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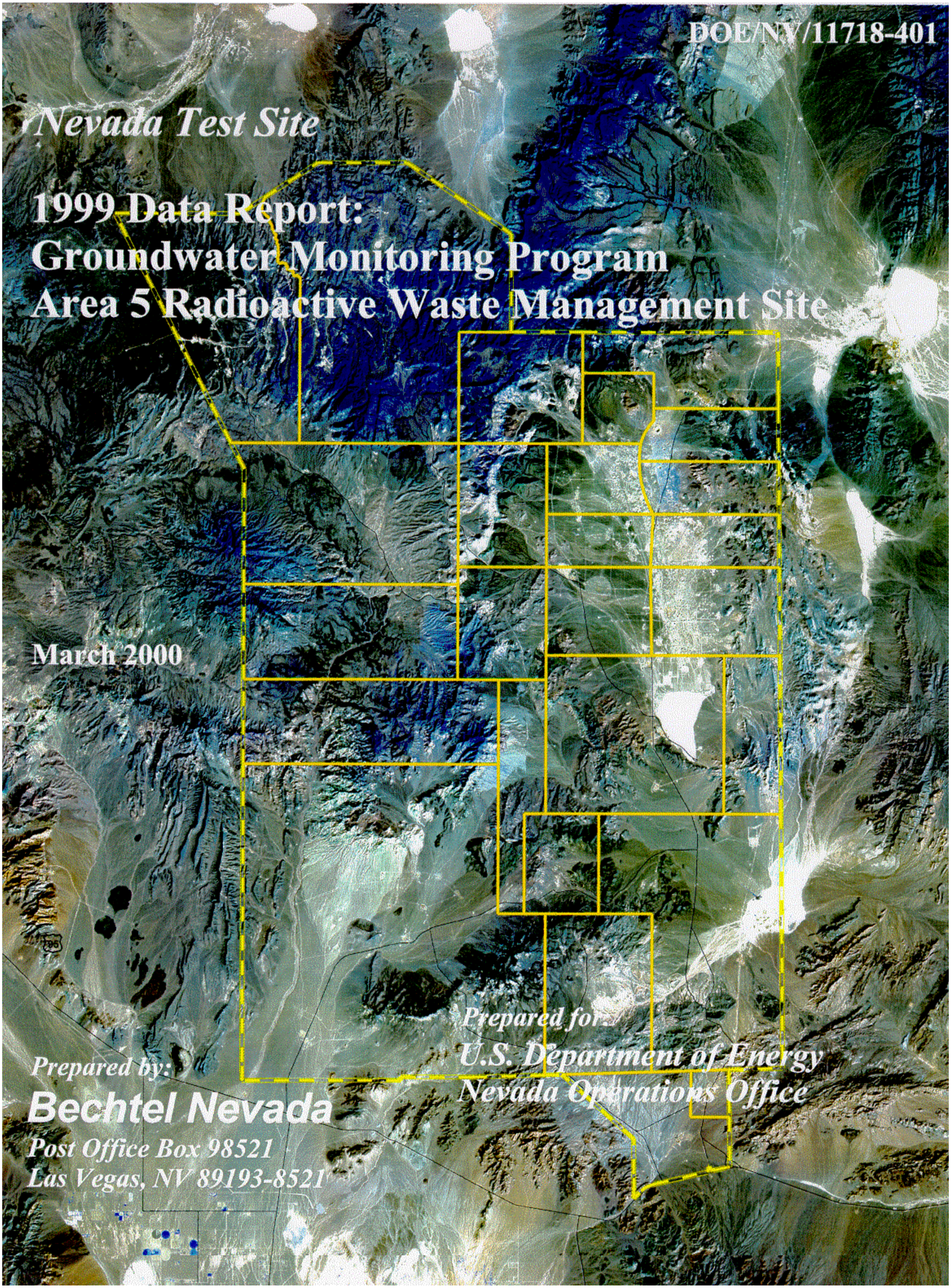

Nevada Test Site

1999 Data Report: Groundwater Monitoring Program Area 5 Radioactive Waste Management Site

March 2000

Prepared for:

U.S. Department of Energy
Nevada Operations Office

Prepared by:

Bechtel Nevada
Post Office Box 98521
Las Vegas, NV 89193-8521

DISCLAIMER

DOE/NV/11718--401

NEVADA TEST SITE

1999 ANNUAL DATA REPORT: GROUNDWATER MONITORING PROGRAM AREA 5 RADIOACTIVE WASTE MANAGEMENT SITE

March 2000

Worked Performed Under
Contract No. DE-AC08-96NV11718

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CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
GW	Groundwater
IL	Investigation Level
MDL	Method Detection Limit
MWDU	Mixed Waste Disposal Unit
NDEP	Nevada Division of Environmental Protection
NTS	Nevada Test Site
QA	Quality Assurance
RCRA	Resource Conservation and Recovery Act
RWMS	Radioactive Waste Management Site
TOC	Total Organic Carbon
TOX	Total Organic Halogen

EXECUTIVE SUMMARY

This report is a compilation of the annual 1999 groundwater sampling results from the Area 5 Radioactive Waste Management Site (RWMS). Contamination indicator data are presented in control chart and tabular form with investigation levels indicated. Gross water chemistry data are presented in graphical and tabular form.

Other information in the report includes, the Cumulative Chronology for Area 5 RWMS Groundwater Monitoring Program, a brief description of the site hydrogeology and the groundwater sampling procedure.

Wells Ue5PW-1, Ue5PW-2, and Ue5PW-3 were sampled semiannually for pH, specific conductance, major cations/anions, metals, tritium, total organic carbon (TOC), and total organic halogen (TOX). Results indicate that there has been no measurable impact to the uppermost aquifer from the Resource Conservation and Recovery Act (RCRA) regulated unit within the Area 5 RWMS.

Groundwater elevation was monitored quarterly with no major changes noted. There continues to be an extremely small gradient to the northeast with a flow velocity of less than one foot per year; however, this is subject to change because the wells have a similar groundwater elevation.

Cumulative Chronology for Area 5 RWMS Groundwater (GW) Monitoring Program

Ue5PW-1		Ue5PW-2		Ue5PW-3	
03/20/1990	U.S. Department of Energy (DOE) letter requesting installation of monitoring wells near the Area 5 RWMS.				
03/13/1992	Drilling begins	06/18/1992	Drilling begins	09/16/1992	Drilling begins
06/16/1992	Drilling ends	09/04/1992	Drilling ends	11/09/1992	Drilling ends
09/11/1992	Well Developed				
03/31/1993	GW Sampling	03/24/1993	GW Sampling	04/04/1993	Well Developed
07/06/1993	GW Sampling	03/30/1993	Well Developed	04/14/1993	GW Sampling
		06/22/1993	GW Sampling	06/02/1993	GW Sampling
09/01/1993	GW Sampling	11/15/1993	GW Sampling	10/12/1993	GW Sampling
12/07/1993	GW Sampling			12/20/1993	GW Sampling
12/17/1993	DOE letter to the Nevada Division of Environmental Protection (NDEP) requesting to establish pilot wells located in Area 5 as RCRA groundwater monitoring wells.				
		01/19/1994	GW Sampling		
02/24/1994	NDEP letter to DOE stating that the pilot wells appear to meet the applicable design, construction, and development criteria for RCRA groundwater monitoring wells.				
06/15/1994	GW Sampling	06/07/1994	GW Sampling	05/24/1994	GW Sampling
08/01/1994	GW Sampling	11/29/1994	GW Sampling	08/08/1994	GW Sampling
09/30/1994	Submitted to the NDEP the 1993 groundwater monitoring results from quarterly sampling effort.				
01/18/1995	GW Sampling	01/18/1995	GW Sampling	01/18/1995	GW Sampling
02/23/1995	DOE letter to NDEP transmitting Groundwater Monitoring Program Outline.				
03/01/1995	1994 Groundwater Monitoring Report submitted to the NDEP.				
04/04/1995	GW Sampling	04/04/1995	GW Sampling	04/04/1995	GW Sampling
11/09/1995	GW Sampling	11/20/1995	GW Sampling	11/09/1995	GW Sampling
11/09/1995	Ue5PW-1 pump snagged in hole and pulled reel from floor; this resulted in a bent shaft on the reel.				
01/22/1996	Ue5PW-1, 2, and 3 Bennet pump seals replaced.				
03/01/1996	1995 Groundwater Monitoring Report submitted to the NDEP.				
10/25/1996	NDEP letter to DOE requesting clarifications/changes in the GW Monitoring Report.				
03/01/1997	Submitted to the NDEP 1996 GW Monitoring Report and revised GW Monitoring Program Outline.				

Cumulative Chronology for Area 5 RWMS GW Monitoring Program (cont.)

Ue5PW-1		**Ue5PW-2**		**Ue5PW-3**	
04/16/1997	GW Sampling	04/16/1997	GW Sampling	04/16/1997	GW Sampling
08/12/1997	NDEP letter to DOE commenting on 1996 GW Monitoring Report/Proposed Outline.				
10/22/1997	The Ue5PW-1 Bennet pump and water level meter while operating simultaneously were lodged in the well casing. Retrieved 10/23/1997.				
10/22/1997	Ue5PW-1, 2, and 3 larger-diameter air lines were installed.				
11/05/1997	GW Sampling	11/05/1997	GW Sampling	11/05/1997	GW Sampling
02/19/1998	1997 GW Monitoring Report submitted to DOE.				
03/01/1998	1997 GW Monitoring Report and new “outline” submitted to NDEP.				
03/31/1998	NDEP letter to DOE stating that they concur on the indicator parameters and investigation levels submitted in the groundwater monitoring outline.				
05/13/1998	GW Sampling	05/13/1998	GW Sampling	05/13/1998	GW Sampling
06/22/1998	TOX detected in the 05/13/1998 samples and blanks from Ue5PW-1, 2, and 3. Results reported to DOE.				
07/10/1998	A verbal agreement between DOE and NDEP permitted sampling of one well (Ue5PW-1) to confirm no TOX.				
07/29/1998	GW resampling for 5/13/1998 TOX hits.				
09/10/1998	Results from the 07/29/1998 sampling event are non-detect for TOX; therefore the TOX results from the 05/13/1998 sampling event are determined to be false positives.				
09/10/1998	Ue5PW-1, 2, 3 and spare Bennett pumps returned to manufacture for refurbishing.				
09/12/1998	Ue5PW-1, 2, and 3 reels returned to manufacture for new tubing bundles.				
10/28/1998	GW Sampling	10/28/1998	GW Sampling	10/28/1998	GW Sampling
09/12/1998	Ue5PW-1 reel returned to manufacture for repair of exhaust tube. Spare pump returned to manufacture for the repair of a leaky seal.				
02/12/1999	1998 GW Monitoring Report submitted to DOE.				
03/01/1999	1998 Groundwater Monitoring Report submitted to NDEP.				
03/31/1999	Letter from NDEP to DOE requesting statistical analysis of data. Letter also stated that values determined to be false positives through resampling do not need to be shown graphically.				
05/19/1999	GW Sampling	05/19/1999	GW Sampling	05/19/1999	GW Sampling
10/27/1999	GW Sampling	10/27/1999	GW Sampling	10/27/1999	GW Sampling
		12/13/1999	GW resampling for 10/27/1999 TOC hit.		
12/27/1999	Results from the 12/13/1999 sampling event at Ue5PW-2 are non-detect for TOC therefore the TOC result from the 10/27/1999 sampling event is determined to be a false positive.				

GW = Groundwater

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I. INTRODUCTION

A. Purpose and Scope

This report is a compilation of the 1999 groundwater sampling results for the Nevada Test Site (NTS) (see Appendix A, Figure 1 for location) Area 5 Radioactive Waste Management Site (RWMS) as required by Title 40 Code of Federal Regulations (CFR) 265 (see Appendix A, Figures 2 and 3 for location). The Resource Conservation and Recovery Act (RCRA) regulated unit within Area 5 is P03U (see Appendix A, Figure 4), referred to as Pit 3 Mixed Waste Disposal Unit (MWDU). The Pit 3 MWDU is operated in accordance with RCRA Interim Status standards for the disposal of mixed low-level waste. In addition to providing groundwater monitoring results, this report also includes information regarding site hydrogeology, well construction, and sample collection.

The format of this report was requested by the Nevada Division of Environmental Protection (NDEP) in a letter dated August 12, 1997. The appearance and arrangement of this document has been modified slightly from the previous years to give the reader additional information and to make the document easier to read. Specifically, the following changes have been made: (1) the "<" notation is used in the raw data tables to indicate a value was less than the method detection limit (MDL); (2) statistical analyses of the sampled data are presented; (3) gradient and velocity calculations are presented; (4) data plots are presented in portrait fashion with two plots per page; and (5) for the purposes of computing summary statistics and plotting data, non-detect values are assumed to be equal to one-half of their MDL.

B. Objective

The objective of this report is to satisfy the reporting requirements of Title 40 CFR 265.94 as well as the agreements made between the U. S. Department of Energy (DOE) and NDEP.

C. Site Hydrogeology

The Area 5 RWMS is located in northern Frenchman Flat in the southeast corner of the NTS. Thick, unsaturated alluvial deposits separate the facility from the uppermost aquifer. An alluvial aquifer is believed to extend beneath all of the active portion of the facility. Monitoring wells (referred to as pilot wells) Ue5PW-1 and Ue5PW-2 are completed in the alluvial aquifer, while Ue5PW-3 is completed in the Timber Mountain Tuff Aquifer in the northwest corner of the facility. The alluvial and Tertiary Tuff contact occurs at a depth of 600 feet at Ue5PW-3. Well construction details are provided in Appendix A, Figures 5, 6, and 7.

The water from all three monitoring wells is characterized as sodium bicarbonate type waters. The alluvial and tuff aquifers are thought to be connected because of their similar hydrochemistry and groundwater elevation. Area 5 RWMS hydraulic parameters are presented in Appendix B, Table 1. Saturated hydraulic conductivity and effective porosity values presented are the mean values from laboratory analysis of the alluvium cores taken from the three pilot wells. Hydraulic conductivity values calculated from slug tests are also in close agreement with values presented in Table 1. Although Ue5PW-3 is completed in the tuff aquifer, alluvial hydraulic properties are assumed in the groundwater velocity calculation. This results in a conservative estimate of the groundwater velocity because of the higher hydraulic conductivity of the alluvium.

Using the hydraulic properties listed in Appendix B, Table 1, the groundwater flow direction and velocity were calculated. The hydraulic gradient, velocity and direction values presented in Appendix B, Table 1 correspond to groundwater elevation measurements made on October 26, 1999. The calculated mean horizontal groundwater flow velocity is less than one foot per year and flows to the northeast (60° east of north) in the uppermost aquifer. Details of velocity and direction calculations are given in Appendix C.

Some amount of vertical groundwater flow is thought to occur from the Alluvial Aquifer and Timber Mountain Aquifer to the Lower Carbonate Aquifer because their respective potentiometric levels are higher than the underlying Lower Carbonate Aquifer by at least ten feet, implying a downward gradient (Burbey and Wheatcraft, 1986). The Lower Carbonate Aquifer is the regional aquifer that flows from central NTS to the south, where it discharges into Death Valley, California, and into smaller depressions (Amargosa Valley and Ash Meadows) in southwest Nevada (see Appendix A, Figure 8). For a more detailed description of the site characteristics, refer to “Revised Area 5 Radioactive Waste Management Site Outline of a Comprehensive Groundwater Monitoring Program”, February 1998.

Appendix A, Figure 9 presents the monthly precipitation measured at the Area 5 RWMS meteorological tower.

II. MONITORING CRITERIA

The Area 5 RWMS pilot wells have been monitored for compliance since 1993 under Title 40 CFR 265. The groundwater monitoring program has transitioned from monitoring all parameters required by Title 40 CFR 265 to a program that monitors parameters applicable to this particular site. The current program is modeled after the Title 40 CFR 264 detection monitoring program. The analytes listed below were agreed upon by DOE and NDEP to be sampled semi-annually and are divided into groups representing indicators of contamination and general water chemistry parameters. The groundwater sampling procedure is presented in Appendix E. Radiological analyses for 1999 were performed by Bechtel Nevada Analytical Services Laboratory (phone [702] 295-7220). Non-radiological samples for 1999 were sent to Nevada Environmental Laboratories (phone [888] 368-3282) in May and Barringer Laboratories, Inc., (phone [800] 654-0506) in October.

Indicators of Contamination

- pH
- specific conductance
- total organic carbon (TOC)
- total organic halogen (TOX)
- tritium

General Water Chemistry Parameters

- total Ca, Fe, Mg, Mn, K, Na, SiO_2
- total SO_4, Cl, F
- alkalinity

Control charts have been developed for each of the indicator parameters. These charts show the relationship of the results from the groundwater analysis to the investigation level (IL). ILs denote the values which, if exceeded, trigger a monitoring well resampling for that parameter. The intent of using an IL was to replace the need for rigorous statistical analyses which attempt to identify when contamination has occurred. ILs for each indicator parameter were negotiated between DOE and NDEP in 1998 and are listed in Appendix B, Table 2. The ILs for pH and specific conductance are based on the statistics from data collected from 1993 through 1996. Historic analyses for TOX, TOC, and tritium have reported concentration levels less than the method detection limits (MDL) and therefore statistical methods are not appropriate for determining their ILs. The ILs for TOX and TOC have been set slightly above their MDLs. The tritium IL has been set at 10 percent of the drinking water standard (20,000 pCi/L).

Statistical analyses have been performed for pH and specific conductance data as requested by NDEP in a letter dated March 31, 1999. Analytical results for TOX, TOC, and tritium are dominated by values less than the MDLs and therefore do not warrant any statistical analyses. Historic results for the general water chemistry parameters are tabulated with summary statistics. Trends over time for these parameters may be inferred from the figures presented in the appendices.

A. pH

Appendix A, Figure 10 is a time series plot of the mean pH values for wells Ue5PW-1, Ue5PW-2, and Ue5PW-3. All pH values are well within upper and lower ILs. The pH values for Ue5PW-2 and Ue5PW-3 reached a peak in 1994 and then declined over the next two years. Since that time, the pH values have remained relatively constant. A plot of the last two years of data is displayed in Appendix A, Figure 11. Appendix B, Table 3 contains the actual pH values.

The statistical significance of pH values between wells was tested using a two-way analysis of variance with the data grouped by well and year. This analysis found Ue5PW-1 to be significantly different than Ue5PW-2 and Ue5PW-3. Ue5PW-2 and Ue5PW-3 were found to be statistically similar. The analysis used required grouping of data collected on similar dates. The statistical significance for trends over time was tested using polynomial regression and one-way analysis of variance. Statistically significant trends were identified in all wells by both tests. A linear trend was identified at Ue5PW-1. A cubic trend as well as a trend other than a polynomial was identified at Ue5PW-2. Ue5PW-3 had a linear trend, cubic trend, and a trend other than polynomial identified. See Appendix D for statistical output from the computer program Minitab, which was used to perform the analyses presented.

There is no indication that the differences between wells and over time are due a release from the Area 5 RWMS facility. Due to the depth and small diameter of the wells, minimal well development was possible at the time of construction. The minimal well development coupled with a very slow groundwater velocity suggests that residual effects of construction may have been seen in the first few years of monitoring. Although the wells show statistically significant differences and trends, they are hydrologically similar as demonstrated by their similar hydrochemistry and exhibit the variability of a natural system.

B. Specific Conductance

Appendix A, Figure 12 is a time series plot of the mean specific conductance values for wells Ue5PW-1, Ue5PW-2, and Ue5PW-3. All conductance values are below the IL. The plot shows a decrease in conductance from 1993 to 1995 and then an increase to 1996 for all wells. Since 1996, the specific conductance in all wells has remained relatively constant. The last two years of data are plotted in Appendix A, Figure 13 and shows that the specific conductance has remained constant. Appendix B, Table 4 contains the actual specific conductance values.

The statistical significance of specific conductance values between wells was tested using a two-way analysis of variance with the data grouped by well and year. This analysis found a statistically significant difference between all wells. The trends identified at each well for specific conductance are similar. All wells had a cubic trend, quadratic trend, and a trend other than a polynomial identified. A linear trend was also identified for Ue5PW-2. These trends were identified using polynomial regression and one-way analysis of variance. See Appendix D for statistical output from the computer program Minitab, which was used to perform the analyses presented.

There is no indication that the differences between wells and over time are due to a release from the Area 5 RWMS facility. Also, as with pH, residual effects of well construction may have been seen in the first few years of monitoring and although the wells show statistically significant differences and trends, they are hydrologically similar as demonstrated by their similar hydrochemistry and exhibit the variability of a natural system.

C. Total Organic Carbon

Since sampling began in 1993 there have been three instances of reported TOC concentrations above the IL. The first was taken from Ue5PW-1 in August 1994. The subsequent samples, taken in January 1995, had reported concentrations above the MDL but below the IL for all three wells. These detections are likely due to laboratory error. A sample from Ue5PW-3, taken in April 1996, had a reported concentration above the IL; the duplicate analysis was below the MDL. Results from the next scheduled sampling event were below the MDL. Although the April 1996 TOC result is likely a product of laboratory/field contamination, it is presented graphically because the well was not resampled specifically to confirm the result (resampling procedure was set in 1998). A sample taken from Ue5PW-2 on October 27, 1999, had a reported concentration above the IL; the duplicate analysis was below the MDL. The well was resampled for TOC on December 13, 1999. The results of the TOC resampling were below the MDL and confirms that the October TOC result was a product of laboratory/field contamination. Appendix A, Figure 14 is the time series plot of the mean TOC values (note that non-detect values are shown as being equal to one-half of their MDL). Results confirmed as false positives by resampling are not displayed graphically per NDEP request (March 31, 1999). Appendix A, Figure 15 shows TOC values over the last two years. Appendix B, Table 5 contains the actual TOC values.

D. Total Organic Halogen

The IL has been exceeded only once for TOX. These samples were collected in May 1998. Eight samples from the three wells (two samples from each well and two trip blanks) had TOX levels above the MDL and six were above the IL. Review of the data showed the control samples had some of the highest levels of TOX, indicating a possible laboratory or sampling error. A verbal agreement between DOE and NDEP on July 10, 1998, resulted in the resampling of one well (Ue5PW-1) to ensure that TOX was not present. Results from the resampling of Ue5PW-1 were below the MDL for TOX. There have been detections for TOX above the MDL but below the IL at all three wells. Detections above the MDL at Ue5PW-1 occurred in March 1993 and August 1994. Ue5PW-2 had occurrences in March 1993 and November 1994. The March 1993 sample at Ue5PW-2 had a detection of TOX in all four replicate samples (the suite of samples include a sample, duplicate, trip blank, and an equipment blank). In October 1999, Ue5PW-3 had a reported concentration above the MDL and below the IL for the sample but below the MDL for the duplicate sample. The detections above the MDL described above are likely due to laboratory error. Appendix A, Figure 16 is a time series plot of the mean TOX values (note that non-detect values are shown as being equal to one-half of their MDL). The false positives (above the IL) discussed above are not displayed graphically per NDEP request (March 31, 1999). Appendix A, Figure 17 shows the data of the last two years. Appendix B, Table 6 contains the actual TOX values.

E. Tritium

A time series plot of the mean sample values for tritium is shown in Appendix A, Figure 18. To plot these data on the vertical log scale requested by NDEP, all negative values were set at 0.001 pCi/L. All tritium results are below the IL and MDL. The November 1993 sample for Ue5PW-2 in not shown on the graph because the standard analysis, not enriched tritium analysis was performed. The variability over time in Appendix A, Figure 18 may be attributed to the counting variability of the analytical method, as all values are below the MDL. Appendix A, Figure 19 shows the data for the last two years. Appendix B, Table 7 contains the actual tritium values.

F. General Water Chemistry Parameters

General water chemistry measurements were made to assess the water's gross chemistry, suitability for human consumption and to evaluate aquifer characteristics such as aquifer continuity and hydraulic connection between wells. Cl, F, Fe, Mn, and SO_4 concentrations were all below National Secondary Drinking Water Standards. A piper diagram showing the concentrations of the major cations and anions from the last two year's sampling events is included as Appendix A, Figure 20 and indicates that the water from all three wells is sodium bicarbonate type waters. Stiff diagrams from each sampling event from the last two years are also included as Appendix A, Figures 21, 22, and 23, to illustrate water composition differences and similarities. A target charge balance error of ±5% was not achieved for the 1999 sampling events; errors ranged from 13-16 percent. Possible sources of this larger deviation include analytical errors, some significant species not being included in the analysis (e.g. NO_3), and high detection limits for minor species. Groundwater temperature at time of sample collection ranged from 19.2 - 21.7 °C at all three wells, for the May and October sampling events. Temperature data were collected at the ground surface in a flow-through cell and may be influenced slightly by the ambient air. Raw data with summary statistics are presented in Appendix B, Tables 8, 9, and 10. Visual inspection of graphical data indicate that the water geochemistry from the three wells is similar, and there is no significant change of the gross groundwater chemistry over time.

G. Groundwater Elevation

Water table elevations were measured quarterly with an electronic water level tape to determine the hydraulic gradient. These measurements are subject to a total error of 0.16 feet (Bechtel Nevada 1998). The approximate depth to groundwater at Ue5PW-1, Ue5PW-2, and Ue5PW-3 is 772 feet, 842 feet, and 891 feet, respectively. Plots of groundwater elevation corrected for borehole deviation with time are shown in Appendix A, Figure 24. Appendix B, Table 11 lists all the groundwater elevation data from the three wells. Appendix A, Figure 25 shows a time series plot of mean groundwater velocity and flow direction. This plot suggests the flow velocity has remained constant, while the flow direction has become slightly more easterly with time. Additionally, due to the flatness of the water table, small changes in elevation produce large changes in the calculated flow direction.

H. Other Parameters

As part of the Nevada Test Site Routine Radiological Environmental Monitoring Plan activities, Ue5PW-1, Ue5PW-2, and Ue5PW-3 were sampled for gross alpha, gross beta, gamma spectroscopy, and isotopic plutonium. Gross alpha and gross beta results were below National Primary Drinking Water Standards. Gamma spectroscopy and plutonium results were below the minimum detectable activities. There is no indication from the analysis of these additional parameters that a release from the Area 5 RWMS facility has occurred.

III. SUMMARY

There have been no significant changes detected in the chemistry of the uppermost aquifer. Groundwater continues to flow to the northeast at a velocity of less than one foot per year. Due to the depth and small diameter of the wells, minimal well development was possible; coupled with a very slow groundwater velocity, it is likely that residual effects of construction may have been seen in the first few years of monitoring. This is evident from the high variability shown in the control charts and may indicate that the data collected after 1996 are the most representative of natural aquifer conditions.

IV. CONCLUSION

There has been no measurable impact to the uppermost aquifer from the RCRA regulated unit within the Area 5 RWMS.

V. RECOMMENDATIONS

A. Resampling Criteria

The resampling procedure that has historically been followed has been to resample if any indicator parameter’s concentration was above the investigation level without regard for the results of the sample’s duplicate. It is recommended that resampling only be required when both the sample and its duplicate are above the IL. For example, if a sample is above the IL and it’s duplicate is below the IL, sampling would not be required until the next scheduled sampling event. This procedure would essentially use the duplicate analysis to confirm the detection of an analyte and ensure that detected levels are representative of the aquifer and not a product of sample handling (i.e., laboratory/field contamination) without incurring the costs of unnecessary resampling and analysis.

B. Statistical Analyses

It is recommended that statistical analyses (trends over time and differences between wells) requested by NDEP in a letter dated March 31, 1999, no longer be required. Results from current and past analyses have indicated that there are statistically significant differences and trends among the wells for the indicator parameters pH and specific conductance. The rationale for using these types of analyses is to determine if contamination has occurred; however, there is no indication that the differences and trends presented in this report are due to a release from the facility.

It is likely that the statistical significance calculated is a product of small sample size and the variability of a natural system. It is therefore recommended that the ILs be used in lieu of statistical analysis to indicate if contamination has occurred, which was the intent when the ILs were developed. Summary statistics and figures would continue to be presented.

VI. REFERENCES

Bechtel Nevada, 1998. *Revised Area 5 Radioactive Waste Management Site, Outline of a Comprehensive Groundwater Monitoring Program*. Report to U.S. Department of Energy, Nevada Operations Office. February 1998.

Burbey, T.J. and Wheatcraft, S.W., 1986. *Tritium and Chlorine-36 Migration from a Nuclear Explosion Cavity*. Desert Research Institute Report 45050 [DOE/NV10384--09].

Code of Federal Regulations, 1999. *Ground-Water Monitoring*. Title 40, Part 265, Subpart F.

Liebendorfer, P.J., 1999. Nevada Division of Environmental Protection, Carson City, Nevada, Letter to E.F. Di Sanza, U.S. Department of Energy Nevada Operations Office, Las Vegas, NV. *1998 Area 5 Radioactive Waste Management Site (RWMS) Groundwater Monitoring Report*. March 31, 1999.

Liebendorfer, P.J., 1998. Nevada Division of Environmental Protection, Carson City, Nevada, Letter to R.C.Wycoff, U.S. Department of Energy Nevada Operations Office, Las Vegas, NV. *The Nevada Division of Environmental Protections (NDEPs) Review of the Revised Groundwater Monitoring for the Area 5 Radioactive waste Management Site (RWMS), Concurrence on Comprehensive Groundwater Monitoring Program Outline and RWMS Groundwater Monitoring Report*. March 31, 1998.

Reynolds Electrical & Engineering Co., Inc. 1994. *Site Characterization and Monitoring Data from Area 5 Pilot Wells, Nevada Test Site, Nye County, Nevada*. U.S. Department of Energy Report DOE/NV/11432--74.

U.S. Department of Energy, 1998. *Nevada Test Site Routine Radiological Environmental Monitoring Plan.* DOE/NV/11718--244, Bechtel Nevada, Las Vegas, NV.

Waddell, R. K., J. H. Robinson, and R. K Blankennagel, 1984. *Hydrology of Yucca Mountain and Vicinity, Nevada-California. Investigative Results through mid-1983*. USGS Water Resources Investigations Report 84-4267, 72 p.

VII. DISTRIBUTION

Office of Scientific and Technical Information, Technical Center, U.S. Department of Energy, P. O. Box 62, Oak Ridge, TN 37831 (2)

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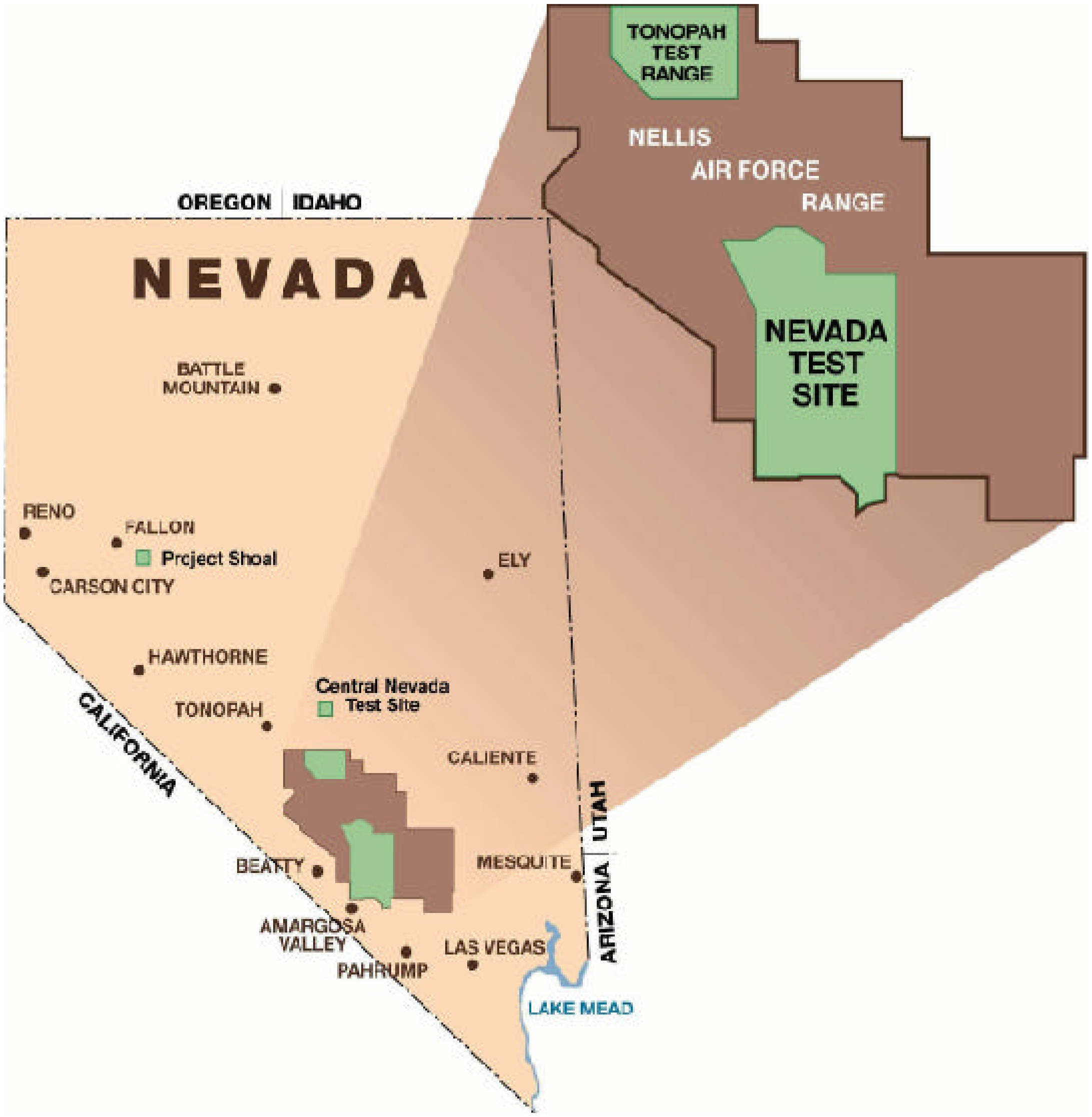
Appendix A

Figures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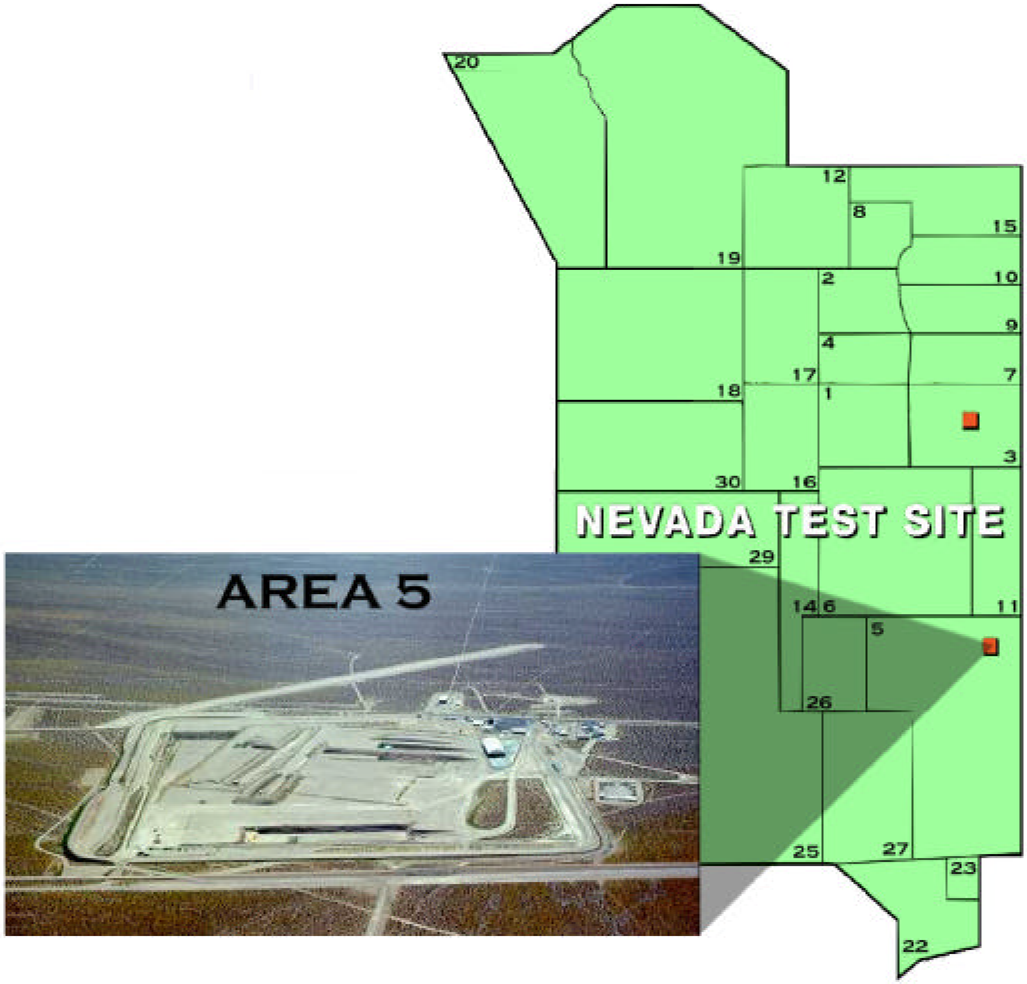

Figure 2 Location of the Area 5 RWMS within the Nevada Test Site

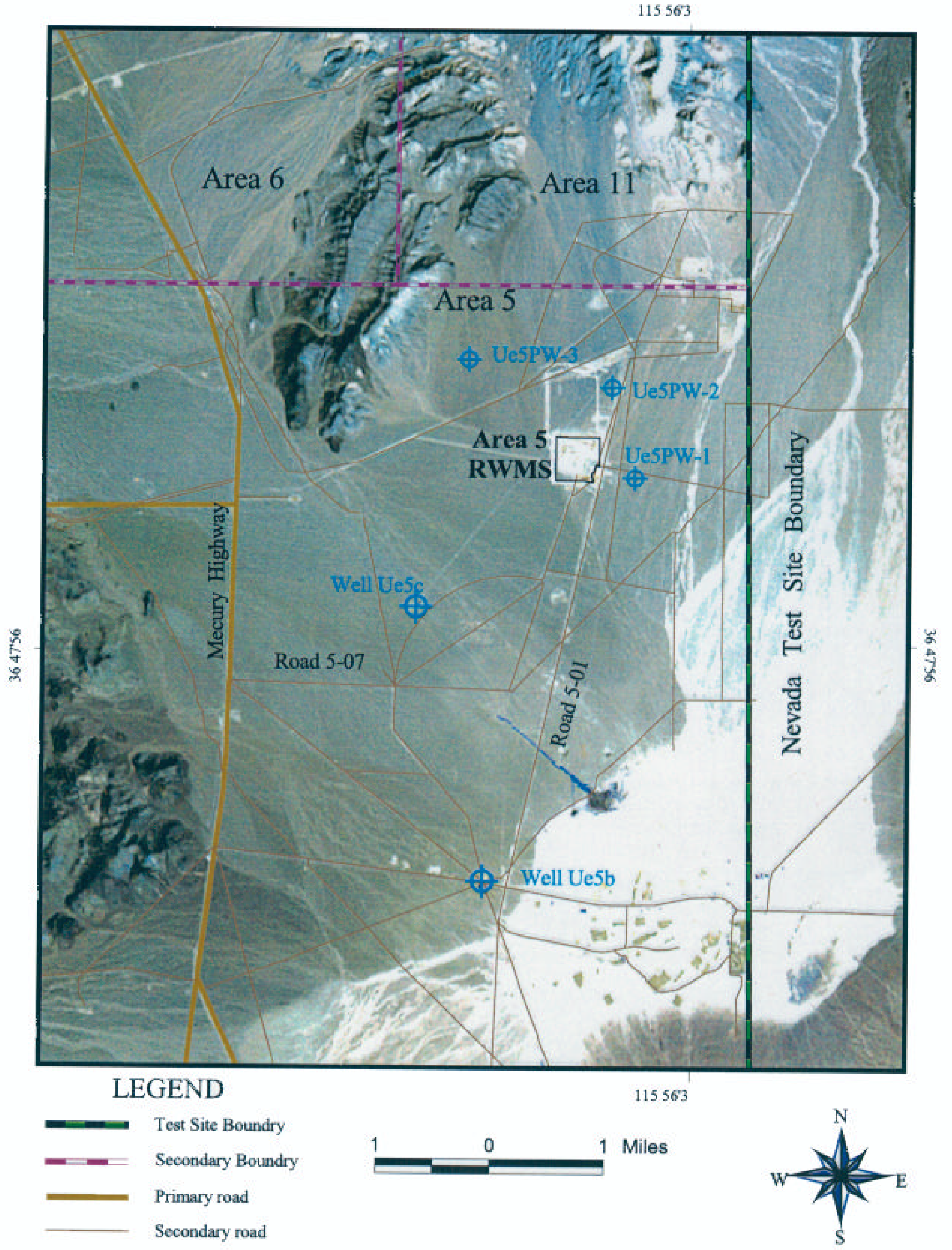

Figure 3 Location of RWMS Groundwater Monitoring Wells and Other Wells in the Vicinity

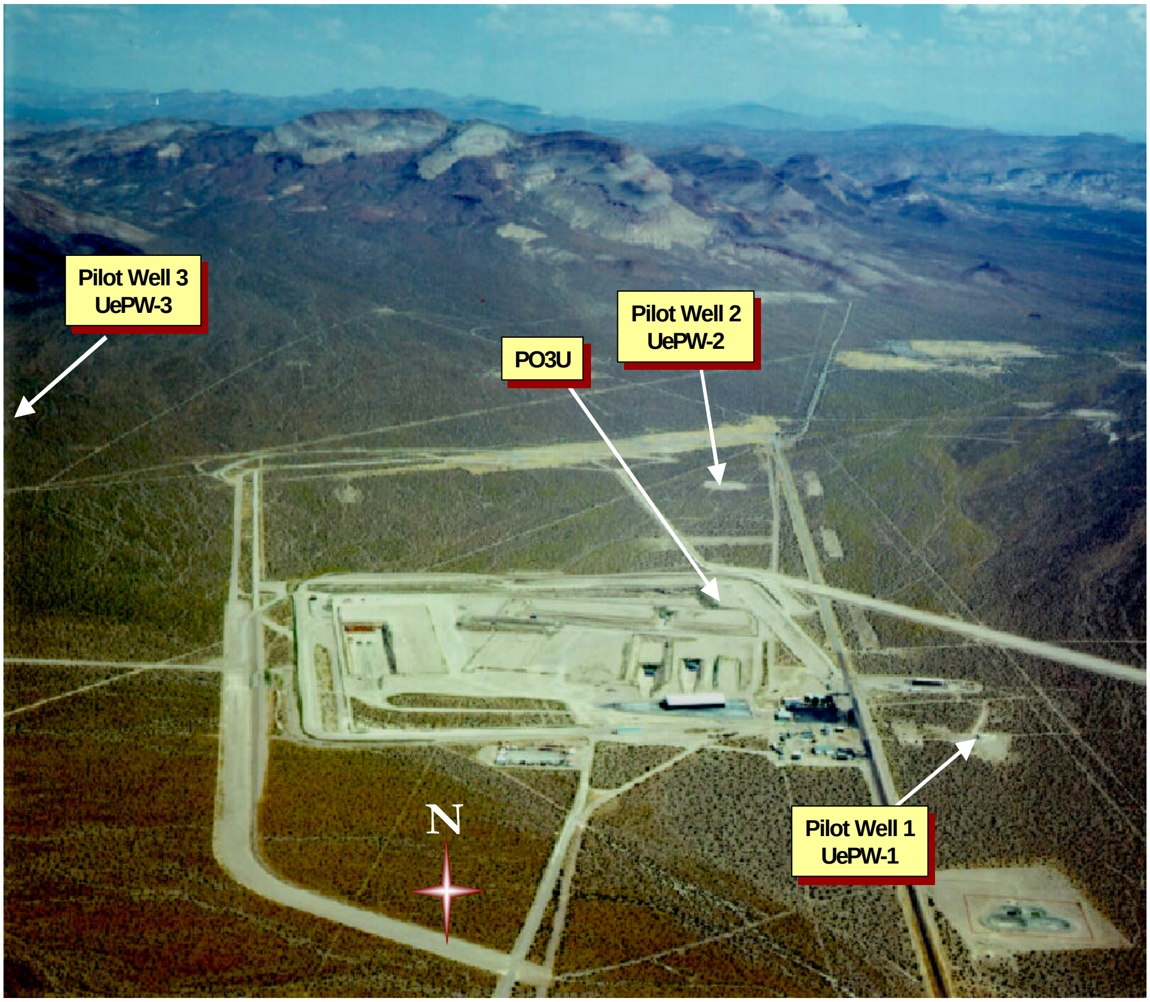

Figure 4 Location of P03U within the Area 5 RWMS

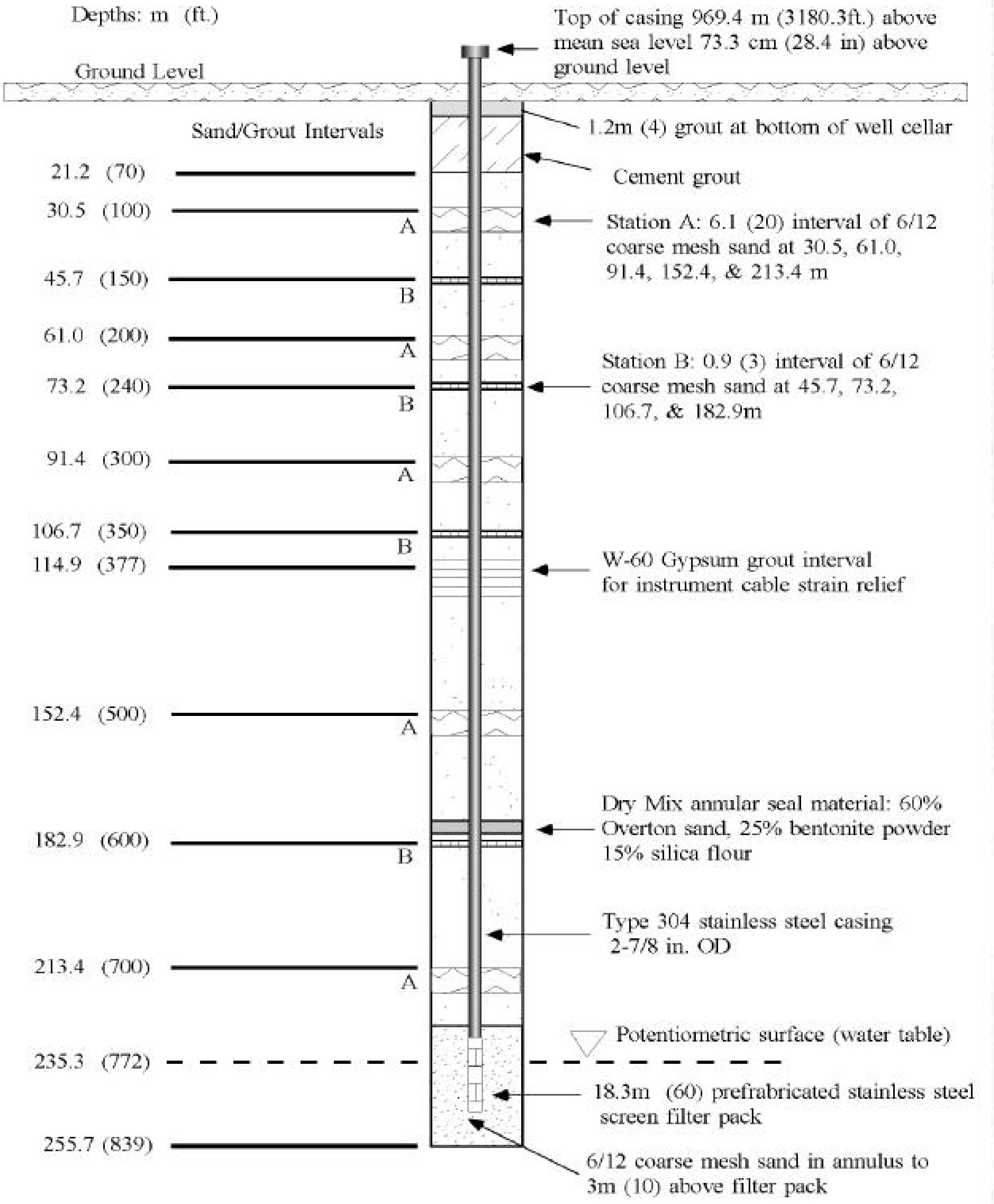

Figure 5 Completion Detail for Ue5PW-1

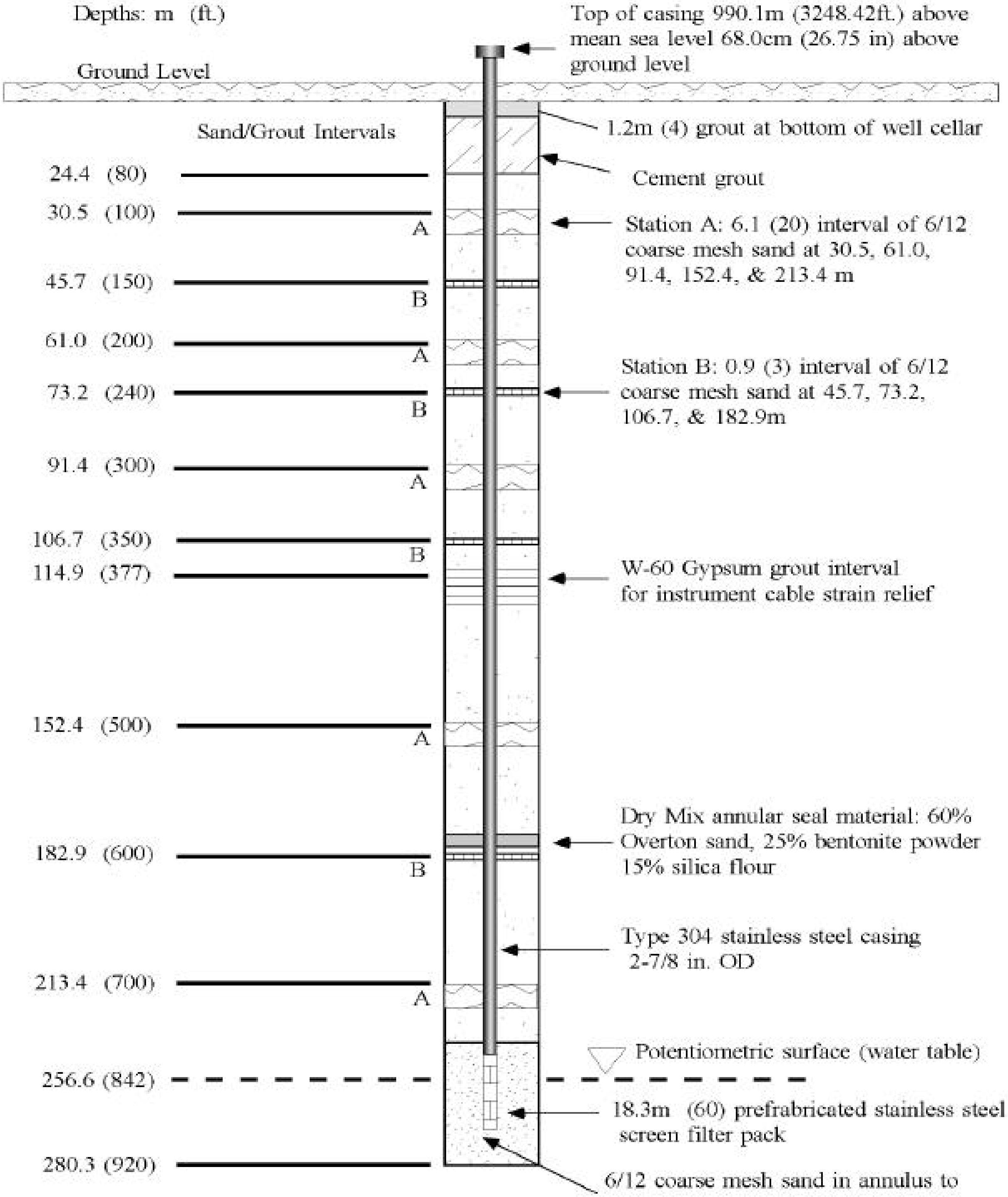

Figure 6 Completion Detail for Ue5PW-2

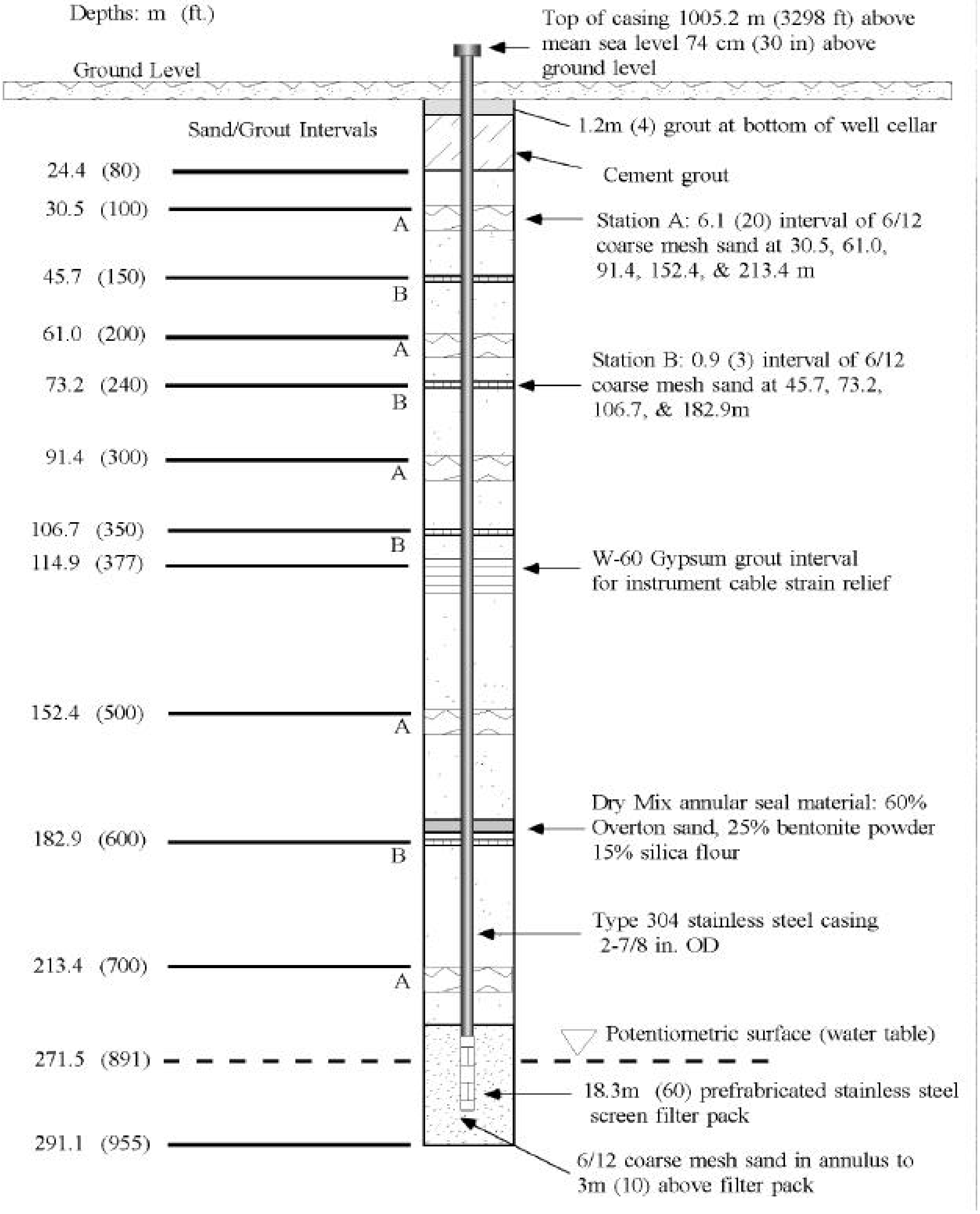

Figure 7 Completion Detail for Ue5PW-3

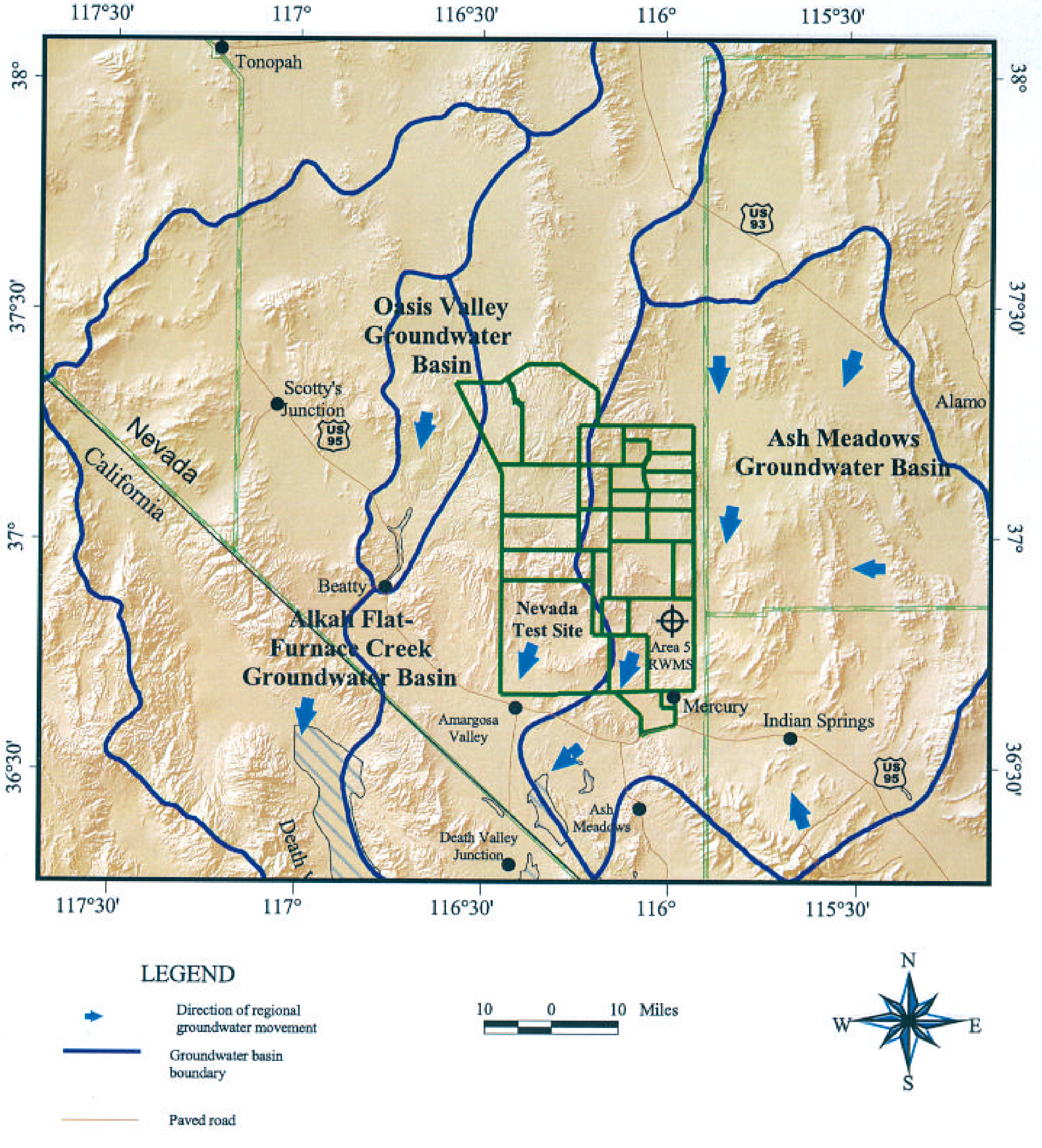

Figure 8 Regional Groundwater Flow Directions in the NTS Area (Waddell et al., 1984)

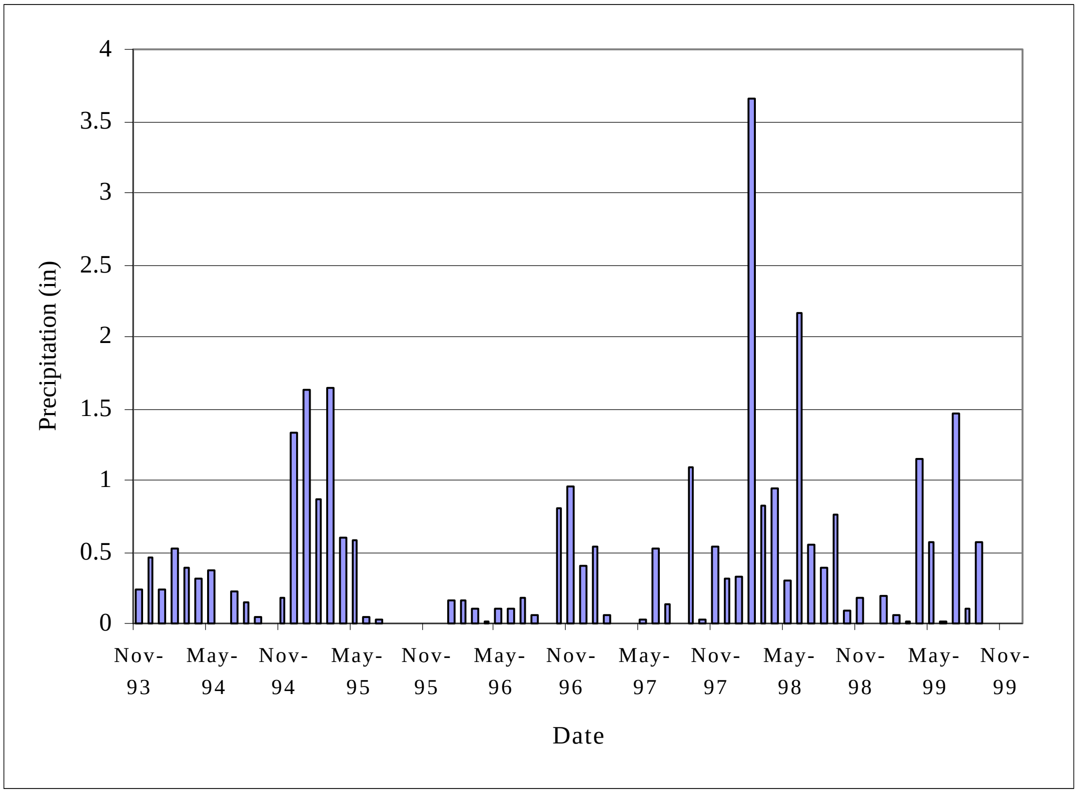

Figure 9 Area 5 RWMS Monthly Precipitation

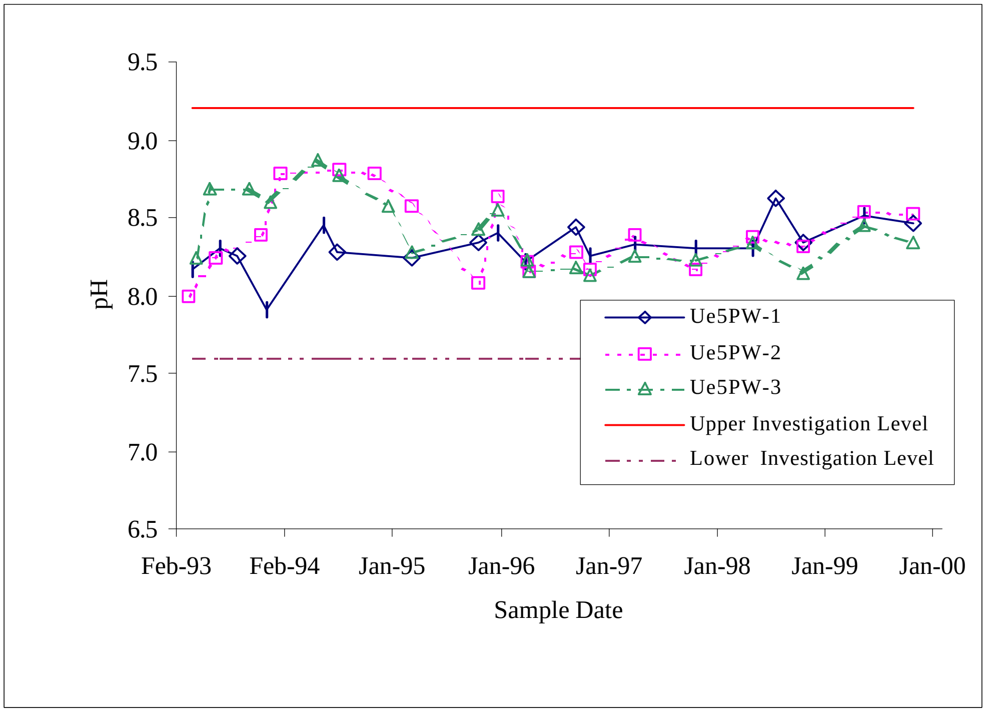

Figure 10 Area 5 RWMS Time Series Plot of pH

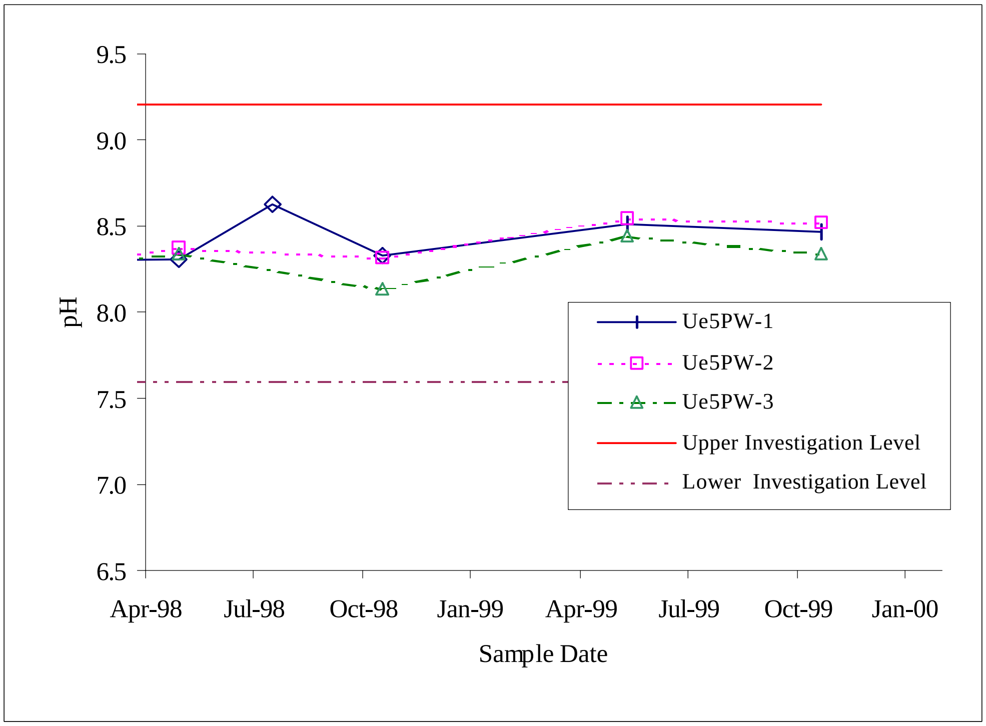

Figure 11 Area 5 RWMS Two-Year Plot of pH

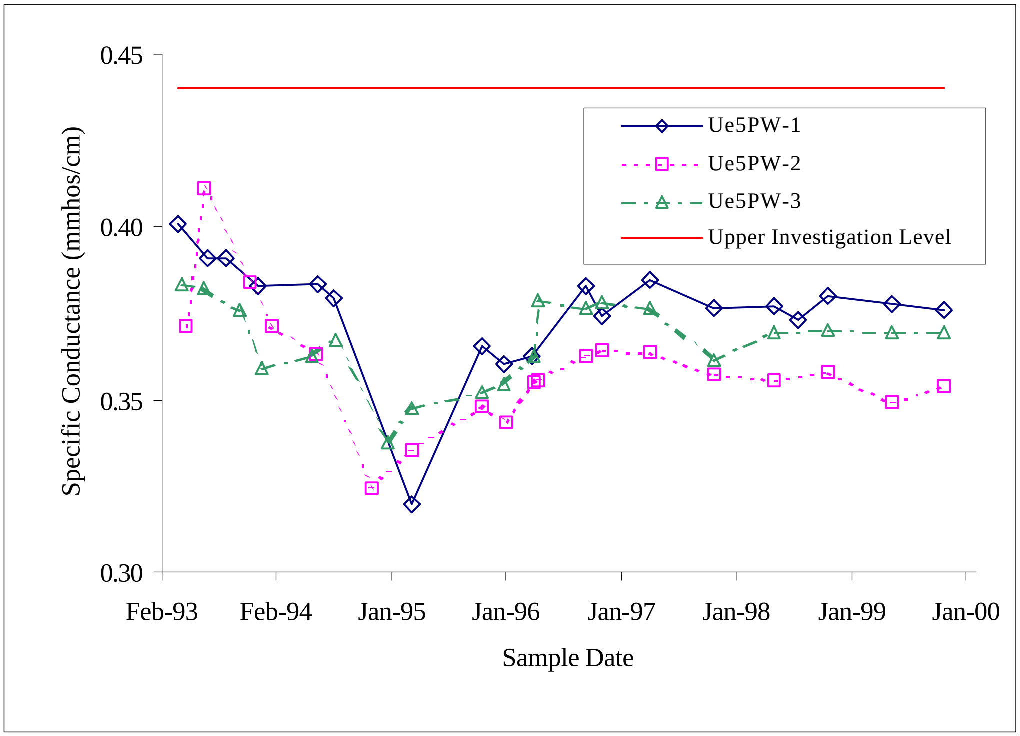

Figure 12 Area 5 RWMS Time Series Plot of Specific Conductance

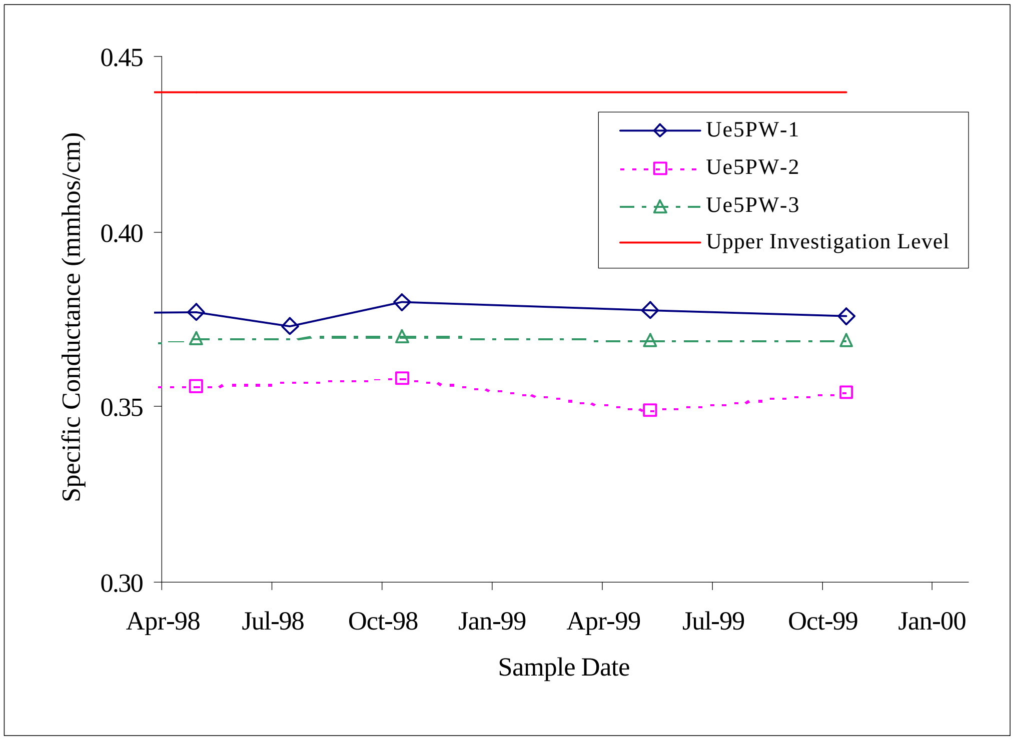

Figure 13 Area 5 RWMS Two-Year Plot of Specific Conductance

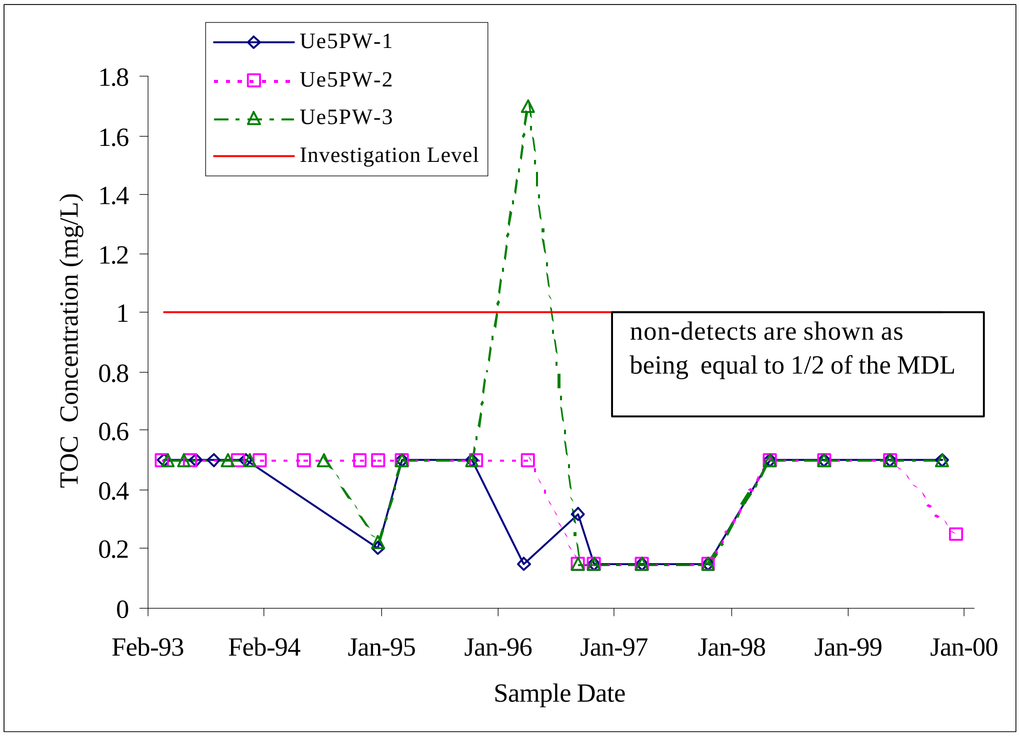

Figure 14 Area 5 RWMS Time Series Plot of Total Organic Carbon

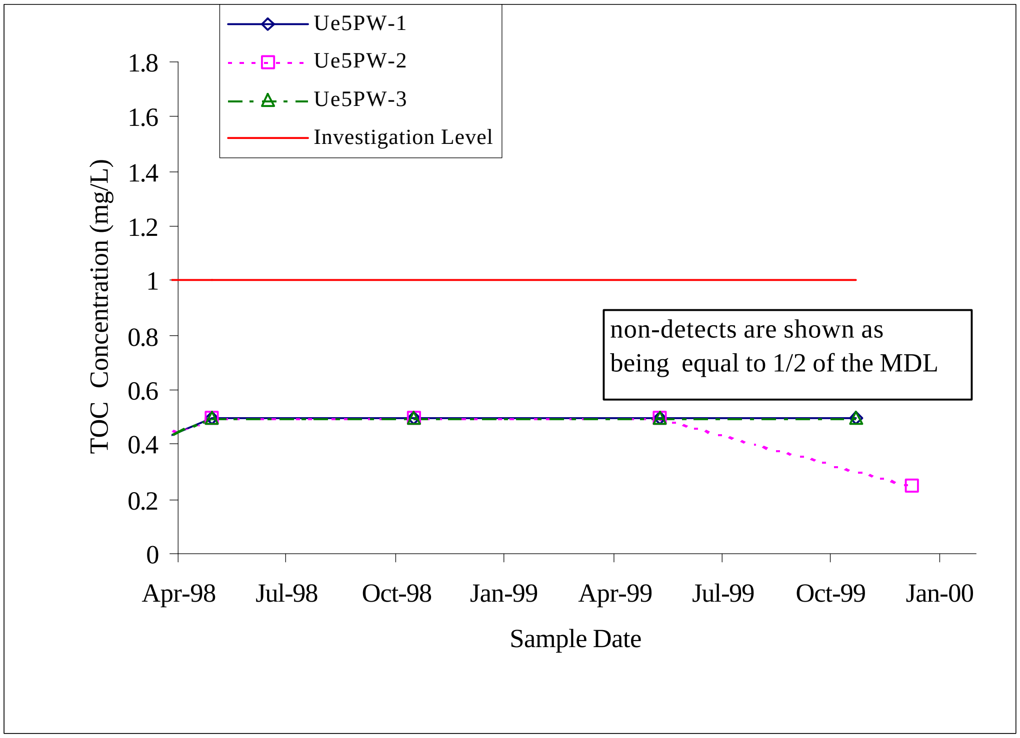

Figure 15 Area 5 RWMS Two-Year Plot of Total Organic Carbon

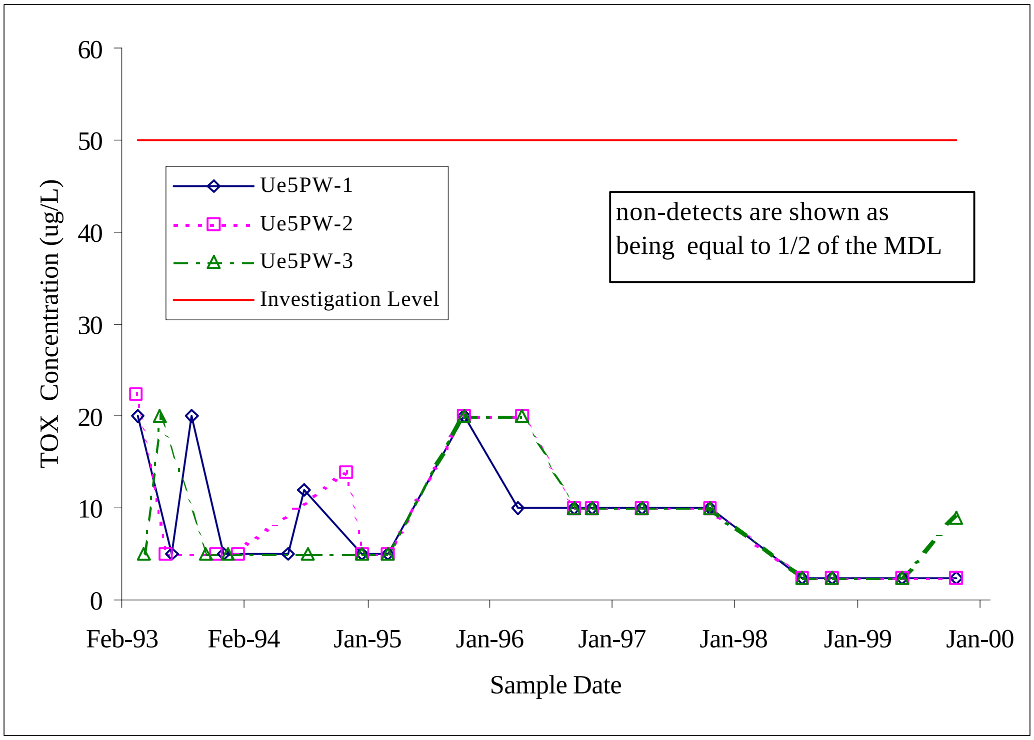

Figure 16 Area 5 RWMS Time Series Plot of Total Organic Halogen

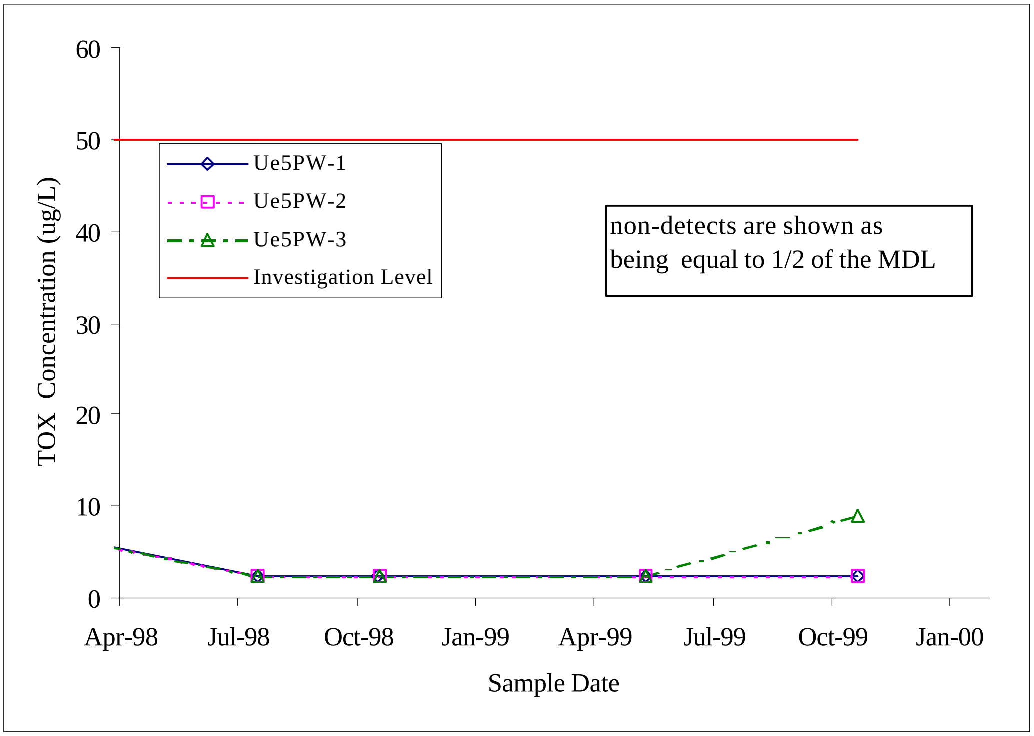

Figure 17 Area 5 RWMS Two-Year Plot of Total Organic Halogen

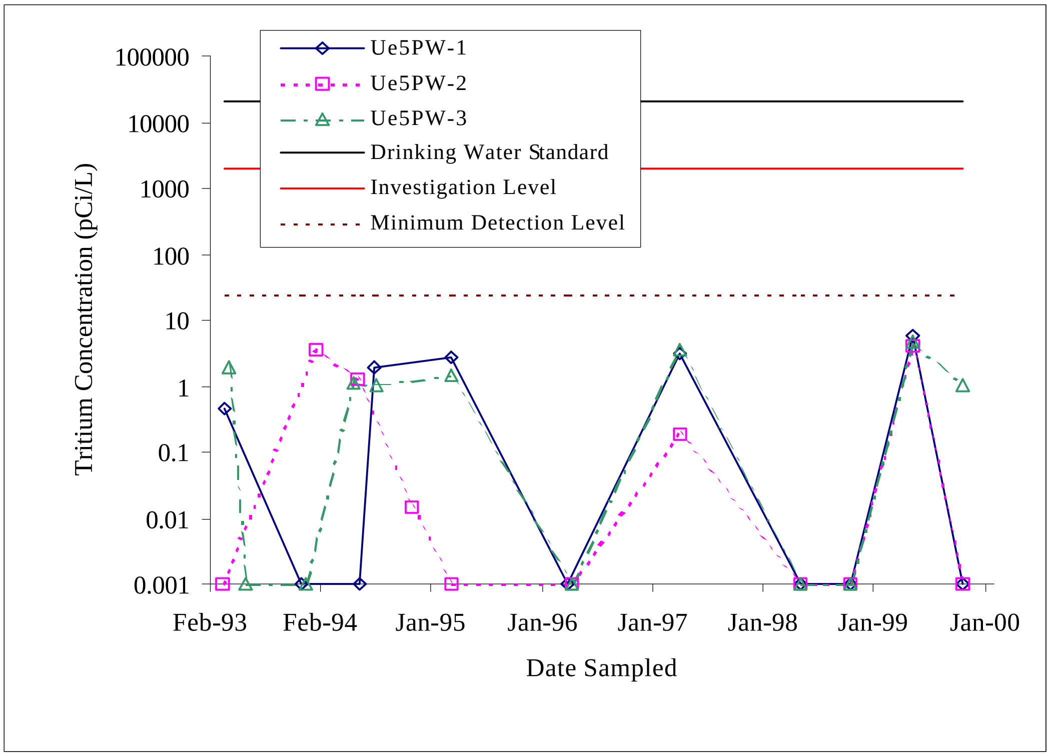

Figure 18 Area 5 RWMS Time Series Plot of Tritium

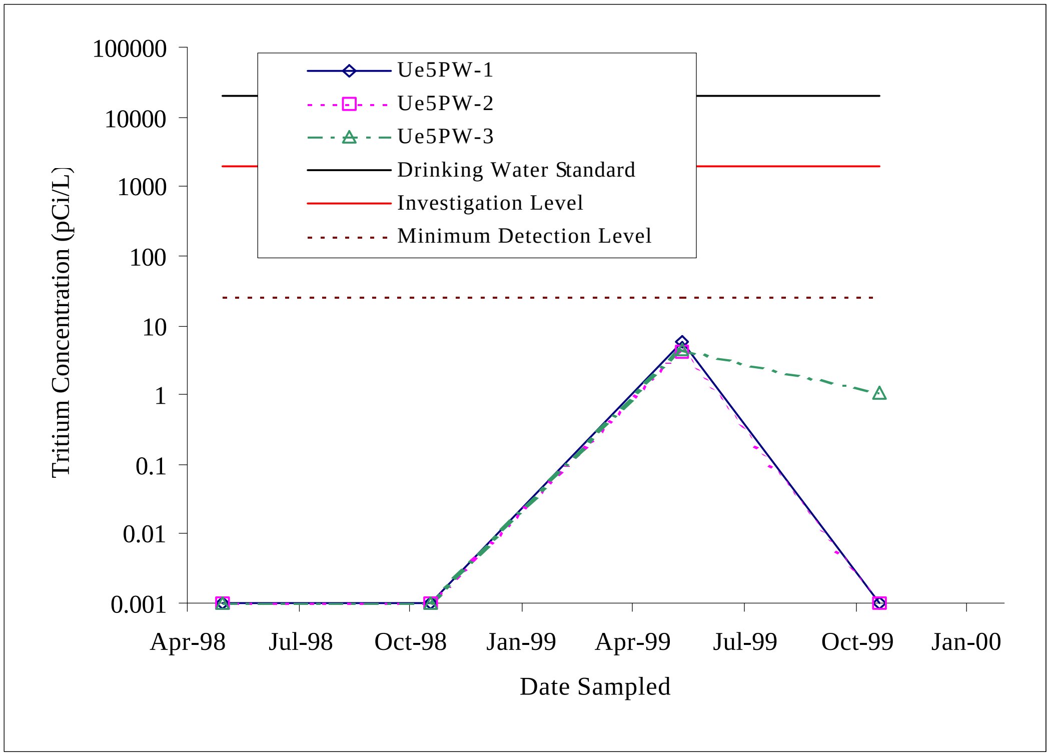

Figure 19 Area 5 RWMS Two-Year Plot of Tritium

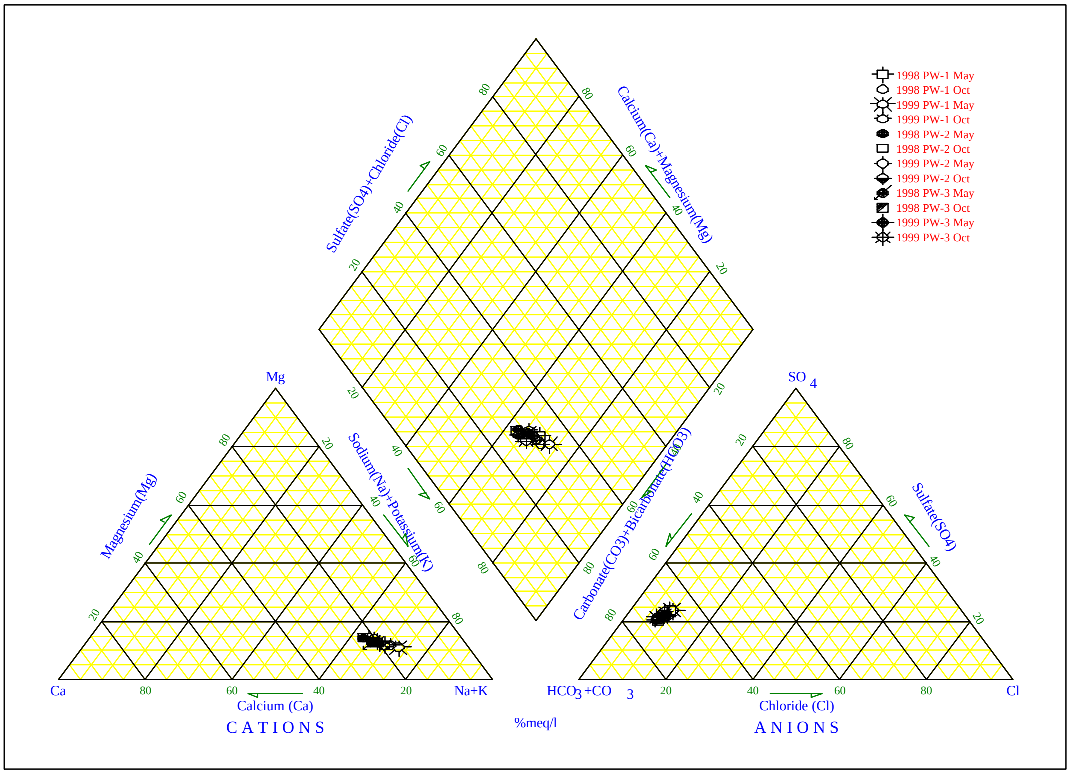

Figure 20 Area 5 RWMS Two-Year Piper Diagram

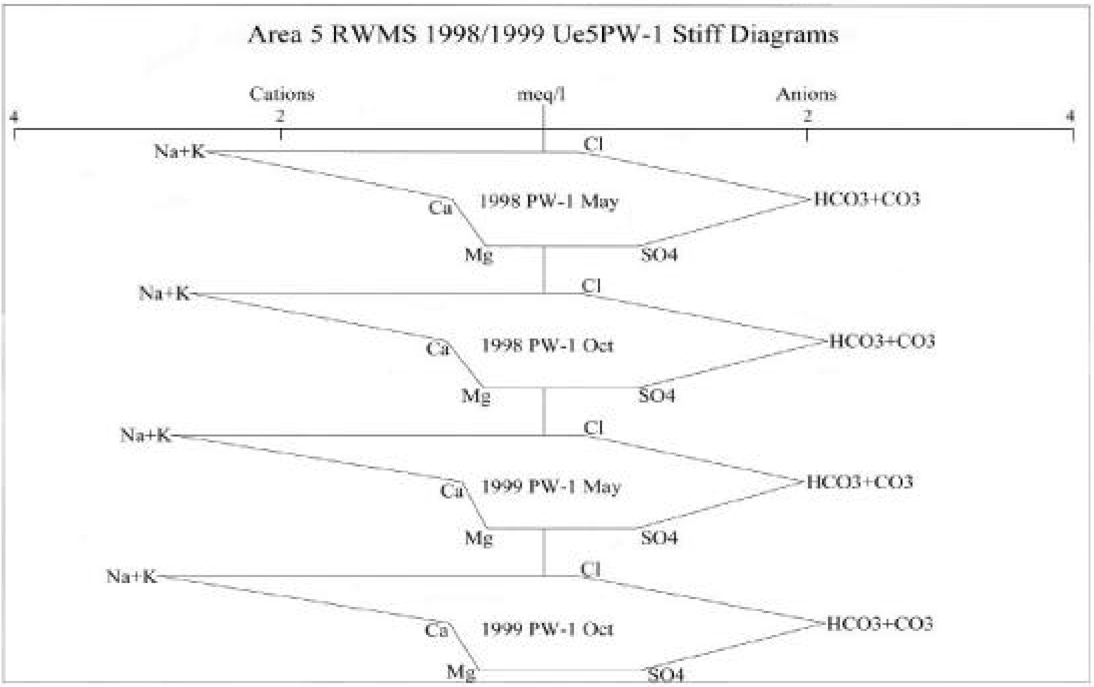

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Figure 21 Ue5PW-1 1998/1999 Stiff Diagrams

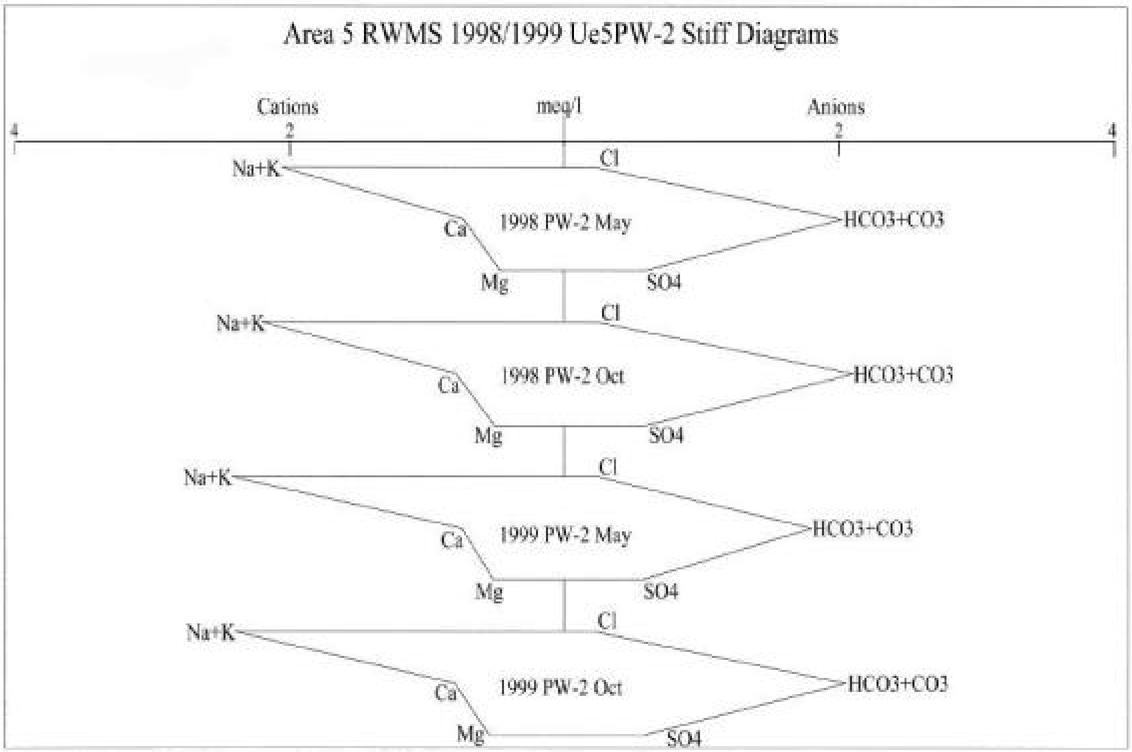


Figure 22 Ue5PW-2 1998/1999 Stiff Diagrams

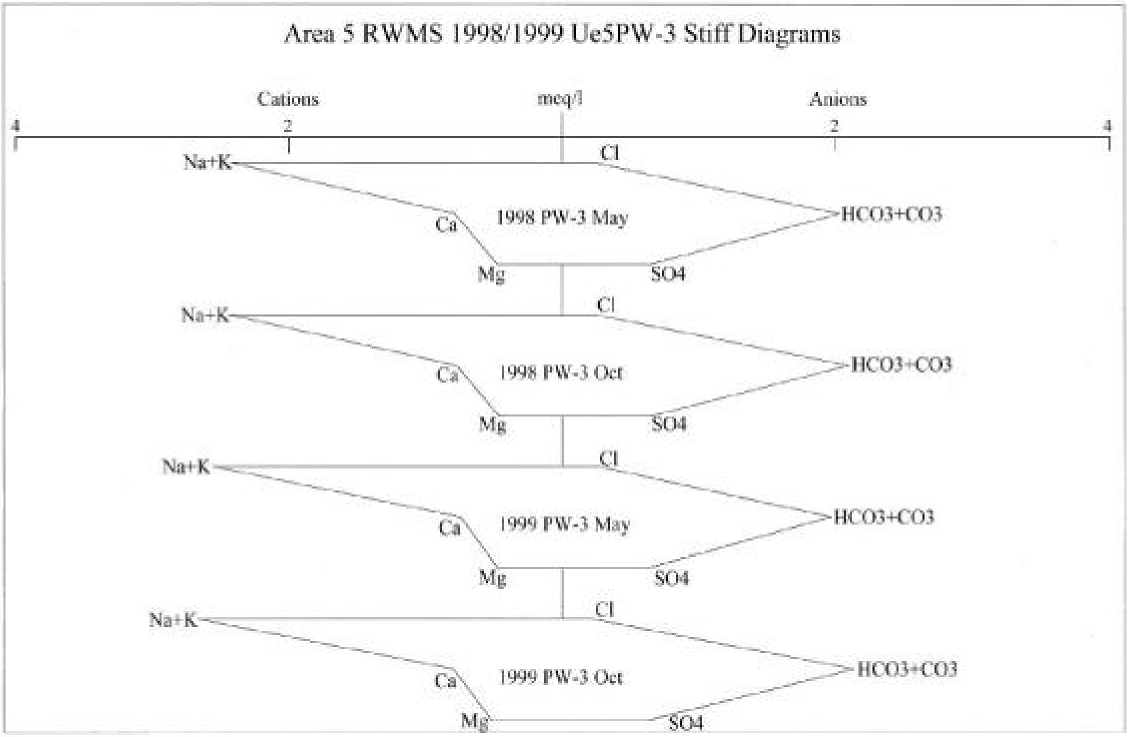


Figure 23 Ue5PW-3 1998/1999 Stiff Diagrams

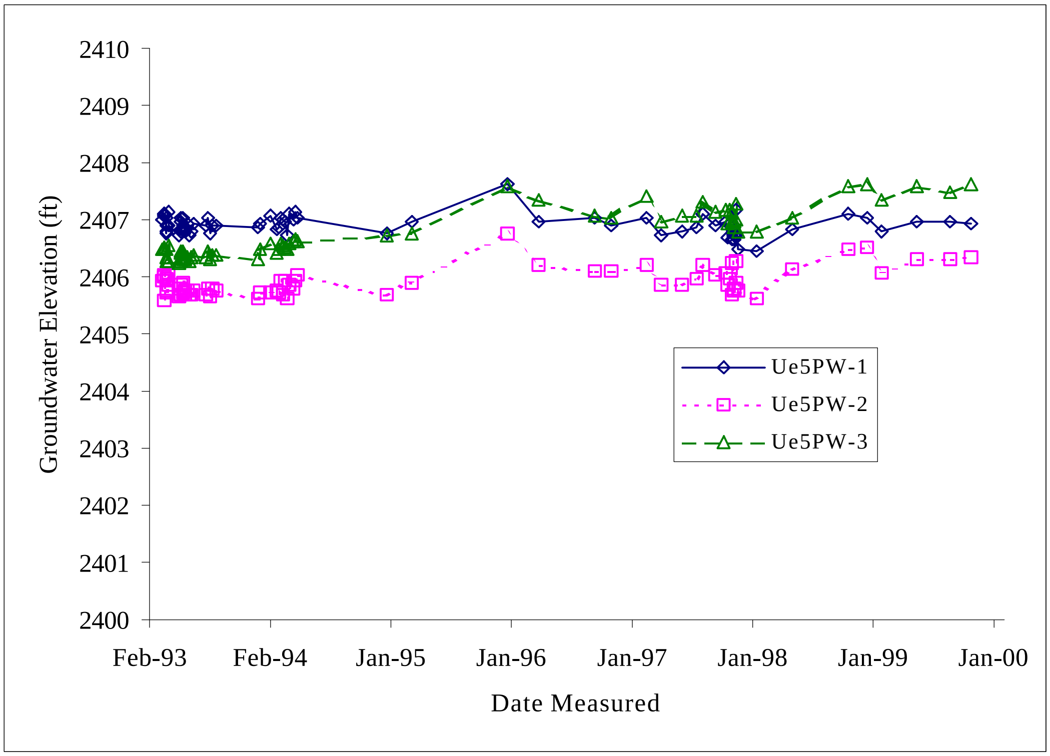


Figure 24 Area 5 RWMS Time Series Plot of Groundwater Elevation

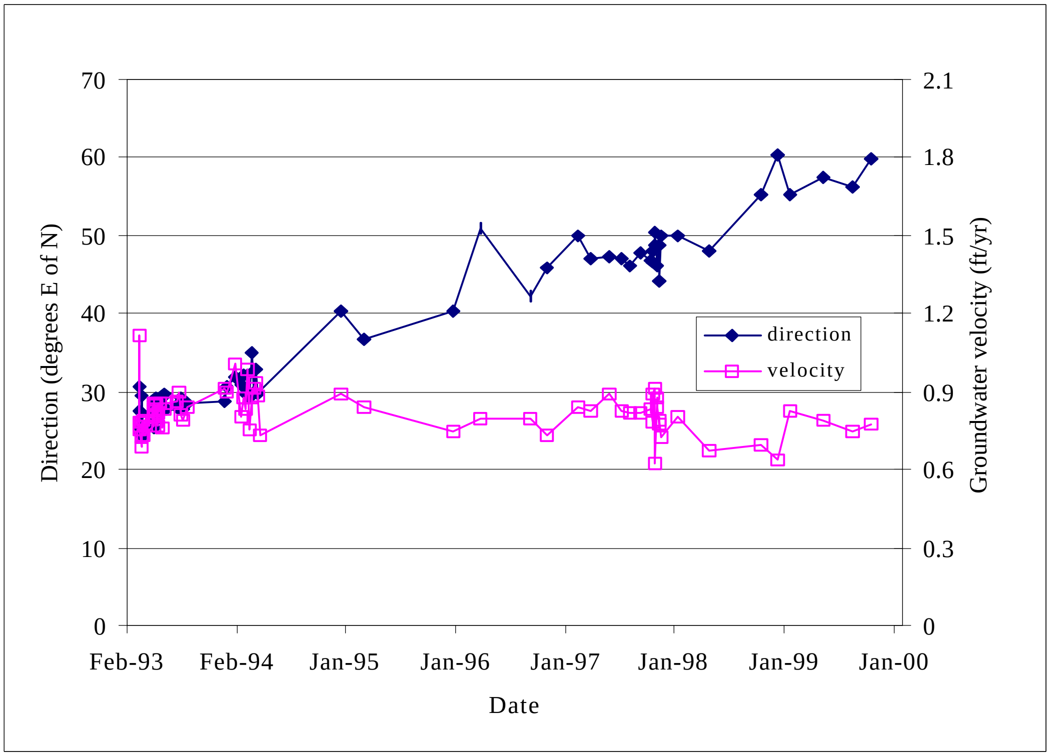


Figure 25 Area 5 RWMS Time Series Plot of Groundwater Velocity and Direction

Appendix B

Tables

Table 1 Area 5 RWMS Hydraulic Parameters

Hydraulic Conductivity	Hydraulic Gradient	Effective Porosity	Mean Velocity	Flow Direction
1.12e-3 cm/s[a] (3.36e-5 ft/s)	0.25 m/km (1.3 ft/mi)	0.38[a]	0.24 m/yr (0.8 ft/yr)	60° E of N

[a](REECO, 1994)

Table 2 Investigation Levels for Indicator Parameters

Parameter	Investigation Level (IL)
TOX	50 ug/L
TOC	1 mg/L
pH	less than 7.6 and greater than 9.2
specific conductance	0.440 mmhos/cm
tritium	2,000 pCi/L

Table 3 Area 5 RWMS pH Values for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
March 1993	8.17	7.99	8.24
July 1993	8.30	8.24	8.68
September 1993	8.25	8.40	8.68
December 1993	7.90	8.79	8.6
June 1994	8.45	8.81	8.87
August 1994	8.28	8.78	8.77
November 1994	no sample	no sample	8.58
April 1995	8.25	8.58	8.28
November 1995	8.34	8.08	8.42
January 1996	8.41	8.63	8.54
April 1996	8.22	8.21	8.23
April 1996	no sample	8.15	8.15
October 1996	8.43	8.28	8.18
November 1996	8.25	8.16	8.12
April 1997	8.32	8.40	8.25

Table 3 (Area 5 RWMS pH Values for Ue5PW-1, Ue5PW-2, and Ue5PW-3 [dates are approximated in 1993 and 1994 to make graphs consistent], cont.)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
November 1997	8.30	8.16	8.22
May 1998	8.31	8.37	8.34
July 1998	8.63	no sample	no sample
October 1998	8.34	8.32	8.14
May 1999	8.51	8.54	8.45
October 1999	8.47	8.53	8.34
Mean	**8.32**	**8.39**	**8.41**
Std Dev	**0.15**	**0.25**	**0.23**

Table 4 Area 5 RWMS Specific Conductance Values in mmhos/cm for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
March 1993	0.401	0.371	0.383
July 1993	0.391	0.411	0.382
September 1993	0.391	0.384	0.376
December 1993	0.383	0.371	0.359
June 1994	0.383	0.363	0.363
August 1994	0.378	0.324	0.367
November 1994	no sample	no sample	0.347
April 1995	0.320	0.336	0.352
November 1995	0.366	0.348	0.338
January 1996	0.360	0.343	0.354
April 1996	0.362	0.355	0.363
April 1996	no sample	0.356	0.379
October 1996	0.383	0.363	0.376
November 1996	0.374	0.364	0.378
April 1997	0.385	0.363	0.376
November 1997	0.376	0.358	0.361
May 1998	0.377	0.356	0.370
July 1998	0.373	no sample	no sample
October 1998	0.380	0.358	0.370

Table 4 (Area 5 RWMS Specific Conductance Values in mmhos/cm for Ue5PW-1, Ue5PW-2, and Ue5PW-3 [dates are approximated in 1993 and 1994 to make graphs consistent], cont.)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
May 1999	0.378	0.349	0.369
October 1999	0.376	0.354	0.369
Mean	**0.376**	**0.359**	**0.367**
Std Dev	**0.017**	**0.018**	**0.012**

Table 5 Area 5 RWMS TOC values in mg/L for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
March 1993	<1.0	<1.0	<1.0
July 1993	<1.0	<1.0	<1.0
September 1993	<1.0	no sample	<1.0
December 1993	<1.0	<1.0	<1.0
June 1994	no sample	<1.0	no sample
August 1994	1.7[1]	<1.0	<1.0
January 1995	0.20	0.5	0.22
April 1995	<1.0	<1.0	<1.0
November 1995	<1.0	<1.0	<1.0
April 1996	<0.3	<1.0	1.7[2]
October 1996	0.32	<0.3	<0.3
November 1996	<0.3	<0.3	<0.3
April 1997	<0.3	<0.3	<0.3
November 1997	<0.3	<0.3	<0.3
May 1998	<1.0	<1.0	<1.0
October 1998	<1.0	<1.0	<1.0
May 1999	<1.0	<1.0	<1.0
October 1999	<1.0	1.6[1,2]	<1.0
December 1999	no sample	<0.5	no sample
Mean	**0.38** [3]	**0.41** [3]	**0.47** [3]
Std Dev	**0.16** [3]	**0.15** [3]	**0.35** [3]

[1] determined to be a false positive through resampling
[2] duplicate sample results were <1.0
[3] assumes non-detects are equal to ½ the MDL

Table 6 Area 5 RWMS TOX Values in ug/L for Ue5PW-1, Ue5PW-2, and Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
March 1993	20	23	<10
July 1993	<10	<10	20[2]
September 1993	20[2]	<10	<10
December 1993	<10	<10	<10
June 1994	<10	no sample	no sample
August 1994	12[2]	no sample	<10
November 1994	no sample	14[2]	no sample
January 1995	<10	<10	<10
April 1995	<10	<10	<10
November 1995	<40	<40	<40
April 1996	<20	<40	<40
October 1996	<20	<20	<20
November 1996	<20	<20	<20
April 1997	<20	<20	<20
November 1997	<20	<20	<20
May 1998	391[1]	842[1]	1000[1]
July 1998	<5	no sample	no sample
October 1998	<5	<5	<5
May 1999	<5	<5	<5
October 1999	<5	<5	9[2]
Mean	**8.7 [3]**	**8.7 [3]**	**9.6 [3]**
Std Dev	**6.1 [3]**	**6.0 [3]**	**6.6 [3]**

[1] determined to be false positive through resampling
[2] duplicate sample results were less than MDL
[3] assumes non-detects are equal to ½ the MDL

Table 7 Area 5 RWMS Tritium Values in pCi/L for Ue5PW-1, Ue5PW-2, Ue5PW-3 (dates are approximated in 1993 and 1994 to make graphs consistent)

Date Sampled	Ue5PW-1	Ue5PW-2	Ue5PW-3
March 1993	0.442	-4.28	1.96
December 1993	-1.58	32.2[1]	-2.74
January 1994	no sample	3.69	-0.46
June 1994	-2.04	1.29	1.13
August 1994	1.86	0.015	1.04
April 1995	2.8	-0.92	1.5

Table 7 (Area 5 RWMS Tritium Values in pCi/L for Ue5PW-1, Ue5PW-2, Ue5PW-3 [dates are approximated in 1993 and 1994 to make graphs consistent], cont).

Date Sampled	**Ue5PW-1**	**Ue5PW-2**	**Ue5PW-3**
April 1996	-1.72	-1.91	-2.29
April 1997	3.15	0.19	3.69
May 1998	-2.35	-1.95	-4.71
October 1998	-1.09	-1.85	-8.25
May 1999	5.17	4.23	4.60
October 1999	-1.36	-3.37	1.08
Mean	**0.30**	**2.3**	**-0.9**
Std Dev	**2.56**	**9.77**	**3.54**

[1] standard, not enriched analysis performed

Table 8 Ue5PW-1 General Water Chemistry Values (mg/L)

Date	Ca	Fe	Mg	Mn	K	SiO_2	Na	SO_4	HCO_3	Cl	F
03-31-1993	no analysis	0.013	no analysis	<0.006	no analysis	no analysis	48	32	137	9.2	1.2
07-06-1993	no analysis	0.059	no analysis	<0.001	no analysis	no analysis	58	37	132	9.7	1.4
09-01-1993	no analysis	0.027	no analysis	0.0066	no analysis	no analysis	56	no analysis	157.5	8.4	5.7
12-07-1993	no analysis	0.012	no analysis	<0.0012	no analysis	no analysis	57	36	150	9.9	1.5
06-15-1994	no analysis	0.01	no analysis	<0.004	no analysis	no analysis	61	no analysis	no analysis	no analysis	no analysis
08-01-1994	no analysis	0.021	no analysis	<0.0012	no analysis	no analysis	53	36	no analysis	10	no analysis
04-04-1995	no analysis	<0.05	no analysis	<0.01	no analysis	no analysis	58	34	no analysis	9.9	no analysis
04-16-1996	no analysis	0.02	no analysis	<0.001	no analysis	no analysis	61	34	no analysis	9.9	no analysis
04-16-1997	15.1	0.012	5.31	<0.001	5.90	no analysis	54.5	32.2	125.5	9.2	1.3
11-05-1997	15.5	0.012	5.61	no analysis	6.44	no analysis	57.8	35.2	128	10.2	1.2
05-13-1998	14.0	0.034	5.36	0.0015	5.21	54.22	55.8	34.6	123.5	9.6	1.1
10-28-1998	14.9	0.024	5.58	0.0015	6.87	60.53	57.6	34	131	9.7	1.1
05-19-1999	12.5	<0.05	5.3	<0.0025	6.85	68.45	61	34	120	10	1
10-27-1999	14.5	<0.1	6.0	<0.005	6.6	62.03	63.5	35	130	8.8	1.1
Mean	**14.4**	**0.025**[1]	**5.53**	**0.002**[1]	**6.31**	**61.31**	**57.3**	**34.5**	**134.6**	**9.58**	**1.66**
Std Dev	**1.07**	**0.014**[1]	**0.27**	**0.002**[1]	**0.64**	**5.84**	**3.9**	**1.48**	**12.0**	**0.53**	**1.43**

[1] assumes non-detects are equal to ½ the MDL

Table 9 Ue5PW-2 General Water Chemistry Values (mg/L)

Date	Ca	Fe	Mg	Mn	K	SiO_2	Na	SO_4	HCO_3	Cl	F
03-24-1993	no analysis	0.062	no analysis	0.11	no analysis	no analysis	46	28	130	8.4	1
06-22-1993	no analysis	0.25	no analysis	0.032	no analysis	no analysis	54	30	150	9.7	1.1
11-15-1993	no analysis	0.180	no analysis	<0.004	no analysis	no analysis	51	31	140	9.4	1.3
01-19-1994	no analysis	0.074	no analysis	<0.0012	no analysis	no analysis	45	29	130	no analysis	1.2
060-7-1994	no analysis	0.14	no analysis	<0.004	no analysis	no analysis	55	no analysis	no analysis	no analysis	no analysis
11-29-1994	no analysis	no analysis	no analysis	no analysis	no analysis	no analysis	no analysis	28	no analysis	8	no analysis
04-04-1995	no analysis	<0.05	no analysis	<0.01	no analysis	no analysis	50	28	no analysis	8.5	no analysis
04-30-1996	no analysis	0.013	no analysis	<0.001	no analysis	no analysis	51	29	no analysis	8.3	no analysis
04-16-1997	15.9	0.012	5.98	<0.001	5.04	no analysis	47.6	26.4	122	7.9	1.21
11-05-1997	17.4	0.018	6.83	no analysis	4.87	no analysis	50.6	28.9	115	8.6	0.91
05-13-1998	14.8	0.066	5.68	<0.0011	3.83	50.80	45.2	28.4	123.5	8.2	1.0
10-28-1998	15.9	0.015	6.18	0.0009	5.56	55.93	47.4	28.4	128.5	8.3	0.98
05-19-1999	15	<0.05	6.3	<0.025	6.2	62.03	52	27.5	110	8.7	0.92
10-27-1999	16	<0.1	6.7	<0.05	5.7	55.61	52	28	125	7.4	0.96
Mean	**15.83**	**0.088[1]**	**6.28**	**0.014[1]**	**5.20**	**56.10**	**49.75**	**28.50**	**127.4**	**8.45**	**1.06**
Std Dev	**0.92**	**0.078[1]**	**0.43**	**0.033[1]**	**0.82**	**4.60**	**3.25**	**1.14**	**11.50**	**0.62**	**0.14**

[1] assumes non-detects are equal to ½ the MDL

Table 10 Ue5PW-3 General Water Chemistry Values (mg/L)

Date	Ca	Fe	Mg	Mn	K	SiO_2	Na	SO_4	HCO_3	Cl	F
04-14-1993	no analysis	0.024	no analysis	0.042	no analysis	no analysis	46	31	129	8.5	1.3
06-02-1993	no analysis	0.014	no analysis	0.009	no analysis	no analysis	53	31	133	9.1	1.2
10-12-1993	no analysis	0.11	no analysis	<0.006	no analysis	no analysis	57	30	128	7.9	1.2
12-20-1993	no analysis	0.1	no analysis	<0.0012	no analysis	no analysis	48	33	128	8.7	1.3
05-24-1994	no analysis	0.02	no analysis	<0.0012	no analysis	no analysis	56	no analysis	no analysis	no analysis	no analysis
08-08-1994	no analysis	<0.009	no analysis	<0.0012	no analysis	no analysis	51	33	no analysis	8.9	no analysis
04-05-1995	no analysis	<0.05	no analysis	<0.01	no analysis	no analysis	55	31	no analysis	8.8	no analysis
04-30-1996	no analysis	0.0088	no analysis	<0.001	no analysis	no analysis	57	32	no analysis	8.7	no analysis
04-16-1997	15.8	<0.006	5.71	<0.001	3.95	no analysis	54.2	29	127.5	8.31	1.26
11-05-1997	16.8	0.0133	6.06	no analysis	4.32	no analysis	55.5	32.1	115	9.15	1.09
05-13-1998	15.8	0.035	5.8	<0.0011	3.33	56.58	53.8	31	124	8.6	1
10-28-1998	15.6	0.015	5.7	0.0009	4.16	57.11	53.7	31.4	128	8.7	1
05-19-1999	15	<0.05	5.8	<0.0025	4.8	66.31	56	30.5	120	9.2	0.88
10-27-1999	16	<0.1	6.4	<0.005	5	59.89	58.5	31	130	7.6	0.94
Mean	**15.83**	**0.035**[1]	**5.91**	**0.006**[1]	**4.26**	**59.97**	**53.9**	**31.20**	**126.2**	**8.63**	**1.12**
Std Dev	**0.59**	**0.035**[1]	**0.27**	**0.012**[1]	**0.60**	**4.47**	**3.50**	**1.11**	**5.26**	**0.47**	**0.16**

[1] assumes non-detects are equal to ½ the MDL

Table 11 Area 5 Groundwater Elevation Data

	Nevada State Central Zone Coordinates		Top of Casing Elevation	Top of Casing to Land Surface	Land Surface Elevation	Deviation Correction
Borehole	North (m)	East (m)	(ft)	(ft)	(ft)	(ft.)
Ue5PW-1	223,386.48	216,357.08	3180.35	2.40	3177.99	-0.27
Ue5PW-2	234,817.13	216,376.00	3248.42	2.23	3246.23	-0.67
Ue5PW-3	235,089.93	214,415.04	3297.97	2.49	3295.51	-0.05

	Ue5PW-1 Water Level Measurements Top of casing elevation: 3180.35 ft			UePW5-2 Water level measurements Top of casing elevation: 3248.42 ft			UEPW5-3 Water level measurements Top of casing elevation: 3297.97 ft		
Date	**Depth to water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**
03/22/1993	773.08	2407.27	2407.00	841.82	2406.60	2405.93	891.43	2406.54	2406.49
03/23/1993	772.99	2407.36	2407.09	842.15	2406.27	2405.60	891.40	2406.57	2406.52
03/24/1993	773.00	2407.35	2407.08	841.75	2406.67	2406.00	891.43	2406.54	2406.49
03/25/1993	772.99	2407.36	2407.09	841.72	2406.70	2406.03	891.43	2406.54	2406.49
03/29/1993	773.20	2407.15	2406.88	841.83	2406.59	2405.92	891.56	2406.41	2406.36
03/30/1993	773.31	2407.04	2406.77	841.98	2406.44	2405.77	891.64	2406.33	2406.28
03/31/1993	773.30	2407.05	2406.78	842.03	2406.39	2405.72	891.59	2406.38	2406.33
04/01/1993	773.03	2407.32	2407.05	841.79	2406.63	2405.96	891.43	2406.54	2406.49
04/05/1993	772.93	2407.42	2407.15	841.71	2406.71	2406.04	891.38	2406.59	2406.54
04/06/1993	773.20	2407.15	2406.88	841.90	2406.52	2405.85	891.63	2406.34	2406.29
05/10/1993	773.37	2406.98	2406.71	842.08	2406.34	2405.67	891.67	2406.30	2406.25
05/11/1993	773.10	2407.25	2406.98	841.94	2406.48	2405.81	891.48	2406.49	2406.44
05/12/1993	773.04	2407.31	2407.04	841.88	2406.54	2405.87	891.52	2406.45	2406.40
05/13/1993	773.28	2407.07	2406.80	842.05	2406.37	2405.70	891.64	2406.33	2406.28
05/17/1993	773.26	2407.09	2406.82	842.05	2406.37	2405.70	891.58	2406.39	2406.34
05/18/1993	773.21	2407.14	2406.87	842.04	2406.38	2405.71	891.60	2406.37	2406.32
05/19/1993	773.20	2407.15	2406.88	842.03	2406.39	2405.72	891.57	2406.40	2406.35
05/20/1993	773.05	2407.30	2407.03	841.87	2406.55	2405.88	891.48	2406.49	2406.44
05/24/1993	773.25	2407.10	2406.83	841.98	2406.44	2405.77	891.60	2406.37	2406.32
05/25/1993	773.27	2407.08	2406.81	842.05	2406.37	2405.70	891.60	2406.37	2406.32
06/01/1993	773.16	2407.19	2406.92	842.00	2406.42	2405.75	891.56	2406.41	2406.36
06/07/1993	773.37	2406.98	2406.71	842.07	2406.35	2405.68	891.65	2406.32	2406.27
06/14/1993	773.28	2407.07	2406.80	842.07	2406.35	2405.68	891.58	2406.39	2406.34
06/21/1993	773.16	2407.19	2406.92	842.00	2406.42	2405.75	891.55	2406.42	2406.37
07/26/1993	773.20	2407.15	2406.88	842.05	2406.37	2405.70	891.58	2406.39	2406.34
08/03/1993	773.05	2407.30	2407.03	841.95	2406.47	2405.80	891.47	2406.50	2406.45
08/09/1993	773.31	2407.04	2406.77	842.08	2406.34	2405.67	891.62	2406.35	2406.30
08/16/1993	773.20	2407.15	2406.88	841.95	2406.47	2405.80	891.55	2406.42	2406.37
08/30/1993	773.17	2407.18	2406.91	841.99	2406.43	2405.76	891.53	2406.44	2406.39
12/28/1993	773.21	2407.14	2406.87	842.12	2406.30	2405.63	891.60	2406.37	2406.32
01/03/1994	773.15	2407.20	2406.93	842.02	2406.40	2405.73	891.45	2406.52	2406.47
02/02/1994	773.02	2407.33	2407.06	842.02	2406.40	2405.73	891.32	2406.65	2406.60
02/22/1994	773.25	2407.10	2406.83	841.99	2406.43	2405.76	891.49	2406.48	2406.43
02/28/1994	773.22	2407.13	2406.86	842.04	2406.38	2405.71	891.45	2406.52	2406.47
03/07/1994	773.03	2407.32	2407.05	841.82	2406.60	2405.93	891.33	2406.64	2406.59
03/14/1994	773.08	2407.27	2407.00	842.05	2406.37	2405.70	891.36	2406.61	2406.56
03/21/1994	773.12	2407.23	2406.96	841.81	2406.61	2405.94	891.40	2406.57	2406.52
03/28/1994	773.34	2407.01	2406.74	842.13	2406.29	2405.62	891.45	2406.52	2406.47
04/04/1994	772.99	2407.36	2407.09	841.89	2406.53	2405.86	891.33	2406.64	2406.59
04/13/1994	773.08	2407.27	2407.00	841.97	2406.45	2405.78	891.30	2406.67	2406.62
04/20/1994	772.95	2407.40	2407.13	841.81	2406.61	2405.94	891.28	2406.69	2406.64
04/26/1994	773.06	2407.29	2407.02	841.71	2406.71	2406.04	891.29	2406.68	2406.63
01/18/1995	773.32	2407.03	2406.76	842.05	2406.35	2405.68	891.20	2406.77	2406.72
04/03/1995	773.13	2407.22	2406.95	841.85	2406.55	2405.88	891.16	2406.81	2406.76
01/16/1996	772.45	2407.90	2407.63	841.00	2407.42	2406.75	890.32	2407.65	2407.60
04/15/1996	773.10	2407.25	2406.98	841.56	2406.86	2406.19	890.57	2407.40	2407.35

Table 11 (Area 5 Groundwater Elevation Data, cont.)

	Nevada State Central Zone Coordinates		Top of Casing Elevation	Top of Casing to Land Surface	Land Surface Elevation	Deviation Correction
Borehole	North (m)	East (m)	(ft)	(ft)	(ft)	(ft.)
Ue5PW-1	223,386.48	216,357.08	3180.35	2.40	3177.99	-0.27
Ue5PW-2	234,817.13	216,376.00	3248.42	2.23	3246.23	-0.67
Ue5PW-3	235,089.93	214,415.04	3297.97	2.49	3295.51	-0.05

	Ue5PW-1 Water Level Measurements Top of casing elevation: 3180.35 ft			UePW5-2 Water level measurements Top of casing elevation: 3248.42 ft			UEPW5-3 Water level measurements Top of casing elevation: 3297.97 ft		
Date	**Depth to water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**	**Depth to water (ft)**	**Elevation (ft)**	**Elevation Corrected for Deviation (ft)**
10/01/1996	773.04	2407.31	2407.04	841.63	2406.79	2406.12	890.84	2407.13	2407.08
11/19/1996	773.19	2407.16	2406.89	841.66	2406.76	2406.09	890.87	2407.10	2407.05
03/03/1997	773.03	2407.32	2407.05	841.55	2406.87	2406.20	890.52	2407.45	2407.40
04/15/1997	773.34	2407.01	2406.74	841.89	2406.53	2405.86	890.95	2407.02	2406.97
06/18/1997	773.28	2407.07	2406.80	841.89	2406.53	2405.86	890.86	2407.11	2407.06
07/28/1997	773.23	2407.12	2406.85	841.78	2406.64	2405.97	890.84	2407.13	2407.08
08/20/1997	772.97	2407.38	2407.11	841.53	2406.89	2406.22	890.62	2407.35	2407.30
09/25/1997	773.19	2407.16	2406.89	841.72	2406.70	2406.03	890.77	2407.20	2407.15
10/27/1997	773.13	2407.22	2406.95	841.69	2406.73	2406.06	890.75	2407.22	2407.17
11/03/1997	773.40	2406.95	2406.68	841.89	2406.53	2405.86	890.98	2406.99	2406.94
11/06/1997	773.14	2407.21	2406.94	841.77	2406.65	2405.98	890.75	2407.22	2407.17
11/12/1997	773.44	2406.91	2406.64	842.05	2406.37	2405.70	890.95	2407.02	2406.97
11/13/1997	773.23	2407.12	2406.85	841.52	2406.90	2406.23	890.79	2407.18	2407.13
11/19/1997	773.35	2407.00	2406.73	841.96	2406.46	2405.79	890.97	2407.00	2406.95
11/20/1997	773.41	2406.94	2406.67	841.99	2406.43	2405.76	891.05	2406.92	2406.87
11/25/1997	773.37	2406.98	2406.71	841.84	2406.58	2405.91	890.93	2407.04	2406.99
11/26/1997	772.92	2407.43	2407.16	841.47	2406.95	2406.28	890.65	2407.32	2407.27
12/03/1997	773.60	2406.75	2406.48	842.00	2406.42	2405.75	891.13	2406.84	2406.79
01/26/1998	773.64	2406.71	2406.44	842.12	2406.30	2405.63	891.14	2406.83	2406.78
05/12/1998	773.25	2407.10	2406.83	841.62	2406.80	2406.13	890.87	2407.10	2407.05
10/27/1998	772.98	2407.37	2407.10	841.27	2407.15	2406.48	890.35	2407.62	2407.57
12/22/1998	773.05	2407.30	2407.03	841.22	2407.20	2406.53	890.31	2407.66	2407.61
02/02/1999	773.28	2407.07	2406.80	841.69	2406.73	2406.06	890.56	2407.41	2407.36
05/18/1999	773.10	2407.25	2406.98	841.44	2406.98	2406.31	890.33	2407.64	2407.59
08/25/1999	773.12	2407.23	2406.96	841.44	2406.98	2406.31	890.42	2407.55	2407.50
10/26/1999	773.14	2407.21	2406.94	841.42	2407.00	2406.33	890.29	2407.68	2407.63

Appendix C

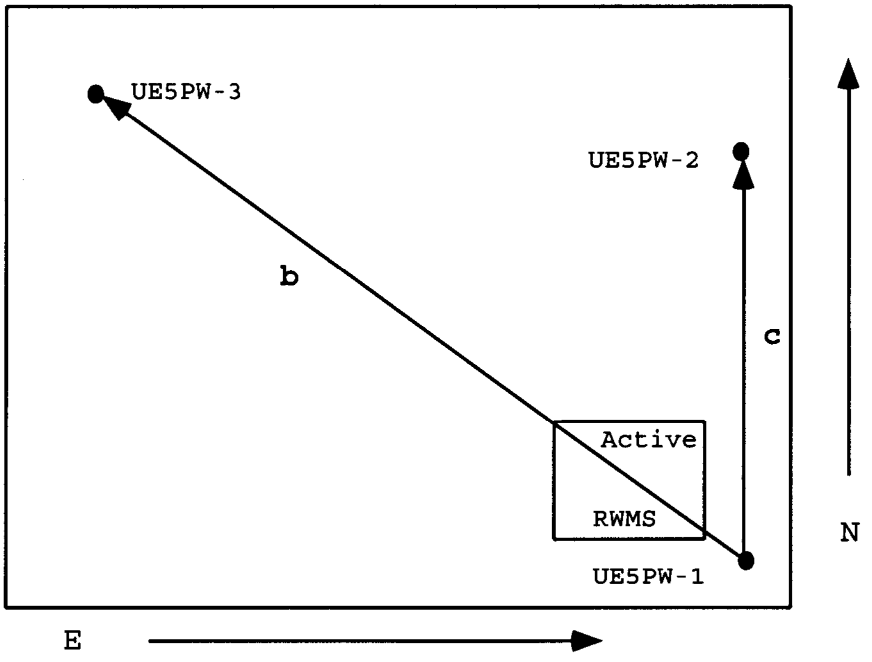
Gradient/Velocity Calculations

CALCULATION OF MAGNITUDE AND DIRECTION OF AREA 5 ALLUVIAL AQUIFER GRADIENT

Water level elevations measured at three wells in the alluvial aquifer near the Area 5 RWMS are used to calculate the magnitude and direction of the hydraulic gradient. The wells sampled are Ue5PW-1, Ue5PW-2, and Ue5PW-3. The locations of the three wells are given in Nevada State Central Zone coordinates in meters as North (N) and East (E) values.

The locations of the wells are shown in the figure below.

Area 5 RWMS Monitoring Wells



(Not to Scale)

The coordinates of each of the three points on the plane are given by (E, N, e) where E is the East coordinate, N is the North coordinate, and e is the water table elevation. The vector **b** representing the line segment $\overrightarrow{13}$ is given by $(E_3-E_1)\mathbf{i} + (N_3-N_1)\mathbf{j} + (e_3-e_1)\mathbf{k}$. Similarly the vector **c** representing the line segment 12 is given by $(E_2-E_1)\mathbf{i} + (N_2-N_1)\mathbf{j} + (e_2-e_1)\mathbf{k}$. A normal vector to the plane is given by the vector product of **b** and **c**,

$$\mathbf{b} \times \mathbf{c} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ [E_2-E_1] & [N_2-N_1] & [e_2-e_1] \\ [E_3-E_1] & [N_3-N_1] & [e_3-e_1] \end{vmatrix}$$

Expanding the determinant gives,

$$[[N_2-N_1]\ [e_3-e_1] - [N_3-N_1]\ [e_2-e_1]]\ \mathbf{i} -$$
$$[[E_2-E_1]\ [e_3-e_1] - [E_3-E_1]\ [e_2-e_1]]\ \mathbf{j} +$$
$$[[E_2-E_1]\ [N_3-N_1] - [E_3-E_1]\ [N_2-N_1]]\ \mathbf{k}.$$

This gives the representation for the plane as,

$$A\ (E) + B\ (N) + C\ (e) = D$$

Where:

$A = [N_2-N_1]\ [e_3-e_1] - [N_3-N_1]\ [e_2-e_1]$

$B = -[[E_2-E_1]\ [e_3-e_1] - [E_3-E_1]\ [e_2-e_1]]$

$C = [E_2-E_1]\ [N_3-N_1] - [E_3-E_1]\ [N_2-N_1]$.

The constant D can be determined by substituting the N, E, and e values for PW-1 into the equation for the plane.

The equation is then written in terms of the elevation,

$$e = -A/C\ (E) - B/C\ (N) + D/C.$$

The gradient is given by the derivative of the function e in the direction of the unit vector **u**.

$$D_{\mathbf{u}}e = \nabla e \bullet \mathbf{u}$$

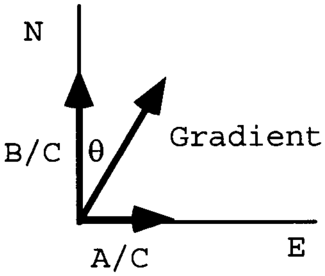
∇e points in the direction **u** that produces the largest directional derivative. $|\nabla e|$ is that largest directional derivative.

For the water table elevations,
$\nabla e = -A/C\ \mathbf{i} + B/C\ \mathbf{j}$.

The gradient is calculated from the E and N components,

$\text{Gradient} = \sqrt{(A/C)^2 + (B/C)^2}$

The direction of the gradient with respect to North is calculated from the component vectors.



The direction of the gradient is given by

$$\theta = 90 - \text{Arctan}\ (B/A).$$

CALCULATION OF MEAN GROUNDWATER VELOCITY

Once the gradient has been calculated, the mean groundwater velocity may be calculated using Darcy's Law,

$$q = Ki$$

where

$$V = q/\Phi$$

Where:

q equals the specific discharge or darcian flux
K is the saturated hydraulic conductivity (length/time)
i is the hydraulic gradient (dimensionless)
Φ is the effective porosity (dimensionless)
V is the mean groundwater velocity (length/time)

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Appendix D

Statistical Output

STATISTICAL OUTPUT

```
All statistical calculations were performed by the MINITAB statistical
Statistical Analyses Program, Version 12.2.

**pH

*Test for significant differences in pH between wells

Analysis of Variance Method: General Linear Model
Factor     Type Levels Values
Loc       fixed      3 UE5PW-1 UE5PW-2 UE5PW-3
Grp       fixed     16 Apr-93 Apr-95 Apr-96 Apr-97 Dec-93 Jan-96 Jun-93
                Jun-94
                       May-98 Nov-95 Nov-96 Nov-97 Oct-93 Oct-96 Oct-98
                Oct-99

Analysis of Variance for pH Result, using Adjusted SS for Tests

Source     DF     Seq SS     Adj SS     Adj MS       F      P
Loc         2    0.25506    0.27213    0.13607   14.16  0.000
Grp        15    4.07486    3.93915    0.26261   27.32  0.000
Loc*Grp    30    3.64904    3.64904    0.12163   12.66  0.000
Error     143    1.37443    1.37443    0.00961
Total     190    9.35340

Tukey Simultaneous Tests
Response Variable: pH Result
All Pairwise Comparisons among Levels of Loc


Loc = UE5PW-1 subtracted from:

Level       Difference       SE of             Adjusted
Loc           of Means  Difference   T-Value    P-Value
UE5PW-2        0.07607     0.01834     4.148     0.0002
UE5PW-3        0.08865     0.01791     4.950     0.0000

Loc = UE5PW-2 subtracted from:

Level       Difference       SE of             Adjusted
Loc           of Means  Difference   T-Value    P-Value
UE5PW-3        0.01258     0.01821    0.6907     0.7693


*Test for trend over time in UE5PW-1

Polynomial Regression
UE5PW-1 pH regressed on sample collection date

Y = -1975.32 + 0.168657X - 4.78E-06X**2 + 4.52E-11X**3
R-Sq = 17.8 %

Analysis of Variance

SOURCE            DF         SS         MS         F         P
Regression         3    0.44081  0.146935   4.69933  4.96E-03
Error             65    2.03238  0.031267
Total             68    2.47318
```

```
SOURCE      DF    Seq SS         F         P
Linear       1  0.428327   14.0342  3.76E-04
Quadratic    1  0.000041  1.32E-03  0.971127
Cubic        1  0.012439  0.397824  0.530427

One-way Analysis of Variance

Analysis of Variance for PW-1 pH by date
Source     DF        SS        MS        F        P
PW-1 D     17    1.4926    0.0878     4.57    0.000
Error      51    0.9805    0.0192
Total      68    2.4732


*Test for trend over time in UE5PW-2

Polynomial Regression
UE5PW-2 pH regressed on sample collection date

Y = -25211.9 + 2.14753X - 6.09E-05X**2 + 5.76E-10X**3
R-Sq = 51.1 %

Analysis of Variance

SOURCE            DF        SS        MS         F         P
Regression         3   2.15163  0.717211   22.6098  3.86E-10
Error             65   2.06188  0.031721
Total             68   4.21352

SOURCE      DF    Seq SS         F         P
Linear       1   0.06739   1.08903  0.300436
Quadratic    1   0.00643  0.102563  0.749787
Cubic        1   2.07781   65.5020  1.99E-11

One-way Analysis of Variance

Analysis of Variance for PW-2 pH by date
Source     DF        SS        MS        F        P
PW-2 D     17   4.09257   0.24074   101.51    0.000
Error      51   0.12095   0.00237
Total      68   4.21352


*Test for trend over time in UE5PW-3

Polynomial Regression
UE5PW-3 pH regressed on sample collection date

Y = -14263.9 + 1.21935X - 3.47E-05X**2 + 3.29E-10X**3
R-Sq = 53.6 %

Analysis of Variance

SOURCE            DF        SS        MS         F         P
Regression         3   2.29145  0.763818   26.2285  2.19E-11
Error             68   1.98028  0.029122
Total             71   4.27173
```

```
SOURCE      DF    Seq SS         F         P
Linear       1   1.46754   36.6337  6.33E-08
Quadratic    1   0.15265   3.97246  5.02E-02
Cubic        1   0.67126   23.0501  9.02E-06

One-way Analysis of Variance

Analysis of Variance for PW-3 pH by date
Source     DF        SS        MS        F        P
PW-3 D     18   3.92173   0.21787    32.99    0.000
Error      53   0.35000   0.00660
Total      71   4.27173

**Specific conductance

*Test for significant differences in Specific Conductance between wells

Analysis of Variance method: General Linear Model
Factor     Type Levels Values
Loc       fixed      3 UE5PW-1 UE5PW-2 UE5PW-3
Grp       fixed     16 Apr-93 Apr-95 Apr-96 Apr-97 Dec-93 Jan-96 Jun-93
                Jun-94
                       May-98 Nov-95 Nov-96 Nov-97 Oct-93 Oct-96 Oct-98
                Oct-99

Analysis of Variance for specific conductance Result, using Adjusted SS
for Tests

Source     DF     Seq SS     Adj SS     Adj MS       F      P
Loc         2  0.0062778  0.0049622  0.0024811   97.15  0.000
Grp        15  0.0305773  0.0311747  0.0020783   81.38  0.000
Loc*Grp    30  0.0094636  0.0094636  0.0003155   12.35  0.000
Error     142  0.0036263  0.0036263  0.0000255
Total     189  0.0499450

Tukey Simultaneous Tests
Response Variable Resul
All Pairwise Comparisons among Levels of Loc


Loc = UE5PW-1 subtracted from:

Level       Difference       SE of             Adjusted
Loc           of Means  Difference   T-Value    P-Value
UE5PW-2       -0.01311    0.000945    -13.87     0.0000
UE5PW-3       -0.00750    0.000950     -7.89     0.0000

Loc = UE5PW-2 subtracted from:

Level       Difference       SE of             Adjusted
Loc           of Means  Difference   T-Value    P-Value
UE5PW-3       0.005615    0.000965     5.819     0.0000


*Test for trend over time in UE5PW-1

Polynomial Regression
UE5PW-1 conductance regressed on sample collection date

Y = 1048.28 - 8.87E-02X + 2.50E-06X**2 - 2.35E-11X**3
R-Sq = 45.2 %
```

```
Analysis of Variance

SOURCE            DF        SS         MS         F          P
Regression         3  8.00E-03  2.67E-03   17.9034  1.40E-08
Error             65  9.68E-03  1.49E-04
Total             68  1.77E-02


SOURCE      DF    Seq SS         F         P
Linear       1  9.22E-04   3.68781  5.91E-02
Quadratic    1  3.71E-03   18.7841  5.11E-05
Cubic        1  3.36E-03   22.5885  1.15E-05


One-way Analysis of Variance

Analysis of Variance for conductance by date UE5PW-1
Source     DF        SS        MS        F        P
PW-1 Dat   17 0.0167462 0.0009851    53.84    0.000
Error      51 0.0009332 0.0000183
Total      68 0.0176793


*Test for trend over time in UE5PW-2

Polynomial Regression
UE5PW-2 conductance regressed on sample collection date

Y = 1347.01 - 0.114067X + 3.22E-06X**2 - 3.03E-11X**3
R-Sq = 52.9 %

Analysis of Variance

SOURCE            DF        SS         MS         F          P
Regression         3  1.27E-02  4.22E-03   24.3481  1.12E-10
Error             65  1.13E-02  1.73E-04
Total             68  2.39E-02


SOURCE      DF    Seq SS         F         P
Linear       1  3.07E-03   9.84974  2.53E-03
Quadratic    1  4.29E-03   17.1086  1.02E-04
Cubic        1  5.30E-03   30.5760  6.12E-07


One-way Analysis of Variance

Analysis of Variance for conductance by date for UE5PW-2
Source     DF        SS        MS        F        P
PW-2 Dat   17 0.0230531 0.0013561    79.18    0.000
Error      51 0.0008735 0.0000171
Total      68 0.0239266


*Test for trend over time in UE5PW-3

Polynomial Regression
UE5PW-3 conductance regressed on sample collection date

Y = 956.474 - 8.12E-02X + 2.30E-06X**2 - 2.16E-11X**3
R-Sq = 32.8 %
```

```
Analysis of Variance

SOURCE            DF         SS         MS          F          P
Regression         3  3.69E-03  1.23E-03   10.8782  6.56E-06
Error             67  7.58E-03  1.13E-04
Total             70  1.13E-02


SOURCE      DF    Seq SS          F          P
Linear       1  4.63E-07  2.84E-03  0.957662
Quadratic    1  8.70E-04   5.68859  1.99E-02
Cubic        1  2.82E-03   24.9391  4.48E-06


One-way Analysis of Variance

Analysis of Variance for conductance by date for UE5PW-3
Source     DF        SS        MS        F        P
PW-3 dat   18 0.0092000 0.0005111    12.87    0.000
Error      52 0.0020658 0.0000397
Total      70 0.0112658
```

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Appendix E

Instructions for Area 5 RWMS Groundwater Well Preparation and Groundwater Sampling

Bechtel Nevada

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING** **Page 1 of 24**

Number: **OP-2151.214** Revision Number: **0**

Document Control Information

Responsible Organization: **Environmental Operations**

Instructions: This is a new procedure.

Signature Approval:

____ ______________________________

Manager, Environmental Operations Date

1.0 PURPOSE

1.1 This procedure establishes procedures for sampling groundwater at the Area 5 Radioactive Waste Management Site (RWMS), as required by Title 40 Code of Federal Regulations (CFR) 265, Subpart F, “Storage and Disposal Facilities”; and U.S. Department of Energy (DOE) Order 5820.2A, “Radioactive Waste Management.”

2.0 SCOPE

2.1 This procedure applies to the routine collection of groundwater samples for groundwater characterization and detection monitoring at the Area 5 RWMS. The Area 5 RWMS is an interim status treatment, storage, and disposal facility.

3.0 RESPONSIBILITIES

3.1 The following entities have responsibilities in this procedure:

- **Monitoring Activity Manager**
- **Samplers**
- **Analytical Services Laboratory (ASL) Personnel**

4.0 PROCEDURE

4.1 GENERAL RESPONSIBILITIES

NOTE: It is the responsibility of all personnel to stop work if they feel they are sampling in an unsafe environment.

4.1.1 The **Monitoring Activity Manager** shall:

4.1.1.1 Ensure that the groundwater sampling program is in full compliance with this procedure.

4.1.1.2 Ensure that all work conducted follows safety standards.

4.1.1.3 Order and control supplies for groundwater sampling.

4.1.1.4 Determine groundwater analytes of interest.

4.1.1.5 Act as the point of contact for all issues regarding groundwater sampling procedures, operations, technical questions, and problem reporting.

4.1.1.6 Ensure that there exists a statement of work with qualified laboratories to perform the following actions.

4.1.1.6.1 Provide laboratory analyses which may consist of inorganic, organic, and radiological samples.

4.1.1.6.2 Provide laboratory quality control tests and maintain a laboratory quality assurance program.

4.1.1.6.3 Review and report data results, as required.

4.1.1.6.4 Maintain complete data analysis packages.

4.1.1.6.5 Provide requested quality control trip blanks.

4.1.2 **Samplers** shall:

4.1.2.1 Prepare/oversee monitoring wells for sampling.

4.1.2.2 Perform analyses of field parameters.

4.1.2.3 Oversee the collection, preservation, transport, and analysis of groundwater samples.

4.1.2.4 Assure accuracy and completeness of the Chain-of-Custody form for samples taken.

4.1.2.5 Evaluate and maintain laboratory data, and coordinate with the Monitoring Activity Manager to determine parameters to be sampled.

4.1.2.6 Conduct all work in accordance with safety standards.

4.2 GROUNDWATER EQUIPMENT AND SITE PREPARATION

NOTE: All personnel working in and around the sampling location must maintain the highest level of cleanliness and housekeeping and adhere to the following requirements:

- Where appropriate, gloves, safety glasses and other personal protective equipment (PPE) as necessary shall be worn.
- Spills and other sampling material shall be cleaned up immediately.
- All equipment shall be inspected and cleaned prior to entering the sampling well.
- All readings must be recorded in the Groundwater Sampling Logbook.
- For groundwater sampling activities, the process outlined in Appendix A, “Groundwater Sampling Flow Diagram” shall be followed.

4.2.1 **Samplers** shall perform the following steps prior to sampling:

4.2.1.1 Inspect the area around the transportainer for any possible source of contamination (vehicles, spill test facility, etc.).

4.2.1.2 Have the water master wet the road and area around the pilot well before sampling if dust control is needed.

4.2.1.3 Note weather conditions and direction of the wind to determine if contamination to the sampling area is possible.

4.2.1.4 Ensure that vehicles are located at a safe distance from the sampling area to minimize contamination.

4.2.1.5 Gather the necessary sample collection containers, preservatives, coolers, etc.

4.2.1.6 Inspect the area around the wellhead for cleanliness and any possible contamination.

4.2.1.7 Loosen the wellhead cap to allow borehole pressure to equilibrate.

NOTE: Bennett™ pumps that are dedicated to and permanently located at the pilot well do not require washing unless they have been contaminated in some fashion or have been removed from the pilot well (e.g. shipped to manufacturer for maintenance).

4.2.2 **Samplers** shall clean any nondedicated equipment (except water level probes) used in the collection of water quality data by the following method prior to sampling:

4.2.2.1 Wash with mild Liquinox™ detergent solution.

4.2.2.2 Triple rinse equipment with tap water.

4.2.2.3 Triple rinse equipment with deionized or distilled water.

4.2.2.4 Thoroughly dry all sampling equipment before use.

4.2.2.5 Use this cleaning method on metal bailers, pumps, and associated equipment used in sampling and/or purging of the monitor well.

4.2.3 When checking and purging Bennett™ pumps, **samplers** shall:

4.2.3.1 Place the Bennett™ pump in a spare purge jar. Turn on the water level sensor.

4.2.3.2 Add enough tap water to cover the top of pump. Listen for audible sound.

4.2.3.3 Remove the pump and dry using Kimwipes™.

4.2.3.4 Check connectors and fittings on pump head.

4.2.3.5 Place the Bennett™ pump in its dedicated purge jar. Add 11 gallons of distilled water.

4.2.3.6 Pump water through the pump until approximately six inches of water remains and water is coming out of the pump.

4.2.4 When measuring the static water level, **samplers** shall:

4.2.4.1 Test the probe's audible electronic signal in tap water.

4.2.4.2 Attach the bell cap and clean the probe and tape with distilled water and Kimwipe™ while lowering down the borehole.

4.2.4.3 Lower the probe down the borehole until an audible electronic signal sounds.

4.2.4.4 Remove bell cap and hold the tape next to the marked rim of the casing to take the measurement. Measure to the nearest 0.01 foot.

4.2.4.5 Repeat measurements until two consecutive measurements are within 0.02 foot.

4.2.4.6 Record the individual's name taking the measurement, the well, the date, the time, and the depth to water from the rim of the casing.

4.2.4.7 The approximate depth to water is 773 feet at Ue5PW-1, 842 feet at Ue5PW-2, and 891 feet at Ue5PW-3.

4.2.4.8 Remove the water level probe, cleaning the tape as it is being wound into the reel.

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING** **Page 6 of 24**

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4.2.4.9 Clean the probe with distilled water and dry with Kimwipes™.

NOTE: Measuring tapes shall be calibrated annually at well WW 5A. Calibration of measuring tapes shall be noted in the Groundwater Sampling Logbook.

4.2.5 When placing the pump, **samplers** shall:

4.2.5.1 Place the Bennett™ hose bundle through the pulley.

4.2.5.2 Inspect the tubing and tape around the bundle and cut or replace the tape as required.

4.2.5.3 Rinse and wipe the unreeled hose using distilled water and Kimwipes™.

4.2.5.4 Attach a bell cap.

4.2.5.5 Lower the pump into the well until the water sensor sounds.

4.2.5.6 Place the tape on the tubing bundle to indicate 5 feet of water depth.

4.2.5.7 Lower the pump to 5 feet below the water surface.

4.2.5.8 Seal the wellhead using plastic.

4.2.6 When setting up the water quality monitoring equipment calibration, **samplers** shall:

4.2.6.1 Set up the Multi-Parameter Water Quality Monitor System without connecting to the well pump lines.

4.2.6.2 Calibrate the water quality monitoring equipment using the manufacturer’s instructions. Note calibration of equipment in the logbook. Re-check calibration at the end of the sampling period to assure that there has been no drift.

NOTE: The temperature probe shall be checked quarterly or prior to use against a certified, calibrated mercury filled thermometer (readings must be within ± 0.5 C of the certified thermometer). Record all calibration data in the Groundwater Sampling Logbook.

4.2.7 When purging the well, **samplers** shall:

4.2.7.1 Purge the well at least three screened casing volumes (150 liters or 40 gallons) at a flow rate greater than or equal to the expected sample rate.

4.2.7.2 During the purging process, measure the following field parameters approximately every 20 liters.

- pH.
- Specific conductance.
- Temperature.

4.2.7.3 Consider the purging process complete when both of the following conditions are satisfied.

- Three screened casing volumes are removed.
- The field parameters remain relatively constant during pumping (±10 percent over last three measurements (U.S. Environmental Protection Agency [EPA], 1995) **or** pH readings within ±0.1, specific conductance ±50 µmhos/cm, and temperature ±0.5 C [the latter is per DOE ERD-05-304]).

NOTE: Purged water shall be stored until analytical results are available, at which time proper arrangements for disposal should be made.

4.3 GROUNDWATER SAMPLE AND COLLECTION

NOTE: Groundwater samples should be collected according to the volatility of the target analytes (e.g. volatile organic compounds [VOCs], total organic carbon [TOC], semi-volatile organic compounds, metals, water quality cations and anions, and radionuclides).

4.3.1 **Samplers** shall:

4.3.1.1 Record the following information in the Groundwater Sampling Logbook.

- Names of personnel collecting samples
- Type of sampling (detection/assessment)
- Date and time of sampling
- Well identification
- Well depth

- Static water level
- Field parameters
- Total volume purged
- Purge pumping rate
- Well yield (high/low)
- Sample flow rate
- Field observations (sample conditions: sediment, odors, immiscible layers)
- Weather conditions (air temperature, wind, dust, etc.)

4.3.1.2 Measure and record the temperature of all ice chests to be used for sample storage and transport.

4.4 COLLECTION OF LABILE ORGANIC PARAMETERS

4.4.1 **Samplers** shall:

4.4.1.1 Collect samples for the parameters listed in Appendix B (TOX and TOC).

4.4.1.2 Select the appropriate container as specified in Appendix B.

4.4.1.3 Collect the number of samples listed in Appendix B.

4.4.1.4 Partially fill and rinse the container with the sample.

4.4.1.5 Place the rinsate in the waste storage container.

4.4.1.6 Fill the container 95 percent full slowly to minimize turbulence.

4.4.1.7 Add the appropriate preservative from Appendix B, remove a small sample, and check the pH. Fill the container slowly with a minimum of turbulence until the meniscus touches the lip of the bottle and cap. Do not allow any plastic material such as gloves to contact the sample during collection.

4.4.1.8 Fill out and attach the premade sample label.

4.4.1.9 Cap the bottle and gently invert. If any air bubbles are observed rising to the top of the container, repeat the collection procedure.

4.4.1.10 Record in the Groundwater Sampling Logbook the sequence in which the samples were collected, the sample identification, the sample container volume and type, and the preservative added.

4.4.1.11 Attach the custody seal to the bottle and fill out the Chain-of-Custody form.

4.4.1.12 Place each sample in a plastic bag (to protect the labels from water), then place the bag in an ice chest and cover with ice immediately after collection to avoid unnecessary heating of the sample.

4.5 COLLECTION OF TOTAL METAL AND ANION SAMPLES

4.5.1 **Samplers** shall:

4.5.1.1 Collect samples for the parameters listed in Appendix B.

4.5.1.2 Select the appropriate container as listed in Appendix B.

4.5.1.3 Partially fill and rinse the container with sample. Place the rinsate in the waste storage drum.

4.5.1.4 Fill the container slowly with a minimum of turbulence until the meniscus touches the lip of the bottle.

4.5.1.5 Add the appropriate preservative listed in Appendix B to the sample container.

4.5.1.6 If a pH value is specified in Appendix B, remove a small sample and check the pH with pH paper.

4.5.1.7 Cap the bottle.

4.5.1.8 Fill out and attach the premade sample label.

4.5.1.9 Attach a custody seal to the bottle and fill out the Chain-of-Custody form.

4.5.1.10 Care should be taken (especially on warm days) to place the sample(s) in a plastic bag (to protect the label from water), then place the bag in the ice chest and cover with ice as soon as reasonable to avoid unnecessary heating of the sample.

4.5.1.11 Record in the Groundwater Sampling Logbook the sequence whereby the samples were collected, the sample identification, the sample container volume and type, and the preservative added.

4.6 COLLECTION OF DISSOLVED METAL SAMPLES

4.6.1 **Samplers** shall:

4.6.1.1 If necessary, attach a 0.45 µm Teflon® in-line filter to the pump outlet (this determination will be made by the Monitoring Activity Manager).

4.6.1.2 Filter approximately 100 ml of the sample and discard.

4.6.1.3 Select the appropriate container as listed in Appendix B.

4.6.1.4 Fill out and attach the premade sample label. Partially fill and rinse the container with the sample. Place the rinse in the waste storage drum.

4.6.1.5 Fill the container slowly with a minimum of turbulence until the meniscus touches the lip of the bottle.

4.6.1.6 Add the appropriate preservative listed in Appendix B to the sample container.

4.6.1.7 If a pH value is specified in Appendix B, remove a small sample and check the pH with pH paper.

4.6.1.8 Cap the bottle.

4.6.1.9 Attach a custody seal to the bottle and fill out the Chain-of-Custody form.

4.6.1.10 Care should be taken (especially on warm days) to place the sample(s) in a plastic bag (to protect the label from water), then place the bag in the ice chest and cover with ice as soon as reasonable to avoid unnecessary heating of the sample.

4.6.1.11 Record in the Groundwater Sampling Logbook the sequence whereby the samples were collected, the sample identification, the sample container volume and type, and the preservative added.

4.7 COLLECTION OF TRITIUM SAMPLES

4.7.1 **Samplers** shall:

4.7.1.1 Remove any luminous materials, such as watch dials, from the immediate area.

4.7.1.2 Rinse the sample bottle with the sample and return the rinse to the waste storage tank.

4.7.1.3 Fill the container slowly (to minimize turbulence) until full and then cap it.

4.7.1.4 Fill out and attach the premade sample label to bottle.

4.7.1.5 Attach a custody seal to the bottle and fill out the Chain-of-Custody form.

4.7.1.6 Care should be taken (especially on warm days) to place the sample(s) in a plastic bag (to protect the label from water), then place the bag in the ice chest and cover with ice as soon as reasonable to avoid unnecessary heating of the sample.

4.7.1.7 Record in the Groundwater Sampling Logbook the sequence whereby the samples were collected, sample identification, sample container volume and type, and preservative added.

4.8 COLLECTION OF COLIFORM BACTERIA SAMPLES

4.8.1 Coliform samples shall be collected by the Bechtel Nevada (BN) Environmental Health Section.

4.9 COMPLETION OF THE GROUNDWATER SAMPLING

4.9.1 **Samplers** shall:

4.9.1.1 Remeasure the field parameters to ensure that the groundwater chemistry has remained constant during sampling.

4.9.1.2 Place the Bennett™ pump in its dedicated purge jar. Add 11 gallons of distilled water.

4.9.1.3 Pump water through the pump until approximately 6 inches of water remains and the water is coming out of the pump

4.9.1.4 Remove the sample input screen from the pump and connect a source of nitrogen to the inlet.

4.9.1.5 Purge the pump of water by passing nitrogen at 20 to 40 psi through the pump.

4.9.1.6 Replace the input screen.

4.9.1.7 Remove the pump and dry using Kimwipes™.

4.9.1.8 Check connectors and fittings on the pump head.

4.9.1.9 Dismantle and store the equipment and probes per the manufacturer’s instructions.

4.9.1.10 Cap and lock the wellhead.

4.10 FIELD QUALITY CONTROL

4.10.1 **Samplers** shall:

4.10.1.1 Prepare field blanks and field duplicates for each parameter (parameters which are analyzed by the same method do not require individual blanks and duplicates), excluding field parameters, at a frequency that is the greater of once per each week whereby sampling occurs or once for every 20 samples. A trip blank shall be prepared for volatile organics (if volatile organics are a target analyte) and tritium for each sampling trip.

NOTE: In the event that nondedicated sampling pumps are used to withdraw samples, a set of equipment blanks will be prepared before placement of the pump in the wells.

4.10.1.2 Prepare field blanks by filling a sample container with laboratory pure water in the field. The blank shall use the same container and preservative as the sample.

4.10.1.3 Prepare equipment blanks by passing distilled water (~10 gallons) through the pump apparatus. The blank shall use the same container and preservative as the target sample.

4.10.1.4 Prepare a field duplicate by collecting two groundwater samples in sequence. The field duplicate is used to assess sampling and analysis precision.

4.10.1.5 Prepare a trip blank for volatile organics (if volatile organics are a target analyte) and tritium by filling the appropriate container with laboratory pure water at the laboratory.

4.10.1.6 Preserve the trip blank by the same method as the samples. The trip blank shall be carried into the field during the sample collection operations.

4.11 TRANSPORT OF SAMPLES

4.11.1 **Samplers** shall:

4.11.1.1 At the conclusion of each sampling day, measure and record in the Groundwater Sampling Logbook the temperature in each cooler.

4.11.1.2 Whenever control of the samples is passed from one individual to another, enter the transfer on the Chain-of-Custody form. Samples shall be considered to be under a custodian’s control if they are in the custodian’s possession or are in a locked, secure enclosure.

NOTE: A radiological survey of the samples is required before laboratory analysis may be conducted.

4.11.1.3 Ensure that samples to be sent to the ASL are transported to the laboratory receiving area. The person receiving the samples shall sign the Chain-of-Custody form.

4.12 GROUNDWATER DATA QUALITY REVIEW

4.12.1 The **Monitoring Activity Manager** shall ensure that data is reviewed in the following manner:

NOTE: The following instructions pertain to the manual review of analytical data. An automated system (BN Integrated Data Management System [BEIDMS]) is being developed and will perform the specified review automatically when completed.

4.12.1.1 Enter on the Data Quality Summary (Appendix D) or the electronic version, the project, monitoring well identification, sampling date, reviewer’s signature, analytical parameters, and field identification numbers.

4.12.1.2 Verify that the analytical method has been reported. Verify that the method used was the method requested. Mark the "Complete" and "Acceptable" column of the "Method" row with Yes (Y) or No (N), as appropriate.

4.12.1.3 Verify that the analysis date has been reported and the extraction date has been reported for organic parameters. Mark the "Complete" column of the "Method" row with Yes (Y) or No (N), as appropriate.

4.12.1.4 Calculate the analysis holding time for the sample group. If semivolatile organics are a target analyte, calculate the extraction holding time (method 8270 semivolatile organics). Record the holding times on the Data Quality Summary. Mark the "Acceptable" column Yes (Y) or No (N), as appropriate.

4.12.1.5 Verify that the concentration and units have been reported for each sample in the packet. Mark the "Complete" column of the "Sample Concentration" and "Concentration Units" row with Yes (Y) or No (N), as appropriate.

4.12.1.6 Verify that the uncertainty and number of standard deviations have been reported for radiological parameters for each sample in the packet. Mark the "Complete" column of the "Concentration Uncertainty" row with Yes (Y) or No (N), as appropriate.

4.12.1.7 Verify that the detection limit has been reported for each sample in the packet. Mark the "Complete" column of the "Detection Limit" row with Yes (Y) or No (N), as appropriate.

4.12.1.8 Compare the reported detection limit with the data quality objectives. Mark the "Acceptable" column with Yes (Y) or No (N), as appropriate.

4.12.1.9 Verify that the laboratory has analyzed and reported blank values and spike results for inorganic and radiological parameters. Verify that the laboratory has analyzed and reported blank and surrogate spike results for organic parameters. Mark the "Complete" column of the "Laboratory QC" row with yes (Y) or No (N), as appropriate.

4.12.1.10 Compare the matrix spike percent recovery with the data quality objectives. Mark the "Acceptable" column of the "Laboratory QA" row with Yes (Y) or No (N), as appropriate.

4.12.1.11 Verify that the Chain-of-Custody form is present. Mark the “Complete” column of the “Chain of Custody” row with Yes (Y) or No (N), as appropriate.

4.12.1.12 Verify that laboratory management has reviewed and signed the data package. Mark the “Complete” column of the “Laboratory Approval” row with Yes (Y) or No (N), as appropriate.

4.12.1.13 Calculate the relative percent difference of the field duplicates or co-located samples for any analyte detected in both samples. If the analyte is not detected in both samples, fill the blank with N/A. Otherwise, record the relative percent difference in the blank. Mark the “Acceptable” column of the “Relative Percent Difference” row with Yes (Y) or No (N), as appropriate.

4.12.1.14 Review the field blank and the trip blank for volatile organics (if volatile organics are a target analyte).

4.12.1.15 If all blanks in the complete and acceptable column are marked (Y) or N/A, the package is considered acceptable. If any blank has been marked (N), the package may still be accepted. For these cases, describe the justification for accepting the package under data qualification. Attach additional pages if necessary. Mark the “Acceptable” column on the “Date Package” row, as appropriate.

5.0 TRAINING

5.1 All personnel shall be trained on the safety and operations of the equipment required for the proper implementation of this procedure as described below.

5.2 Personnel involved in this activity shall read and understand this procedure and demonstrate proper implementation of this procedure.

5.3 All sampling personnel shall have the following training:

- Occupational Safety and Health Administration 40-hour Hazardous Waste Site General Worker
- Radiation Worker Training

5.4 Attend the periodic facility safety training program. See Appendix C for the Groundwater Sampling Qualification and Training History documentation.

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6.0 FORMS

NOTE: The implementation of the BEIDMS system may change the number of forms required.

6.1 Analytical Services Laboratory Statement of Work.

6.2 Chain-of-Custody.

7.0 RECORDS MANAGEMENT

7.1 This procedure generates the following records:

Record	Disposition Authority	Disposition Instructions	Office of Record
Analytical Services Laboratory Statement of Work	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Chain-of-Custody	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Data Quality Summary	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Groundwater Sampling Qualification and Training History	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Groundwater Sampling Logbook	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Groundwater Sampling Instruction Procedure	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07
Laboratory deliverables	Draft ENV 5.g.(2)	Keep records throughout life of facility and post-closure care period	RWMS Bldg 5-07

8.0 REFERENCES

8.1 Title 40 CFR Part 265, U.S. Environmental Protection Agency, “Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities.”

8.2 U.S. Environmental Protection Agency, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846.

8.3 U.S. Environmental Protection Agency, "Methods for Chemical Analysis of Water and Wastes," EPA-600/4-82-055, 1982.

8.4 U.S. EPA, RCRA Ground Water Monitoring: Draft Technical Guidance, 1994.

8.5 Nevada Administrative Code, Public Water Supplies, State of Nevada, Chapter 445, December 30, 1980.

8.6 DOE Order 5820.2A, "Radioactive Waste Management," 1988.

8.7 *Radiological Control Manual*, DOE N 5480.6, 1999, Revision 3.

8.8 DOE, 1995. Revision 0, "Groundwater Monitoring Well Purging and Sampling," ERD-05-304. Las Vegas, Nevada.

8.9 Bechtel Nevada, Revised Area 5 Radioactive Waste Management Site Outline of a Comprehensive Groundwater Monitoring Program, February 1998.

8.10 Bechtel Nevada Company Policy A-A11.01, "Safety and Health Policy."

8.11 Bechtel Nevada Company Safety Procedure M-A11.001, "General Safety Rules."

8.12 Bechtel Nevada Company Safety Procedure M-A11.003, "Safety Meetings."

8.13 Bechtel Nevada Company Safety Procedure M-A11.006, "Employee/Supervisor Safety Inspections."

8.14 Bechtel Nevada Company Safety Procedure M-A11.014, "Selecting, Using, and Storing Chemicals."

8.15 Bechtel Nevada Company Safety Procedure M-A11.015, "Hazard Communication."

8.16 Bechtel Nevada Company Safety Procedure M-A11.050, "Housekeeping/Fire Protection."

8.17 Bechtel Nevada Company Safety Procedure M-A11.060, "Personal Protective Equipment."

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING**

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9.0 DEFINITIONS

9.1 **Accuracy**. A measure of the deviation of a measured value from the true value.

9.2 **Completeness**. The percentage of required data that is obtained that meets the data quality objectives.

9.3 **Data Quality Objective**. Data quality requirements used to assure that environmental data is usable for its intended purpose.

9.4 **Equipment Blank**. A field quality control sample prepared by rinsing sampling equipment with laboratory pure water. The equipment blank is used to assess contamination by sampling equipment.

9.5 **Field Blank**. A field quality control sample prepared from laboratory pure water in the field. The field blank is used to assess contamination from sample containers and contamination present in the sampling environment.

9.6 **Field Duplicate**. A field quality control sample prepared by collecting two groundwater samples in sequence. The field duplicate is used to assess sampling and analysis precision.

9.7 **Percent Recovery**. The percentage of an analyte added to a sample that is recovered in analysis. Computationally, the measured concentration of a spiked sample divided by the sum of the concentration of the analyte added and the concentration of the sample, expressed as a percentage.

9.8 **Precision**. A measure of the dispersion of replicate measurements about the mean value.

9.9 **Relative Percent Difference**. An estimate of the precision of replicate samples. Computationally, the difference between two measure values divided by the mean, expressed as a percentage.

9.10 **Representativeness**. The extent to which the concentration of an analyte in a sample represents the concentration of the analyte in the environment.

9.11 **Sensitivity**. A measure of the ability of an analysis system to detect the presence of an analyte.

9.12 **Trip Blank**. A quality control sample prepared from laboratory pure water in the laboratory and transported to and from the sampling site with the samples. The trip blank is used to assess contamination of samples by volatile parameters during transport.

10.0 APPENDICES

10.1 Appendix A: Groundwater Sampling Flow Diagram.

10.2 Appendix B: Sample Containers and Preservation.

10.3 Appendix C: Groundwater Sampling Qualification and Training History.

10.4 Appendix D: Sample Data Quality Summary.

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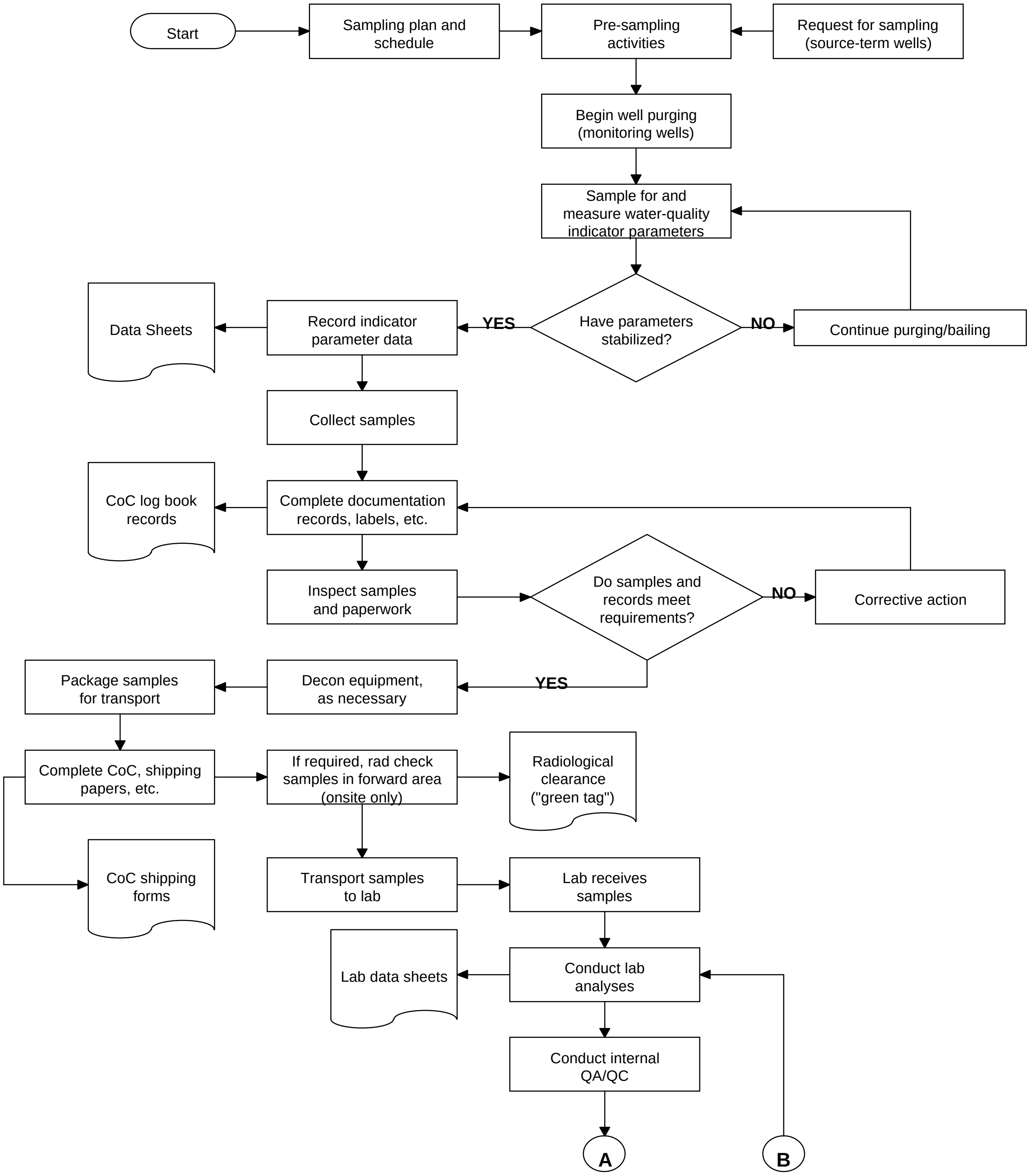
APPENDIX A - Groundwater Sampling Flow Diagram



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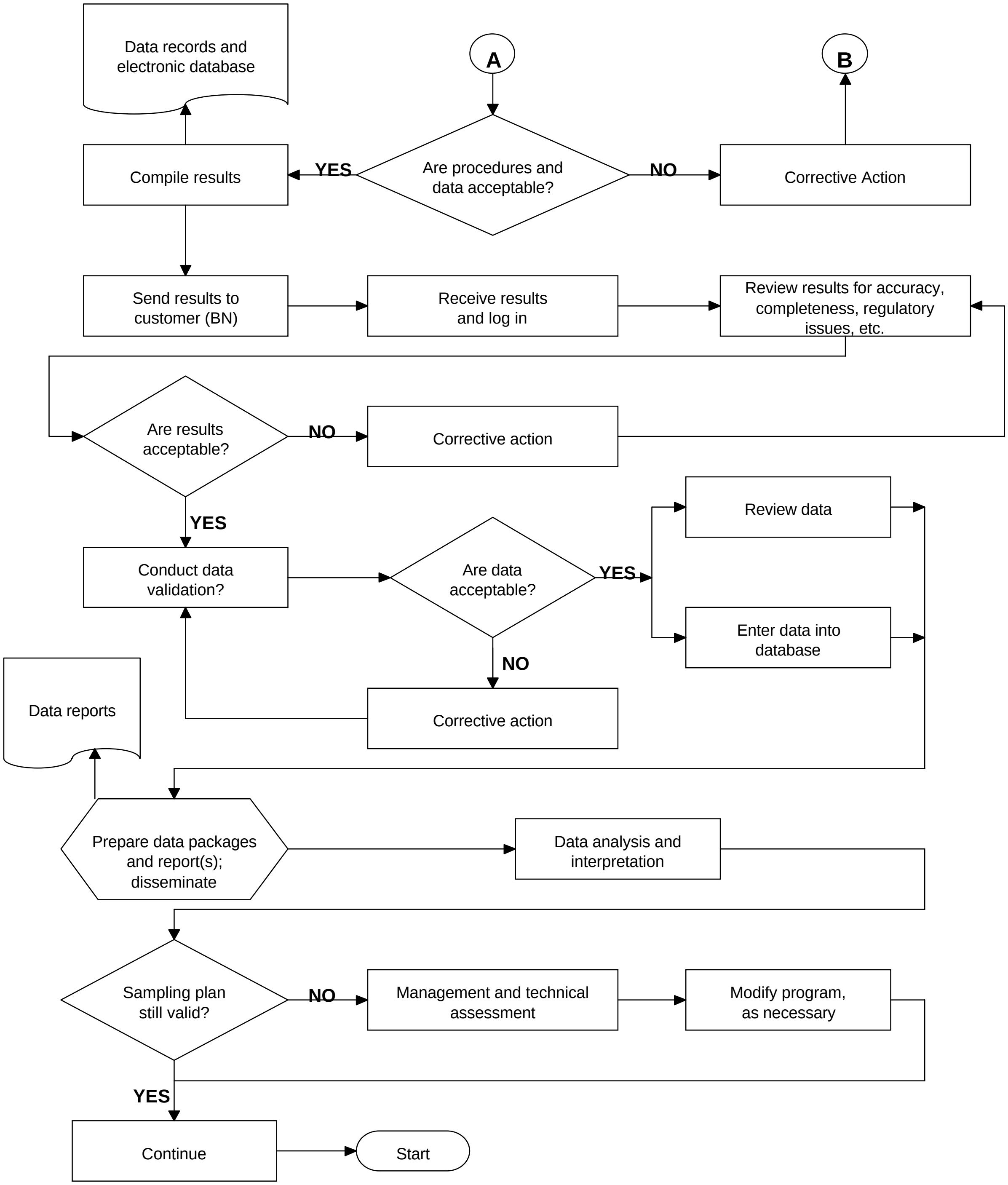
APPENDIX A (Continued)



APPENDIX B

Sample Containers and Preservation

Parameter (Method)	# per Sample	Volume	Container	Preservation	Holding Time
TOX (9020B)	1	500 ml	Amber glass bottle with Teflon™-lined cap	Acidify pH < 2 with concentrated H_2SO_4; cool to 4°C. No headspace.	7 days for extraction 40 days for analysis
TOC (415.2)	1	250 ml	Amber glass bottle with Teflon™-lined cap	Acidify to pH < 2 with concentrated HCl; cool to 4°C. No headspace.	28 days
Cl, SO_4, F (300)	1	250 ml	Polyethylene bottle	None required per method.	28 days
HCO_3 and H_2CO_3 (2320B)	1	250 ml	Polyethylene bottle	None required per method.	14 days
Na, Ca, Mg, Mn, K, Fe, SiO_2 (200.7)	1	500 ml	Polyethylene bottle	Acidify to pH < 2 with HNO_3.	180 days
Enriched Tritium (L-E10.615.PL)	1	1 liter	Glass bottle	None	6 months

ORGANIZATION PROCEDURE

Title: **INSTRUCTIONS FOR AREA 5 RWMS GROUNDWATER WELL PREPARATION AND GROUNDWATER SAMPLING**

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APPENDIX C

Groundwater Sampling Qualification and Training History

Name:	Activity Manager:
QUALIFICATIONS	
Education:	
Brief Description of Experience	

ASSIGNMENT	Required (Y/N)	1) Initials and Date	2) Initials and Date	3) Initials and Date
Read instruction	Y			
Demonstrate proper implementation of instruction	Y			
Familiar with Facility Safety & Area 5 Contingency Plan	Y			
OSHA 40-hr/Hazardous Waste Site General Worker	Y			
Radiation Worker Training	Y			
Attend Program Safety Training Meetings	Y			
Proper handling of acid	Y			
Familiar with MSDS’s	Y			

ORGANIZATION PROCEDURE

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APPENDIX D - Sample Data Quality Summary

WELL IDENTIFICATION **Ue5PW-1**
SAMPLE COLLECTION DATE: **DD MM YY**

SAMPLE IDENTIFICATION NUMBER	ID		ID		ID	
Fraction	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D	X=A X=B X=C X=D
Parameter	Parameter	Parameter	Parameter	Parameter	Parameter	Parameter
Method	Method	Method	Method	Method	Method	Method
Extraction/Prep Holding Time	NA	NA	NA	NA	NA	NA
Analysis Holding Time	YES	YES	YES	YES	YES	YES
Sample Concentration	YES	YES	YES	YES	YES	YES
Concentration Units	YES	YES	YES	YES	YES	YES
Concentration Uncertainty (Rad)	NA	NA	NA	NA	NA	NA
Number of Standard Deviations (Rad)	NA	NA	NA	NA	NA	NA
Detection Limit	YES	YES	YES	YES	YES	YES
Laboratory QC	YES	YES	YES	YES	YES	YES
Laboratory QA	YES	YES	YES	YES	YES	YES
Chain of Custody	YES	YES	YES	YES	YES	YES
Laboratory Approval	YES	YES	YES	YES	YES	YES
Relative Percent Difference	YES	YES	YES	YES	YES	YES
Field Blank/Trip Blank	NA	NA	NA	NA	YES	YES
Data Package	YES	YES	YES	YES	YES	YES
Data Qualifications	YES	YES	YES	YES	YES	YES
REVIEWER:						
REVIEWER'S INITIALS AND DATE:						

COMMENTS: YES - Complete and acceptable; NO - Incomplete and/or unacceptable; NA - Nonapplicable