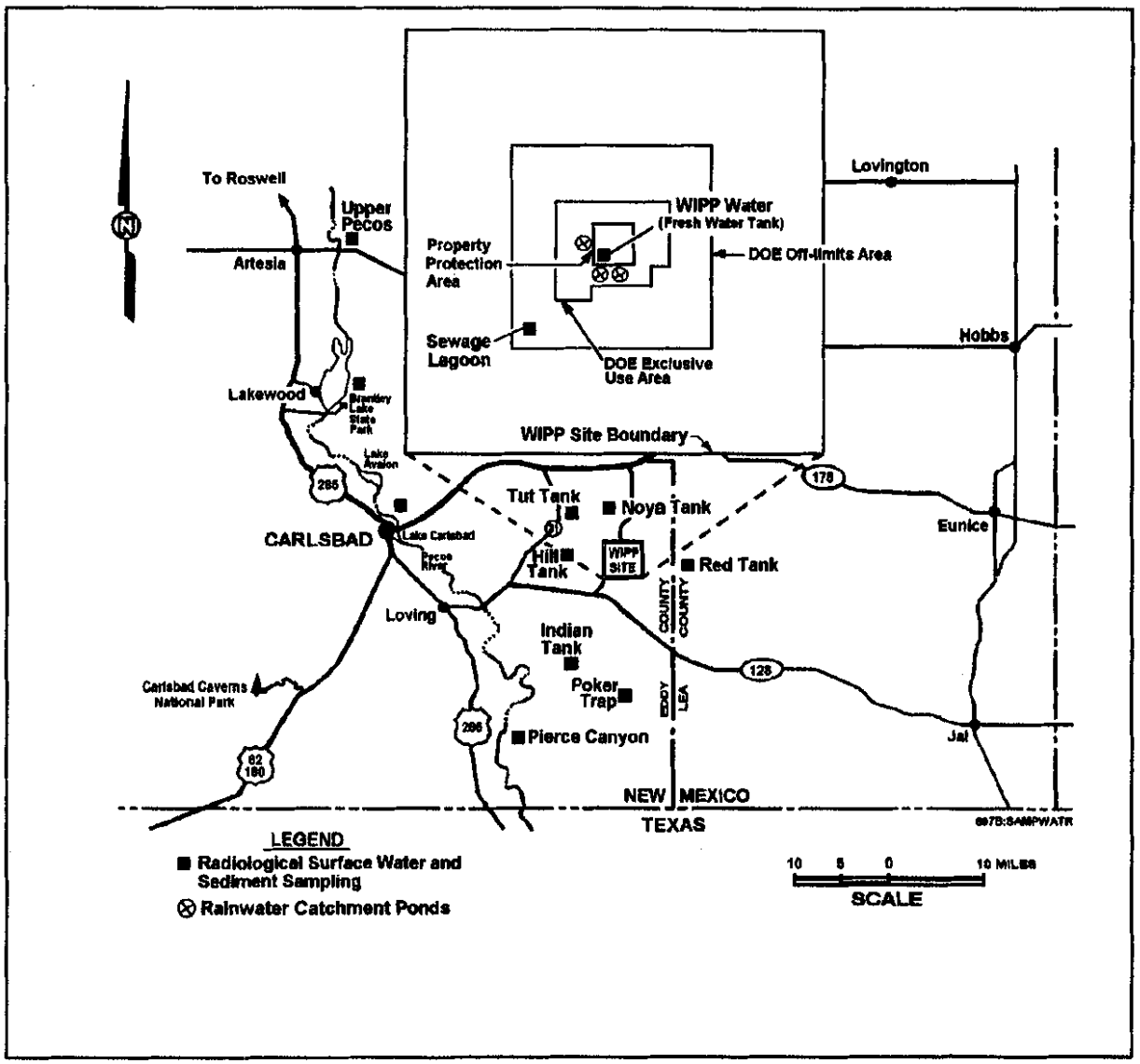


Figure 5.4.1 - Environmental Sampling Locations

Table 5.4.1 - Concentration of Radionuclides in Surface Water			
		Concentration Bq/L	TPU 2 Sigma
Brantley Lake (BRA)	K-40	1.57E+00	2.02E+00
	Co-60	5.48E-02	2.19E-01
	Sr-90	6.67E-02	5.65E-02
	Cs-137	1.27E-01	1.50E-01
	U-234	7.63E-02	7.07E-03
	U-235	2.96E-03	1.29E-03
	U-238	4.11E-02	4.75E-03
	Pu-238	-7.23E-04	7.54E-04
	Pu-239+240	1.13E-04	4.93E-04
	Am-241	-1.06E-03	8.79E-04
Lake Carlsbad (CBD)	K-40	3.97E+00	2.19E+00
	Co-60	2.18E-01	2.69E-01
	Sr-90	6.71E-02	3.16E-02
	Cs-137	1.90E-01	1.91E-01
	U-234	9.75E-02	8.30E-03
	U-235	3.22E-03	1.43E-03
	U-238	4.96E-02	5.23E-03
	Pu-238	-6.05E-04	7.88E-04
	Pu-239+240	-2.35E-04	4.61E-04
	Am-241	-3.42E-04	7.26E-04
Fresh Water Tank (FWT)	K-40	3.69E+00	2.13E+00
	Co-60	1.57E-01	1.11E-01
	Sr-90	1.98E-02	5.05E-02
	Cs-137	-9.68E-02	1.51E-01
	U-234	4.38E-02	4.93E-03
	U-235	1.56E-03	9.76E-04
	U-238	1.41E-02	2.60E-03
	Pu-238	-3.91E-04	9.97E-04
	Pu-239+240	-3.31E-04	4.60E-04
	Am-241	3.51E-04	9.69E-04
HILL Tank (HIL)	K-40	4.40E+00	2.81E+00
	Co-60	1.02E-01	2.23E-01
	Sr-90	2.06E-02	3.09E-02
	Cs-137	2.15E-01	2.39E-01
	U-234	2.07E-03	1.03E-03
	U-235	5.22E-04	9.01E-04
	U-238	1.19E-03	8.45E-04
	Pu-238	4.50E-04	6.03E-04
	Pu-239+240	-6.90E-05	5.60E-04
	Am-241	-3.36E-04	7.30E-04

Table 5.4.1 - Concentration of Radionuclides in Surface Water			
		Concentration Bq/L	TPU 2 Sigma
Indian Tank (IDN)	K-40	4.13E+00	2.54E+00
	Co-60	1.18E-01	1.47E-01
	Sr-90	-2.22E-02	4.97E-02
	Cs-137	7.17E-02	9.22E-02
	U-234	5.34E-03	1.55E-03
	U-235	6.88E-04	7.31E-04
	U-238	5.56E-03	1.71E-03
	Pu-238	-5.64E-04	8.17E-04
	Pu-239+240	-3.18E-04	4.41E-04
	Am-241	-2.37E-04	8.83E-04
Noya (NOY)	K-40	3.12E+00	2.20E+00
	Co-60	1.16E-01	1.43E-01
	Sr-90	4.44E-02	4.65E-02
	Cs-137	8.31E-02	9.19E-02
	U-234	5.97E-03	1.81E-03
	U-235	-2.84E-04	5.58E-04
	U-238	2.75E-03	1.26E-03
	Pu-238	2.75E-05	3.66E-04
	Pu-239+240	-6.24E-05	5.66E-04
	Am-241	-7.28E-05	8.16E-04
Pierce Canyon (PCN)	K-40	3.17E+00	1.77E+00
	Co-60	1.48E-01	1.02E-01
	Sr-90	-7.16E-02	5.11E-02
	Cs-137	2.50E-02	1.37E-01
	U-234	1.27E-01	1.09E-02
	U-235	5.55E-03	1.87E-03
	U-238	7.11E-02	7.18E-03
	Pu-238	-9.22E-04	8.54E-04
	Pu-239+240	1.99E-04	6.74E-04
	Am-241	-1.13E-04	1.08E-03
Poker Trap (PKT)	K-40	5.50E+00	3.27E+00
	Co-60	-4.58E-02	2.00E-01
	Sr-90	4.99E-02	3.07E-02
	Cs-137	1.97E-01	1.89E-01
	U-234	7.69E-03	2.19E-03
	U-235	9.03E-05	7.62E-04
	U-238	4.29E-03	1.65E-03
	Pu-238	3.70E-04	5.31E-04
	Pu-239+240	1.27E-05	5.74E-04
	Am-241	-4.62E-04	6.89E-04

Table 5.4.1 - Concentration of Radionuclides in Surface Water			
		Concentration Bq/L	TPU 2 Sigma
Red Tank (RED)	K-40	1.07E+00	1.08E+00
	Co-60	2.14E-02	1.44E-01
	Sr-90	-2.56E-02	4.88E-02
	Cs-137	1.13E-01	1.26E-01
	U-234	8.29E-03	2.01E-03
	U-235	-2.84E-04	6.90E-04
	U-238	4.62E-03	1.62E-03
	Pu-238	-5.87E-04	8.00E-04
	Pu-239+240	1.36E-04	4.61E-04
	Am-241	6.40E-04	1.33E-03
Sample of Opportunity (SOO)	K-40	2.78E+00	1.78E+00
	Co-60	6.12E-02	1.43E-01
	Sr-90	-6.98E-02	5.17E-02
	Cs-137	4.34E-02	1.33E-01
	U-234	1.67E-02	2.99E-03
	U-235	5.99E-04	7.18E-04
	U-238	1.25E-02	2.63E-03
	Pu-238	-7.23E-04	9.04E-04
	Pu-239+240	1.78E-04	6.05E-04
	Am-241	-5.81E-04	5.73E-04
Sewage Lagoon (SEW)	K-40	1.35E+00	2.00E+00
	Co-60	8.25E-02	1.47E-01
	Sr-90	-8.28E-02	4.98E-02
	Cs-137	5.00E-02	1.38E-01
	U-234	9.37E-03	2.62E-03
	U-235	-2.84E-04	5.58E-04
	U-238	3.24E-03	1.48E-03
	Pu-238	2.59E-04	4.85E-04
	Pu-239+240	-4.77E-04	6.79E-04
	Am-241	1.94E-04	9.42E-04
Tut Tank (TUT)	K-40	2.85E+00	2.82E+00
	Co-60	1.70E-02	2.07E-01
	Sr-90	-1.34E-01	5.63E-02
	Cs-137	7.00E-03	1.94E-01
	U-234	5.62E-03	1.83E-03
	U-235	1.61E-04	5.19E-04
	U-238	4.21E-03	1.59E-03
	Pu-238	-6.09E-04	7.86E-04
	Pu-239+240	1.13E-04	5.88E-04
	Am-241	-4.34E-04	7.58E-04

Table 5.4.1 - Concentration of Radionuclides in Surface Water			
		Concentration Bq/L	TPU 2 Sigma
Upper Pecos River (UPR)	K-40	6.42E+00	2.38E+00
	Co-60	5.46E-02	1.52E-01
	Sr-90	-4.49E-02	3.49E-02
	Cs-137	7.33E-03	1.30E-01
	U-234	1.52E-01	1.53E-02
	U-235	1.11E-02	3.06E-03
	U-238	1.34E-01	1.38E-02
	Pu-238	3.61E-04	5.23E-04
	Pu-239+240	1.26E-04	6.15E-04
	Am-241	2.56E-03	2.20E-03

Table 5.4.2 Measurement of Radionuclides in Duplicate Samples of Red Tank Surface Water				
	Bq/L	TPU 2 Sigma	Bq/L	TPU 2 Sigma
Potassium-40	3.80E+00	3.12E+00	1.07E+00	1.08E+00
Cobalt-60	8.88E-02	5.26E-02	2.14E-02	1.44E-01
Strontium-90	5.02E-02	4.50E-02	-2.56E-02	4.88E-02
Cesium-137	1.67E-01	1.59E-01	1.13E-01	1.26E-01
Uranium-234	9.66E-03	2.69E-03	8.29E-03	2.01E-03
Uranium-235	1.30E-04	9.84E-04	-2.84E-04	6.90E-04
Uranium-238	4.58E-03	1.85E-03	4.62E-03	1.62E-03
Plutonium-238	1.23E-04	4.05E-04	-5.87E-04	8.00E-04
Plutonium-239+240	-2.32E-04	4.64E-04	1.36E-04	4.61E-04
Americium-241	-4.74E-04	6.78E-04	6.40E-04	1.33E-03

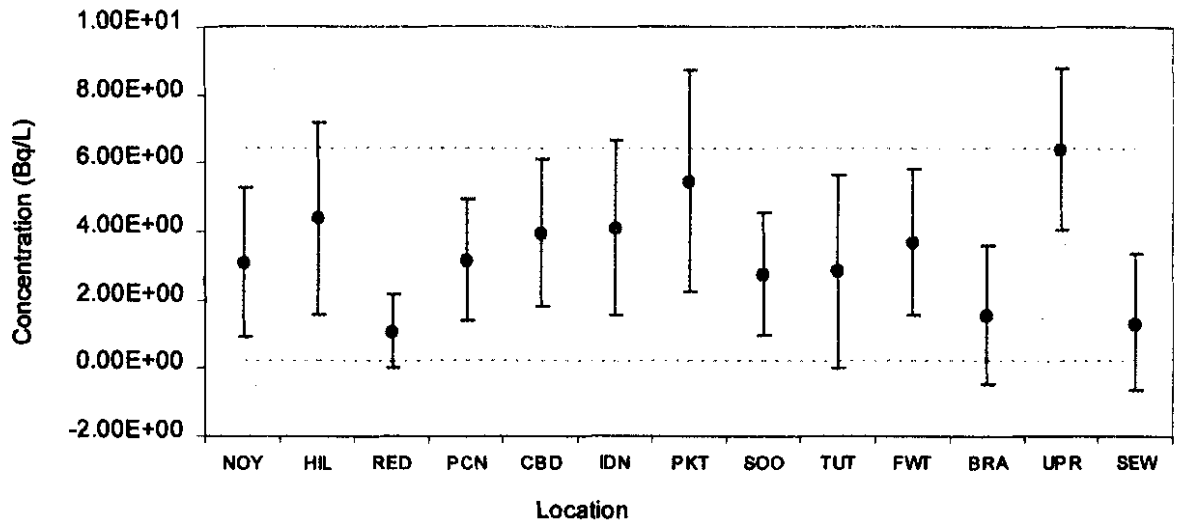


Figure 5.4.2 - Potassium-40 in Surface Water

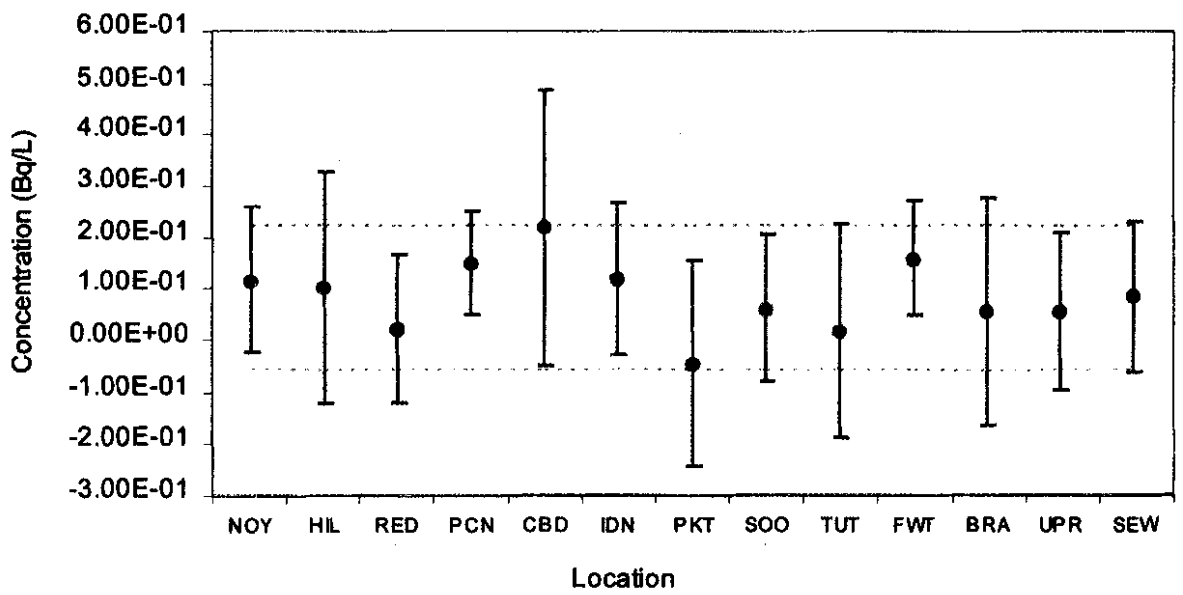


Figure 5.4.3 - Cobalt-60 in Surface Water

● Concentration - - - - - - - - - +-2 Sigma

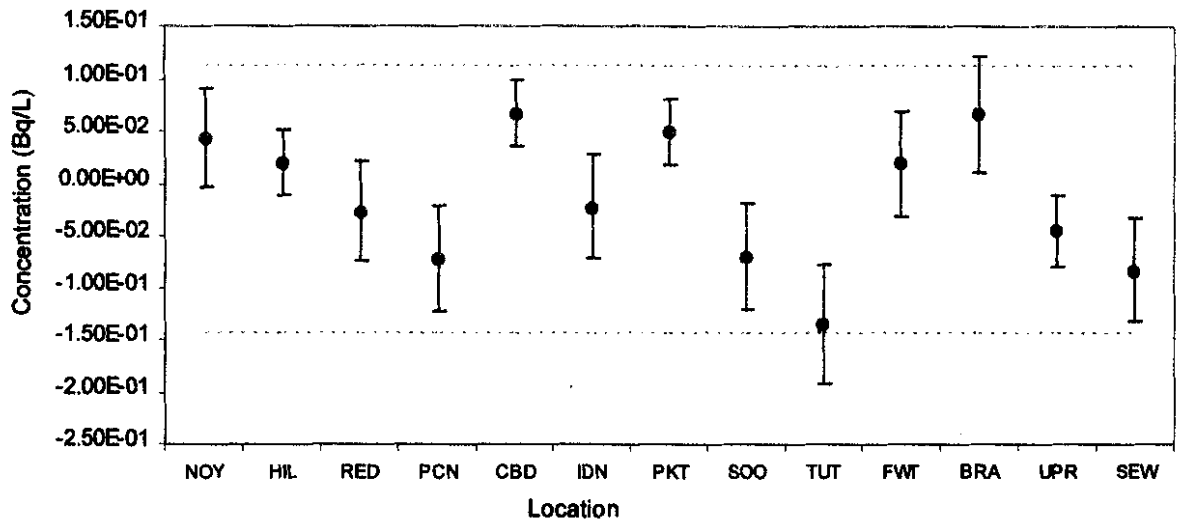


Figure 5.4.4 - Strontium-90 in Surface Water

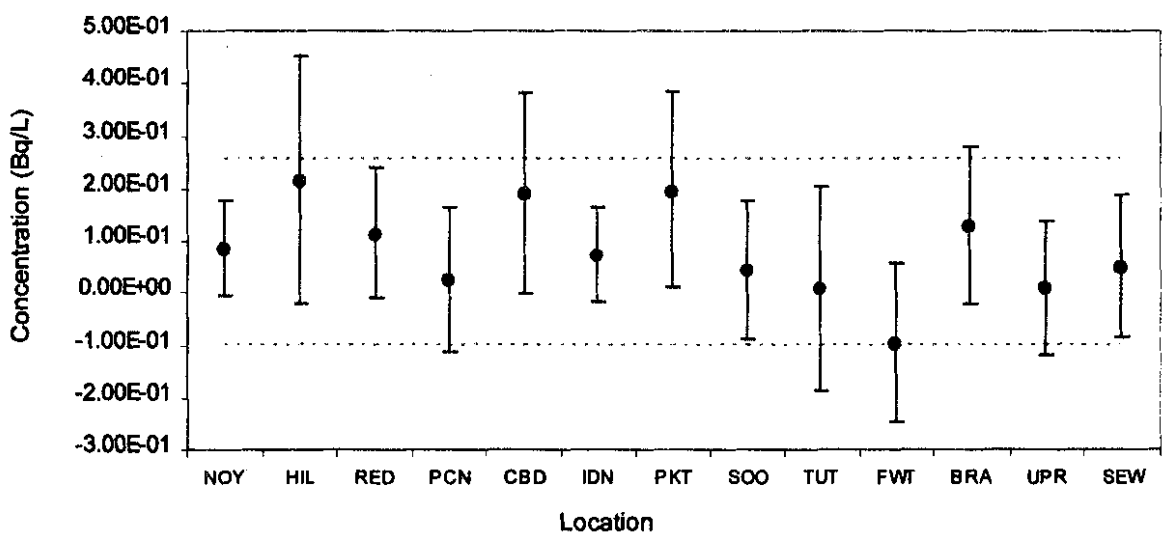


Figure 5.4.5 - Cesium-137 in Surface Water

● Concentration - - - - - - - - - +-2 Sigma

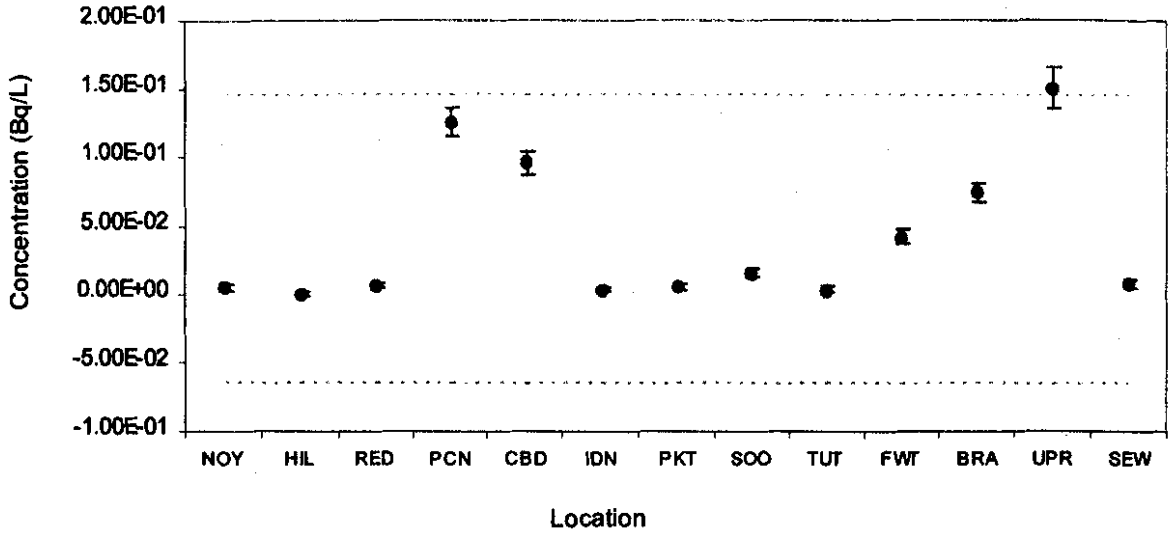


Figure 5.4.6 - Uranium-234 in Surface Water

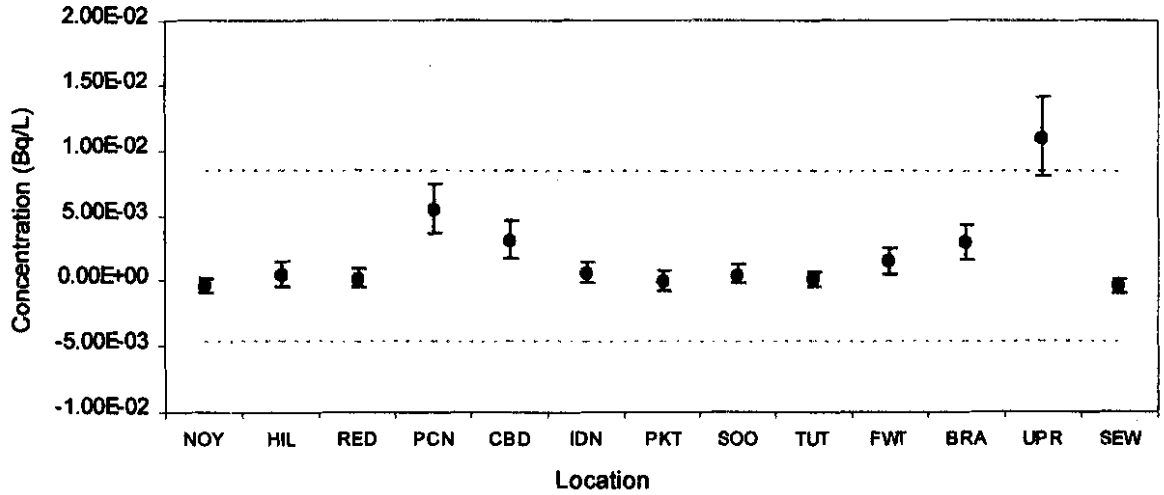


Figure 5.4.7 - Uranium-235 in Surface Water

● Concentration - - - - - - - - - +-2 Sigma

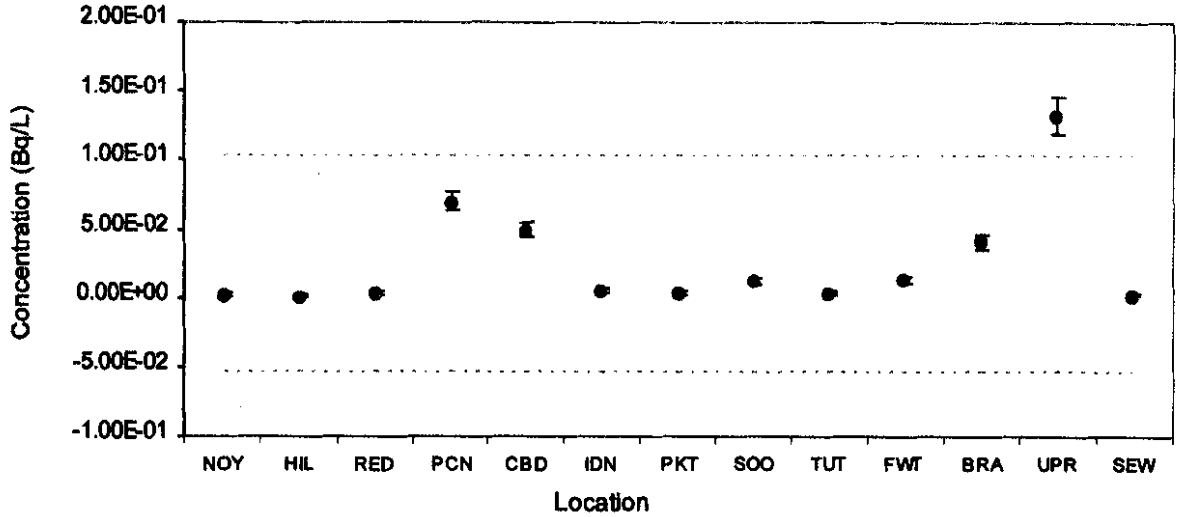


Figure 5.4.8 - Uranium-238 in Surface Water

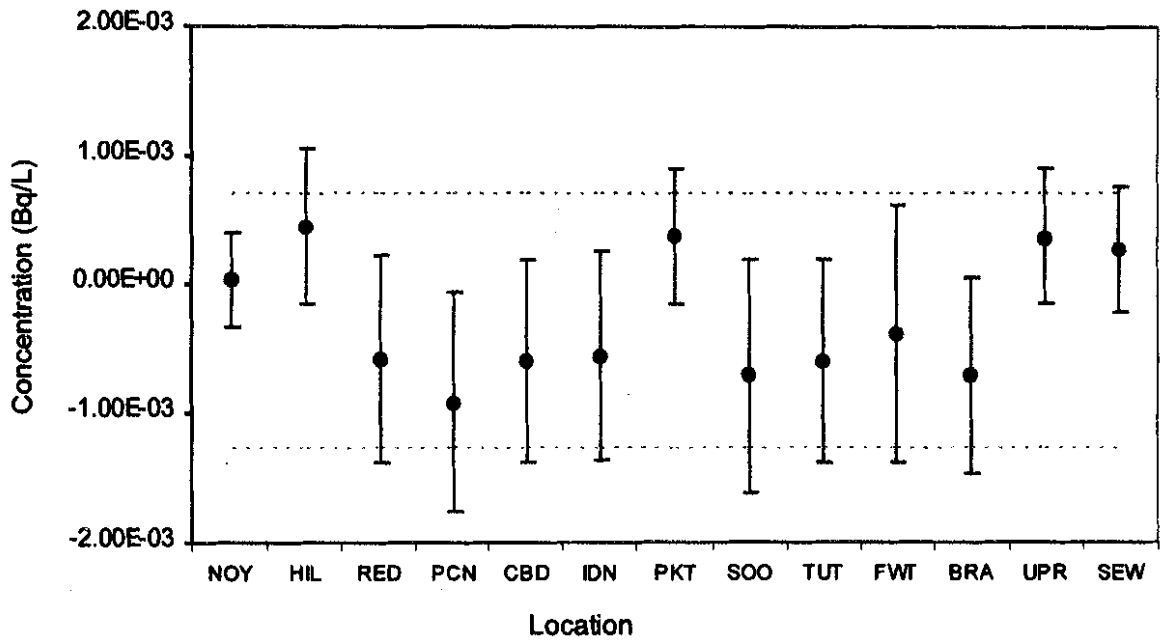


Figure 5.4.9 - Plutonium-238 in Surface Water

● Concentration - - - - - - - - - +-2 Sigma

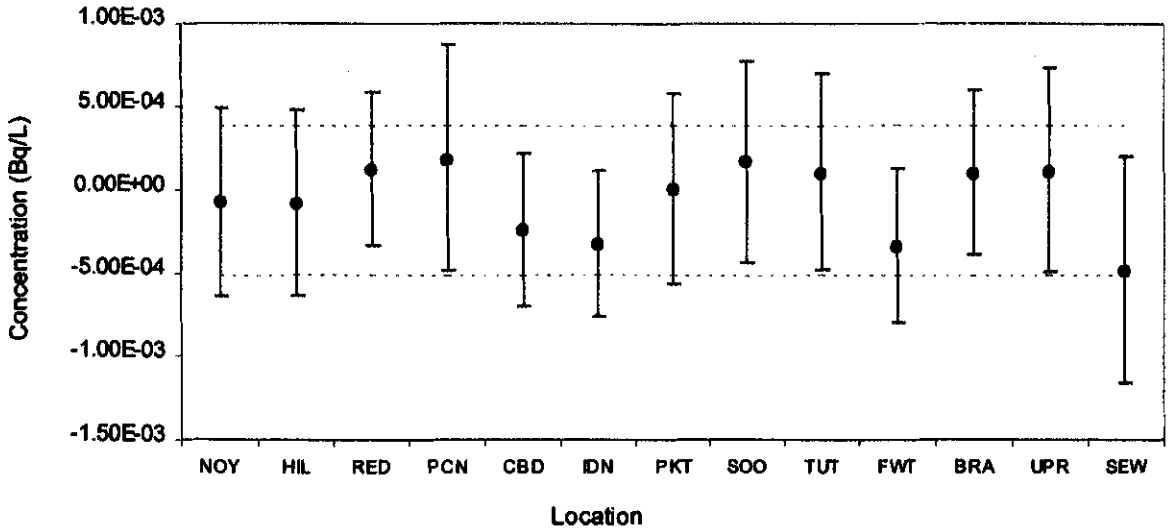


Figure 5.4.10 - Plutonium-239+240 in Surface Water

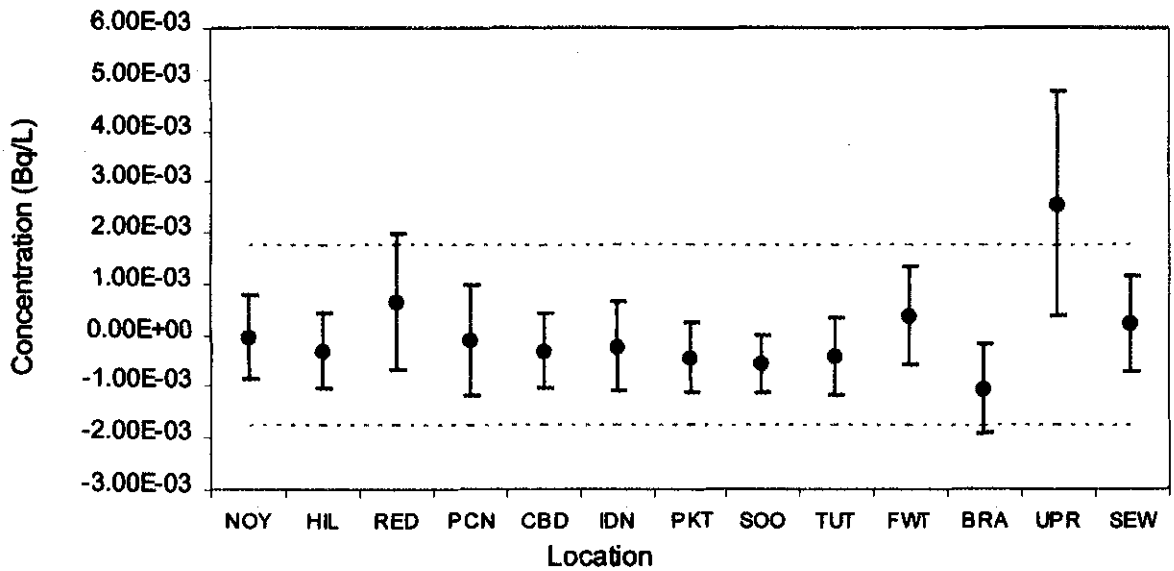


Figure 5.4.11 - Americium-241 in Surface Water

● Concentration - - - - - - - - - +-2 Sigma

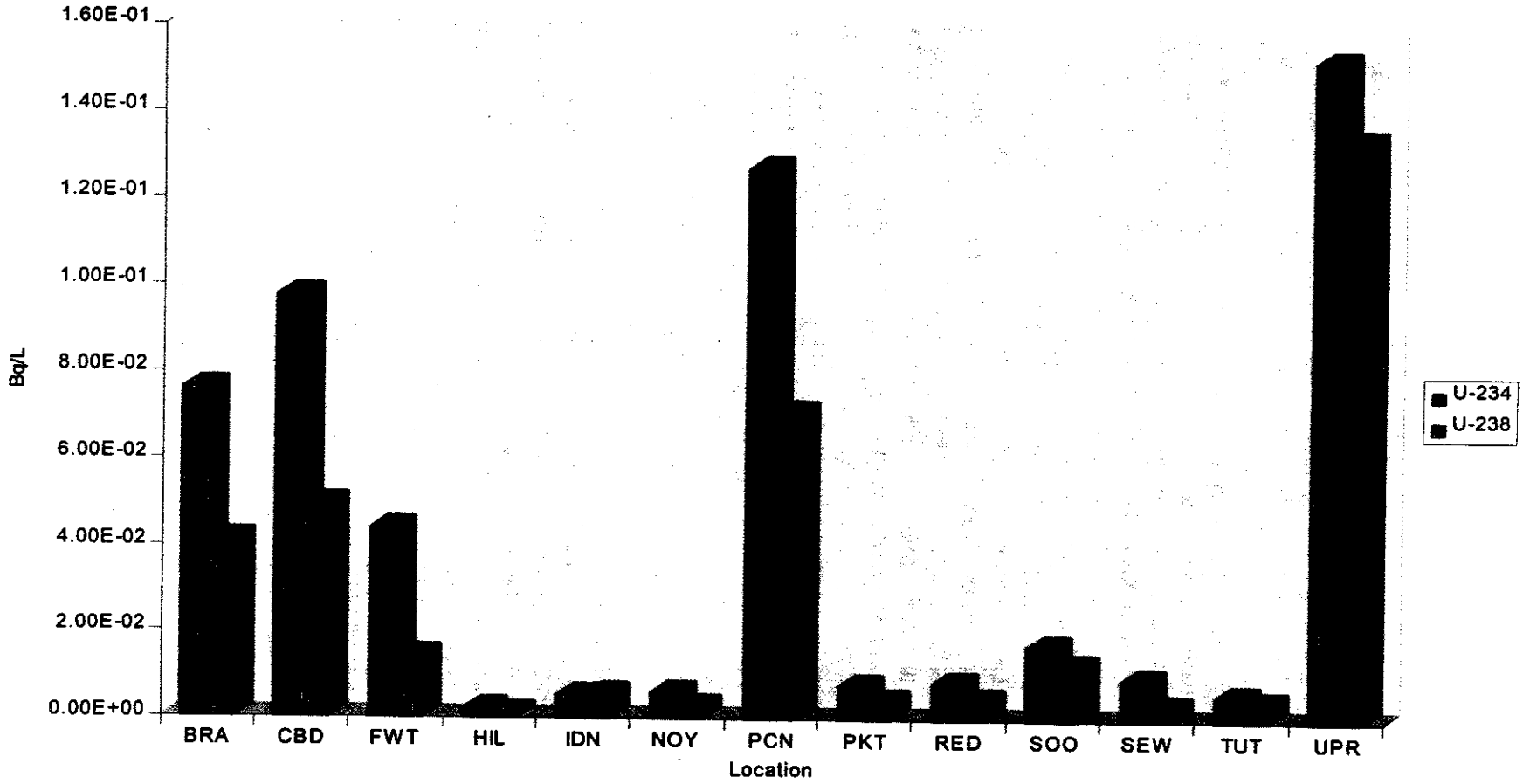


Figure 5.4.12 - Comparison Between the Concentrations of Uranium-234 and Uranium-238

5.5 Ground Water

Sample Collection: Ground water samples were collected from seven different wells located around the WIPP site as shown in Figure 7.1. Approximately three bore volumes (around 1,000 gallons) of water were pumped out of these wells before collecting approximately 10 gallons of water samples for analyses. The water samples from six wells (WQSP-1 to 6) were collected from the depths ranging from 600 to 900 feet and from a depth of 225 feet from well WQSP-6A. Samples were collected twice a year approximately six months apart to see the variability in the concentrations of radiological and nonradiological constituents in water samples. Also, biannual sampling of water is required by the RCRA permit. Nearly two gallons of water were sent to the WIPP laboratory for the radiochemical analyses and the rest was used for the determination of nonradiological constituents and storage.

Sample Preparation: Sufficient amount of concentrated nitric acid (drop by drop) was added to the water samples with constant stirring to attain a pH < 2.

Determination of Individual Radionuclides: The acidified water samples were used for gamma spectrometry for the determination of gamma-emitting radionuclides. Strontium was determined in an aliquot of acidified water (500 ml) by using a standard procedure. Appropriate amount of tracers and iron carrier were added to another aliquot of acidified water samples (500 ml) for the determination of actinides. The technique involved coprecipitation, ion exchange chromatographic separation of individual radionuclides, source preparation and alpha spectrometry.

Results and Discussions: The results on the QA/QC samples analyzed along with these water samples did not meet the acceptance criteria for the sampling and the radiochemical analyses. Therefore, all the results became questionable. The samples could not be reanalyzed at the site laboratory. These samples and the associated QC samples have been sent to a contract laboratory. The analyses of the samples are in progress. The results will be submitted in a supplementary report issued at a later date.

5.6 Sediments

Sample Collection: Sediment samples were collected from 13 different locations as shown in Figure 5.4.1. Most of the samples were collected from the same ponds from where the surface water samples were collected. However, a few ponds were dried by the time of sampling; therefore, sediment samples were collected from such ponds but water samples could not be collected. The samples were collected in a knee-deep location of the water body except the Upper Pecos River (UPR). The sample from UPR was collected from the middle section of the river from a bridge on the river. The samples collected were approximately from top six inches of the sediments of the water body. The samples were collected in polyethylene bags, brought to the laboratory, dried, and shipped to a commercial laboratory for the determinations of individual radionuclides.

Samples were prepared for gamma spectrometry and determination of individual radionuclides by following the same procedures as described for the soil samples. The concentrations of K-40, Co-60 and Cs-137 were measured by gamma spectrometry and Sr-90, U-234, U-235, U-238, Pu-238, Pu-239+240, and Am-241 by sequential separation and beta counting for Sr-90 and alpha counting for all other radionuclides.

Results and Discussions: The results on the concentrations of these radionuclides for each sampling locations are given in Table 5.6.1. Also, the concentrations of individual radionuclides for all sampling locations are presented graphically in Figures 5.6.1 through 5.6.10.

Concentration of K-40 was above MDA in all the samples (MDA=70 mBq/g) and ranged

from 220 ± 137 mBq/L (BRA) to 999 ± 181 mBq/L (TUT) with a mean of 686 ± 444 (± 2 SD). All but one of the data points (Figure 5.6.1) were within ± 2 sigma of the mean suggesting that the concentration of K-40 did not vary significantly from location to location. Concentration of K-40 in sediment sample collected from BRA was slightly below -2 sigma level.

The results on the concentrations of Co-60 in sediment samples of all the locations are given in Figure 5.6.2. Concentrations of Co-60 in nine out of thirteen samples were below its MDA (MDA ranged from 1.48 to 14.1 mBq/g). Among the remaining four samples, the sample collected from BHT contained 7.03 ± 5.18, HIL 4.44 ± 1.78, LST 12.6 ± 4.07, and TUT 5.55 ± 7.03 mBq/g. All the data points were within ± 2 sigma of the mean which suggests that the concentration of Co-60 in these samples did not vary significantly from location to location.

The results on the concentrations of Sr-90 in sediment samples collected from all the locations are given in Figure 5.6.3. Strontium-90 was not detected in most of the samples. Concentrations were mostly below its MDA. The MDA for Sr-90 was 20 mBq/g. Also, the results were either negative or associated with large analytical uncertainties. The concentration ranged from -1.9 ± 11.1 to 23.7 ± 15.9 mBq/g. All the data points were within ± 2 sigma of the mean, suggesting that there was no significant variation in the concentration of Sr-90 from location to location. This may, however, also be due to fact that there was no detectable activity of Sr-90 in these samples.

The results for the concentrations of Cs-137 in these sediment samples are given in Figure 5.6.4. The concentration ranged from 1.04 ± 3.15 to 27.8 ± 11.8 mBq/g with a mean of 10.5 ± 15.7 (± 2 SD). Concentrations in seven out of thirteen samples were below its MDA (MDA ranged from 4.44 to 15.5 mBq/g). Except the concentration in sediment sample of PKT all were within ± 2 sigma of the mean.

Concentrations of U-234, U-235, and U-238 are graphically presented in Figures 5.6.5, 5.6.6 and 5.6.7, respectively. Concentrations of U-234 ranged from 14.1 ± 2.5 (NOY) to 40.7 ± 5.2 mBq/g (CBD) with a mean of 22.8 ± 12.8 (± 2 SD). Concentration of U-234 was significantly higher in the sample collected from CBD as shown in Figure 5.6.5. Concentrations in all other samples were not significantly different from each other. Concentration of U-235, as expected, was much lower than U-234 and ranged from 0.33 ± 0.41 (RED) to 1.37 ± 0.78 mBq/g (TUT) with a mean of 0.85 ± 0.59 (± 2 SD). All the data points were within ± 2 sigma of the mean, suggesting that the concentration did not vary significantly from location to location (Figure 5.6.6). Concentration of U-238 ranged from 13.3 ± 2.37 (NOY) to 28.9 ± 4.07 mBq/g (CBD) with a mean of 22.2 ± 9.6 (± 2 SD). The concentration of U-238 in all the sediment samples were within ± 2 sigma of the mean (Figure 5.6.7). This suggests that there was no significant variation in the concentration of U-238 from one location to other location.

The activity ratio of U-234 to U-238 for each location is given in following table. In most samples, the ratio was close to 1, showing that parent U-238 and daughter U-234 were in equilibrium. Samples collected from BRA and CBD showed slightly higher ratio of U-234 to U-238, suggesting a disequilibrium between U-238 and U-234. There is no obvious reason(s) for such disequilibrium found in these two sediment samples. This may, however, be due to the analytical artifacts in sample analyses. For example, a radiochemical recovery of 141 percent was reported by the commercial laboratory for uranium in a sediment sample collected from CBD.

The results on the concentrations of Pu-238 in these sediment samples are graphically presented in Figure 5.6.8. The results were either negative or associated with large analytical uncertainties. The concentrations were mostly below its MDA (0.59 mBq/g) suggesting that Pu-238 could not be detected in these samples. The results also show that

The concentration of Pu-239+240 ranged from -0.33 ± 0.56 (BRA) to 0.85 ± 0.52 mBq/g (IDN) with a mean of 0.32 ± 0.62 (± 2 SD). All but one of the data points were within ± 2 sigma of the mean (Figure 5.6.9), suggesting that there were no significant variations among the concentrations of Pu-239+240 in sediment samples collected from various locations. In majority of the samples, the results were associated with large analytical uncertainties (uncertainties were larger than the concentrations) and in remaining samples the uncertainties were close to the concentrations found. It is therefore reasonable to state that the concentrations of Pu-239+240 were almost nondetectable in these samples.

The results on the concentration of Am-241 are given in Figure 5.6.10. The concentrations found were below its MDA (0.77 mBq/g). Also, the analytical uncertainties associated with the results for Am-241 in these samples were larger than the concentrations found. This suggests that the concentrations of Am-241 in these samples were nondetectable. The results, as given in Figure 5.6.10, were within ± 2 sigma of the mean, suggesting that the concentrations of Am-241 did not vary significantly from location to location. This may, however, also be due to fact that there was no detectable activity of Am-241 in these samples.

A duplicate sample of sediment was collected from Red Tank and analyzed to check the reproducibility of the data. The results are given in Table 5.6.2. The results for the concentrations of K-40 and uranium isotopes were more reliable because of their higher activities in the environment. The results for these radionuclides in original and duplicate samples were therefore compared to check the reproducibility of the data. The concentration of K-40 in the original sample (518 ± 144 mBq/g) was not different from the concentration found in duplicate sample (555 ± 122 mBq/g). Similarly, the concentrations of U-234 (17.0 ± 2.66 mBq/g) and U-238 (17.4 ± 2.70 mBq/g) in the original sample were not different from the concentrations of U-234 (18.5 ± 2.74 mBq/g) and U-238 (17.4 ± 2.63 mBq/g) found in duplicate samples. These results clearly suggest that the results were quite reproducible.

Table 5.6.1 - Concentrations of Radionuclides in Sediment			
		Concentration Bq/g	TPU 2 Sigma
Bottom Hill Tank (BHT)	Potassium-40	8.14E-01	2.15E-01
	Cobalt-60	7.03E-03	5.18E-03
	Strontium-90	5.92E-03	1.81E-02
	Cesium-137	1.55E-02	1.07E-02
	Uranium-234	2.04E-02	3.03E-03
	Uranium-235	6.66E-04	4.44E-04
	Uranium-238	2.26E-02	3.26E-03
	Plutonium-238	-3.70E-05	2.22E-04
	Plutonium-239+240	2.22E-04	3.33E-04
	Americium-241	4.07E-04	4.81E-04
Brantley Lake (BRA)	Potassium-40	2.22E-01	1.37E-01
	Cobalt-60	3.18E-03	5.55E-03
	Strontium-90	5.55E-03	1.59E-02
	Cesium-137	1.48E-03	5.18E-03
	Uranium-234	2.33E-02	3.40E-03
	Uranium-235	9.62E-04	5.92E-04
	Uranium-238	1.92E-02	2.92E-03
	Plutonium-238	7.40E-05	5.18E-04
	Plutonium-239+240	-3.33E-04	5.55E-04
	Americium-241	1.11E-04	2.96E-04
Lake Carlsbad (CBD)	Potassium-40	4.81E-01	1.74E-01
	Cobalt-60	1.18E-02	1.15E-02
	Strontium-90	6.29E-03	1.55E-02
	Cesium-137	9.62E-03	7.77E-03
	Uranium-234	4.07E-02	5.18E-03
	Uranium-235	7.40E-04	4.81E-04
	Uranium-238	2.89E-02	3.70E-03
	Plutonium-238	5.92E-04	4.81E-04
	Plutonium-239+240	3.33E-04	2.96E-04
	Americium-241	2.22E-04	3.70E-04
Hill Tank (HIL)	Potassium-40	7.03E-01	1.22E-01
	Cobalt-60	4.44E-03	1.78E-03
	Strontium-90	2.37E-02	1.59E-02
	Cesium-137	6.66E-03	3.70E-03
	Uranium-234	1.89E-02	3.11E-03
	Uranium-235	9.62E-04	6.66E-04
	Uranium-238	1.78E-02	2.92E-03
	Plutonium-238	7.40E-05	4.07E-04
	Plutonium-239+240	4.81E-04	4.07E-04
	Americium-241	4.81E-04	4.81E-04

Table 5.6.1 - Concentrations of Radionuclides in Sediment			
		Concentration Bq/g	TPU 2 Sigma
Indian Tank (IDN)	Potassium-40	7.03E-01	1.81E-01
	Cobalt-60	5.18E-03	7.40E-03
	Strontium-90	-1.89E-03	1.11E-02
	Cesium-137	1.81E-02	9.62E-03
	Uranium-234	2.18E-02	3.29E-03
	Uranium-235	8.88E-04	6.29E-04
	Uranium-238	2.22E-02	3.26E-03
	Plutonium-238	1.48E-04	4.07E-04
	Plutonium-239+240	8.51E-04	5.18E-04
	Americium-241	5.92E-04	5.55E-04
Lost Tank (LST)	Potassium-40	8.88E-01	1.92E-01
	Cobalt-60	1.26E-02	4.07E-03
	Strontium-90	-1.55E-03	9.62E-03
	Cesium-137	1.30E-02	8.14E-03
	Uranium-234	2.26E-02	3.29E-03
	Uranium-235	1.26E-03	6.29E-04
	Uranium-238	2.44E-02	3.52E-03
	Plutonium-238	-1.11E-04	2.22E-04
	Plutonium-239+240	5.92E-04	6.29E-04
	Americium-241	3.70E-04	4.07E-04
Noya Tank (NOY)	Potassium-40	7.40E-01	1.37E-01
	Cobalt-60	1.96E-03	2.74E-03
	Strontium-90	9.25E-03	1.37E-02
	Cesium-137	3.70E-03	4.81E-03
	Uranium-234	1.41E-02	2.48E-03
	Uranium-235	5.18E-04	4.44E-04
	Uranium-238	1.33E-02	2.37E-03
	Plutonium-238	7.40E-05	3.70E-04
	Plutonium-239+240	2.96E-04	3.33E-04
	Americium-241	3.33E-04	5.18E-04
Pierce Canyon (PCN)	Potassium-40	8.51E-01	1.81E-01
	Cobalt-60	5.55E-03	8.88E-03
	Strontium-90	1.63E-02	1.74E-02
	Cesium-137	5.18E-03	5.55E-03
	Uranium-234	2.59E-02	3.66E-03
	Uranium-235	7.77E-04	5.18E-04
	Uranium-238	2.89E-02	4.07E-03
	Plutonium-238	-1.11E-04	3.33E-04
	Plutonium-239+240	1.11E-04	2.96E-04
	Americium-241	1.85E-04	2.96E-04

Table 5.6.1 - Concentrations of Radionuclides in Sediment			
		Concentration Bq/g	TPU 2 Sigma
Poker Trap (PKT)	Potassium-40	9.25E-01	1.89E-01
	Cobalt-60	5.92E-03	7.77E-03
	Strontium-90	7.03E-03	1.74E-02
	Cesium-137	2.78E-02	1.18E-02
	Uranium-234	2.78E-02	3.55E-03
	Uranium-235	1.18E-03	5.18E-04
	Uranium-238	2.85E-02	3.59E-03
	Plutonium-238	4.44E-04	4.07E-04
	Plutonium-239+240	5.92E-04	4.81E-04
	Americium-241	3.70E-04	5.55E-04
Red Tank (RED)	Potassium-40	5.18E-01	1.44E-01
	Cobalt-60	4.81E-03	4.81E-03
	Strontium-90	1.70E-02	1.59E-02
	Cesium-137	3.63E-03	3.18E-03
	Uranium-234	1.70E-02	2.66E-03
	Uranium-235	3.33E-04	4.07E-04
	Uranium-238	1.74E-02	2.70E-03
	Plutonium-238	-2.59E-04	2.96E-04
	Plutonium-239+240	1.11E-04	3.70E-04
	Americium-241	5.18E-04	3.70E-04
Sample of Opportunity (SOO)	Potassium-40	6.29E-01	1.26E-01
	Cobalt-60	-5.55E-03	6.66E-03
	Strontium-90	2.04E-02	1.92E-02
	Cesium-137	1.63E-02	4.81E-03
	Uranium-234	2.04E-02	3.11E-03
	Uranium-235	7.77E-04	5.18E-04
	Uranium-238	2.22E-02	3.29E-03
	Plutonium-238	3.70E-05	2.59E-04
	Plutonium-239+240	1.85E-04	2.59E-04
	Americium-241	4.07E-04	4.44E-04
Tut Tank (TUT)	Potassium-40	9.99E-01	1.81E-01
	Cobalt-60	5.55E-03	7.03E-03
	Strontium-90	3.70E-03	1.85E-02
	Cesium-137	1.41E-02	7.40E-03
	Uranium-234	2.26E-02	3.52E-03
	Uranium-235	1.37E-03	7.77E-04
	Uranium-238	2.41E-02	3.63E-03
	Plutonium-238	-2.22E-04	4.07E-04
	Plutonium-239+240	6.29E-04	6.29E-04
	Americium-241	0.00E+00	4.44E-04

Table 5.6.1 - Concentrations of Radionuclides in Sediment			
		Concentration Bq/g	TPU 2 Sigma
Upper Pecos River (UPR)	Potassium-40	4.44E-01	1.07E-01
	Cobalt-60	4.07E-03	3.52E-03
	Strontium-90	6.66E-03	1.55E-02
	Cesium-137	1.04E-03	3.15E-03
	Uranium-234	2.07E-02	2.92E-03
	Uranium-235	6.29E-04	4.81E-04
	Uranium-238	1.96E-02	2.78E-03
	Plutonium-238	2.96E-04	3.70E-04
	Plutonium-239+240	1.11E-04	2.22E-04
	Americium-241	3.33E-04	5.55E-04

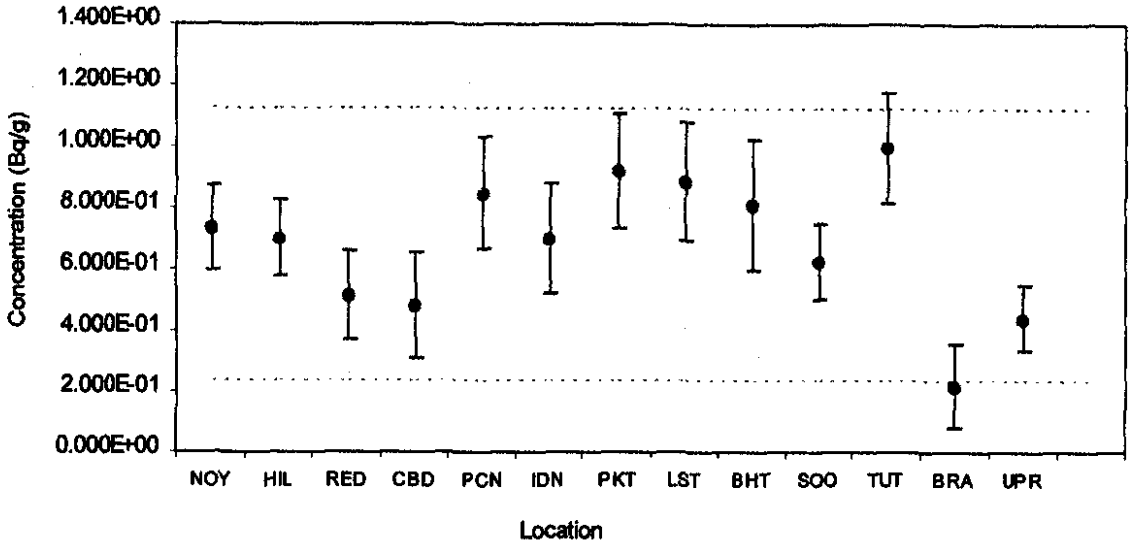


Figure 5.6.1 - Potassium-40 in Sediment

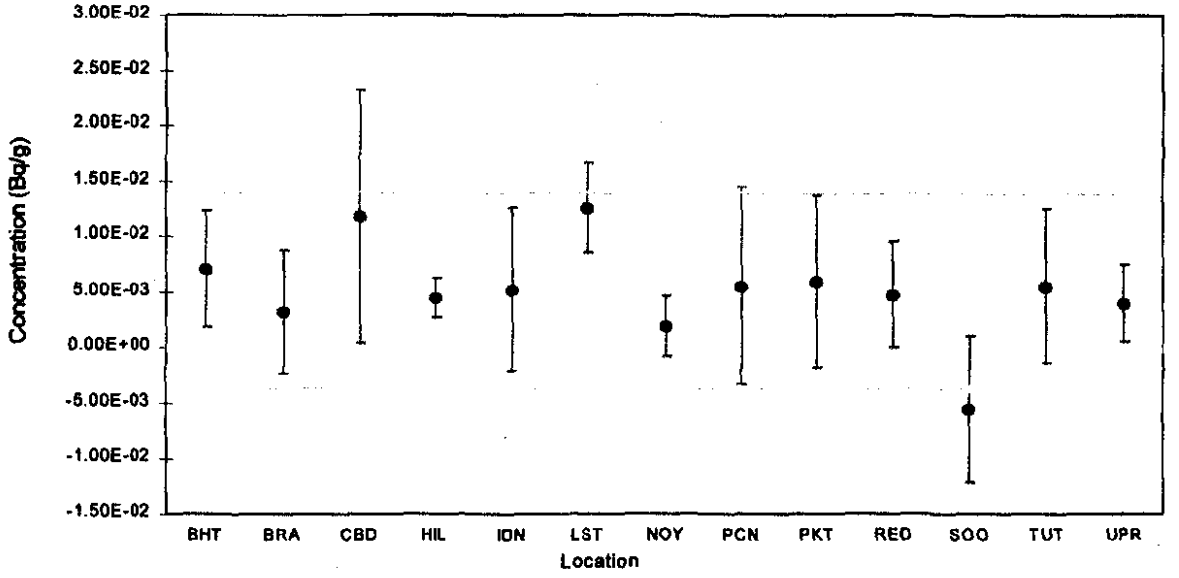


Figure 5.6.2 - Cobalt-60 in Sediment

● Concentration - - - - - - - - - - - ± 2 Sigma

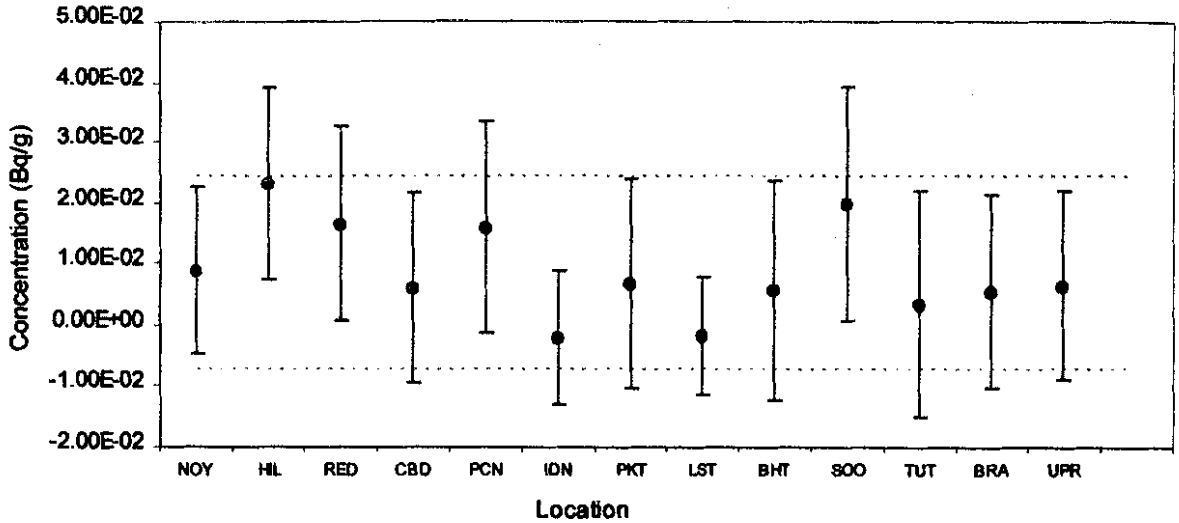


Figure 5.6.3 - Strontium-90 in Sediment

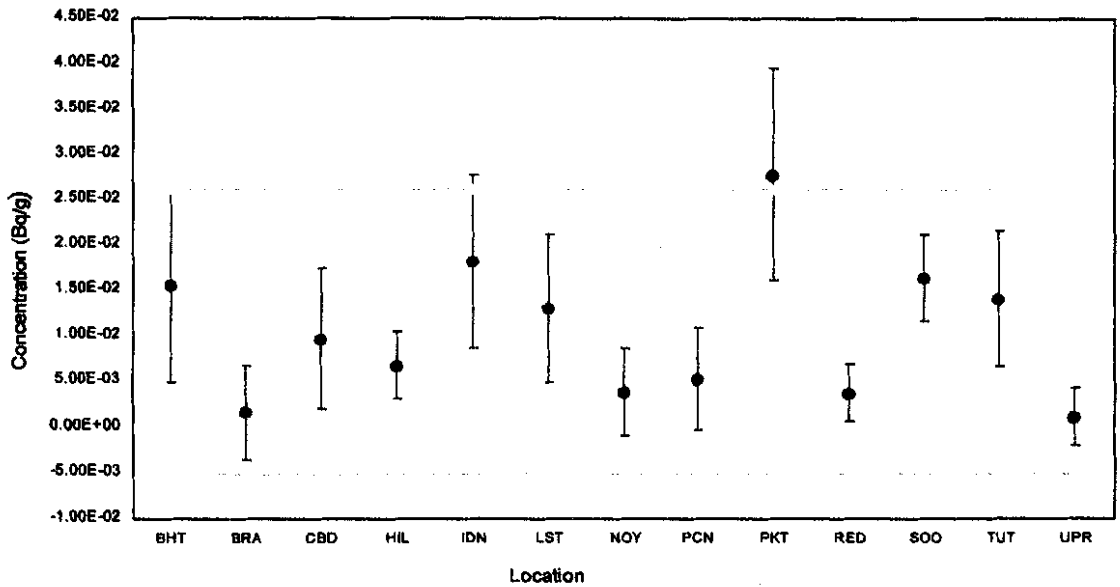


Figure 5.6.4 - Cesium-137 in Sediment

● Concentration - - - - - - - - - - - ± 2 Sigma

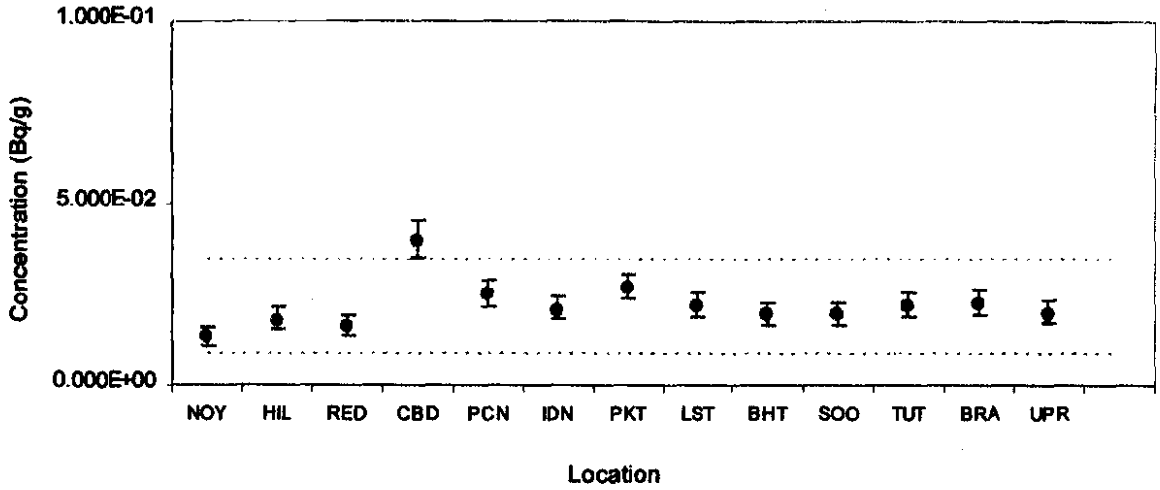


Figure 5.6.5 - Uranium-234 in Sediment

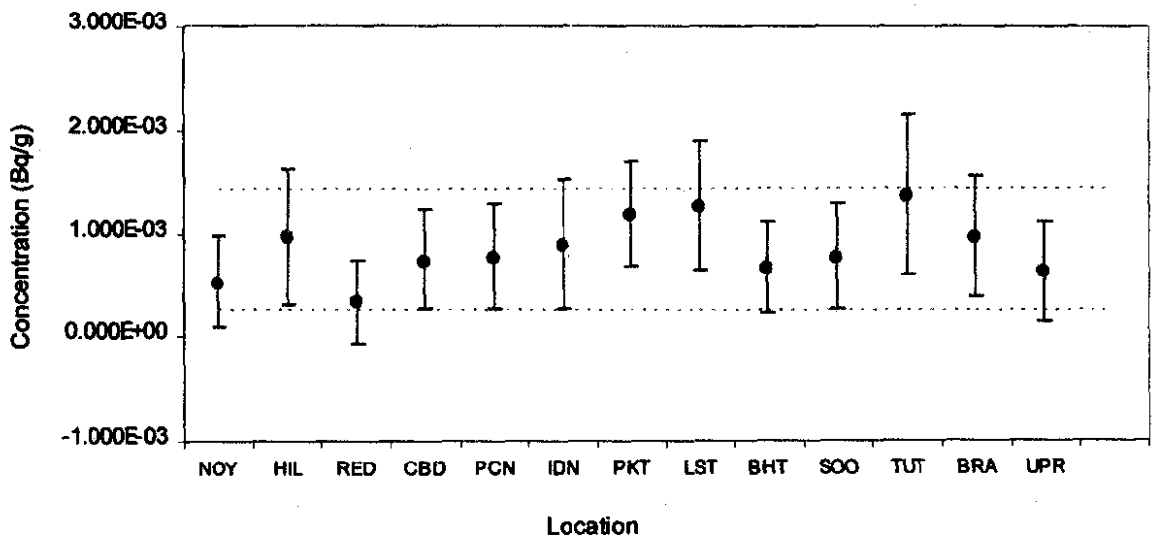


Figure 5.6.6 - Uranium 235 in Sediment

● Concentration - - - - - - - - - - - ± 2 Sigma

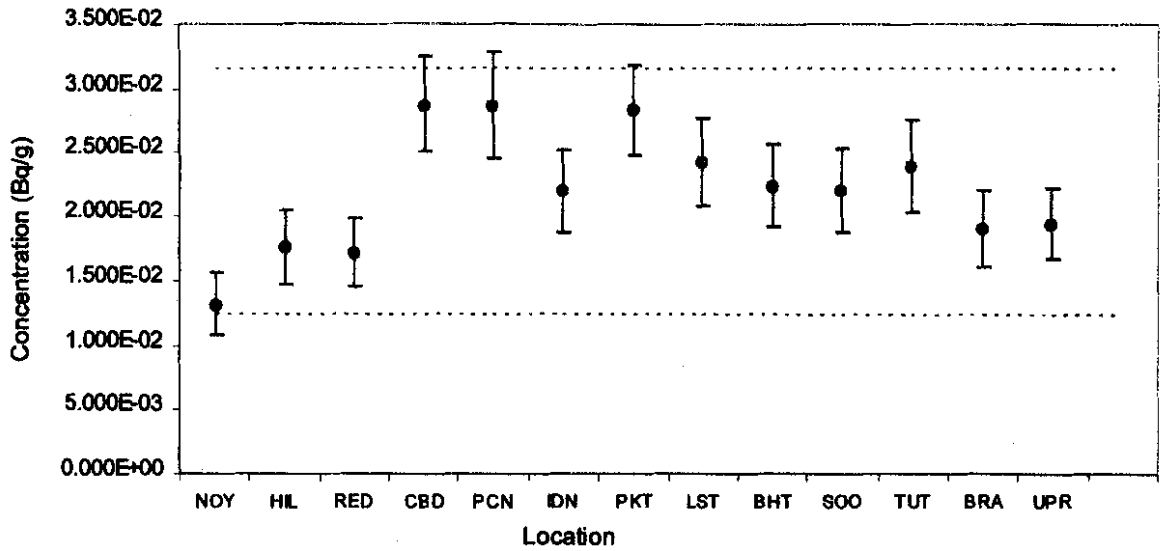


Figure 5.6.7 - Uranium-238 in Sediment

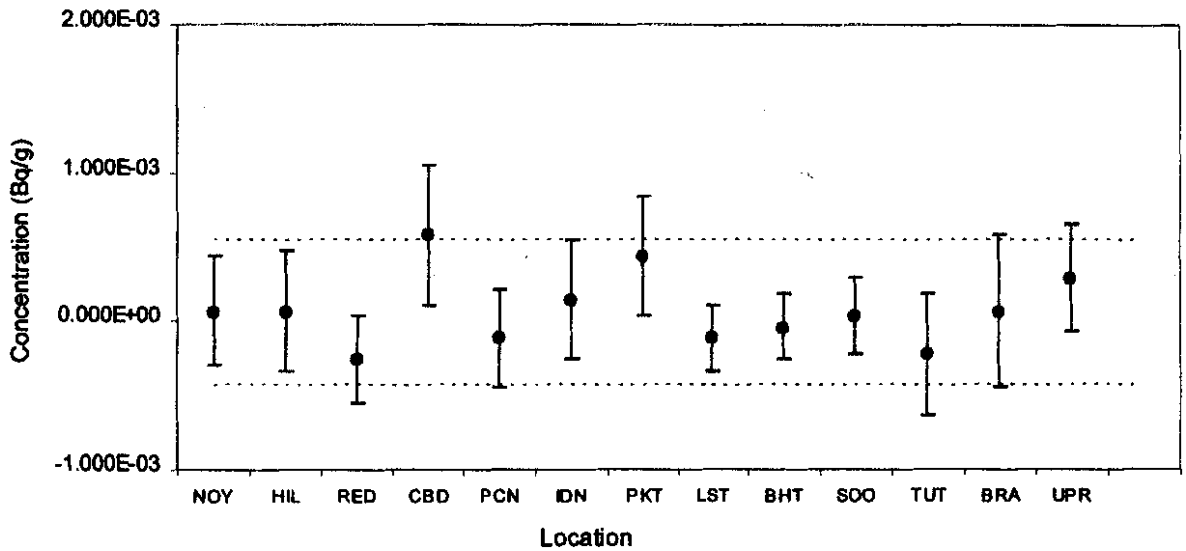


Figure 5.6.8 - Plutonium-238 in Sediment

● Concentration - - - - - - - - - - - ± 2 Sigma

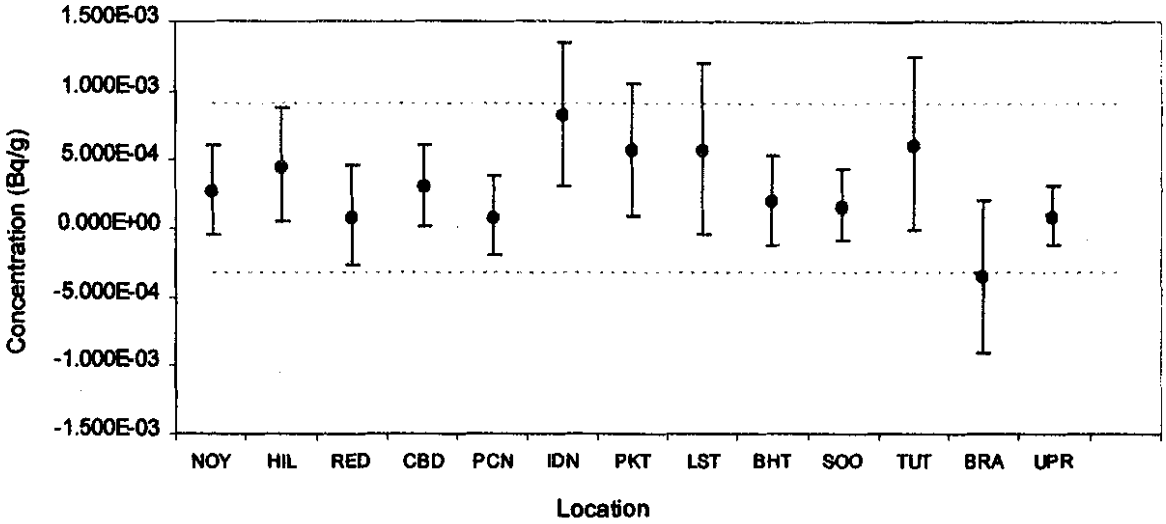


Figure 5.6.9 - Plutonium-239+240 in Sediment

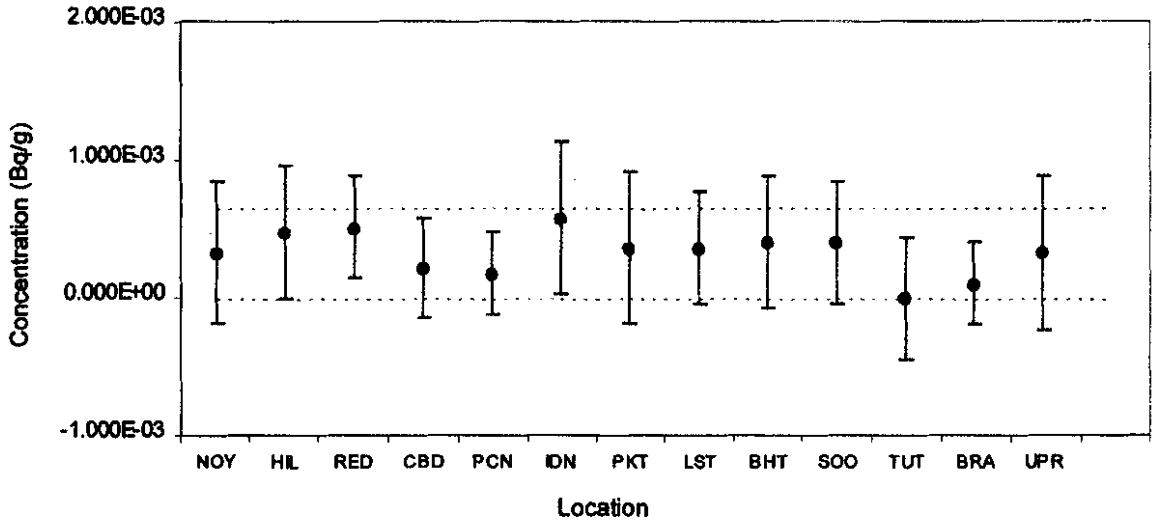


Figure 5.6.10 - Americium-241 in Sediment

● Concentration - - - - - - - - - - - ± 2 Sigma

5.7 Biota

Sample Collection: Vegetation samples were collected from the same six locations around WIPP site from where the soil samples were collected. Also, a fish sample was collected from Brantley Lake. The vegetation samples were collected, chopped into one to two-inch-long pieces, mixed together as best as possible, air-dried at room temperature, and sent to the contract laboratory for the analyses. The composite vegetation samples collected for the determination of individual radionuclides include diverse vegetation such as Havard shinnery oak (Quercus havardii), sand sage (Artemesia filifolia) in woody plants, and mesa dropseed (Sporobolus flexuosus) in grasses.

Sample Preparation: An aliquot (weighed amount) from each of the bulk vegetation samples were transferred into separate containers and dried at 100°C. The samples were then dry ashed. The residue (ash) was then wet ashed and finally dissolved in 8M nitric acid for the determinations of Sr-90 and alpha- emitting radionuclides. For gamma spectrometry, an aliquot of vegetation samples were directly taken from the bulk samples without going through the drying process. All the results were however reported per gram of air dried sample as provided by the WIPP Environmental Monitoring Group.

The fish sample was wet ashed and finally dissolved in 8M nitric acid for the determination of all the radionuclides of interest.

Results and Discussions: The results on the concentrations of all the radionuclides measured in vegetation samples collected from each location are given in Table 5.7.1. Also, the results on the concentrations of individual radionuclides in the vegetation samples of all the locations are given in Figures 5.7.1 through 5.7.10. The concentrations of naturally occurring radionuclides such as K-40 and isotopes of uranium were predominantly higher than all other radionuclides as expected.

Concentration of K-40 for each sampling location is given in Figure 5.7.1. The concentration ranged from 193 ± 70 (in sample collected at MLR) to 614 ± 148 mBq/g (sample collected at WSS) with a mean of 370 ± 372 mBq/g (± 2 SD). It is evident from Figure 5.7.1 that the concentration of K-40 did not vary significantly from location to location as all data points were within ± 2 sigma of the mean.

Concentration of Co-60 (Figure 5.7.2) was below its MDA in all the samples (MDA ranged from 0.44 to 18.5 mBq/g) except in the sample collected at MLR. The concentration in this sample was 3.81 ± 2.96 mBq/g which is associated with large analytical uncertainty. Also, there is no obvious reason for this sample to have higher Co-60 as compared to all other samples. Based on these observations, it is reasonable to state that Co-60 was not detected in the vegetation samples collected around WIPP site.

Concentrations of Sr-90 in these samples are graphically presented in Figure 5.7.3. Concentrations ranged from 1.38 ± 0.44 to 4.92 ± 0.93 mBq/g with a mean of 2.35 ± 8.10 mBq/g (± 2 SD). The results indicate that there is no significant variation in the concentration of Sr-90 in vegetation samples collected from various locations.

Concentration of Cs-137 in these samples (Figure 5.7.4) ranged from -2.95 ± 5.92 to 1.58 ± 5.55 mBq/g. These concentrations were below the MDA of Cs-137 (MDA ranged from 4 to 11 mBq/g) and also the results were associated with large analytical uncertainties. It may therefore be concluded that Cs-137 was not detected in these samples.

Concentrations of U-234, U-235, and U-238 are given in Figures 5.7.5 through 5.7.7 respectively. Concentration of U-234 ranged from 0.54 ± 0.17 to 1.59 ± 0.31 mBq/g with a mean of 0.98 ± 0.81 (± 2 SD) and U-238 ranged from 0.50 ± 0.13 to 1.47 ± 0.29 mBq/g with a mean of 0.90 ± 0.72 (± 2 SD). Concentration of U-235, as expected, was very

low. Concentrations of these uranium isotopes did not vary significantly from one location to another as all the data points were within ± 2 sigma of the mean.

The results on the concentrations of Pu-238, and Pu-239+240 are given in Figures 5.7.8 and 5.7.9 respectively. Concentrations of Pu-238 in these samples were below its MDA (MDA ranged from 0.02 to 0.15 mBq/g). The concentration of Pu-239+240 ranged from 0.02 ± 0.02 to 0.43 ± 0.14 mBq/g with a mean of 0.12 ± 0.30 (± 2 SD). The results suggest that there were no significant differences between the concentrations of Pu-239+240 in these samples because all the data points were within ± 2 sigma of the mean.

The results on the concentration of Am-241 in the vegetation samples are given in Figure 5.7.10. The concentrations of Am-241 in these samples were mostly below its MDA. In two samples the concentrations were above MDA but were associated with large analytical uncertainties. Based on these facts it is reasonable to state that Am-241 was not detected in these samples.

A fish sample was collected from Brantley Lake and analyzed for all the above-mentioned radionuclides. The results are given in Table 5.7.2. None of the radionuclides except U-234 and U-238 were detected. Concentrations of U-234 and U-238 were 0.32 ± 0.063 and 0.22 ± 0.048 mBq/g of wet weight of fish respectively. These results were above their MDA (0.022 mBq/g) and the analytical uncertainties were hardly 20 to 25 percent at the 2 sigma level. It is therefore appropriate to state that the fish sample did contain uranium. However, looking at the uranium content of drinking water this low concentration of uranium is not significant.

Table 5.7.1 - Concentrations of Radionuclides in Biota			
		Concentration Bq/g	TPU 2 Sigma
WIPP Far Field (WFF)	Potassium 40	5.99E-01	1.63E-01
	Cobalt 60	6.18E-04	1.15E-02
	Strontium 90	4.92E-03	9.25E-04
	Cesium 137	1.16E-03	6.66E-03
	Uranium 234	5.37E-04	1.67E-04
	Uranium 235	1.11E-05	3.33E-05
	Uranium 238	7.22E-04	1.92E-04
	Plutonium 238	7.03E-05	8.51E-05
	Plutonium 239+240	4.29E-04	1.41E-04
	Americium 241	-7.40E-05	8.51E-05
WIPP East (WEE)	Potassium 40	2.53E-01	1.15E-01
	Cobalt 60	-3.29E-04	5.55E-03
	Strontium 90	1.38E-03	4.44E-04
	Cesium 137	-2.95E-03	5.92E-03
	Uranium 234	1.02E-03	2.29E-04
	Uranium 235	4.81E-05	4.07E-05
	Uranium 238	7.10E-04	1.85E-04
	Plutonium 238	0.00E+00	2.22E-05
	Plutonium 239+240	8.51E-05	5.18E-05
	Americium 241	6.66E-05	5.18E-05
WIPP South (WSS)	Potassium 40	6.14E-01	1.48E-01
	Cobalt 60	4.59E-03	6.29E-03
	Strontium 90	1.89E-03	9.62E-04
	Cesium 137	1.58E-03	5.55E-03
	Uranium 234	5.48E-04	1.48E-04
	Uranium 235	-1.48E-05	4.44E-05
	Uranium 238	5.00E-04	1.30E-04
	Plutonium 238	1.48E-05	3.70E-05
	Plutonium 239+240	6.29E-05	4.44E-05
	Americium 241	4.44E-05	4.44E-05
Mills Ranch (MLR)	Potassium 40	1.93E-01	7.03E-02
	Cobalt 60	3.81E-03	2.96E-03
	Strontium 90	2.50E-03	8.14E-04
	Cesium 137	1.32E-03	2.81E-03
	Uranium 234	9.58E-04	1.92E-04
	Uranium 235	1.85E-05	4.44E-05
	Uranium 238	7.99E-04	1.70E-04
	Plutonium 238	1.85E-05	1.48E-05
	Plutonium 239+240	6.66E-05	2.96E-05
	Americium 241	2.96E-05	3.33E-05

Table 5.7.1 - Concentrations of Radionuclides in Biota			
		Concentration Bq/g	TPU 2 Sigma
South East Control (SEC)	Potassium 40	2.60E-01	1.26E-01
	Cobalt 60	-5.03E-03	6.29E-03
	Strontium 90	1.38E-03	7.40E-04
	Cesium 137	4.74E-04	6.29E-03
	Uranium 234	1.59E-03	3.11E-04
	Uranium 235	6.29E-05	5.18E-05
	Uranium 238	1.47E-03	2.85E-04
	Plutonium 238	3.70E-06	2.96E-05
	Plutonium 239+240	8.14E-05	4.44E-05
	Americium 241	3.33E-05	3.33E-05
Smith Ranch (SMR)	Potassium 40	3.03E-01	9.25E-02
	Cobalt 60	-6.59E-04	4.07E-03
	Strontium 90	2.05E-03	8.51E-04
	Cesium 137	7.03E-04	4.07E-03
	Uranium 234	1.24E-03	2.26E-04
	Uranium 235	5.92E-05	4.44E-05
	Uranium 238	1.20E-03	2.18E-04
	Plutonium 238	0.00E+00	3.33E-05
	Plutonium 239+240	2.22E-05	2.22E-05
	Americium 241	5.55E-05	2.59E-05

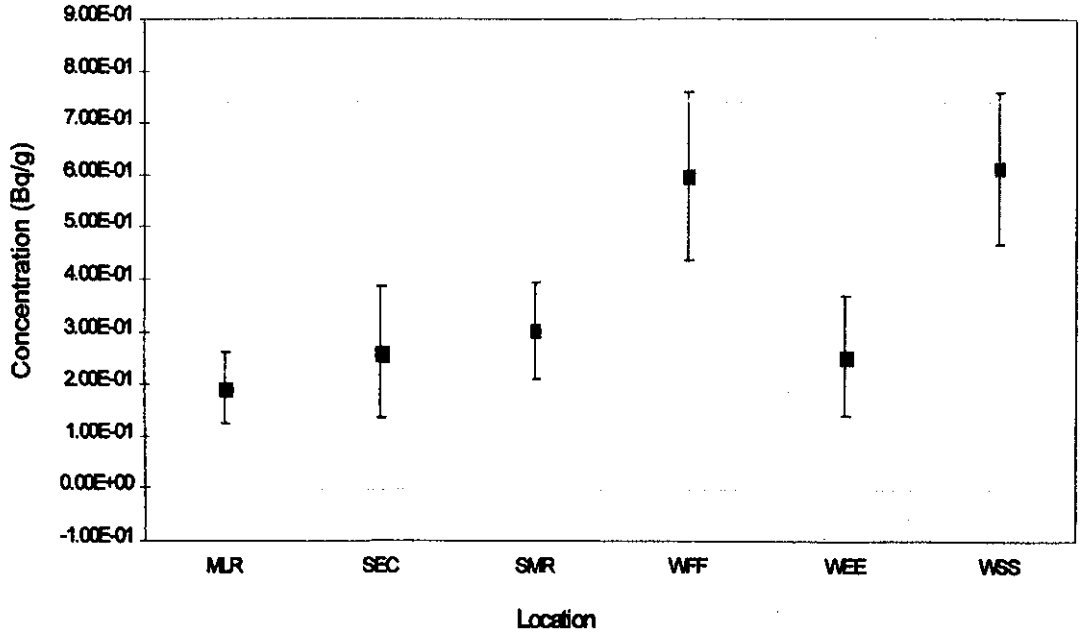


Figure 5.7.1 - Potassium-40 in Vegetation

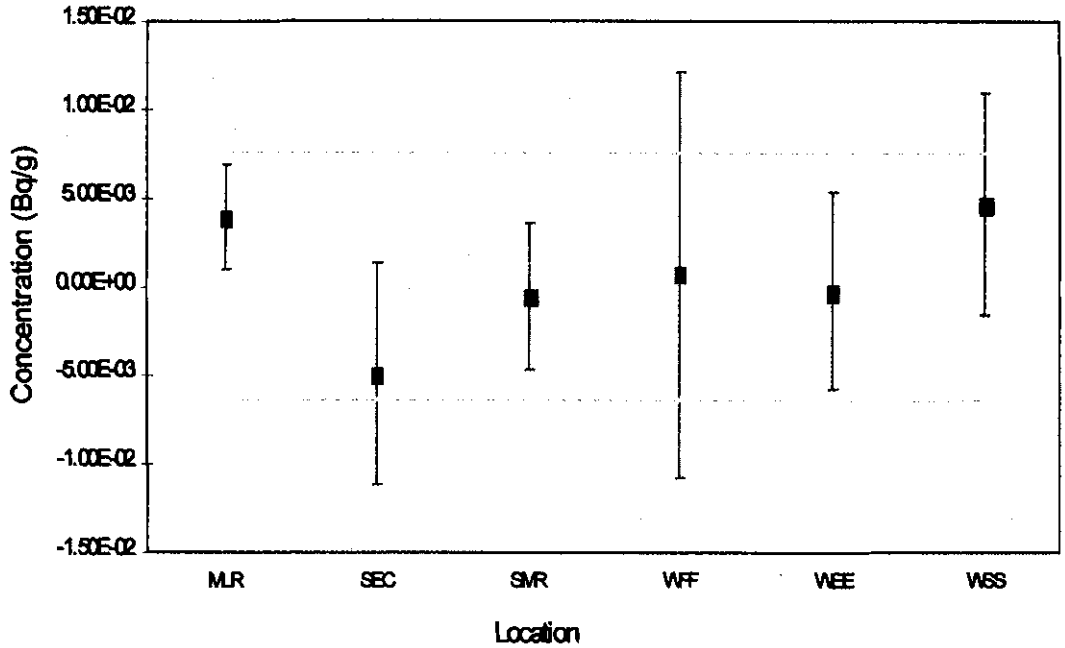


Figure 5.7.2 - Cobalt-60 in Vegetation

■ Concentration - - - - - - - - - - - ± 2 Sigma

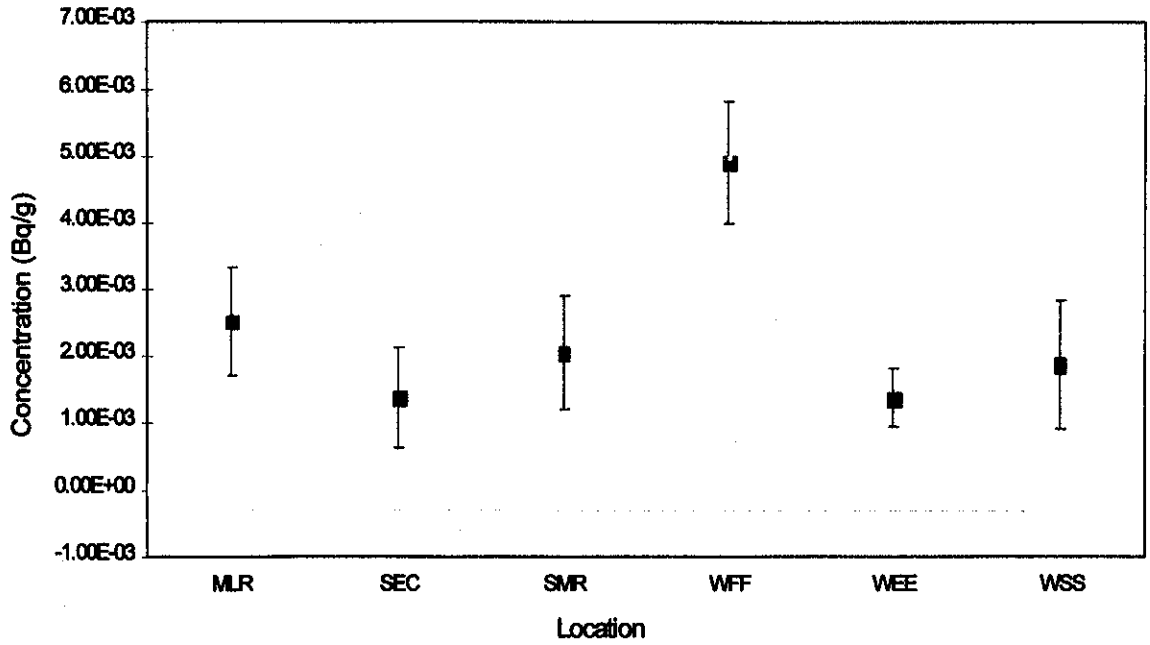


Figure 5.7.3 - Strontium-90 in Vegetation

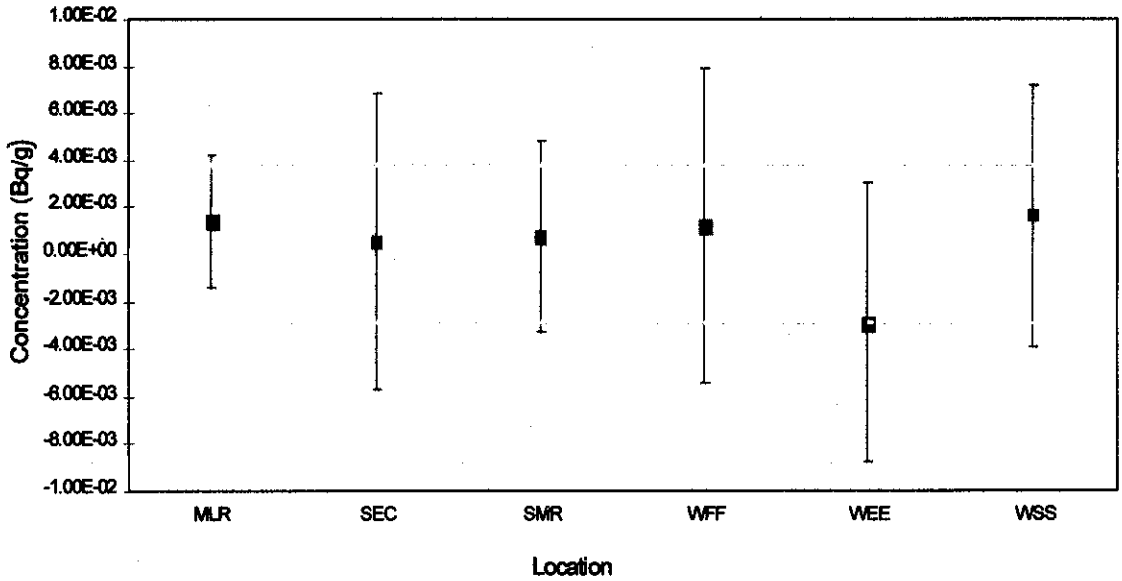


Figure 5.7.4 - Cesium-137 in Vegetation

■ Concentration - - - - - - - - - - - ± 2 Sigma

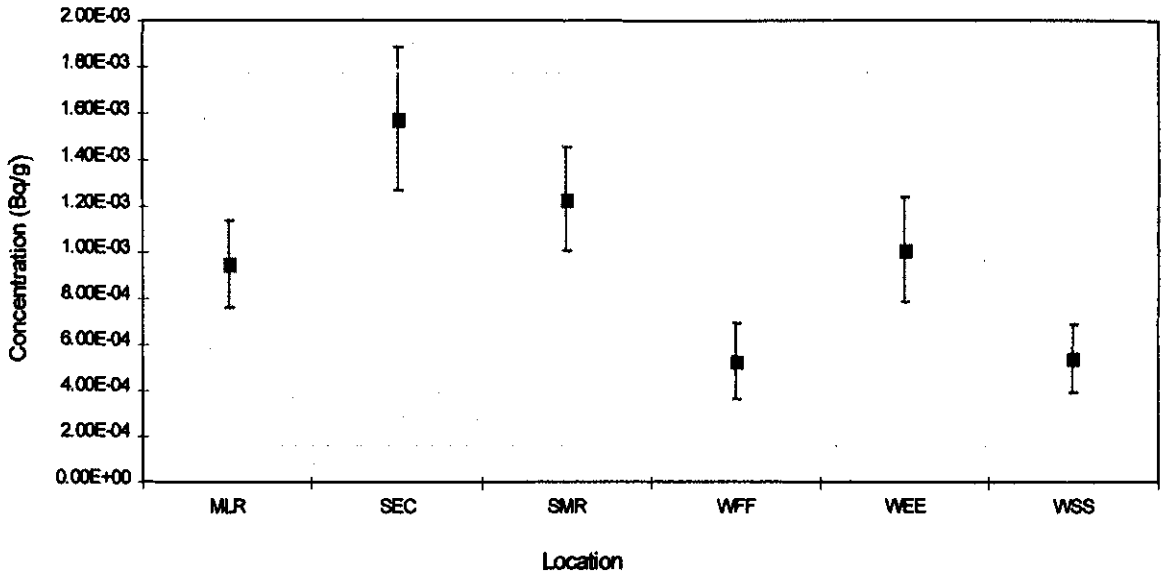


Figure 5.7.5 - Uranium-234 in Vegetation

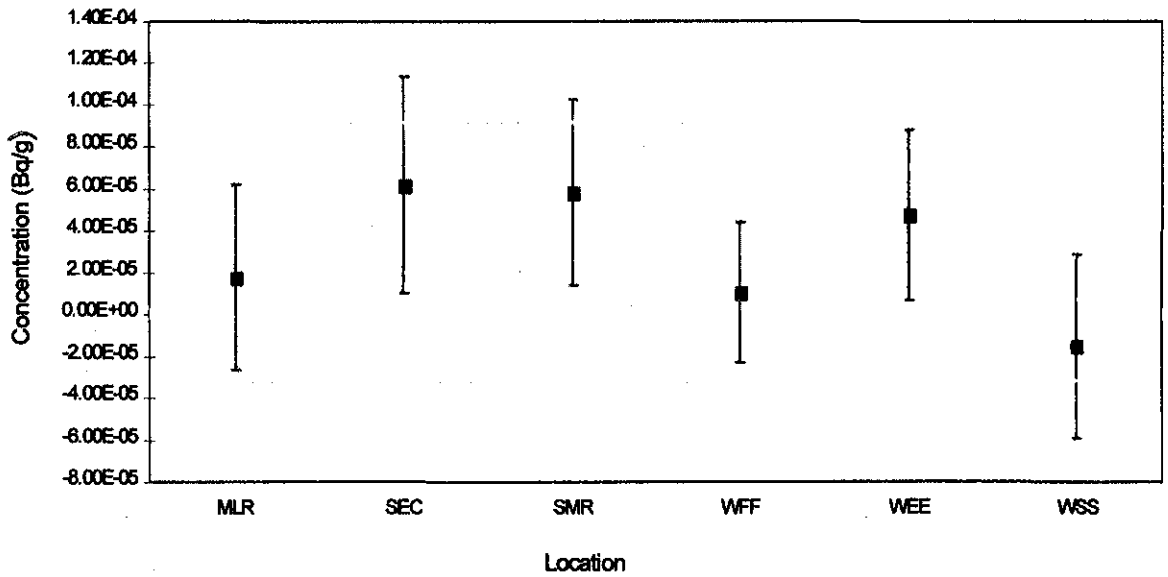


Figure 5.7.6 - Uranium-235 in Vegetation

■ Concentration - - - - - - - - - - - ± 2 Sigma

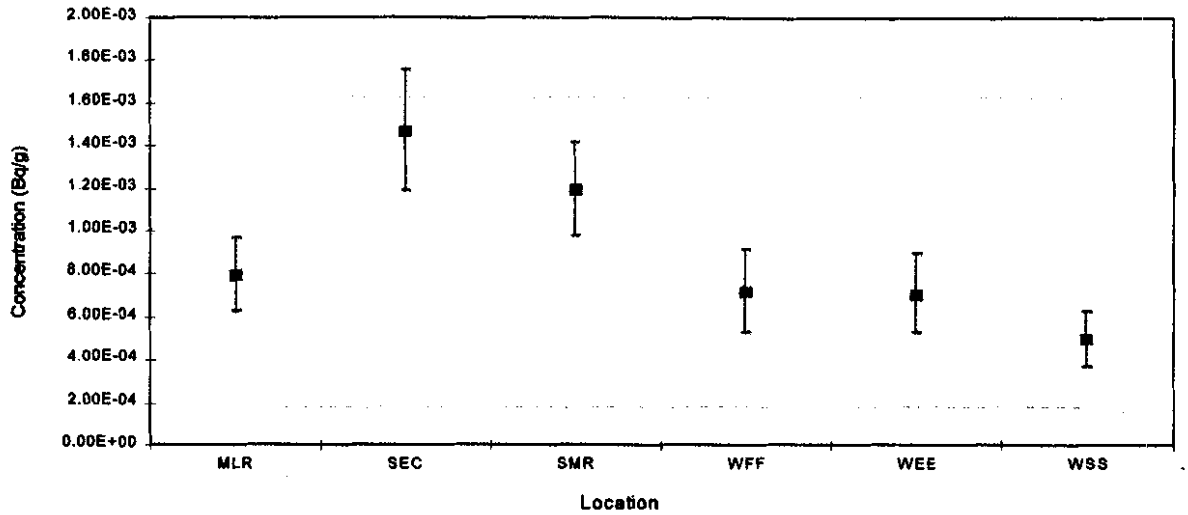


Figure 5.7.7 - Uranium-238 in Vegetation

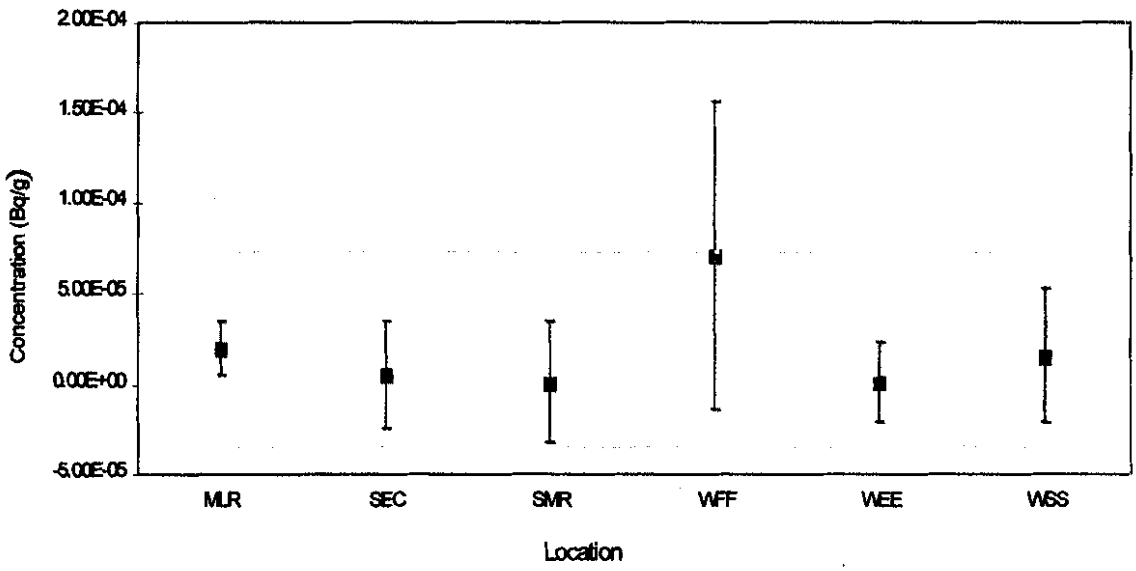


Figure 5.7.8 - Plutonium-238 in Vegetation

■ Concentration - - - - - - - - - - - ± 2 Sigma

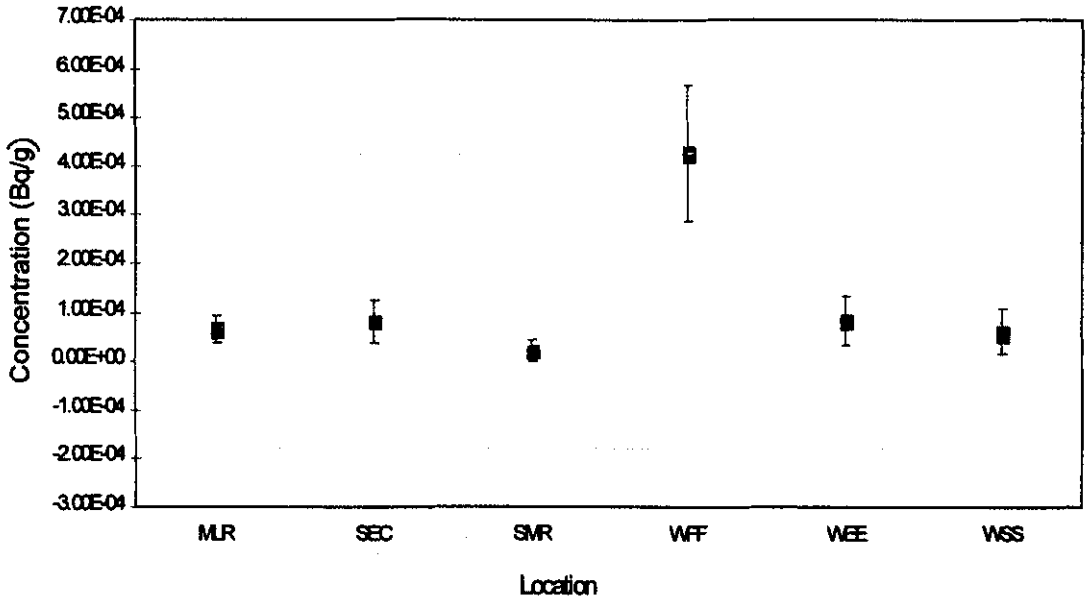


Figure 5.7.9 - Plutonium-239+240 in Vegetation

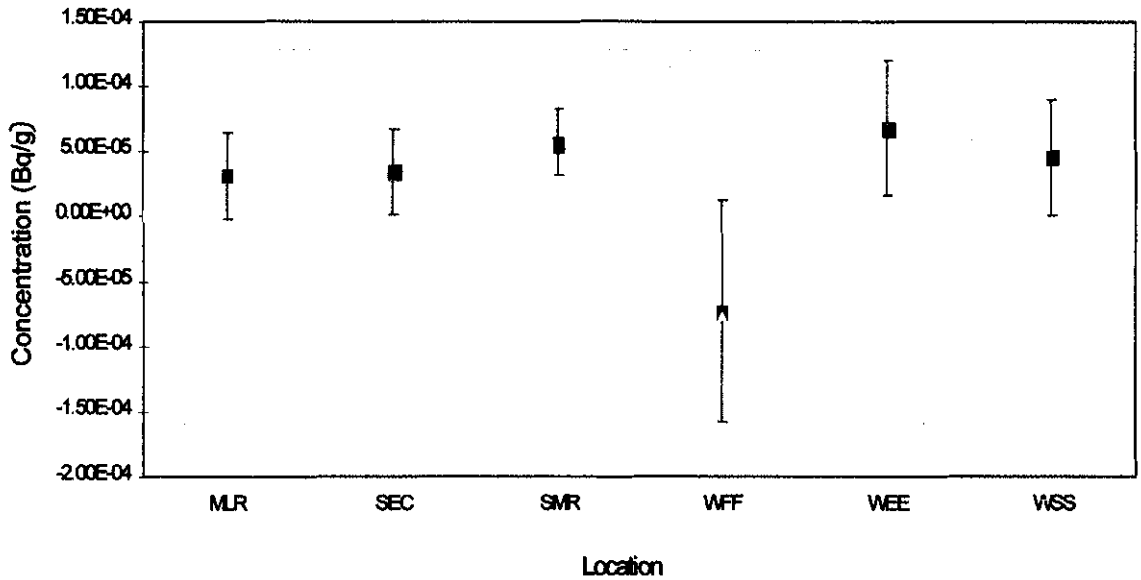


Figure 5.7.10 - Americium-241 in Vegetation

■ Concentration - - - - - - - - - - - ± 2 Sigma

5.8 Trend Analyses

Trend analyses of the analytes are performed to observe changes in the concentrations of analytes with time, meteorological conditions, and operational activities at/or around a site. It was therefore considered quite appropriate to perform the trend analyses for all the parameters at the WIPP site to see the variability from year to year before receiving the transuranic wastes and also after receiving the wastes.

Except the gross alpha and beta measurements in weekly air particulate samples all other analytes were measured by two different laboratories in last two years (1996 and 1997). Therefore, the trend analyses was performed only for gross alpha and beta activities for these two years. These measurements were made by the WIPP laboratory.

The results for the weekly measurements of gross alpha and beta activities for 1996 and 1997 for each sampling locations are presented graphically in Figures 5.8.1 through 5.8.12. These figures clearly indicate that approximately 95 percent of the data points (for both years) were within ± 2 sigma of the mean concentration of both years. These results suggest that gross alpha and beta activities for any sampling location in 1996 did not vary significantly from the gross alpha and beta activities measured at the same location in 1997. This was true for all sampling locations.

The annual mean concentrations of gross alpha and beta activities for each sampling location are given in Table 5.8.1. The mean concentrations of gross alpha activities for each sampling location in 1996 were not different from the mean concentrations of gross alpha activities for corresponding locations in 1997. Similar results were found for gross beta activities also. These results clearly suggest that the gross alpha and beta activities for each of the sampling location as measured in 1996 and 1997 were not significantly different from each other.

Table 5.8.1 - Mean Concentrations (Bq/m³) of Gross Alpha and Beta Activities for 1996 and 1997

Gross Alpha						
	Mean	± 1 SD	Mean	± 1 SD	Mean	± 1 SD
Location	1996		1997		Combined 1996-1997	
CBD	1.50E-04	2.75E-04	2.73E-05	3.12E-05	8.95E-05	2.05E-04
MLR	1.04E-04	1.26E-04	2.27E-05	2.42E-05	6.25E-05	9.85E-05
SEC	8.78E-05	1.15E-04	2.64E-05	2.62E-05	5.71E-05	8.88E-05
SMR	9.97E-05	1.50E-04	2.92E-05	3.15E-05	6.63E-05	1.16E-04
WEE	1.06E-04	1.18E-04	2.15E-05	2.81E-05	6.61E-05	9.72E-05
WFF	1.12E-04	1.26E-04	1.85E-05	2.52E-05	6.45E-05	1.01E-04
WSS	1.03E-04	1.14E-04	2.30E-05	3.07E-05	6.29E-05	9.20E-05

Gross Beta						
	Mean	± 1 SD	Mean	± 1 SD	Mean	± 1 SD
Location	1996		1997		Combined 1996-1997	
CBD	8.79E-04	5.29E-04	6.40E-04	2.33E-04	7.61E-04	4.26E-04
MLR	7.58E-04	3.04E-04	6.41E-04	2.33E-04	6.99E-04	2.75E-04
SEC	6.46E-04	4.29E-04	6.31E-04	2.43E-04	6.39E-04	3.47E-04
SMR	7.49E-04	2.80E-04	6.04E-04	2.07E-04	6.80E-04	2.58E-04
WEE	7.84E-04	2.70E-04	6.21E-04	2.26E-04	7.06E-04	2.62E-04
WFF	7.90E-04	3.04E-04	6.39E-04	2.39E-04	7.14E-04	2.82E-04
WSS	7.41E-04	2.75E-04	6.06E-04	2.17E-04	6.74E-04	2.56E-04

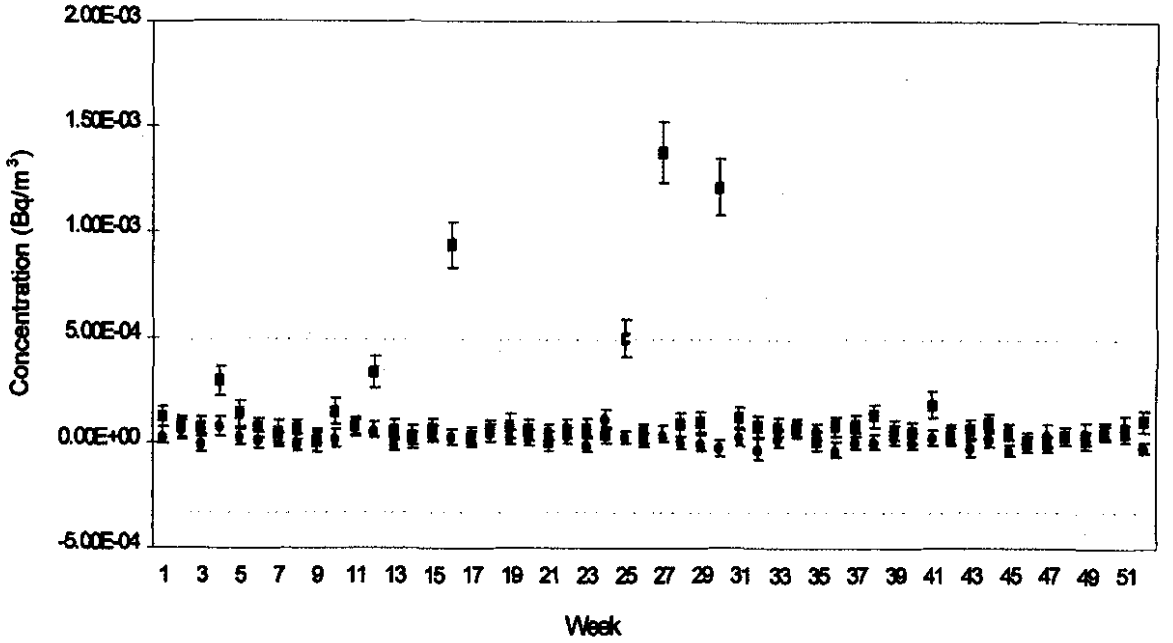


Figure 5.8.1 - Comparison Gross Alpha 1996-1997 - Carlsbad (CBD)

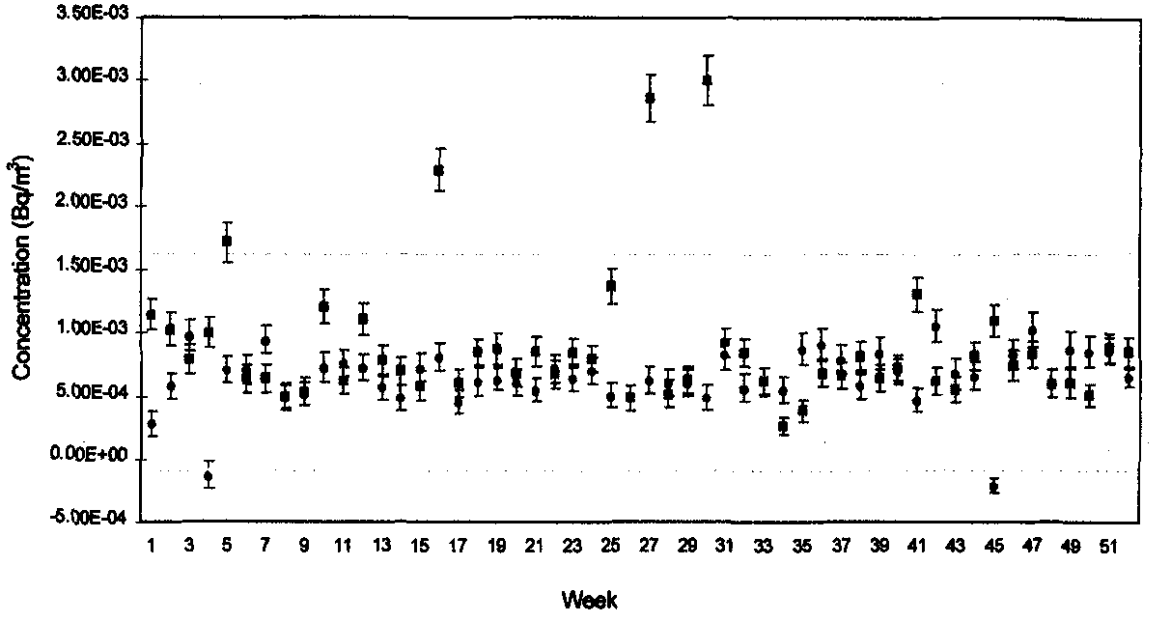


Figure 5.8.2 - Comparison Gross Beta 1996-1997 - Carlsbad (CBD)

●●Carlsbad 1997 ■ Carlsbad 1996 - - - - ± 2 Sigma

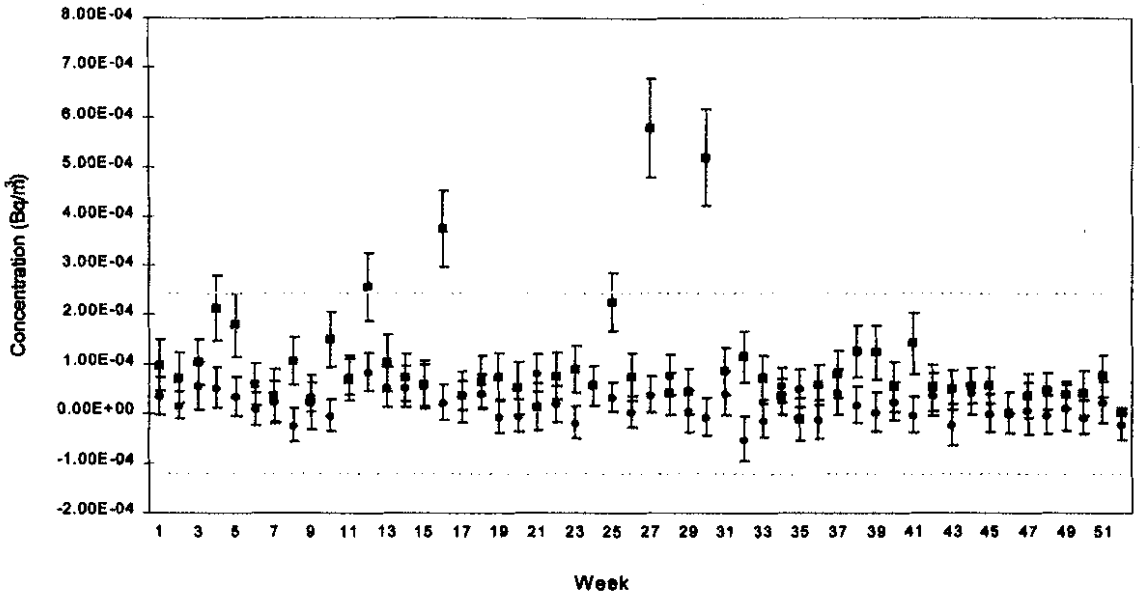


Figure 5.8.3 - Comparison Gross Alpha 1996-1997- WIPP South (WSS)

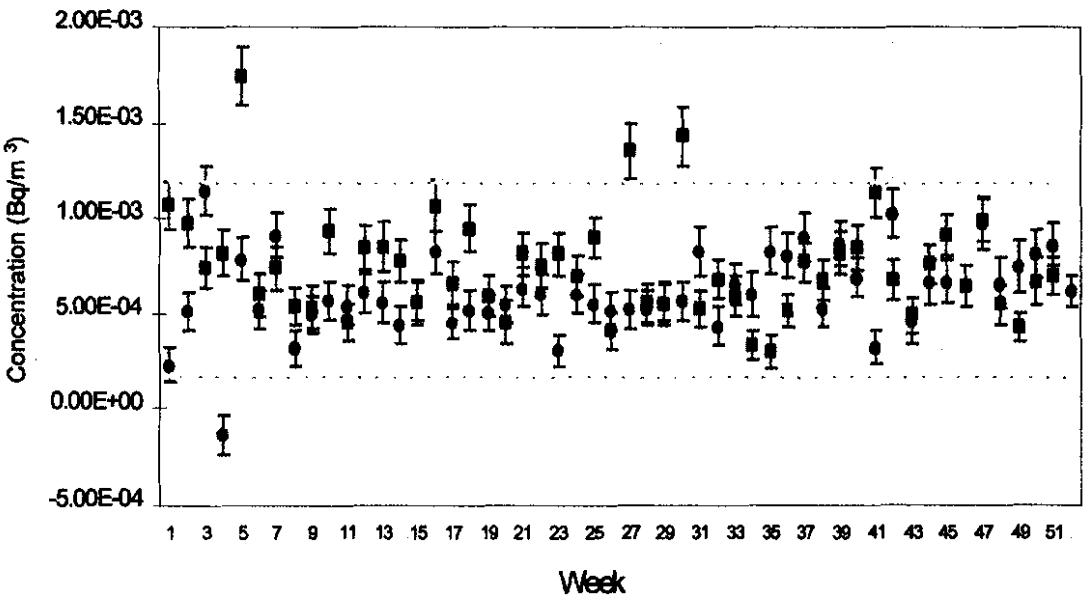


Figure 5.8.4 - Comparison Gross Beta 1996-1997 - WIPP South (WSS)

●WIPP South 1997 ■WIPP South 1996 - - - - ± 2 Sigma

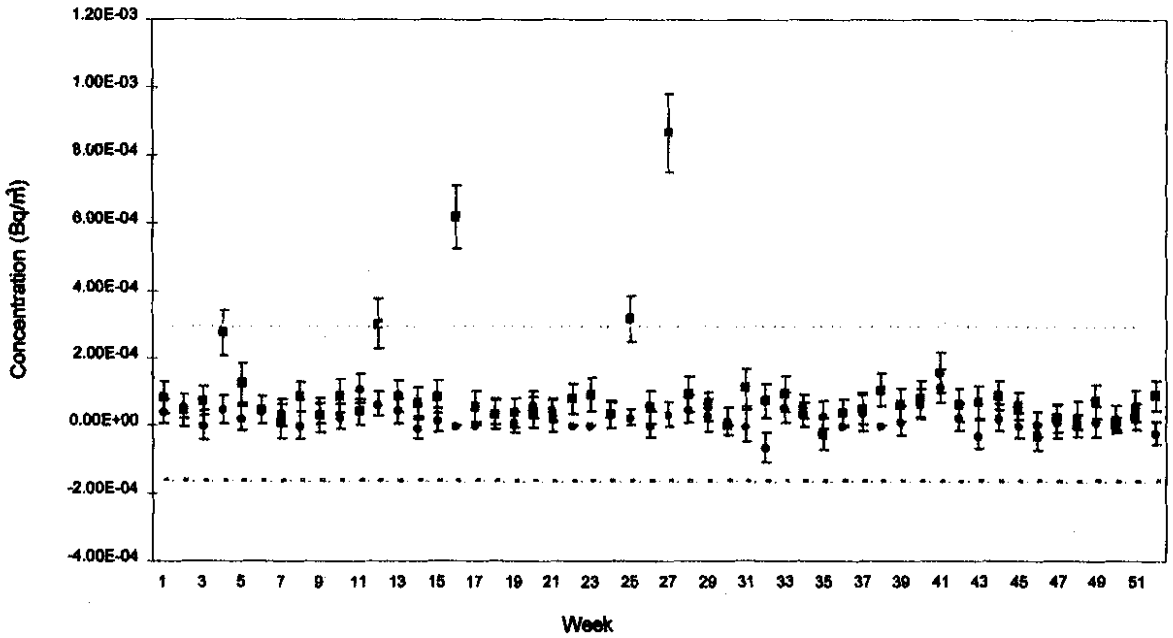


Figure 5.8.5 - Comparison Gross Alpha 1996-1997 - Smith Ranch (SMR)

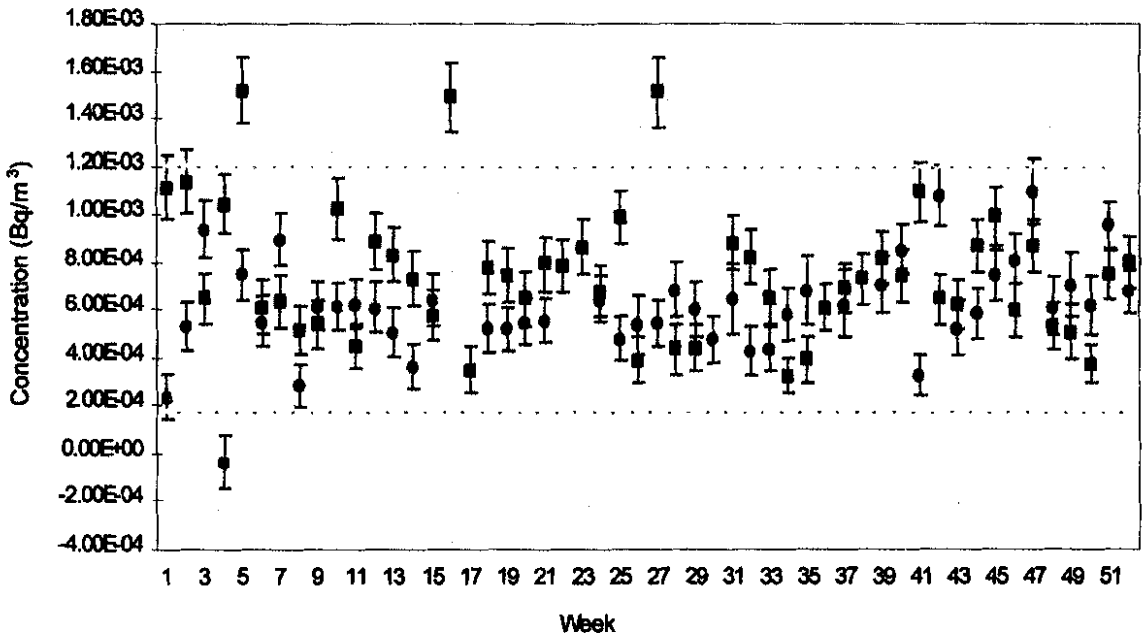


Figure 5.8.6 - Comparison Gross Beta 1996-1997 - Smith Ranch (SMR)

● Smith Ranch 1997 ■ Smith Ranch 1996 - - - - ± 2 Sigma

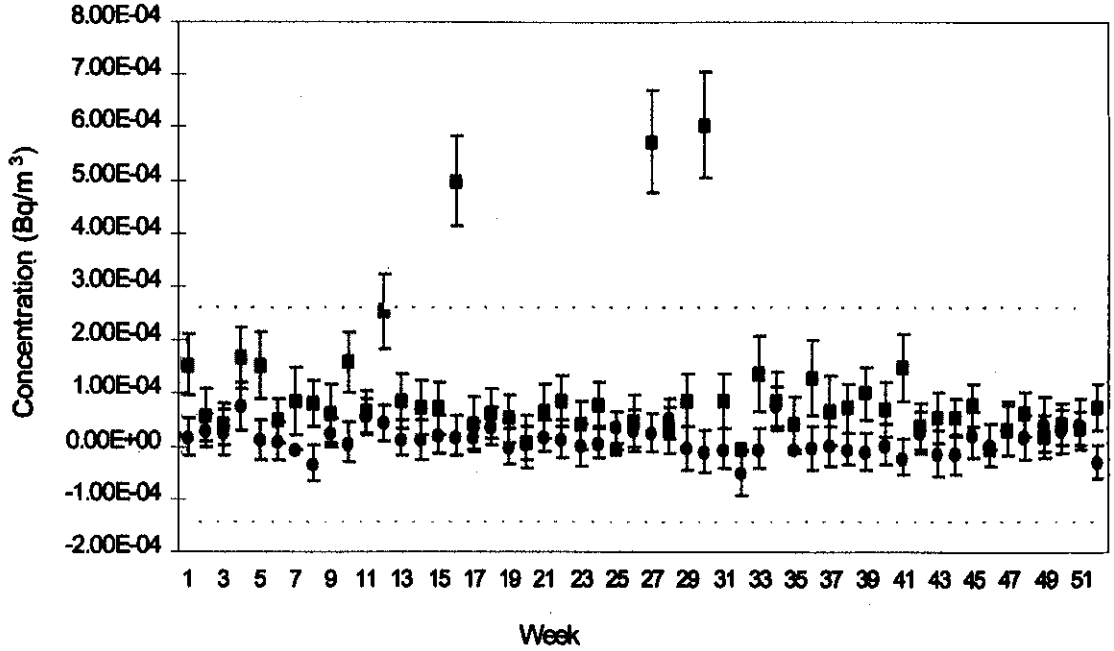


Figure 5.8.7 - Comparison Gross Alpha 1996-1997 - WIPP Far Field (WFF)

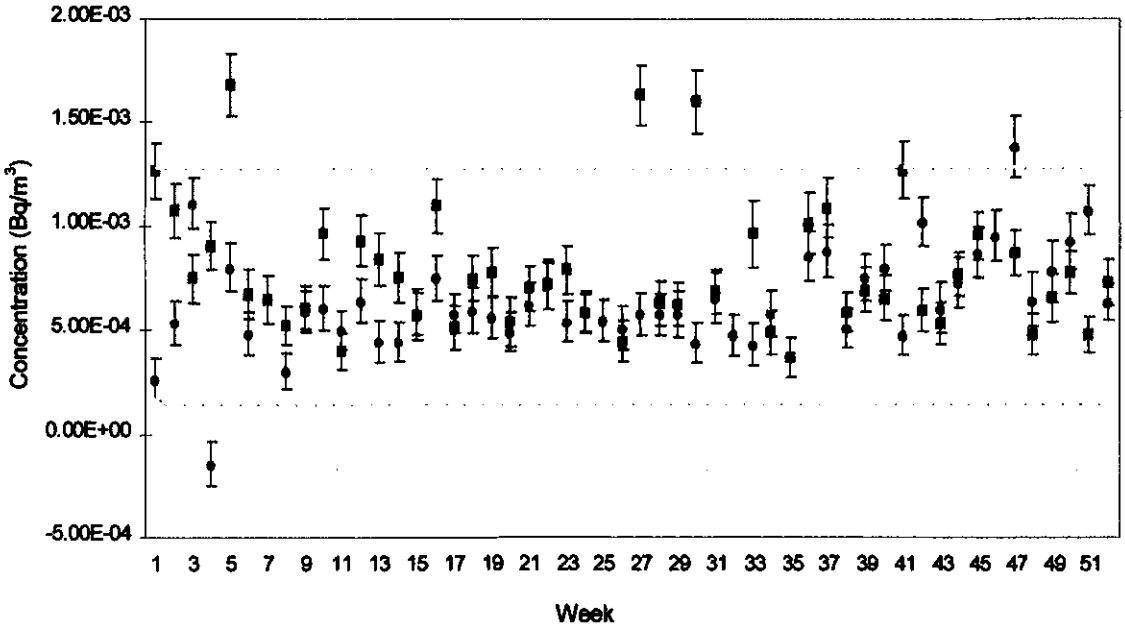


Figure 5.8.8 - Comparison Gross Beta 1996-1997 - WIPP Far Field (WFF)

● WIPP Far Field 1997 ■ WIPP Far Field 1996 - - - - ± 2 Sigma

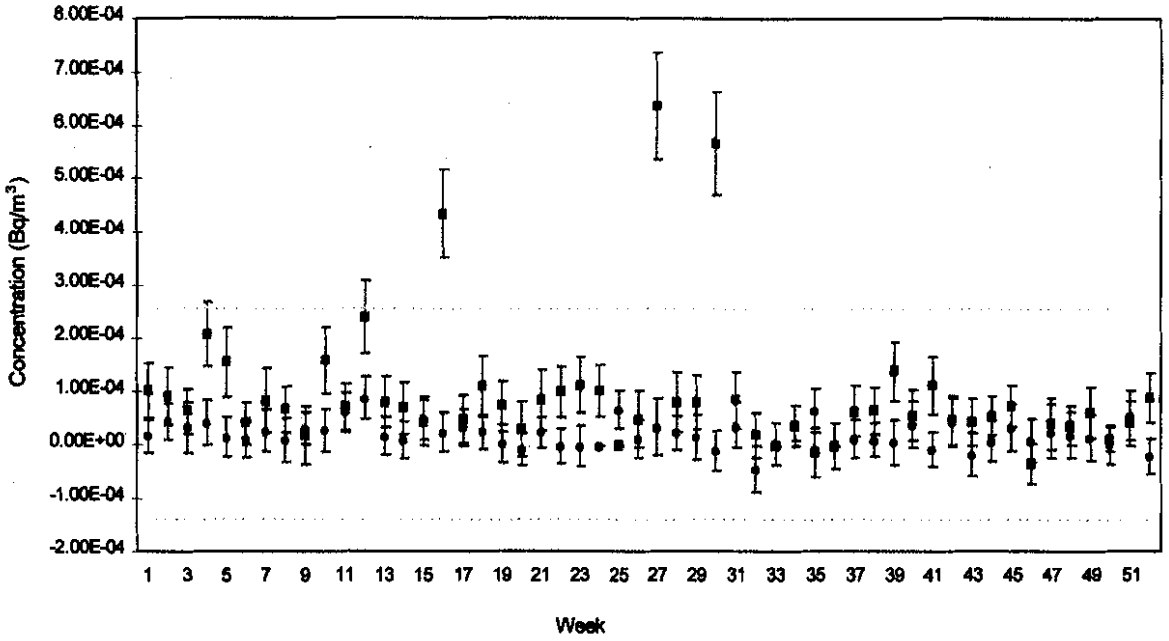


Figure 5.8.9 - Comparison Gross Alpha 1996-1997 - Mills Ranch (MLR)

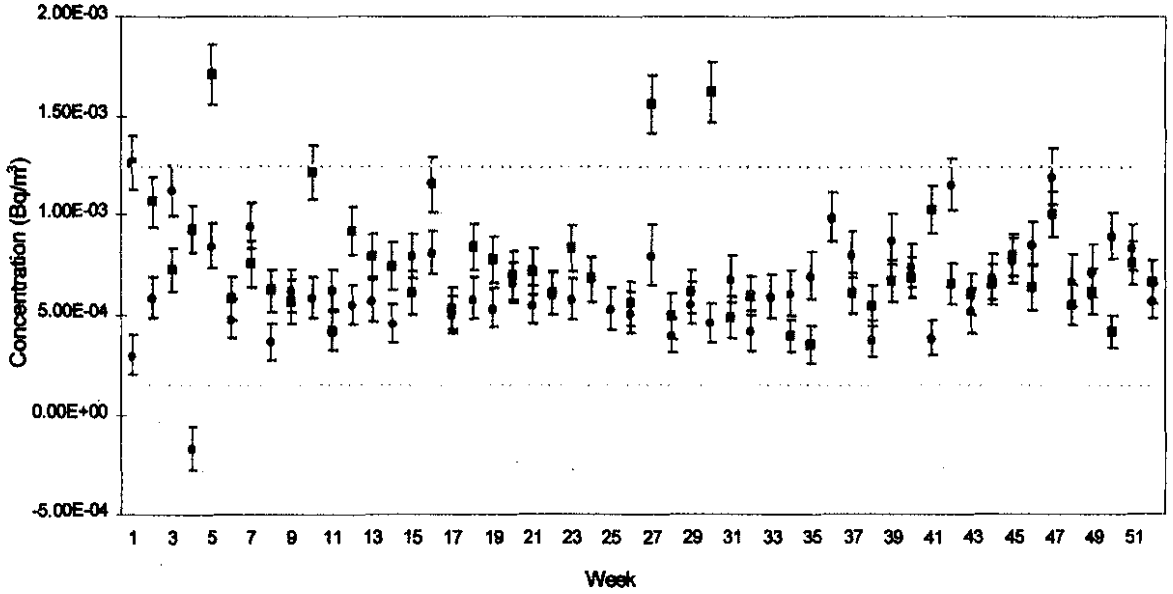


Figure 5.8.10 - Comparison Gross Beta 1996-1997 - Mills Ranch (MLR)

● Mills Ranch 1997 ■ Mills Ranch 1996 - - - - ± 2 Sigma

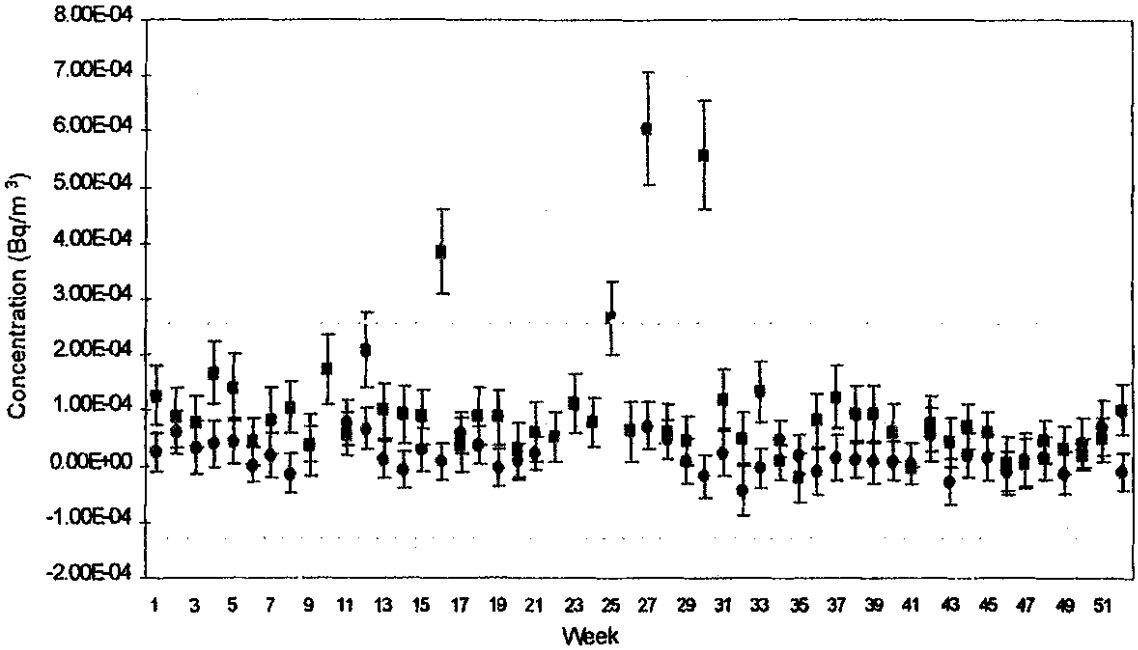


Figure 5.8.11 - Comparison Gross Alpha 1996-1997 - WIPP East (WEE)

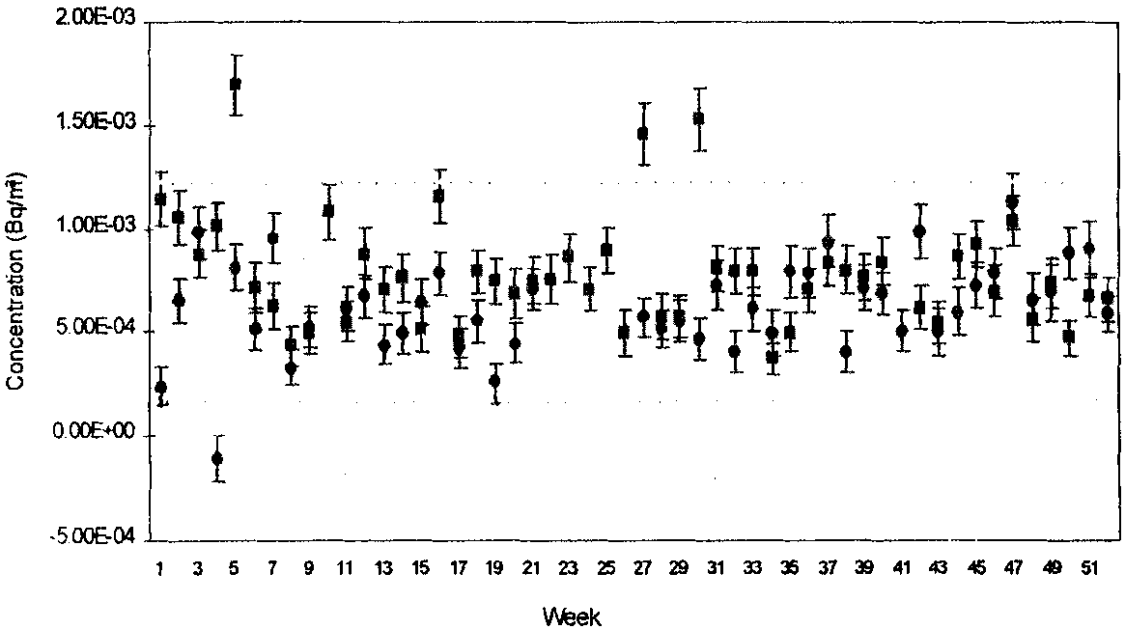


Figure 5.8.12 - Comparison Gross Beta 1996-1997 - WIPP East (WEE)

● WIPP East 1997 ■ WIPP East 1996 - - - - ± 2 Sigma

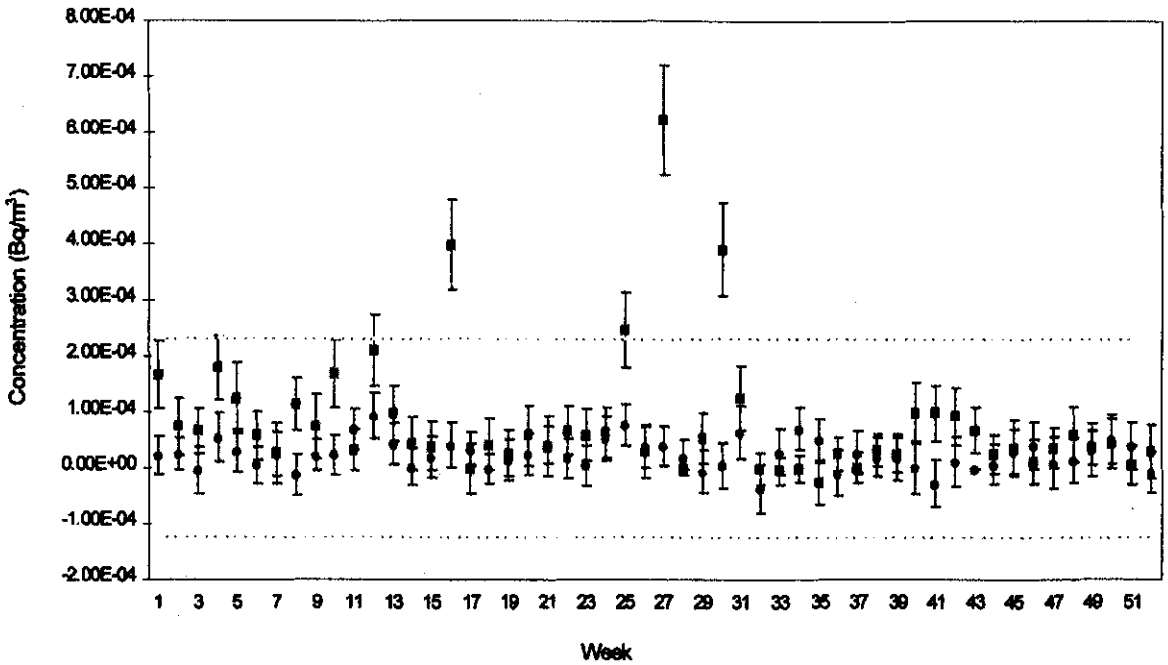


Figure 5.8.13 - Comparison Gross Alpha 1996-1997 - Southeast Control (SEC)

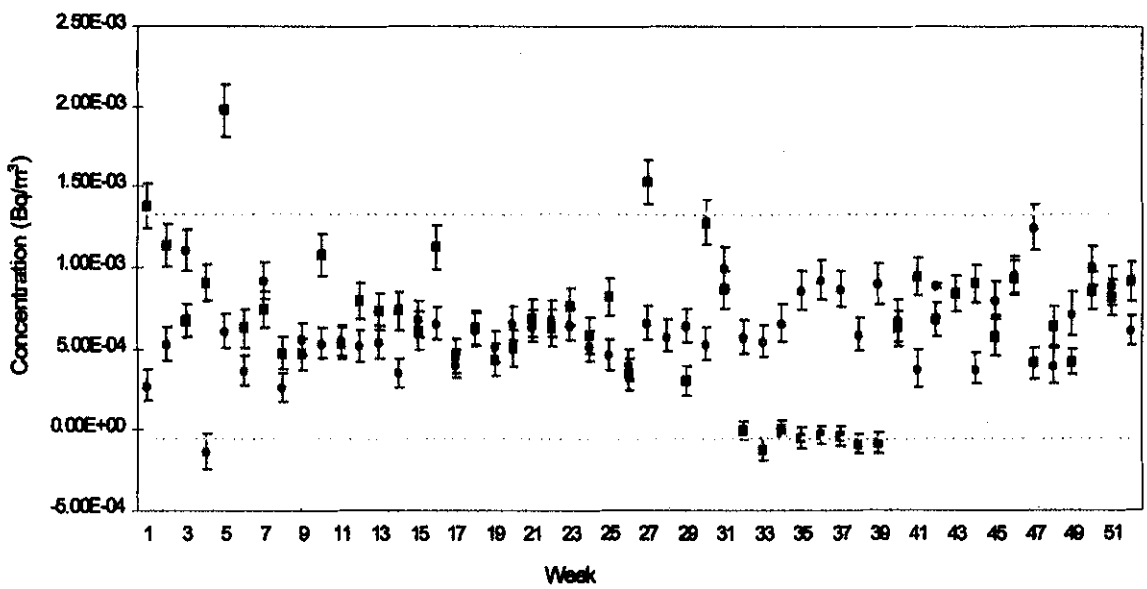


Figure 5.8.14 - Comparison Gross Beta 1996-1997 - Southeast Control (SEC)

● Southeast Control 1997 ■ Southeast Control 1996 - - - - ± 2 Sigma

THIS PAGE LEFT BLANK INTENTIONALLY

CHAPTER 6 ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

This chapter discusses nonradiological environmental surveillance data collected between January 1 and December 31, 1997. Nonradiological programs at WIPP include the following subprograms: land management, including reclamation and restoration of disturbed lands; oil and gas surveillance; wildlife population monitoring (Chapter 4, "Environmental Program Information"); and meteorological monitoring. In addition to the nonradiological environmental surveillance programs, VOCs were monitored to comply with provisions of WIPP's current NMD and liquid effluent monitoring was conducted in accordance with DP-831 criteria. The results of the environmental monitoring activities and discussions of significant findings are presented in this report.

6.1 Principal Functions of Nonradiological Sampling

The principal functions of the nonradiological environmental surveillance are to:

- Assess the impacts of construction and operational activities from WIPP on the surrounding ecosystem.
- Monitor ecological conditions in the Los Medaños region.
- Investigate unusual or unexpected elements in the ecological databases.
- Provide environmental data which are important to the mission of the WIPP Project, but which have not or will not be acquired by other programs.
- Comply with applicable commitments identified with existing agreements (e.g., BLM/DOE MOU, Interagency Agreements, Agreements in Principal, etc.).

6.2 Meteorology

A principle component of the nonradiological environmental surveillance is a primary meteorological station located 600 meters northeast of the Waste Handling Building. The main function of the station is to generate data for modeling atmospheric conditions. The station provides measurements of wind speed, wind direction, and temperature at 2, 10, and 50 meters. The station also provides ground-level measurements of barometric pressure, relative humidity, precipitation, and solar radiation. These parameters are measured continuously and the data are stored in the Central Monitoring System.

In addition to the primary meteorological station, the WIPP Far Field Station is located 1,000 meters northwest of the Waste Handling Building. At the WIPP Far Field Station a secondary meteorological station measures and records temperature and barometric pressure at ground level and wind speed and wind direction at 10 meters (32.8 feet).

6.2.1 Climatic Data

The mean annual temperature for the WIPP area in 1997 was 16°C (61°F). The mean monthly temperatures for the WIPP area ranged from 5°C (41°F) during January to 27°C (81°F) in July. Generally, maximum temperatures occur in June through September, while minimum temperatures occur in December through February, as illustrated in Figures 6.2, 6.3, and 6.4.

The first freezing day of the 1997-98 winter season was October 6; the last freezing day of the 1996-97 winter season was April 13. The maximum temperature recorded was 39°C (102°F) on July 1.

The annual rate of precipitation at the WIPP site for 1997 was 53.95 cm (21.24 in), which is 24.7 cm (9.73 in) above last year's rate. The annual precipitation for 1997 was 54 percent

greater than that recorded for 1996. Figure 6.1 displays the monthly precipitation at WIPP.

6.2.2 Wind Direction and Wind Speed

The predominate wind direction in the WIPP area was from the southeast sector (135°); however, winds occurring in late spring were primarily from the west. Various weather systems move through this area, briefly altering the predominant southeasterly winds and sometimes resulting in violent convectional storms. Wind speed noted as calm (less than 0.5 meters per second [mps]) occurred .57 percent of the time. Winds of 3.7 through 6.3 mps were the most prevalent over 1996, accounting for 39.14 percent of the time. Figures 6.6, 6.7, and 6.8 display the annual wind data at WIPP for CY 1997.

6.3 Volatile Organic Compounds Monitoring

The VOC Confirmatory Monitoring Program is designed to differentiate VOC concentrations attributed to open and closed panels from other potential sources. There are two locations designated as air monitoring stations. The two stations are defined as VOC A, downstream from Panel 1, and VOC B, upstream from Panel 1. Samples were collected from each station on designated sample days. Any target analytes found in VOC B represent the ambient air found in the mine before passing through the storage area. Target analytes found in VOC A would represent both the background mine air and any potential releases from Panel 1.

Volatile organic compound sampling reported in this section is performed using guidance included in Compendium Method TO-14, The Determination of Volatile Organic Compounds in Ambient Air Using Summa® Passivated Canister Sampling and Gas Chromatographic Analysis (EPS, 1988b: Winberry and others, 1990) as a basis. The samples are analyzed using gas chromatography/mass spectrometry under an established QA/QC program. Laboratory analytical procedures have been developed based on the concepts contained in both TO-14 and the draft EPA Contract Laboratory Program Statement of Work for Volatile Organic analysis of Ambient Air in Canisters (EPA, 1991).

With the implementation on the Confirmatory VOC Monitoring Program on April 21, 1997, nine compounds were chosen to represent the VOCs responsible for approximately 99 percent of the calculated RCRA constituent posed human health risks: 1,1-dichloroethylene, methylene chloride, chloroform, 1,1,1-trichloroethane, carbon tetrachloride, 1,2-dichloroethane, toluene, chlorobenzene, and 1,1,2,2-tetrachloroethane.

Routine laboratory reporting method detection limit (MDL) is 5.0 and 2.0 parts per billion by volume (ppbv) for laboratory results with a dilution factor of 1. Values for constituents detected at concentration less than the laboratory reporting limits but above the 0.5 ppbv method detection limit are estimated and designated with the "J" flag.

Toluene was the predominate target analyte to show concentrations above the "J" flagged laboratory method detection limit. Other occasional hits were recorded for 1,1,1-trichloroethane and dichloromethane. Possible sources could be paint products, cleaning solvents, petroleum products, or aerosol propellants.

The following tables (Tables 4.2 and 4.3, respectively) represent data with reportable concentrations of target analytes collected during the April 29, 1997, through December 26, 1997, sampling schedule. A close correlation could be found between target compounds found at VOC A and VOC B.

Table 6.1 - VOC Monitoring Program Data - Station VOC-A

SAMPLE DATE	SAMPLE NUMBER	CONCENTRATION (ppbv) DATE																	
		111TA		1122T		11DCE		12DCA		CCL4		CHBNZ		CHFRM		DCM		C7H8	
4/29/97	6		U		U		U		U		U		U		U		U	3.1	J
5/5/97	10		U		U		U		U		U		U		U		U	0.67	J
5/7/97	12		U		U		U		U		U		U		U		U	1.1	J
5/14/97	16		U		U		U		U		U		U		U		U	0.71	J
5/27/97	22		U		U		U		U		U		U		U		U	0.73	J
5/28/97	24		U		U		U		U		U		U		U		U	0.92	J
6/2/97	26		U		U		U		U		U		U		U		U	0.52	J
6/11/97	32		U		U		U		U		U		U		U		U	0.81	J
6/16/97	34		U		U		U		U		U		U		U		U	0.86	J
6/23/97	37		U		U		U		U		U		U		U		U	0.82	J
6/25/97	39		U		U		U		U		U		U		U		U	1.3	J
6/25/97	41		U		U		U		U		U		U		U		U	1.4	J
7/8/97	44		U		U		U		U		U		U		U		U	2.0	J
7/14/97	48		U		U		U		U		U		U		U		U	0.51	J
7/29/97	54		U		U		U		U		U		U		U		U	0.84	U
7/30/97	56		U		U		U		U		U		U		U		U	0.53	J
8/4/97	58		U		U		U		U		U		U		U		U	0.96	J
8/13/97	64		U		U		U		U		U		U		U		U	0.99	J
9/17/97	86		U		U		U		U		U		U		U		U	1.60	J
9/29/97	92		U		U		U		U		U		U		U		U	0.74	J
10/1/97	94		U		U		U		U		U		U		U		U	0.74	J
10/6/97	96	6.3			U		U		U		U		U		U		U		U
10/8/97	98		U		U		U		U		U		U		U		U	0.54	J
10/13/97	100		U		U		U		U		U		U		U		U	0.54	J
10/15/97	102		U		U		U		U		U		U		U		U	0.66	J
10/20/97	104		U		U		U		U		U		U		U	0.9	J		U
10/27/97	108		U		U		U		U		U		U		U		U	0.55	J

Table 6.1 - VOC Monitoring Program Data - Station VOC-A

SAMPLE DATE	SAMPLE NUMBER	CONCENTRATION (ppbv) DATE																	
		111TA		1122T		11DCE		12DCA		CCL4		CHBNZ		CHFRM		DCM		C7H8	
10/29/97	110	1.7	J		U		U		U		U		U		U		U	0.61	J
11/24/97	124		U		U		U		U		U		U		U		U	0.76	J
11/25/97	126		U		U		U		U		U		U		U		U	6.40	
12/1/97	128		U		U		U		U		U		U		U		U	0.54	J
12/8/97	134	0.7	J		U		U		U		U		U		U		U	1.30	J
12/11/97	138		U		U		U		U		U		U		U		U	77.00	
12/19/97	144		U		U		U		U		U		U		U		U	0.62	J
12/26/97	148		U		U		U		U		U		U		U		U	0.56	J
12/26/97	150		U		U		U		U		U		U		U		U	0.56	J

LEGEND

111TA = 1,1,1-Trichloroethane
1122T = 1,1,2,2-Tetrachloroethane
11DCE = 1,1-Dichloroethylene
12DCA = 1,2-Dichloroethane
CCL4 = Carbon tetrachloride
CHBNZ = Chlorobenzene
CHFRM = Chloroform
DCM = Methylene chloride
C7H8 = Toluene

FLAGS

J = Estimated value: Below Method Reporting Limits (MRL), but above Practical Quantitation Limits (PQL)

U = Compound analyzed for, but not detected above

Table 6.2 - VOC Monitoring Program Data - Station VOC-B

SAMPLE DATE	SAMPLE NUMBER	CONCENTRATION (ppbv)																	
		111TA		1122T		11DCE		12DCA		CCL4		CHBNZ		CHFRM		DCM		C7H8	
4/29/97	5		U		U		U		U		U		U		U		U	2.9	J
5/7/97	11		U		U		U		U		U		U		U		U	0.91	J
5/27/97	21		U		U		U		U		U		U		U		U	0.91	J
5/28/97	23		U		U		U		U		U		U		U		U	1.2	J
6/11/97	31		U		U		U		U		U		U		U		U	0.85	J
6/16/97	33		U		U		U		U		U		U		U		U	0.84	J
6/19/97	35		U		U		U		U		U		U		U		U	1.4	J
6/23/97	38		U		U		U		U		U		U		U		U	0.97	J
7/29/97	53		U		U		U		U		U		U		U		U	0.67	J
8/4/97	57		U		U		U		U		U		U		U		U	0.86	J
8/13/97	63		U		U		U		U		U		U		U		U	0.53	J
9/17/97	85		U		U		U		U		U		U		U		U	0.69	J
10/1/97	93		U		U		U		U		U		U		U		U	0.53	J
10/6/98	95	8.6			U		U		U		U		U		U		U		U
10/15/97	101		U		U		U		U		U		U		U		U	0.55	J
10/20/97	103		U		U		U		U		U		U		U	0.6	J		U
10/23/97	105		U		U		U		U		U		U		U	0.5	J		U
10/29/97	109	1.4	J		U		U		U		U		U		U		U	0.56	J
12/1/97	127		U		U		U		U		U		U		U		U	0.54	J
11/24/97	123		U		U		U		U		U		U		U		U	0.56	J
11/25/97	125		U		U		U		U		U		U		U		U	0.57	J
12/8/97	133	0.5	J		U		U		U		U		U		U		U	1.50	J
12/11/97	137		U		U		U		U		U		U		U		U	69.00	

Table 6.2 - VOC Monitoring Program Data - Station VOC-B

SAMPLE DATE	SAMPLE NUMBER	CONCENTRATION (ppbv)																	
		111TA		1122T		11DCE		12DCA		CCL4		CHBNZ		CHFRM		DCM		C7H8	
12/19/97	143		U		U		U		U		U		U		U		U	1.60	J
12/19/97	146		U		U		U		U		U		U		U		U	1.00	J

LEGEND

111TA = 1,1,1-Trichloroethane
1122T = 1,1,2,2-Tetrachloroethane
11DCE = 1,1-Dichloroethylene
12DCA = 1,2-Dichloroethane
CCL4 = Carbon tetrachloride
CHBNZ = Chlorobenzene
CHFRM = Chloroform
DCM = Methylene chloride
C7H8 = Toluene

FLAGS

J = Estimated value: Below Method Reporting Limits (MRL), but above Practical Quantitation Limits (PQL)

U = Compound analyzed for, but not detected above the detection limits

6.4 Seismic Activity

Geologic structures and tectonism of the Permian Basin are associated with large-scale basin, interbasin, and basin-margin subsidence or emergence that occurred during the Paleozoic era. The WIPP facility is about 60 miles from the western margin of the Permian Basin. The basin is a broad structural feature made up of a series of Paleozoic sedimentary basins whose last episodes of major subsidence occurred during late Permian time. The area today is characterized by the basin filled with thick evaporite layers and bordered by the Amarillo uplift to the north, the Marathon thrust belt to the south, and the Diablo Platform, Sacramento and Guadalupe mountain orogenies to the west.

All major tectonic elements of the Permian Basin were completely formed before deposition of the Permian salt-bearing rocks, and the region has been relatively stable since that time. Deep-seated faults are rare, except along the west margin of the basin, and no indications of younger deep-seated faults are noted. On June 16, 1978, an earthquake near Snyder, Texas, led researchers to conclude that the earthquake may have been induced from secondary oil recovery operations and hydrocarbon production. The depth of the earthquake closely approximated the bottom of the relatively shallow drill holes located in the oil and gas-producing area.

Historically, the seismic information for the WIPP facility region before 1962 was based on chronicles of the effects of those tremors on people, structures, and land forms. Seismicity reported in New Mexico prior to 1962 occurred in the Rio Grande area between Albuquerque and Socorro and was associated with a structure known as the Rio Grande rift. These earthquakes had intensities of Modified Mercalli V or greater, based on the perceptions of people experiencing the quakes.

Since 1962, virtually all seismic information has been based on instrumental data recorded at various seismograph stations. Currently, seismicity within 300 km of the WIPP site is being monitored at the New Mexico Institute of Mining and Technology (NMIMT), Socorro, New Mexico, using data from a seven-station network approximately centered on the site (Figure 6.8). Station signals are telemetered to the NMIMT Seismological Observatory in Socorro. When appropriate, readings from the WIPP network stations are combined with readings from an additional New Mexico Tech network in Socorro, New Mexico, in the central Rio Grande rift. Occasionally, data are exchanged with the University of Texas at El Paso and Texas Tech, both of whom operate stations in West Texas. The annual mean for the operational efficiency of seismic monitoring stations during CY 1997 was approximately 96.3 percent.

From January 1 through December 31, 1997, locations for 82 seismic events were recorded within 300 kilometers of WIPP. These data include origin times, epicenter coordinates, and magnitudes. The strongest recorded event (magnitude 3.5 Richter) was located approximately 15 km west of the site. This event was determined to be induced by a collapse at a neighboring potash mine. Aside from the collapse event, the strongest recorded event (magnitude 2.7 Richter) occurred approximately 270 km northwest of the WIPP site.

6.5 Liquid Effluent Monitoring

The WIPP sewage lagoon system is a zero-discharge facility consisting of two primary settling lagoons, two polishing lagoons, a chlorination system, and three evaporation basins. The entire facility is lined with 30 mil synthetic liners, and is designed to dispose of domestic sewage as well as site-generated brine waters from observation well pumping and underground dewatering activities at the site.

The WIPP sewage facility is operated under DP-831 and managed in accordance with EPA sewage sludge regulations (40 CFR § 503), New Mexico Solid Waste Management

Regulations (Part 700), New Mexico Water Quality Control Regulations (3-100), and applicable WIPP controlled procedures. These requirements provide guidance for disposal of domestic sewage, site-generated brine waters and nonhazardous waste waters.

DP-831 allows for the disposal of 2,000 gallons per day of nonhazardous brines. The DOE submits quarterly discharge monitoring reports to the NMED to demonstrate compliance with the inspection, monitoring, and reporting requirements identified in the plan. No effluent limits were established in DP-831. The NMED Groundwater Protection and Remediation Bureau established a list of analytes to be sampled on a quarterly basis as indicators of sewage system performance.

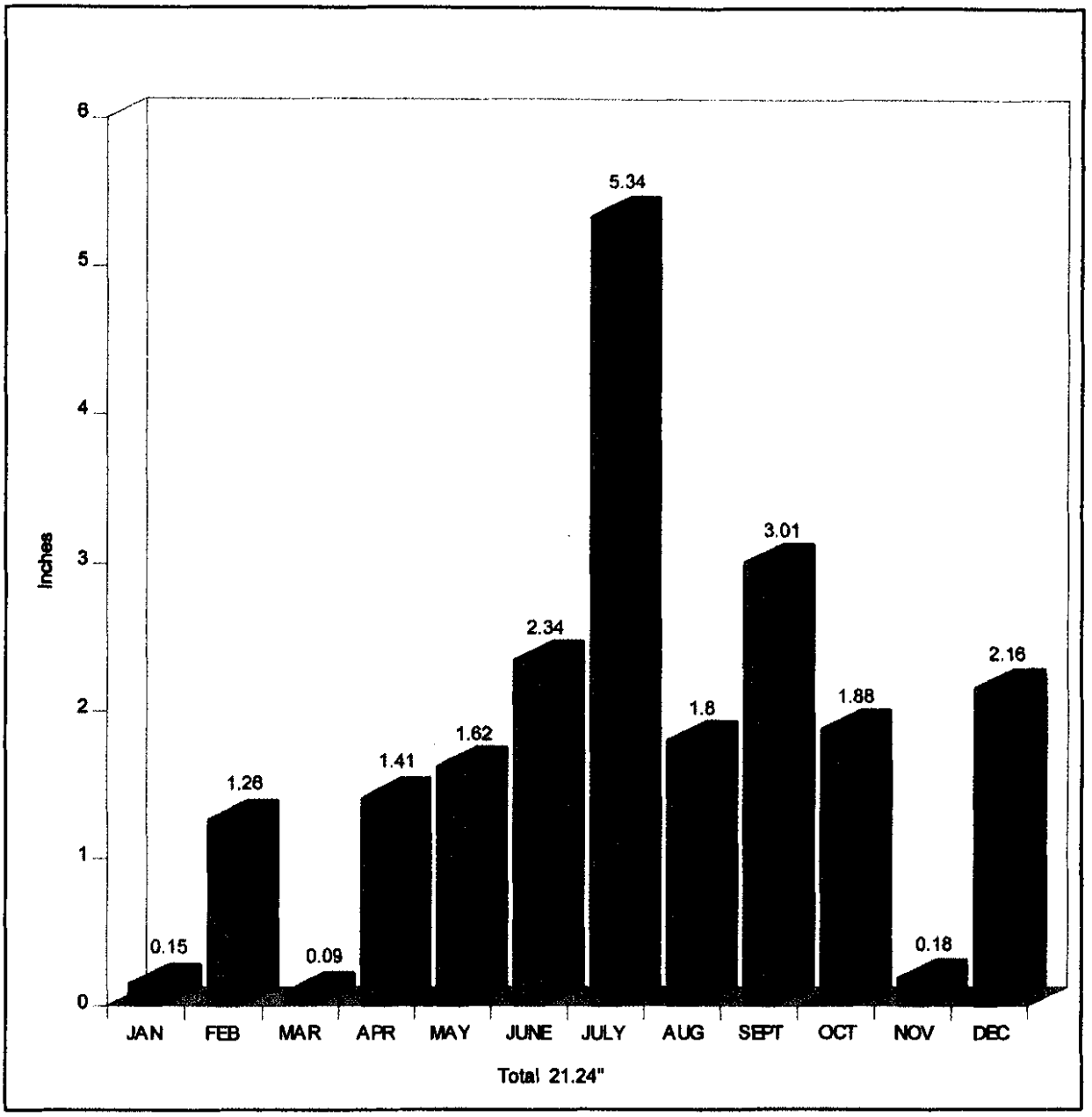
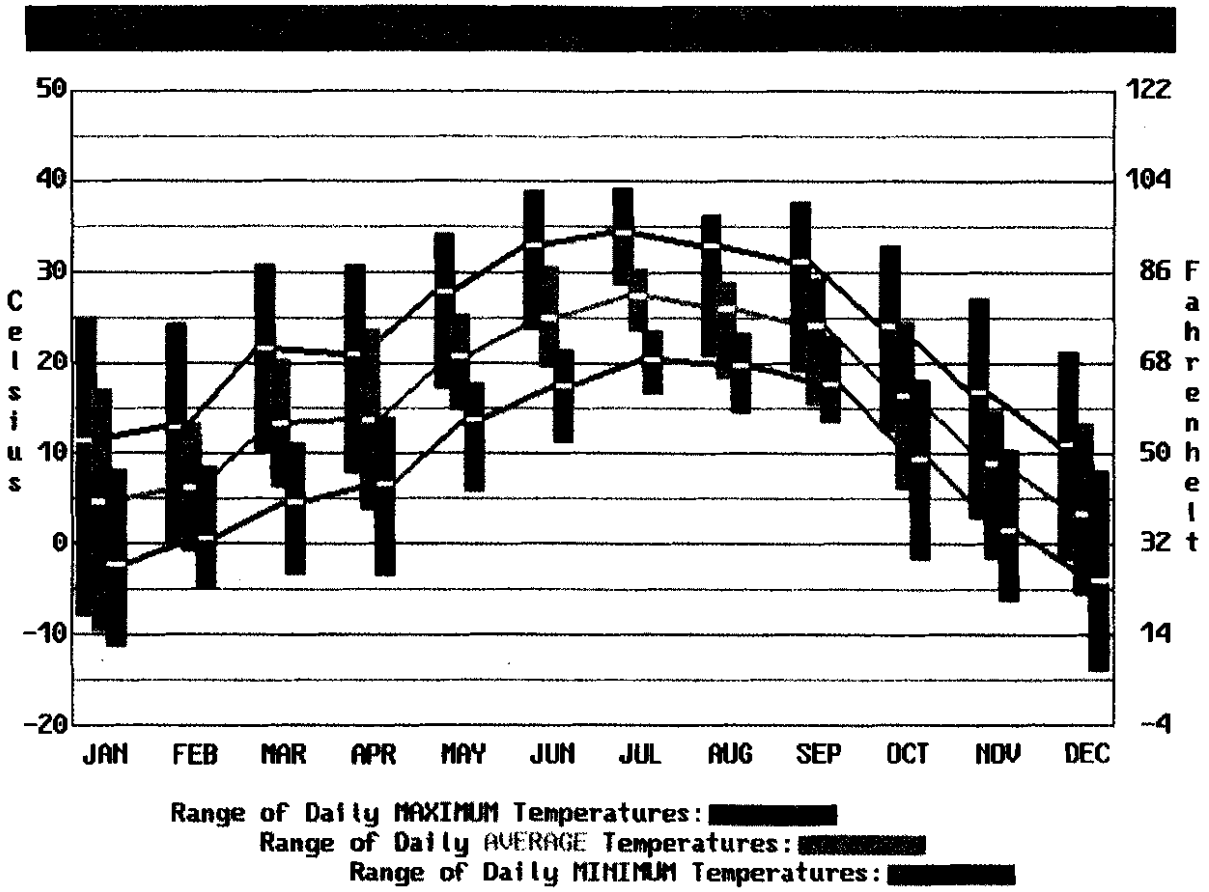


Figure 6.1 - 1997 Precipitation

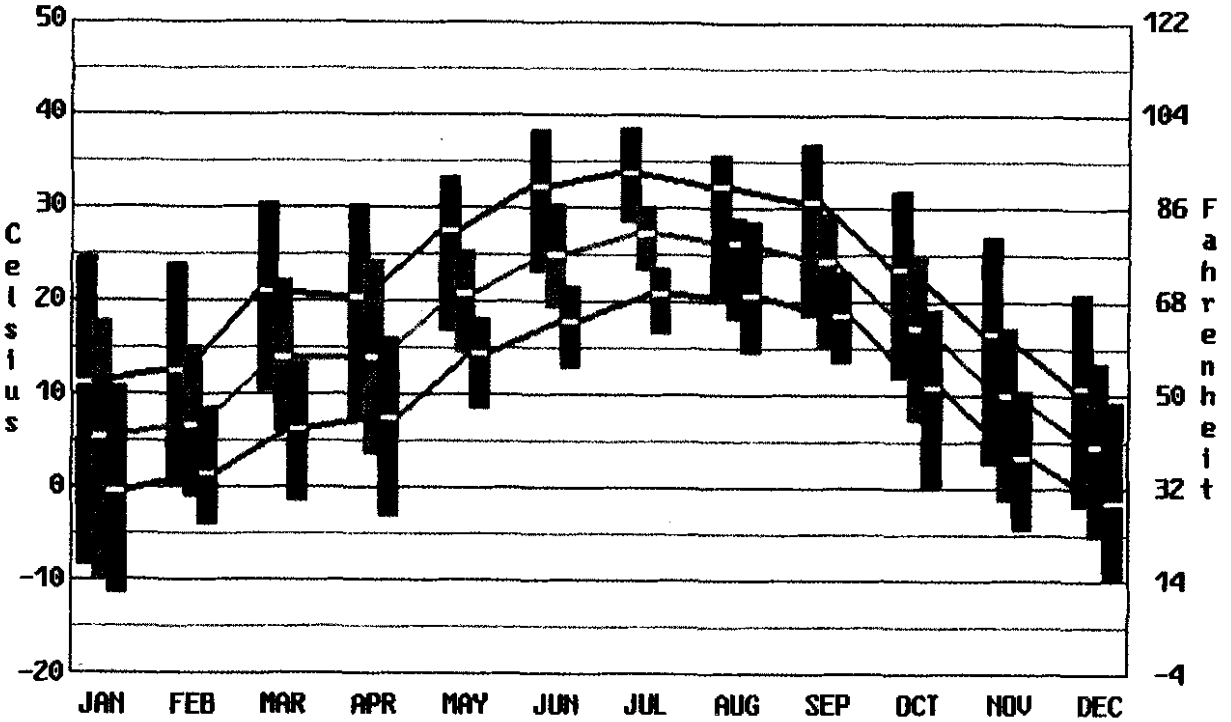


Year Location: WIPP SITE Elevation: 2m

1997	Max HI	Avg HI	Min HI	Max AV	Avg AV	Min AV	Max LO	Avg LO	Min LO
Jan:	24.94	11.49	-8.00	17.09	4.62	-9.65	8.03	-2.38	-11.34
Feb:	24.35	12.85	0.20	13.26	6.35	-0.83	8.55	0.60	-4.76
Mar:	30.80	21.62	10.50	20.41	13.37	6.33	11.05	4.67	-3.35
Apr:	30.89	20.99	7.88	23.70	13.78	3.67	13.90	6.62	-3.57
May:	34.27	28.02	17.23	25.39	20.92	14.80	17.74	13.68	5.80
Jun:	38.89	32.89	23.80	30.70	25.05	19.58	21.48	17.49	11.15
Jul:	39.16	34.43	28.84	30.32	27.41	23.57	23.45	20.38	16.72
Aug:	36.35	32.84	20.84	29.05	25.98	18.25	23.32	19.82	14.59
Sep:	37.75	31.32	19.15	29.40	24.09	15.44	22.94	17.67	13.52
Oct:	32.99	24.19	12.47	24.51	16.52	6.13	18.04	9.35	-1.66
Nov:	27.18	16.97	3.02	14.59	8.87	-1.62	10.39	1.47	-6.18
Dec:	21.16	11.02	-1.60	13.41	3.39	-5.65	8.21	-3.99	-13.97
Ann:	39.16	23.22	-8.00	30.70	15.86	-9.65	23.45	8.78	-13.97

Figure 6.2 - WIPP Site Temperature Graph for the Year 1997 - Elevation: 2m

[redacted]

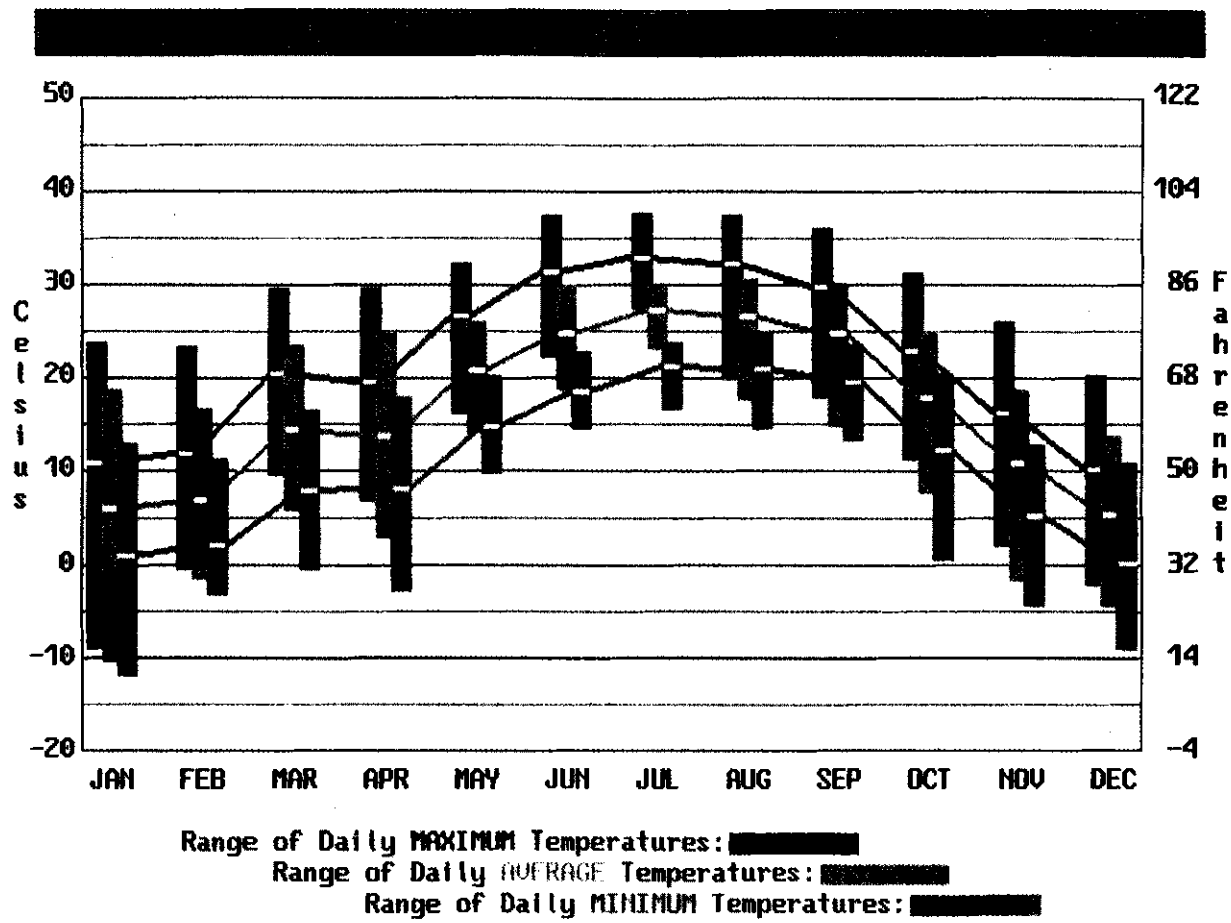


Range of Daily MAXIMUM Temperatures: [redacted]
Range of Daily AVERAGE Temperatures: [redacted]
Range of Daily MINIMUM Temperatures: [redacted]

Year Location: WIPP SITE Elevation: 10m

1997	Max HI	Avg HI	Min HI	Max AV	Avg AV	Min AV	Max LO	Avg LO	Min LO
Jan:	24.56	11.27	-8.37	17.93	5.45	-9.88	10.83	-0.36	-11.44
Feb:	24.06	12.53	0.02	15.26	6.68	-1.00	8.56	1.53	-4.03
Mar:	30.33	21.07	10.40	22.31	13.94	6.14	13.35	6.19	-1.40
Apr:	30.27	20.40	7.56	24.40	13.90	3.45	16.12	7.52	-3.17
May:	33.41	27.51	16.89	25.36	20.89	14.65	18.20	14.29	8.45
Jun:	38.29	32.32	23.20	30.47	24.99	19.34	21.57	17.82	12.99
Jul:	38.60	33.79	28.49	30.12	27.36	23.43	23.57	20.74	16.75
Aug:	35.64	32.25	20.61	29.03	26.18	18.08	28.44	20.56	14.55
Sep:	36.91	30.71	18.57	29.33	24.40	15.23	23.06	18.59	13.61
Oct:	31.92	23.63	11.87	24.87	17.28	7.20	19.23	10.83	0.19
Nov:	26.83	16.60	2.70	17.23	10.02	-1.32	10.40	3.32	-4.42
Dec:	20.83	10.73	-1.86	13.61	4.57	-5.15	9.11	-1.51	-9.80
Ann:	38.60	22.73	-8.37	30.47	16.31	-9.88	28.44	9.96	-11.44

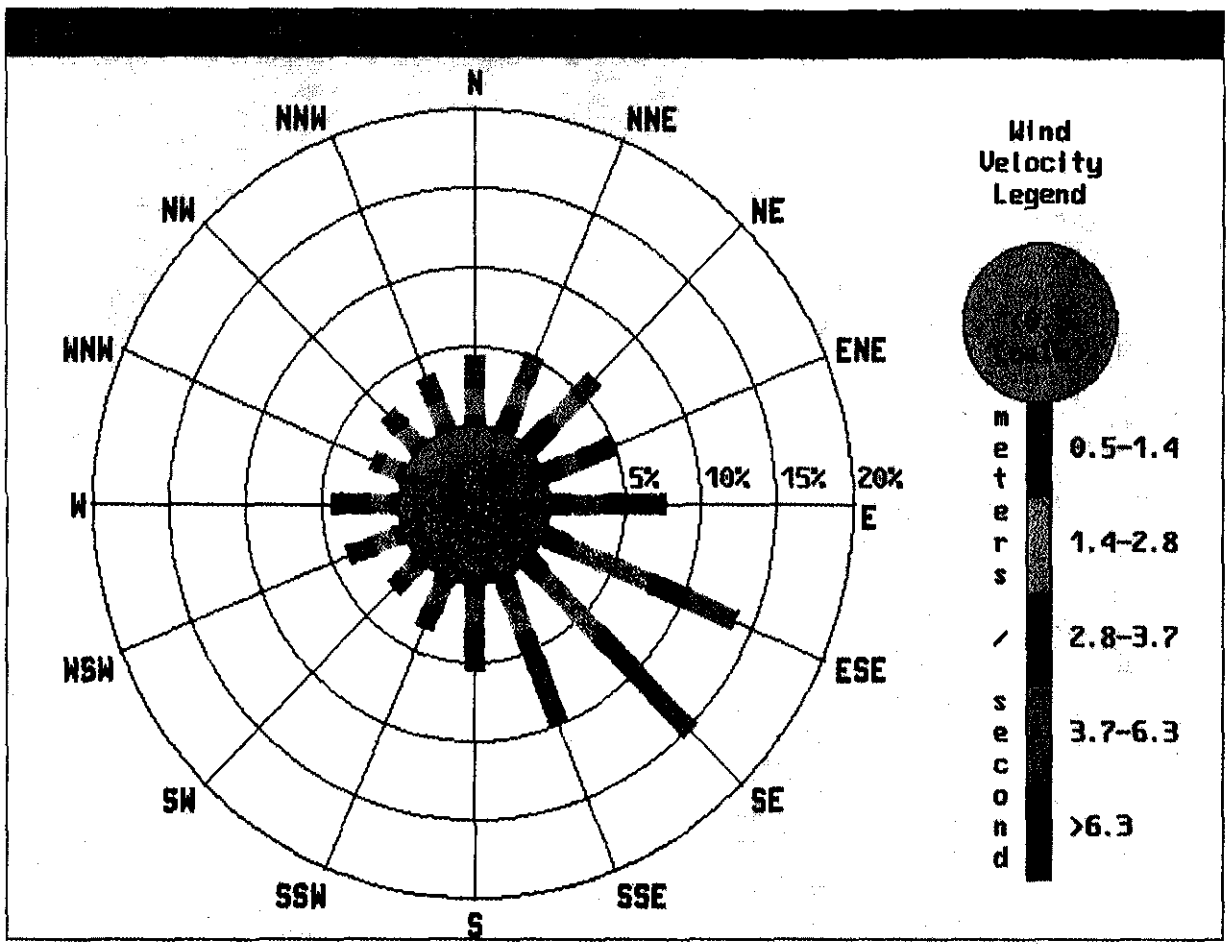
Figure 6.3 - WIPP Site Temperature Graph for the Year 1997 - Elevation: 10m



Year Location: WIPP SITE Elevation: 50m

1997	Max HI	Avg HI	Min HI	Max AV	Avg AV	Min AV	Max LO	Avg LO	Min LO
Jan:	23.75	10.82	-8.92	18.76	5.96	-10.41	12.98	1.09	-11.91
Feb:	23.42	11.96	-0.47	16.58	6.85	-1.37	11.32	2.15	-3.10
Mar:	29.50	20.33	9.67	23.57	14.31	5.76	16.42	7.85	-0.52
Apr:	29.60	19.60	6.93	24.70	13.80	2.97	17.93	8.09	-2.69
May:	32.38	26.76	16.23	26.11	20.79	14.25	20.29	14.87	9.86
Jun:	37.44	31.48	22.24	30.03	24.88	18.81	22.71	18.48	14.52
Jul:	37.68	32.95	27.43	29.76	27.34	23.05	23.68	21.30	16.65
Aug:	37.41	32.23	20.06	30.58	26.68	17.61	24.85	21.14	14.65
Sep:	36.05	29.86	17.84	30.13	24.75	14.78	23.51	19.59	13.23
Oct:	31.26	22.90	11.23	25.08	17.83	7.66	20.47	12.32	0.66
Nov:	26.12	16.15	2.14	18.70	10.85	-1.60	12.76	5.27	-4.36
Dec:	20.21	10.25	-2.01	13.81	5.42	-4.45	10.76	0.16	-9.06
Ann:	37.68	22.11	-8.92	30.58	16.62	-10.41	24.85	11.03	-11.91

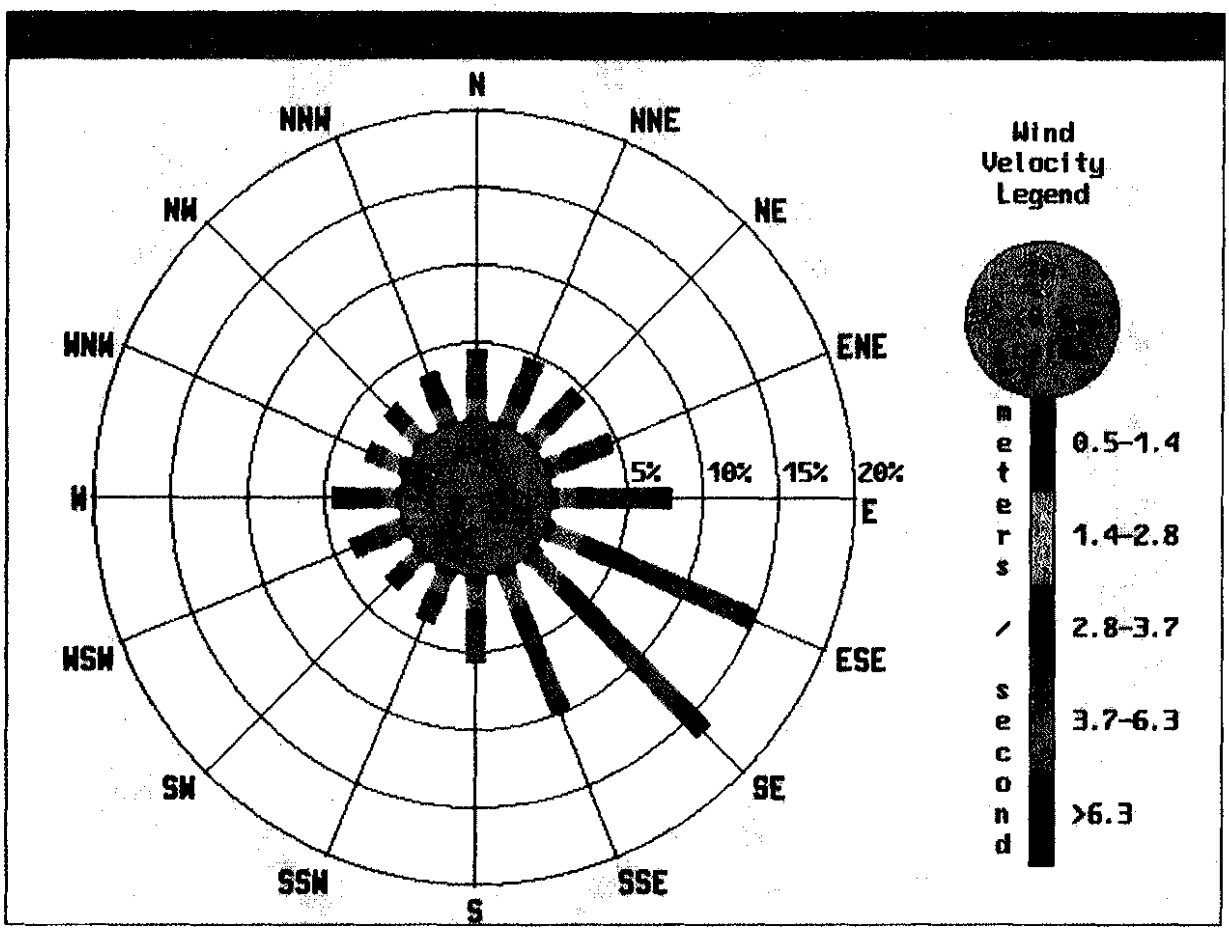
Figure 6.4 - WIPP Site Temperature Graph for the Year 1997 - Elevation: 50m



Location: WIPP SITE Elevation: 2m
Beginning Date: 01/01/97 End Date: 12/31/97

m/s:	<0.5	0.5-1.4	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	Totals
N :	0.078	0.713	1.634	0.823	1.242	0.165	4.654
NNE:	0.115	1.594	1.692	0.603	1.227	0.260	5.492
NE :	0.188	2.428	2.168	0.554	0.808	0.471	6.618
ENE:	0.283	1.288	1.169	0.696	1.291	0.485	5.212
E :	0.205	1.256	2.446	1.574	2.047	0.393	7.920
ESE:	0.170	1.871	5.778	2.910	3.219	0.225	14.174
SE :	0.084	1.386	5.073	3.430	5.056	0.384	15.413
SSE:	0.066	0.956	2.899	2.538	3.511	0.182	10.152
S :	0.058	0.806	2.102	1.418	1.374	0.035	5.792
SSW:	0.069	0.603	1.481	0.762	0.722	0.043	3.681
SW :	0.038	0.427	1.230	0.525	0.488	0.095	2.804
WSW:	0.055	0.508	1.516	0.707	0.912	0.300	3.999
W :	0.052	0.537	1.262	0.693	1.184	0.765	4.493
WNW:	0.055	0.494	1.083	0.358	0.387	0.141	2.518
NW :	0.046	0.462	1.360	0.517	0.797	0.115	3.297
NNW:	0.061	0.491	1.386	0.638	1.051	0.156	3.782
Total:	1.623	15.820	34.278	18.747	25.316	4.216	100.000

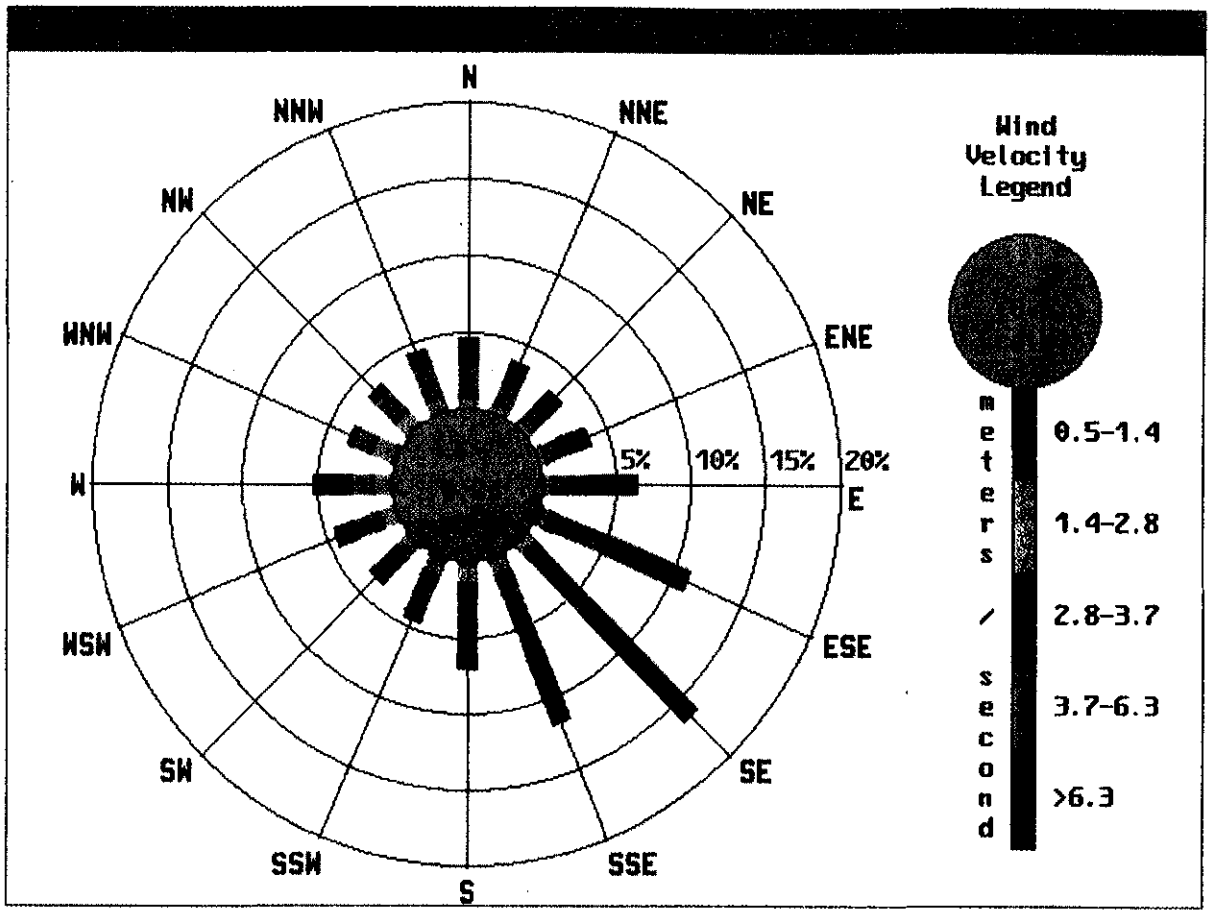
Figure 6.5 - WIPP Site Wind Rose for the Period January 1, 1997, through December 31, 1997 - Elevation: 2m



Location: WIPP SITE Elevation: 10m
Beginning Date: 01/01/97 End Date: 12/31/97

m/s:	<0.5	0.5-1.4	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	Totals
N :	0.035	0.260	1.224	0.930	1.712	0.523	4.683
NNE:	0.032	0.274	1.172	0.976	1.692	0.725	4.871
NE:	0.040	0.315	1.132	1.005	1.296	0.785	4.574
ENE:	0.032	0.263	0.904	0.852	1.747	0.970	4.767
E:	0.038	0.416	1.204	1.320	3.794	1.294	8.064
ESE:	0.058	0.393	2.044	3.676	7.825	1.042	15.037
SE:	0.046	0.497	2.512	3.635	7.649	2.099	16.438
SSE:	0.029	0.445	2.206	2.024	4.351	0.884	9.938
S:	0.040	0.511	1.732	1.311	2.116	0.208	5.919
SSW:	0.043	0.318	1.259	0.840	1.065	0.156	3.681
SW:	0.032	0.295	1.120	0.702	0.765	0.153	3.066
WSW:	0.038	0.338	1.123	0.728	1.184	0.676	4.086
W:	0.023	0.372	1.091	0.520	1.247	1.588	4.842
WNW:	0.049	0.439	1.233	0.523	0.560	0.225	3.029
NW:	0.014	0.364	1.158	0.629	0.924	0.243	3.332
NNW:	0.026	0.266	0.982	0.806	1.207	0.387	3.673
Total:	0.575	5.763	22.097	20.474	39.135	11.956	100.000

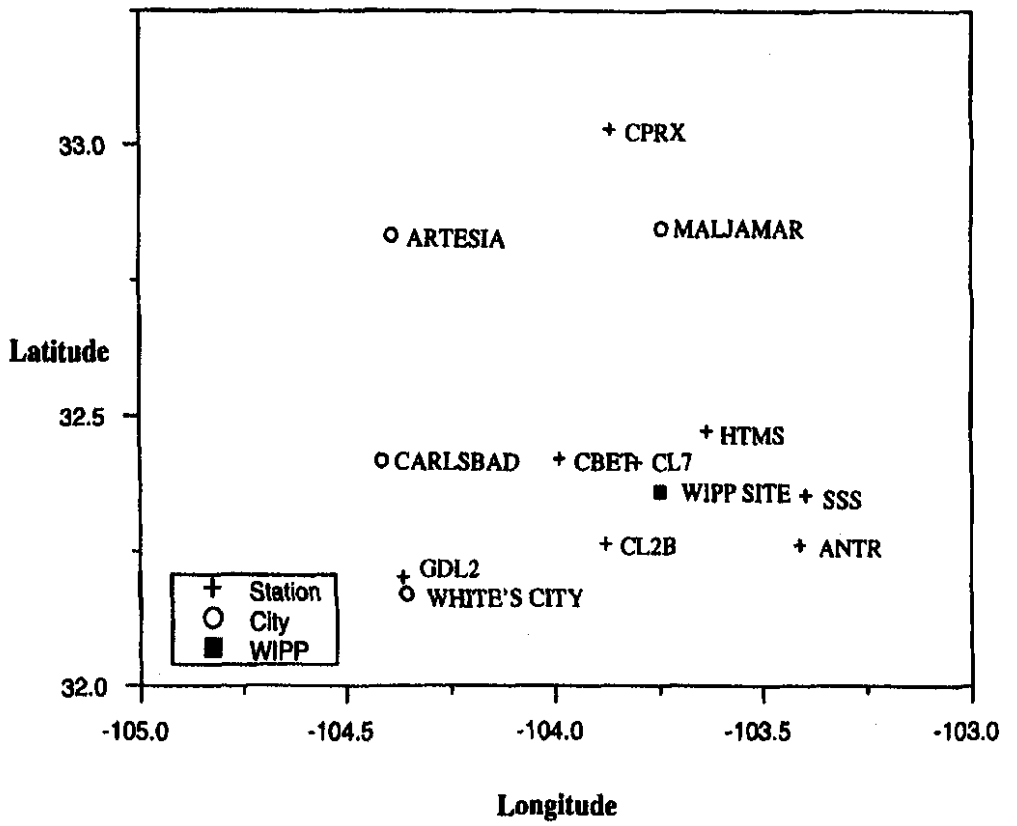
Figure 6.6 - WIPP Site Wind Rose for the Period January 1, 1997, through December 31, 1997 - Elevation: 10m



Location: WIPP SITE Elevation: 50m
Beginning Date: 01/01/97 End Date: 12/31/97

m/s:	<0.5	0.5-1.4	1.4-2.8	2.8-3.7	3.7-6.3	>6.3	Totals
N :	0.020	0.104	0.546	0.575	1.978	1.747	4.969
NNE:	0.020	0.121	0.430	0.407	1.305	1.643	3.927
NE :	0.017	0.124	0.346	0.280	1.132	1.513	3.413
ENE:	0.003	0.113	0.355	0.315	1.172	1.992	3.950
E :	0.017	0.136	0.474	0.459	1.859	3.673	6.618
ESE:	0.012	0.136	0.621	0.765	3.439	6.225	11.197
SE :	0.009	0.118	0.681	0.935	4.637	10.036	16.417
SSE:	0.012	0.156	0.935	1.042	4.686	5.030	11.861
S :	0.023	0.162	1.149	1.169	3.563	1.013	7.080
SSW:	0.009	0.208	1.011	0.895	1.885	0.580	4.588
SW :	0.014	0.228	0.961	0.751	1.320	0.491	3.765
WSW:	0.014	0.193	0.999	0.641	1.221	1.513	4.582
W :	0.014	0.211	0.878	0.502	1.109	2.705	5.420
WNW:	0.014	0.292	1.305	0.684	0.852	0.396	3.543
NW :	0.012	0.231	0.947	0.676	1.340	0.840	4.045
NNW:	0.020	0.156	0.725	0.748	1.773	1.204	4.626
Total:	0.231	2.688	12.364	10.845	33.271	40.602	100.000

Figure 6.7 - WIPP Site Wind Rose for the Period January 1, 1997, through December 31, 1997 - Elevation: 50m



Definitions of Abbreviations

SSS - Sam Simon Swale
CBET - Carlsbad East Tower
CL2B - Carlsbad Station
CL7 - Carlsbad Station 7
CPRX - Caprock
GDL2 - Guadalupe Mountains
HTMS - Hat Mesa

Figure 6.8 - WIPP Seismograph Station Locations

CHAPTER 7 GROUNDWATER PROTECTION

Current groundwater monitoring activities at WIPP are outlined in the Groundwater Monitoring Program Plan and Procedure Manual (WP 02-1, Revision 3). The plan is a QA document that contains program plans for each of the activities performed by groundwater monitoring personnel. In addition, WP 02-1 provides detailed procedures for performing specific activities such as pumping system installations, field parameter analyses and documentation, and QA records management. Groundwater monitoring activities are also defined in the EMP.

The objective of the groundwater monitoring program is to determine the physical and chemical characteristics of groundwater; maintain surveillance of groundwater levels surrounding the WIPP facility, both before and throughout the operational lifetime of the facility; and fulfill the requirements of the RCRA Part B permit application and DOE Order 5400.1.

Background water quality data were collected from 1985 through the 1990 sampling period to fulfill the requirements of DOE Order 5400.1 as reported in DOE/WIPP 92-013, "Background Water Quality Characterization Report for the Waste Isolation Pilot Plant." In the latter part of 1994 seven new wells were drilled (Figures 7.5 through 7.11) in anticipation of the RCRA permitting process. Background data were collected from these wells from 1995 through 1997 and reported in DOE/WIPP 98-2285, "Waste Isolation Pilot Plant RCRA Background Groundwater Quality Baseline Report." This background data will be compared to water quality data collected throughout the operational life of the facility. Preoperational data gathered in the interim period will be used to strengthen the background data, to evaluate the need to make adjustments to comparison criteria, and to determine future regulatory needs and land-use decisions.

The data obtained by the WQSP in 1997 supported two major programs at WIPP: (1) the Groundwater Monitoring Program in compliance with 40 CFR § 264 and (2) performance assessment in compliance with 40 CFR § 191. Each of these programs requires a unique set of analyses and data. Particular sample needs are defined by each program. In addition to the characterization of groundwater, the WQSP supported radionuclide monitoring for the WID Environmental Analysis and Compliance Section. Results of radionuclide sampling are discussed in Chapter 5. Representatives from the EEG were on hand at selected sampling events to collect samples for independent evaluation.

The WIPP site lies within the Pecos Valley section of the Southern Great Plains physiographic province (Powers et al., 1978). Geologic and lithologic descriptions of the area surrounding the site can be found in documents such as the EMP, the Groundwater Protection Management Program Plan (DOE/WIPP 96-2162), and USGS 83-4016 (Mercer, 1983). Industries in the vicinity that could potentially contribute to the pollution of the groundwater are potash mining, oil and gas exploration/production, and agriculture.

The Culebra is the most significant water-bearing unit within the vicinity of WIPP. No known hydrologic connection exists between the repository horizon and the Culebra. Surveillance of hydrological characteristics in the Culebra provides data that can be used to detect changes in water characterization. It also provides additional data for use in hydrologic models designed to predict long-term performance of the repository.

Groundwater surface elevation data is gathered from 77 well bores; five of which are equipped with production-inflated packers to allow groundwater level surveillance of more than one producing zone through the same well bore (Figure 7.2).

Groundwater quality data were gathered from six wells completed in the Culebra member of the Rustler formation and one well completed in the Dewey Lake formation (Figure 7.1). The

water quality sampling process has been developed using logistics from groundwater wells originally constructed for characterization, not intended for groundwater monitoring activities.

Seven wells were drilled in the latter part of 1994 constructed for the explicit purpose of gathering water quality data. These wells are constructed with fiberglass casing and screens that will not bias sample collection. Similar sampling protocols to those used in the past for wells drilled for resource evaluation and site geologic characterization were used through CY 1997. More efficient sampling methods are being evaluated and should be phased in during CY 1998.

Sampling episodes are referred to as a "sampling round." Each sampling round consists of the collection of two types of samples: (1) serial samples and (2) final samples. Serial samples are taken periodically while the well is being purged. Key physical and chemical parameters (known as field parameters) are analyzed and compared with past serial sampling data, when available, until a chemical steady state has been reached. A chemical steady state is defined as ± 5 percent of the average of the three to five preceding parameter measurements made on the final day of serial sampling from preceding sampling rounds. Stabilization of these field parameters is a function of purging and is used as an indicator to determine if the groundwater is representative of the zone being sampled. A final sample is collected when it has been determined that the pumped groundwater has achieved a representative state. The sample is then sent off site to a contract laboratory for analysis.

Groundwater monitoring activities during CY 1997 included Groundwater Quality Sampling and Groundwater Level Surveillance.

Groundwater Quality Sampling

Sampling for groundwater quality was performed semiannually at seven well sites during CY 1997 (Figure 7.1). The wells were serially sampled as soon as possible after the pump was turned on to better observe early chemical reactions to pumping. Field analysis for Eh, pH, specific gravity, specific conductance, alkalinity, chloride, divalent cations, and total iron were performed on a periodic basis during the serial sampling. These field parameters were used as indicators, during the purging process to better determine when the formation water being pumped had reached a representative state. Normally this process required four to seven days to complete. Following the field analysis of the final serial sample, samples were collected and shipped to an independent, contracted, laboratory for analysis. Parameters of analysis by the contracted laboratory include the groundwater monitoring list in Appendix IX of 40 CFR § 264 and those indicator parameters common to the Culebra member of the Rustler as listed in Table 7.1.

WIPP has not received waste; therefore no hazardous constituent has been introduced to the environment as a result of WIPP operations. Data collected provide background information.

The total gallons of water removed from the Culebra as a result of groundwater surveillance activity was approximately 44,318 gallons throughout the year. During the same period 10,962 gallons of water were removed from the Dewey lake formation. Water quality of the Culebra sampled near WIPP is naturally poor and is not suitable for human consumption or for agricultural purposes. The groundwater of the Culebra is considered to be class III waters by EPA guidelines. The water contains naturally high concentrations of total dissolved solids and mineral constituents primarily of chloride, calcium, magnesium, sodium and potassium (Mercer, 1983). The high total of dissolved solids concentration has historically posed problems for laboratories performing analysis because the water interferes with the normal operation of standard laboratory equipment such as Atomic Absorption or Inductively Coupled Plasma, causing estimated quantitation limits to be inconsistent.

Water quality measurements performed in the Dewey Lake formation indicate that the waters are considerably fresher. Samples collected from the Dewey Lake formation are suitable for livestock consumption having TDS values below 10,000 mg/L. These waters are classified as Class II waters according to EPA Guidance. Saturation of the Dewey Lake Formation in the area of WIPP is discontinuous and no hydrologic connection has been established that would indicate that WIPP activities would have an Impact on the Dewey Lake.

Sampling during calendar year 1997 marked the end of data collection for baseline purposes for the RCRA permitting process. A detailed baseline report entitled "Waste Isolation Pilot Plant RCRA Background Groundwater Quality Report" was issued just prior to the Issuance of the 1997 ASER.

To summarize; this report contains calculated background concentrations for groundwater-quality parameters from seven monitoring wells that are located within the boundaries of the WIPP site. From 1995 to 1997, the GMP collected groundwater samples from the Culebra and Dewey Lake water-bearing zones in the area of the WIPP site. The GMP has sampled 7 WIPP monitoring wells five separate times. Groundwater was sampled during the GMP from the Culebra Dolomite Member of the Rustler Formation and the Dewey Lake. The GMP focused primarily on the characterization of Culebra Dolomite groundwater, since the Culebra is the first continuous water-bearing zone above the waste repository horizon and is the most transmissive hydrologic unit in the WIPP area.

Because Culebra groundwater chemistry is extremely variable across the WIPP site, areawide background values for groundwater constituents could not be established. Instead, background groundwater quality was defined for each individual well. A minimum of four separate rounds of data from a well was required to establish the background groundwater quality at that well.

Preliminary analysis categorized GMP data into three groups based on the frequency of detection and the proximity of detections to MDLs. The three groups are as follows:

- Major Cations and Anions. Constituents that collectively make up greater than 99 percent of the dissolved solids. These constituents are generally detected at concentrations that are well above the MDL.

- Minor Cations, Trace Metals, Anions, and Indicator Parameters. Constituents with concentrations that are generally less than 10 mg/L in groundwater. A substantial amount of the data are below the MDL, and those detected concentrations are generally close to the MDL.

- Organic Compounds. Include VOCs, SVOCs, pesticides, and PCBs (all of the parameters included in 40 CFR § 264, Appendix IX). Very few detections of these compounds were observed in GMP data.

Given the three data groups defined above, background concentrations were determined and reported in the following manner:

- A 95th UTL or 95th percentile confidence interval based on the distribution type was computed for every major constituent from each well. Thus, the expected background concentration for a major constituent at a given well is represented by a 95 percent confidence interval.

- The 95th UTL for most minor constituents could not be calculated due to the large number of NDs; thus, the background concentration range for a minor constituent at a given well is represented by the observed 95th percentile concentration range based on MDLs for that parameter at that well.

Prior to the determination of background concentration values, the GMP data were evaluated for trends. Trend analysis was necessary to determine if any concentrations

were changing with time due to natural (or non-WIPP related) causes. The procedure used to determine background water quality is dependent on, or somewhat controlled by, the nature of the concentration/time relationship. In general, temporal trends in concentrations were not found in the GMP data, and the procedure used to establish background water quality reflected this finding. Additional sampling rounds at each GMP well may provide more insight into potential trends in water quality.

The GMP data were also evaluated for potential outliers. Potential outliers were evaluated through visual examination only. If a value appeared to be an outlier by visual examination, an additional observation was performed to estimate if that value was within ±20 percent of its nearest neighbor or if it was due to routine analytical uncertainty. Only four values were actually excluded from the major and minor constituent data set prior to the establishment of background concentration summary statistics and box-and-whisker plots (Figures 7.12 through 7.72).

The following are the specific findings and conclusions of the baseline study:

- Some constituents at several wells, including WQSP-1, WQSP-2, WQSP-3, WQSP-5, WQSP-6, and WQSP-6A show potential concentration trends. However, in almost every case the trend is within the range of expected analytical uncertainty, or the trend is not supported by charge-balance considerations or by similar trends in other constituents, such as TDS.

- Wells WQSP-4, WQSP-5, and WQSP-6 exhibit concentrations of several parameters that decrease significantly from the first to the second or later sampling rounds. This may indicate that the first sample is not representative, possibly due to incomplete well development and that the wells are "cleaning up" from the initial well installation process.

- Background groundwater quality was successfully defined for seven wells. Background concentrations for major and minor cations, anions, and indicator parameters were established for Culebra Dolomite and Dewey Lake groundwater. Although the background concentrations of many minor constituents are uncertain, the baseline report documents the "expected" values for these constituents, if similar analytical techniques are used in future sampling efforts.

- Hazardous organic compounds are not present in groundwater in the vicinity of the WIPP site. Detections of these compounds are very infrequent, and the majority of detected compounds are typical laboratory contaminants as defined by the EPA. Some of the occurrences may also be related to well installation or sampling practices.

Specific details on statistical methods and formulas used to reach these conclusions can be found in DOE/WIPP 98-2285, "Waste Isolation Pilot Plant RCRA Background Groundwater Quality Base line Report."

Groundwater Level Surveillance

In October 1988, WIPP was tasked with conducting a groundwater level surveillance program. Seventy-seven well bores are used to perform surveillance of seven water- bearing zones in the WIPP area. The two zones of primary interest are the Culebra and Magenta members of the Rustler formation. Fifty-nine measurements are taken in the Culebra; and ten, in the Magenta. Three measurements each are taken in the Dewey Lake and Santa Rosa formations. Two measurements are taken in the Rustler/Salado contact. One measurement each is taken in Bell Canyon, Forty-niner, and an unnamed lower member. Locations of groundwater level surveillance sites are pictured in Figure 7.2.

Five well bores are configured to allow monitoring of more than one formation. These are H-01 Culebra/Magenta, H-03d Dewey Lake/ Forty-niner, H-16 Dewey Lake/unnamed lower

member, WIPP-25 Culebra/Magenta, and WIPP-27 Culebra/Magenta.

Groundwater surface elevations in the vicinity of WIPP may be influenced by site activities such as pumping tests for site characterization, water quality sampling, or shaft sealing. Other influences on groundwater surface elevations may be caused by natural groundwater level fluctuations and industrial influences from agriculture, mining, and resource exploration.

Groundwater elevation measurements in the Culebra indicate that the generalized directional flow of groundwater is north to south in the vicinity of WIPP (Figure 7.3). Regional groundwater levels taken in 43 Culebra observation wells with more than four data points for the year show increases in water levels occurred in 26 wells and 17 wells showed a decrease in water levels over the period of January 1997 through December 1997. During this period 23 wells had net water level increases or decreases of less than one foot.

Total fluctuation of more than one foot in groundwater levels occurred in 33 of the wells. Nine wells with fluctuations of more than one foot (WQSP-1 through WQSP-6, H-19b0, H-18, and H-14) may have been influenced by groundwater quality sampling activities. Four wells (ERDA [United States Energy Research and Development Administration]-9, WIPP-18, WIPP-19, WIPP-21, and WIPP-22) may have been influenced by site activities.

Water level increases originating to the south of the site in the H-9 area and extending up gradient toward the site are currently unexplained. Studies are currently being conducted to try and explain the anomalies.

Groundwater flow directions in the Magenta appear to be generally from an east to west direction across the WIPP site (Figure 7.4). Regional groundwater level measurements taken in the Magenta dolomite indicate that water levels are increasing in wells located near the center of the site, while water levels near or outside the WIPP boundary appear to be relatively stable. One well H-01 has had anomalus water level increases and appears to be influencing the wells in the immediate vicinity (H-2b1 and H-3b1). The cause is as yet undetermined.

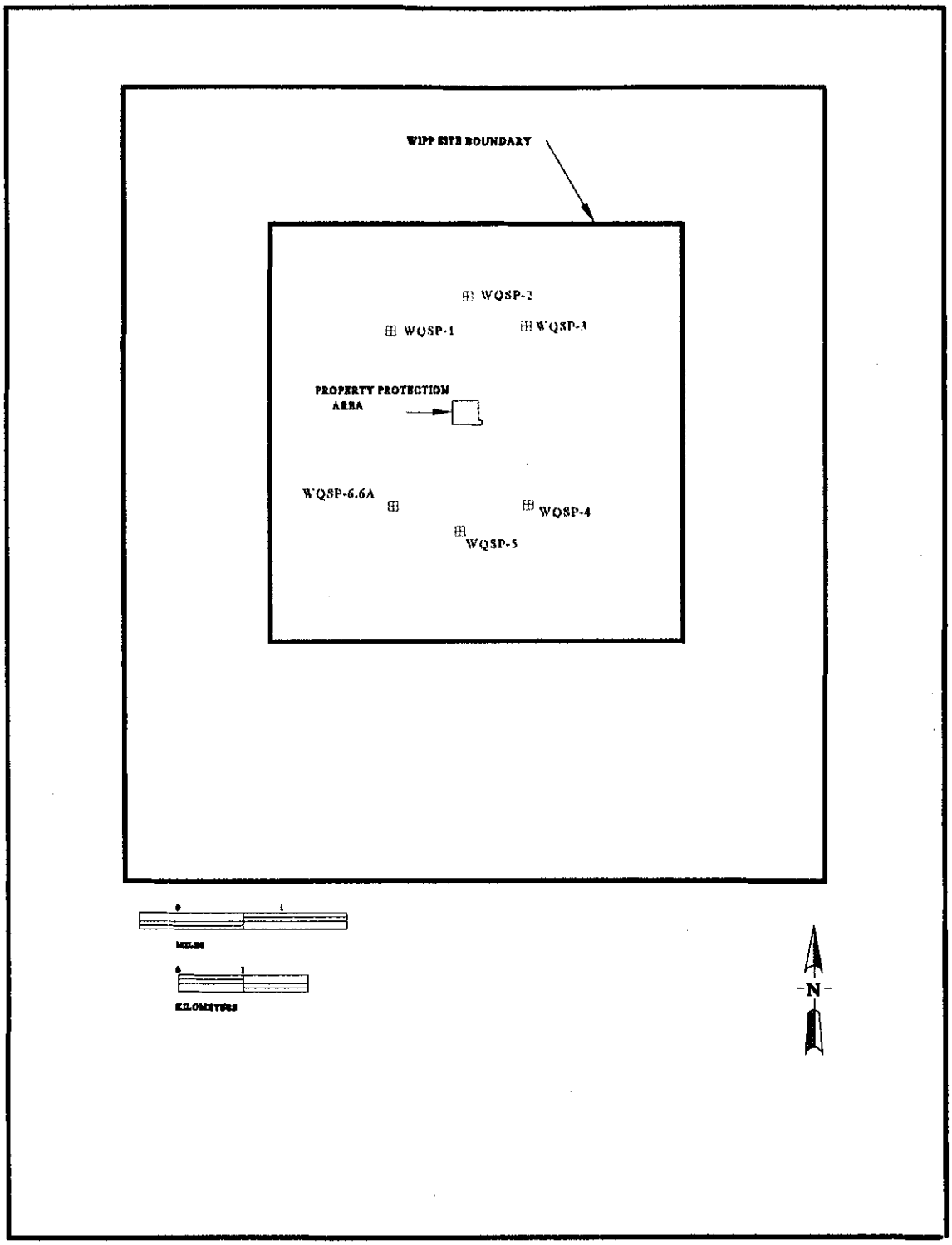


Figure 7.1 - Water Quality Sampling Program Sample Wells - 1997

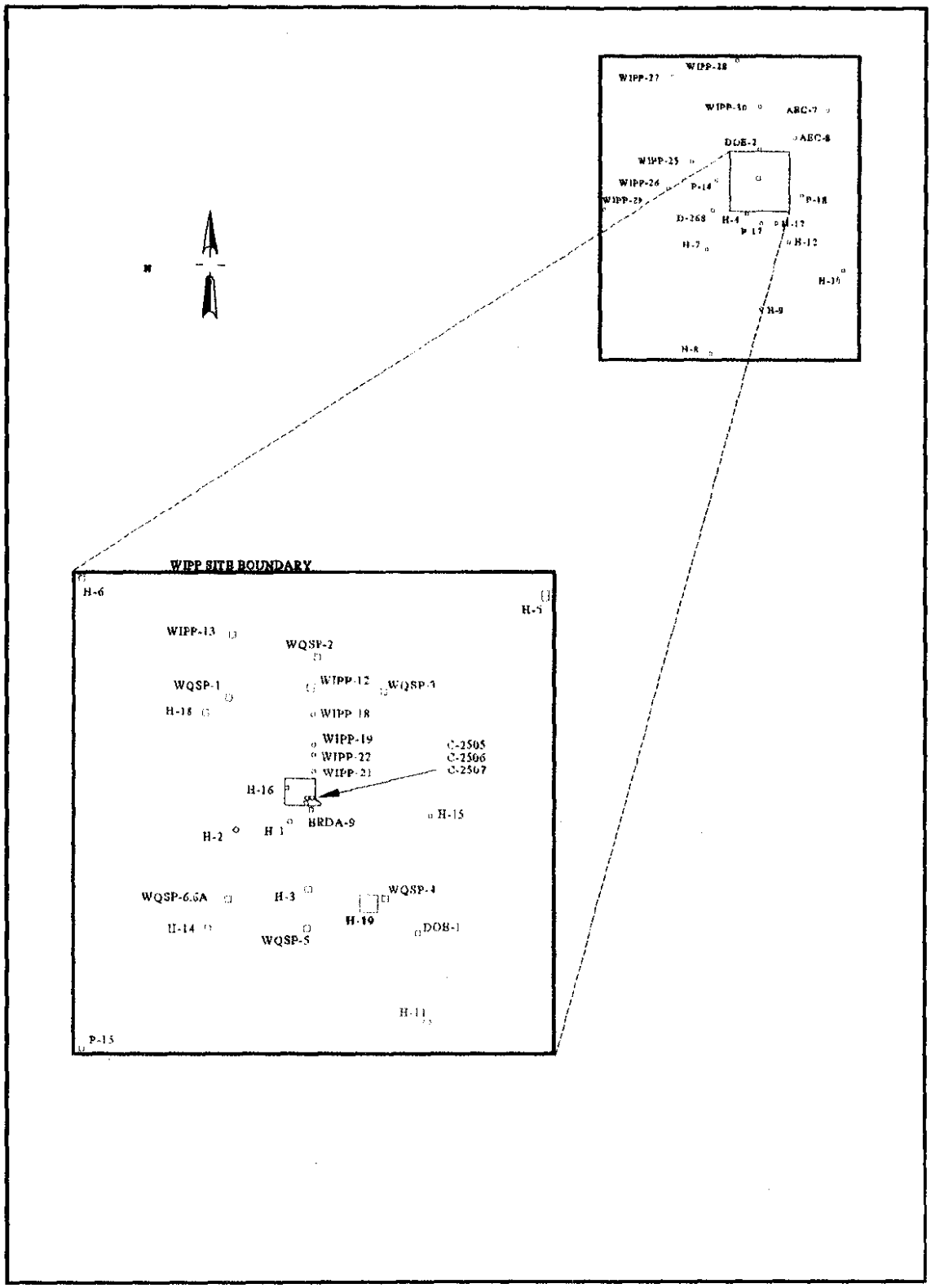


Figure 7.2 - Groundwater Level Surveillance Wells

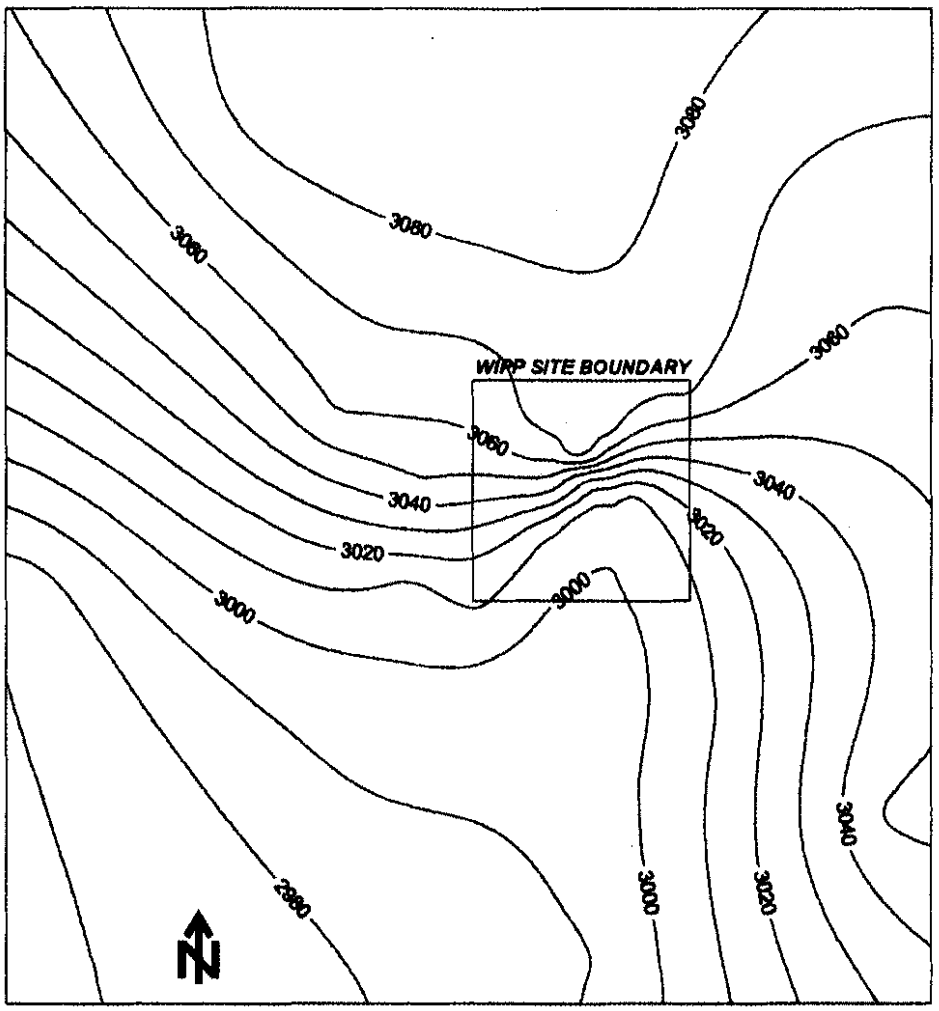


Figure 7.3 - Potentiometric Surface of the Culebra Dolomite Member of the Rustler Formation Near the WIPP Site as of December 1997

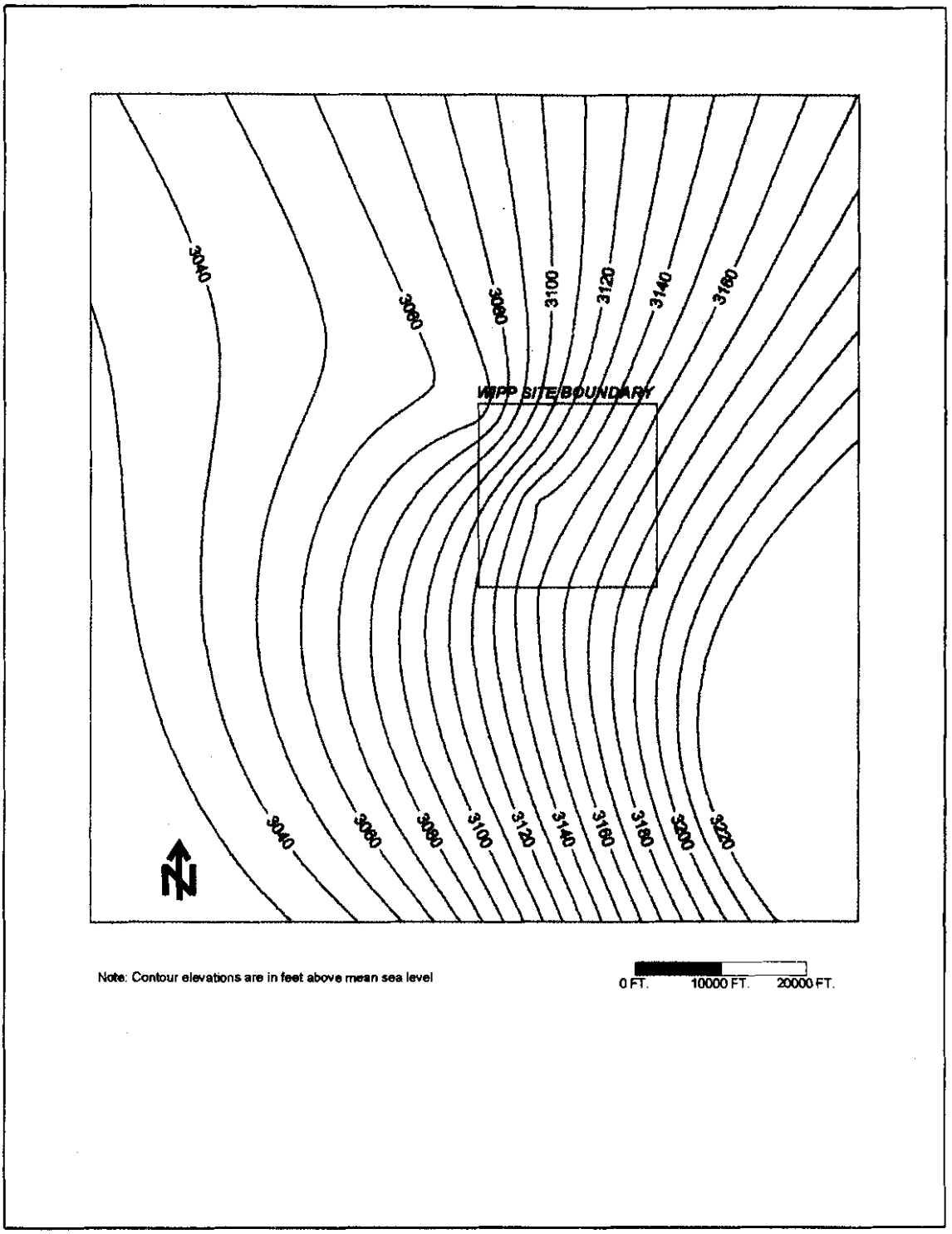


Figure 7.4 - Potentiometric Surface of the Magenta Dolomite Member of the Rustler Formation Near the WIPP Site as of December 1997

Table 7.1
Indicator Parameters Analyzed in Addition to Appendix IX
During Calendar Year 1997

SPECIFIC CONDUCTANCE	BORON
SULFATE	TOTAL DISSOLVED SOLIDS
CALCIUM	TOTAL SUSPENDED SOLIDS
DENSITY	IRON
pH	ALKALINITY
LITHIUM	BROMIDE
MAGNESIUM	CHLORIDE
FLUORIDE	POTASSIUM
IODIDE	NITROGEN, N03 (AS N)
SILICA	TOTAL ORGANIC CARBON
TOTAL ORGANIC HALOGENS	SODIUM
SODIUM	ORTHOPHOSPHATE (AS P)

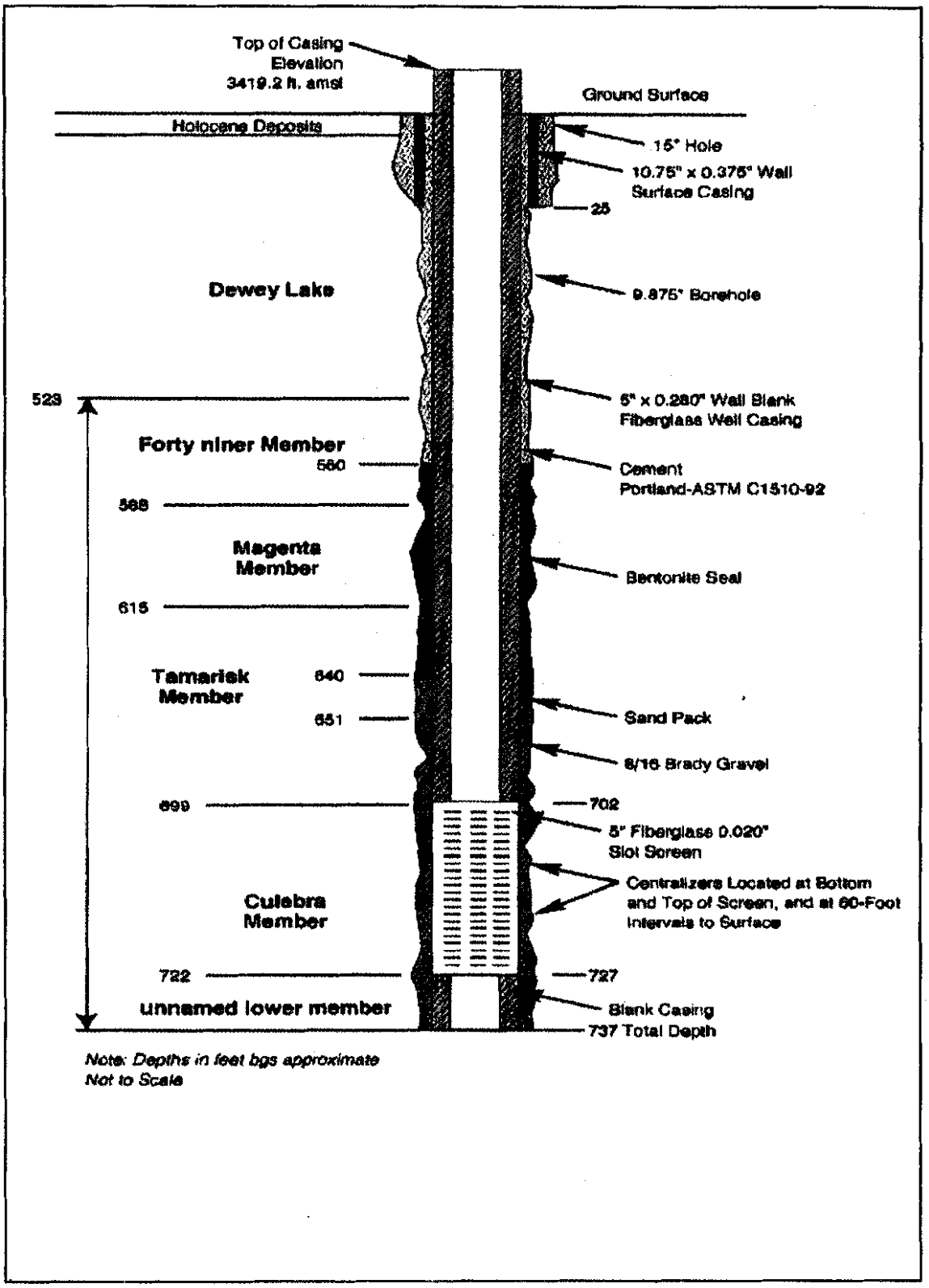


Figure 7.5 - As-Built Configuration of Well WQSP-1

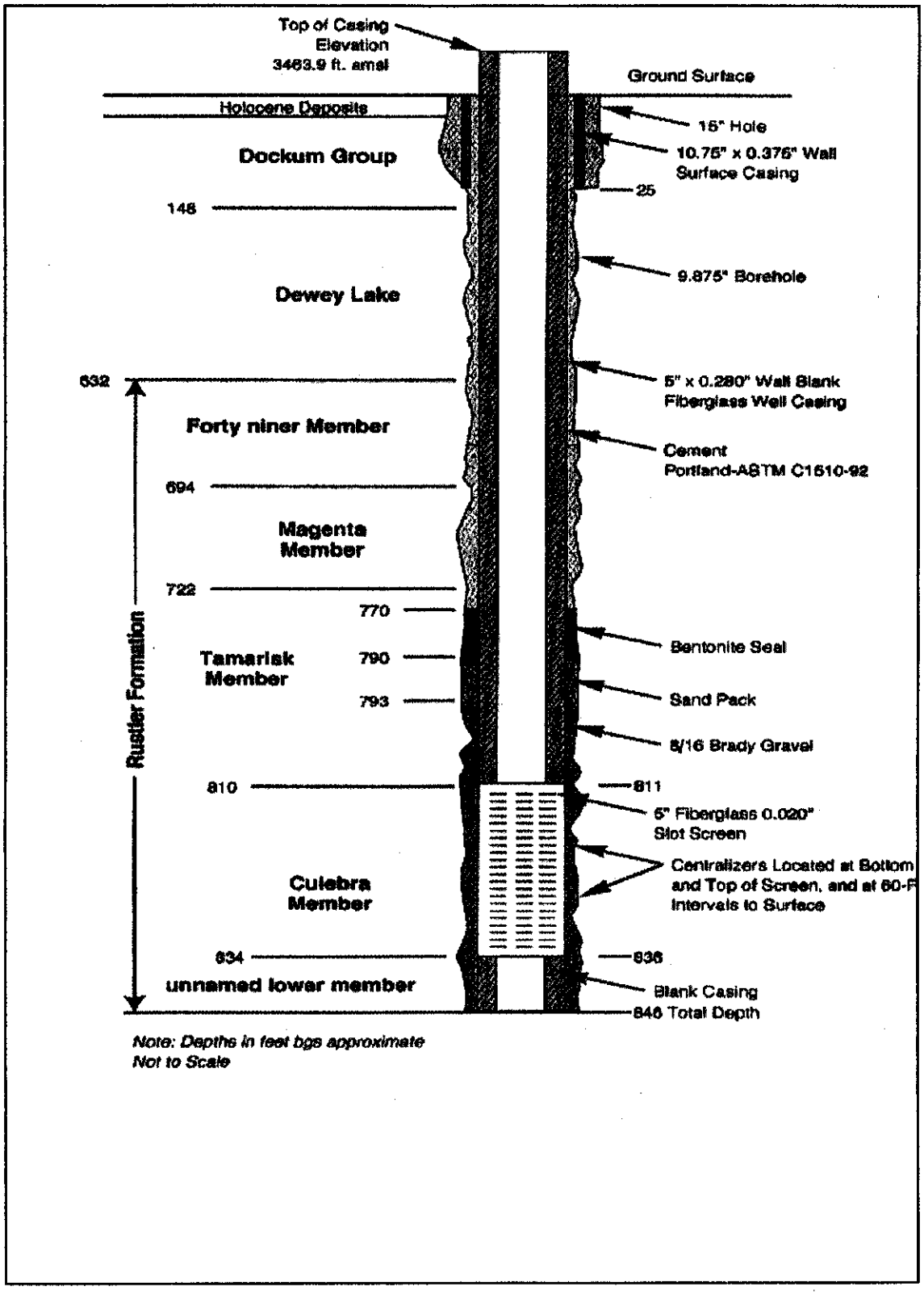


Figure 7.6 - As-Built Configuration of Well WQSP-2

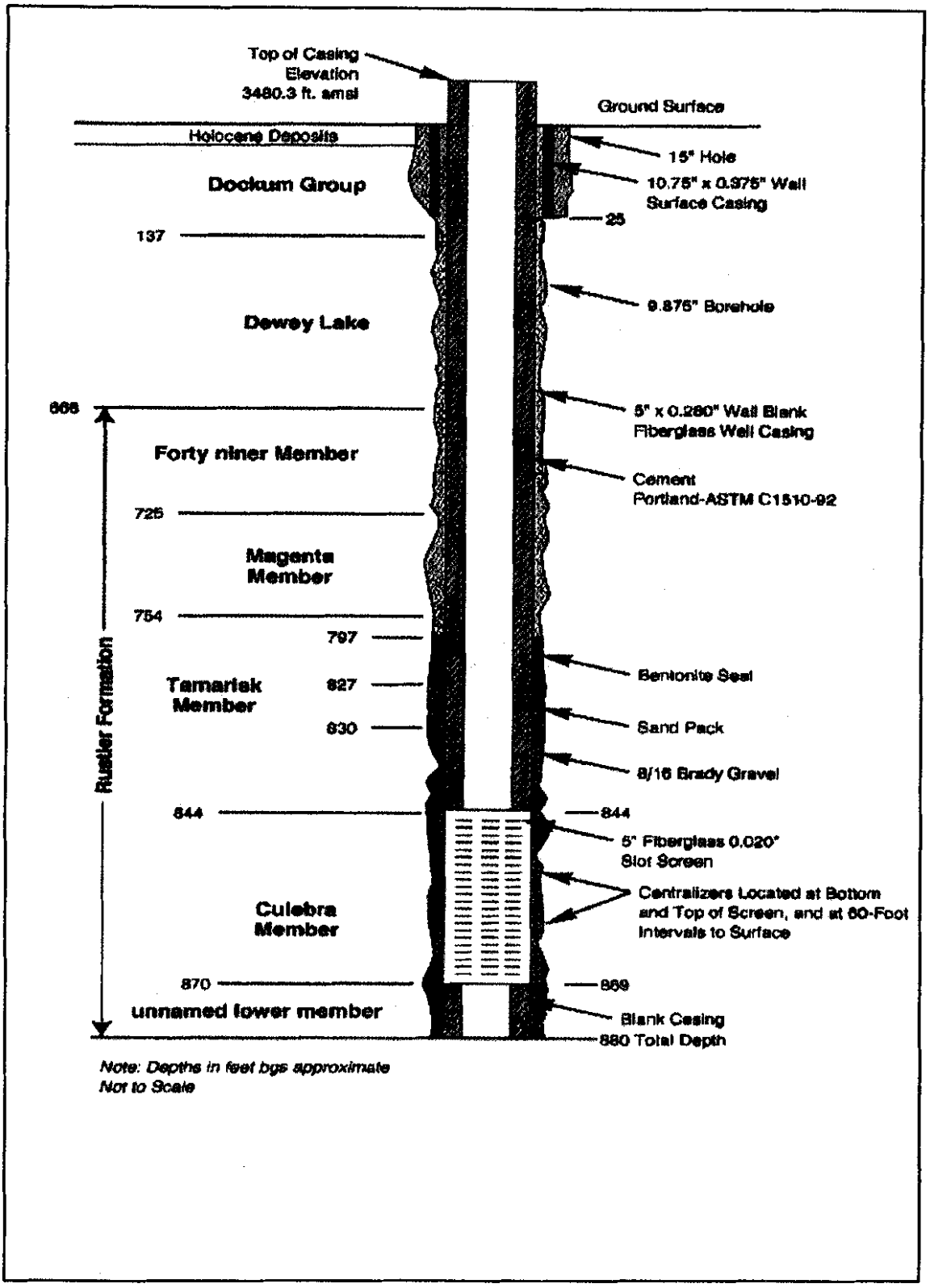


Figure 7.7 - As-Built Configuration of Well WQSP-3

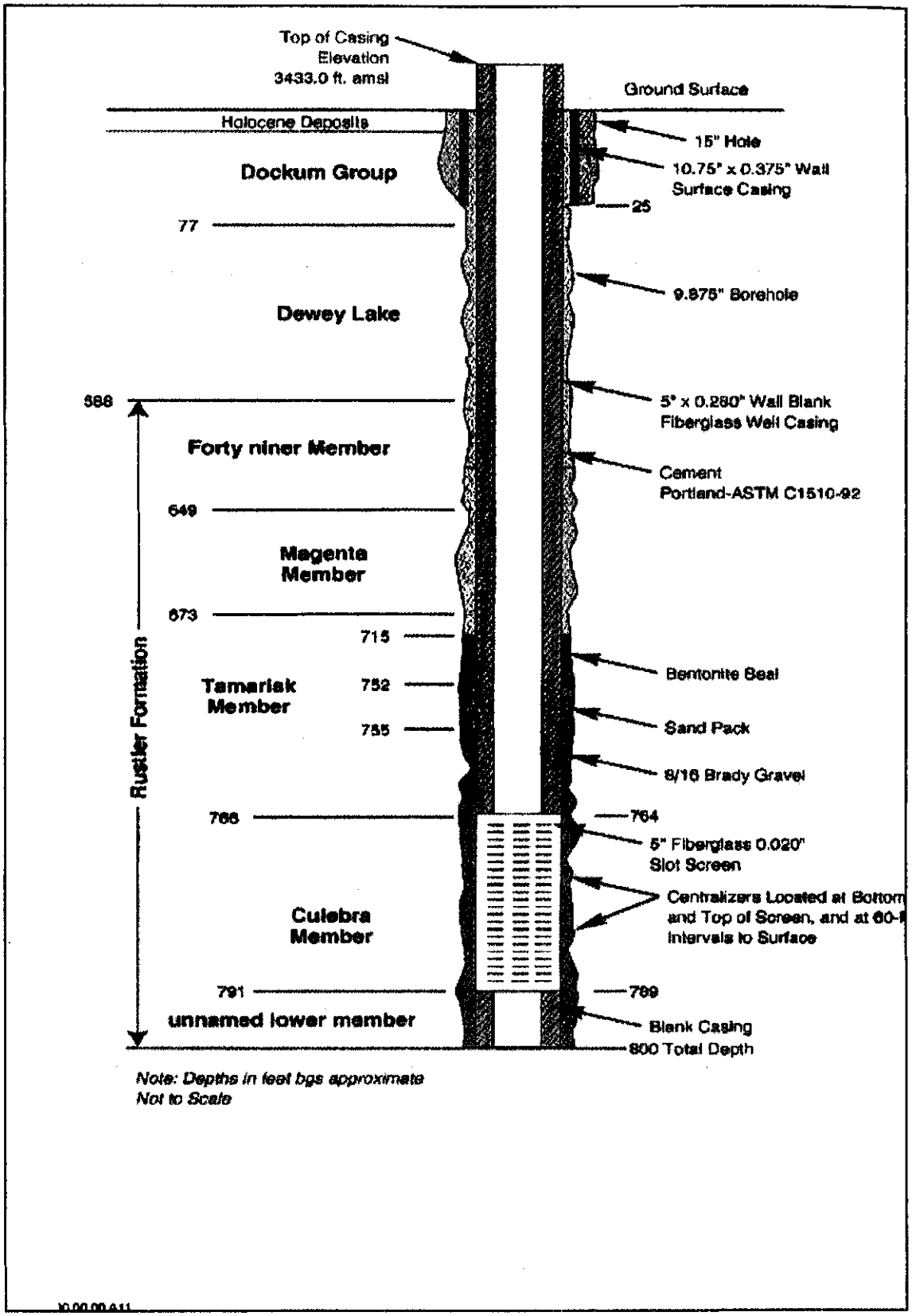


Figure 7.8 - As-Built Configuration of Well WQSP-4

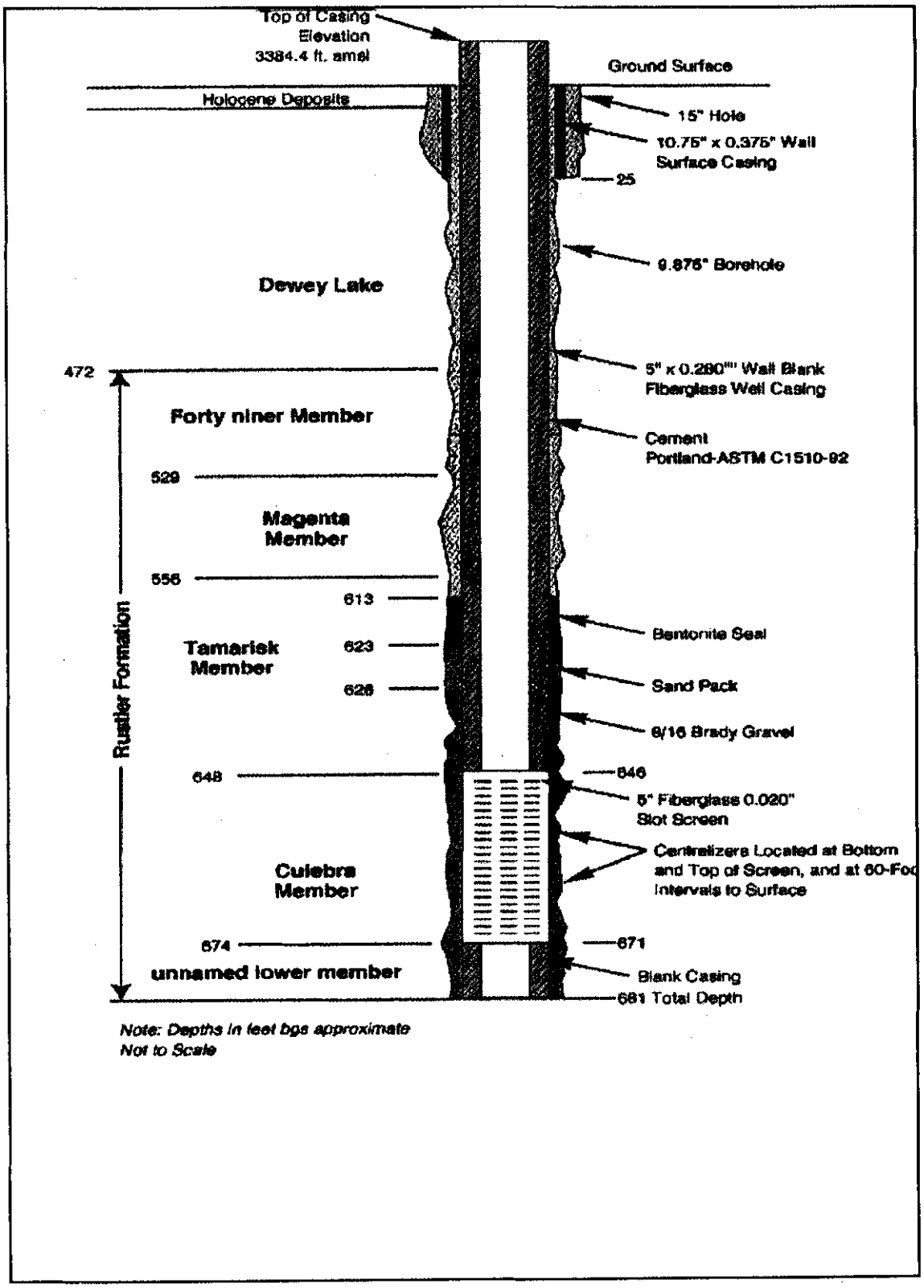


Figure 7.9 - As-Built Configuration of Well WQSP-5

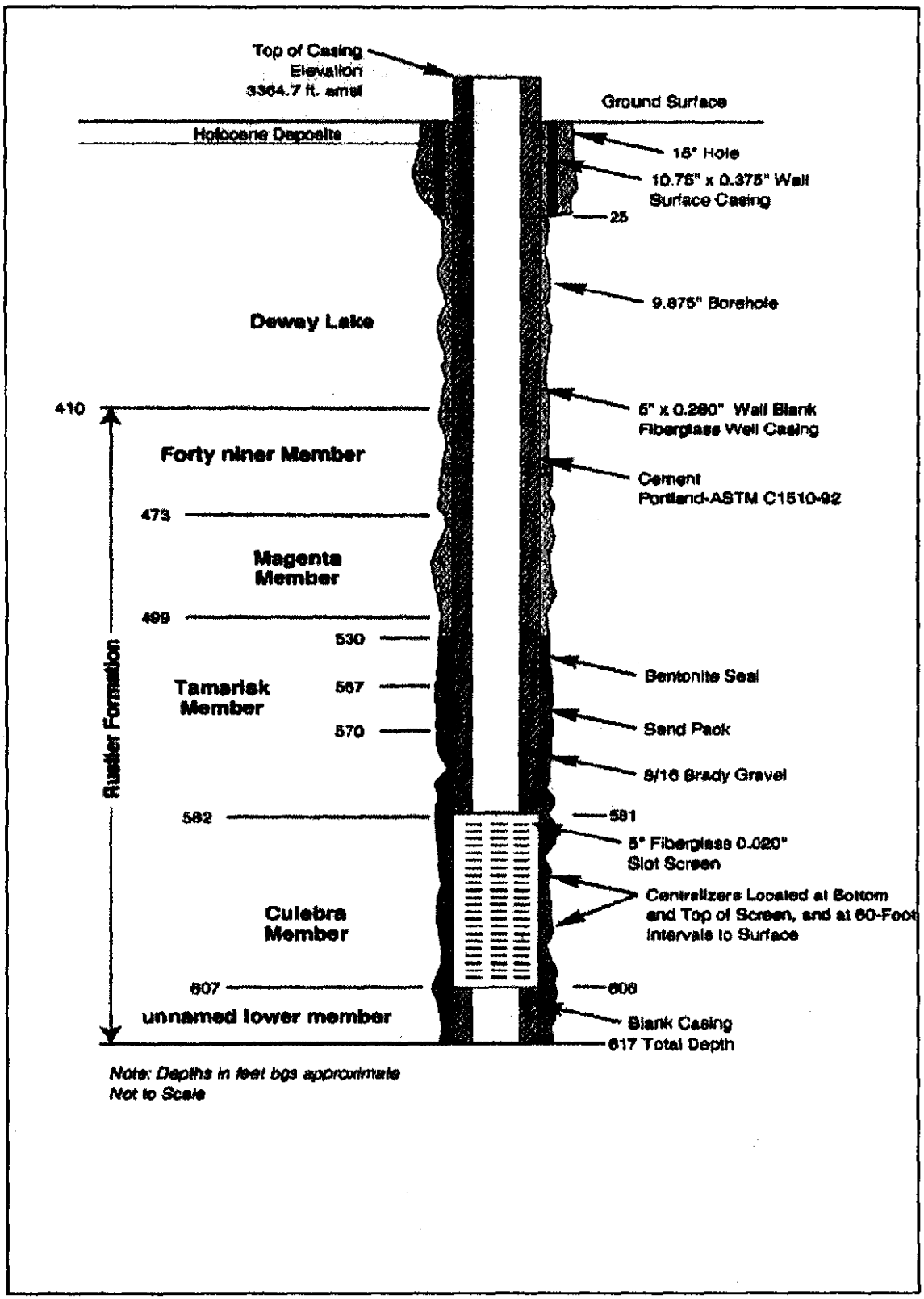


Figure 7.10 - As-Built Configuration of Well WQSP-6

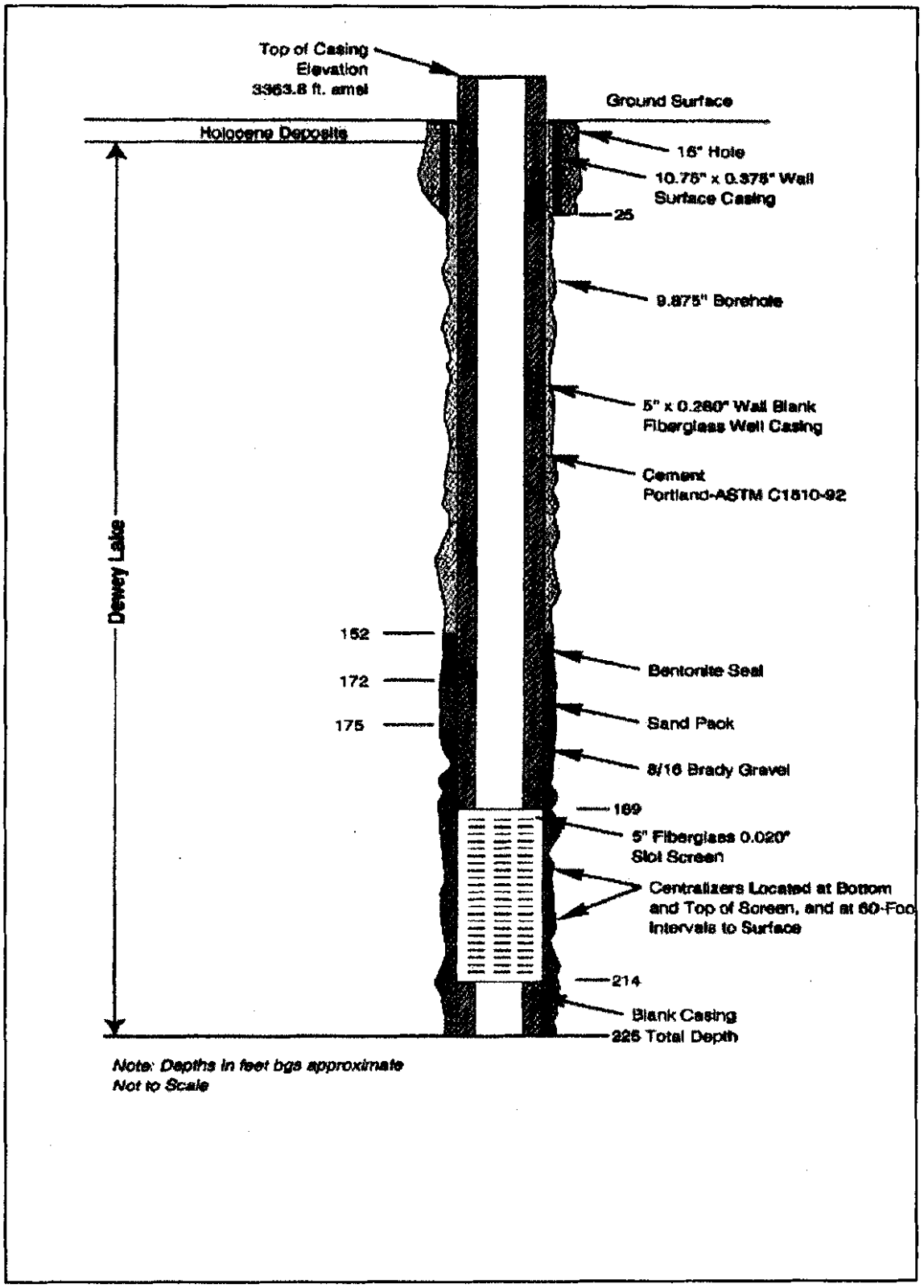


Figure 7.11 - As-Built Configuration of Well WQSP-6A

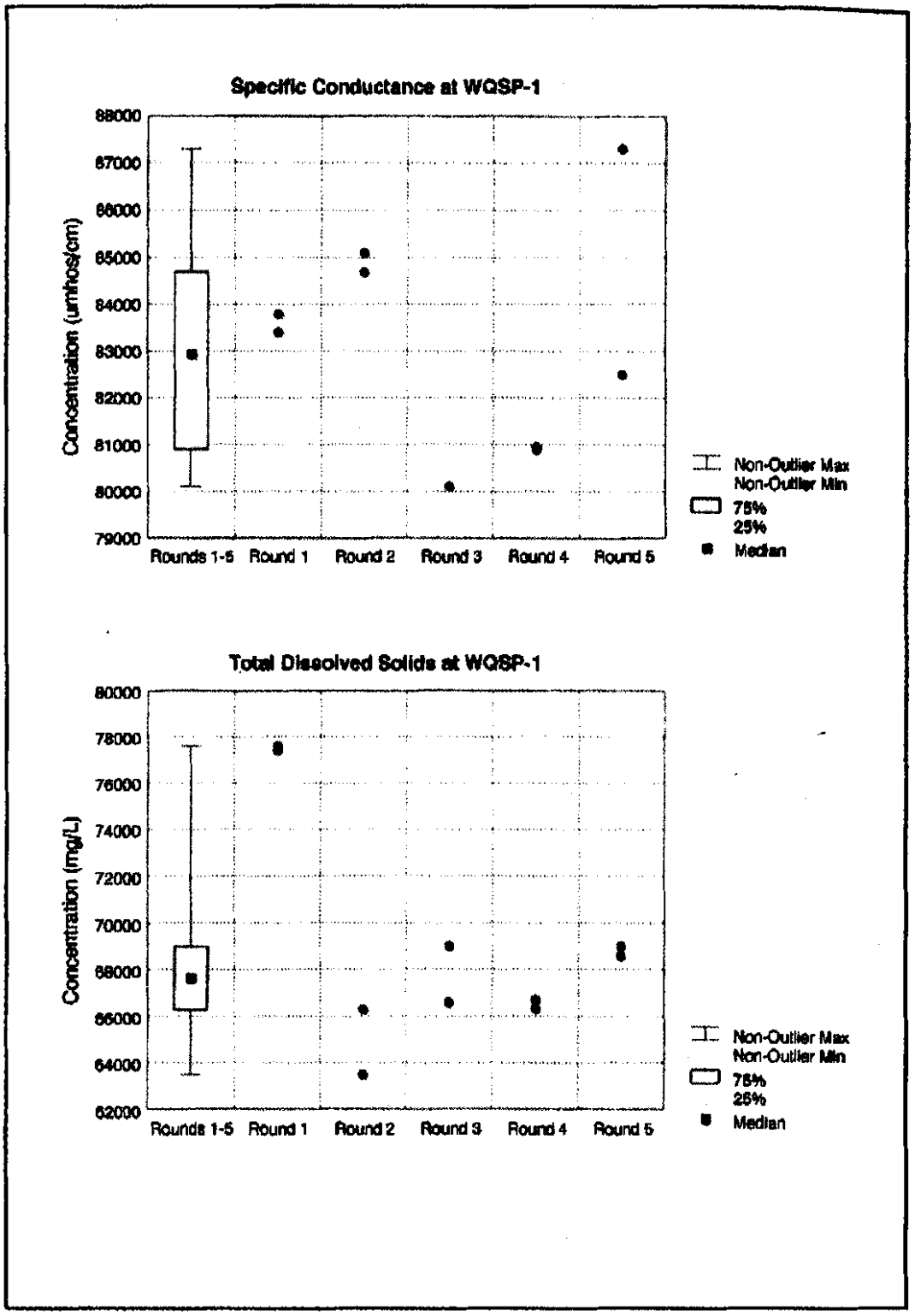


Figure 7.12 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-1

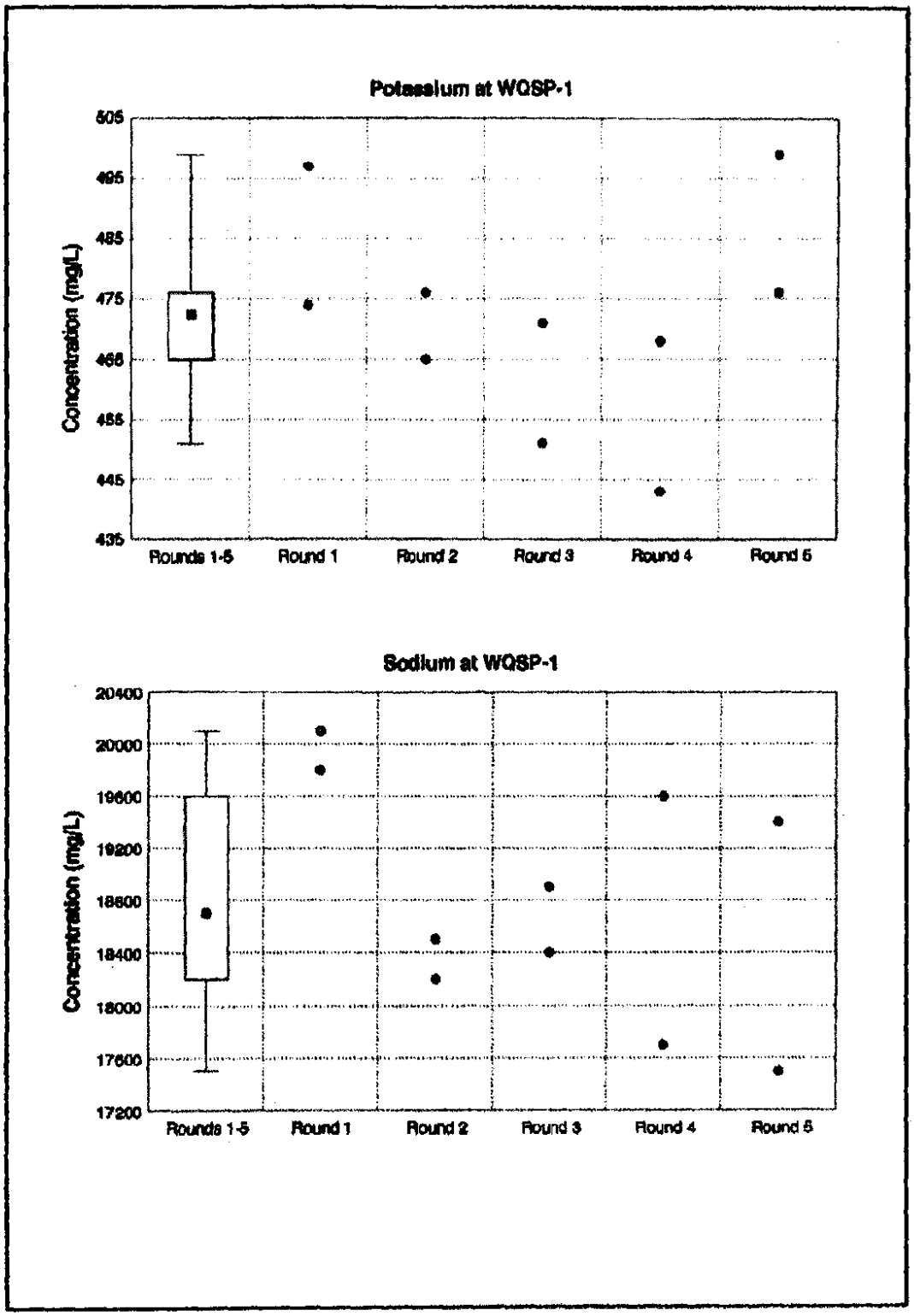


Figure 7.13 - Time Trend Plot for Potassium and Sodium at WQSP-1

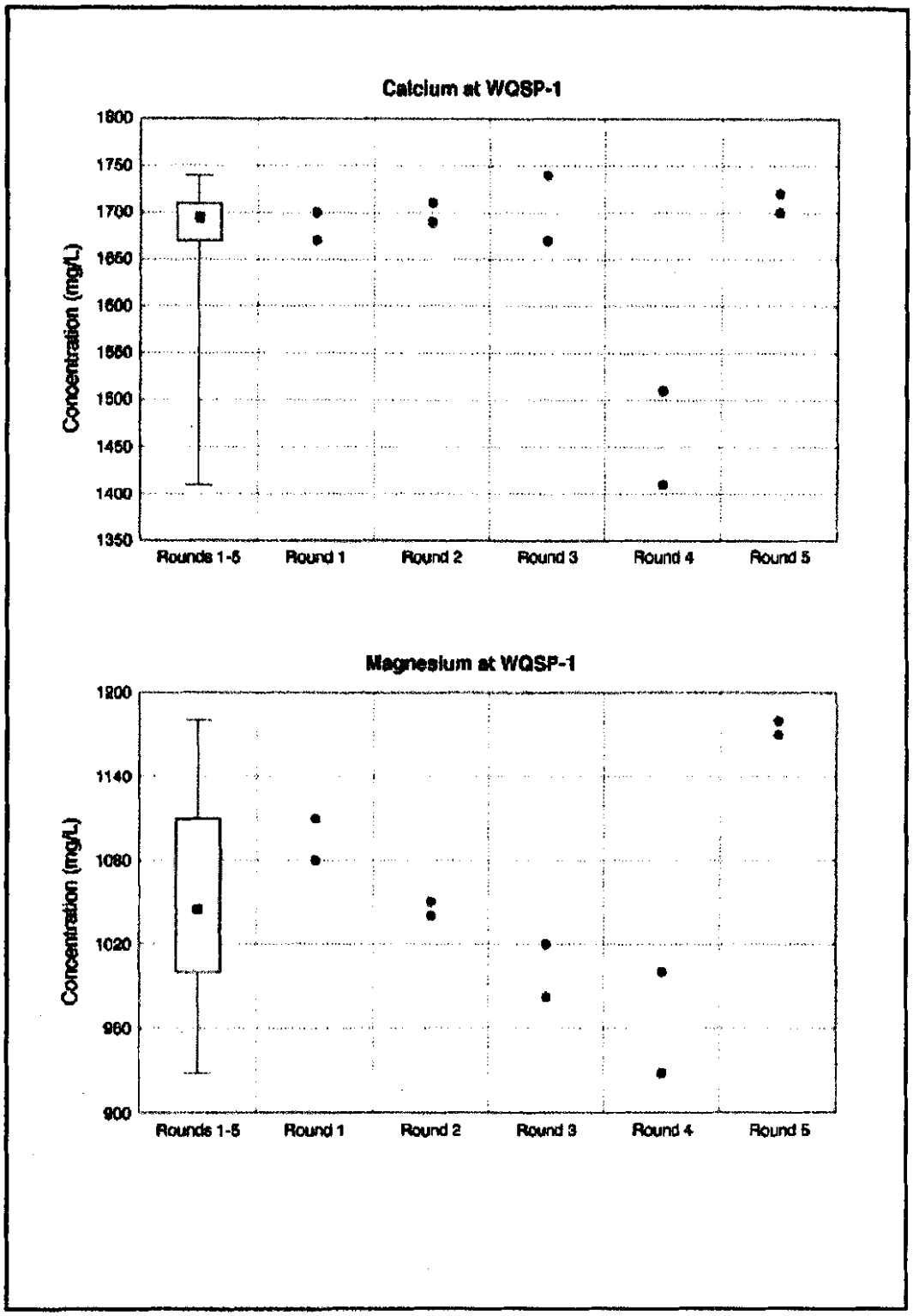


Figure 7.14 - Time Trend Plot for Calcium and Magnesium at WQSP-1

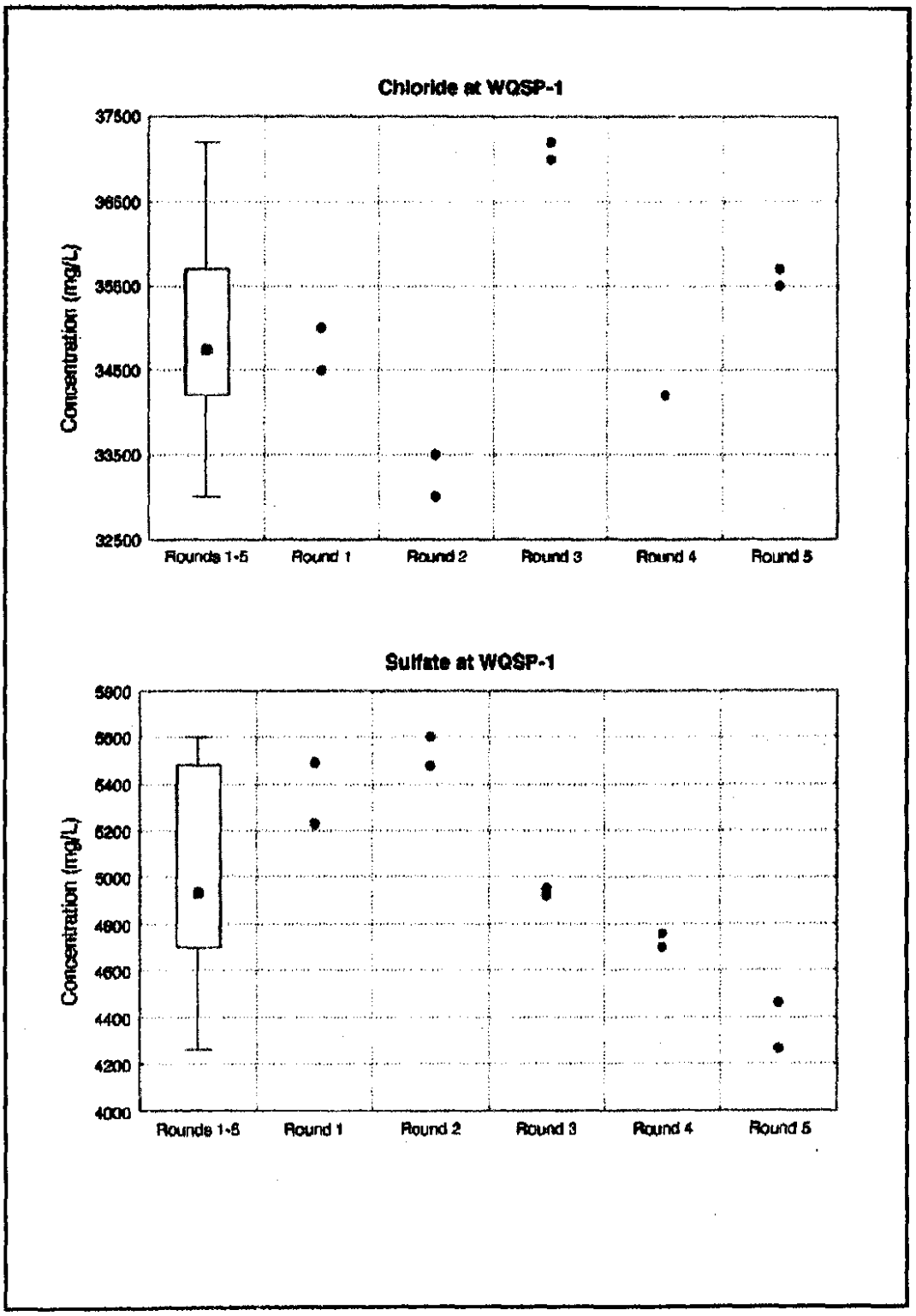


Figure 7.15 - Time Trend Plot for Chloride and Sulfate at WQSP-1

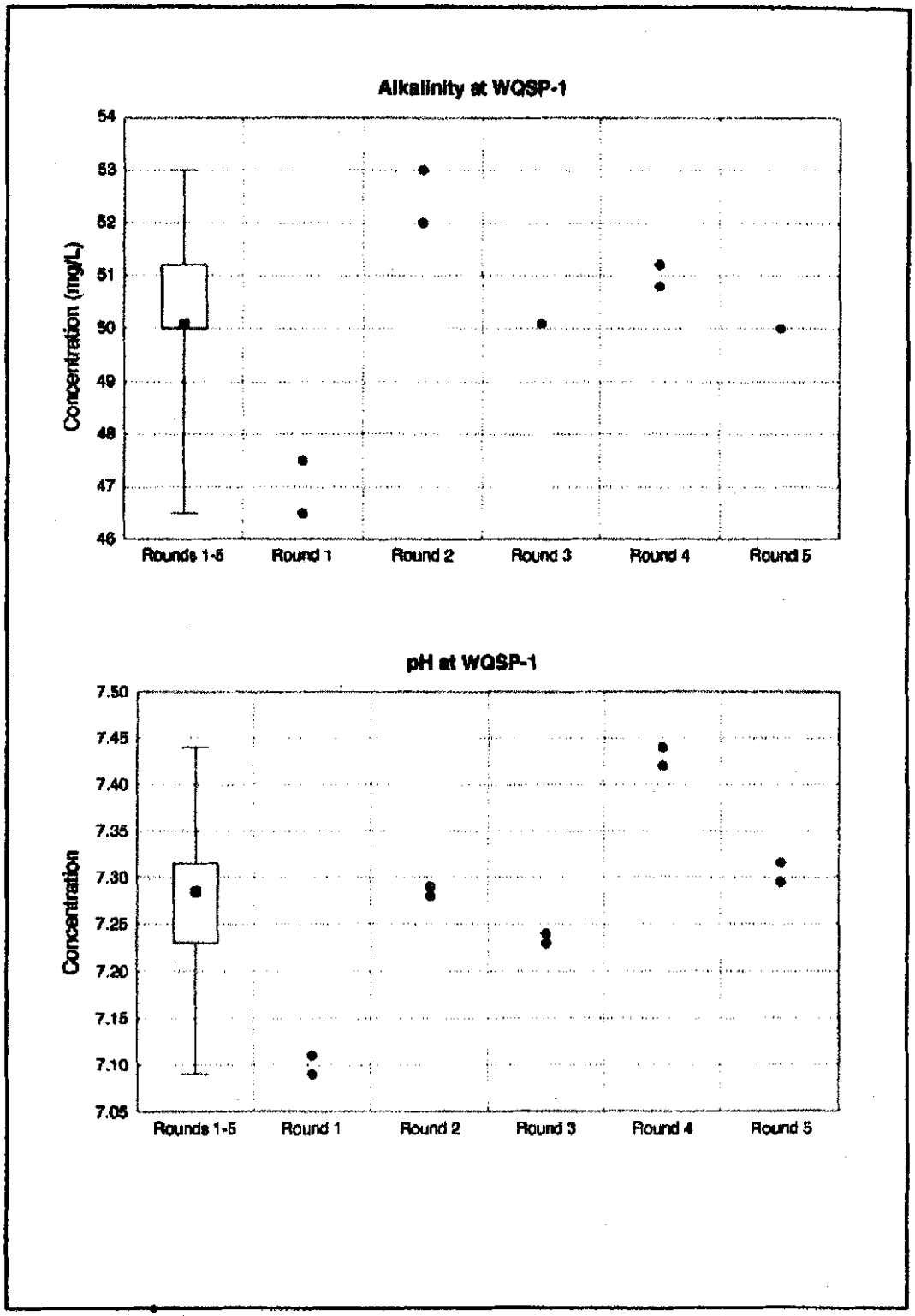


Figure 7.16 - Time Trend Plot for Alkalinity and pH at WQSP-1

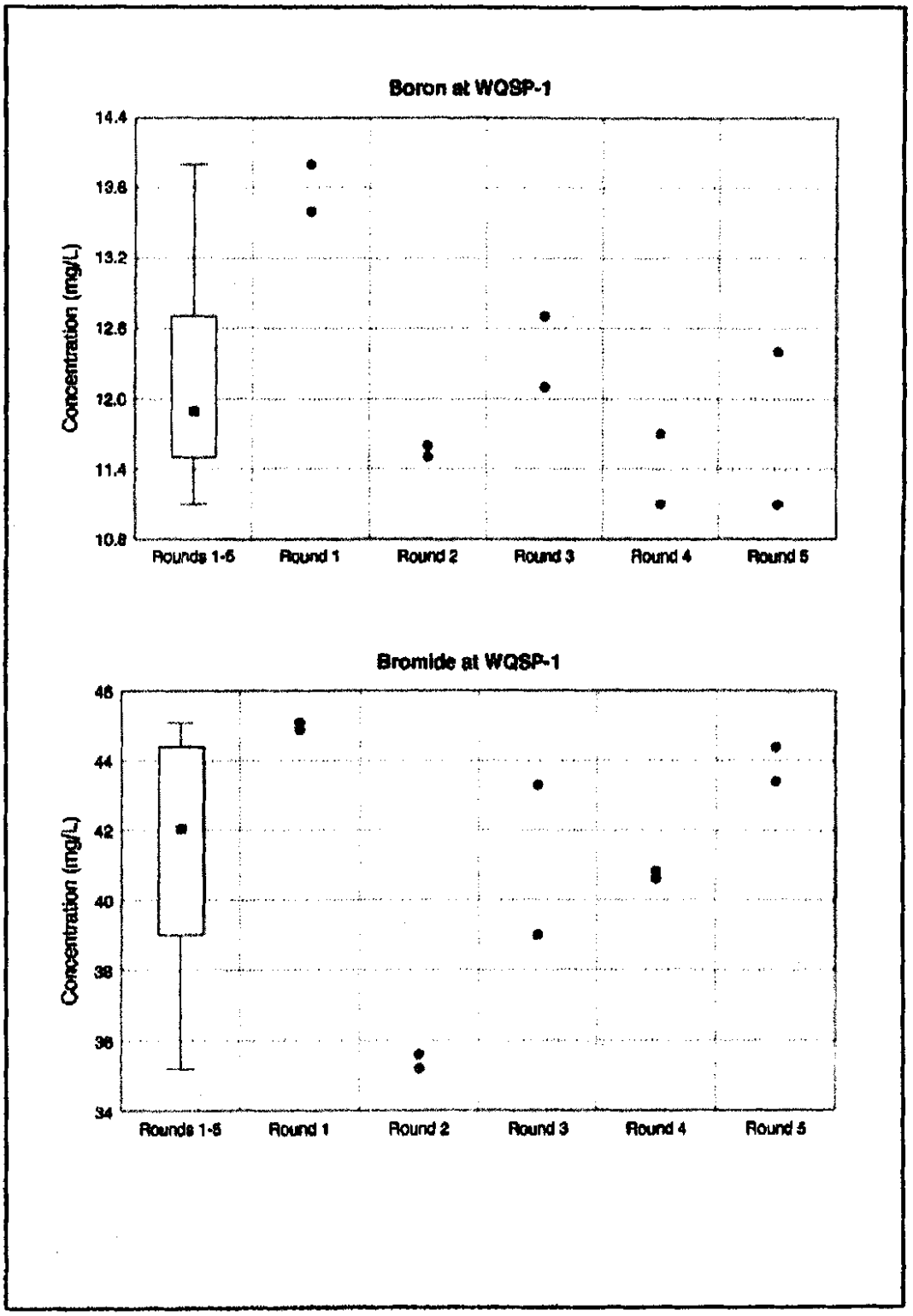


Figure 7.17 - Time Trend Plot for Boron and Bromide at WQSP-1

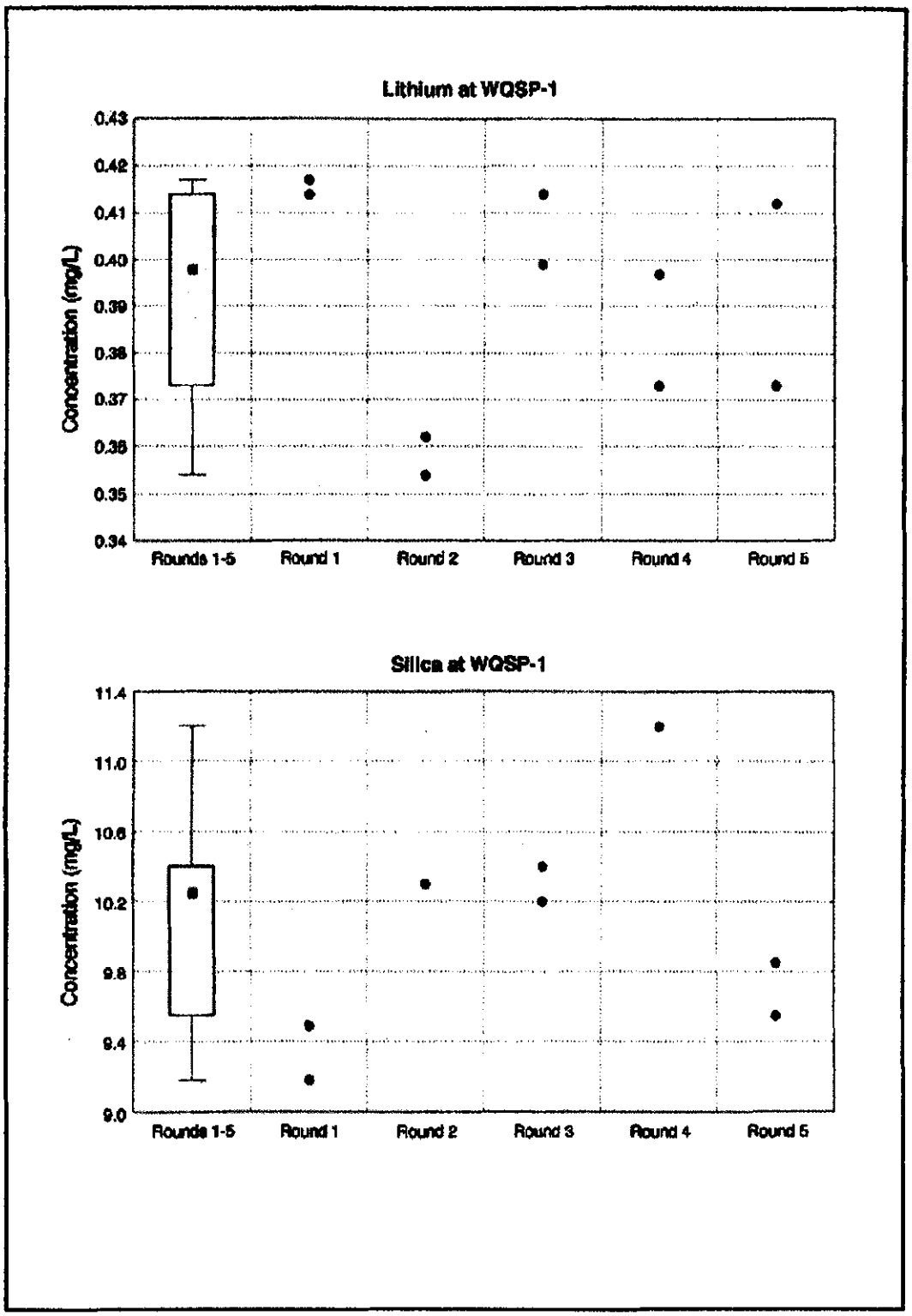


Figure 7.18 - Time Trend Plot for Lithium and Silica at WQSP-1

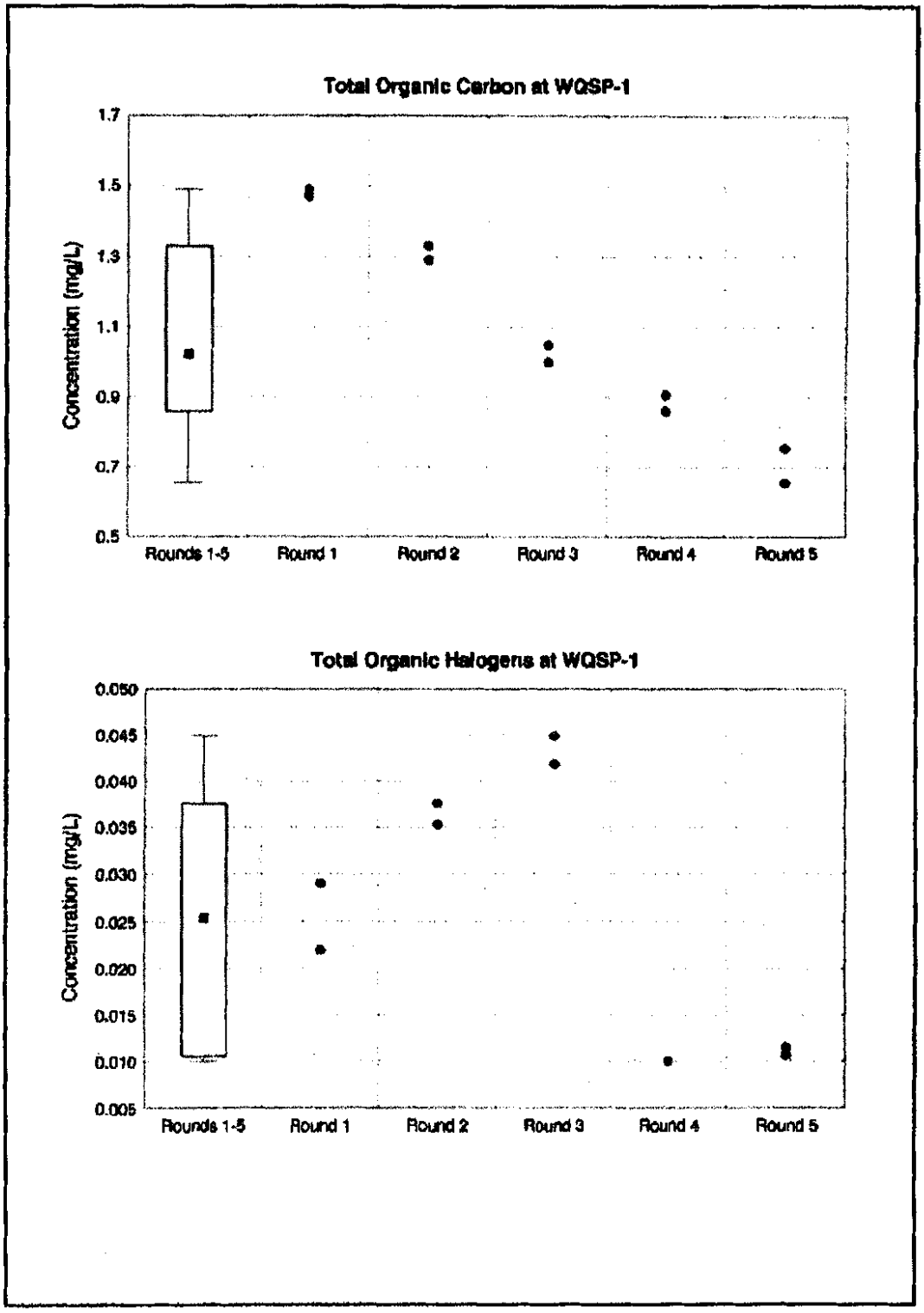


Figure 7.19 - Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-1

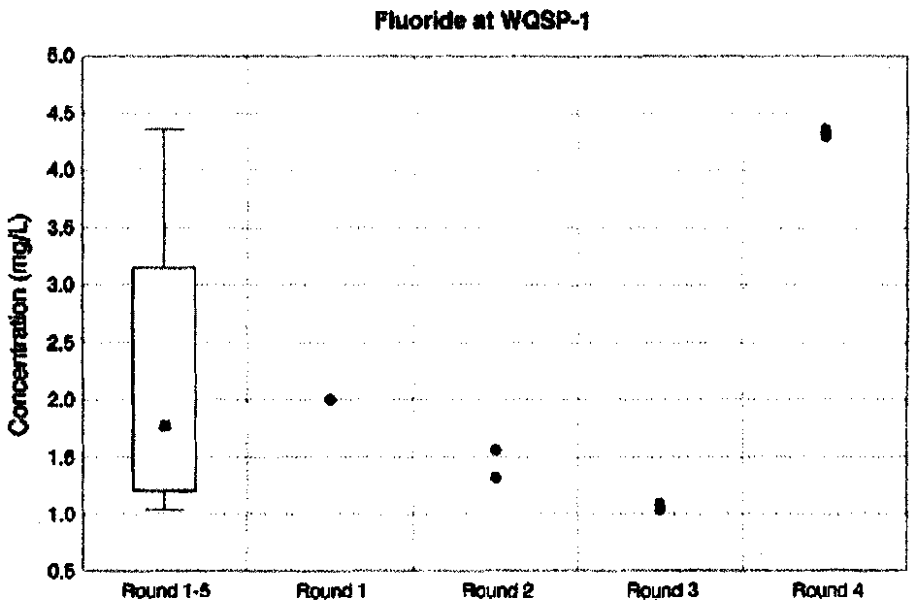


Figure 7.20 - Time Trend Plot for Fluoride at WQSP-1

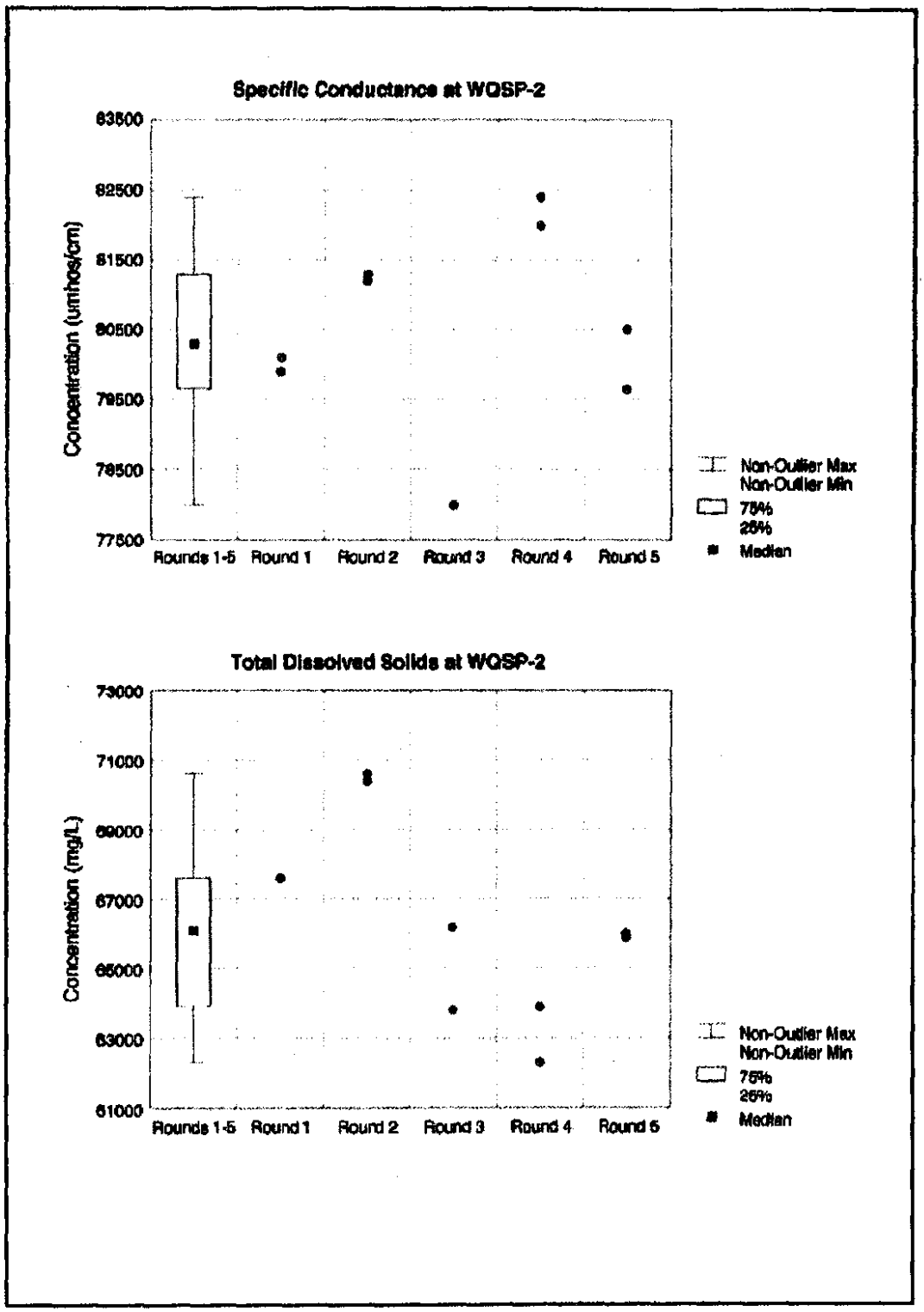


Figure 7.21 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-2

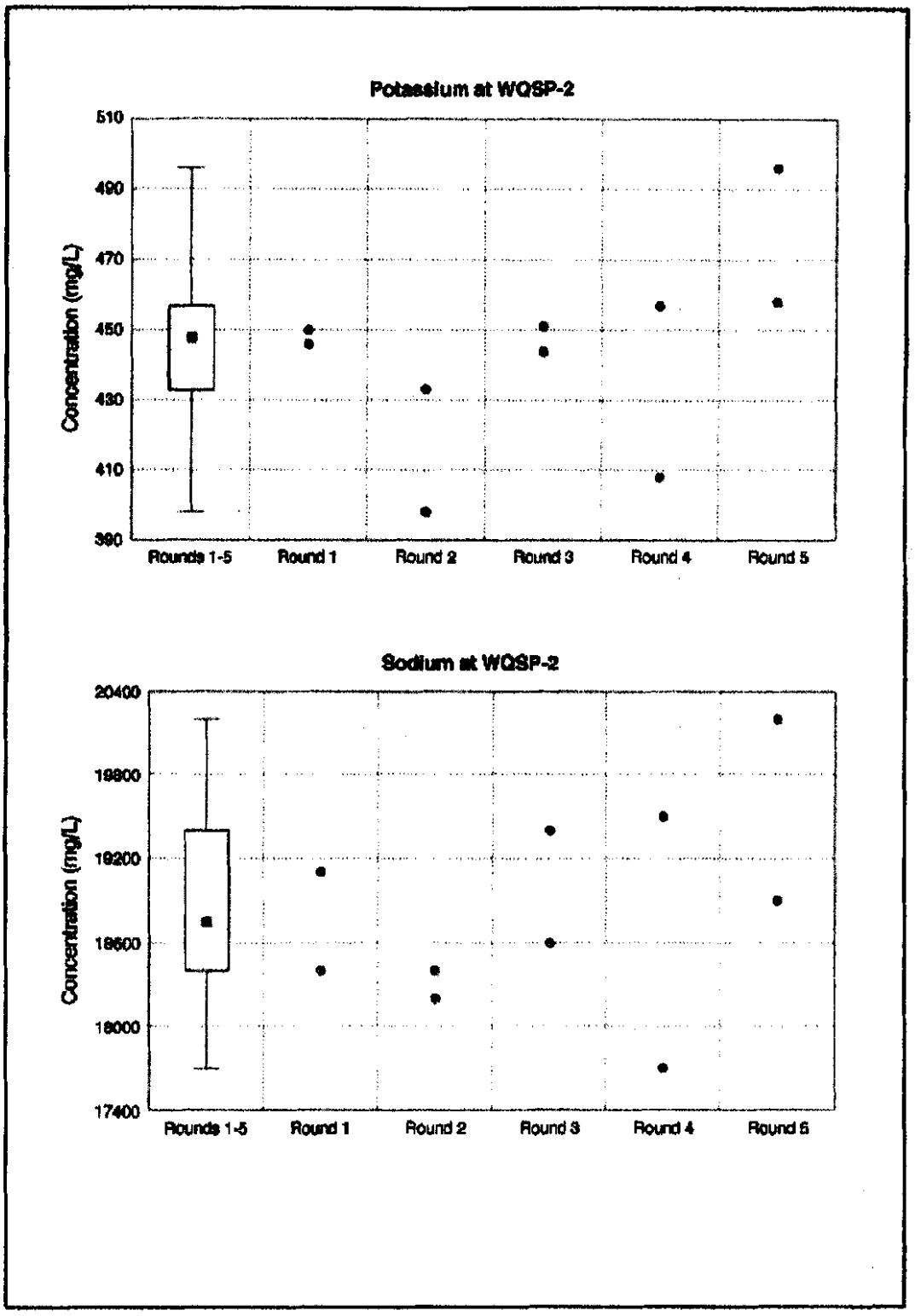


Figure 7.22 - Time Trend Plot for Potassium and Sodium at WQSP-2

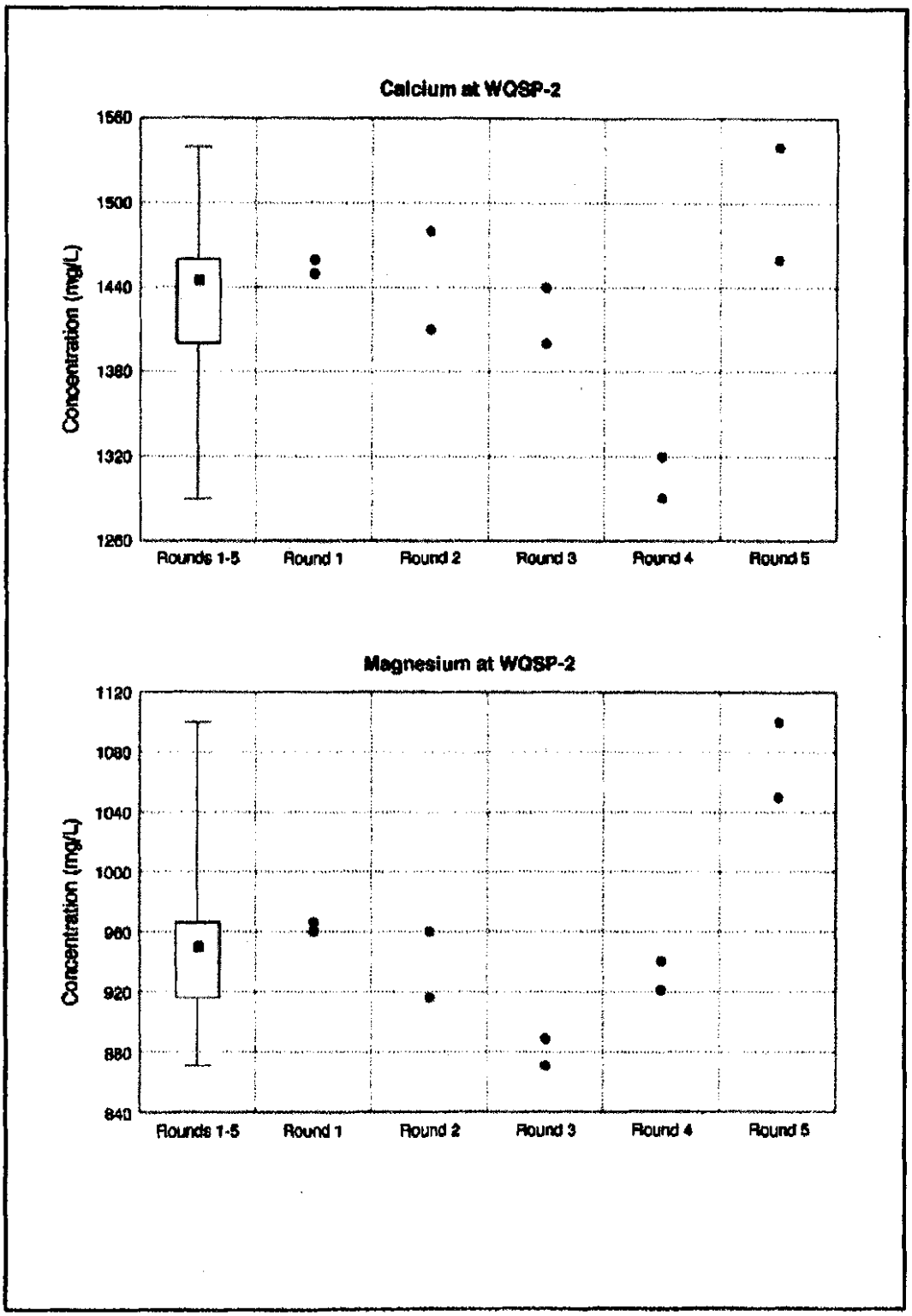


Figure 7.23 - Time Trend Plot for Calcium and Magnesium at WQSP-2

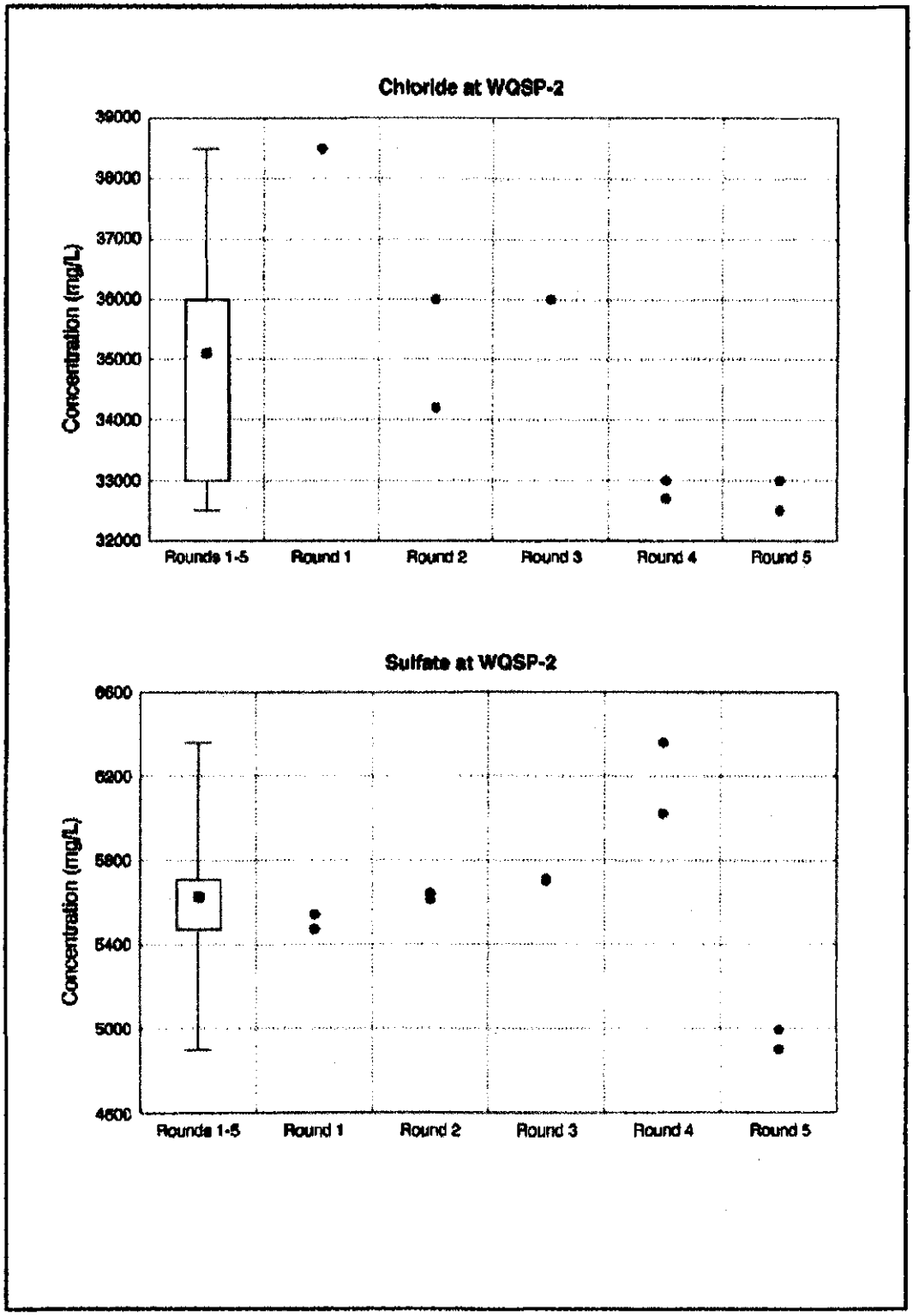


Figure 7.24 - Time Trend Plot for Chloride and Sulfate at WQSP-2

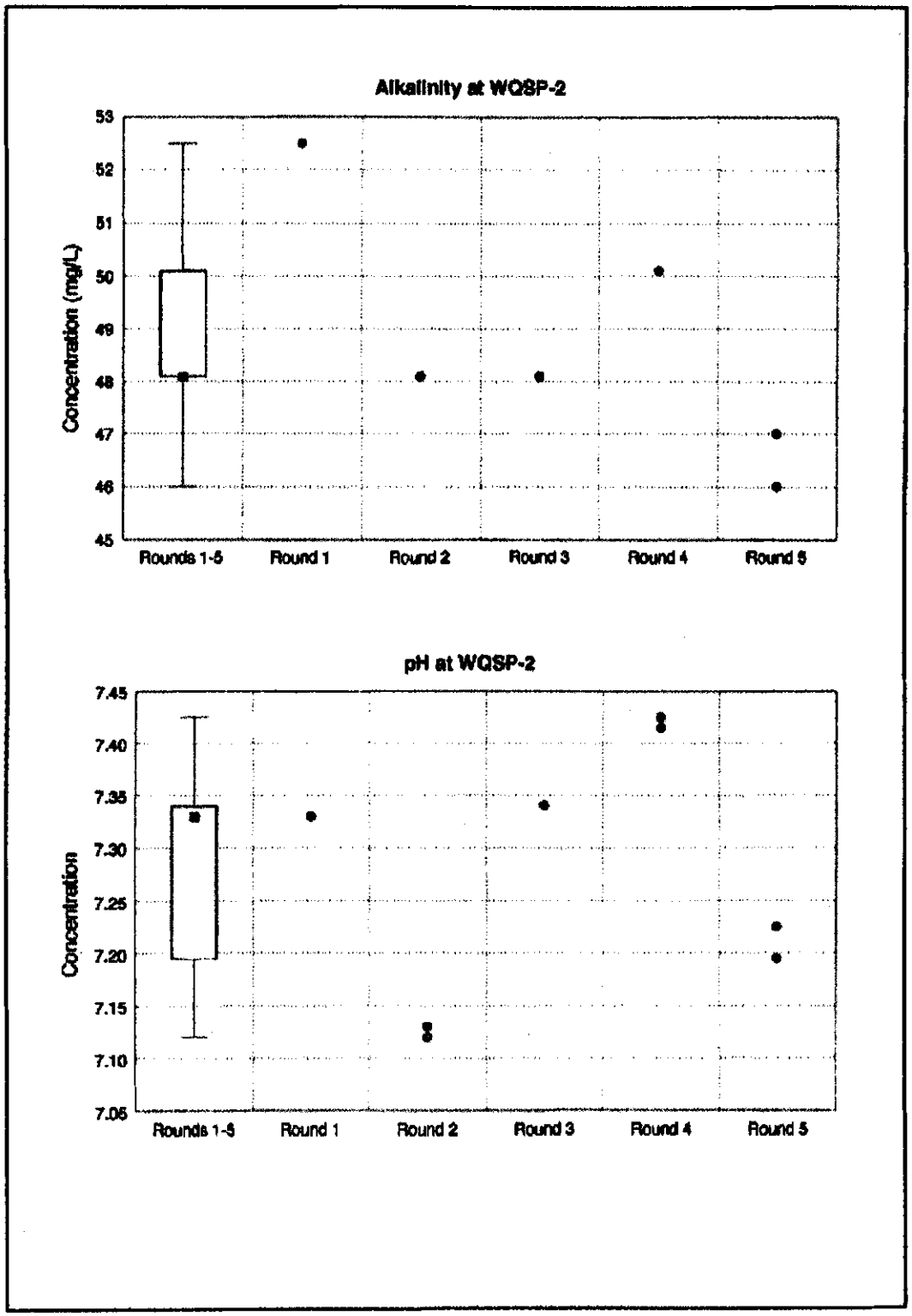


Figure 7.25 - Time Trend Plot for Alkalinity and pH at WQSP-2

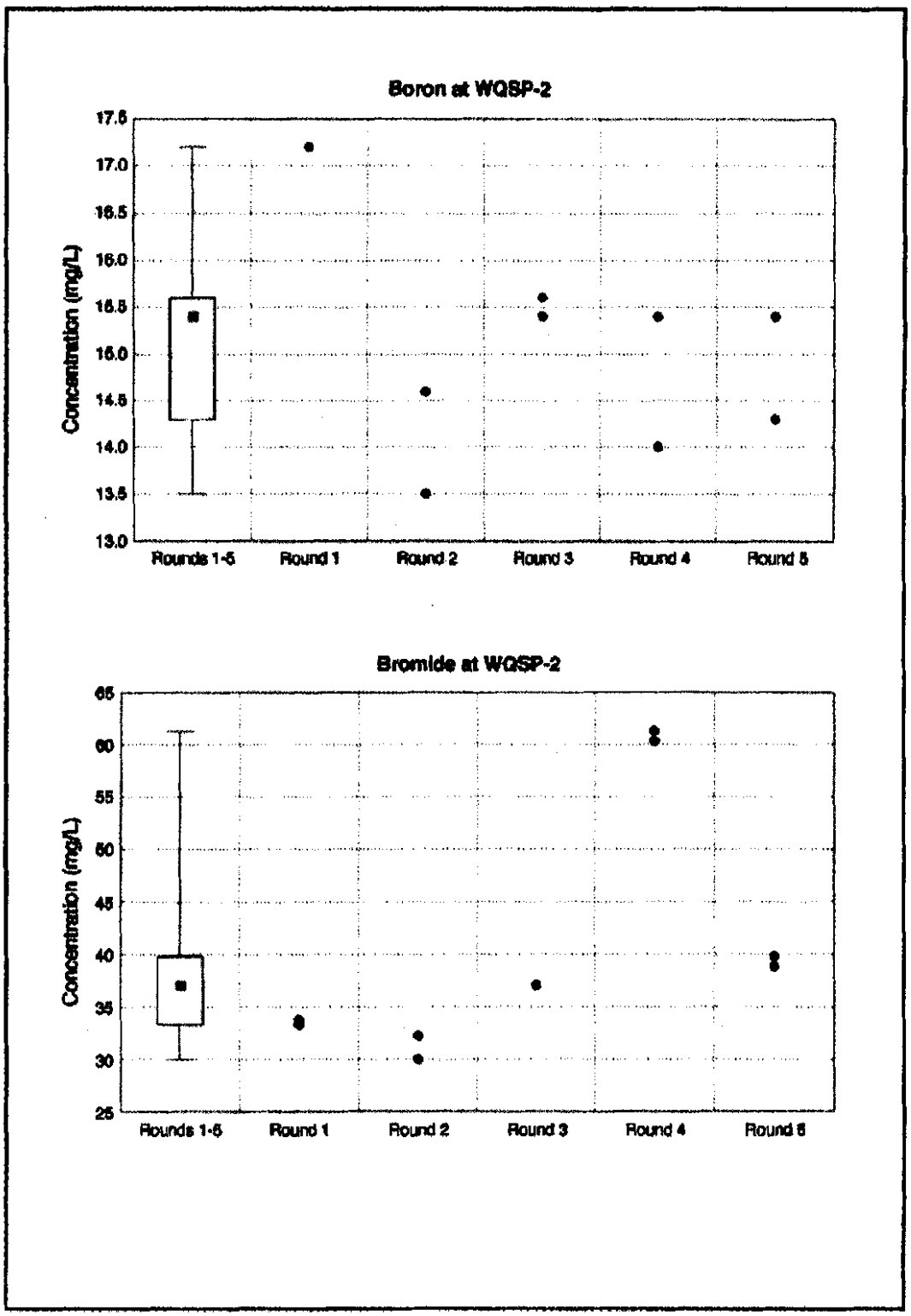


Figure 7.26 - Time Trend Plot for Boron and Bromide at WQSP-2

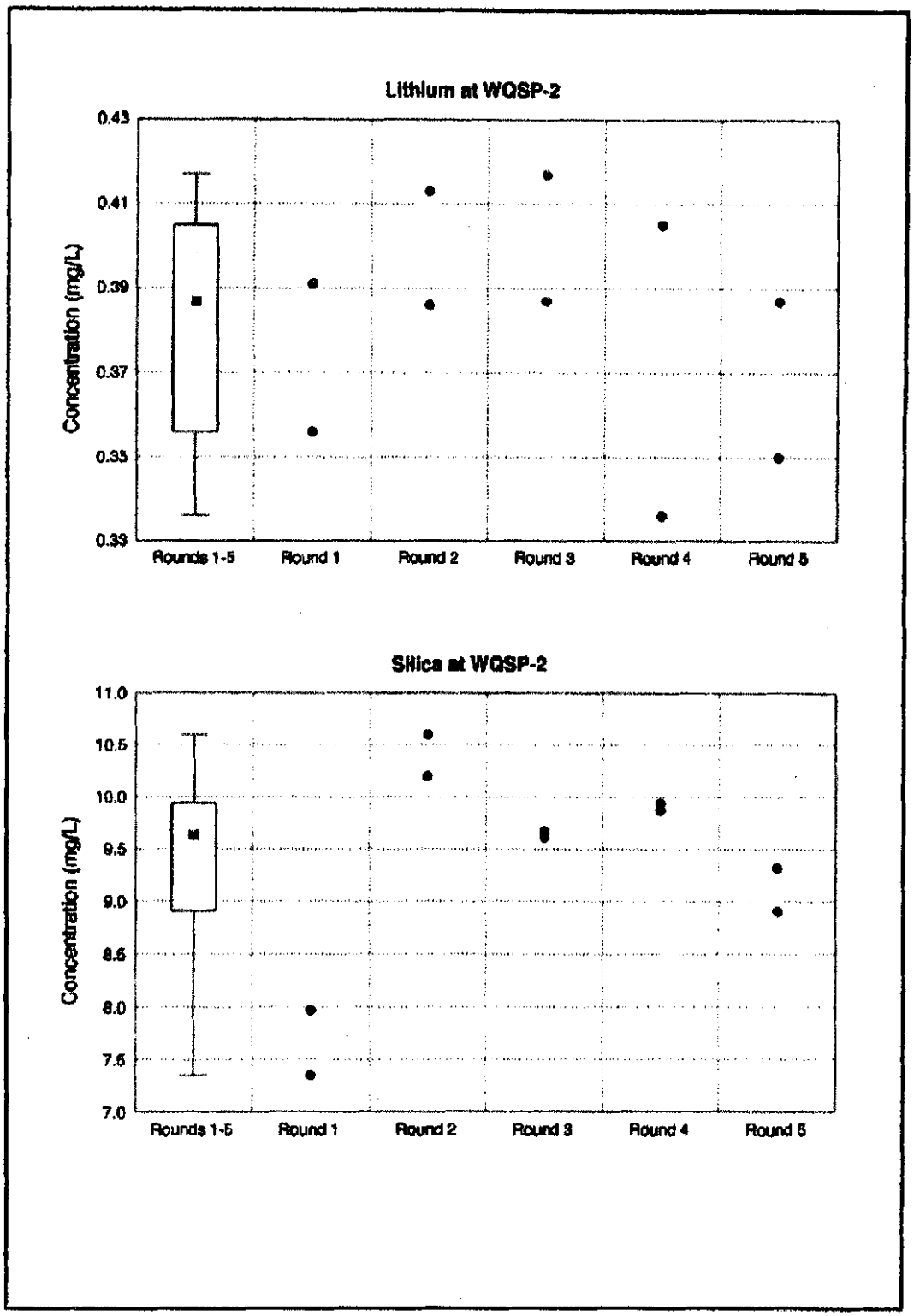


Figure 7.27 - Time Trend Plot for Lithium and Silica at WQSP-2

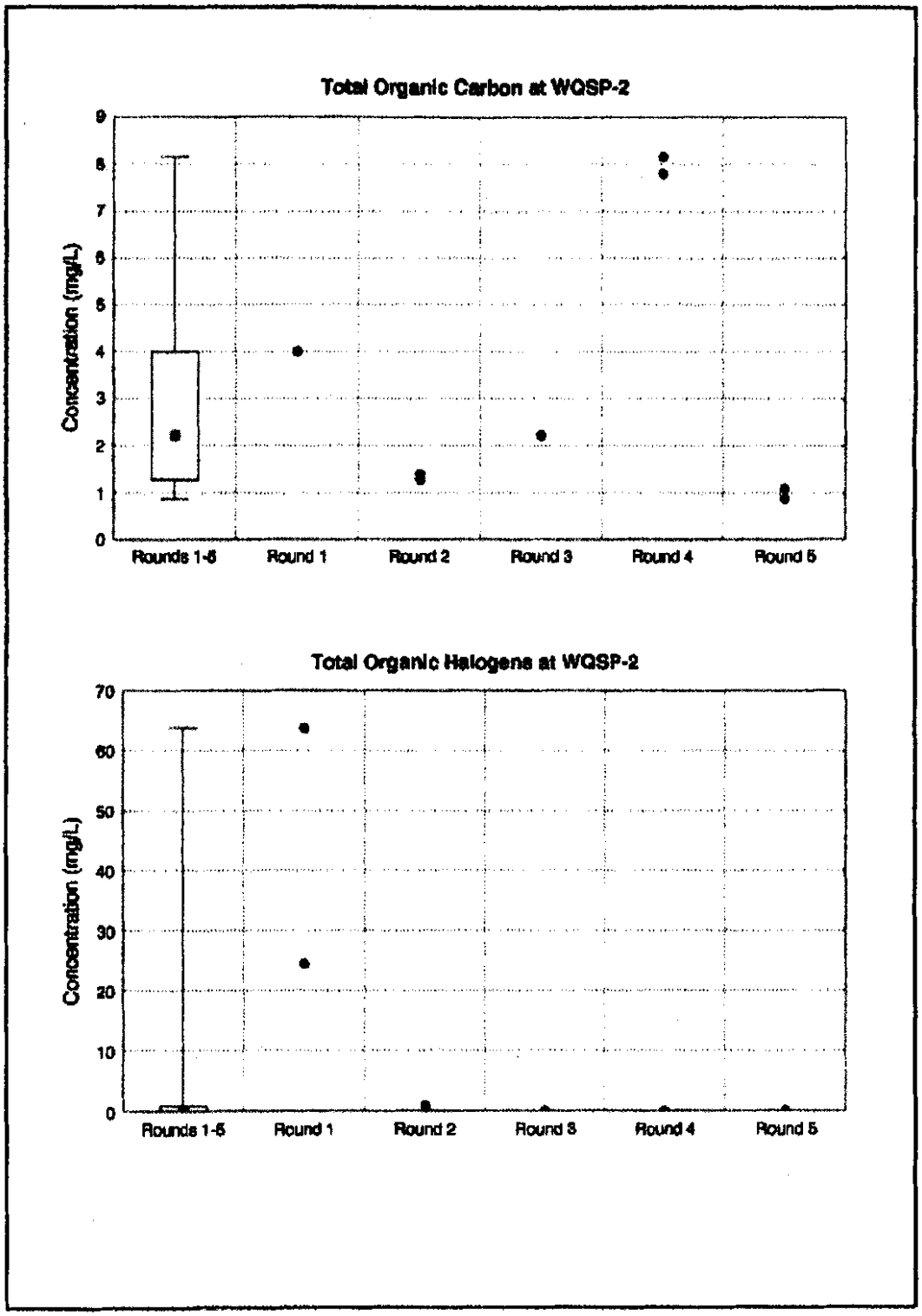


Figure 7.28 - Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-2

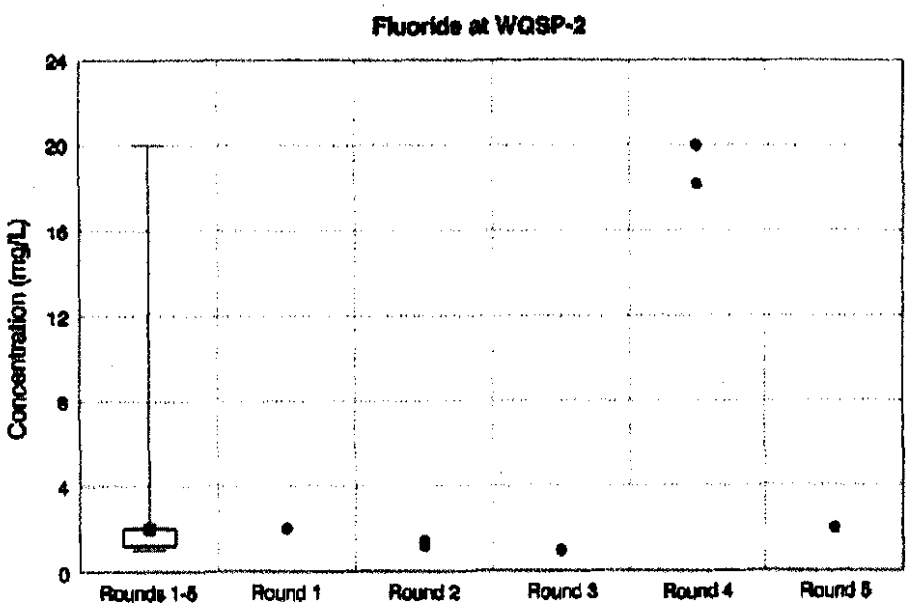


Figure 7.29 - Time Trend Plot for Fluoride at WQSP-2

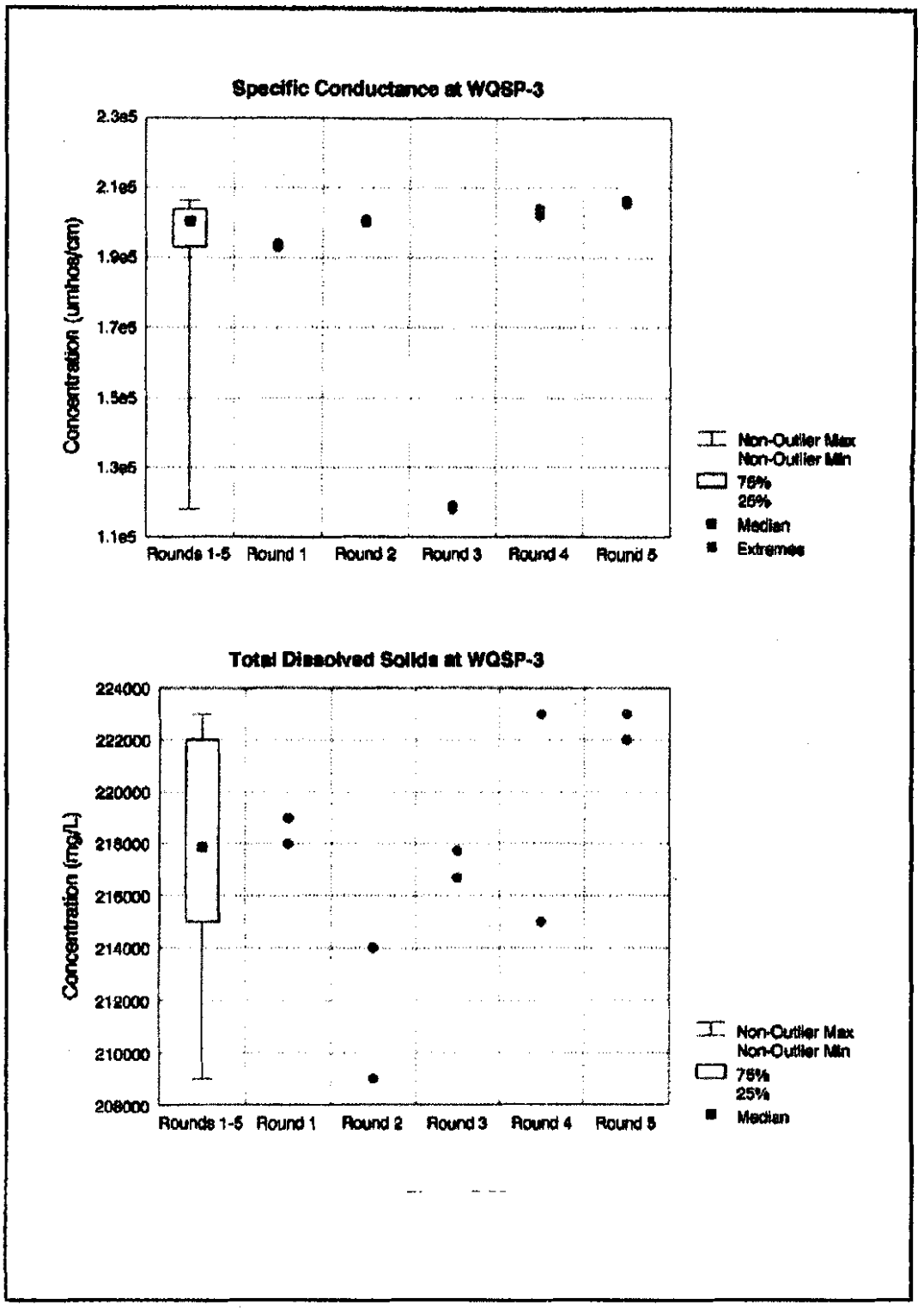


Figure 7.30 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-3

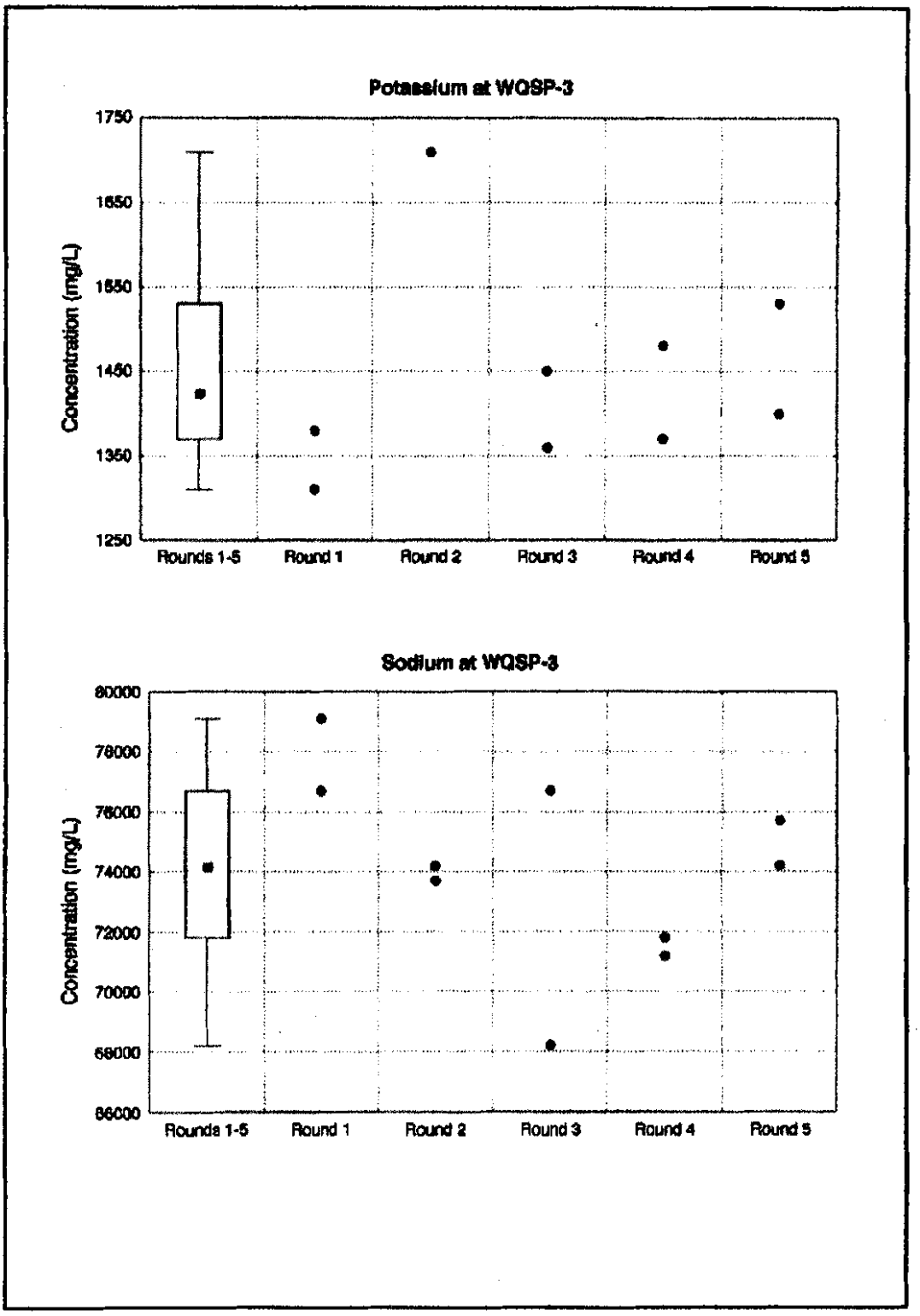


Figure 7.31 - Time Trend Plot for Potassium and Sodium at WQSP-3

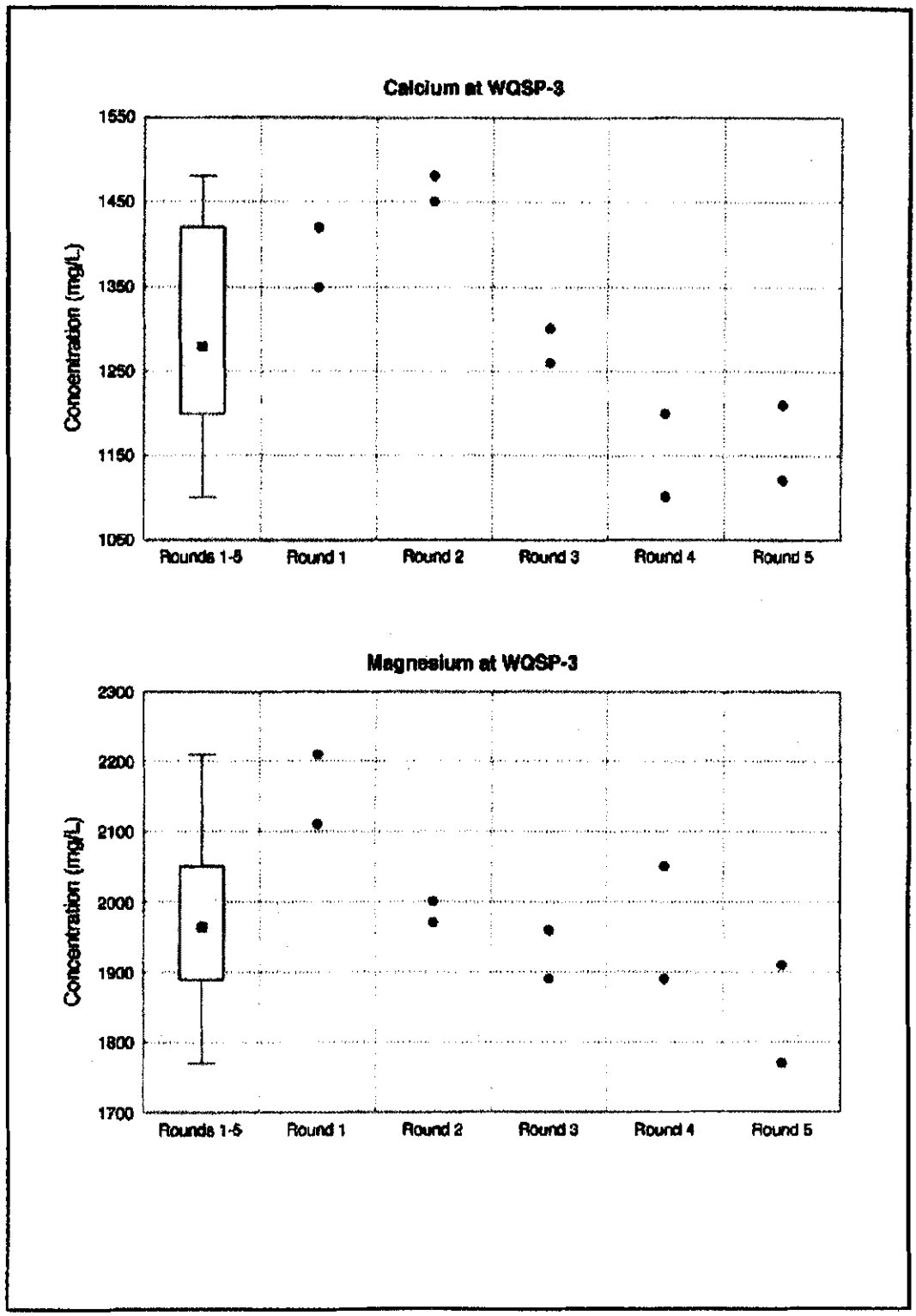


Figure 7.32 - Time Trend Plot for Calcium and Magnesium at WQSP-3

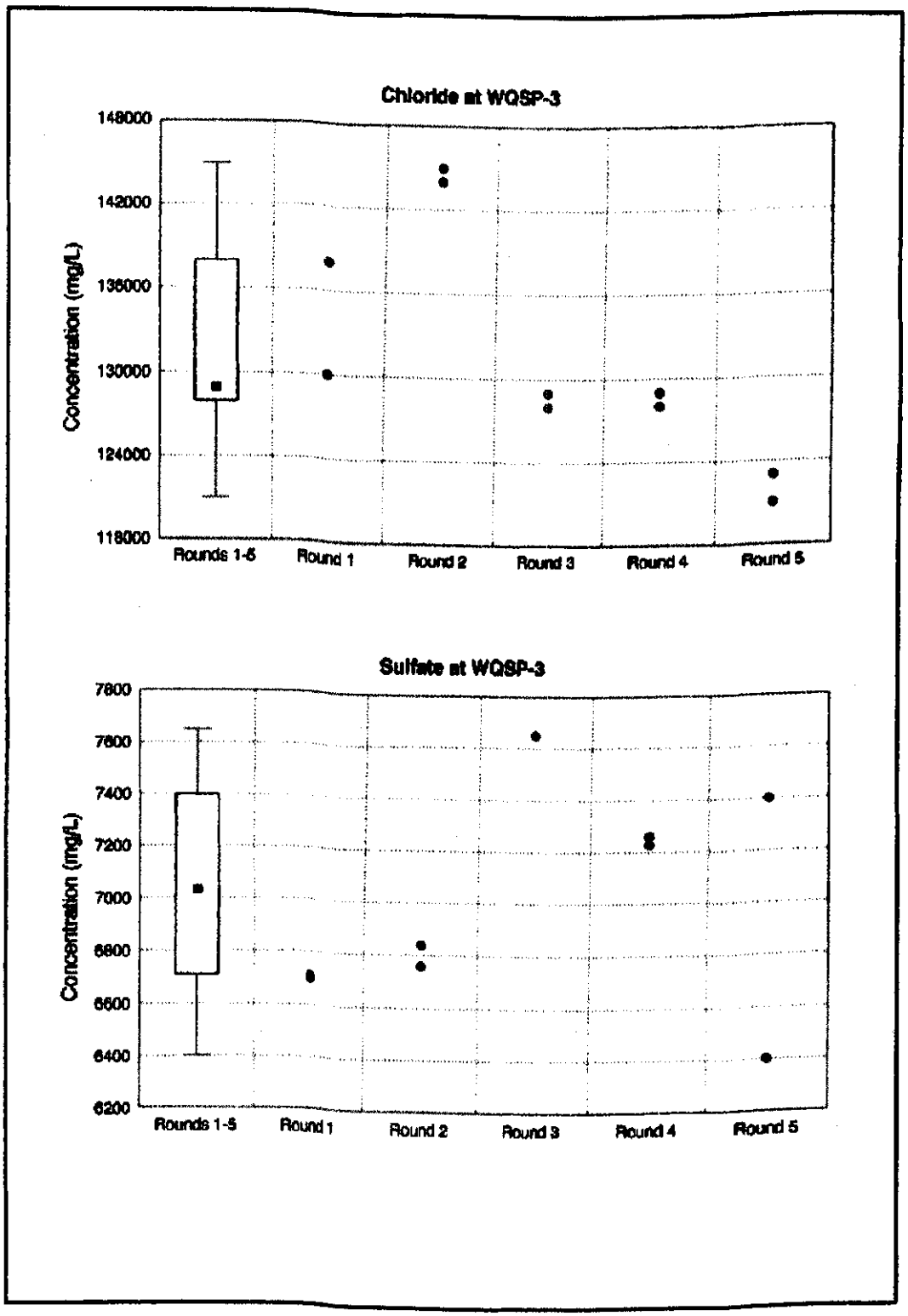


Figure 7.33 - Time Trend Plot for Chloride and Sulfate at WQSP-3

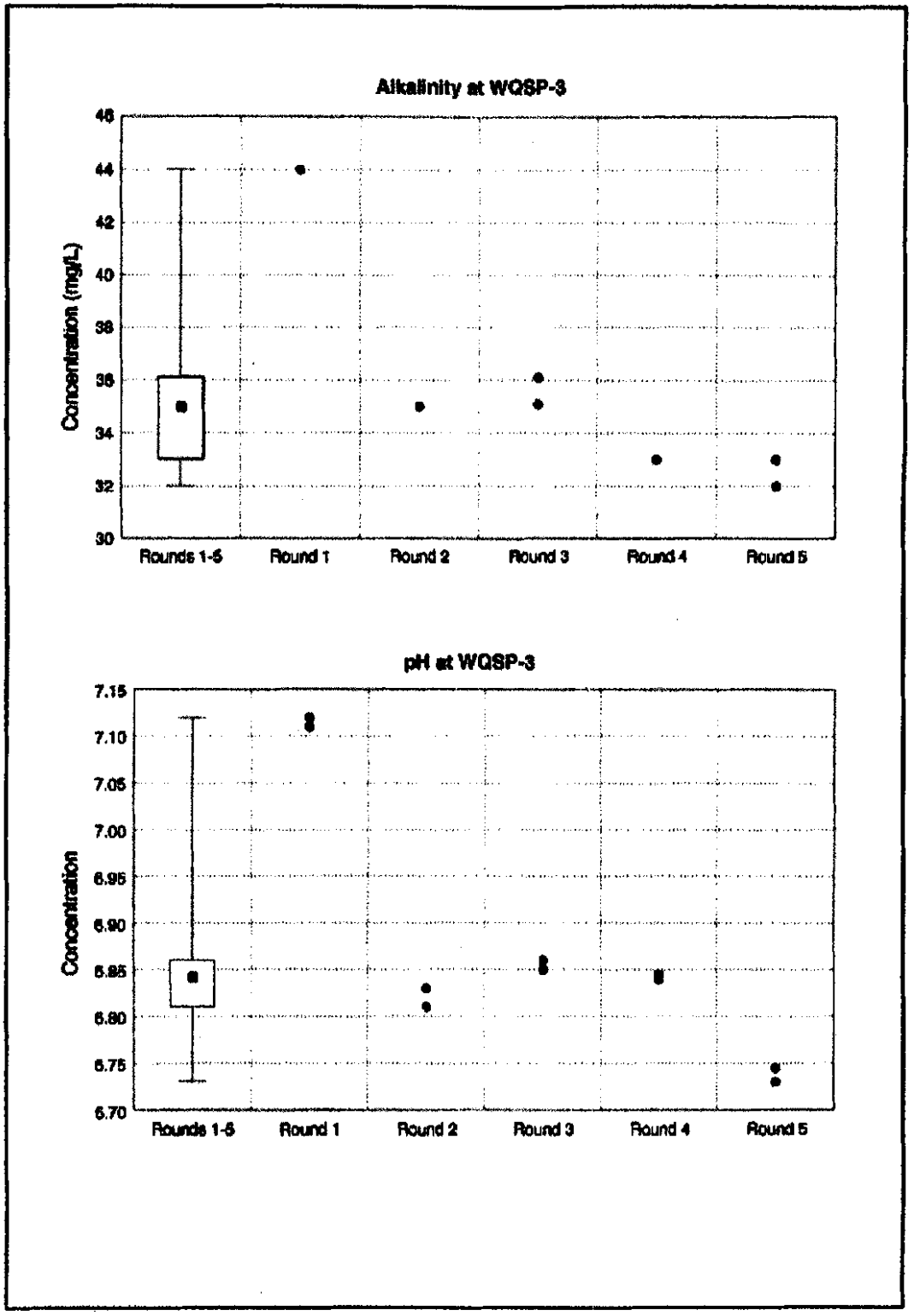


Figure 7.34 - Time Trend Plot for Alkalinity and pH at WQSP-3

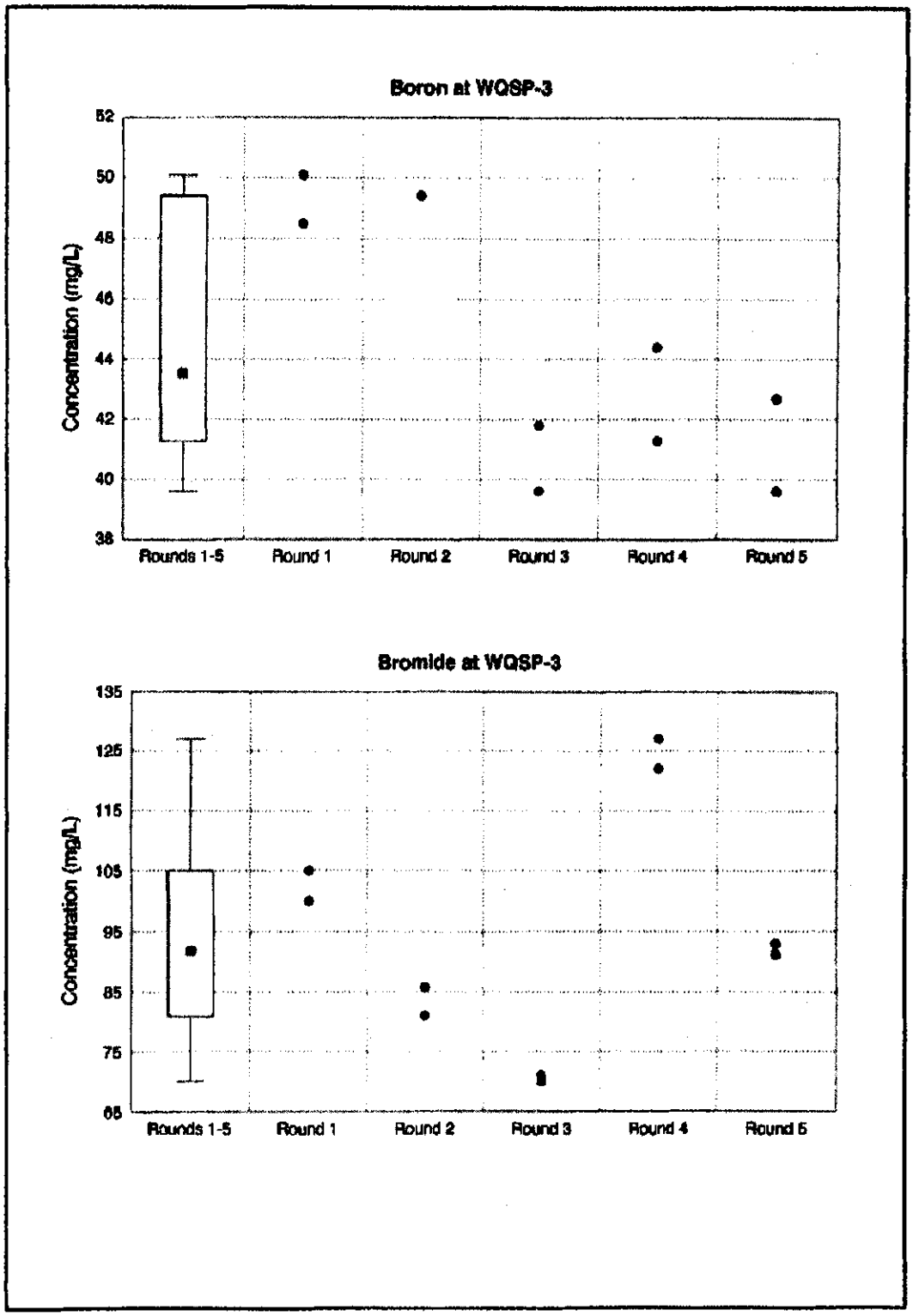


Figure 7.35 - Time Trend Plot for Boron and Bromide at WQSP-3

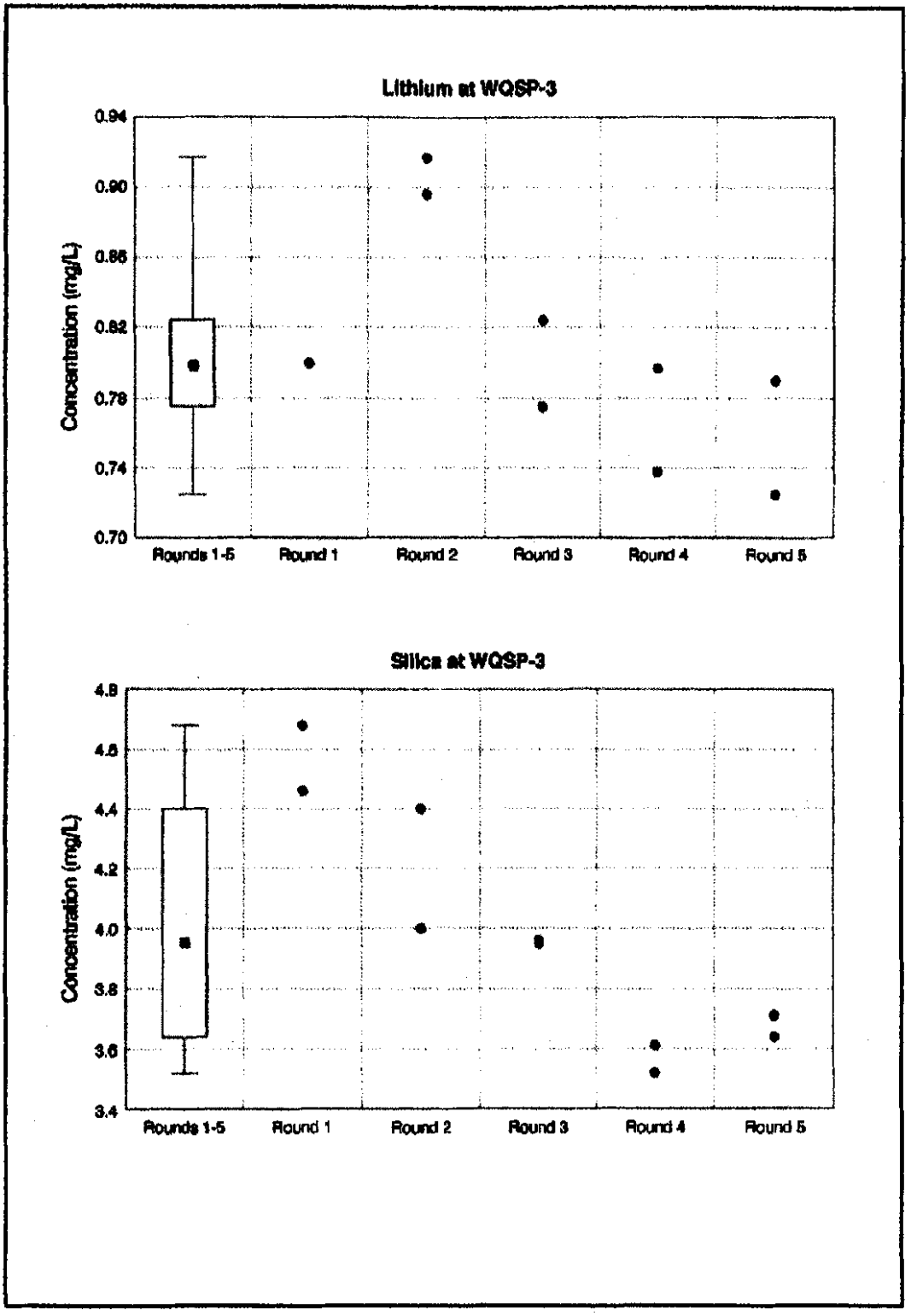


Figure 7.36 - Time Trend Plot for Lithium and Silica at WQSP-3

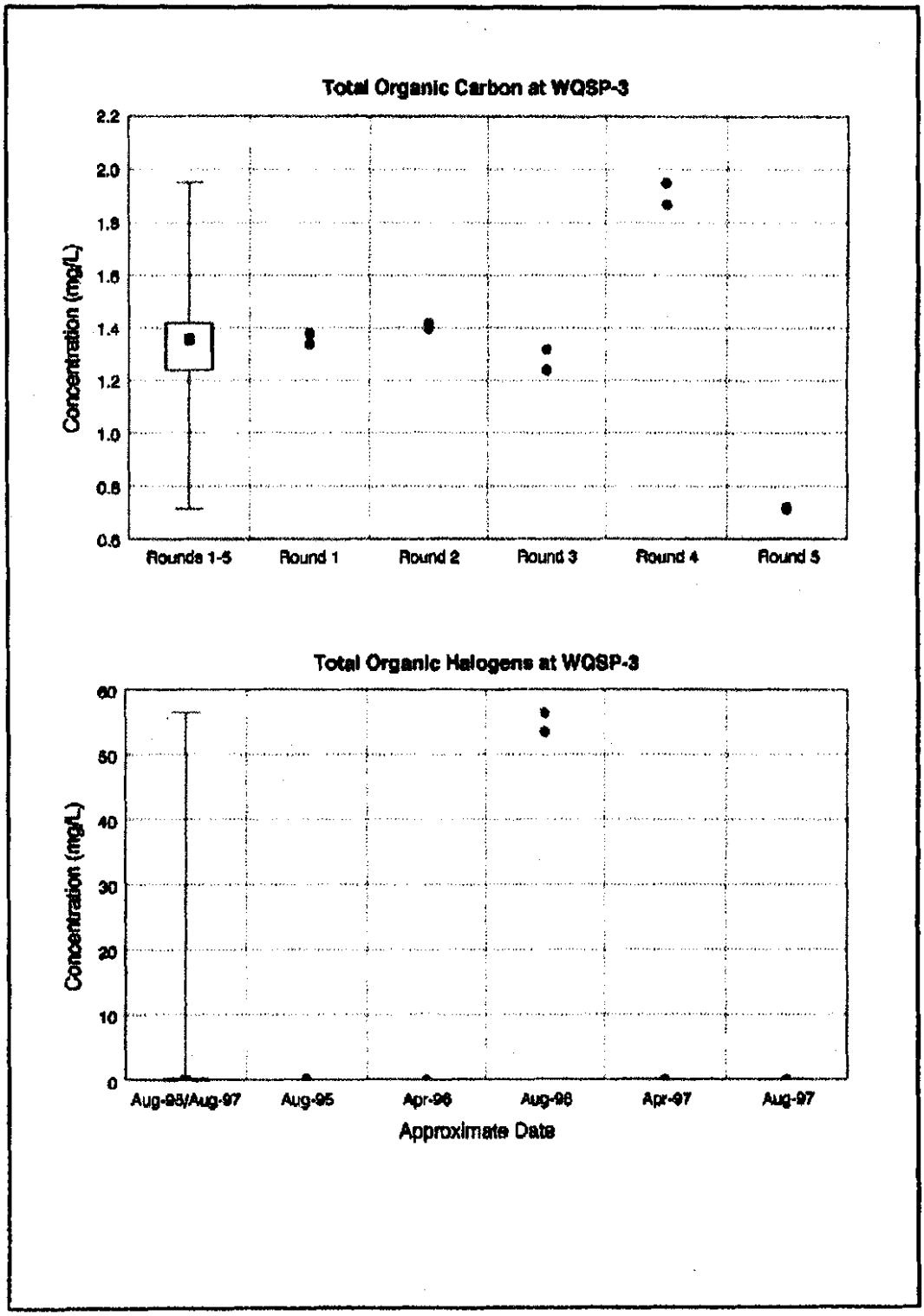


Figure 7.37 - Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-3

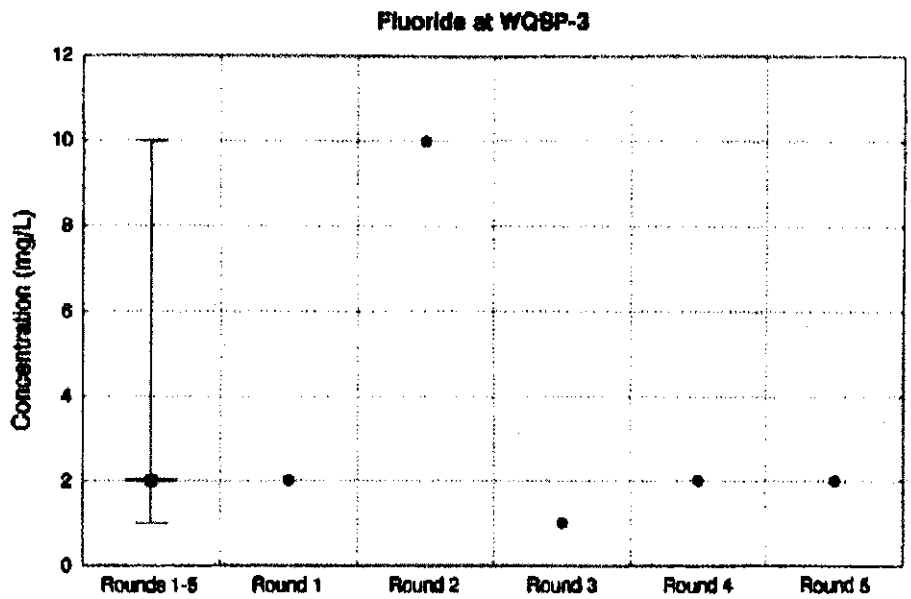


Figure 7.38 - Time Trend Plot for Fluoride at WQSP-3

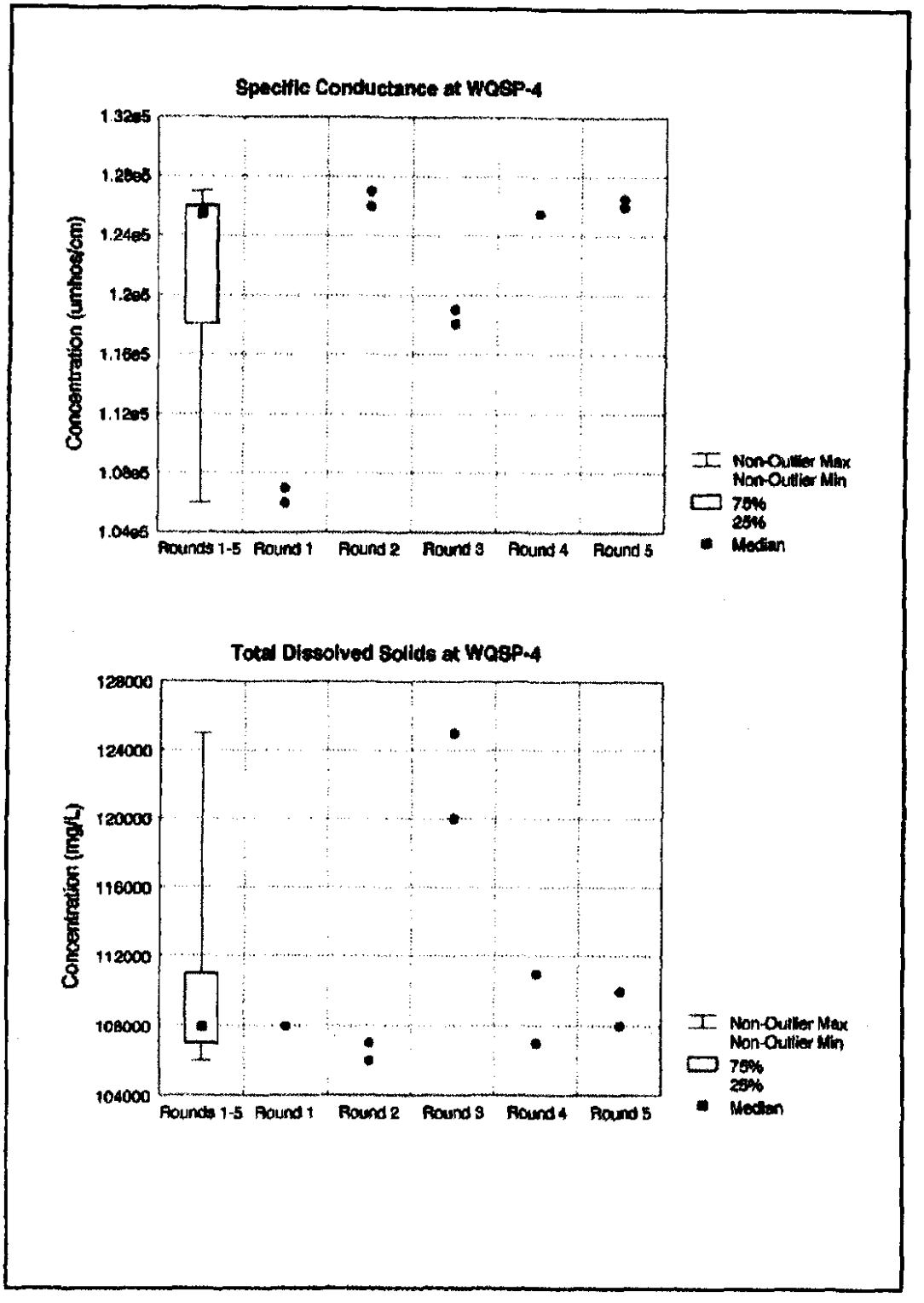


Figure 7.39 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-4

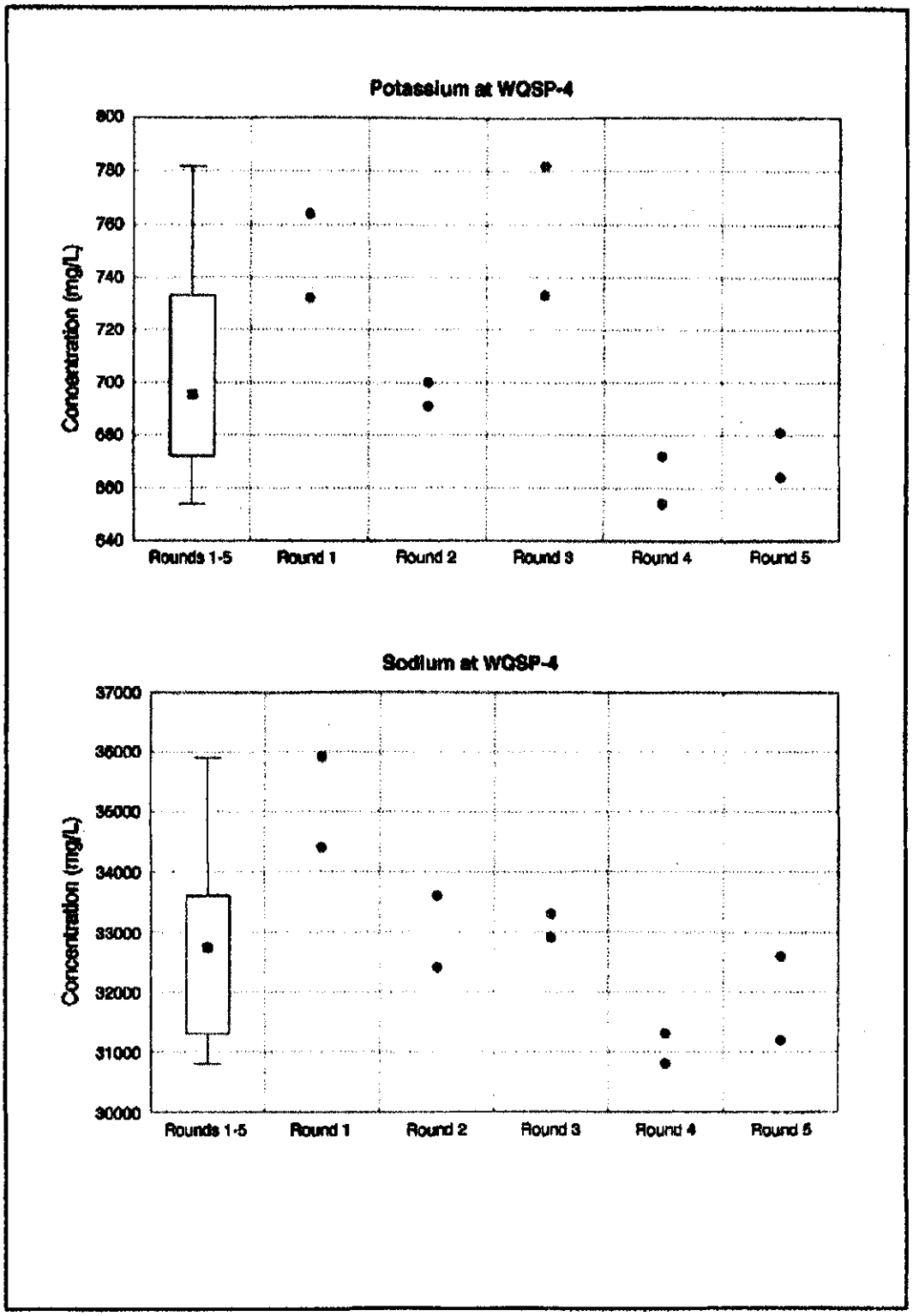


Figure 7.40 - Time Trend Plot for Potassium and Sodium at WQSP-4

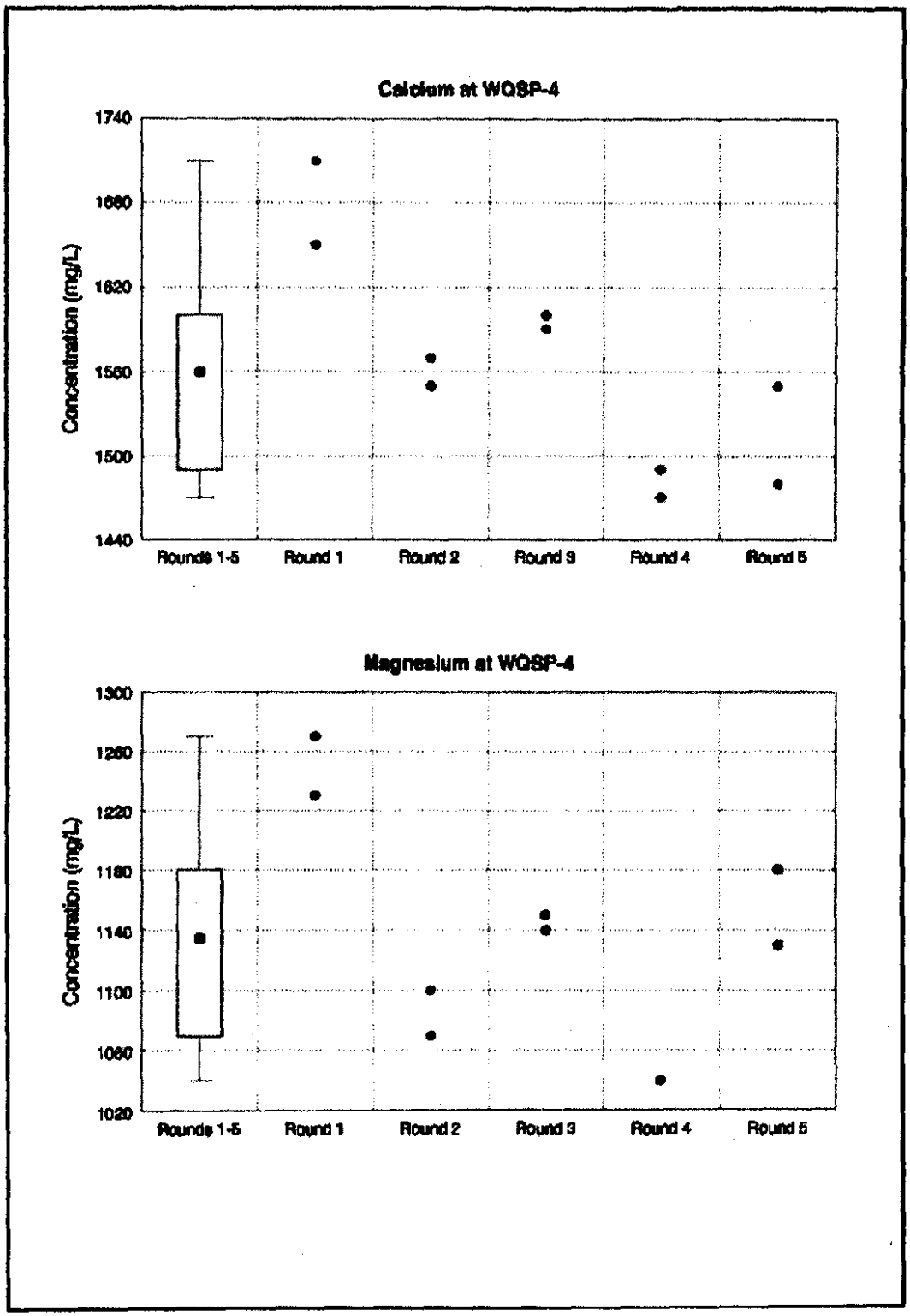


Figure 7.41 - Time Trend Plot for Calcium and Magnesium at WQSP-4

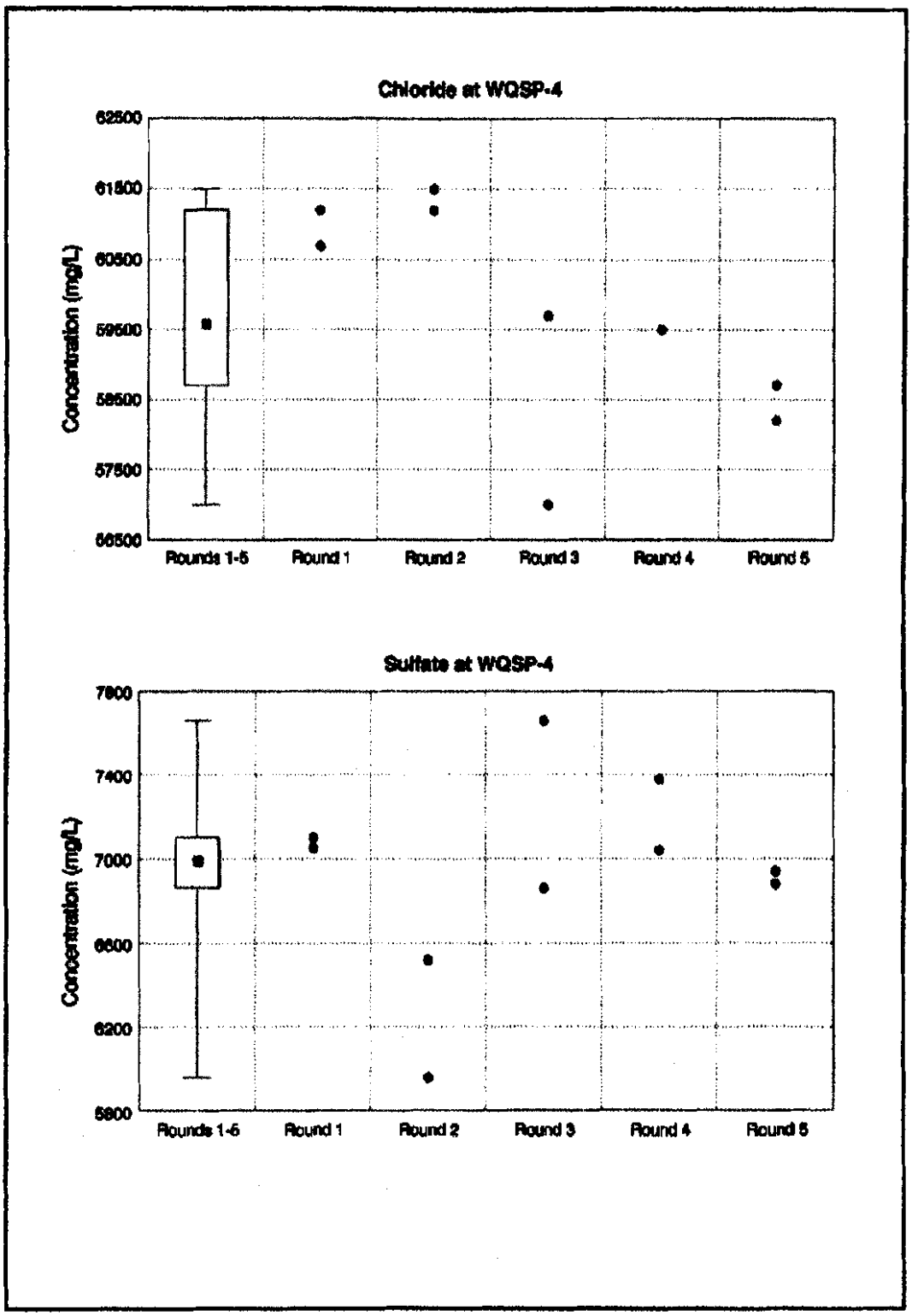


Figure 7.42 - Time Trend Plot for Chloride and Sulfate at WQSP-4

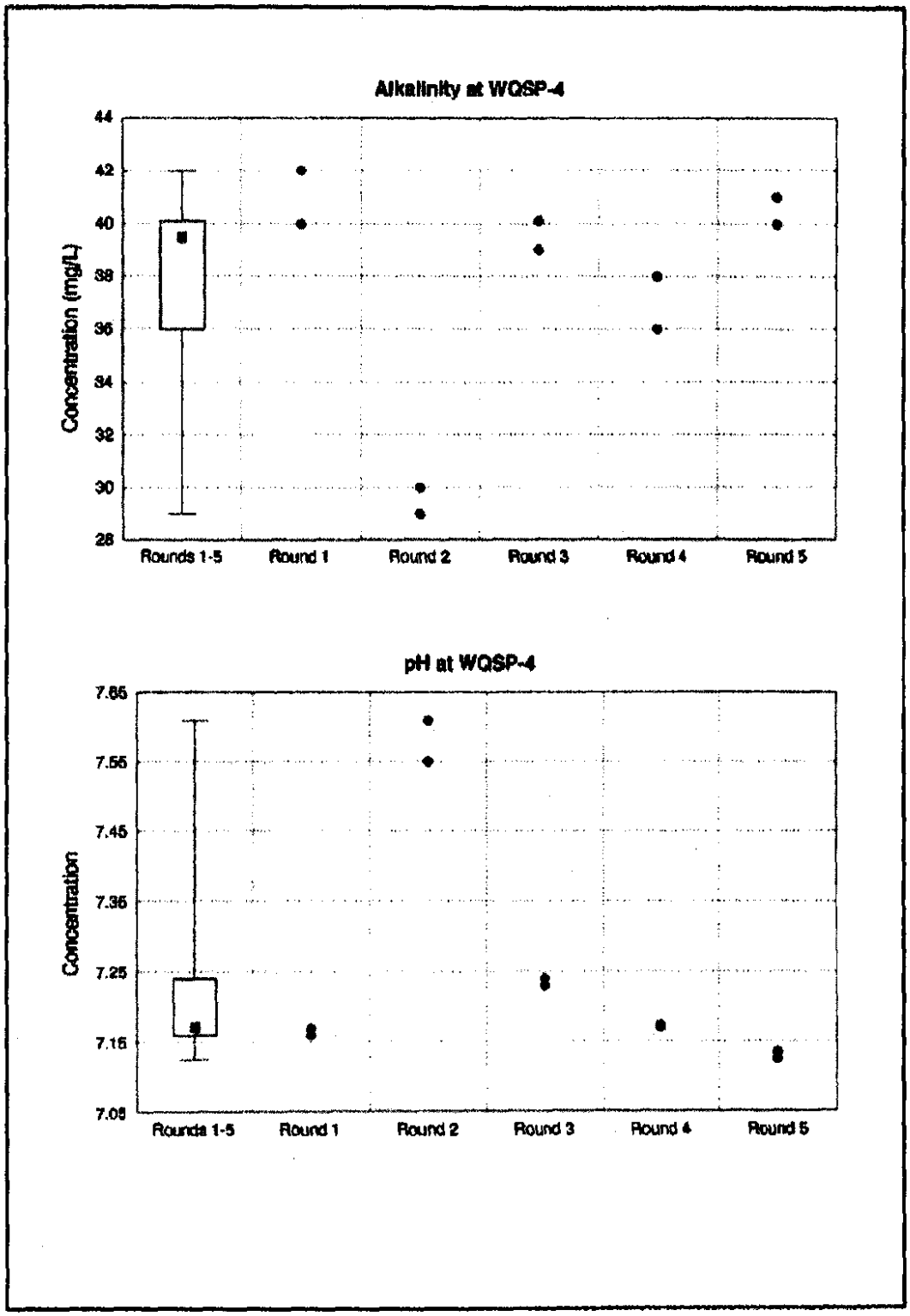


Figure 7.43 - Time Trend Plot for Alkalinity and pH at WQSP-4

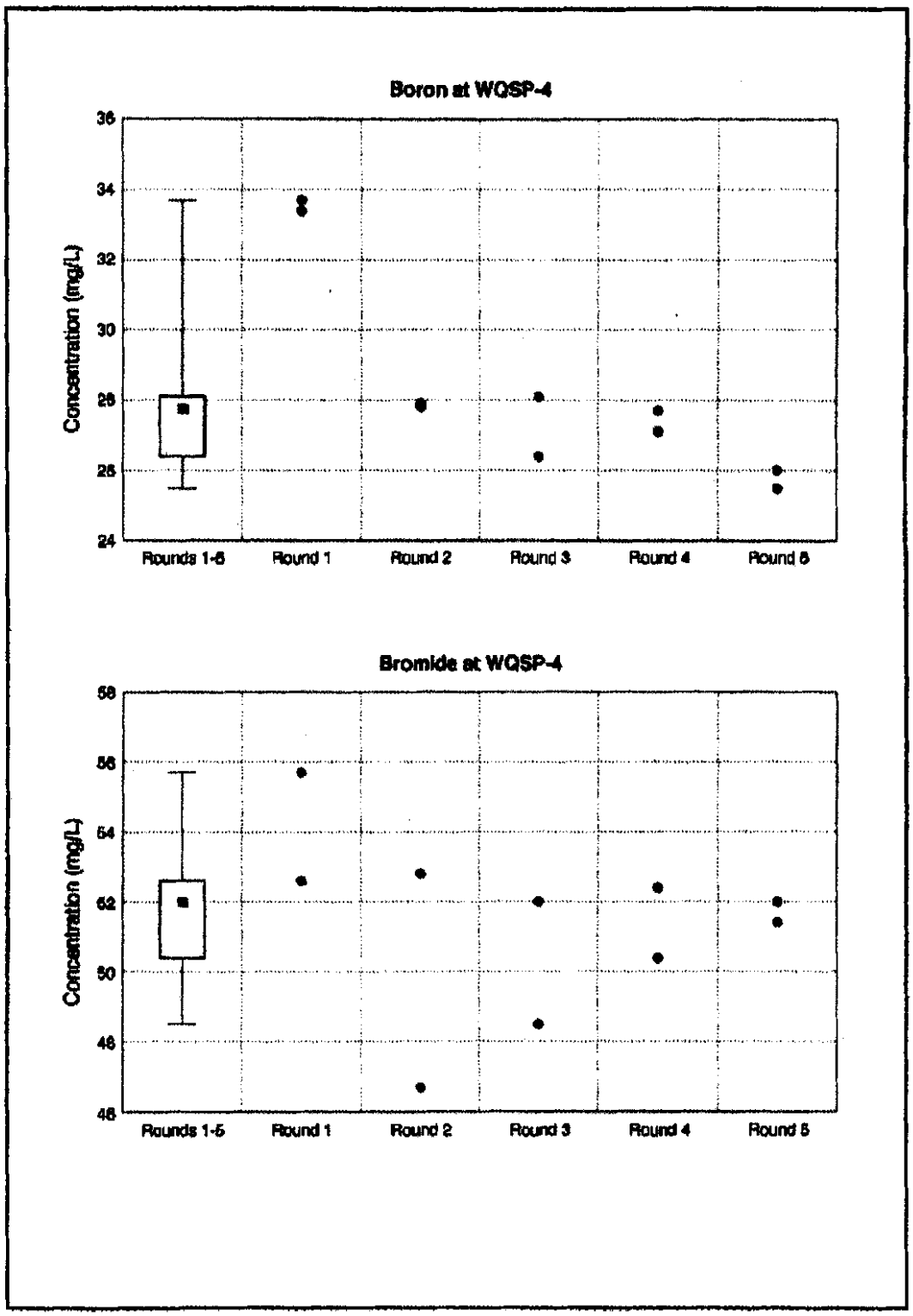


Figure 7.44 - Time Trend Plot for Boron and Bromide at WQSP-4

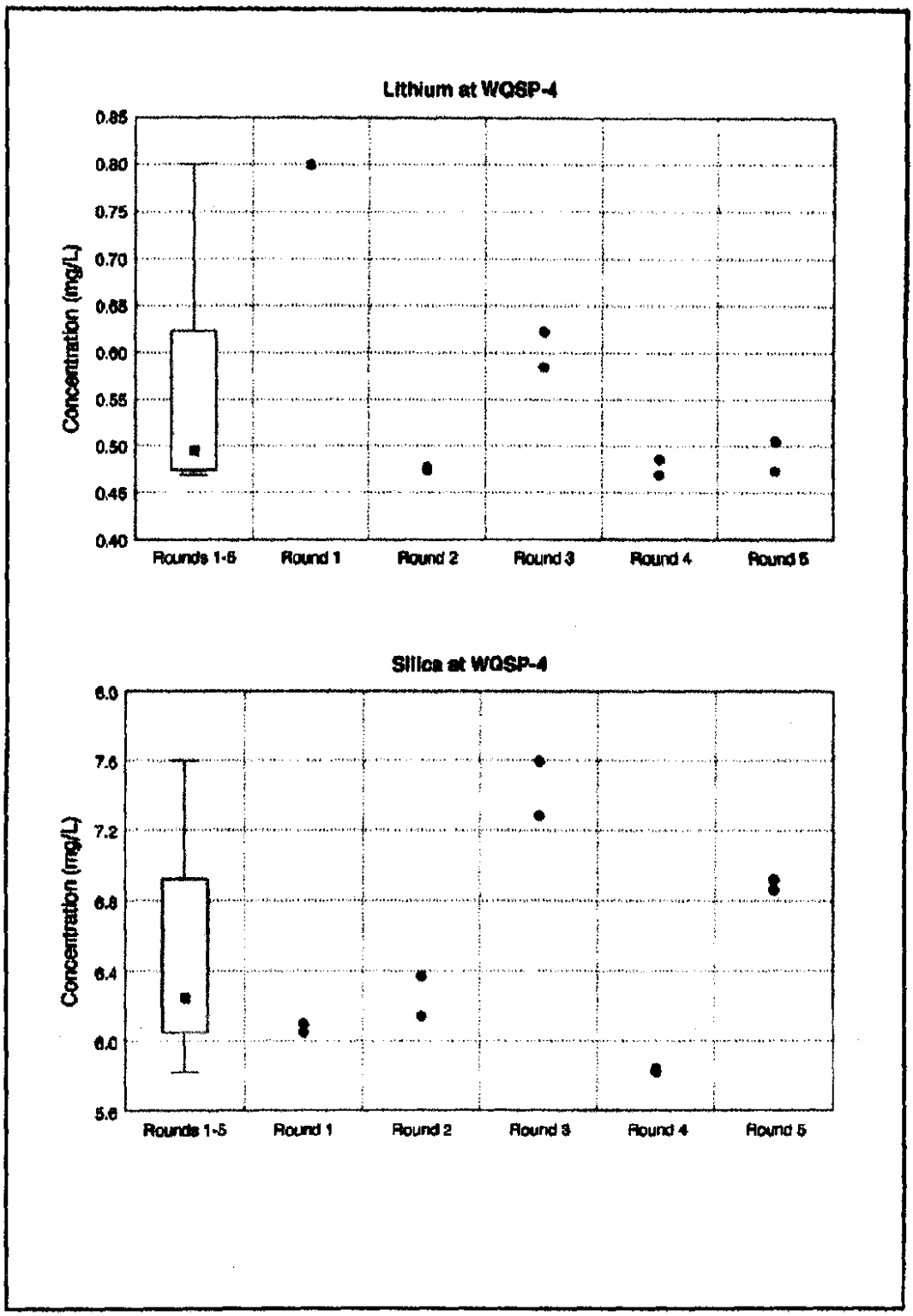


Figure 7.45 - Time Trend Plot for Lithium and Silica at WQSP-4

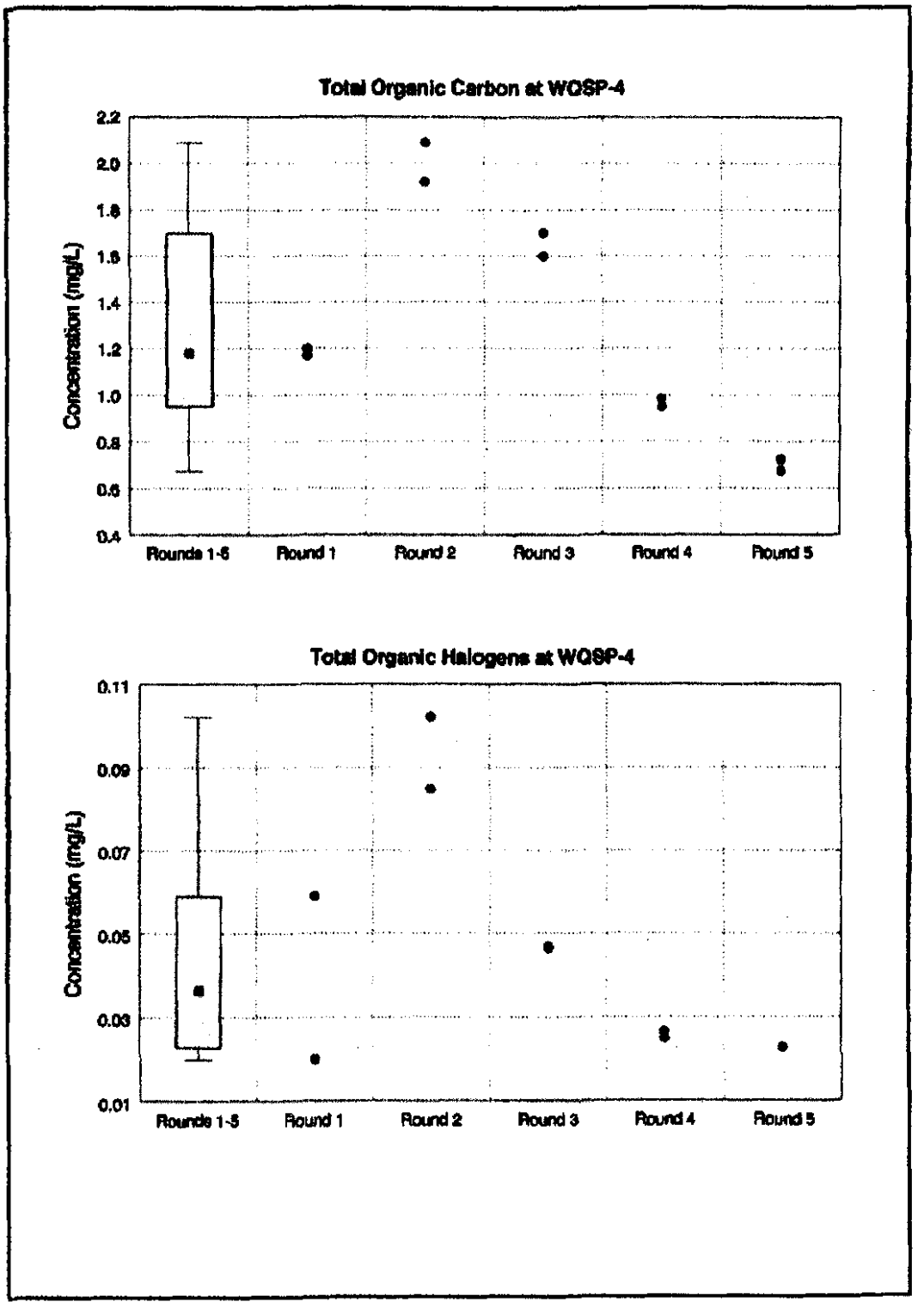


Figure 7.46 - Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-4

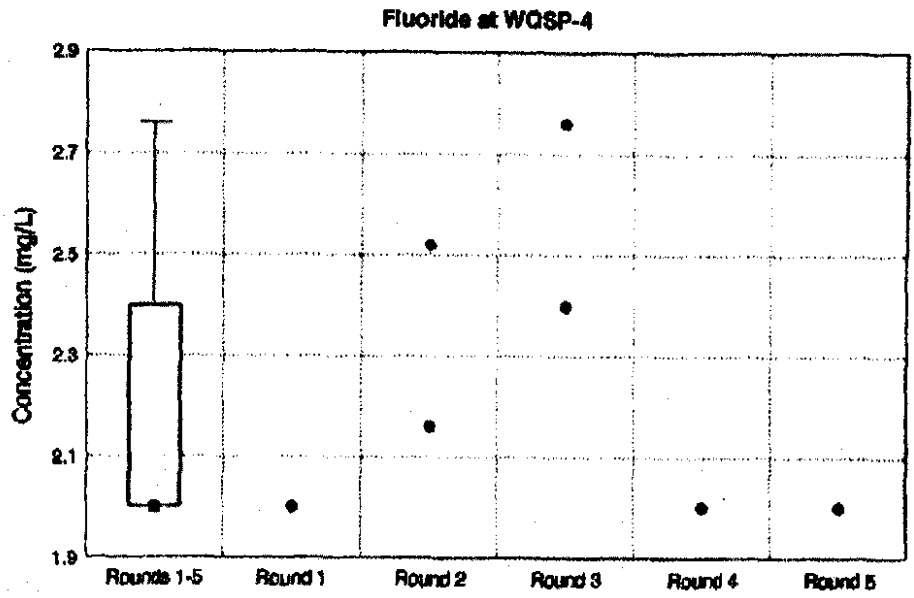


Figure 7.47 - Time Trend Plot for Fluoride at WQSP-4

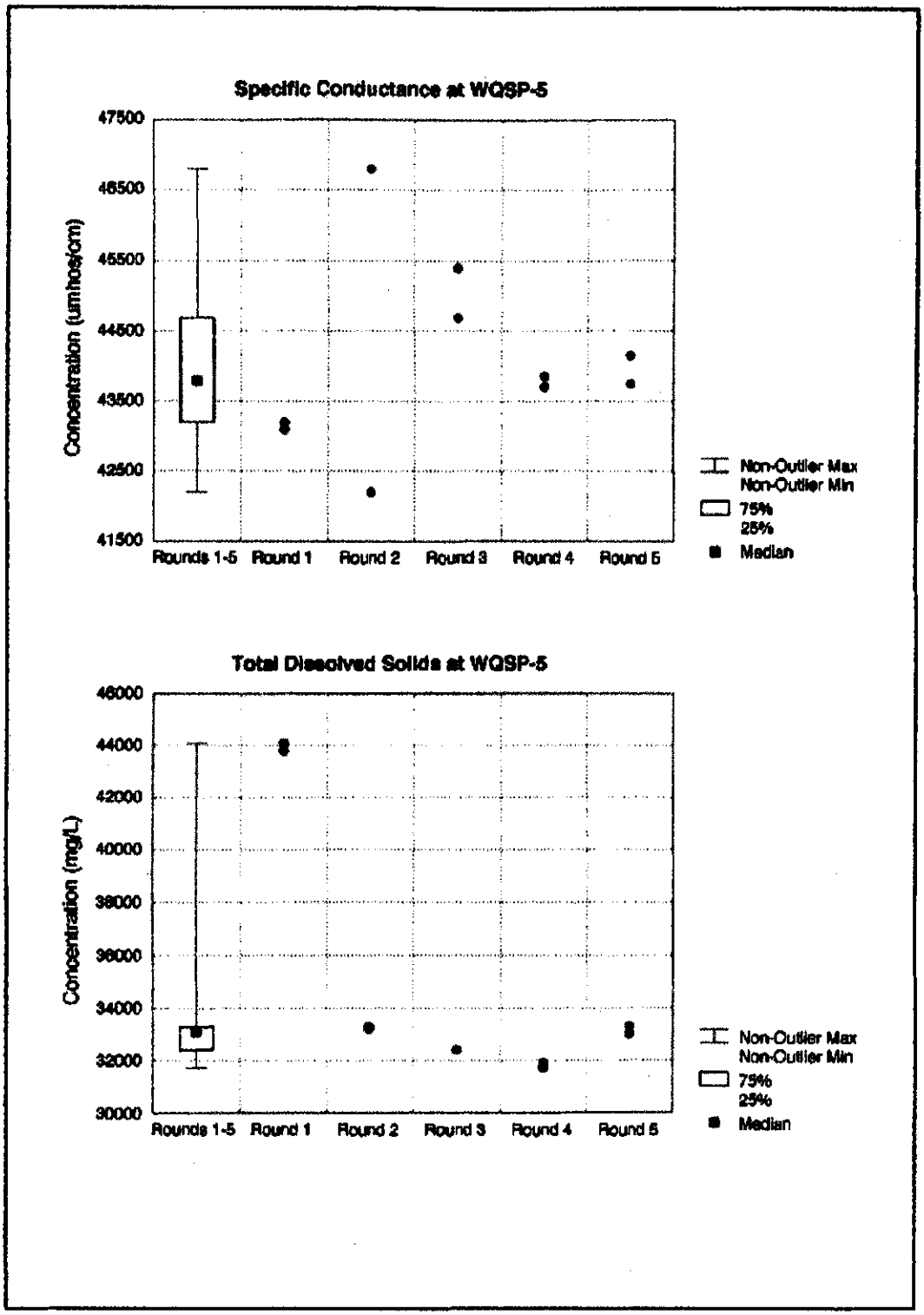


Figure 7.48 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-5

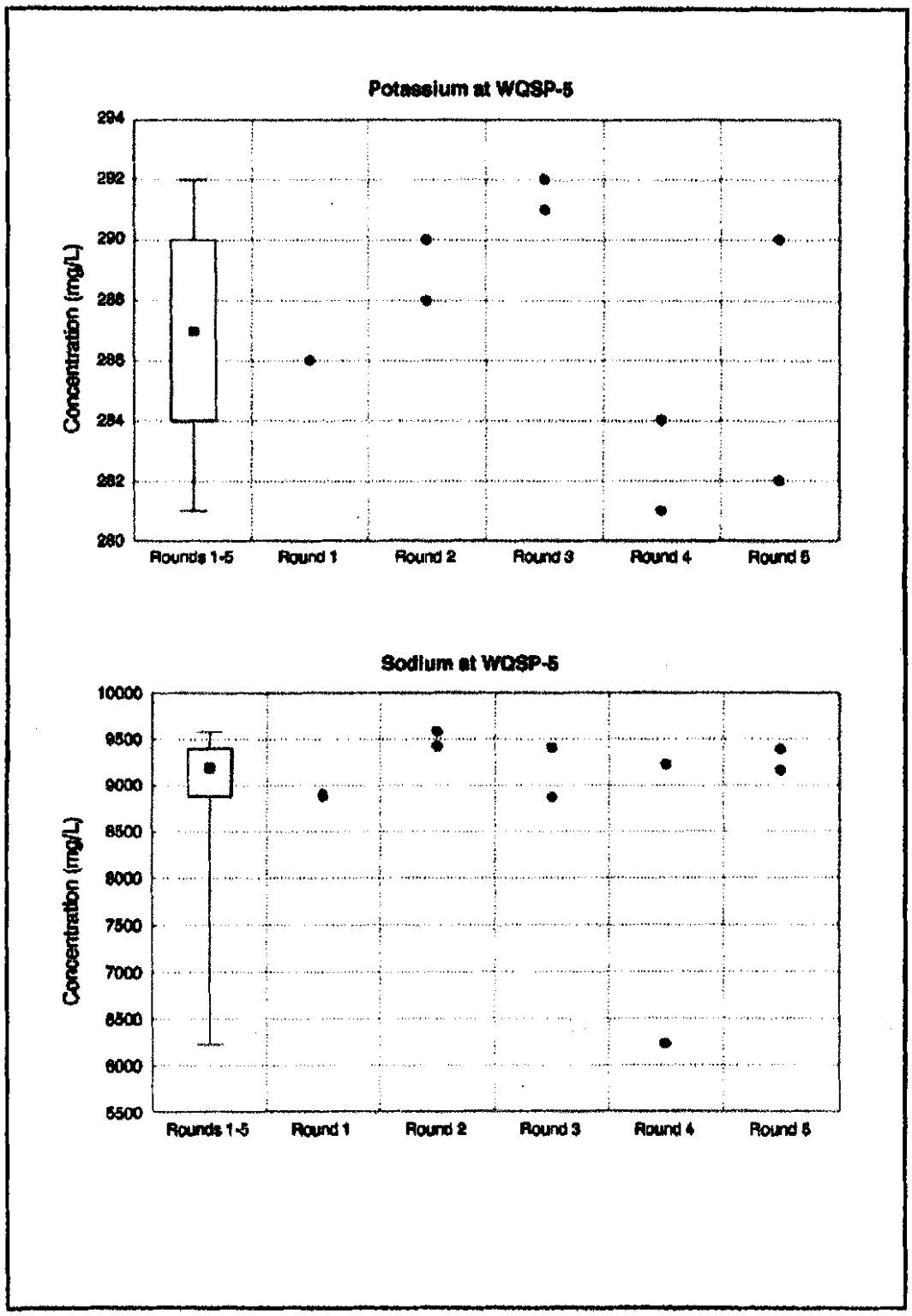


Figure 7.49 - Time Trend Plot for Potassium and Sodium at WQSP-5

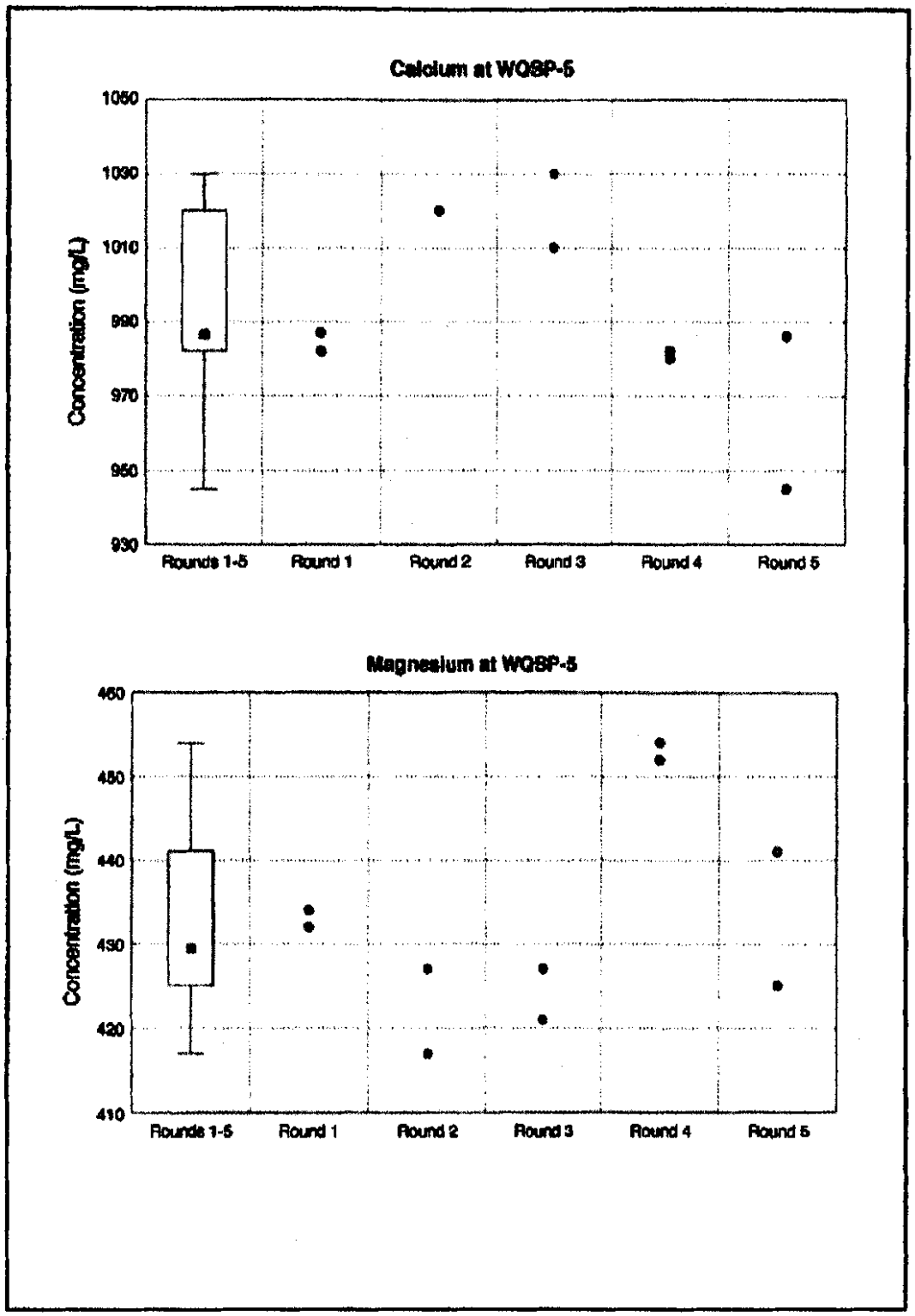


Figure 7.50 - Time Trend Plot for Calcium and Magnesium at WQSP-5

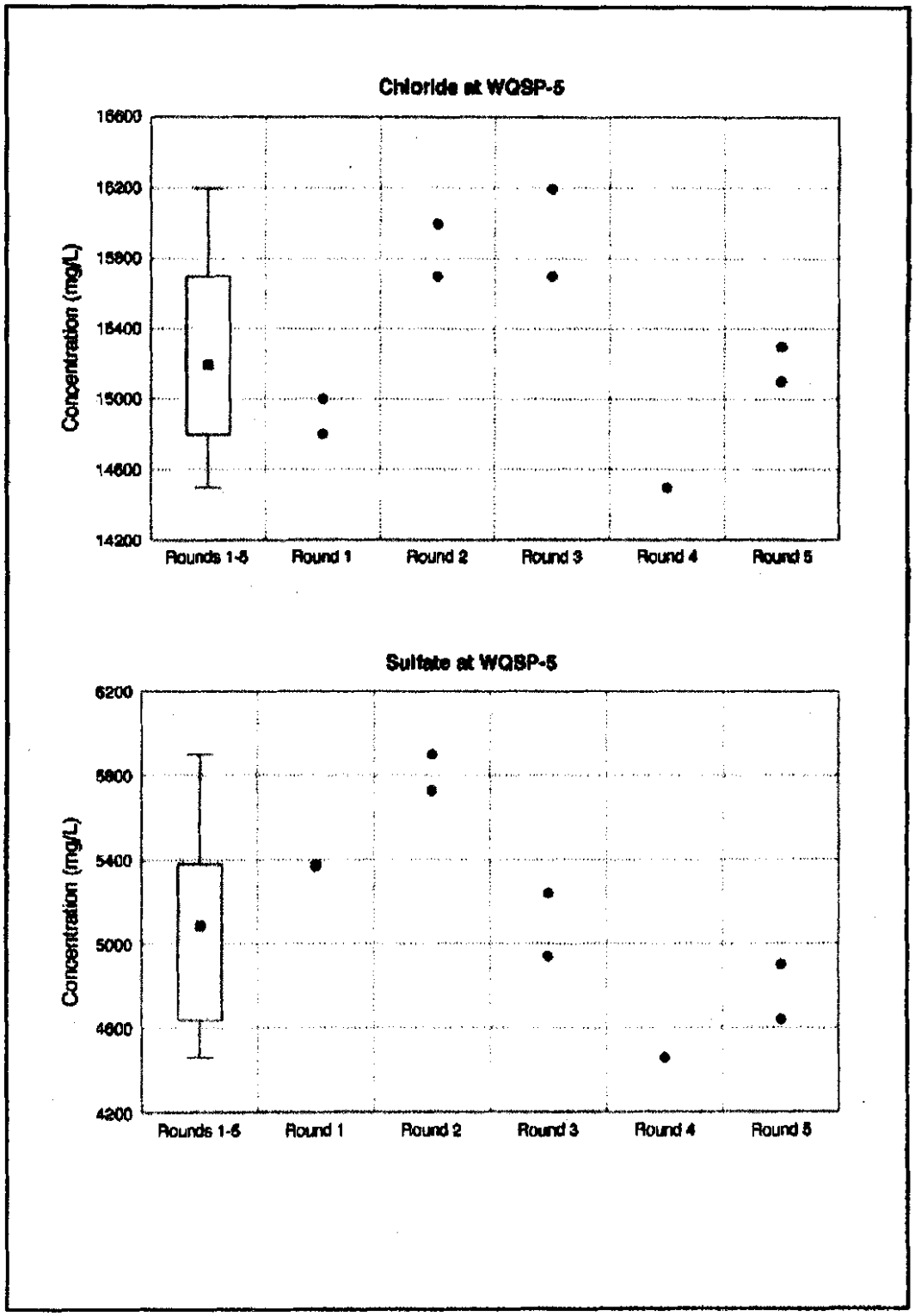


Figure 7.51 - Time Trend Plot for Chloride and Sulfate at WQSP-5

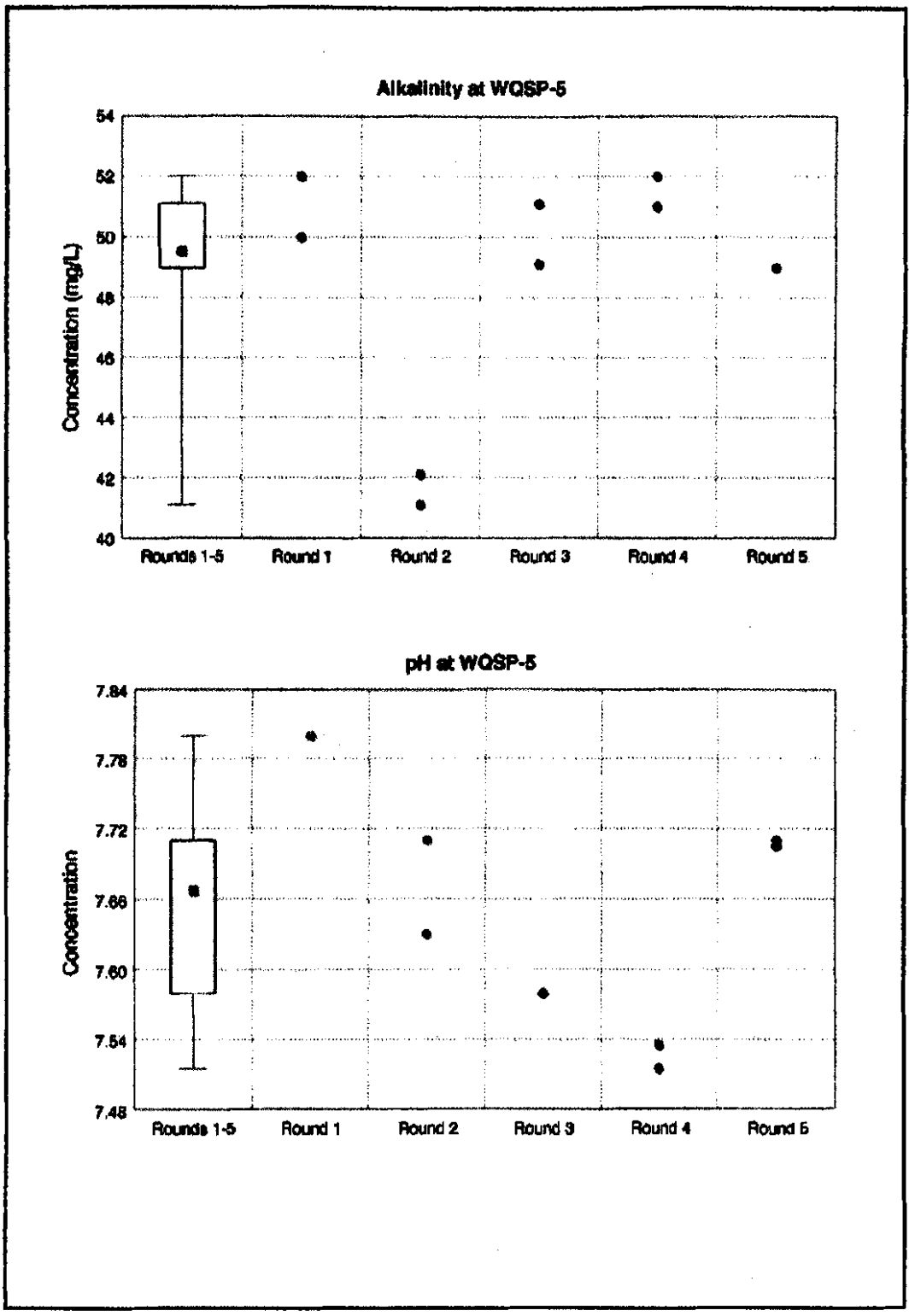


Figure 7.52 - Time Trend Plot for Alkalinity and pH at WQSP-5

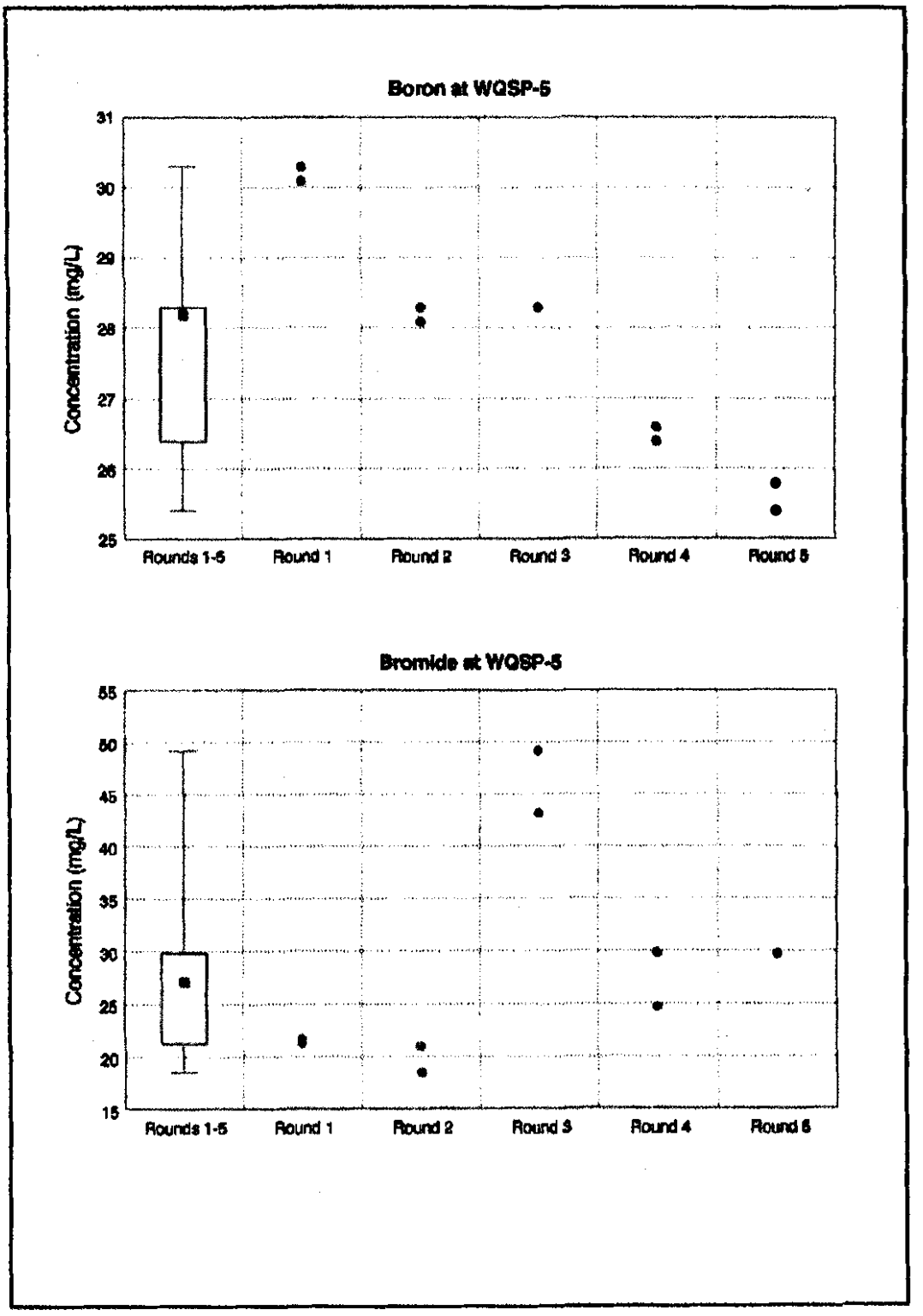


Figure 7.53 - Time Trend Plot for Boron and Bromide at WQSP-5

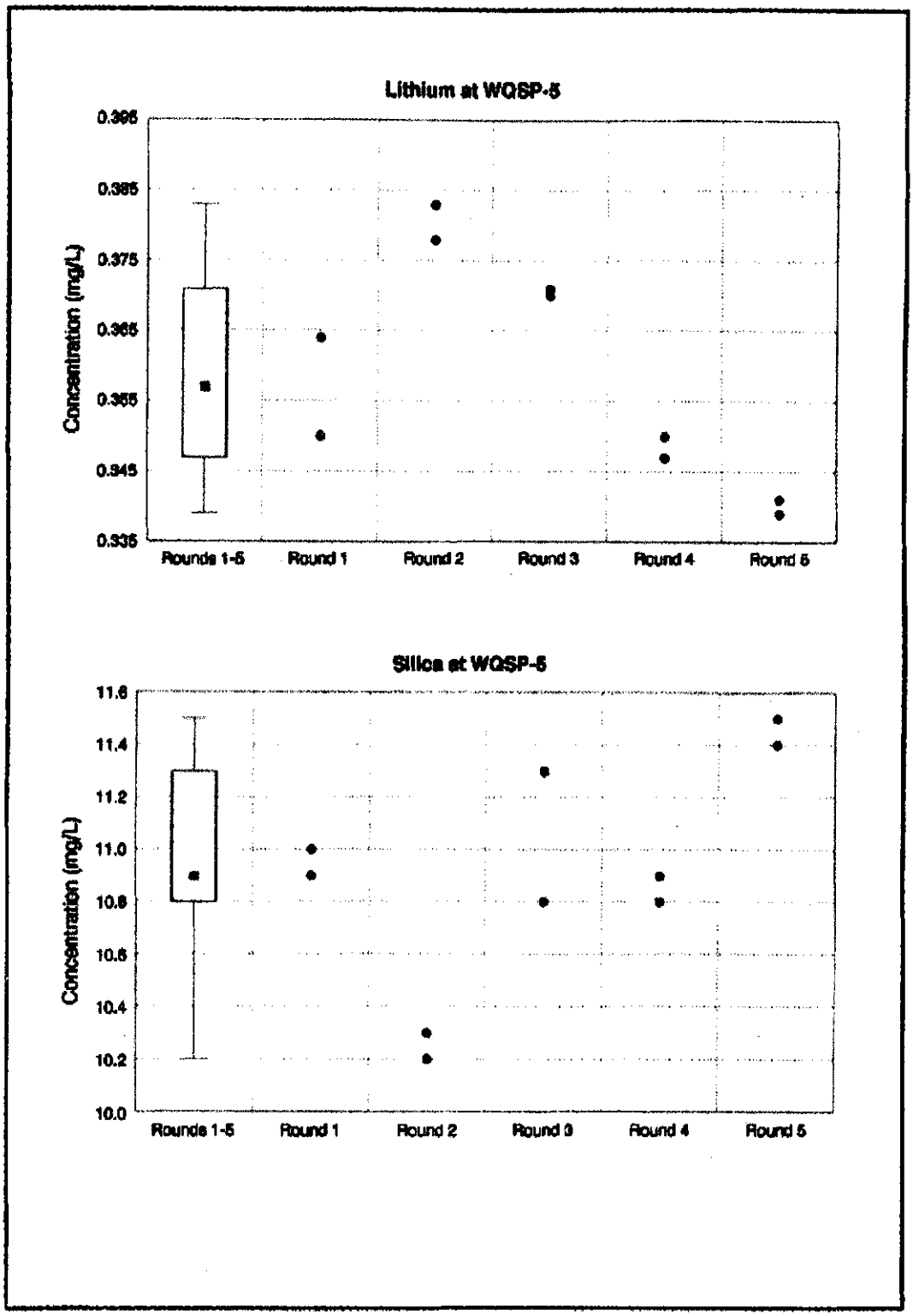


Figure 7.54 - Time Trend Plot for Lithium and Silica at WQSP-5

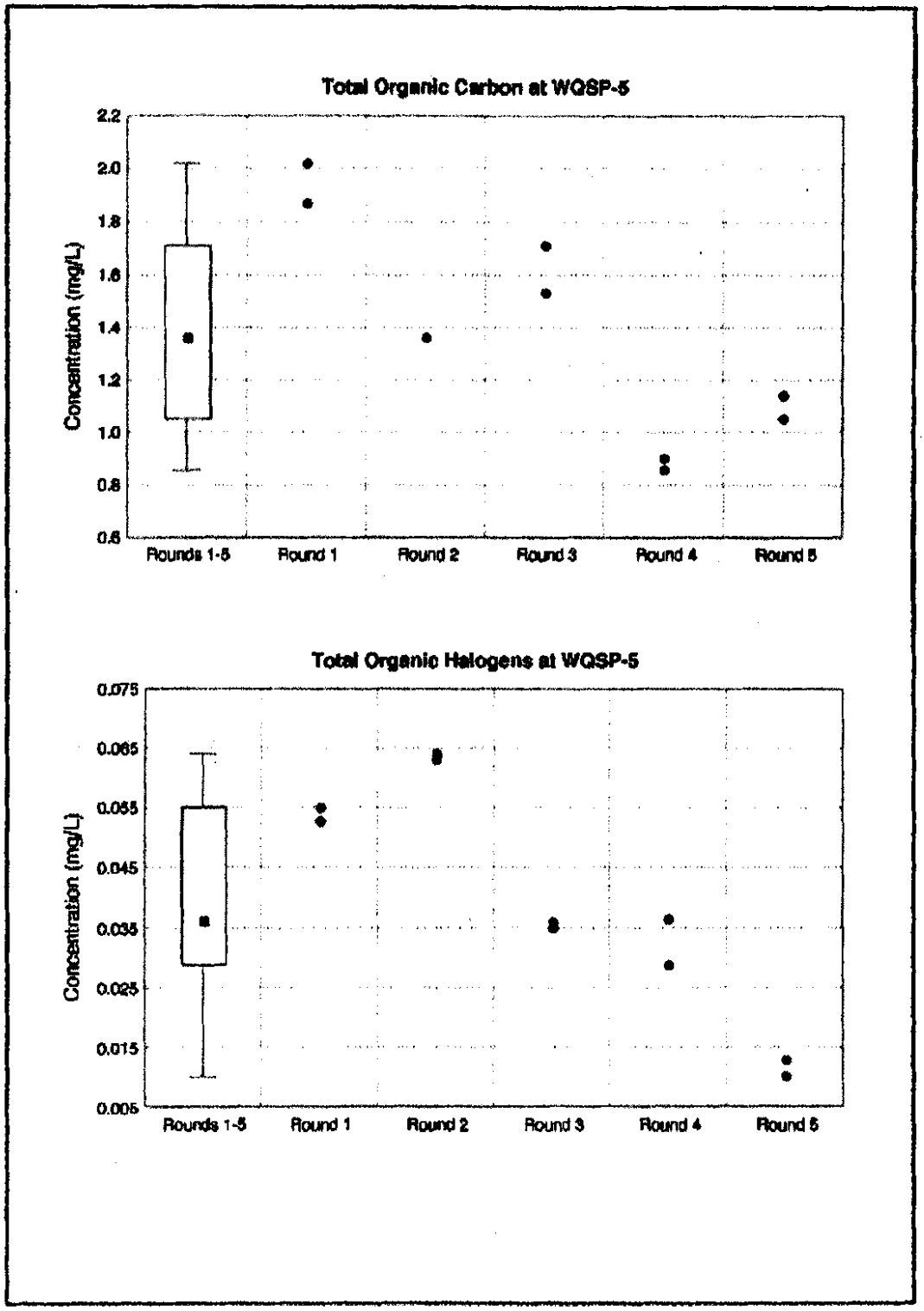


Figure 7.55 - Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-5

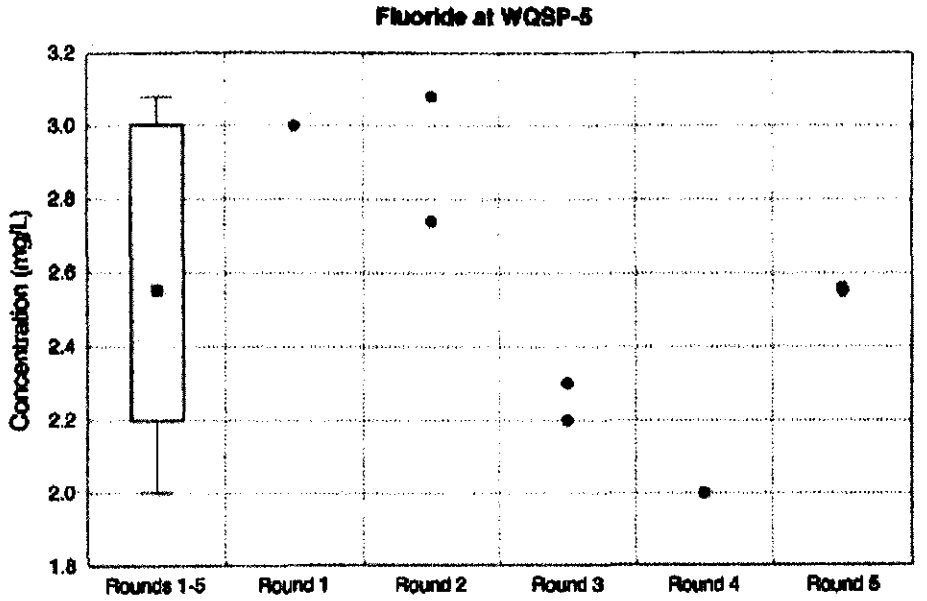


Figure 7.56 - Time Trend for Fluoride at WQSP-5

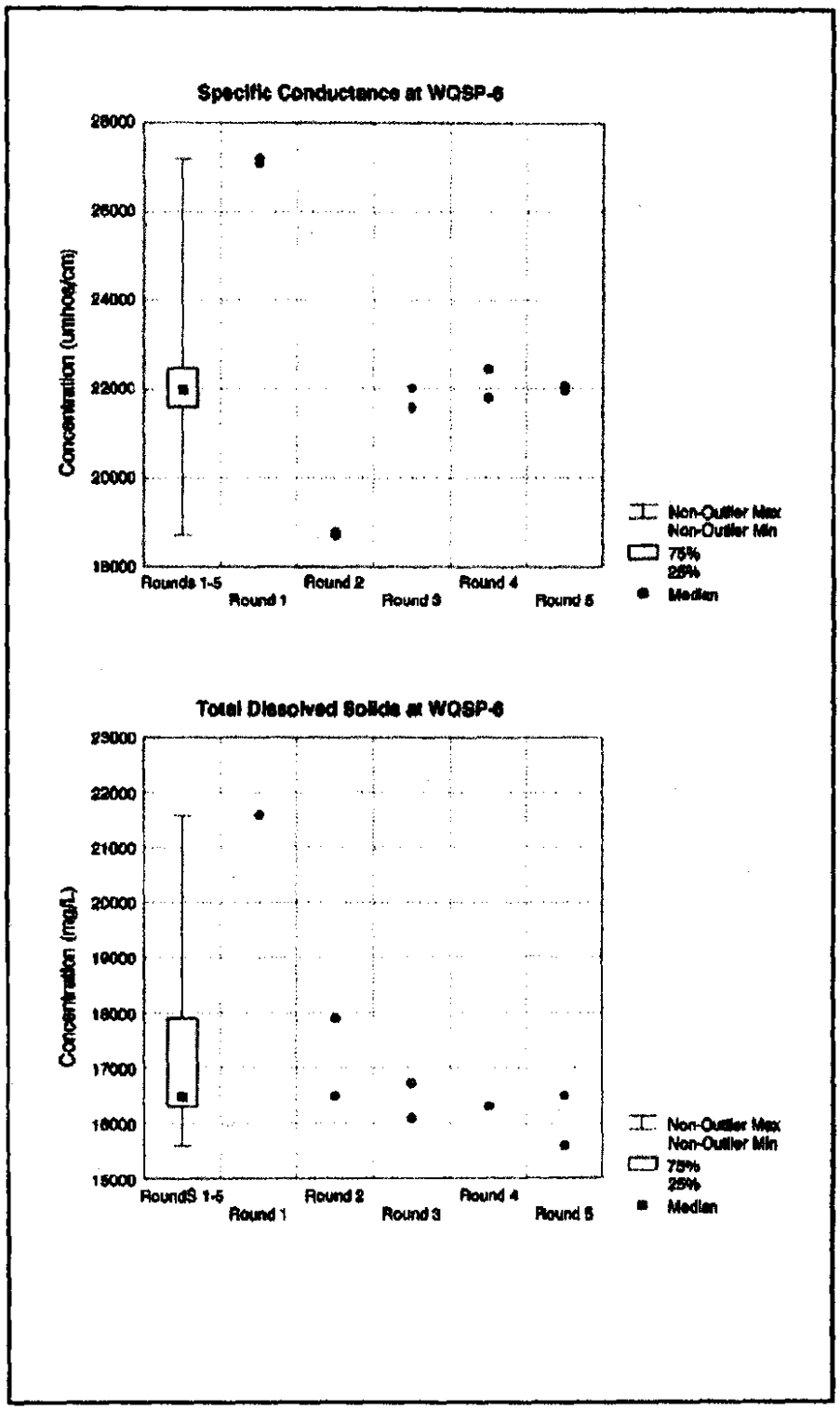


Figure 7.57 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-6

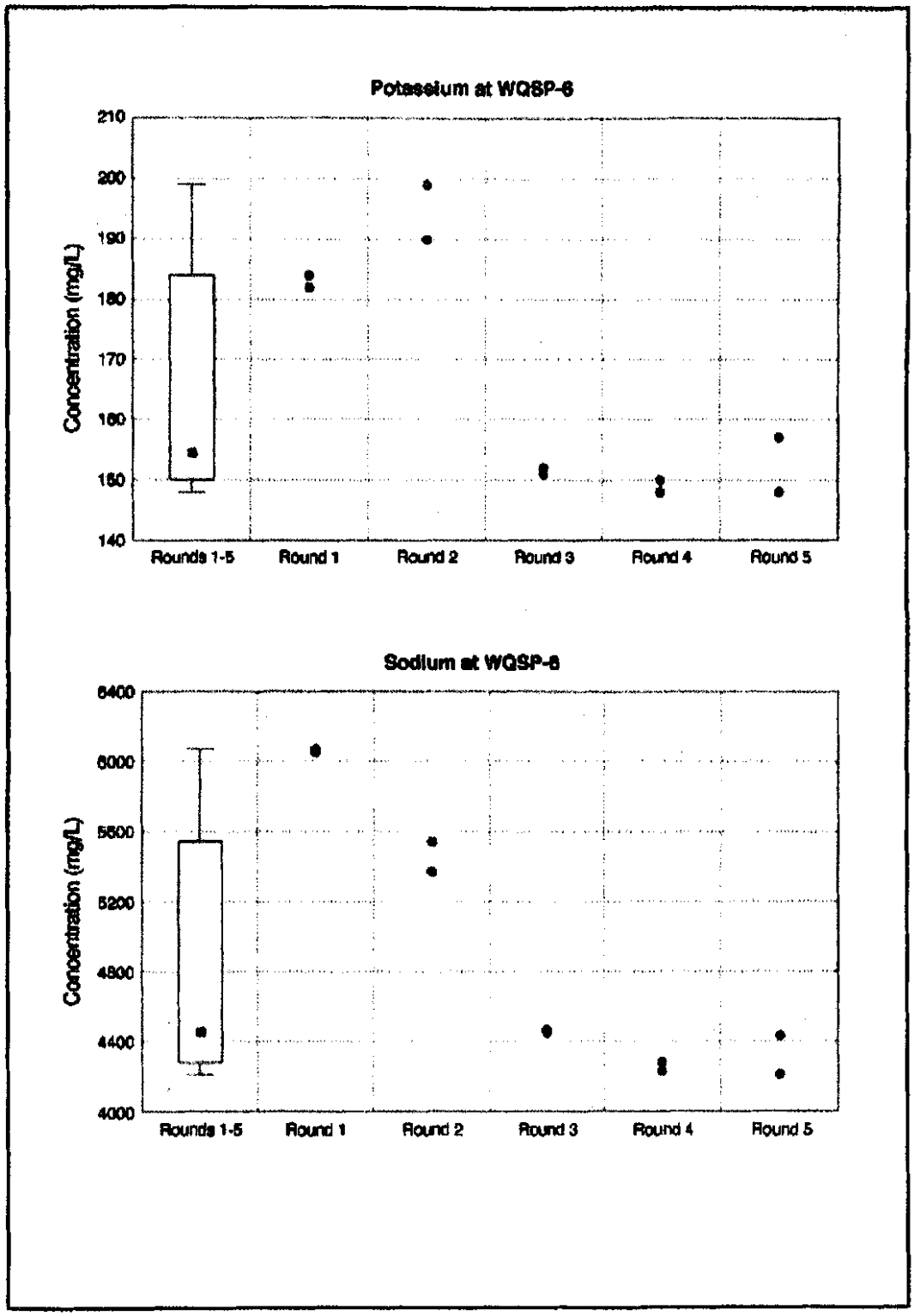


Figure 7.58 - Time Trend Plot for Potassium and Sodium at WQSP-6

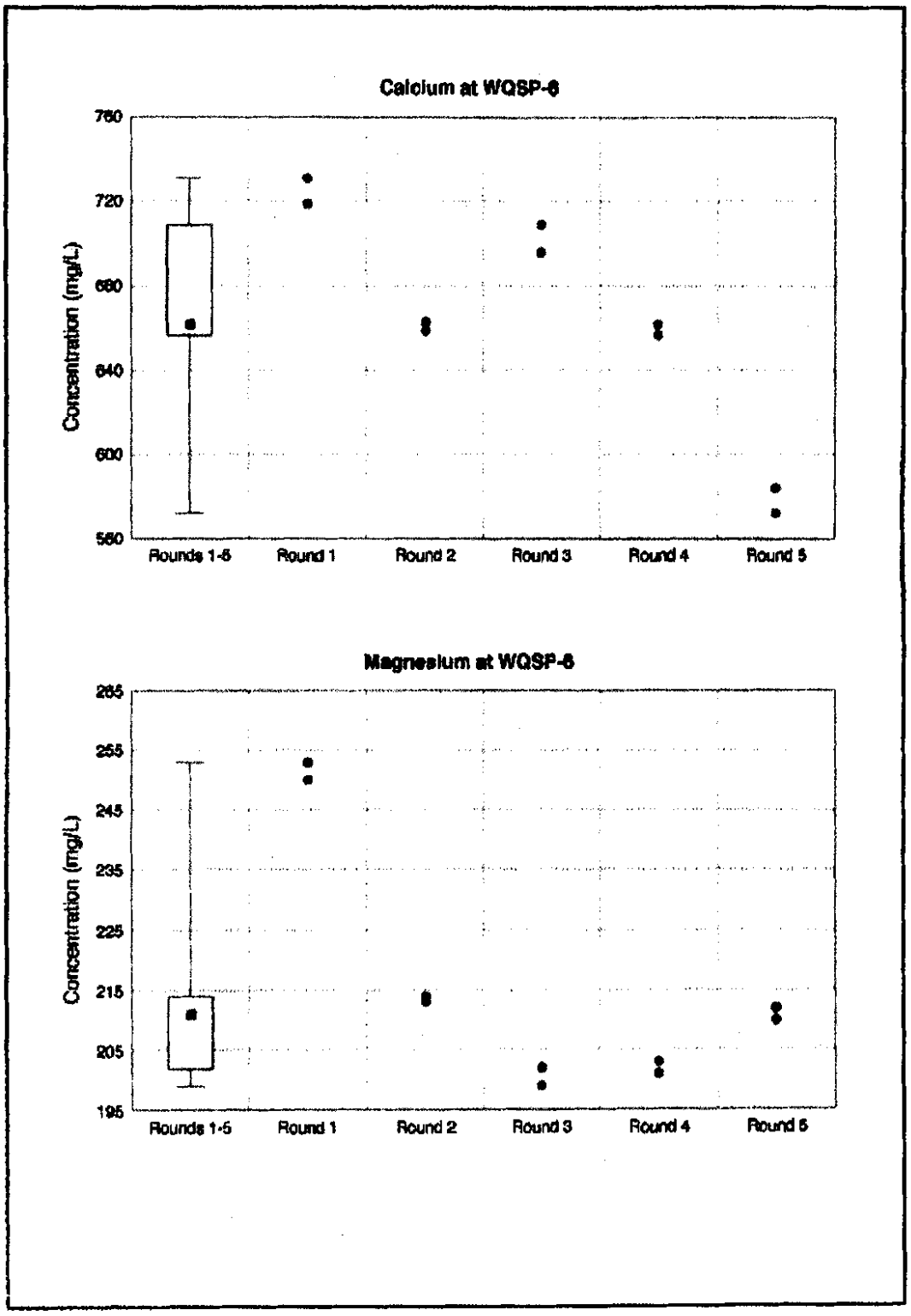


Figure 7.59 - Time Trend Plot for Calcium and Magnesium at WQSP-6

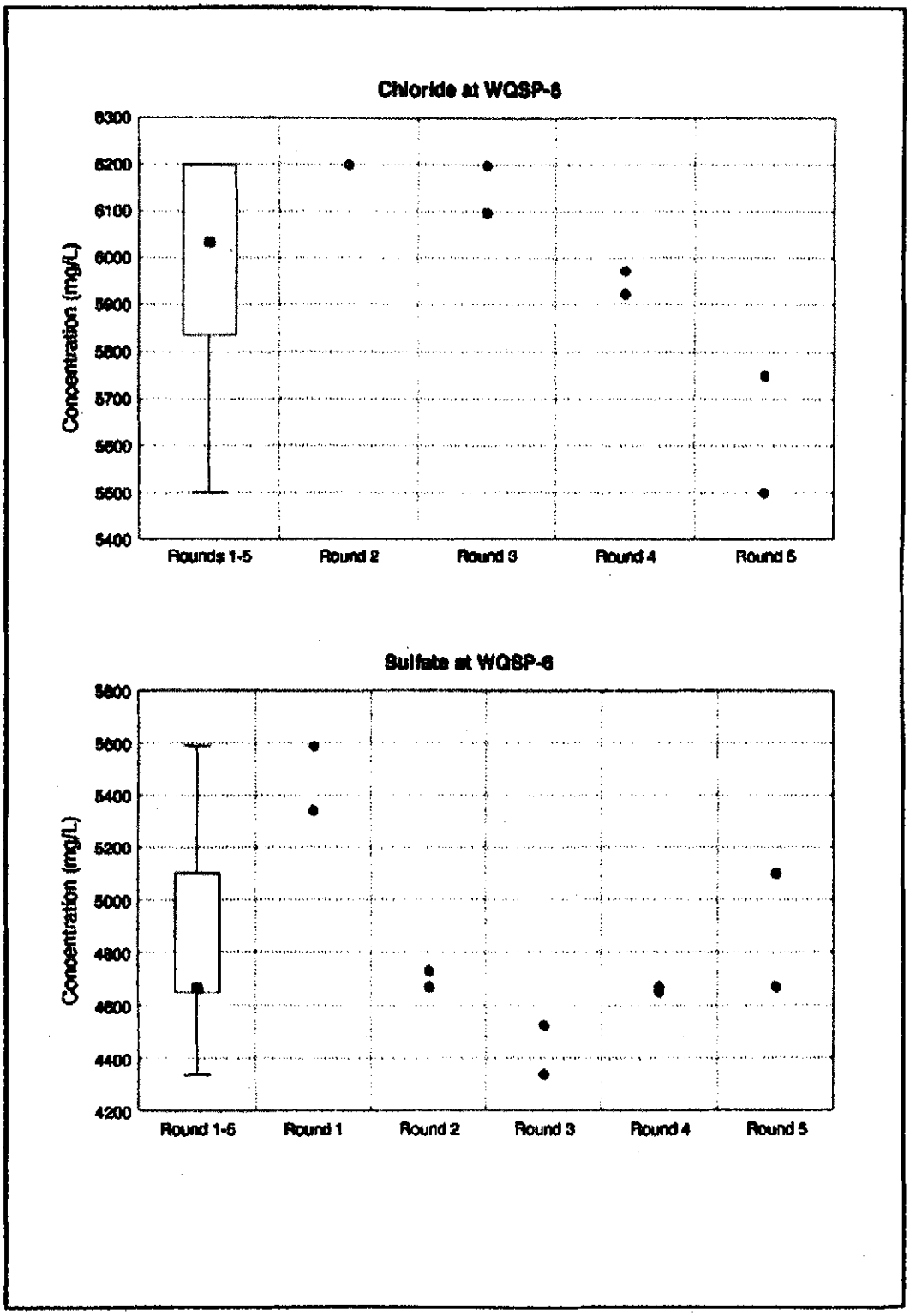


Figure 7.60 - Time Trend Plot for Chloride and Sulfate at WQSP-6

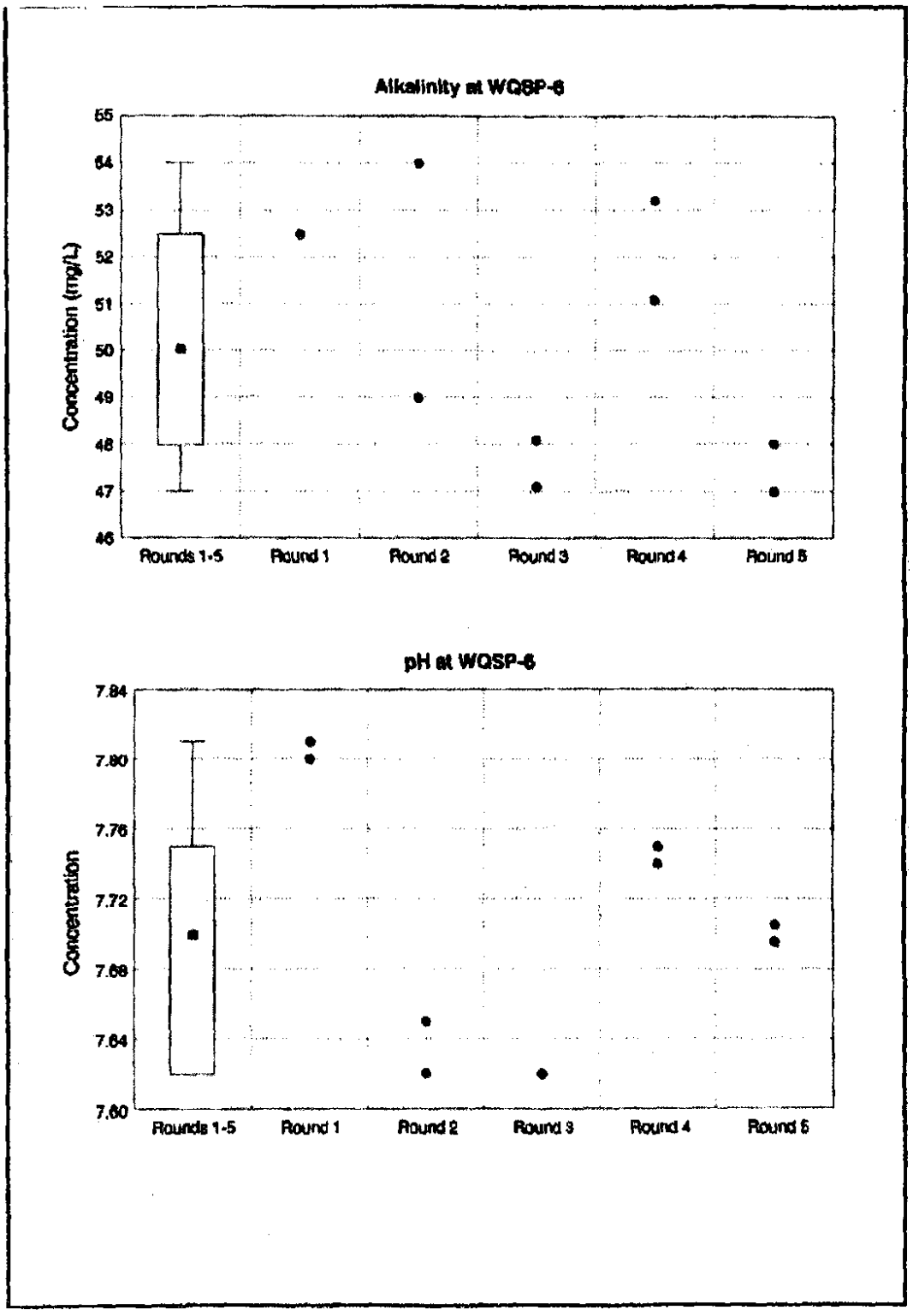


Figure 7.61 - Time Trend Plot for Alkalinity and pH at WQSP-6

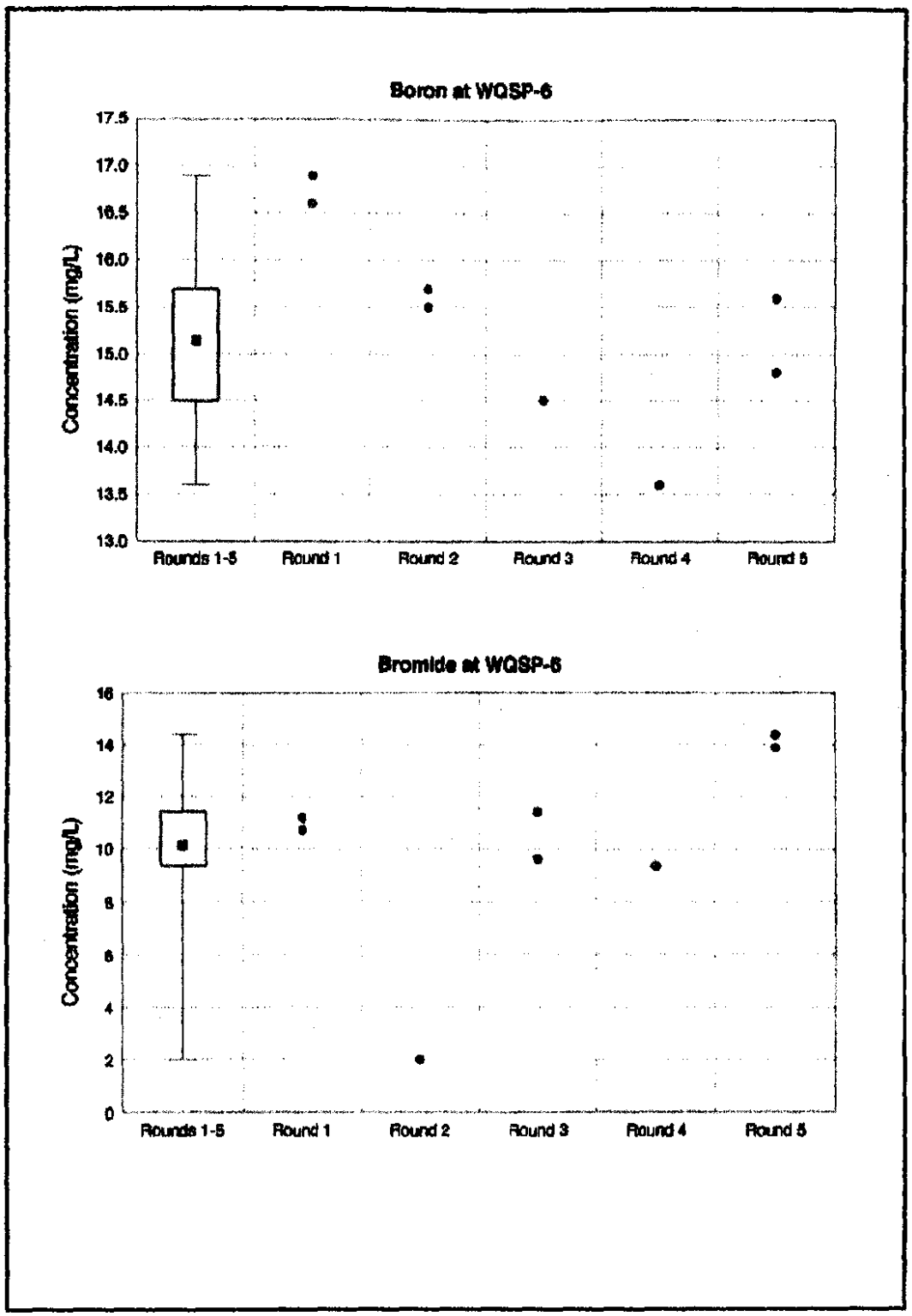


Figure 7.62 - Time Trend Plot for Boron and Bromide at WQSP-6

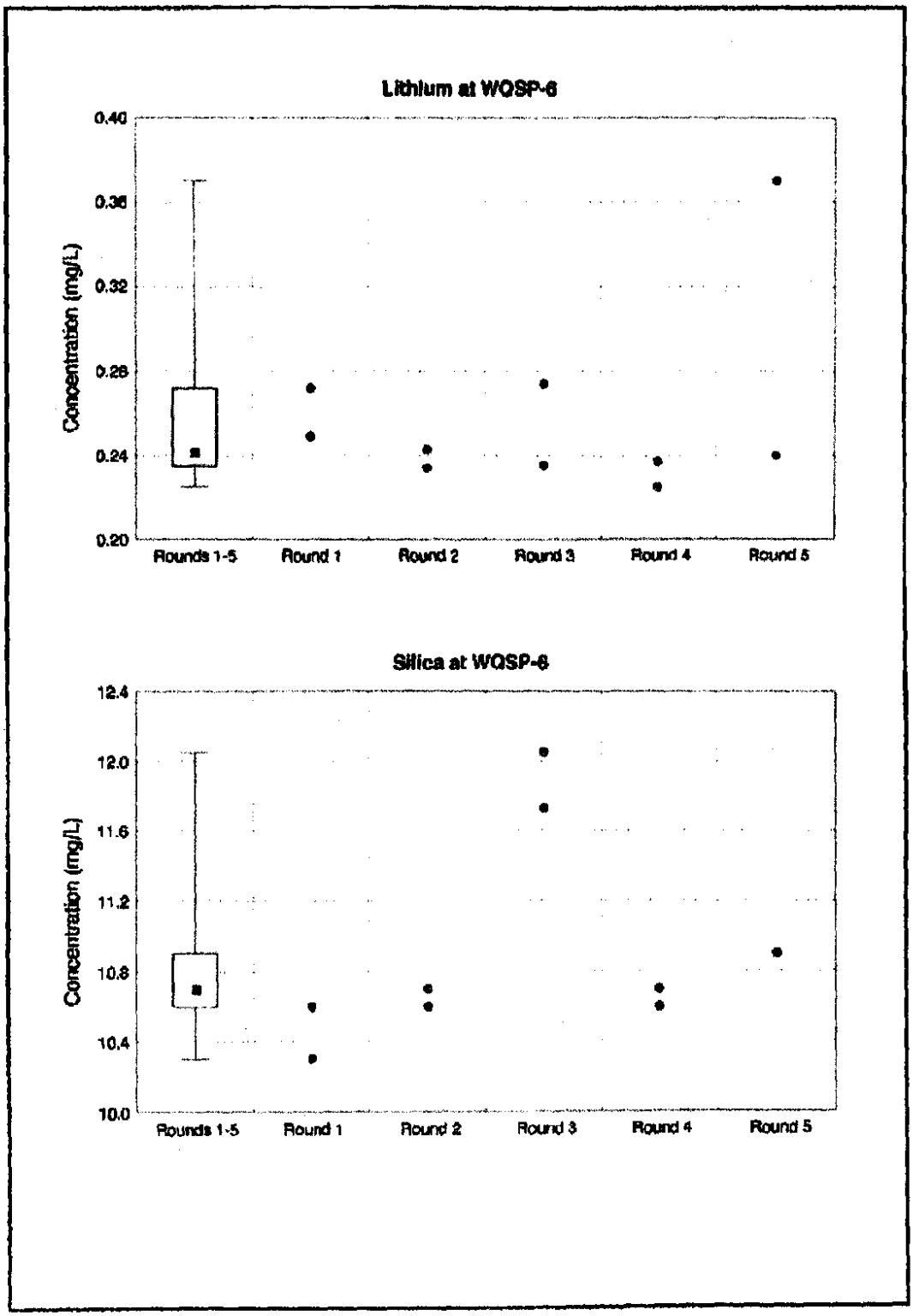


Figure 7.63 - Time Trend Plot for Lithium and Silica at WQSP-6

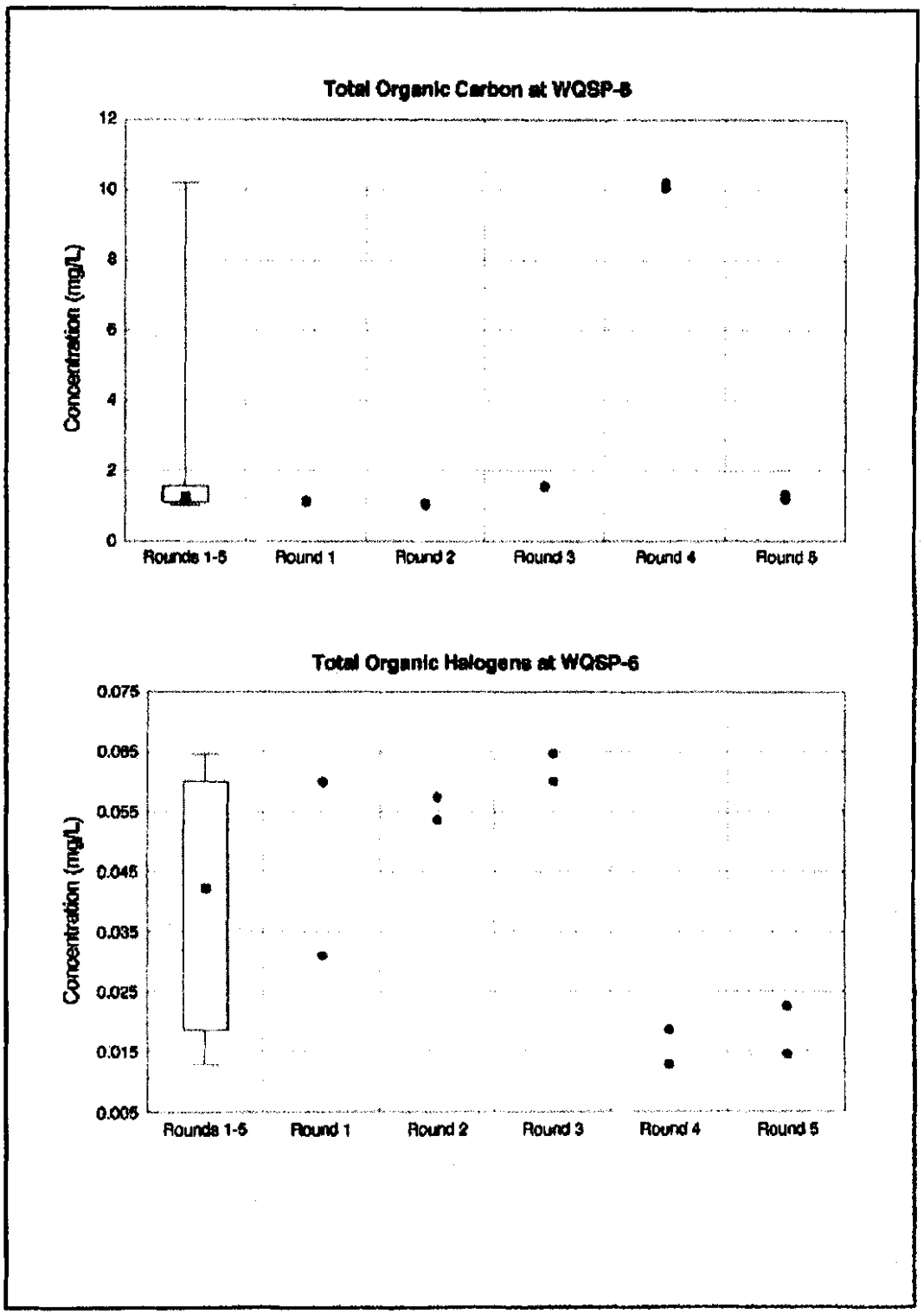


Figure 7.64 - Time Trend Plot for Organic Carbon and Total Organic Halogens at WQSP-6

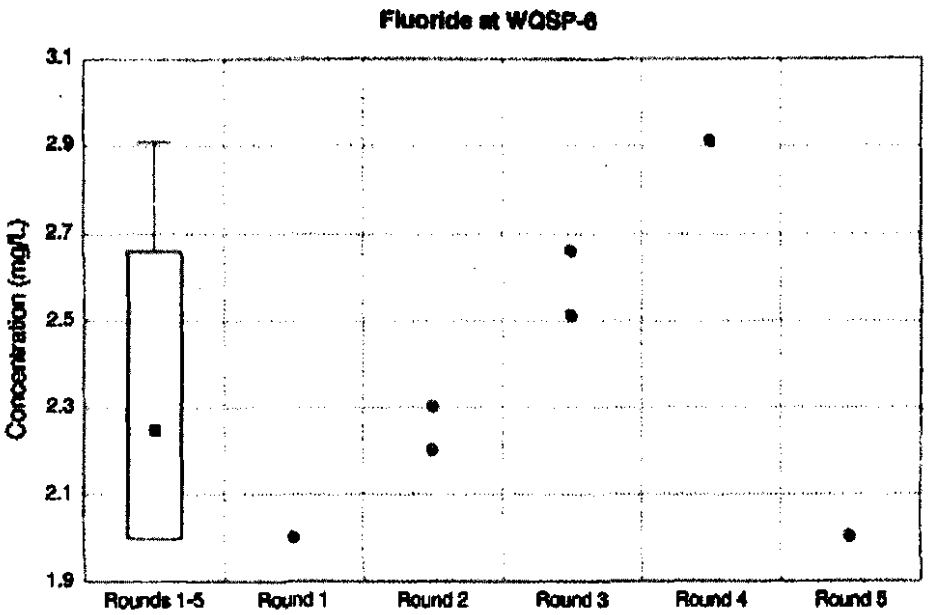


Figure 7.65 - Time Trend Plot for Fluoride at WQSP-6

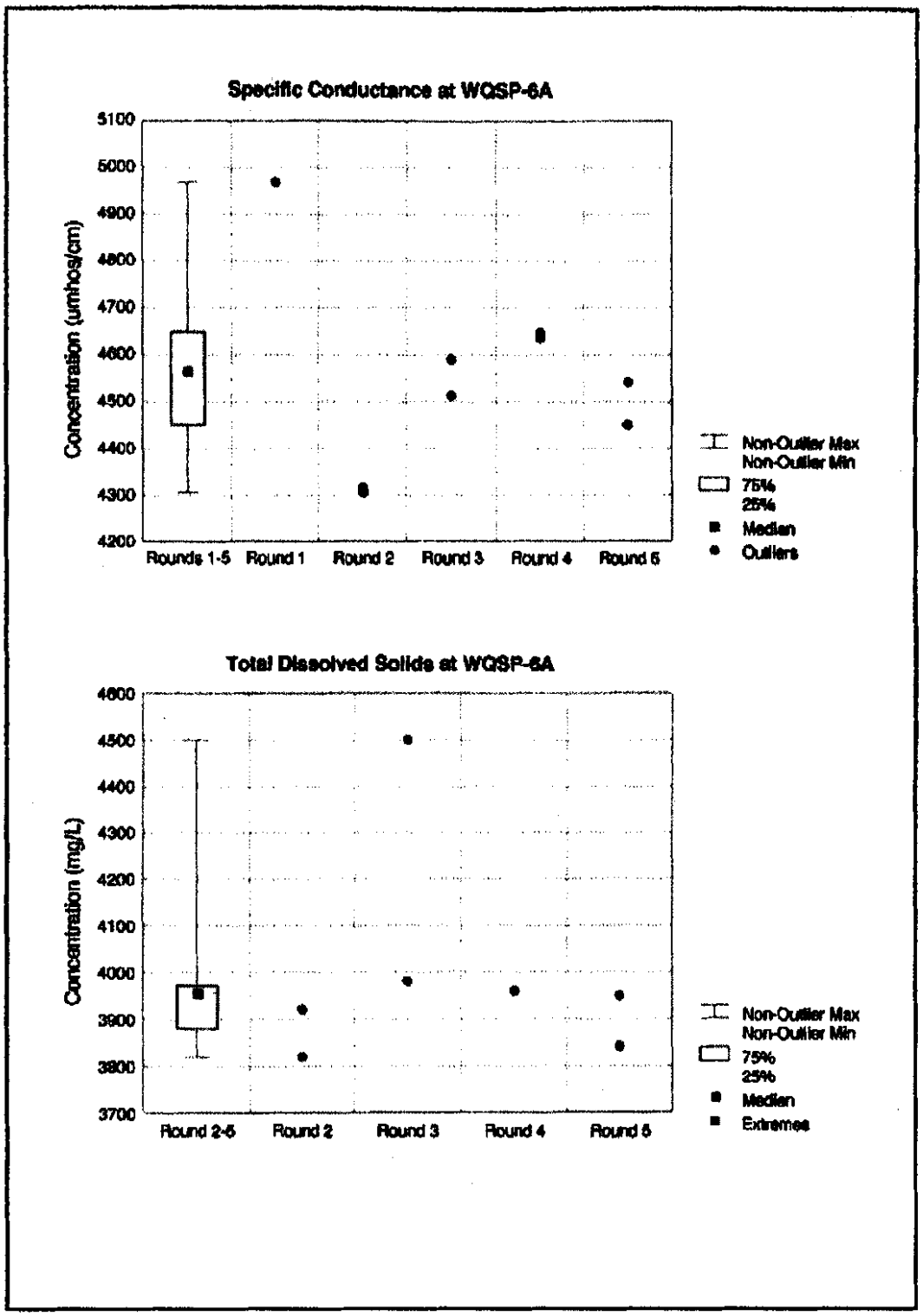


Figure 7.66 - Time Trend Plot for Specific Conductance and Total Dissolved Solids at WQSP-6A

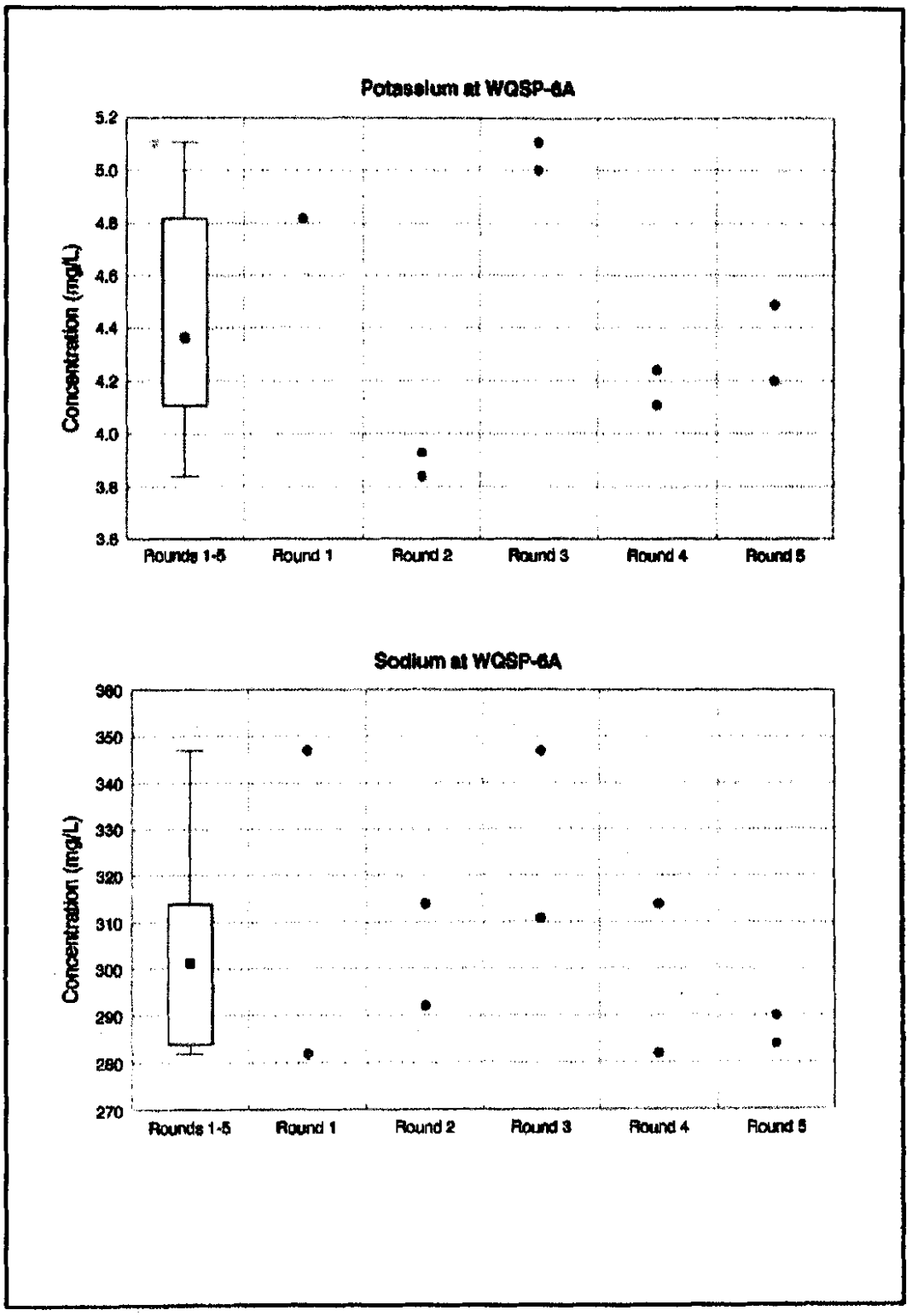


Figure 7.67 - Time Trend Plot for Potassium and Sodium at WQSP-6A

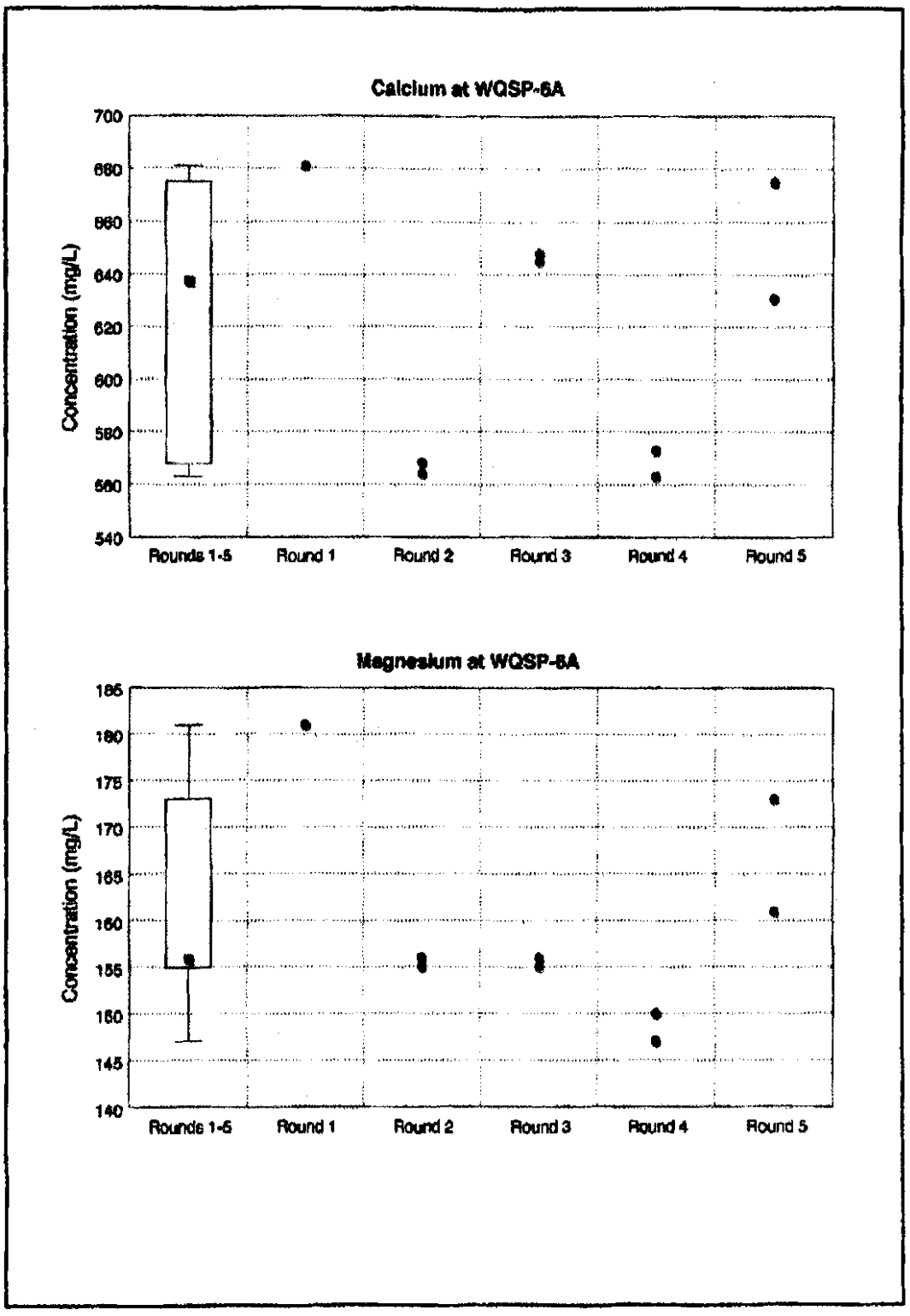


Figure 7.68 - Time Trend Plot for Calcium and Magnesium at WQSP-6A

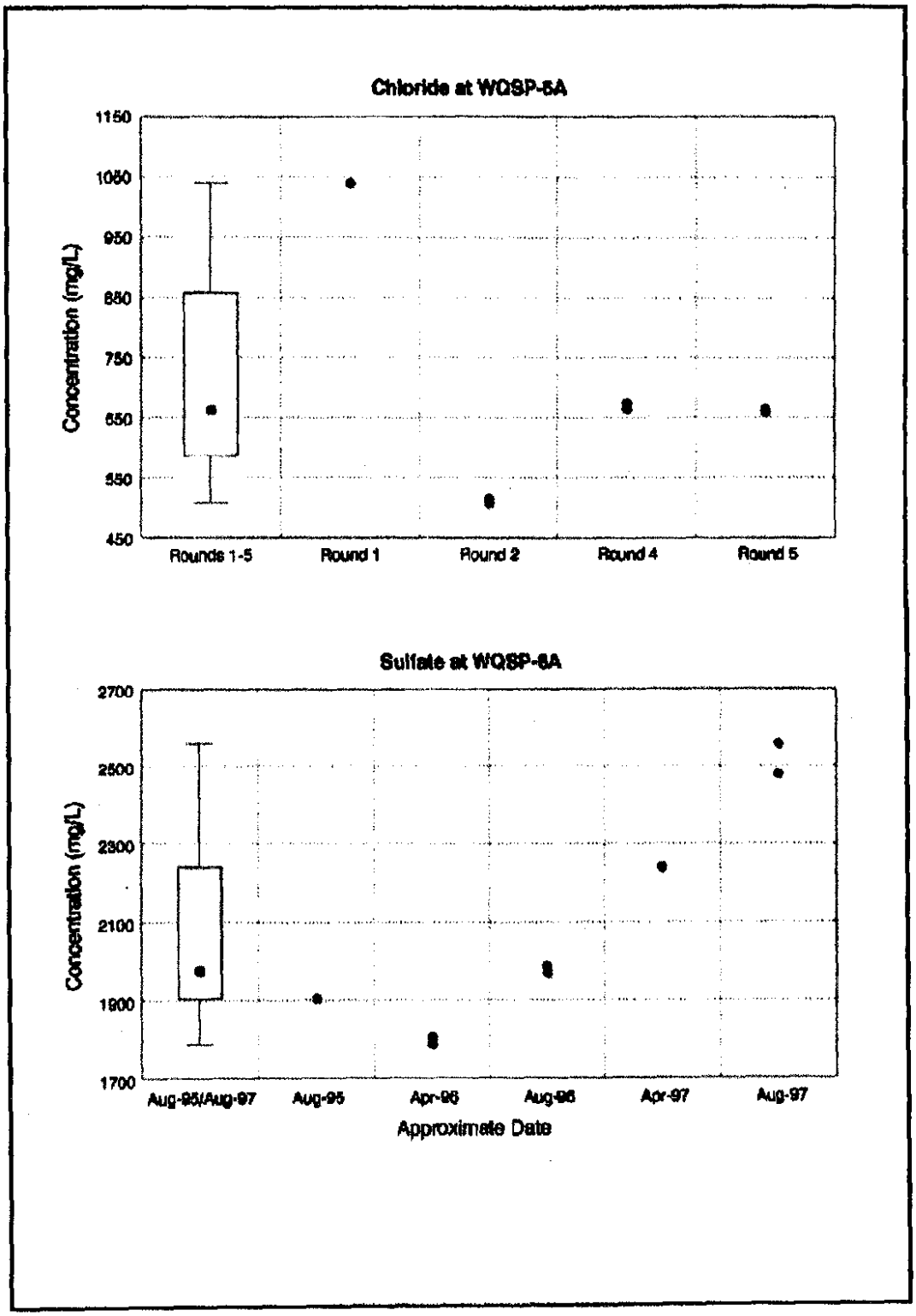


Figure 7.69 - Time Trend Plot for Chloride and Sulfate at WQSP-6A

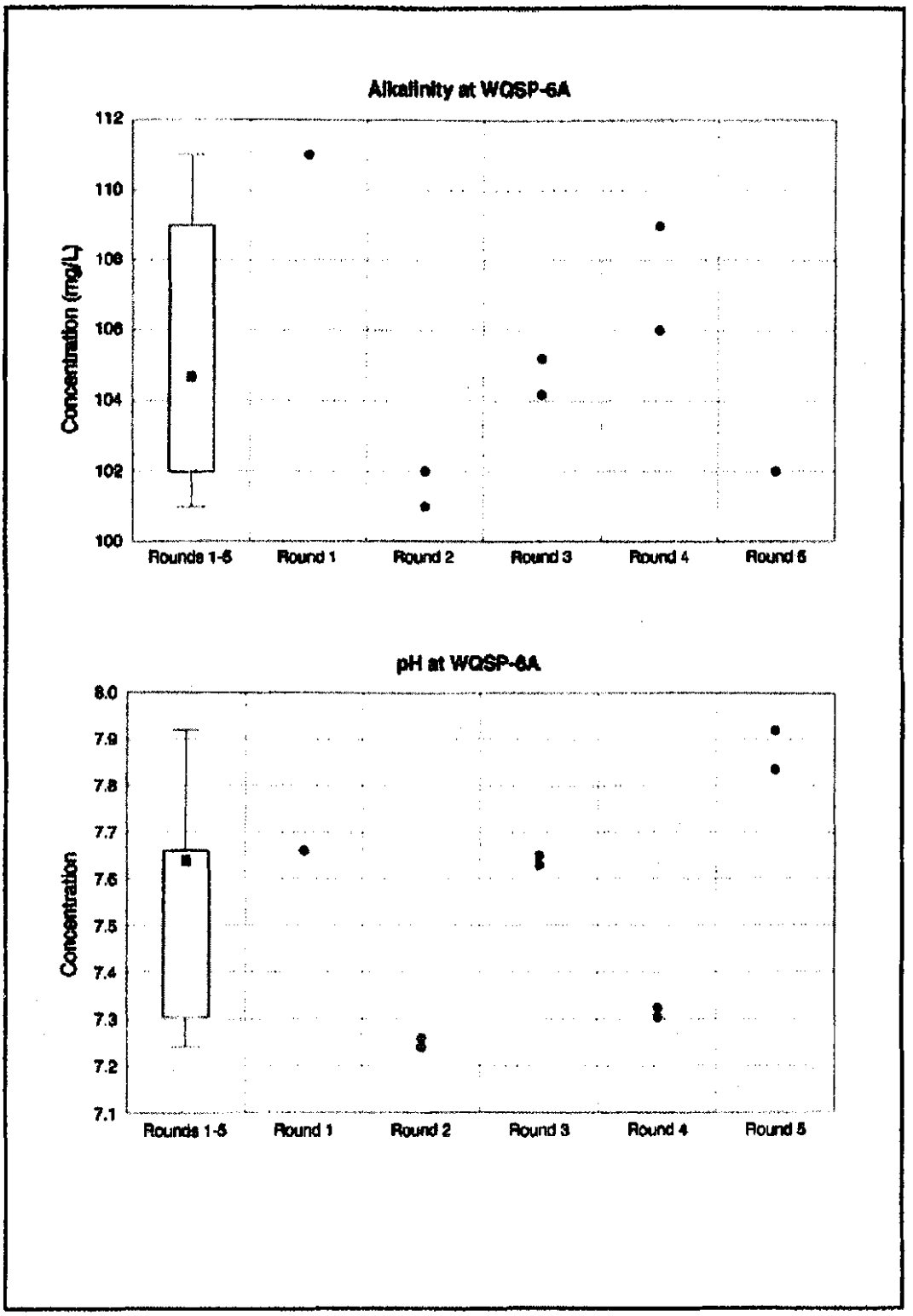


Figure 7.70 - Time Trend Plot for Alkalinity and pH at WQSP-6A

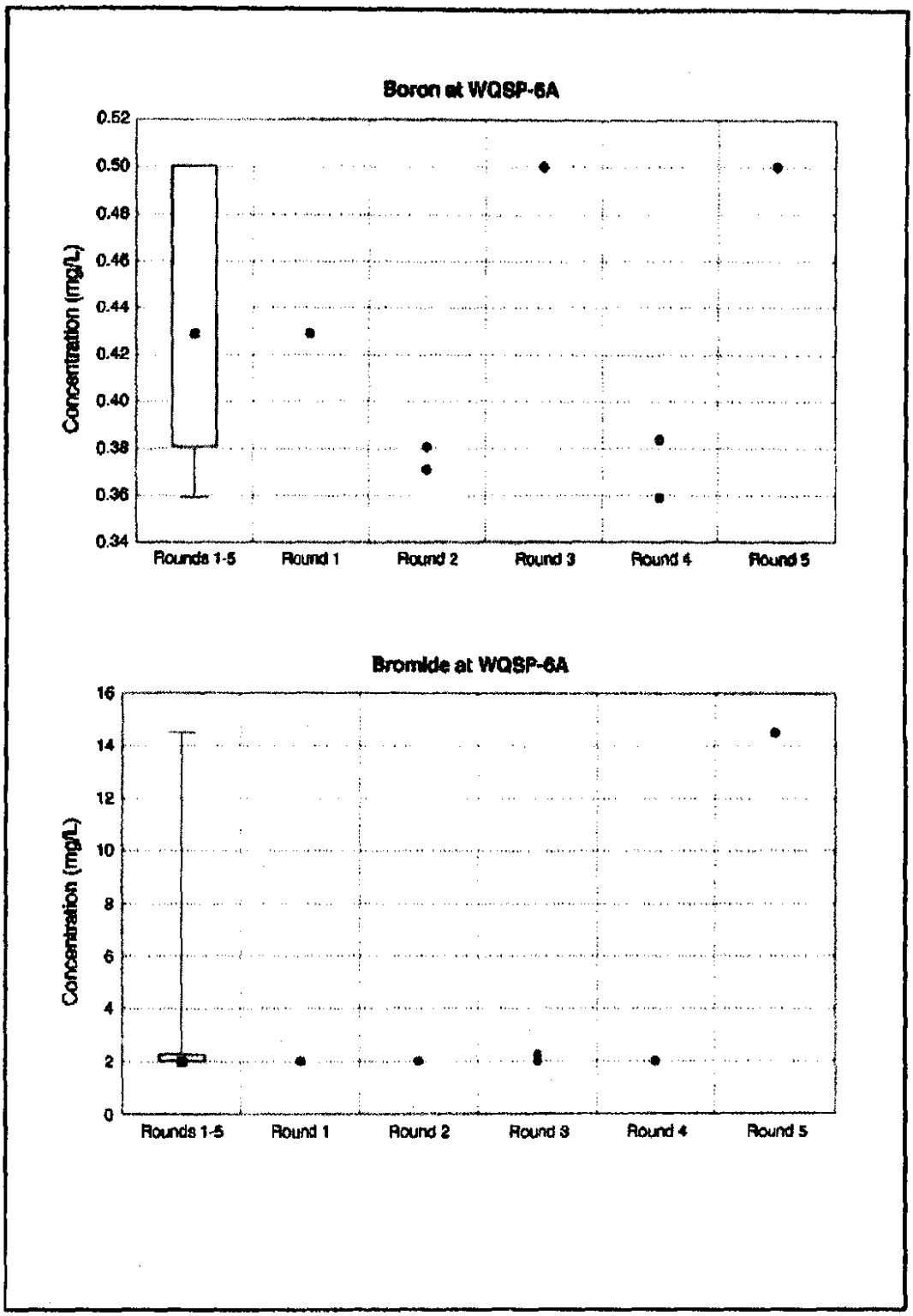


Figure 7.71 - Time Trend Plot for Boron and Bromide at WQSP-6A

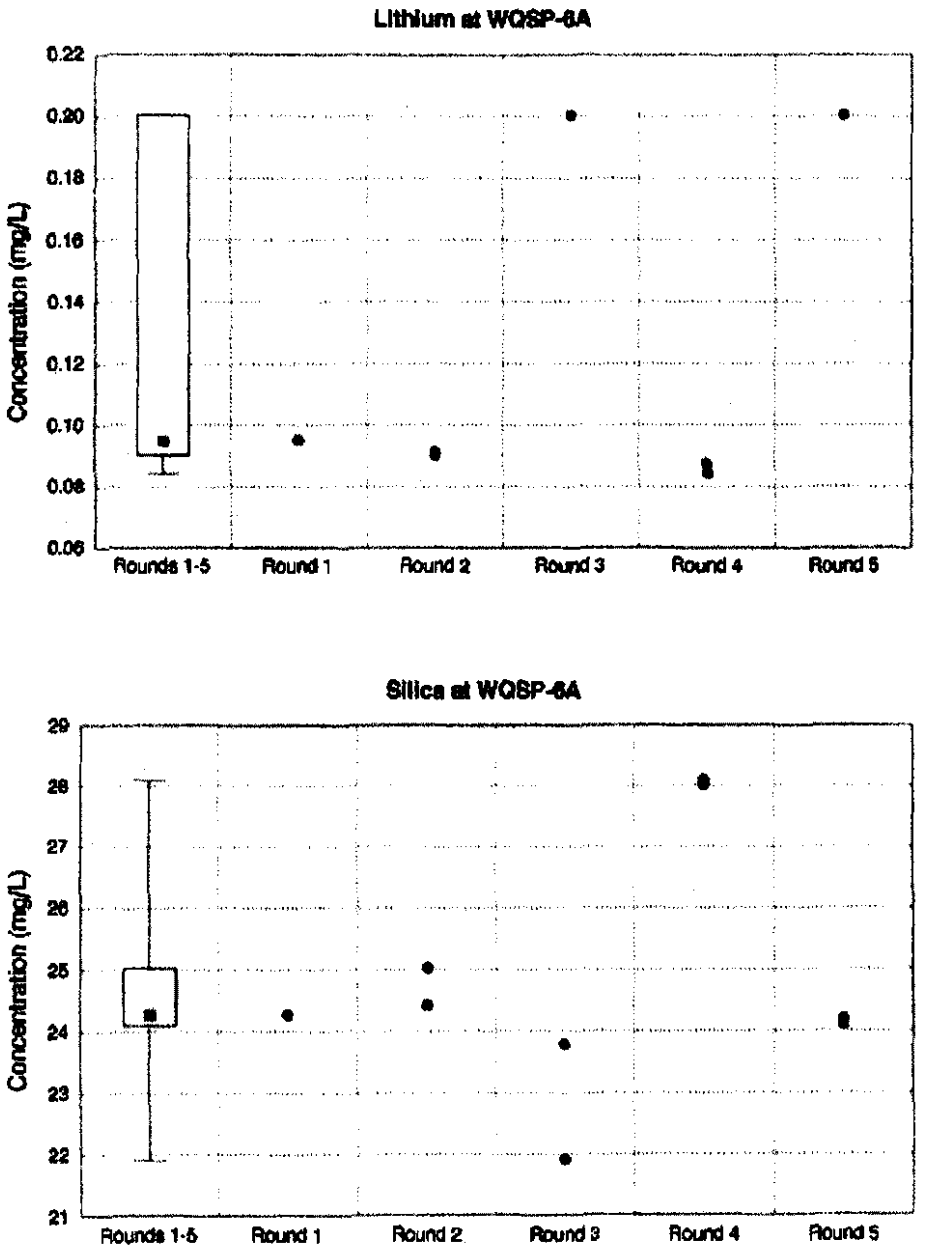


Figure 7.
Time Trend Plot for Lithium and Silica at WQSP-6A

Figure 7.72 - Time Trend Plot for Lithium and Silica at WQSP-6A

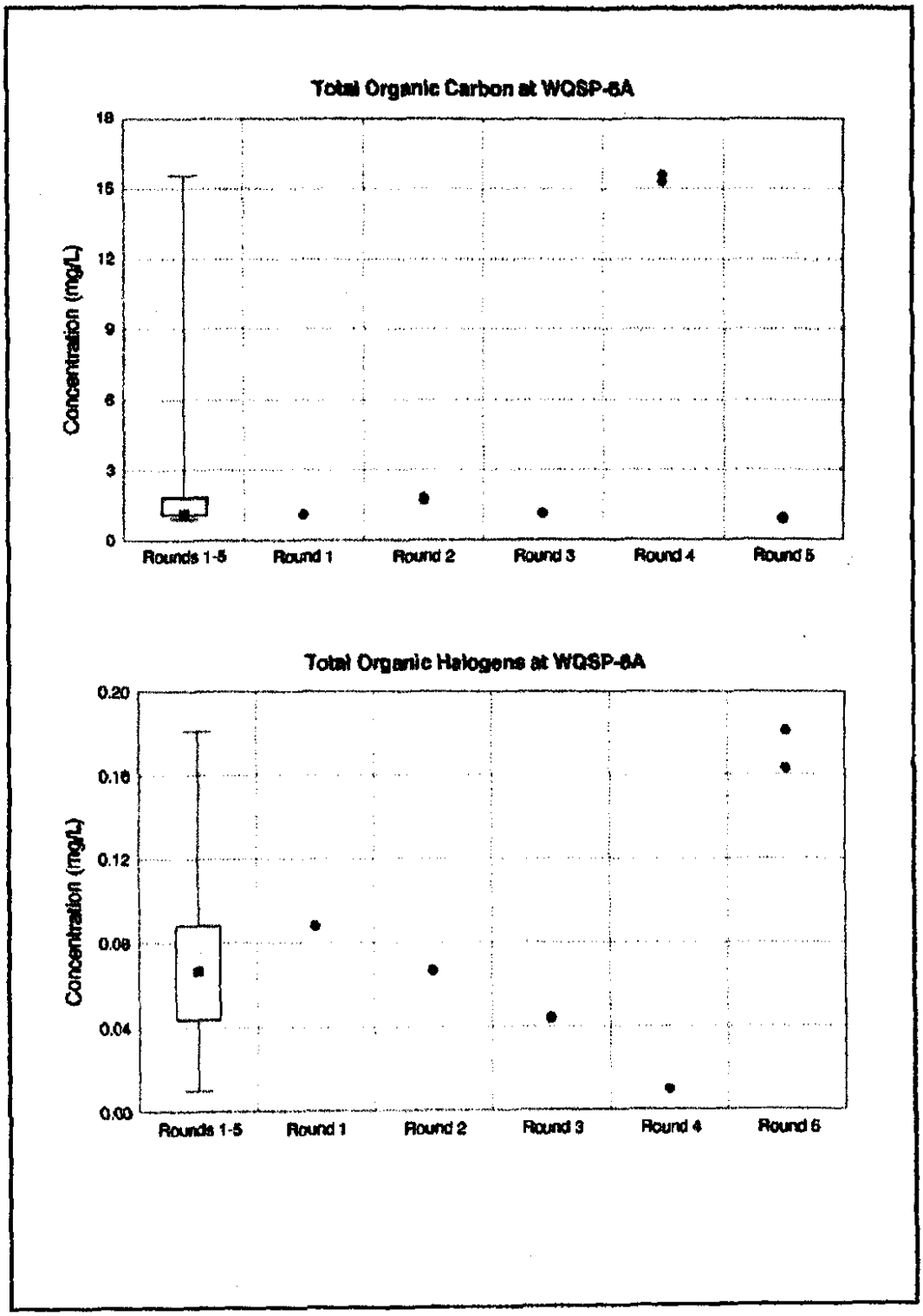


Figure 7.73 - Time Trend Plot for Total Organic Carbon and Total Organic Halogens at WQSP-6A

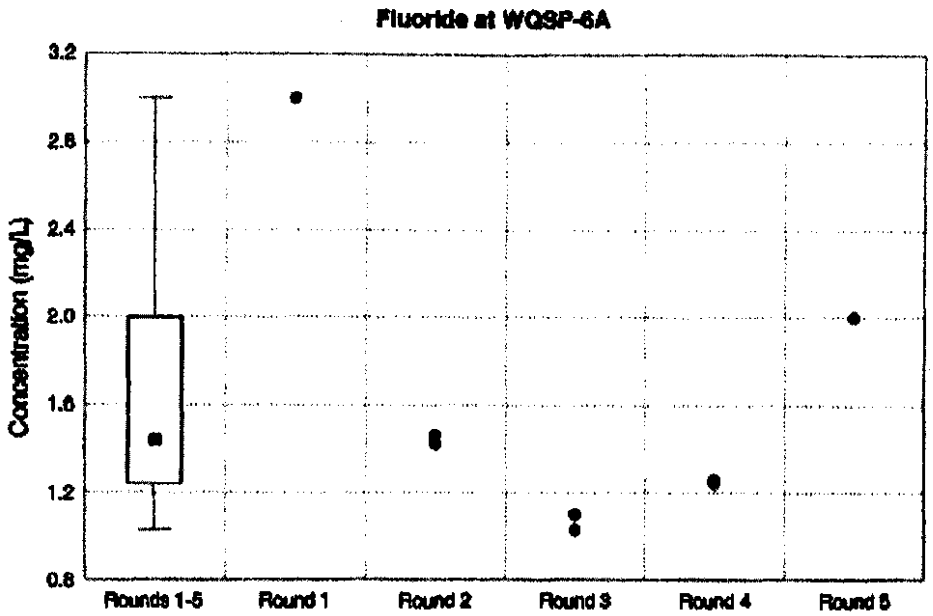


Figure 7.74 - Time Trend Plot for Fluoride at WQSP-6A

CHAPTER 8 QUALITY ASSURANCE

The purpose of the QA/QC program is to ensure that processes, activities, and products that potentially impact health, safety, and the environment are appropriately planned, implemented, and assessed. The goal of the QA/QC program is twofold: (1) to provide confidence that the data used in demonstrating regulatory compliance are adequate, and (2) to promote continuous improvement in WIPP's operations. The QA program is successful when risks and environmental impacts are identified and minimized, and when safety, reliability, and performance are maximized.

This chapter outlines the QA processes applicable to the radiological and nonradiological environmental monitoring programs. The QA program is used to monitor the reliability, accuracy, and precision of environmental data, and to detect and correct problems in sample collection, preparation, and analysis, and the data evaluation phases.

A comprehensive QA program has been implemented to ensure that the data collected reflect selected parameters of the environment. The data have been obtained prior to commencement of operations to provide a sound baseline for comparison with operational-phase data. The data will be evaluated to determine future impacts of WIPP on the environment. The focus of this program includes the following:

- Sample collection at specified locations in accordance with approved procedures. These procedures are based on established and accepted practices.
- Procedure review and revision to minimize uncertainties introduced through sampling and analysis, while maintaining comparability and continuity between past and future data.
- Verification of data through a continuing program of analytical laboratory QC, including the performance of interlaboratory cross-checks, duplicate and split sample radiological analysis, and sample splits provided to the EEG and the NMED.

Requirements and guidance sources for QA program content include 10 CFR § 830.120; DOE-CAO Quality Assurance Program Description (CAO-94-1012, Revision 1); DOE/EH-0173T (ASME NQA-1); and "Test Methods for Evaluating Solid Waste" (Chapter 1 of SW-846).

8.1 Sample Collection Methodologies

WID follows approved sampling plans and procedures in the collection and handling of samples used in environmental monitoring. The sampling plans and procedures specify proper sampling techniques for the particular sample medium. Elements of sample QA include specifying the following:

- Method used to select sampling sites
- Specific sampling methods to be used
- Containers, preservatives, transportation, and storage requirements
- Labeling requirements
- Preparatory measures for sampling equipment and containers
- Preservation methods and allowable hold times, including transportation
- Sample chain of custody
- Documentation used to record sample history, sampling conditions, and analyses

Sampling procedures are contained in the following documents:

- WIPP Groundwater Monitoring Program Plan and Procedure Manual (WP 02-1)

- WIPP Environmental Procedures Manual (WP 02-3)
- Nonradioactive Hazardous Materials Environmental Compliance Manual (WP 02-5)
- Quality Assurance Project Plan for WIPP Site Effluent and Hazardous Materials Sampling (WP 02-EM1)
- WIPP Site Effluent and Hazardous Materials Sampling Plan (WP 02-EM2)
- WIPP VOC Operating Procedures Manual (WP 12-VC)
- Quality Assurance Project Plan for Sampling Emissions of Radionuclides to the Ambient Air at WIPP (DOE-WIPP 93-042)

Chapter 7 of the EMP defines the policies and practices followed to ensure that the data are accurate, complete, representative, and comparable. The data collected in the nonradiological environmental surveillance monitoring programs are analyzed as stated in DOE/EH-0023 (Corley et al., 1981). Section 8.0 of the EMP discusses, at length, the statistical procedures used to analyze data.

8.2 Revision of Procedures

Written procedures are essential in providing instruction to field personnel for sample collection. As data are collected, and records are generated, these procedures form the basis for an auditable program. The WID Quality and Regulatory Assurance Department and the ECAP periodically conduct assessments of environmental monitoring activities to determine the degree of compliance and effectiveness in implementation of the procedures.

In addition to independent assessment, one of the responsibilities of data collection personnel is to assess collection and analysis methodologies on a routine and ongoing basis. Field procedures, analytical procedures, and laboratory methodologies are periodically assessed for adequacy and effectiveness. Processes that require improvement are modified according to established document control procedures. The EEG and the NMED act as the performance-based checkpoint to ensure that radiological sampling procedures are adequately implemented and that data are comparable among WIPP, EEG, and NMED samples.

8.3 Interlaboratory Comparisons

The mission of the WIPP laboratory is to produce defensible and quality analytical data in support of WIPP operational activities. A key element in the WIPP laboratory QA program is active participation in intercomparison programs that are administered by credible agencies. WIPP laboratory participated in the following intercomparison study programs: (1) U.S. DOE Environmental Measurements Laboratory (EML), and (2) National Institute of Standards and Technology Radiochemistry Inter-comparison Program (NRIP). Laboratory Data Quality Objectives are met by reporting high quality results in the performance evaluation (see pages 8-4 through 8-6 for NRIP results).

The Data Quality Objectives are integrated in the laboratory operations by implementing the criteria set forth in ANSI [American National Standards Institute] N13.30 "Performance Criteria for Radiobioassay." The scientist, analyst, and technicians are dedicated, qualified, and well-trained to carry out the analytical processes. The instrument operational checks and calibrations are performed on a daily basis with standards traceable to the National Institute of Standards and Technology. Laboratory control sample batches include reagent blank, tracer, spike, and replicate samples. To demonstrate a high level of data quality, laboratory analytical results must pass a set of stringent criteria. The bias must be within -25 percent to +50 percent (ANSI N13.30, Section 3.4.2).

The laboratory participated in analyzing environmental samples (filters, water, and

synthetic urine) by radiochemical separation in conjunction with proportional counting, gamma spectroscopy, and alpha spectroscopy.

The performance evaluation samples are prepared and distributed to participating laboratories by the sponsoring agencies. Each laboratory performs the analysis for which the capacity exist. Using standard analytical methods specific to the WIPP laboratory, the samples are analyzed and the results are reported electronically. The results for each laboratory are compared with known values and then analyzed for accuracy.

Accuracy refers to variation of the analytical "measured value" from the "known value" of a given radionuclide. The intercomparison performance evaluation is reported as individual bias (B_n), which is calculated by the formula given below:

$$Bias = \frac{(S_m - S_k)}{S_k}$$

S_m = measured reported sample activity
S_k = known sample activity

The relative bias (B_r) is the average of the individual bias and the relative precision (S_b) is the standard deviation of the individual bias.

RESULTS EVALUATION

EML RESULTS			
Matrix: Air Filter		Units: Bq/Filter	
Isotope	Known Value	Reported Value	Bias (B_n)
Mn-54	7.62	7.70	0.01
Co-57	10.80	11.28	0.04
Co-60	5.10	5.09	-0.00
Sb-125	12.30	13.03	0.06
Cs-134	10.90	10.64	-0.02
Cs-137	8.70	8.62	-0.01
Ce-144	15.90	15.06	-0.05
Pu-238	0.10	0.10	0.00
Pu-239	0.12	0.12	0.00
Am-241	0.15	0.16	0.07
U-234	0.10	0.10	0.00
U-238	0.11	0.10	-0.09

EML RESULTS			
Matrix: Water		Units: Bq/L	
Isotope	Known Value	Reported Value	Bias (B_n)
Mn-54	20.80	23.50	0.13
Co-60	90.90	98.90	0.09
Cs-134	20.10	23.00	0.14
Cs-137	69.80	76.20	0.09
Ce-144	9.10	11.04	0.21
Pu-238	1.29	1.41	0.09
Pu-239	0.85	0.95	0.12
Am-241	0.84	0.95	0.13
U-234	0.54	0.58	0.08
U-238	0.55	0.55	0.00

NRIP RESULTS			
Matrix: Water	Units: mBq/g	Isotope: Am-241	
Sample	Known Value	Reported Value	Bias (B_n)
1	3.43	3.14	-0.08
2	3.43	3.44	0.00
3	3.43	3.82	0.11
4	3.43	3.45	0.01
5	3.43	3.45	0.01
		Relative Bias (B_r)	0.01
		Relative Precision (S_b)	0.07

NRIP RESULTS			
Matrix: Water Units: mBq/g Isotope: Pu-238			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	2.21	2.41	0.09
2	2.21	2.37	0.07
3	2.21	2.61	0.18
4	2.21	2.55	0.15
5	2.21	2.57	0.16
		Relative Bias (B_r)	0.13
		Relative Precision (S_b)	0.05

NRIP RESULTS			
Matrix: Water Units: mBq/g Isotope: Pu-239+240			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	1.95	2.26	0.16
2	1.95	2.36	0.21
3	1.95	2.34	0.20
4	1.95	2.39	0.23
5	1.95	2.20	0.13
		Relative Bias (B_r)	0.19
		Relative Precision (S_b)	0.04

NRIP RESULTS			
Matrix: Water Units: mBq/g Isotope: Pu-239+240			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	1.30E-03	1.27E-03	0.02
2	1.30E-03	1.32E-03	0.02
3	1.30E-03	1.33E-03	0.02
4	1.30E-03	1.35E-03	0.04
5	1.30E-03	1.22E-03	-0.06
		Relative Bias (B_r)	0.00
		Relative Precision (S_b)	0.04

NRIP RESULTS			
Matrix: Synthetic Urine Units: Bq/g Isotope: Pu-238			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	8.37E-04	7.96E-04	-0.05
2	8.37E-04	8.13E-04	-0.03
3	8.37E-04	7.91E-04	-0.06
4	8.37E-04	8.24E-04	-0.02
5	8.37E-04	8.07E-04	-0.04
		Relative Bias (B_r)	-0.04
		Relative Precision (S_b)	0.02

NRIP RESULTS			
Matrix: Synthetic Urine Units: Bq/g Isotope: Pu-239+240			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	7.41E-04	7.26E-04	-0.02
2	7.41E-04	7.25E-04	-0.02
3	7.41E-04	6.88E-04	-0.07
4	7.41E-04	7.25E-04	-0.02
5	7.41E-04	7.32E-04	-0.01
		Relative Bias (B_r)	-0.03
		Relative Precision (S_b)	0.02

NRIP RESULTS			
Matrix: Filters Units: Bq/Filter Isotope: Am-241			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	9.33E-02	9.05E-02	-0.03
2	8.16E-02	8.78E-02	0.07
3	9.37E-02	7.49E-02	-0.21
4	8.63E-02	8.12E-02	-0.06
5	9.33E-02	8.86E-02	-0.05
		Relative Bias (B_r)	-0.06
		Relative Precision (S_b)	0.10

NRIP RESULTS			
Matrix: Filters Units: Bq/Filter Isotope: Pu-238			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	6.00E-02	4.71E-02	-0.21
2	5.27E-02	4.68E-02	-0.11
3	6.08E-02	4.98E-02	-0.18
4	5.55E-02	4.29E-02	-0.23
5	6.01E-02	4.82E-02	-0.20
		Relative Bias (B_r)	-0.19
		Relative Precision (S_b)	0.05

NRIP RESULTS			
Matrix: Filters Units: Bq/Filter Isotope: Pu-239+240			
Sample	Known Value	Reported Value	Bias (B_{ri})
1	5.30E-02	4.70E-02	-0.11
2	4.66E-02	4.23E-02	-0.09
3	5.37E-02	4.92E-02	-0.08
4	4.91E-02	4.36E-02	-0.11
5	5.30E-02	5.08E-02	-0.04
		Relative Bias (B_r)	-0.09
		Relative Precision (S_b)	0.03

8.4 Analytical Laboratory Quality Assurance and Quality Control

During CY 1997, WIPP extended contracts to the following analytical laboratories: Ross Analytical Services Inc. in Strongsville, Ohio, and Datachem Laboratories in Salt Lake City, Utah. The contract laboratories are required to follow established QA/QC procedures as specified in the contract statement of work. Successful bidders performing environmental analyses are required to be on the Qualified Suppliers List and must undergo program reviews and assessments. Laboratory QA/QC includes the following:

- Reviewing and approving the laboratory QA plan
- Qualifying and training staff
- Specifying acceptable tolerances in data quality
- Performing internal laboratory QC
- Analyzing blind samples
- Calibrating and maintaining analytical equipment
- Reporting on the performance of measurement systems and data quality
- Reporting the performance of demonstration programs

8.5 Data Handling

Field data are collected and recorded in data books, organized by sample location and sampling round. Separate data books are prepared for sampling, field notes, and contract laboratory data. If samples are sent to more than one laboratory for analysis, a book is kept for each laboratory. Samples are collected and sent to the laboratory for analysis, accompanied by QC samples. QC sampling methodology follows the guidance of QAMS-005 and SW-846, Chapter 1. Analytical results are verified through specifying method blanks, duplicates, spikes, and trip blanks. QC reviews are performed in comparison to specified limits to determine whether the data set is suitable for inclusion in the report. The data are reported in the ASER.

8.6 Records Management

Documents and records generated under the CAO QA program are specified, prepared, reviewed, approved, controlled, and maintained in accordance with CAO 94-1012. The document provides a single reference for WIPP Project participants in meeting records management requirements as specified in DOE Orders and regulations. Further records management requirements and procedures are provided in the CAO Information Management Plan (CAO 94-1001).

Records are maintained in fire-resistant file cabinets until they are transmitted to the DOE-CAO Central Records Facility for permanent filing. All records, including raw data, calculations, computer programs, or other data manipulation media are subject to review and verification under the WIPP Quality Assurance Program Plan and the ECAP. The WID Environmental Monitoring Section is responsible for validating these records before transmitting them to the DOE-CAO Central Records Facility in accordance with an approved Records Inventory Disposition Schedule.

Records (i.e., reports of analyses and sample receipt forms transmitted by contract analytical laboratories) are dated upon receipt and a copy made for QC review. Specific record and data management procedures, including those referencing data manipulations, are implemented according to the approved QA project plan or work plan.

WIPP complies with the NESHAPs record-keeping requirements issued under 40 CFR § 61, Subpart H, which addresses atmospheric radionuclide emissions. Unless regulations are amended in the future, records developed pursuant to these criteria (i.e.,

medical, health and safety) will be maintained at least 30 years as specified in DOE Order 1324.2A, "Records Disposition" (DOE, 1992), Chapter V, Attachment 1, Schedule 25.

Consistent record keeping for all aspects of the Environmental Monitoring Program is a QA requirement. The EMP implements the records management requirements specified by DOE Orders.

CHAPTER 9 REFERENCES

American National Standards Institute/ American Society of Mechanical Engineers (ASME/NQA-1). 1986; Revised 1989. Quality Assurance Program Requirements for Nuclear Facilities (NQA-1-1989)

American National Standards Institute N13.30, Performance Criteria for Radiobioassay

Antelope Ridge Allotment (No. 77032)

Atomic Energy Act of 1954, 42 U.S.C. § 2278a

1996 Annual Mitigation Report for the Waste Isolation Pilot Plant (NEPA ID# WIP:97:0001)

Best, T.L. 1980. *WIPP Biology Library*

Carlsbad Resource Area Resource Management Plan and Environmental Impact Statement (BLM-NM-PT-86-004-4410)

Clean Air Act (42 U.S.C. § 7401 et seq.)

Clean Water Act, Section 402

Code of Federal Regulations 10, "Energy," 1996

Code of Federal Regulations 40, "Protection of the Environment" 1996

Code of Federal Regulations 43, "Public Lands: Interior," 1996

Code of Federal Regulations 49, "Transportation," 1996

Comprehensive Environmental Response, Compensation, and Liability Act (42 U.S.C. § 9601 et seq.) (including the Superfund Amendments and Reauthorization Act of 1986)

Resource Conservation and Recovery Act Compliance Manual (WP 02-6, 02-7)

Corley et al, *Guide For: Environmental Surveillance at U.S. DOE Installations,* 1981

U.S. Department of Energy Order 451.1, "National Environmental Policy Act Compliance Program"

Nonradioactive Hazardous Material Environmental Compliance Manual (WP 02-5)

Evaluation of Mineral Resources at the Waste Isolation Pilot Plant Site, March 31, 1995

Executive Order 12088, "Federal Compliance with Pollution Control Standards"

Executive Order 12873, "Federal Acquisition, Recycling, and Pollution Prevention"

Federal Land Policy and Management Act, 1976 (43 U.S.C. § 1751 et seq.)

Hazardous Materials Transportation Act (49 App. U.S.C. § 1801 et seq.; 49 CFR § 106-179)

Hazardous and Solid Waste Amendments of 1984

International Standards Organization 14000

Keith, L. H., *Environmental Sampling and Analysis: A Practical Guide*, Lewis Publishers Inc., 1991

Land Withdrawal Act (Public Law 102-579)

Livingston Ridge Allotment (No. 77027)

Lord, K. J. and W. E. Reynolds, ed., 1985. *Archeological Investigations of Three Sites within the WIPP Core Area, Eddy County, New Mexico*, Chambers Consultants and Planners, Albuquerque, New Mexico, prepared for the U.S. Army Corps of Engineers

MacLennan, R. B., and S. C. Shermer, 1979. *An Archeological Survey for the Waste Isolation Pilot Plant: Access Roads and Railroad Right-of-Way,* Agency for Conservation Archeology, Eastern New Mexico University, Portales, New Mexico

Mariah Associates, Inc., 1987. "Report of Class II Survey and Testing of Cultural Resources at the WIPP Site at Carlsbad, New Mexico," prepared for the U.S. Army Corps of Engineers, Albuquerque District

Mercer, J. W., 1983. "Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medaños Area, Southeastern New Mexico," *U.S. Geological Survey, Water Resources Investigations Report* 83-4016, U.S. Geologic Survey, Albuquerque, New Mexico

Materials Act of 1947 (30 U.S.C. §§ 602 and 603) July 31, 1947

National Council of Radiation Protection Report No. 94, Exposure of the Population in the United States and Canada from Natural Background. 1987

National Environmental Policy Act, 1969

National Historic Preservation Act (16 U.S.C. § 470 et seq.)

National Oil and Hazardous Substances Pollution Contingency Plan (40 CFR § 300)

National Pollution Discharge Elimination System

Neilson, J., 1976. *An Archeological Reconnaissance of Sandia Laboratories' Los Medaños Nuclear Waste Disposal Facility, Eddy County, New Mexico,* SAND 77-7024, Sandia National Laboratories, Albuquerque, New Mexico

New Mexico Air Quality Permit 310-M-2

New Mexico Air Quality Permit 702

Powers, D. W., et al. (eds.), *Geological Characterization Report, Waste Isolation Pilot Plant (WIPP) Site, SAND 78-1596*, Sandia National Laboratories, Albuquerque, New Mexico, 1978

Public Rangelands Improvement Act of 1979 (43 U.S.C. § 1901 et seq.)

Resource Conservation and Recovery Act (42 U.S.C. § 3251 et seq.)

Reith, C. C. and G. Daer, *Radiological Baseline Program for the Waste Isolation Pilot Plant: Program Plan*, WTSD-TME-057, Waste Isolation Pilot Plant, Carlsbad, New Mexico, 1985

Reith, C. C., et al., *Ecological Monitoring Program for the Waste Isolation Pilot Plant, Semi-Annual Report*: July-December 1984, WTSD-TME-058, Waste Isolation Pilot Plant, Carlsbad, New Mexico, 1985

Safe Drinking Water Act (42 U.S.C. § 300f et seq.)

Discharge Plan, DP-831

Superfund Amendments and Reauthorization Act Title III, Section 312

SW 846, "Test Methods for Evaluating Solid Waste"

Taylor Grazing Act (43 U.S.C. § 315 et seq.) 1934

Quality Assurance Management Staff (QAMS 005)

U.S. Department of Energy, DOE/CAO 94-1001, Rev.1, DOE Carlsbad Area Office Information Management Plan, 1994

U.S. Department of Energy, DOE/CAO 94-1012, Rev.1, DOE Carlsbad Area Office Quality Assurance Program Description, 1994

U.S. Department of Energy,
DOE/CAO 96-2184, Compliance Certification Application, October 1996

U.S. Department of Energy, DOE/EH-0349, Environmental Management Assessment of the WIPP, Carlsbad, New Mexico , July 1993

U.S. Department of Energy, DOE/EH-0173T, Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance, January 1991

U.S. Department of Energy,
DOE/EIS-0026-S-2, Disposal Phase Draft Supplemental Environmental Impact Statement

U.S. Department of Energy,
DOE/WIPP 88-008, Ecological Monitoring Program at the Waste Isolation Pilot Plant, Annual Report, Calendar Year 1987, 1988

U.S. Department of Energy,
DOE/WIPP 89-003, DOE, Waste Isolation Pilot Plant No-Migration Variance Petition, Revision 1, 1990d

U.S. Department of Energy,
DOE/WIPP 90-008, Waste Isolation Pilot Plant Groundwater Protection Management Plan, 1990

U.S. Department of Energy,
DOE/WIPP 92-040, Environmental Monitoring Plan

U.S. Department of Energy,
DOE/WIPP 93-042, Quality Assurance Project Plan for Sampling Emissions of Radionuclides to the Ambient Air at WIPP

U.S. Department of Energy,
DOE/WIPP 96-2162, Waste Isolation Pilot Plant Groundwater Protection Management Plan, 1996

U.S. Department of Energy,
DOE/WIPP 90-050, Environmental Protection Implementation Plan, 1990

U.S. Department of Energy,
DOE/WIPP 91-059, Waste Isolation Pilot Plant No-Migration Determination Annual Report for the Period November 1990 through September 1991, Waste Isolation Pilot Plant, Carlsbad, New Mexico, 1991

U.S. Department of Energy, 1997, Resource Conservation and Recovery Act Part B Permit Application, DOE/WIPP 91-005, Revision 6.5, Waste Isolation Pilot Plant, Carlsbad, New Mexico

U.S. Department of Energy,
DOE/WIPP 92-013, Background Water Quality Characterization Report for the WIPP, 1992

U.S. Department of Energy,
DOE/WIPP 92-037, Statistical Summary of the Radiological Baseline Program for the WIPP, 1992

U.S. Department of Energy,
DOE/WIPP 92-038, Summary of the Salt Impact Studies at the WIPP, 1984 to 1990, 1992

U.S. Department of Energy,
DOE/WIPP 93-004, WIPP Land Management Plan

U.S. Department of Energy,
DOE/WIPP 94-026, WIPP Land Management Plan

U.S. Department of Energy,
DOE/WIPP 95-2065, Safety Analysis Report

U.S. Department of Energy,
DOE/WIPP 96-2194, WIPP Environmental Monitoring Plan, 1996

U.S. Department of Energy,
DOE/WIPP 96-2199, Environmental Protection Implementation Plan for the Waste Isolation Pilot Plant, 1991

U.S. Department of Energy,
DOE/WIPP 96-2209, Final Voluntary Release

Assessment/Corrective Action (RA/CA) Report, 1996

U.S. Department of Energy, DOE/WIPP Draft 2115, Voluntary Release Assessment/Corrective Action Work Plan

NMED/DOE/AIP 94/1, Assessment of Solid Waste Management Units at the Waste Isolation Pilot Plant

U.S. Department of Energy, WP 02-3, Environmental Procedures Manual, 1988

U.S. Department of Energy, WP 02-1, Rev. 2, Groundwater Monitoring Program Plan and Procedures Manual, 1990

U.S. Department of Energy, Implementation of the National Environmental Policy Act, DOE Order AL 5440.1E, Albuquerque Operations Office, Albuquerque, New Mexico

U.S. Department of Energy, 1981, "Department of Energy/Waste Isolation Pilot Plant, Record of Decision," *Federal Register*, Vol. 46, No. 18, pp. 9162-9164

U.S. Department of Energy, Final Environmental Impact Statement, Waste Isolation Pilot Plant, DOE/EIS-0026, Volumes 1 and 2, Washington, D.C., 1980

U.S. Department of Energy, DOE Order 420.1, "Facility Safety"
U.S. Department of Energy, DOE Order 451.1E, "National Environmental Compliance Policy Act Compliance Program"

U.S. Department of Energy, DOE Order 5700.6C, "Quality Assurance," Washington, D.C., 1986

U.S. Department of Energy, DOE Order 5400, "General Environmental Protection Program,"Washington, D.C., 1988

U.S. Department of Energy, DOE Order 5400.3, "Hazardous and Radioactive Mixed Waste Program"

U.S. Department of Energy, DOE Order 5400.5, "Radiation Protection of the Public and the Environment," Washington, D.C., 1988b

U.S. Department of Energy, DOE Order 5480.23, "Nuclear Safety Analysis Reports"

U.S. Department of Energy, DOE Order 5482.1B, "Environment, Safety, and Health Appraisal Program"

U.S. Department of Energy, DOE Order 5632.1c, "Protection and Control of Safeguards and Security Interests"

U.S. Department of Energy, DOE Order 5820.2A, "Radioactive Waste Management," Washington, D.C., 1988d

U.S. Department of Energy, 1990a, Final Supplement Environmental Impact Statement, Waste Isolation Pilot Plant, DOE/EIS-0026-FS, U.S. Department of Energy, Office of Environmental Restoration and Waste Management, Washington, D.C.

U.S. Department of Energy, 1990b, "Record of Decision, Waste Isolation Pilot Plant," *Federal Register*, Vol. 55, No. 121, June 22, 1990

U.S. Department of Energy, 1991b, Waste Isolation Pilot Plant Resource Conservation and Recovery Act Part A Permit Application, Waste Isolation Pilot Plant, Carlsbad, New Mexico

U.S. Department of Energy, DOE Order 151.1, "Comprehensive Emergency Management System"

U.S. Department of Energy, DOE Order 231.1, "Environmental, Safety, and Health Reporting"

U.S. Department of Energy, DOE Order 460.1, "Packaging and Transportation Safety"

U.S. Department of Energy, DOE Order 1324.2A, "Records Description," Washington D.C., 1992

U.S. Department of Energy, WIPP Land Withdrawal Act of 1992 (Public Law 102-579)

U.S. Department of Energy, National Security, and Military Applications of Nuclear Energy Authorization Act of 1980 (i.e., Public Law 96-164)

U.S. Department of Energy, Organization Act (42 U.S.C. § 7112)

U.S. Department of Energy, DOE/EP-0023, "A Guide for: Environmental Radiological Surveillance at the U.S. Department of Energy Installations"

U.S. Environmental Protection Agency, "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans," EPA Publication QAMS-005/80, December 29, 1980

U.S. Geological Survey, "Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medaños Area, Southeastern New Mexico," USGS 83-4016, 1983

U.S. Nuclear Regulatory Commission, 1990, Certificate of Compliance for Radioactive Materials Packaging, No. 9218, U.S. Nuclear Regulatory Commission, Washington, D.C.

Waste Minimization and Pollution Prevention Awareness Plan

THIS PAGE LEFT BLANK INTENTIONALLY

APPENDIX A - LOCATION CODES

The location codes identify the site from which the sample was collected.

LOCATION CODES			
BHT	Bottom of the Hill Tank	RCP	Rainwater Catchment Pond
BRA	BRantley Lake	RED	RED tank
CBD	CarlsBaD	RNS	RiNSe aid blank
COW	COyote Well (deionized water blank)	SE1	South East 1
COY	COYote (surface water duplicate)	SE2	South East 2
CT1	ConTrol 1	SEC	South East Control
CT2	ConTrol 2	SMR	SMith Ranch
FWT	Fresh Water Tank	SOO	Sample Of Opportunity
HIL	HILl Tank	SEL	SEwage Lagoons
IDN	InDiaN Tank	TUT	TUT tank
LGS	Laguna Grande del Sol	UPR	Upper Pecos River
LST	LoSt Tank	WAB	WIPP Air Blank
MLR	MiLls Ranch	WE1	WIPP East 1
NOY	NOYa tank	WEE	WIPP East
NW1	NorthWest1	WIP	WIPP 16 sections
NW2	NorthWest2	WFF	WIPP Far Field
PCN	Pierce CanyoN	WQSP	Water Quality Sample Program
PEC	PECos river	WSS	WIPP South
PKT	PoKer Trap		

THIS PAGE LEFT BLANK INTENTIONALLY

APPENDIX B - CONCENTRATIONS OF ALPHA AND BETA ACTIVITIES IN AIR PARTICULATE

Week of Sample	Sample ID	Alpha Activity (Bq/m^3)	TPU (2 Sigma)	Beta Activity (Bq/m^3)	TPU (2 Sigma)
Carlsbad (CBD)					
1	AL-CBD-19970101 1.1	3.66E-05	3.63E-05	2.71E-04	9.61E-05
2	AL-CBD-19970108 1.1	6.64E-05	3.87E-05	5.73E-04	9.99E-05
3	AL-CBD-19970115 1.1	-1.09E-06	4.24E-05	9.70E-04	1.20E-04
4	AL-CBD-19970122 1.1	8.05E-05	4.68E-05	-1.40E-04	1.10E-04
5	AL-CBD-19970129 1.1	3.03E-05	3.76E-05	7.02E-04	1.06E-04
6	AL-CBD-19970205 1.1	1.58E-05	3.70E-05	7.05E-04	1.14E-04
7	AL-CBD-19970212 1.1	1.72E-05	3.56E-05	9.37E-04	1.10E-04
8	AL-CBD-19970219 1.1	2.80E-06	3.87E-05	4.84E-04	9.79E-05
9	AL-CBD-19970226 1.1	2.50E-05	2.73E-05	5.04E-04	9.32E-05
10	AL-CBD-19970305 1.1	2.58E-05	4.06E-05	7.13E-04	1.12E-04
11	AL-CBD-19970312 1.1	8.14E-05	3.88E-05	7.46E-04	1.04E-04
12	AL-CBD-19970319 1.1	6.10E-05	3.53E-05	7.15E-04	1.05E-04
13	AL-CBD-19970326 1.1	-5.11E-06	2.87E-05	5.58E-04	1.03E-04
14	AL-CBD-19970402 1.1	1.32E-05	3.61E-05	4.77E-04	9.66E-05
15	AL-CBD-19970409 1.1	4.58E-05	4.10E-05	7.17E-04	1.11E-04
16	AL-CBD-19970416 1.1	3.05E-05	3.73E-05	8.01E-04	1.06E-04
17	AL-CBD-19970423 1.1	2.62E-05	2.93E-05	4.44E-04	9.45E-05
18	AL-CBD-19970430 1.1	4.92E-05	4.13E-05	6.12E-04	1.23E-04
19	AL-CBD-19970507 1.1	3.22E-05	3.36E-05	6.27E-04	8.84E-05
20	AL-CBD-19970514 1.1	3.10E-05	3.73E-05	6.02E-04	1.03E-04
21	AL-CBD-19970521 1.1	5.47E-05	3.48E-05	5.39E-04	9.61E-05
22	AL-CBD-19970528 1.1	4.09E-05	3.82E-05	7.11E-04	1.08E-04
23	AL-CBD-19970604 1.1	-7.69E-06	3.70E-05	6.36E-04	1.03E-04
24	AL-CBD-19970611 1.1	1.13E-04	4.87E-05	6.93E-04	1.04E-04
25	AL-CBD-19970618 1.1	3.22E-05	2.81E-05	4.98E-04	9.88E-05
26	AL-CBD-19970625 1.1	1.62E-05	3.31E-05	4.78E-04	9.79E-05
27	AL-CBD-19970702 1.1	4.36E-05	3.80E-05	6.24E-04	1.05E-04
28	AL-CBD-19970709 1.1	5.00E-06	3.00E-05	5.96E-04	1.02E-04
29	AL-CBD-19970716 1.1	3.47E-06	4.01E-05	5.99E-04	1.05E-04
30	AL-CBD-19970723 1.1	-1.80E-05	3.68E-05	4.77E-04	1.01E-04
31	AL-CBD-19970730 1.1	3.36E-05	4.30E-05	8.16E-04	1.26E-04
32	AL-CBD-19970806 1.1	-2.37E-05	4.78E-05	5.56E-04	1.08E-04
33	AL-CBD-19970813 1.1	2.38E-05	4.15E-05	6.06E-04	1.07E-04
34	AL-CBD-19970820 1.1	5.85E-05	3.46E-05	5.42E-04	1.07E-04
35	AL-CBD-19970827 1.1	5.53E-05	3.93E-05	8.63E-04	1.24E-04
36	AL-CBD-19970903 1.1	-3.23E-05	3.72E-05	9.04E-04	1.25E-04
37	AL-CBD-19970910 1.1	9.16E-06	3.70E-05	7.79E-04	1.17E-04
38	AL-CBD-19970917 1.1	8.14E-06	3.05E-05	5.71E-04	9.68E-05
39	AL-CBD-19970924 1.1	3.73E-05	4.75E-05	8.31E-04	1.27E-04
40	AL-CBD-19971001 1.1	9.05E-06	3.69E-05	6.85E-04	1.04E-04
41	AL-CBD-19971008 1.1	3.02E-05	3.74E-05	4.60E-04	8.89E-05
42	AL-CBD-19971015 1.1	4.74E-05	4.44E-05	1.05E-03	1.26E-04
43	AL-CBD-19971022 1.1	-1.80E-05	4.17E-05	6.63E-04	1.20E-04
44	AL-CBD-19971029 1.1	2.75E-05	4.11E-05	6.49E-04	1.11E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
45	AL-CBD-19971105 1.1	-3.44E-05	2.53E-05	-2.22E-04	5.59E-05
46	AL-CBD-19971112 1.1	-3.56E-06	3.83E-05	8.15E-04	1.16E-04
47	AL-CBD-19971119 1.1	3.97E-05	5.29E-05	1.02E-03	1.37E-04
48	N/A	N/A	N/A	N/A	N/A
49	AL-CBD-19971203 1.1	4.73E-05	5.09E-05	8.64E-04	1.44E-04
50	AL-CBD-19971210 1.1	6.35E-05	4.03E-05	8.44E-04	1.22E-04
51	AL-CBD-19971217 1.1	8.42E-05	5.12E-05	8.54E-04	1.04E-04
52	AL-CBD-19971224 1.1	-1.65E-05	2.87E-05	6.40E-04	7.80E-05
Mills Ranch (MLR)					
1	AL-MLR-19970101 1.2	1.89E-05	3.34E-05	2.97E-04	9.83E-05
2	AL-MLR-19970108 1.2	4.50E-05	3.35E-05	5.83E-04	1.03E-04
3	AL-MLR-19970115 1.2	3.41E-05	4.71E-05	1.12E-03	1.24E-04
4	AL-MLR-19970122 1.2	4.37E-05	4.15E-05	-1.65E-04	1.08E-04
5	AL-MLR-19970129 1.2	1.66E-05	3.69E-05	8.41E-04	1.15E-04
6	AL-MLR-19970205 1.2	1.27E-05	3.33E-05	4.79E-04	9.79E-05
7	AL-MLR-19970212 1.2	2.77E-05	3.89E-05	9.45E-04	1.14E-04
8	AL-MLR-19970219 1.2	1.13E-05	3.98E-05	3.63E-04	9.22E-05
9	AL-MLR-19970226 1.2	3.19E-05	3.05E-05	6.18E-04	1.03E-04
10	AL-MLR-19970305 1.2	2.86E-05	3.83E-05	5.84E-04	1.01E-04
11	AL-MLR-19970312 1.2	6.43E-05	3.66E-05	6.18E-04	1.02E-04
12	AL-MLR-19970319 1.2	9.04E-05	3.93E-05	5.45E-04	9.77E-05
13	AL-MLR-19970326 1.2	1.88E-05	3.57E-05	5.73E-04	1.11E-04
14	AL-MLR-19970402 1.1	1.07E-05	3.56E-05	4.53E-04	9.54E-05
15	AL-MLR-19970409 1.1	5.07E-05	4.05E-05	7.92E-04	1.11E-04
16	AL-MLR-19970416 1.1	2.55E-05	3.74E-05	8.08E-04	1.09E-04
17	AL-MLR-19970423 1.1	3.60E-05	3.03E-05	4.96E-04	9.34E-05
18	AL-MLR-19970430 1.1	2.62E-05	3.16E-05	5.78E-04	1.04E-04
19	AL-MLR-19970507 1.1	4.96E-06	3.51E-05	5.29E-04	9.73E-05
20	AL-MLR-19970514 1.1	-4.67E-06	2.95E-05	6.55E-04	1.01E-04
21	AL-MLR-19970521 1.1	2.65E-05	2.83E-05	5.50E-04	9.29E-05
22	AL-MLR-19970528 1.1	-3.87E-07	3.21E-05	6.01E-04	1.07E-04
23	AL-MLR-19970604 1.1	8.77E-08	3.86E-05	5.74E-04	1.01E-04
24	N/A	N/A	N/A	N/A	N/A
25	AL-MLR-19970618 1.1	6.74E-05	3.53E-05	5.29E-04	1.02E-04
26	AL-MLR-19970625 1.1	1.36E-05	3.40E-05	5.07E-04	1.03E-04
27	AL-MLR-19970702 1.1	3.64E-05	5.39E-05	7.96E-04	1.57E-04
28	AL-MLR-19970709 1.1	2.62E-05	3.14E-05	3.95E-04	8.64E-05
29	AL-MLR-19970716 1.1	1.77E-05	4.30E-05	5.56E-04	1.05E-04
30	AL-MLR-19970723 1.1	-7.91E-06	3.71E-05	4.59E-04	9.74E-05
31	AL-MLR-19970730 1.1	3.82E-05	4.22E-05	6.77E-04	1.18E-04
32	AL-MLR-19970806 1.1	-4.34E-05	4.34E-05	4.18E-04	9.92E-05
33	AL-MLR-19970813 1.1	4.18E-06	3.88E-05	5.93E-04	1.07E-04
34	AL-MLR-19970820 1.1	4.38E-05	3.30E-05	6.05E-04	1.13E-04
35	AL-MLR-19970827 1.1	6.79E-05	4.06E-05	6.96E-04	1.17E-04
36	AL-MLR-19970903 1.1	1.74E-06	4.15E-05	9.91E-04	1.25E-04
37	AL-MLR-19970910 1.1	1.49E-05	3.74E-05	8.03E-04	1.16E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
38	AL-MLR-19970917 1.1	1.20E-05	3.17E-05	3.77E-04	9.05E-05
39	AL-MLR-19970924 1.1	7.63E-06	4.21E-05	8.74E-04	1.26E-04
40	AL-MLR-19971001 1.1	4.12E-05	4.30E-05	7.44E-04	1.09E-04
41	AL-MLR-19971008 1.1	-5.59E-06	3.29E-05	3.79E-04	8.79E-05
42	AL-MLR-19971015 1.1	4.54E-05	4.47E-05	1.16E-03	1.31E-04
43	AL-MLR-19971022 1.1	-1.28E-05	4.09E-05	5.17E-04	1.12E-04
44	AL-MLR-19971029 1.1	1.07E-05	3.81E-05	6.87E-04	1.12E-04
45	AL-MLR-19971105 1.1	3.52E-05	4.23E-05	7.70E-04	1.12E-04
46	AL-MLR-19971112 1.1	1.07E-05	3.93E-05	8.55E-04	1.14E-04
47	AL-MLR-19971119 1.1	2.81E-05	5.09E-05	1.19E-03	1.41E-04
48	AL-MLR-19971126 1.1	2.16E-05	4.27E-05	6.70E-04	1.32E-04
49	AL-MLR-19971203 1.1	1.57E-05	4.29E-05	7.16E-04	1.33E-04
50	AL-MLR-19971210 1.1	4.31E-06	3.56E-05	8.95E-04	1.17E-04
51	AL-MLR-19971217 1.1	5.86E-05	4.57E-05	8.34E-04	1.16E-04
52	AL-MLR-19971224 1.1	-1.73E-05	3.45E-05	5.71E-04	8.60E-05
South East Control (SEC)					
1	AL-SEC-19970101 1.1	2.39E-05	3.51E-05	2.77E-04	9.97E-05
2	AL-SEC-19970108 1.1	2.62E-05	3.01E-05	5.34E-04	1.01E-04
3	AL-SEC-19970115 1.1	-2.58E-06	4.23E-05	1.11E-03	1.24E-04
4	AL-SEC-19970122 1.1	5.56E-05	4.36E-05	-1.39E-04	1.10E-04
5	AL-SEC-19970129 1.1	3.19E-05	3.78E-05	6.11E-04	1.02E-04
6	AL-SEC-19970205 1.1	6.96E-06	3.29E-05	3.66E-04	9.53E-05
7	AL-SEC-19970212 1.1	2.66E-05	3.99E-05	9.16E-04	1.16E-04
8	AL-SEC-19970219 1.1	-1.12E-05	3.63E-05	2.62E-04	8.73E-05
9	AL-SEC-19970226 1.1	2.47E-05	2.76E-05	5.58E-04	9.65E-05
10	AL-SEC-19970305 1.1	2.51E-05	3.63E-05	5.34E-04	9.61E-05
11	AL-SEC-19970312 1.1	7.18E-05	3.66E-05	5.55E-04	9.59E-05
12	AL-SEC-19970319 1.1	9.60E-05	4.04E-05	5.23E-04	9.80E-05
13	AL-SEC-19970326 1.1	4.44E-05	3.72E-05	5.41E-04	1.02E-04
14	AL-SEC-19970402 1.1	3.59E-06	3.31E-05	3.55E-04	8.85E-05
15	AL-SEC-19970409 1.1	2.03E-05	3.65E-05	6.82E-04	1.11E-04
16	AL-SEC-19970416 1.1	4.21E-05	3.83E-05	6.58E-04	9.96E-05
17	AL-SEC-19970423 1.1	3.55E-05	3.07E-05	4.07E-04	9.13E-05
18	AL-SEC-19970430 1.1	-7.73E-08	2.59E-05	6.16E-04	1.04E-04
19	AL-SEC-19970507 1.1	1.50E-05	3.72E-05	5.14E-04	9.77E-05
20	AL-SEC-19970514 1.1	2.62E-05	3.58E-05	6.57E-04	1.03E-04
21	AL-SEC-19970521 1.1	4.42E-05	3.25E-05	6.39E-04	9.83E-05
22	AL-SEC-19970528 1.1	2.06E-05	3.57E-05	6.84E-04	1.09E-04
23	AL-SEC-19970604 1.1	6.80E-06	3.62E-05	6.48E-04	9.68E-05
24	AL-SEC-19970611 1.1	5.51E-05	3.99E-05	5.14E-04	9.47E-05
25	AL-SEC-19970618 1.1	7.93E-05	3.74E-05	4.65E-04	9.99E-05
26	AL-SEC-19970625 1.1	4.09E-05	3.81E-05	4.02E-04	9.72E-05
27	AL-SEC-19970702 1.1	4.17E-05	3.57E-05	6.66E-04	1.01E-04
28	AL-SEC-19970709 1.1	2.01E-05	3.15E-05	5.83E-04	9.73E-05
29	AL-SEC-19970716 1.1	-3.99E-06	3.76E-05	6.46E-04	1.04E-04
30	AL-SEC-19970723 1.1	6.63E-06	3.99E-05	5.38E-04	1.02E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
31	AL-SEC-19970730 1.1	6.49E-05	4.72E-05	9.97E-04	1.31E-04
32	AL-SEC-19970806 1.1	-3.54E-05	4.29E-05	5.67E-04	1.03E-04
33	AL-SEC-19970813 1.1	3.01E-05	4.11E-05	5.48E-04	1.01E-04
34	AL-SEC-19970820 1.1	7.16E-05	3.80E-05	6.59E-04	1.15E-04
35	AL-SEC-19970827 1.1	5.19E-05	3.86E-05	8.60E-04	1.24E-04
36	AL-SEC-19970903 1.1	-6.79E-06	3.98E-05	9.23E-04	1.22E-04
37	AL-SEC-19970910 1.1	2.98E-05	3.76E-05	8.67E-04	1.12E-04
38	AL-SEC-19970917 1.1	2.21E-05	3.54E-05	5.91E-04	1.04E-04
39	AL-SEC-19970924 1.1	2.19E-05	4.21E-05	9.02E-04	1.22E-04
40	AL-SEC-19971001 1.1	3.16E-06	4.79E-05	6.72E-04	1.29E-04
41	AL-SEC-19971008 1.1	-2.67E-05	4.30E-05	3.80E-04	1.17E-04
42	AL-SEC-19971015 1.1	1.36E-05	4.43E-05	8.93E-04	1.33E-05
43	N/A	N/A	N/A	N/A	N/A
44	AL-SEC-19971029 1.1	8.78E-06	3.62E-05	3.80E-04	9.75E-05
45	AL-SEC-19971105 1.1	3.08E-05	3.92E-05	8.08E-04	1.08E-04
46	AL-SEC-19971112 1.1	4.16E-05	4.19E-05	9.59E-04	1.13E-04
47	AL-SEC-19971119 1.1	1.17E-05	4.67E-05	1.25E-03	1.38E-04
48	AL-SEC-19971126 1.1	1.57E-05	3.86E-05	3.92E-04	1.11E-04
49	AL-SEC-19971203 1.1	3.49E-05	4.76E-05	7.13E-04	1.35E-04
50	AL-SEC-19971210 1.1	5.29E-05	4.35E-05	1.01E-03	1.18E-04
51	AL-SEC-19971217 1.1	4.25E-05	4.30E-05	8.86E-04	1.21E-04
52	AL-SEC-19971224 1.1	-5.21E-06	3.70E-05	6.17E-04	8.92E-05
Smith Ranch (SMR)					
1	AL-SMR-19970101 1.1	4.18E-05	3.72E-05	2.25E-04	9.42E-05
2	AL-SMR-19970108 1.1	5.66E-05	3.55E-05	5.25E-04	1.01E-04
3	AL-SMR-19970115 1.1	6.62E-07	4.34E-05	9.33E-04	1.20E-04
4	AL-SMR-19970122 1.1	4.78E-05	4.21E-05	-4.67E-05	1.11E-04
5	AL-SMR-19970129 1.1	2.25E-05	3.57E-05	7.46E-04	1.06E-04
6	AL-SMR-19970205 1.1	4.59E-05	4.14E-05	5.44E-04	1.08E-04
7	AL-SMR-19970212 1.1	3.73E-05	4.01E-05	8.94E-04	1.12E-04
8	AL-SMR-19970219 1.1	8.67E-07	3.87E-05	2.77E-04	8.90E-05
9	AL-SMR-19970226 1.1	3.40E-05	3.03E-05	6.12E-04	1.01E-04
10	AL-SMR-19970305 1.1	2.39E-05	3.65E-05	6.07E-04	9.97E-05
11	AL-SMR-19970312 1.1	1.09E-04	4.33E-05	6.19E-04	1.01E-04
12	AL-SMR-19970319 1.1	6.52E-05	3.67E-05	6.04E-04	1.04E-04
13	AL-SMR-19970326 1.1	4.36E-05	3.78E-05	5.03E-04	1.02E-04
14	AL-SMR-19970402 1.1	-8.09E-06	3.24E-05	3.58E-04	9.15E-05
15	AL-SMR-19970409 1.1	1.69E-05	3.47E-05	6.35E-04	1.11E-04
16	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A
18	AL-SMR-19970430 1.1	4.09E-05	3.45E-05	5.19E-04	1.03E-04
19	AL-SMR-19970507 1.1	9.75E-06	3.28E-05	5.15E-04	9.01E-05
20	AL-SMR-19970514 1.1	6.02E-05	4.02E-05	5.47E-04	9.68E-05
21	AL-SMR-19970521 1.1	4.77E-05	3.35E-05	5.52E-04	9.64E-05
22	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	N/A	N/A

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
24	AL-SMR-19970611 1.1	3.32E-05	4.05E-05	6.39E-04	9.72E-05
25	AL-SMR-19970618 1.1	2.47E-05	2.55E-05	4.78E-04	9.44E-05
26	AL-SMR-19970625 1.1	2.34E-06	3.83E-05	5.32E-04	1.21E-04
27	AL-SMR-19970702 1.1	3.29E-05	3.44E-05	5.40E-04	9.72E-05
28	AL-SMR-19970709 1.1	4.98E-05	4.19E-05	6.81E-04	1.15E-04
29	AL-SMR-19970716 1.1	2.92E-05	4.73E-05	5.99E-04	1.12E-04
30	AL-SMR-19970723 1.1	1.36E-05	4.01E-05	4.74E-04	9.74E-05
31	AL-SMR-19970730 1.1	1.05E-07	4.78E-05	6.42E-04	1.47E-04
32	AL-SMR-19970806 1.1	-6.41E-05	4.15E-05	4.24E-04	1.01E-04
33	AL-SMR-19970813 1.1	5.17E-05	4.42E-05	4.34E-04	9.66E-05
34	AL-SMR-19970820 1.1	5.70E-05	3.52E-05	5.78E-04	1.12E-04
35	AL-SMR-19970827 1.1	3.09E-05	4.36E-05	6.78E-04	1.47E-04
36	N/A	N/A	N/A	N/A	N/A
37	AL-SMR-19970910 1.1	3.95E-05	5.40E-05	6.23E-04	1.40E-04
38	N/A	N/A	N/A	N/A	N/A
39	AL-SMR-19970924 1.1	1.38E-05	4.20E-05	7.07E-04	1.18E-04
40	AL-SMR-19971001 1.1	6.51E-05	4.36E-05	8.52E-04	1.07E-04
41	AL-SMR-19971008 1.1	1.18E-04	4.95E-05	3.22E-04	8.46E-05
42	AL-SMR-19971015 1.1	2.43E-05	4.14E-05	1.08E-03	1.28E-04
43	AL-SMR-19971022 1.1	-2.60E-05	4.14E-05	5.21E-04	1.17E-04
44	AL-SMR-19971029 1.1	2.48E-05	3.93E-05	5.83E-04	1.06E-04
45	AL-SMR-19971105 1.1	1.00E-06	3.61E-05	7.44E-04	1.09E-04
46	AL-SMR-19971112 1.1	3.69E-06	3.56E-05	8.08E-04	1.07E-04
47	AL-SMR-19971119 1.1	1.30E-05	4.79E-05	1.10E-03	1.36E-04
48	AL-SMR-19971126 1.1	2.98E-05	4.23E-05	6.12E-04	1.24E-04
49	AL-SMR-19971203 1.1	1.21E-05	4.33E-05	7.02E-04	1.35E-04
50	AL-SMR-19971210 1.1	2.66E-05	3.65E-05	6.16E-04	1.22E-04
51	AL-SMR-19971217 1.1	5.88E-05	4.61E-05	9.57E-04	1.00E-04
52	AL-SMR-19971224 1.1	-2.00E-05	3.42E-05	6.75E-04	9.01E-05
WIPP East (WEE)					
1	AL-WEE-19970101 1.1	2.78E-05	3.49E-05	2.36E-04	9.52E-05
2	AL-WEE-19970108 1.1	6.32E-05	3.75E-05	6.51E-04	1.08E-04
3	AL-WEE-19970115 1.1	3.38E-05	4.75E-05	9.81E-04	1.21E-04
4	AL-WEE-19970122 1.1	4.09E-05	4.09E-05	-1.06E-04	1.09E-04
5	AL-WEE-19970129 2.2	4.67E-05	4.00E-05	8.20E-04	1.10E-04
6	AL-WEE-19970205 1.1	3.14E-06	3.19E-05	5.10E-04	1.00E-04
7	AL-WEE-19970212 1.1	2.04E-05	3.96E-05	9.55E-04	1.18E-04
8	AL-WEE-19970219 1.1	-1.22E-05	3.47E-05	3.26E-04	8.76E-05
9	AL-WEE-19970226 1.1	3.94E-05	3.17E-05	5.24E-04	9.91E-05
10	N/A	N/A	N/A	N/A	N/A
11	AL-WEE-19970312 1.1	8.04E-05	4.00E-05	6.10E-04	1.04E-04
12	AL-WEE-19970319 1.1	6.90E-05	3.74E-05	6.72E-04	1.07E-04
13	AL-WEE-19970326 1.1	1.32E-05	3.22E-05	4.38E-04	9.89E-05
14	AL-WEE-19970402 1.1	-5.05E-06	3.37E-05	4.93E-04	9.85E-05
15	AL-WEE-19970409 1.1	3.07E-05	3.80E-05	6.46E-04	1.11E-04
16	AL-WEE-19970416 1.1	1.00E-05	3.41E-05	7.80E-04	1.06E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
17	AL-WEE-19970423 1.1	6.18E-05	3.61E-05	4.22E-04	9.37E-05
18	AL-WEE-19970430 1.1	3.96E-05	3.41E-05	5.51E-04	1.03E-04
19	AL-WEE-19970507 1.1	-6.65E-07	3.34E-05	2.64E-04	8.38E-05
20	AL-WEE-19970514 1.1	1.02E-05	3.26E-05	4.48E-04	9.32E-05
21	AL-WEE-19970521 1.1	2.45E-05	2.90E-05	7.02E-04	1.02E-04
22	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A
25	N/A	N/A	N/A	N/A	N/A
26	N/A	N/A	N/A	N/A	N/A
27	AL-WEE-19970702 1.2	7.38E-05	4.14E-05	5.70E-04	9.97E-05
28	AL-WEE-19970709 1.2	4.82E-05	3.56E-05	5.12E-04	9.21E-05
29	AL-WEE-19970716 1.2	9.93E-06	3.96E-05	5.56E-04	1.01E-04
30	AL-WEE-19970723 1.2	-1.79E-05	3.72E-05	4.64E-04	1.01E-04
31	AL-WEE-19970730 1.2	2.59E-05	4.19E-05	7.23E-04	1.23E-04
32	AL-WEE-19970806 1.2	-4.05E-05	4.46E-05	4.08E-04	1.00E-04
33	AL-WEE-19970813 1.2	-3.10E-06	3.65E-05	6.10E-04	1.06E-04
34	AL-WEE-19970820 1.2	4.82E-05	3.31E-05	4.95E-04	1.07E-04
35	AL-WEE-19970827 1.2	2.20E-05	3.41E-05	7.92E-04	1.24E-04
36	AL-WEE-19970903 1.2	-7.95E-06	3.97E-05	7.86E-04	1.18E-04
37	AL-WEE-19970910 1.2	1.72E-05	3.97E-05	9.38E-04	1.25E-04
38	AL-WEE-19970917 1.2	1.34E-05	3.48E-05	4.07E-04	9.92E-05
39	AL-WEE-19970924 1.2	8.79E-06	3.88E-05	7.12E-04	1.12E-04
40	AL-WEE-19971001 1.1	1.13E-05	3.59E-05	6.85E-04	1.01E-04
41	AL-WEE-19971008 1.1	5.39E-06	3.79E-05	5.08E-04	1.00E-04
42	AL-WEE-19971015 1.1	5.74E-05	4.64E-05	9.86E-04	1.26E-04
43	AL-WEE-19971022 1.1	-2.87E-05	4.06E-05	5.01E-04	1.16E-04
44	AL-WEE-19971029 1.1	2.08E-05	4.12E-05	5.99E-04	1.13E-04
45	AL-WEE-19971105 1.1	1.80E-05	4.03E-05	7.22E-04	1.12E-04
46	AL-WEE-19971112 1.1	-9.09E-06	3.86E-05	7.87E-04	1.18E-04
47	AL-WEE-19971119 1.1	1.25E-05	4.82E-05	1.13E-03	1.38E-04
48	AL-WEE-19971126 1.1	1.54E-05	3.93E-05	6.60E-04	1.26E-04
49	AL-WEE-19971203 1.1	-1.07E-05	3.93E-05	6.90E-04	1.37E-04
50	AL-WEE-19971210 1.1	4.28E-05	4.56E-05	8.81E-04	1.23E-04
51	AL-WEE-19971217 1.1	7.05E-05	4.89E-05	9.08E-04	1.25E-04
52	AL-WEE-19971224 1.1	-1.03E-05	3.34E-05	5.92E-04	8.31E-05
WIPP Far Field (WFF)					
1	AL-WFF-19970101 1.1	2.12E-05	3.50E-05	2.64E-04	1.00E-04
2	AL-WFF-19970108 1.1	3.33E-05	3.21E-05	5.37E-04	1.04E-04
3	AL-WFF-19970115 1.1	3.10E-05	4.47E-05	1.11E-03	1.20E-04
4	AL-WFF-19970122 1.1	8.13E-05	4.57E-05	-1.43E-04	1.06E-04
5	AL-WFF-19970129 1.1	1.72E-05	3.69E-05	8.04E-04	1.13E-04
6	AL-WFF-19970205 1.1	1.36E-05	3.48E-05	4.89E-04	1.02E-04
7	N/A	N/A	N/A	N/A	N/A
8	AL-WFF-19970219 1.1	-2.75E-05	3.37E-05	3.03E-04	8.96E-05
9	AL-WFF-19970226 1.1	2.97E-05	2.85E-05	5.93E-04	9.74E-05

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
10	AL-WFF-19970305 1.1	1.10E-05	3.74E-05	6.10E-04	1.07E-04
11	AL-WFF-19970312 1.1	6.03E-05	3.42E-05	5.00E-04	9.27E-05
12	AL-WFF-19970319 1.1	4.88E-05	3.33E-05	6.45E-04	1.04E-04
13	AL-WFF-19970326 1.1	1.93E-05	3.33E-05	4.46E-04	9.91E-05
14	AL-WFF-19970402 1.1	1.72E-05	3.71E-05	4.48E-04	9.63E-05
15	AL-WFF-19970409 1.1	2.44E-05	3.59E-05	5.86E-04	1.11E-04
16	AL-WFF-19970416 1.1	2.39E-05	3.71E-05	7.51E-04	1.07E-04
17	AL-WFF-19970423 1.1	2.21E-05	2.72E-05	5.79E-04	9.56E-05
18	AL-WFF-19970430 1.1	4.23E-05	3.65E-05	5.94E-04	1.11E-04
19	AL-WFF-19970507 1.1	4.20E-06	3.43E-05	5.62E-04	9.73E-05
20	AL-WFF-19970514 1.1	1.00E-05	3.34E-05	4.93E-04	9.72E-05
21	AL-WFF-19970521 1.1	2.33E-05	2.88E-05	6.28E-04	9.93E-05
22	AL-WFF-19970528 1.1	1.70E-05	3.54E-05	7.15E-04	1.11E-04
23	AL-WFF-19970604 1.1	7.17E-06	3.94E-05	5.41E-04	9.85E-05
24	AL-WFF-19970611 1.1	1.06E-05	2.97E-05	5.86E-04	9.02E-05
25	AL-WFF-19970618 1.1	4.11E-05	3.02E-05	5.49E-04	1.02E-04
26	AL-WFF-19970625 1.1	3.38E-05	3.82E-05	5.13E-04	1.05E-04
27	AL-WFF-19970702 1.1	3.01E-05	3.48E-05	5.83E-04	1.01E-04
28	AL-WFF-19970709 1.1	5.63E-05	3.84E-05	5.80E-04	9.88E-05
29	AL-WFF-19970716 1.1	1.03E-06	4.16E-05	5.80E-04	1.08E-04
30	AL-WFF-19970723 1.1	-4.34E-06	3.91E-05	4.42E-04	9.96E-05
31	AL-WFF-19970730 1.1	3.76E-07	3.81E-05	6.58E-04	1.22E-04
32	AL-WFF-19970806 1.1	-4.63E-05	4.14E-05	4.75E-04	9.90E-05
33	AL-WFF-19970813 1.1	1.83E-07	3.90E-05	4.32E-04	1.02E-04
34	AL-WFF-19970820 1.1	8.00E-05	3.92E-05	5.79E-04	1.12E-04
35	N/A	N/A	N/A	N/A	N/A
36	AL-WFF-19970903 1.1	4.09E-07	4.07E-05	8.57E-04	1.20E-04
37	AL-WFF-19970910 1.1	4.89E-06	3.83E-05	8.82E-04	1.25E-04
38	AL-WFF-19970917 1.1	1.81E-07	2.84E-05	5.11E-04	9.31E-05
39	AL-WFF-19970924 1.1	-5.05E-06	3.56E-05	7.57E-04	1.11E-04
40	AL-WFF-19971001 1.2	7.69E-06	3.74E-05	8.00E-04	1.10E-04
41	AL-WFF-19971008 1.2	-1.64E-05	3.28E-05	4.80E-04	9.61E-05
42	AL-WFF-19971015 1.2	3.15E-05	3.99E-05	1.02E-03	1.20E-04
43	AL-WFF-19971022 1.2	-1.12E-05	4.38E-05	6.07E-04	1.21E-04
44	AL-WFF-19971029 1.2	-1.13E-05	3.68E-05	7.32E-04	1.18E-04
45	AL-WFF-19971105 1.2	2.58E-05	4.29E-05	8.75E-04	1.21E-04
46	AL-WFF-19971112 1.2	5.81E-06	3.98E-05	9.53E-04	1.20E-04
47	AL-WFF-19971119 1.2	3.80E-05	5.30E-05	1.38E-03	1.49E-04
48	AL-WFF-19971126 1.2	2.15E-05	4.21E-05	6.46E-04	1.29E-04
49	AL-WFF-19971203 1.2	4.58E-05	5.18E-05	7.83E-04	1.44E-04
50	AL-WFF-19971210 1.2	3.30E-05	4.09E-05	9.29E-04	1.32E-04
51	AL-WFF-19971217 1.2	4.60E-05	4.66E-05	1.08E-03	1.19E-04
52	AL-WFF-19971224 1.2	-2.65E-05	3.22E-05	6.35E-04	8.68E-05
WIPP South (WSS)					
1	AL-WSS-19970101 1.1	3.55E-05	3.65E-05	2.23E-04	9.53E-05
2	AL-WSS-19970108 1.1	1.52E-05	2.78E-05	5.03E-04	1.00E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
3	AL-WSS-19970115 1.1	5.49E-05	4.96E-05	1.14E-03	1.25E-04
4	AL-WSS-19970122 1.1	5.12E-05	4.20E-05	-1.40E-04	1.07E-04
5	AL-WSS-19970129 1.1	3.40E-05	3.96E-05	7.78E-04	1.12E-04
6	AL-WSS-19970205 1.1	9.02E-06	3.30E-05	5.16E-04	1.00E-04
7	AL-WSS-19970212 1.1	2.50E-05	4.09E-05	9.09E-04	1.18E-04
8	AL-WSS-19970219 1.1	-2.38E-05	3.29E-05	3.11E-04	8.72E-05
9	AL-WSS-19970226 1.1	3.35E-05	3.03E-05	4.83E-04	9.67E-05
10	AL-WSS-19970305 1.1	-4.60E-06	3.21E-05	5.59E-04	9.87E-05
11	AL-WSS-19970312 1.1	7.63E-05	3.91E-05	5.32E-04	1.01E-04
12	AL-WSS-19970319 1.1	8.36E-05	3.87E-05	6.03E-04	1.01E-04
13	AL-WSS-19970326 1.1	5.41E-05	4.04E-05	5.48E-04	1.07E-04
14	AL-WSS-19970402 1.2	5.45E-05	4.28E-05	4.33E-04	9.64E-05
15	AL-WSS-19970409 1.2	5.64E-05	4.23E-05	5.63E-04	1.11E-04
16	AL-WSS-19970416 1.2	2.22E-05	3.69E-05	8.15E-04	1.09E-04
17	AL-WSS-19970423 1.2	3.56E-05	3.12E-05	4.48E-04	9.45E-05
18	AL-WSS-19970430 1.2	4.22E-05	3.53E-05	5.10E-04	1.04E-04
19	AL-WSS-19970507 1.2	-7.24E-06	3.35E-05	4.99E-04	9.74E-05
20	AL-WSS-19970514 1.2	-3.14E-06	3.15E-05	5.42E-04	1.01E-04
21	AL-WSS-19970521 1.2	8.21E-05	3.89E-05	6.31E-04	9.82E-05
22	AL-WSS-19970528 1.2	1.96E-05	3.59E-05	5.92E-04	1.07E-04
23	AL-WSS-19970604 2.2	-1.80E-05	3.31E-05	3.01E-04	8.36E-05
24	AL-WSS-19970611 1.2	5.61E-05	4.15E-05	5.97E-04	1.01E-04
25	AL-WSS-19970618 1.2	3.17E-05	2.83E-05	5.45E-04	1.02E-04
26	AL-WSS-19970625 1.2	3.72E-06	3.17E-05	5.08E-04	1.02E-04
27	AL-WSS-19970702 1.12	3.90E-05	3.69E-05	5.16E-04	9.99E-05
28	AL-WSS-19970709 1.1	7.72E-05	4.06E-05	5.22E-04	9.39E-05
29	AL-WSS-19970716 1.12	4.61E-06	4.16E-05	5.57E-04	1.06E-04
30	AL-WSS-19970723 1.12	-6.39E-06	3.86E-05	5.59E-04	1.04E-04
31	AL-WSS-19970730 1.12	4.05E-05	4.42E-05	8.18E-04	1.26E-04
32	AL-WSS-19970806 1.1	-5.18E-05	4.43E-05	4.24E-04	1.03E-04
33	AL-WSS-19970813 1.1	-1.35E-05	3.37E-05	6.50E-04	1.05E-04
34	AL-WSS-19970820 1.1	5.75E-05	3.57E-05	5.95E-04	1.13E-04
35	AL-WSS-19970827 1.1	5.01E-05	3.85E-05	8.24E-04	1.23E-04
36	AL-WSS-19970903 1.1	-1.12E-05	3.92E-05	7.93E-04	1.18E-04
37	AL-WSS-19970910 1.1	4.41E-05	4.49E-05	8.96E-04	1.26E-04
38	AL-WSS-19970917 1.1	1.80E-05	3.58E-05	5.22E-04	1.04E-04
39	AL-WSS-19970924 1.1	2.93E-06	3.86E-05	8.61E-04	1.19E-04
40	AL-WSS-19971001 1.1	2.48E-05	3.94E-05	6.84E-04	1.04E-04
41	AL-WSS-19971008 1.1	-1.43E-06	3.63E-05	3.16E-04	9.06E-05
42	AL-WSS-19971015 1.1	3.98E-05	4.40E-05	1.02E-03	1.27E-04
43	AL-WSS-19971022 1.1	-2.21E-05	4.24E-05	4.55E-04	1.16E-04
44	AL-WSS-19971029 1.1	4.47E-05	4.67E-05	6.58E-04	1.20E-04
45	AL-WSS-19971105 1.1	2.74E-07	3.79E-05	6.63E-04	1.11E-04
46	N/A	N/A	N/A	N/A	N/A
47	AL-WSS-19971119 1.1	8.62E-06	5.14E-05	9.67E-04	1.41E-04
48	AL-WSS-19971126 1.1	-1.58E-06	3.84E-05	6.50E-04	1.34E-04
49	AL-WSS-19971203 1.1	1.24E-05	4.51E-05	7.46E-04	1.41E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
50	AL-WSS-19971210 1.1	-6.30E-06	3.45E-05	8.09E-04	1.25E-04
51	AL-WSS-19971217 1.1	2.36E-05	4.32E-05	8.56E-04	1.15E-04
52	AL-WSS-19971224 1.1	-2.07E-05	3.19E-05	6.11E-04	8.39E-05
WIPP Air Blank (WAB)					
1	AL-WAB-19970101 1.1	3.31E-03	1.00E-02	9.92E-03	2.95E-02
2	AL-WAB-19970108 1.1	4.25E-03	1.06E-02	3.87E-02	3.21E-02
3	AL-WAB-19970115 1.1	-1.04E-02	1.56E-02	4.35E-02	2.92E-02
4	AL-WAB-19970122 1.1	2.95E-02	1.45E-02	2.74E-02	3.20E-02
5	AL-WAB-19970129 1.1	1.03E-02	1.24E-02	4.25E-02	2.76E-02
6	AL-WAB-19970205 1.1	9.58E-03	1.24E-02	5.90E-02	3.11E-02
7	AL-WAB-19970212 1.1	1.58E-02	1.39E-02	4.18E-02	2.90E-02
8	AL-WAB-19970219 1.1	8.56E-04	1.53E-02	4.80E-02	2.93E-02
9	AL-WAB-19970226 1.1	-3.90E-04	8.74E-03	2.83E-02	2.91E-02
10	AL-WAB-19970305 1.1	3.24E-03	1.34E-02	2.11E-02	2.98E-02
11	AL-WAB-19970312 1.1	7.00E-03	7.38E-03	1.95E-02	2.76E-02
12	AL-WAB-19970319 1.1	6.88E-03	7.26E-03	1.96E-02	2.85E-02
13	AL-WAB-19970326 1.1	1.72E-02	1.15E-02	6.75E-02	3.14E-02
14	AL-WAB-19970402 1.1	-6.64E-03	1.38E-02	5.28E-02	3.05E-02
15	AL-WAB-19970409 1.1	-1.34E-02	1.18E-02	3.20E-02	2.86E-02
16	AL-WAB-19970416 1.1	-4.30E-04	1.23E-02	1.95E-02	2.77E-02
17	AL-WAB-19970423 1.1	-1.98E-04	8.63E-03	1.53E-02	2.73E-02
18	AL-WAB-19970430 1.1	9.64E-04	9.38E-03	4.16E-02	2.98E-02
19	AL-WAB-19970507 1.1	-7.51E-03	1.33E-02	1.71E-02	2.75E-02
20	AL-WAB-19970514 1.1	-1.14E-02	1.23E-02	4.70E-02	2.82E-02
21	AL-WAB-19970521 1.1	-2.44E-03	8.01E-03	3.19E-02	2.55E-02
22	AL-WAB-19970528 1.1	-2.65E-03	1.18E-02	4.91E-02	2.91E-02
23	AL-WAB-19970604 1.1	-1.51E-02	1.43E-02	2.91E-02	2.62E-02
24	AL-WAB-19970611 1.1	-2.88E-03	1.17E-02	5.47E-02	2.65E-02
25	AL-WAB-19970618 1.1	7.17E-03	7.19E-03	9.73E-03	3.00E-02
26	AL-WAB-19970625 1.1	8.80E-03	1.17E-02	1.08E-02	2.96E-02
27	AL-WAB-19970702 1.1	1.60E-02	1.05E-02	1.86E-03	2.70E-02
28	AL-WAB-19970709 1.1	-7.60E-03	1.01E-02	1.59E-02	2.59E-02
29	AL-WAB-19970716 1.1	1.10E-02	1.52E-02	-6.91E-04	2.93E-02
30	AL-WAB-19970723 1.1	-2.16E-04	1.51E-02	1.25E-02	2.95E-02
31	AL-WAB-19970730 1.1	-7.15E-03	1.34E-02	-7.96E-03	3.41E-02
32	AL-WAB-19970806 1.1	-1.28E-02	1.92E-02	4.93E-03	3.04E-02
33	AL-WAB-19970813 1.1	-6.13E-03	1.38E-02	4.33E-02	2.83E-02
34	AL-WAB-19970820 1.1	-1.50E-03	8.06E-03	-1.79E-02	3.38E-02
35	AL-WAB-19970827 1.1	3.97E-03	1.02E-02	-1.55E-02	3.40E-02
36	AL-WAB-19970903 1.1	-1.82E-02	1.60E-02	-1.74E-03	3.28E-02
37	AL-WAB-19970910 1.1	-1.07E-02	1.25E-02	-1.62E-02	2.94E-02
38	AL-WAB-19970917 1.1	-2.29E-03	1.20E-02	2.64E-02	2.98E-02
39	AL-WAB-19970924 1.1	-1.54E-02	1.44E-02	3.41E-02	3.19E-02
40	AL-WAB-19971001 1.1	-1.67E-02	1.40E-02	8.03E-03	2.77E-02
41	AL-WAB-19971008 1.1	7.05E-03	1.43E-02	1.62E-02	2.89E-02
42	AL-WAB-19971015 1.1	-9.67E-03	1.28E-02	2.57E-02	3.00E-02

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
43	AL-WAB-19971015 1.1	-4.18E-02	1.80E-02	-3.93E-02	3.85E-02
44	AL-WAB-19971029 1.1	-1.36E-02	1.44E-02	-4.25E-02	3.40E-02
45	AL-WAB-19971105 1.1	-3.08E-03	1.42E-02	-2.89E-02	3.08E-02
46	AL-WAB-19971112 1.1	-6.05E-03	1.41E-02	2.00E-02	2.97E-02
47	AL-WAB-19971119 1.1	-2.41E-02	1.72E-02	1.81E-02	3.60E-02
48	AL-WAB-19971126 1.1	7.50E-03	1.42E-02	4.38E-02	3.62E-02
49	AL-WAB-19971203 1.1	2.67E-03	1.61E-02	4.02E-03	3.90E-02
50	AL-WAB-19971210 1.1	-9.88E-03	1.30E-02	3.56E-02	2.67E-02
51	AL-WAB-19971217 1.1	7.66E-03	1.19E-02	5.79E-02	2.94E-02
52	AL-WAB-19971224 1.1	-3.05E-03	1.70E-02	4.81E-02	2.70E-02
Duplicate Samples					
Mills Ranch (MLR)					
1	AL-MLR-19970101 1.2	1.89E-05	3.34E-05	2.97E-04	9.83E-05
1	AL-MLR-19970101 2.2	2.37E-05	3.33E-05	2.30E-04	9.27E-05
2	AL-MLR-19970108 1.2	4.50E-05	3.35E-05	5.83E-04	1.03E-04
2	AL-MLR-19970108 2.2	3.96E-05	3.24E-05	5.64E-04	1.02E-04
3	AL-MLR-19970115 1.2	3.41E-05	4.71E-05	1.12E-03	1.24E-04
3	AL-MLR-19970115 2.2	1.06E-05	4.14E-05	9.18E-04	1.13E-04
4	AL-MLR-19970122 1.2	4.37E-05	4.15E-05	-1.65E-04	1.08E-04
4	AL-MLR-19970122 2.2	6.32E-05	4.43E-05	-1.10E-04	1.10E-04
5	AL-MLR-19970129 1.2	1.66E-05	3.69E-05	8.41E-04	1.15E-04
5	AL-MLR-19970129 2.2	2.24E-05	3.84E-05	7.32E-04	1.12E-04
6	AL-MLR-19970205 1.2	1.27E-05	3.33E-05	4.79E-04	9.79E-05
6	AL-MLR-19970205 2.2	2.97E-05	3.75E-05	5.82E-04	1.05E-04
7	AL-MLR-19970212 1.2	2.77E-05	3.89E-05	9.45E-04	1.14E-04
7	AL-MLR-19970212 2.2	1.67E-05	3.69E-05	8.69E-04	1.11E-04
8	AL-MLR-19970219 1.2	1.13E-05	3.98E-05	3.63E-04	9.22E-05
8	AL-MLR-19970219 2.2	-1.02E-05	3.58E-05	3.70E-04	9.11E-05
9	AL-MLR-19970226 1.2	3.19E-05	3.05E-05	6.18E-04	1.03E-04
9	AL-MLR-19970226 2.2	4.82E-05	3.29E-05	5.03E-04	9.69E-05
10	AL-MLR-19970305 1.2	2.86E-05	3.83E-05	5.84E-04	1.01E-04
10	AL-MLR-19970305 2.2	1.09E-05	3.54E-05	5.55E-04	1.00E-04
11	AL-MLR-19970312 1.2	6.43E-05	3.66E-05	6.18E-04	1.02E-04
11	AL-MLR-19970312 2.2	4.52E-05	3.23E-05	6.21E-04	9.90E-05
12	AL-MLR-19970319 1.2	9.04E-05	3.93E-05	5.45E-04	9.77E-05
12	AL-MLR-19970319 2.2	6.60E-05	3.69E-05	6.65E-04	1.06E-04
13	AL-MLR-19970326 1.2	1.88E-05	3.57E-05	5.73E-04	1.11E-04
13	AL-MLR-19970326 2.2	1.88E-05	3.31E-05	4.64E-04	9.96E-05
WIPP South (WSS)					
14	AL-WSS-19970402 1.2	5.45E-05	4.28E-05	4.33E-04	9.64E-05
14	AL-WSS-19970402 2.2	-1.19E-06	3.53E-05	4.69E-04	9.97E-05
15	AL-WSS-19970409 1.2	5.64E-05	4.23E-05	5.63E-04	1.11E-04
15	N/A	N/A	N/A	N/A	N/A
16	AL-WSS-19970416 1.2	2.22E-05	3.69E-05	8.15E-04	1.09E-04
16	AL-WSS-19970416 2.2	6.52E-05	4.67E-05	7.88E-04	1.16E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
17	AL-WSS-19970423 1.2	3.56E-05	3.12E-05	4.48E-04	9.45E-05
17	AL-WSS-19970423 2.2	3.19E-05	2.96E-05	3.96E-04	8.97E-05
18	AL-WSS-19970430 1.2	4.22E-05	3.53E-05	5.10E-04	1.04E-04
18	N/A	N/A	N/A	N/A	N/A
19	AL-WSS-19970507 1.2	-7.24E-06	3.35E-05	4.99E-04	9.74E-05
19	AL-WSS-19970507 2.2	-7.10E-06	3.35E-05	4.88E-04	9.69E-05
20	AL-WSS-19970514 1.2	-3.14E-06	3.15E-05	5.42E-04	1.01E-04
20	N/A	NA	N/A	N/A	N/A
21	AL-WSS-19970521 1.2	8.21E-05	3.89E-05	6.31E-04	9.82E-05
21	AL-WSS-19970521 2.2	4.57E-05	3.26E-05	5.69E-04	9.52E-05
22	AL-WSS-19970528 1.2	1.96E-05	3.59E-05	5.92E-04	1.07E-04
22	AL-WSS-19970528 2.2	1.87E-05	3.76E-05	7.24E-04	1.16E-04
23	N/A	N/A	N/A	N/A	N/A
23	AL-WSS-19970604 2.2	-1.80E-05	3.31E-05	3.01E-04	8.36E-05
24	AL-WSS-19970611 1.2	5.61E-05	4.15E-05	5.97E-04	1.01E-04
24	AL-WSS-19970611 2.2	3.50E-05	3.77E-05	6.33E-04	1.02E-04
25	AL-WSS-19970618 1.2	3.17E-05	2.83E-05	5.45E-04	1.02E-04
25	AL-WSS-19970618 2.2	2.24E-05	2.51E-05	4.61E-04	9.44E-05
26	AL-WSS-19970625 1.2	3.72E-06	3.17E-05	5.08E-04	1.02E-04
26	AL-WSS-19970625 2.2	5.25E-05	3.97E-05	4.29E-04	9.76E-05
WIPP East (WEE)					
27	AL-WEE-19970702 1.2	7.38E-05	4.14E-05	5.70E-04	9.97E-05
27	AL-WEE-19970702 2.2	4.69E-05	3.73E-05	6.46E-04	1.03E-04
28	AL-WEE-19970709 1.2	4.82E-05	3.56E-05	5.12E-04	9.21E-05
28	AL-WEE-19970709 2.2	3.55E-05	3.53E-05	6.68E-04	1.03E-04
29	AL-WEE-19970716 1.2	9.93E-06	3.96E-05	5.56E-04	1.01E-04
29	AL-WEE-19970716 2.2	3.83E-05	4.33E-05	5.14E-04	9.80E-05
30	AL-WEE-19970723 1.2	-1.79E-05	3.72E-05	4.64E-04	1.01E-04
30	AL-WEE-19970723 2.2	-2.37E-06	3.94E-05	3.29E-04	9.47E-05
31	AL-WEE-19970730 1.2	2.59E-05	4.19E-05	7.23E-04	1.23E-04
31	AL-WEE-19970730 2.2	2.68E-05	4.13E-05	7.87E-04	1.23E-04
32	AL-WEE-19970806 1.2	-4.05E-05	4.46E-05	4.08E-04	1.00E-04
32	AL-WEE-19970806 2.2	-5.52E-05	4.19E-05	5.40E-04	1.05E-04
33	AL-WEE-19970813 1.2	-3.10E-06	3.65E-05	6.10E-04	1.06E-04
33	AL-WEE-19970813 2.2	7.98E-06	3.63E-05	4.85E-04	9.61E-05
34	AL-WEE-19970820 1.2	4.82E-05	3.31E-05	4.95E-04	1.07E-04
34	AL-WEE-19970820 2.2	6.55E-05	3.74E-05	5.87E-04	1.15E-04
35	AL-WEE-19970827 1.2	2.20E-05	3.41E-05	7.92E-04	1.24E-04
35	AL-WEE-19970827 2.2	2.07E-05	3.18E-05	7.30E-04	1.15E-04
36	AL-WEE-19970903 1.2	-7.95E-06	3.97E-05	7.86E-04	1.18E-04
36	AL-WEE-19970903 2.2	-3.88E-05	3.46E-05	7.27E-04	1.15E-04
37	AL-WEE-19970910 1.2	1.72E-05	3.97E-05	9.38E-04	1.25E-04
37	AL-WEE-19970910 2.2	2.86E-05	4.17E-05	8.97E-04	1.24E-04
38	AL-WEE-19970917 1.2	1.34E-05	3.48E-05	4.07E-04	9.92E-05
38	AL-WEE-19970917 2.2	2.93E-06	3.42E-05	4.53E-04	1.05E-04

Week of Sample	Sample ID	Alpha Activity (Bq/m³)	TPU (2 Sigma)	Beta Activity (Bq/m³)	TPU (2 Sigma)
39	AL-WEE-19970924 1.2	8.79E-06	3.88E-05	7.12E-04	1.12E-04
39	AL-WEE-19970924 2.2	-9.95E-06	3.68E-05	8.70E-04	1.20E-04
WIPP Far Field (WFF)					
40	AL-WFF-19971001 1.2	7.69E-06	3.74E-05	8.00E-04	1.10E-04
40	AL-WFF-19971001 2.2	-3.75E-06	3.48E-05	7.02E-04	1.04E-04
41	AL-WFF-19971008 1.2	-1.64E-05	3.28E-05	4.80E-04	9.61E-05
41	AL-WFF-19971008 2.2	-6.39E-06	3.66E-05	4.33E-04	9.82E-05
42	AL-WFF-19971015 1.2	3.15E-05	3.99E-05	1.02E-03	1.20E-04
42	AL-WFF-19971015 2.2	2.36E-05	4.08E-05	1.08E-03	1.27E-04
43	AL-WFF-19971022 1.2	-1.12E-05	4.38E-05	6.07E-04	1.21E-04
43	AL-WFF-19971022 2.2	-2.11E-05	4.42E-05	5.92E-04	1.24E-04
44	AL-WFF-19971029 1.2	-1.13E-05	3.68E-05	7.32E-04	1.18E-04
44	AL-WFF-19971029 2.2	2.11E-05	4.21E-05	7.35E-04	1.19E-04
45	AL-WFF-19971105 1.2	2.58E-05	4.29E-05	8.75E-04	1.21E-04
45	AL-WFF-19971105 2.2	1.67E-05	4.03E-05	7.93E-04	1.15E-04
46	AL-WFF-19971112 1.2	5.81E-06	3.98E-05	9.53E-04	1.20E-04
46	AL-WFF-19971112 2.2	1.59E-05	4.33E-05	8.96E-04	1.23E-04
47	AL-WFF-19971119 1.2	3.80E-05	5.30E-05	1.38E-03	1.49E-04
47	AL-WFF-19971119 2.2	3.71E-05	5.26E-05	1.27E-03	1.45E-04
48	AL-WFF-19971126 1.2	2.15E-05	4.21E-05	6.46E-04	1.29E-04
48	AL-WFF-19971126 2.2	7.71E-07	3.77E-05	7.56E-04	1.35E-04
49	AL-WFF-19971203 1.2	4.58E-05	5.18E-05	7.83E-04	1.44E-04
49	AL-WFF-19971203 2.2	1.19E-05	4.46E-05	7.63E-04	1.41E-04
50	AL-WFF-19971210 1.2	3.30E-05	4.09E-05	9.29E-04	1.32E-04
50	AL-WFF-19971210 2.2	3.31E-05	4.04E-05	7.62E-04	1.36E-04
51	AL-WFF-19971217 1.2	4.60E-05	4.66E-05	1.08E-03	1.19E-04
51	AL-WFF-19971217 2.2	4.34E-05	4.75E-05	1.12E-03	1.12E-04
52	AL-WFF-19971224 1.2	-2.65E-05	3.22E-05	6.35E-04	8.68E-05
52	AL-WFF-19971224 2.2	-4.30E-05	2.85E-05	5.08E-04	8.02E-05

AUTHORS AND CONTRIBUTORS

1.0 Executive Summary

Stewart B. Jones
Doug C. Lynn
Karen J. Morris

2.0 Introduction

Stewart B. Jones
Doug C. Lynn
Karen J. Morris

3.0 Compliance Summary

Grayden R. Allen
Rick R. Chavez
Ed G. Hess
Jim R. Hollen
Jeff W. Knox
Steve C. Kouba
Patty G. Loughmiller
Wille A. Most
Dan C. Robertson
J. R. Stroble
Mike Strum
Linda Frank-Supka
Cindy L. Woodin

4.0 Environmental Program Information

Tim W. Brown
Don L. Gilbert
Stewart B. Jones
Doug C. Lynn
Karen J. Morris
Shawna Nelson
Roger D. Simmons

5.0 Environmental Radiological Program Information

Mansour Akbarzadeh
Tim Cone
Tony D. Donner
Balwan S. Hooda
Irene Joo
Karen J. Morris
Dr. Narayani Singh

6.0 Environmental Nonradiological Program Information

Tim W. Brown
Rey C. Carrasco
Liane J. Terrill

7.0 Groundwater Surveillance

Melvin L. Balderama
Butch S. Daszczyszak
William L. Foster
Ron G. Richardson

8.0 Quality Assurance

Peter S. Damm

Administrative Support

Vivian L. Allen
Frank E. Burchardt
Larry E. Porter
Randy T. Randolph
Crystal Yeager

Reader Comment Form

Waste Isolation Pilot Plant

Your input is requested as it will help us improve our Environmental Site Report and gives you an opportunity to get involved in protecting the environment. Please check **one** box of each statement.

1. The information presented in the 1997 Site Environmental Report was helpful in understanding the WIPP project and its impact on the environment and public health.
   ❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly Disagree

2. The Environmental Report provided appropriate technical information in a form so the general reader can understand the monitoring activities at the WIPP project.
   ❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly Disagree

3. The Environmental Report provided sufficient analytical data, tables, charts, and graphs for the general reader to understand the monitoring activities at the WIPP project.
   ❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly Disagree

4. The Environmental Report provided sufficient information to characterize the conditions present at the WIPP site for the general reader to understand.
   ❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly Disagree

5. The Environmental Report provided sufficient historical background and regulatory information for the general reader to understand the overall scope of WIPP's management leadership, performance, and legal responsibilities.
   ❑ Strongly Agree ❑ Agree ❑ Unsure ❑ Disagree ❑ Strongly Disagree

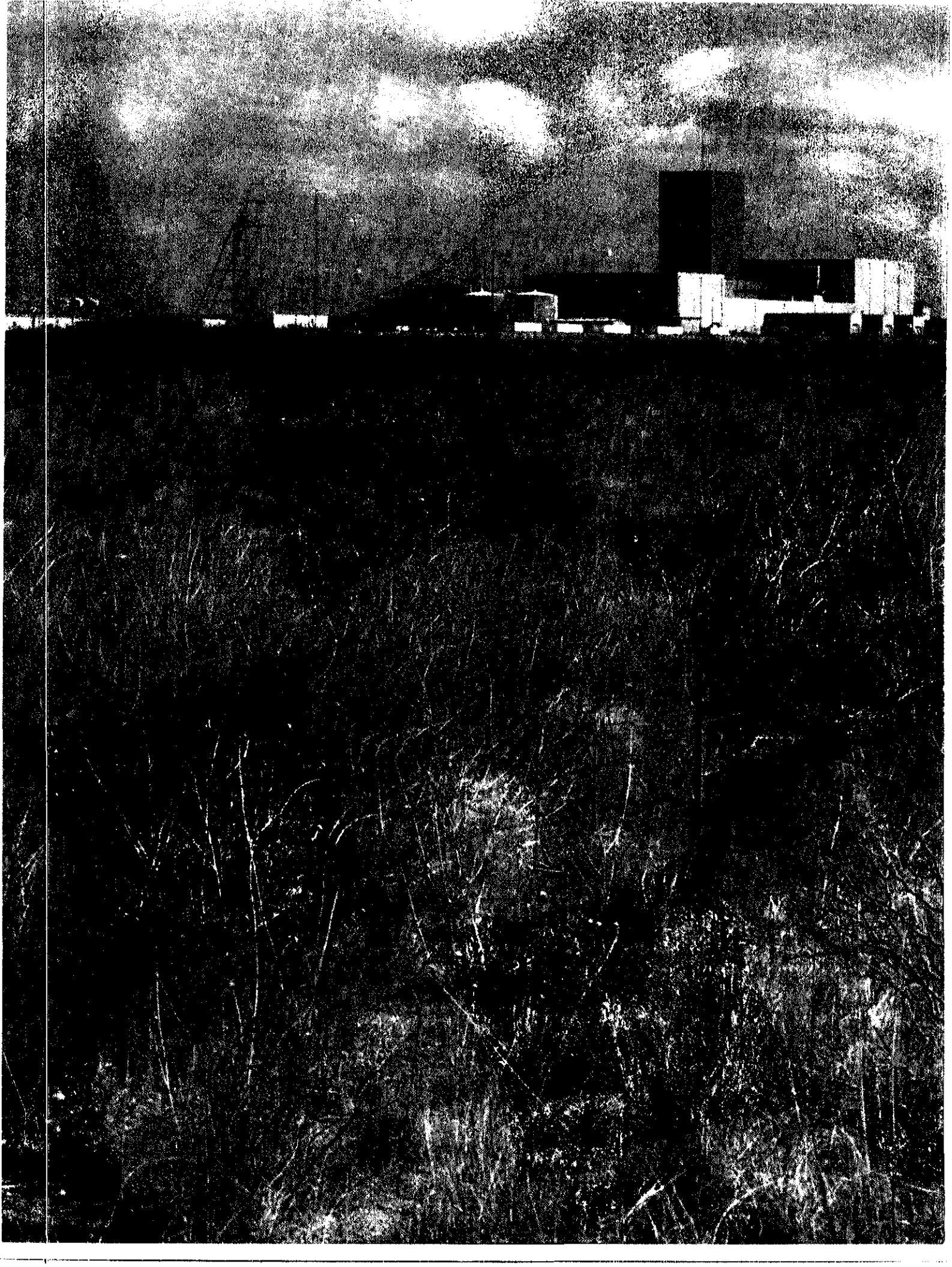
Please write any additional environmental information that you would like to see included in future Site Environmental Reports. Thank you for taking the time to complete this form.

_____

_____

_____

_____

_____

_____