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SUPPORTING DOCUMENT

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7. Abstract

This report presents the findings of the groundwater quality assessment program for the 216-A-29 Ditch. The information presented in this report is the result of a study to determine if effluents discharged to the 216-A-29 Ditch have affected the quality of the groundwater in the unconfined aquifer beneath the facility. The results indicate that the 216-A-29 Ditch is the source of elevated specific conductance in well 299-E25-35 and that the source is nonhazardous.

This report describes the current monitoring status of the 216-A-29 Ditch, groundwater chemical data interpretation, and recommends the reinstatement of an indicator-evaluation monitoring program in accordance with 40 CFR 265.93(d)(6).

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Revision 0

Results of Groundwater Quality Assessment Program at the 216-A-29 Ditch RCRA Facility

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Westinghouse
Hanford Company Richland, Washington

Management and Operations Contractor for the
U.S. Department of Energy under Contract DE-AC06-87RL10930

Approved for public release

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1.0 INTRODUCTION

The 216-A-29 Ditch (A-29) is located east of the 200 East Area in the central portion of the Hanford Site (Figure 1) and is regulated under the *Resource Conservation and Recovery Act of 1976* (RCRA). Groundwater at this inactive site is currently monitored under an interim-status groundwater quality assessment program as described in Chou et al. (1990). This assessment program was initiated in June 1990 after groundwater samples from downgradient well 299-E25-35 exceeded the critical mean established for specific conductance for the A-29 groundwater monitoring network. The assessment program was implemented to determine if effluents discharged to the A-29 Ditch have affected the quality of the groundwater in the unconfined aquifer beneath the facility. This report presents the findings of the assessment program. It discusses the detected constituent concentration, the rate and extent of constituent migration in the aquifer, and conditions supporting the recommendation to reinstate an indicator-evaluation program.

1.1 FACILITY DESCRIPTION

A-29 was an excavated unlined ditch located east of the PUREX Plant in the southeast corner of the 200 East Area. The ditch was approximately 1.8 m (6 ft) wide at the bottom of the ditch and 1,097 m (3,600 ft) long. The depth of the ditch varied from 0.6 to 0.9 m (2 to 3 ft) at the south end to approximately 4.6 m (15 ft) at the north end. The discharge to the ditch was a pipeline outfall located approximately 270 m (900 ft) inside of the east perimeter fence line of the 200 East Area. The ditch passed beneath the perimeter fence and extended northeast to join the 216-B-3 Ditch system (Figure 2). The 216-B-3 Ditch series (216-B-3-1, 216-B-3-2, and 216-B-3-3) discharged into the 216-B-3 Pond. The head of A-29 was at approximately 61 m (200 ft) mean sea level (MSL) and the outlet, where effluent entered the 216-B-3 Ditches, was at approximately 53.3 m (175 ft) MSL (Smith 1992). The 7.6 m (25 ft) elevation difference provided the hydraulic potential for moving the effluent through A-29 and into the B-3 Ditches to the 216-B-3 Pond.

The ditch was first used in 1955 when the PUREX Plant started. All discharges to the ditch originated in the PUREX Plant and were carried to the ditch via the Chemical Sewer Line (CSL). Flow from the PUREX Plant CSL was continuous and varied from 950 to 2,000 L/min (250 to 1,100 gal/min) depending on the PUREX Plant operating status. Chemical and radiological analytical data for the ditch effluent are listed in detail in the *PUREX Plant Chemical Sewer Stream-Specific Report* (WHC 1990).

On July 15, 1991, discharges to A-29 were discontinued and the effluent from the PUREX Plant CSL was rerouted to the PUREX Plant Cooling Water Line. The ditch was subsequently backfilled and the site was contoured and revegetated as an interim stabilization measure. This action marked the completion of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) Milestone M-17-10 (Ecology et al. 1994).

Figure 1. 216-A-29 Ditch Regional Location.

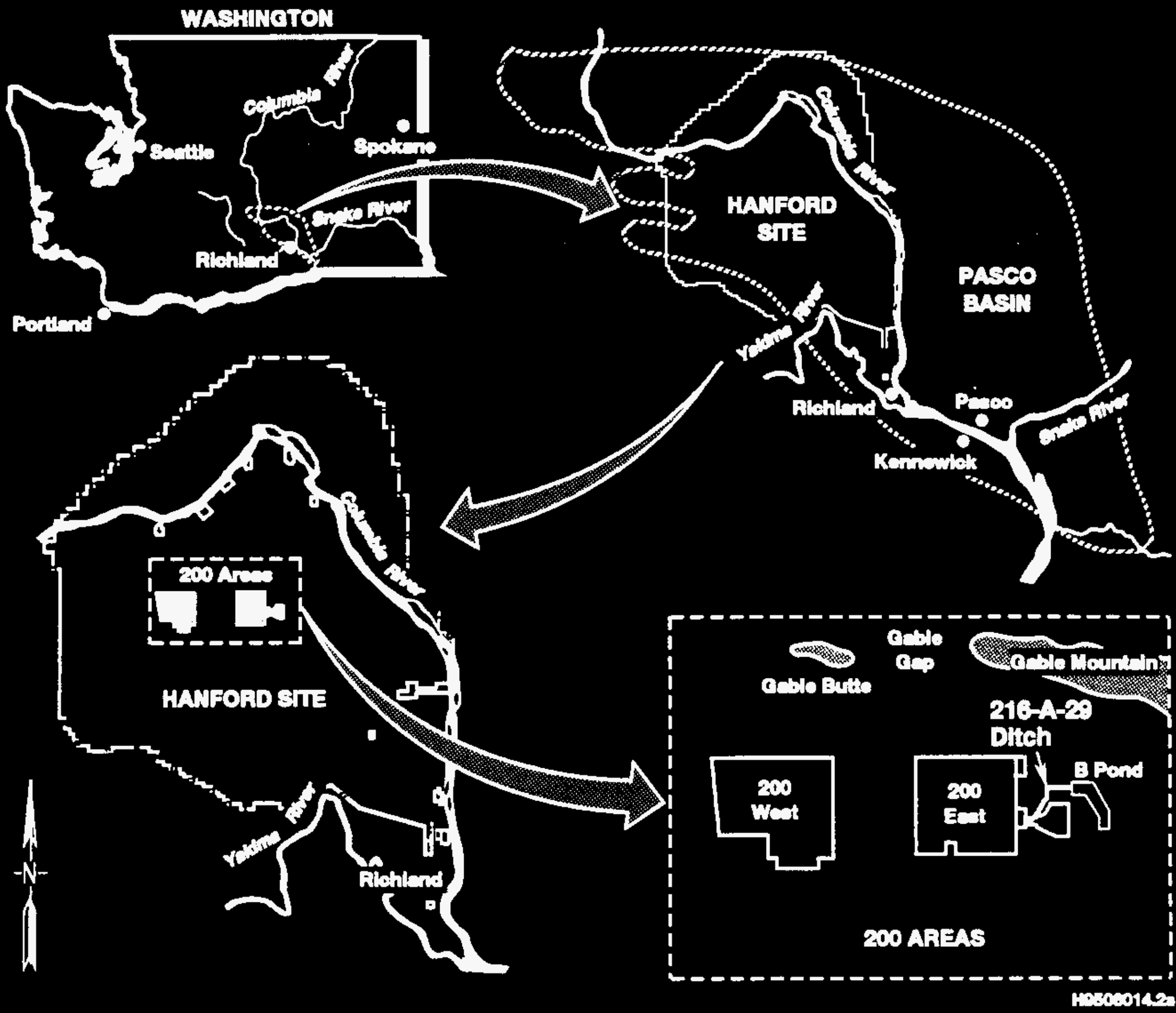
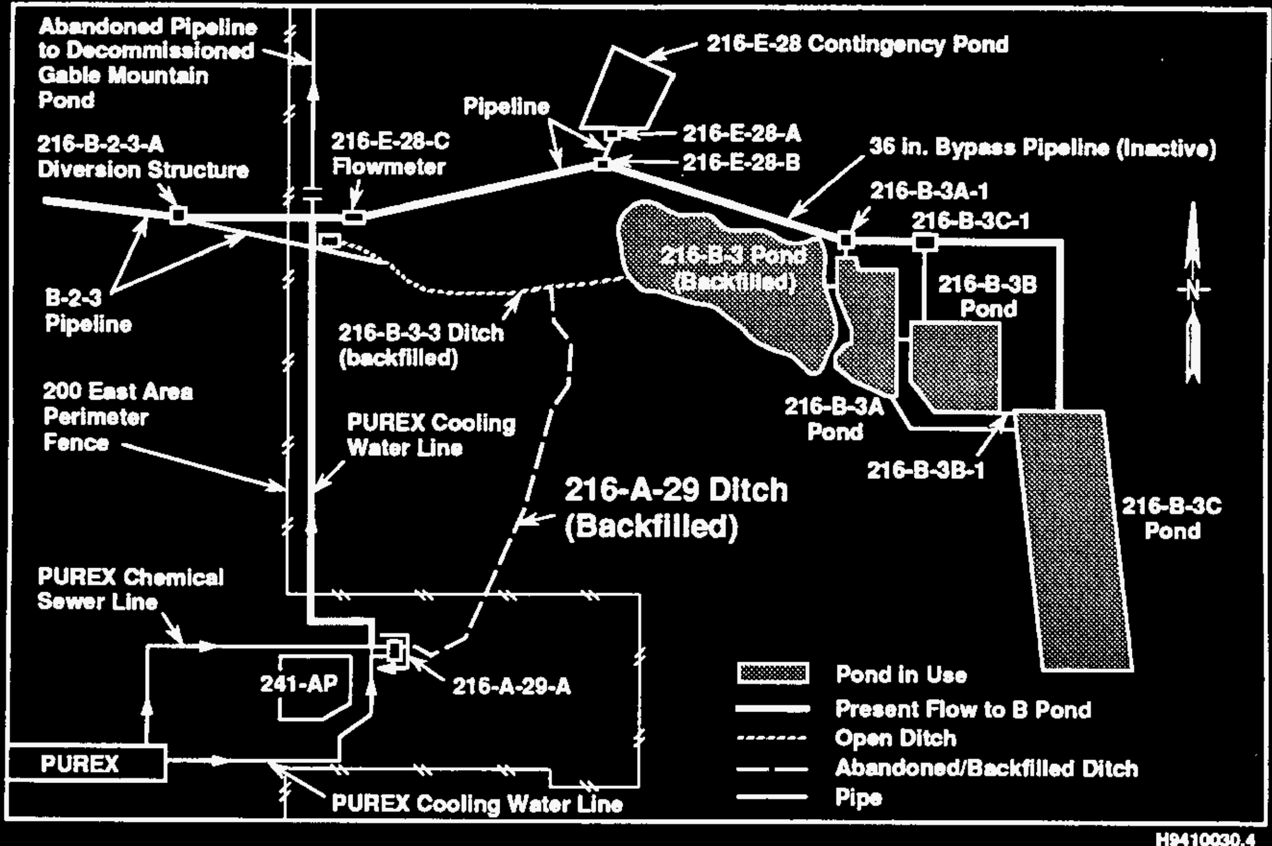


Figure 2. Location of 216-A-29 Ditch.



A-29 is located adjacent to several liquid waste disposal sites in the 200 East Area that introduced large volumes of radioactive and hazardous waste to the soil at various times during the operational history of the PUREX Plant (Figure 3). A general synopsis of the pertinent surrounding facilities is given in the following paragraphs. Complete details of all the PUREX facilities are provided in the *PUREX Source Aggregate Area Management Study Report* (DOE 1993c).

The 216-B-3 Pond (B Pond) system is located northeast and east of A-29. It was the largest liquid effluent disposal site operating in the 200 Areas. The main pond was backfilled and interim stabilized in 1994. The 3C Expansion Pond is still receiving wastewater. The B Pond system dramatically altered the water table in the region around the 200 East Area but the groundwater mound has been gradually decaying since 1994.

Cribs 216-A-24 and 216-A-8 are located west of A-29. They received a combined volume of approximately 1.97×10^9 L (5.2×10^8 gal) of effluent during their operating life from the 241-AX and 241-A single-shell tank (SST) farms. Both facilities were closed by 1991. The 241-AX and 241-A SST farms are directly west of A-29. The groundwater flow from A-29 to these cribs and the tank farms is downgradient.

Cribs 216-A-37-1, 216-A-37-2, and 216-A-30 are located directly south of A-29. These cribs received PUREX Plant steam condensate and 202-A Evaporator condensate. They were closed by 1992. These cribs received a combined volume of approximately 8.58×10^9 L (2.27×10^9 gal) of effluent during their operating life. Groundwater under cribs 216-A-30 and 216-A-37-2 is hydraulically downgradient from A-29 while groundwater under crib 216-A-37-1 has nearly the same head as under the southern portion of A-29. Groundwater under this crib may have influenced A-29.

The Grout Treatment Facility is located east of the southern portion of A-29. Groundwater beneath this facility and A-29 is at approximately the same elevation. The Grout Treatment Facility was never operational.

1.2 HYDROGEOLOGY

The hydrogeology of the 200 East Area is completely described in the *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1993* (DOE 1993a). Sediments of the Hanford Formation and Ringold Formation underlie A-29 (Figure 4). The majority of the vadose zone and the uppermost unconfined aquifer beneath the northernmost portion of A-29 are located within the Hanford Formation. This formation is a glaciofluvial deposit that is generally subdivided into three informal units: an upper, coarse grained unit; a middle, sand unit; and a lower, coarse grained unit. In the central and southern parts of A-29, the top of the unconfined aquifer is in the Ringold Formation. The Ringold Formation is a semi-consolidated sand and gravel that directly overlies the Elephant Mountain Member of the Saddle Mountain Basalt. The Elephant Mountain Basalt dips gently to the south beneath A-29.

Figure 3. Location of 216-A-29 Ditch and Monitoring Well Locations.

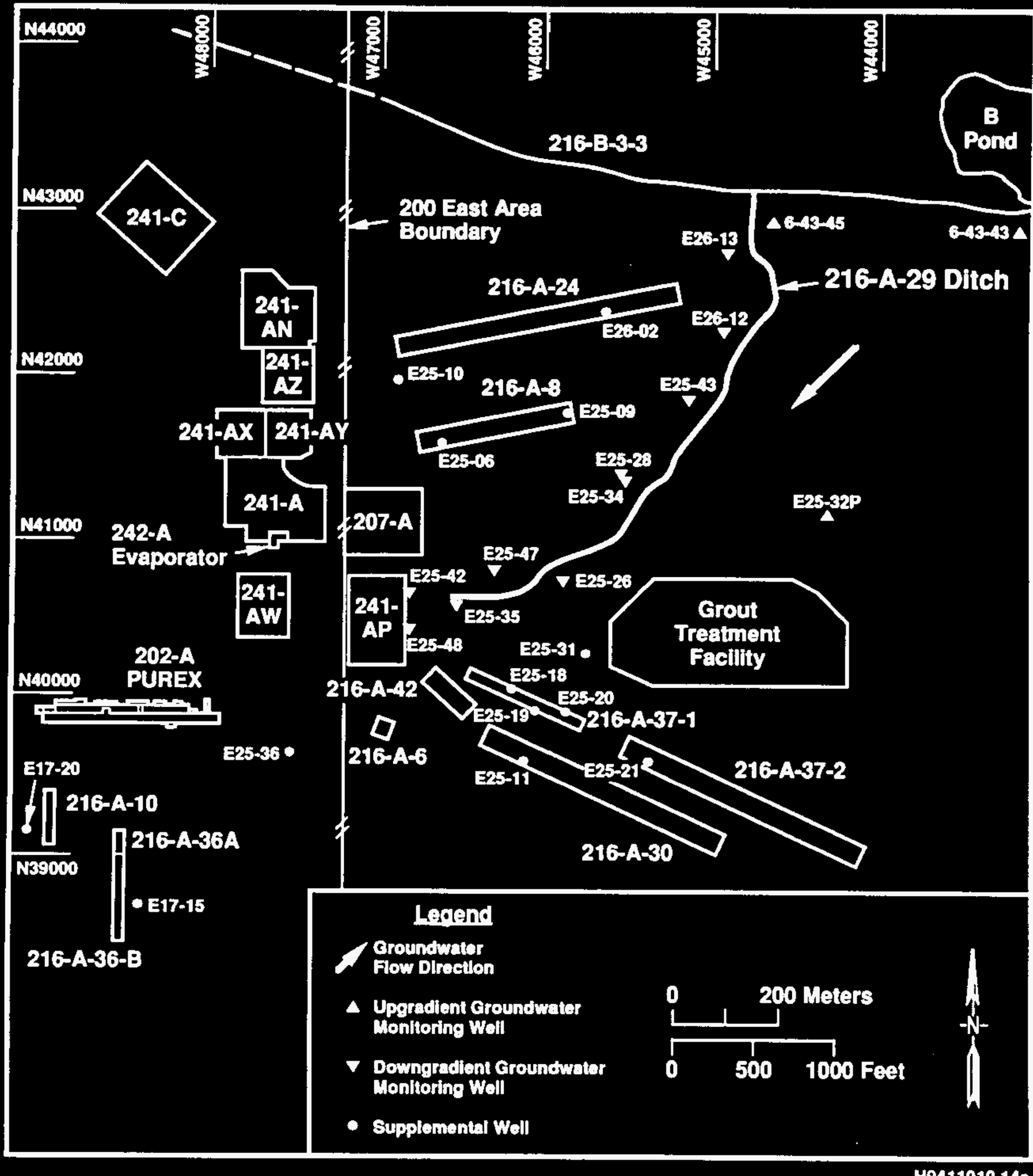
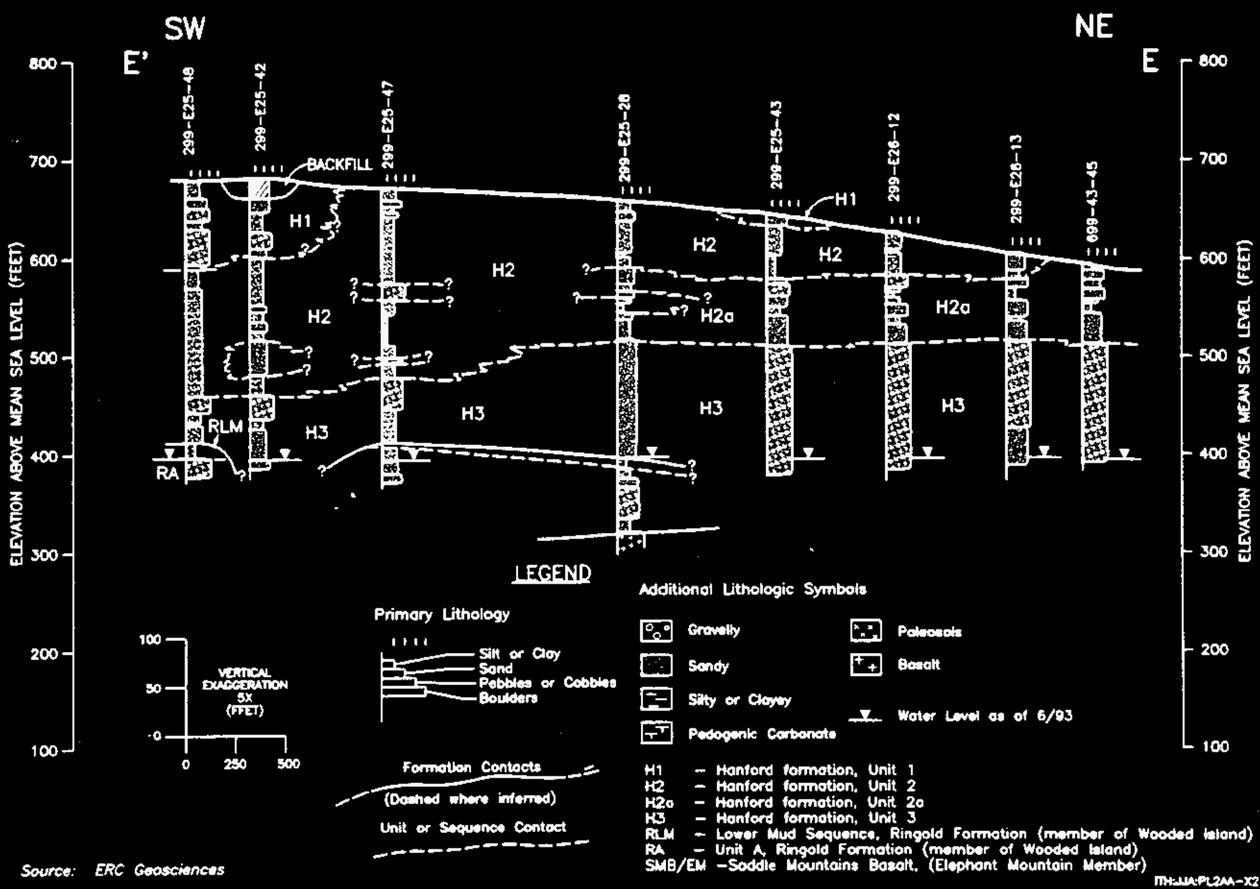


Figure 4. Cross Section Parallel to the 216-A-29 Ditch (DOE 1993b).



Recharge to the uppermost aquifer occurs principally from artificial sources, including Hanford Site wastewater disposal to surface ponds, ditches, and various cribs within the 200 East and 200 West Areas. Two of the largest recharge mounds have developed beneath the 200 Areas at B Pond and U Pond. The mound under B Pond rose more than 9 m (30 ft) compared to pre-Hanford conditions. Since 1990 the B Pond mound has been gradually declining due to termination of the PUREX Plant and related operations. The water table under U Pond had risen in excess of 26 m (85 ft) since the start of disposal operations. U Pond was decommissioned in 1985.

The local groundwater flow direction near the A-29 Ditch ranges from a westward flow at the north end of the ditch to a west-southwestward flow at the south end of the ditch (Figure 5). The groundwater flow direction is directly influenced by B Pond disposal practices. The estimated groundwater hydraulic conductivity for the uppermost aquifer beneath A-29 is 18 m/day (60 ft/day). Groundwater flow velocities beneath the A-29 Ditch in June 1994 ranged from 0.02 m/day (0.07 ft/day) in the southern portion to 0.15 m/day (0.48 ft/day) in the northern portion (Freeman 1994a). These values were estimated based on aquifer properties and hydraulic gradient.

1.3 A-29 GROUNDWATER MONITORING PROGRAM

The RCRA interim-status groundwater monitoring program for A-29 began in 1988. Three RCRA-compliant groundwater monitoring wells (299-25-32P, 299-E25-34, and 299-E25-35) were constructed and two additional older groundwater monitoring wells (299-E25-26 and 299-E25-28) were used for the monitoring network (see Figure 3) (Kasza and Goodwin 1992).

Upon completion of the first four quarters of sampling, it was determined that the specific conductance in down gradient well 299-E25-35 was above the critical means established for the A-29 groundwater monitoring network. Resampling of well 299-E25-35 confirmed the exceedence. This triggered the initiation of a groundwater quality assessment monitoring program (Chou et al. 1990). Quarterly sampling of the A-29 monitoring network and several nearby wells began as part of the groundwater quality assessment monitoring investigation, as well as monthly measurement of the water table beneath the facility.

In 1991, four additional groundwater monitoring wells (299-E25-42, 299-E25-41, 299-E26-12, and 299-E26-13) were constructed in areas downgradient of the A-29 Ditch to increase the monitored area. Adding these wells to the monitoring network raised the theoretical monitoring efficiency above 90%, as calculated by the Monitoring Efficiency Model (MEMO) (Kasza and Goodwin 1992). Two nearby monitoring wells (699-43-43 and 699-43-45) in the 216-B-3 Pond monitoring network were also added to the A-29 network as upgradient monitoring wells when the decline of the 216-B-3 Pond groundwater mound caused changes in the groundwater flow direction.

Two monitoring wells (299-E25-47 and 299-E25-48) were constructed in 1992 near well 299-E25-35 to help define the source of the high specific conductance at that well. A complete list of groundwater monitoring wells for A-29 is shown in Table 1. With the exception of wells used for supplemental

Figure 5. Water Table Contour Map.

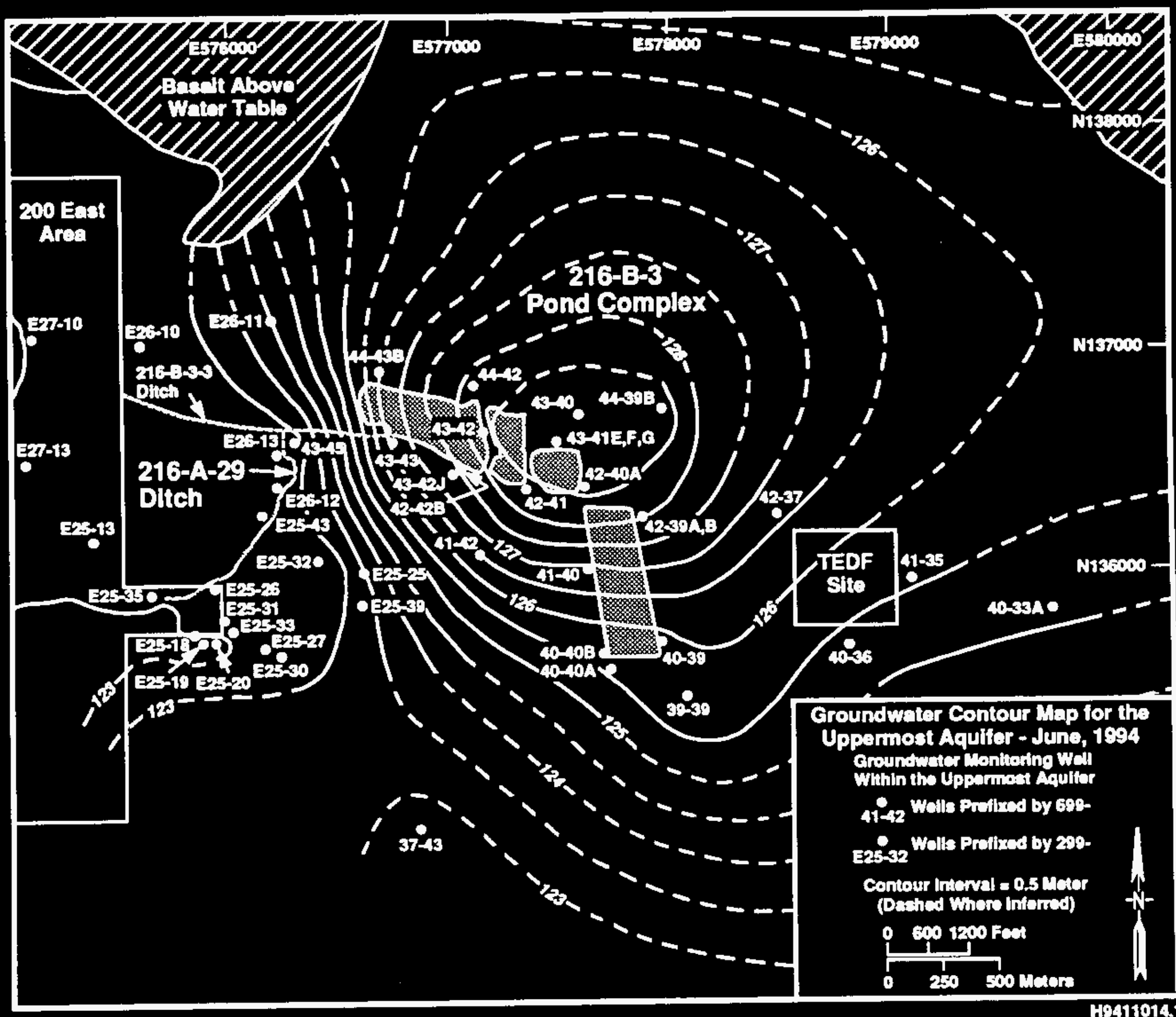


Table 1. Monitoring Wells Used for the 216-A-29 Ditch.

Well	Aquifer	Sampling frequency	Water levels	Well standard	Other network
299-E25-26[86]	Top of unconfined	Q^a	M	RCRA	--
299-E25-28[86]	Deep unconfined	Q^a	M	RCRA	--
299-E25-32P[90]	Top of unconfined	Q^a	M	RCRA	--
299-E25-34[90]	Top of unconfined	Q^a	M	RCRA	--
299-E25-35[90]	Top of unconfined	Q^a	M	RCRA	--
299-E25-42[91]	Top of unconfined	Q^a	M	RCRA	--
299-E25-43[91]	Top of unconfined	Q^a	M	RCRA	--
299-E25-47[92]	Top of unconfined	Q^a	M	RCRA	--
299-E25-48[92]	Top of unconfined	Q^a	M	RCRA	--
299-E26-12[91]	Top of unconfined	Q^a	M	RCRA	--
299-E26-13[91]	Top of unconfined	Q^a	M	RCRA	--
699-43-43[90]	Top of unconfined	Q^a	M	RCRA	B Pond
699-43-45[90]	Top of unconfined	Q^a	M	RCRA	B Pond
299-E17-15[88] S	Top of unconfined	--	Q	RCRA	A-36B
299-E17-20[88] S	Top of unconfined	Q^b	Q	RCRA	A-10
299-E25-06[56] S	Top of unconfined	--	Q	NON	--
299-E25-09[56] S	Top of unconfined	--	Q	NON	--
299-E25-10[56] S	Deep unconfined	--	Q	NON	--
299-E25-11[66] S	Deep unconfined	Q^b	Q	NON	--
299-E25-18[76] S	Top of unconfined	Q^b	Q	NON	--
299-E25-19[76] S	Top of unconfined	Q^b	Q	NON	--
299-E25-20[76] S	Top of unconfined	Q^b	Q	NON	--
299-E25-21[83] S	Top of unconfined	Q^b	Q	NON	--
299-E25-31[87] S	Top of unconfined	Q^b	Q	RCRA	--
299-E25-36[88] S	Top of unconfined	Q^b	Q	RCRA	A-10
299-E26-02[56] S	Top of unconfined	--	Q	NON	--

[1]Shading denotes upgradient wells.
[2]Superscript following well number denotes the year of installation.
M = frequency on a monthly basis.
NON = well was constructed prior to RCRA-specified standards.
Q = frequency on a quarterly basis.
Q^a = assessment program parameter list: alkalinity, anions, specific conductance, ICP metals filter/unfiltered, total dissolved solids, turbidity, pH
Q^b = A-29 monitoring program parameter list: alkalinity, gross alpha, gross beta, anions, arsenic, specific conductance, ICP metals filter/unfiltered, pH, phenols, total organic carbon, total organic halide, total dissolved solids, tritium, turbidity
RCRA = well is constructed to RCRA specified standards.
S = well that is sampled for supplementary data only.

investigation, all wells in the A-29 network are RCRA compliant, monitor the unconfined aquifer, and, in most cases, have been completed to monitor the top of the unconfined aquifer. Figure 3 shows the location of wells for the current A-29 groundwater network. *Under the Hanford Site Permit, groundwater* monitoring at the A-29 Ditch is scheduled to continue until closure in 2000.

2.0 WASTE CHARACTERISTICS

Disposal activities at A-29 began in 1955 with the startup of the PUREX Plant and continued until the rerouting of CSL effluents in 1991. A-29 received occasional batches of potentially hazardous spilled chemical materials or off-specification process chemicals. Regular discharges of corrosive effluents containing sulfuric acid and sodium hydroxide were introduced to the CSL from the PUREX Plant demineralizer regeneration system. These discharges occurred almost daily until 1986. Other known and potential discharges included demineralizer regenerant, oxalic acid, nitric acid, hydrogen peroxide, calcium nitrate, potassium permanganate, sodium carbonate, potassium hydroxide, sodium nitrate, cadmium nitrate, and hydrazine. A complete summary of the type and amount of potentially hazardous wastes discharged to A-29 is included in Kasza and Goodwin (1992). The *PUREX Plant Chemical Sewer Stream-Specific Report* (WHC 1990) proposes that effluent leaving the PUREX Plant via the CSL through A-29 was not hazardous.

3.0 RESULTS OF THE GROUNDWATER QUALITY ASSESSMENT

3.1 WATER TABLE ELEVATION

Since the start of the groundwater quality assessment monitoring in June 1990, water levels have been measured monthly in the A-29 groundwater monitoring network wells and at least quarterly in nearby wells used for regional comparison. These data have been published in the RCRA quarterly reports (e.g., Freeman 1994b). The main hydraulic effect on the groundwater under A-29 is currently from the B Pond. The water table elevation around A-29 and B Pond has been steadily declining (Figure 6). This coincides with reduced liquid effluent to B Pond and the closing of A-29.

3.2 GROUNDWATER CHEMISTRY

The groundwater beneath the A-29 Ditch has been monitored by a RCRA interim-status well network since November 1988. Per requirements in 40 CFR 265.92, the monitoring wells have been sampled quarterly for indicator parameters, groundwater quality parameters, and drinking water quality parameters. The background stage of monitoring was initially completed in August 1989. After the first year, all monitoring wells were sampled on an annual schedule to establish groundwater quality and on a semiannual schedule for indicator parameters. In addition, all wells have been sampled for site-specific parameters each sampling event and at least once for Appendix IX constituents (EPA 1980).

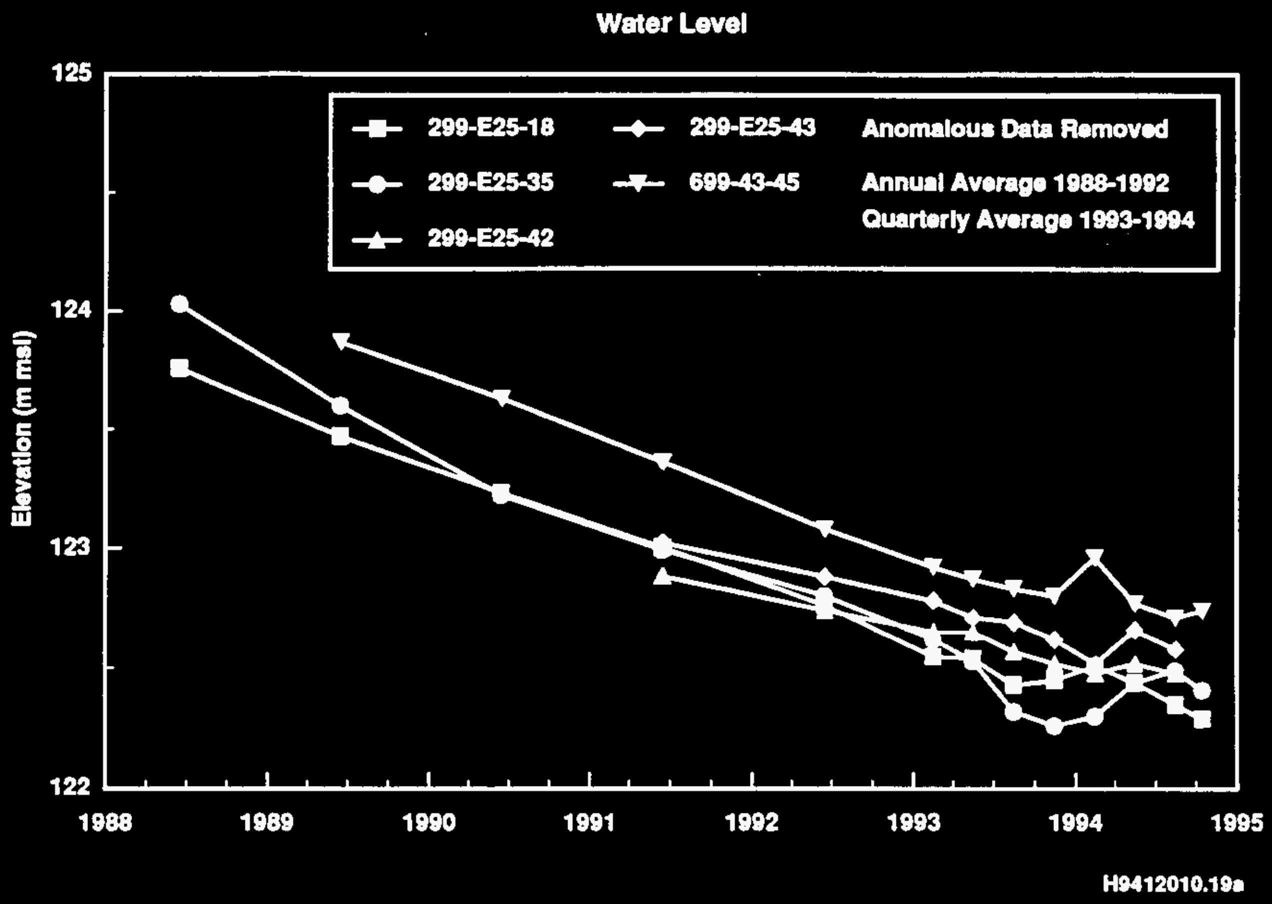
Groundwater samples were not collected between June 1990 and June 1991 due to the lack of analytical laboratory services. When sampling resumed, the A-29 groundwater monitoring network and the surrounding regional comparison wells were sampled quarterly (DOE 1991, DOE 1992, and DOE 1993a). Analytical results have been reported in the RCRA quarterly reports.

The groundwater quality assessment monitoring program was initiated at A-29 in 1990 because field measured specific conductance at well 299-E25-35 was 784 μmhos (January 29, 1990). This was above the original critical mean of 455.31 μmhos. The mean was established using well 299-E25-32P, which was then upgradient. Ongoing upgradient specific conductance data are consistent with the critical means calculated from well 299-E25-32P. The investigation method included evaluating concentrations of major anions and cations that have been monitored and compared to average concentrations of waste constituents disposed to the A-29 Ditch and surrounding cribs.

Specific conductance reflects the quantity of ions in the groundwater. Time concentration patterns of specific conductance in well 299-E25-35 correspond to similar trends of sulfate, calcium, and sodium. Figure 7 depicts the similar historical concentration plots of these constituents and specific conductance over time. Hanford Site background levels for these constituents illustrate them to be below or near original levels. Calcium and sodium, however, are not ideal indicators of contamination because they occur naturally in the uppermost aquifer and they are reported at considerably lower values than sulfate. Therefore, the following discussion focuses primarily on sulfate concentrations and specific conductance over time (Figure 8).

Sulfate is highly concentrated in the groundwater at well 299-E25-35. Sulfuric acid from the CSL effluent disassociates into sulfate in water matrices. Well 299-E25-35 is located at the head of the ditch; therefore, if any infiltration occurred, it would be first noticed at this well. Well 299-E25-35 recorded the highest values for specific conductance (771 μmhos) and sulfate (236,000 ppb) on November 21, 1988. This was attributed to routine PUREX Plant operations. The PUREX Plant was shut down for a year in 1989 to upgrade the facility safety controls. The PUREX Plant CSL provided 946 L/min (250 gal/min) to A-29 during the shutdown. The effluent during this time was primarily raw river water, which had a specific conductance of <200 μmhos. After July 15, 1991, all effluent was rerouted and A-29 received no effluent. From 1992 through 1994, specific conductance and sulfate in well 299-E25-35 began to decline rapidly. The average of the last three specific conductance results taken in calendar year 1994 (334.1 μmhos) was significantly lower than the critical mean (397.6 μmhos) for the current A-29 groundwater monitoring network (Figure 9).

Figure 6. Hydrograph of Select 216-A-29 Ditch Monitoring Wells (Freeman 1994a).



Specific conductance and sulfate are also elevated slightly, but are not above the critical mean, in well E25-42, which is downgradient of well 299-E25-35. This contamination from A-29 is expected and will continue to move westward as long as 216-B-3 Pond and future land disposal facilities (e.g., the Treated Effluent Disposal Facility [TEDF]) influence the 200 East Area groundwater. Sulfate and specific conductance data are provided in Appendix A. Sulfate concentrations in the groundwater never exceeded the secondary drinking water standard (250,000 ppb) and it is not a hazardous waste constituent.

3.3 TOTAL ORGANIC HALOGENS AT WELL 299-E25-32P

At the time that the A-29 groundwater quality assessment monitoring plan was prepared, the quadruplicate total organic halogen (TOX) concentrations from the upgradient monitoring well 299-E25-32P had been rising and exceeded the critical mean on January 29, 1990 and February 20, 1990. However, current monitoring results (Appendix B) indicate all total organic halogen (TOX) concentrations are below the critical mean of 21.9 ppb (Appendix C, Table C-2).

4.0 CONCLUSIONS

The groundwater quality assessment data provide evidence that elevated specific conductance in groundwater results is not due to a hazardous waste disposed to the A-29 facility. The elevated specific conductance results for some of the downgradient monitoring wells are primarily due to elevated concentrations of sulfate, sodium, and calcium, which are nonregulated constituents. These conclusions are based on the following:

- **Groundwater chemistry.** The groundwater chemistry of well 299-E25-35 indicates that A-29 caused increased sulfate, sodium and calcium concentrations in ambient groundwater. The high concentrations of sulfate, sodium, and calcium in the groundwater increased the specific conductance. These constituents are migrating in the groundwater flow direction and are influencing 299-E25-42. Sulfate, sodium, and calcium are not considered hazardous waste.

- **Variations in chemical constituent concentrations with changes in A-29 operations.** Specific conductance values and sulfate, sodium, and calcium concentrations in well 299-E25-35 were highest when the facility was operating and providing a substantial amount of effluent to the groundwater. There is a direct correlation between constituent concentrations and the facility operations. The water table has declined and constituent concentrations have decreased since closure of the A-29 facility in July 1991.

Figure 7. Specific Conductance and Sulfate, Sodium, and Calcium Concentrations Over Time at Well 299-E25-35.

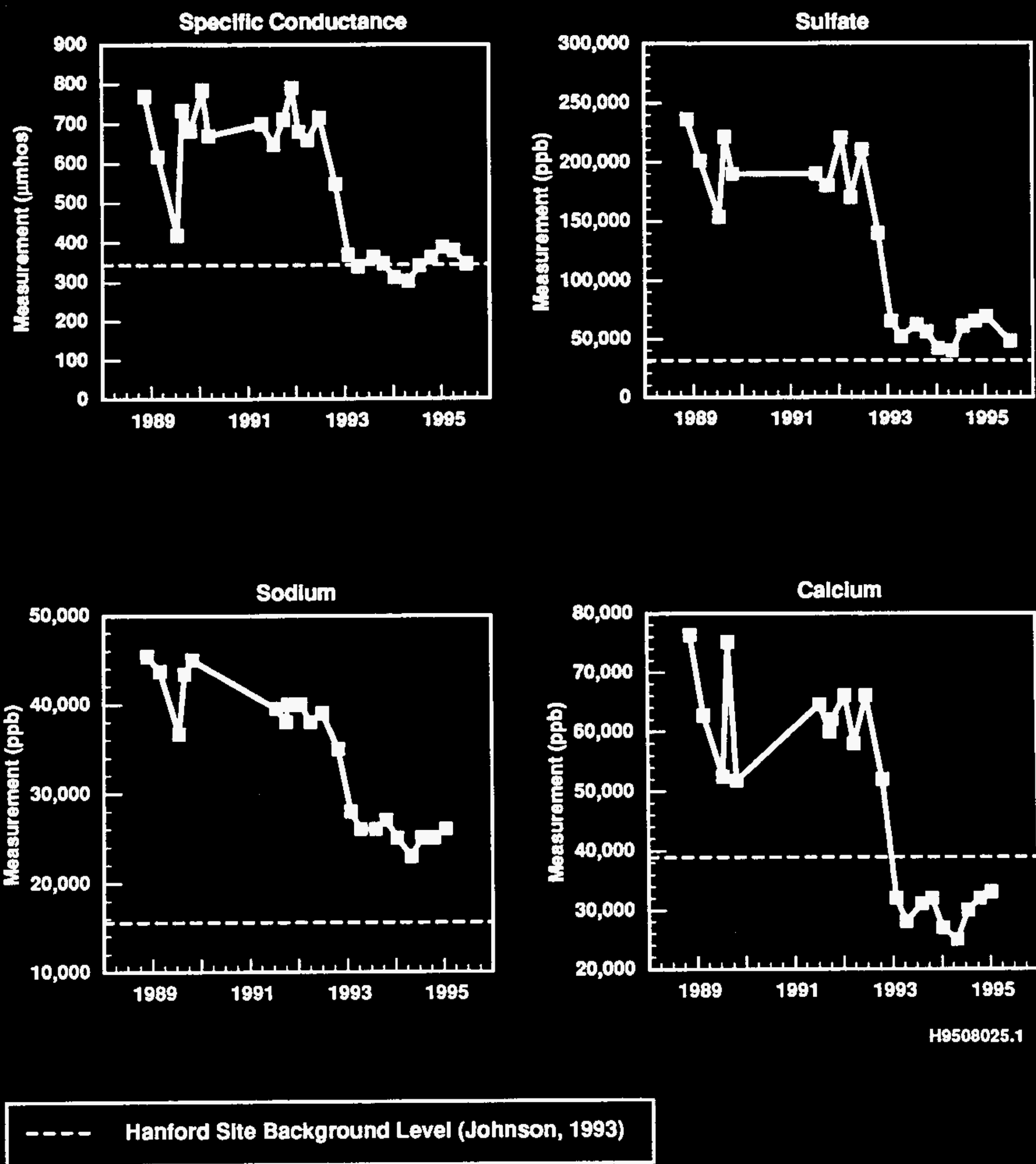
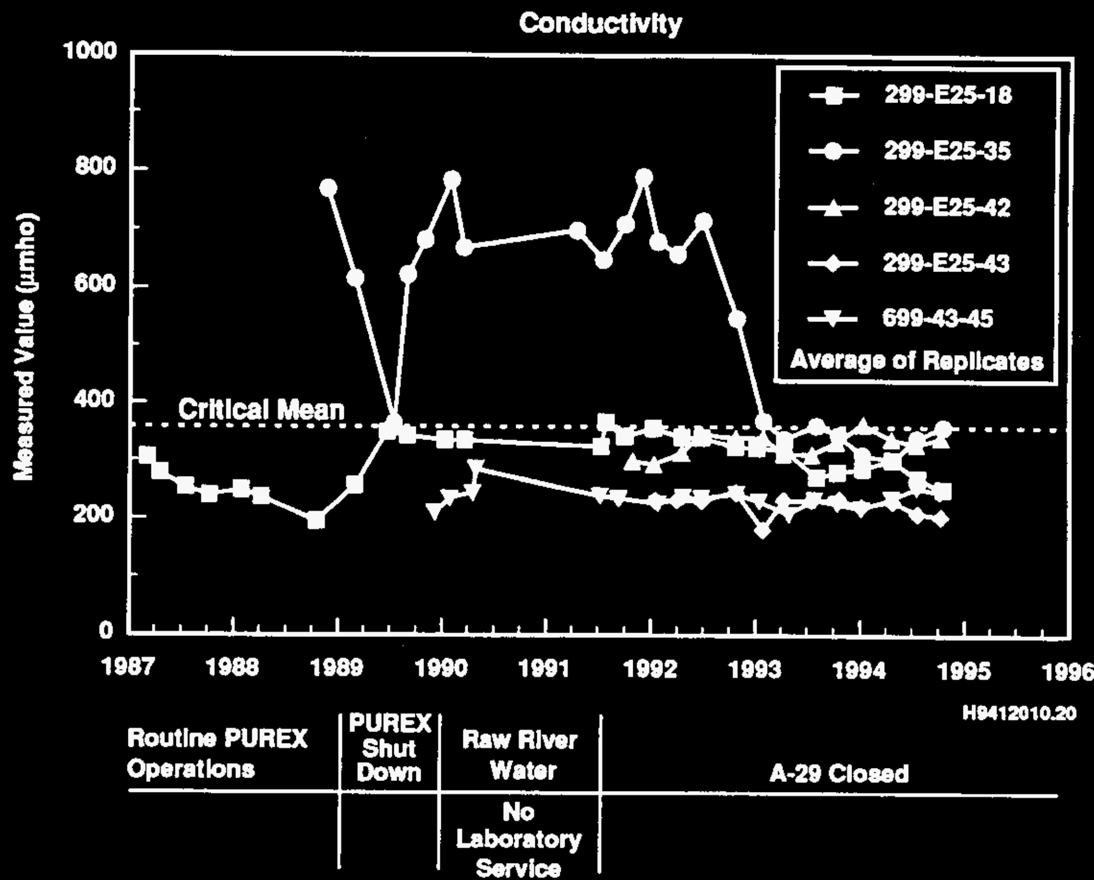


Figure 8. Specific Conductance and Sulfate Concentrations Over Time at Well 299-E25-35 and Select Wells.



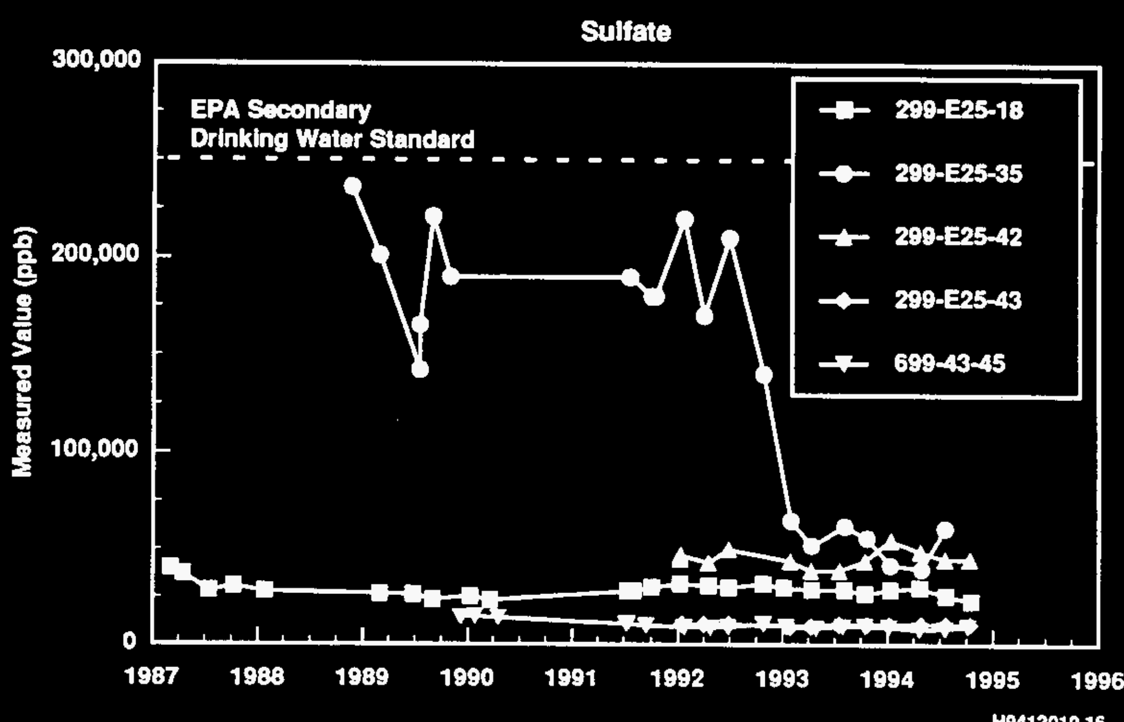
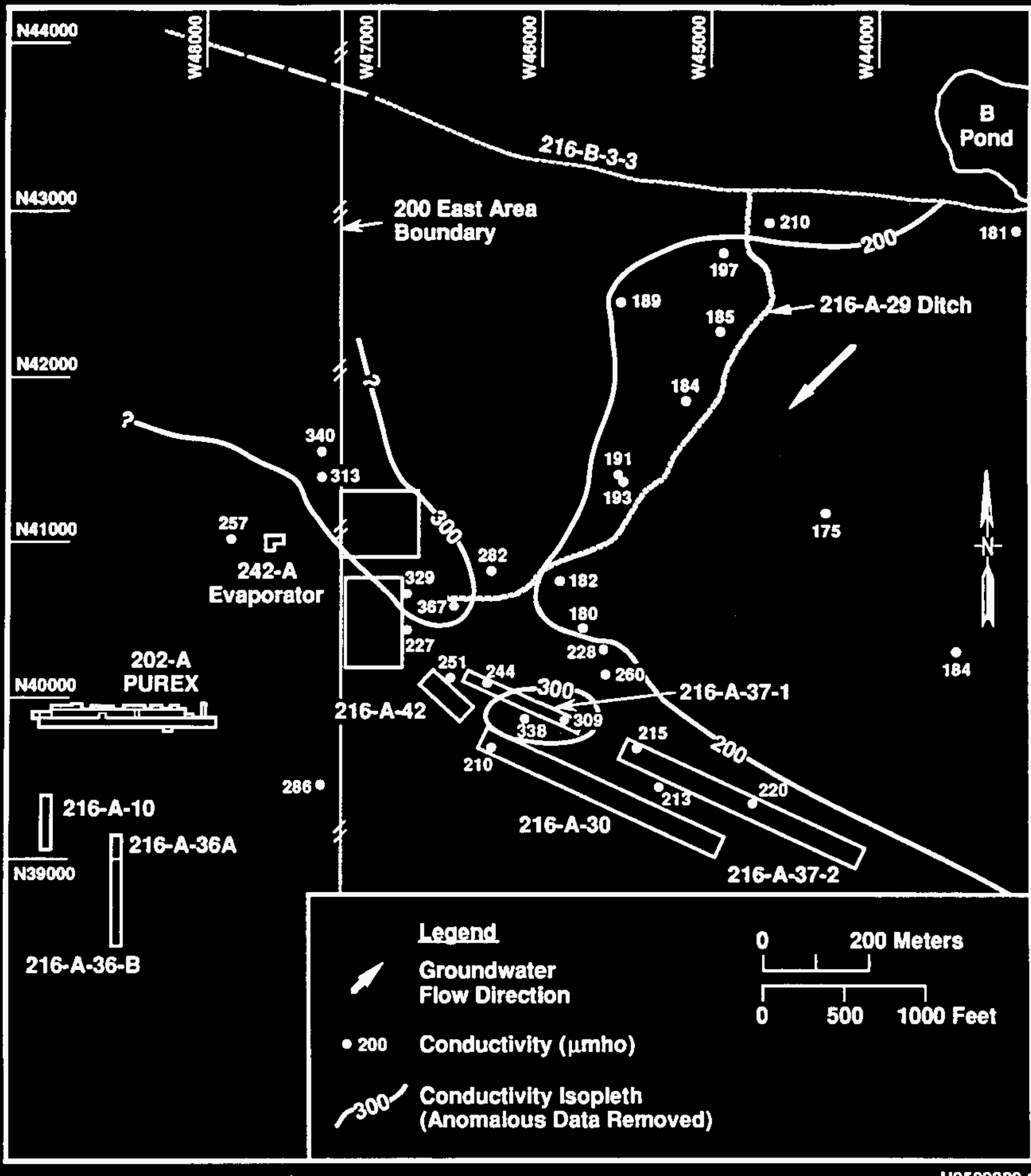


Figure 9. Contour Map of Current Specific Conductance Migration Pattern.



- **Present and future decrease of specific conductance values and sulfate, sodium, and calcium concentrations at well E25-35.** Reduced effluent disposal throughout the 200 East Area has caused the local water table to decline at least 0.6 m (2 ft) beneath A-29 and has resulted in a very slight difference in the water table across the 200 East Area. However, the quality of the groundwater beneath the A-29 Ditch is not static due to the large volume of water still discharged to the 216-B-3C Expansion Pond. Since the nuclear fuel processing facilities are no longer operating in the 200 East Area, the specific conductance of the effluent disposed to the 216-B-3 Pond is almost unchanged from its Columbia River source. The specific conductance of the river is less than the site groundwater. Therefore, it is expected that the residual concentrations of specific conductance, sulfate, sodium, and calcium will decline due to dilution.

5.0 RECOMMENDATIONS

Based on the foregoing conclusions, it is recommended that the A-29 facility revert to an indicator evaluation monitoring program in accordance with 40 CFR 265.93(d)(6). The elevated specific conductance was due to a combination of high concentrations of sulfate, sodium, and calcium in the A-29 Ditch. However, sulfate, sodium, and calcium are not regulated as hazardous waste.

Appendix C describes a supplemental groundwater monitoring plan outline of a detection monitoring program. This program will be incorporated into a revised *Groundwater Monitoring Plan For The 216-A-29 Facility* (Kasza and Goodwin 1992). The modified program differs from Chou (1990) in the number of wells included in the monitoring network and sampling frequency. This outline will begin with the October 1995 sampling event and proceed with semiannual sampling.

The reinstated indicator evaluation groundwater monitoring program will consist of the A-29 groundwater monitoring network as described in Table 2 and shown in Figure 10. The network viability has been tested using the MEMO (Wilson et al. 1992), based on the current and projected effluent discharge to 216-B-3 Pond and the TEDF facilities (Figure 11). The MEMO was run using the recommended A-29 groundwater monitoring network wells and a general groundwater flow to the southwest. The monitoring efficiency is 88.2%.

In compliance with 40 CFR 265.92, the A-29 network wells will be monitored semiannually for TOX, TOC, pH, alkalinity, anions, and specific conductance. The wells will be monitored annually for inductively coupled plasma (ICP) metals and tritium. Phenols will not be included as a groundwater quality parameter because process knowledge indicates that phenols were not added to the A-29 Ditch. This is confirmed by the fact that phenols have never been detected in the groundwater samples. Water levels will be measured semiannually. The critical means have been recalculated to reflect the revised monitoring network as shown in Table 3. Raw data and supplemental summary statistics for the background levels are presented in Appendix D.

Table 2. Reinstated Indicator Evaluation Network for the 216-A-29 Ditch.

Well	Aquifer	Sampling frequency	Water levels	Well standard	Other network
299-E25-26[86]	Top of unconfined	SA	SA	RCRA	--
299-E25-28[86]	Deep unconfined	SA	SA	RCRA	--
299-E25-32P7[88]	Top of unconfined	SA	SA	RCRA	--
299-E25-34[88]	Top of unconfined	SA	SA	RCRA	--
299-E25-35[88]	Top of unconfined	SA	SA	RCRA	--
299-E25-48[92]	Top of unconfined	SA	SA	RCRA	--
299-E26-12[91]	Top of unconfined	SA	SA	RCRA	--
299-E26-13[91]	Top of unconfined	SA	SA	RCRA	--
699-43-43[88]	Top of unconfined	SA	SA	RCRA	B Pond
699-43-45[88]	Top of unconfined	SA	SA	RCRA	B Pond

[1]Shading denotes upgradient wells.
[2]Superscript following well number denotes the year of installation.
NON = well was constructed prior to RCRA specified standards.
SA = frequency on a semiannual basis.
A = frequency on an annual basis.
RCRA = well is constructed to RCRA specified standards.

Table 3. 216-A-29 Ditch Critical Means Calculated Using Upgradient Wells 299-43-43 and 299-43-45

Parameters	Critical Mean
pH	6.16 - 9.71 pH units
Specific Conductance	397.6 μmhos
Total Organic Halide	21.9 ppb
Total Organic Carbon[a]	1,252 ppb

[a] - LOQ in 1993

Figure 10. Recommended 216-A-29 Groundwater Monitoring Network.

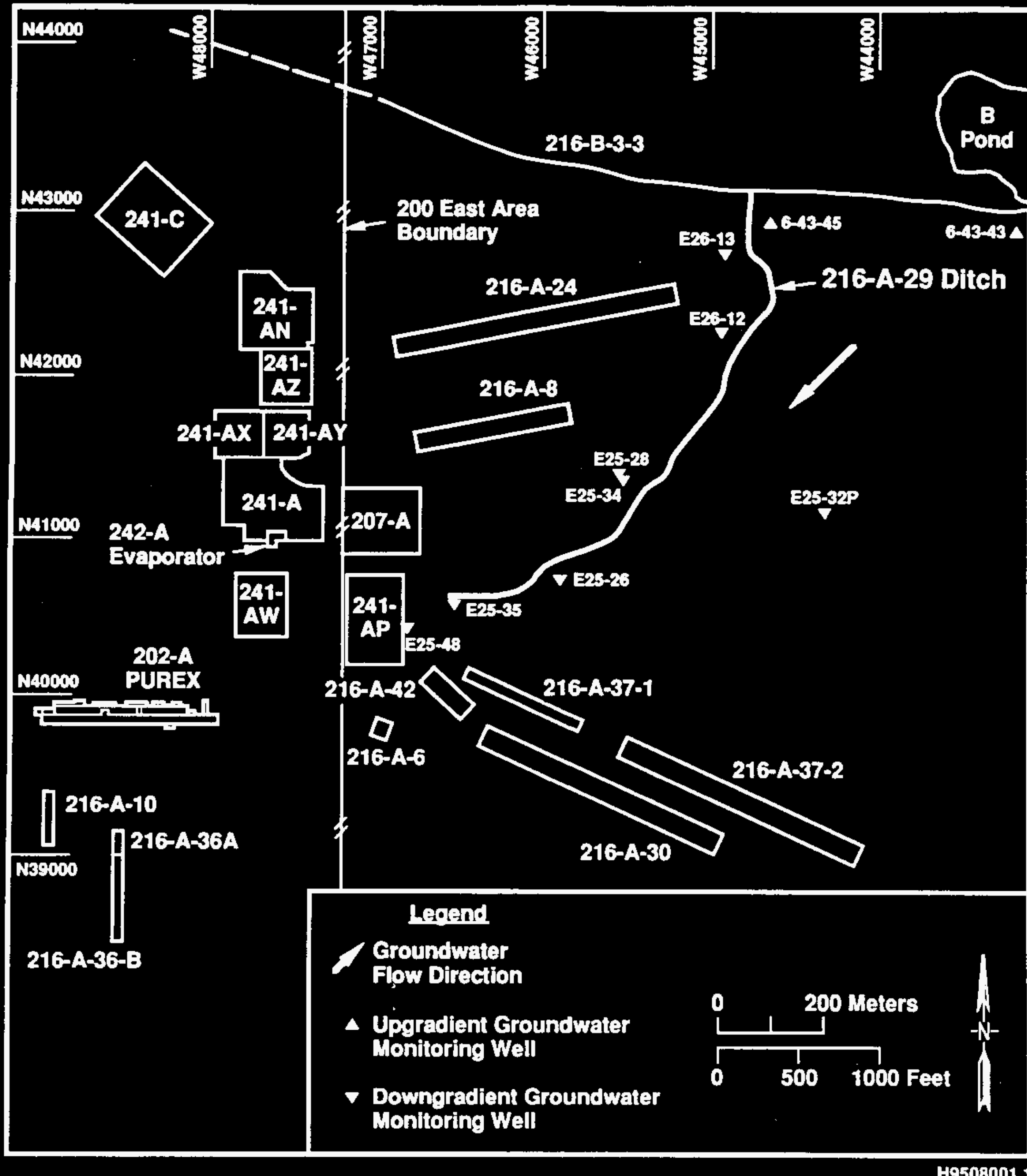
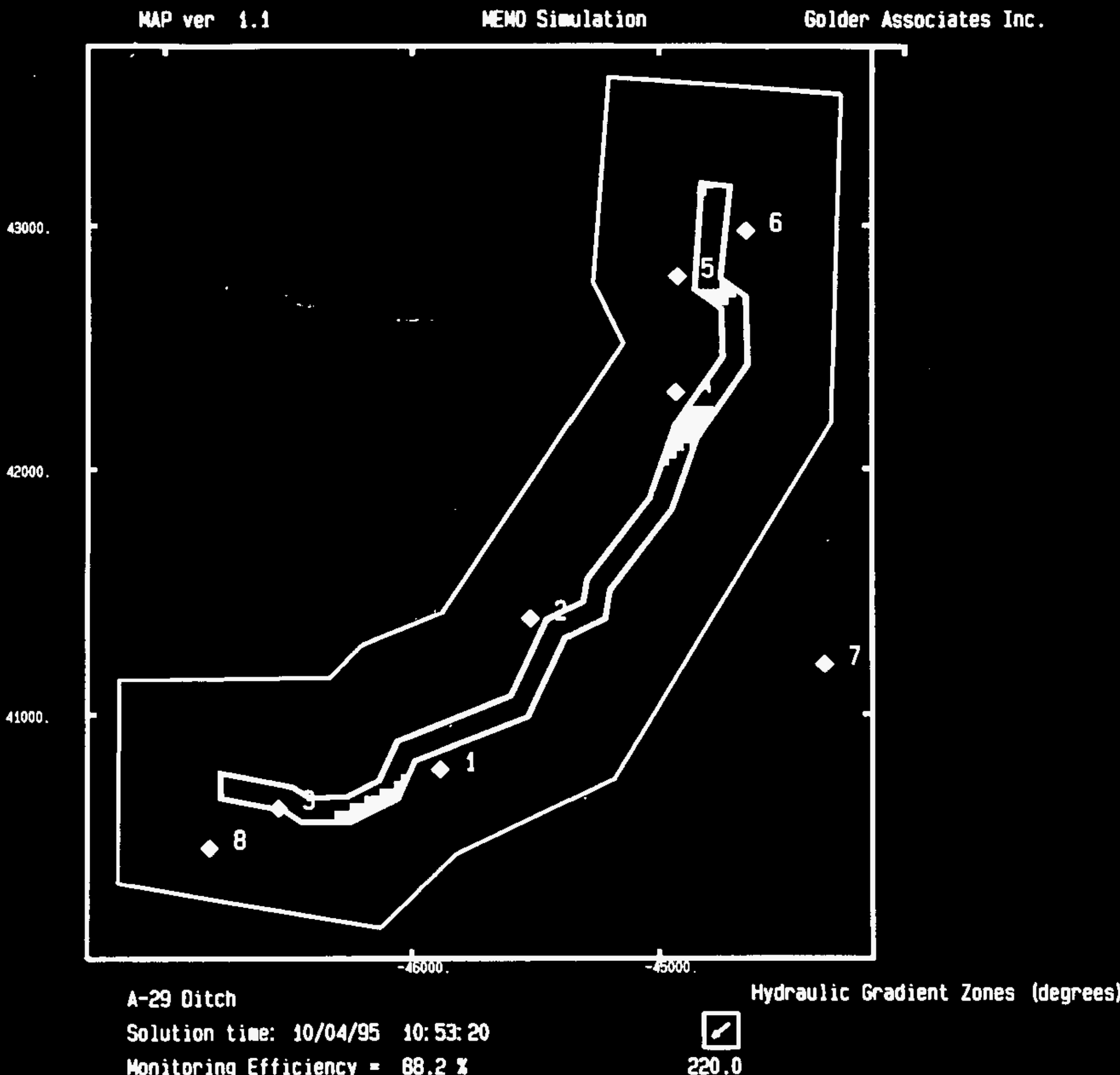


Figure 11. 216-A-29 Ditch MEMO Results.



1. 299-E25-26	5. 299-E26-13
2. 299-E25-34	6. 699-43-45
3. 299-E25-35	7. 299-E25-32P
4. 299-E26-12	8. 299-E25-48

▬ - area not covered by monitoring.
♦ - monitoring wells

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PREFACE TO APPENDICES

The appendix displays data using qualifiers and flags. They are assigned by the laboratory and WHC personnel, respectively. Qualifiers reflect conditions occurring in the laboratory relating to the analytical procedure. Flags serve a wider function of alerting the data user to the limitations of the reported value. Qualifiers and flags can be appended to each other to form a string of letters when several factors apply to a result. The qualifiers and flags used are as follows:

Laboratory qualifiers:

B - Blank associated with analyte is contaminated
D - Analyzed sample is diluted
E - Concentration is out of instrument calibration range
J - Concentration is estimated
L - Concentration is below the CRQL[1] but above the MDL[2]
U - Concentration is below the indicated value.

Data flags:

D - Laboratory incident report
F - Suspect data currently under review
H - Laboratory holding time exceeded
G - Reviewed data that are considered valid
P - Potential problem; see text associated with table
Q - Result associated with suspect QC[3] data
R - Reviewed data that have been rejected
Y - Reviewed data that continue to be suspect

NOTE:

[1]CRQL - Contractually required quantitation limits
[2]MDL - Method Detection Limit
[3]QC - Quality control.

DWS - Drinking water standard
RADE - Request for analytical data evaluation

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APPENDIX A. SULFATE AND SPECIFIC CONDUCTANCE AT WELL 299-E25-35

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APPENDIX A. SPECIFIC CONDUCTANCE AND SULFATE AT WELL 299-E25-35

Table A-1. Specific Conductance at Well 299-E25-35

Well	Sample No	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-35	H0008H00	Specific conductance	µmhos	21-Nov-88	767		
299-E25-35	H0008H01	Specific conductance	µmhos	21-Nov-88	771		
299-E25-35	H0008H02	Specific conductance	µmhos	21-Nov-88	771		
299-E25-35	H0008H03	Specific conductance	µmhos	21-Nov-88	767		
299-E25-35	H0008H04	Specific conductance	µmhos	27-Feb-89	605		
299-E25-35	H0008H04	Specific conductance	µmhos	27-Feb-89	628		
299-E25-35	H0008H08	Specific conductance	µmhos	17-Jul-89	330		
299-E25-35	H0008H08	Specific conductance	µmhos	17-Jul-89	506		
299-E25-35	H0008H09	Specific conductance	µmhos	17-Jul-89	330		
299-E25-35	H0008H10	Specific conductance	µmhos	17-Jul-89	330		
299-E25-35	H0008H11	Specific conductance	µmhos	17-Jul-89	330		
299-E25-35	H0008H12	Specific conductance	µmhos	30-Aug-89	185		
299-E25-35	H0008H12	Specific conductance	µmhos	30-Aug-89	731		
299-E25-35	H0008H13	Specific conductance	µmhos	30-Aug-89	736		
299-E25-35	H0008H14	Specific conductance	µmhos	30-Aug-89	734		
299-E25-35	H0008H15	Specific conductance	µmhos	30-Aug-89	729		
299-E25-35	H0008H16	Specific conductance	µmhos	30-Oct-89	682		
299-E25-35	H0008H17	Specific conductance	µmhos	29-Jan-90	777		
299-E25-35	H0008H17	Specific conductance	µmhos	29-Jan-90	780		
299-E25-35	H0008H18	Specific conductance	µmhos	29-Jan-90	783		
299-E25-35	H0008H18	Specific conductance	µmhos	29-Jan-90	794		
299-E25-35	H0008H19	Specific conductance	µmhos	29-Jan-90	782		
299-E25-35	H0008H19	Specific conductance	µmhos	29-Jan-90	788		
299-E25-35	H0008H20	Specific conductance	µmhos	29-Jan-90	784		
299-E25-35	H0008H20	Specific conductance	µmhos	29-Jan-90	785		
299-E25-35	H0008H21	Specific conductance	µmhos	16-Mar-90	673		
299-E25-35	H0008H22	Specific conductance	µmhos	16-Mar-90	672		
299-E25-35	H0008H23	Specific conductance	µmhos	16-Mar-90	666		

Table A-1. Specific Conductance at Well 299-E25-35

Well	Sample No	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-35	H0008H24	Specific conductance	µmhos	16-Mar-90	670		
299-E25-35	H0008H25	Specific conductance	µmhos	16-Mar-90	660		
299-E25-35	H0008H26	Specific conductance	µmhos	16-Mar-90	667		
299-E25-35	H0008H27	Specific conductance	µmhos	16-Mar-90	677		
299-E25-35	H0008H28	Specific conductance	µmhos	16-Mar-90	664		
299-E25-35	H0008H29	Specific conductance	µmhos	17-Apr-91	699		
299-E25-35	H00071W6	Specific conductance	µmhos	19-Jul-91	642		
299-E25-35	H00071W6	Specific conductance	µmhos	19-Jul-91	650		
299-E25-35	H00071Z9	Specific conductance	µmhos	19-Jul-91	650		
299-E25-35	B00LF3	Specific conductance	µmhos	01-Oct-91	710		
299-E25-35	B00N76	Specific conductance	µmhos	02-Dec-91	790		
299-E25-35	B01Q34	Specific conductance	µmhos	22-Jan-92	680		
299-E25-35	B065L1	Specific conductance	µmhos	01-Apr-92	658		
299-E25-35	B070T1	Specific conductance	µmhos	29-Jun-92	715		
299-E25-35	B07JF1	Specific conductance	µmhos	26-Oct-92	547		
299-E25-35	B07TR6	Specific conductance	µmhos	29-Jan-93	369		G
299-E25-35	B08D84	Specific conductance	µmhos	12-Apr-93	339		
299-E25-35	B08R18	Specific conductance	µmhos	04-Aug-93	360		
299-E25-35	B08R18	Specific conductance	µmhos	04-Aug-93	364		
299-E25-35	B09BP4	Specific conductance	µmhos	20-Oct-93	330		
299-E25-35	B09BP4	Specific conductance	µmhos	20-Oct-93	353		
299-E25-35	B09BP5	Specific conductance	µmhos	20-Oct-93	340		
299-E25-35	B09BP5	Specific conductance	µmhos	20-Oct-93	355		
299-E25-35	B09BP6	Specific conductance	µmhos	20-Oct-93	330		
299-E25-35	B09BP6	Specific conductance	µmhos	20-Oct-93	357		
299-E25-35	B09BP7	Specific conductance	µmhos	20-Oct-93	340		
299-E25-35	B09BP7	Specific conductance	µmhos	20-Oct-93	357		
299-E25-35	B09Q72	Specific conductance	µmhos	11-Jan-94	310		
299-E25-35	B09Q73	Specific conductance	µmhos	11-Jan-94	310		
299-E25-35	B09Q73	Specific conductance	µmhos	11-Jan-94	312		

Table A-1. Specific Conductance at Well 299-E25-35

Well	Sample No	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-35	B09Q74	Specific conductance	µmhos	11-Jan-94	310		
299-E25-35	B09Q75	Specific conductance	µmhos	11-Jan-94	310		
299-E25-35	B09Q75	Specific conductance	µmhos	11-Jan-94	311		
299-E25-35	B0BSH6	Specific conductance	µmhos	28-Apr-94	300		
299-E25-35	B0BSH6	Specific conductance	µmhos	28-Apr-94	303		
299-E25-35	B0BSH7	Specific conductance	µmhos	28-Apr-94	303		
299-E25-35	B0BSH8	Specific conductance	µmhos	28-Apr-94	303		
299-E25-35	B0BSH9	Specific conductance	µmhos	28-Apr-94	303		
299-E25-35	B0C6R4	Specific conductance	µmhos	19-Jul-94	338		
299-E25-35	B0C6R4	Specific conductance	µmhos	19-Jul-94	340		
299-E25-35	B0C6R5	Specific conductance	µmhos	19-Jul-94	338		
299-E25-35	B0C6R6	Specific conductance	µmhos	19-Jul-94	343		
299-E25-35	B0C6R7	Specific conductance	µmhos	19-Jul-94	341		
299-E25-35	B0D2N0	Specific conductance	µmhos	19-Oct-94	352		
299-E25-35	B0D2N0	Specific conductance	µmhos	19-Oct-94	380		
299-E25-35	B0D2N1	Specific conductance	µmhos	19-Oct-94	354		
299-E25-35	B0D2N2	Specific conductance	µmhos	19-Oct-94	357		
299-E25-35	B0D2N3	Specific conductance	µmhos	19-Oct-94	357		
299-E25-35	B0DHS8	Specific conductance	µmhos	13-Jan-95	370		
299-E25-35	B0DHS8	Specific conductance	µmhos	13-Jan-95	395		
299-E25-35	B0DHS9	Specific conductance	µmhos	13-Jan-95	395		
299-E25-35	B0F7M0	Specific conductance	µmhos	13-Jan-95	395		
299-E25-35	B0DHT1	Specific conductance	µmhos	13-Jan-95	396		
299-E25-35	B0F7M0	Specific conductance	µmhos	06-Apr-95	380		
299-E25-35	B0F7M1	Specific conductance	µmhos	06-Apr-95	380		
299-E25-35	B0F7M2	Specific conductance	µmhos	06-Apr-95	378		

Table A-1. Specific Conductance at Well 299-E25-35

Well	Sample No	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-35	B0F7M3	Specific conductance	µmhos	06-Apr-95	376		
299-E25-35	B0G6D7	Specific conductance	µmhos	14-Jul-95	353		
299-E25-35	B0G6D8	Specific conductance	µmhos	14-Jul-95	345		
299-E25-35	B0G6F0	Specific conductance	µmhos	14-Jul-95	340		
299-E25-35	B0G6F2	Specific conductance	µmhos	14-Jul-95	338		

Table A-2. Sulfate at Well 299-E25-35

Well	Sample No	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-35	H0008H00	Sulfate	ppb	21-Nov-88	236000		
299-E25-35	H0008H04	Sulfate	ppb	27-Feb-89	201000		
299-E25-35	H0008H08	Sulfate	ppb	17-Jul-89	142000		
299-E25-35	H0008H11	Sulfate	ppb	17-Jul-89	165000		
299-E25-35	H0008H12	Sulfate	ppb	30-Aug-89	221000		
299-E25-35	H0008H16	Sulfate	ppb	30-Oct-89	190000		
299-E25-35	B00LF3	Sulfate	ppb	01-Oct-91	180000		
299-E25-35	B00LF9	Sulfate	ppb	16-Oct-91	180000		
299-E25-35	B01Q34	Sulfate	ppb	22-Jan-92	220000		H
299-E25-35	B065L1	Sulfate	ppb	01-Apr-92	170000		H
299-E25-35	B070T1	Sulfate	ppb	29-Jun-92	210000		DH
299-E25-35	B07JF1	Sulfate	ppb	26-Oct-92	140000		
299-E25-35	B07TR6	Sulfate	ppb	29-Jan-93	65000		
299-E25-35	B08D84	Sulfate	ppb	12-Apr-93	52000		
299-E25-35	B08R18	Sulfate	ppb	04-Aug-93	62000		
299-E25-35	B09BP4	Sulfate	ppb	20-Oct-93	56000	D	
299-E25-35	B09Q72	Sulfate	ppb	11-Jan-94	42000	D	
299-E25-35	B0BSH6	Sulfate	ppb	28-Apr-94	40000	D	F
299-E25-35	B0C6R4	Sulfate	ppb	19-Jul-94	61000	D	
299-E25-35	B0D2N0	Sulfate	ppb	19-Oct-94	65000	D	
299-E25-35	B0DHSH	Sulfate	ppb	13-Jan-95	69000	D	
299-E25-35	B0G6D7	Sulfate	ppb	14-Jul-95	48000	D	

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APPENDIX B. TOX

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APPENDIX B. TOX

Table B-1. TOX for Well 299-E25-32P

Well	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-32P	TOX	ppb	11-Aug-88	11	U	
299-E25-32P	TOX	ppb	19-Oct-88	5	U	
299-E25-32P	TOX	ppb	21-Nov-88	5	U	
299-E25-32P	TOX	ppb	04-Jan-89	3	U	
299-E25-32P	TOX	ppb	24-Feb-89	4	U	
299-E25-32P	TOX	ppb	13-Jul-89	7	U	
299-E25-32P	TOX	ppb	29-Aug-89	5	U	
299-E25-32P	TOX	ppb	31-Oct-89	4	U	
299-E25-32P	TOX	ppb	12-Dec-89	4	U	
299-E25-32P	TOX	ppb	29-Jan-90	175		
299-E25-32P	TOX	ppb	20-Feb-90	272		
299-E25-32P	TOX	ppb	25-Mar-90	5	U	
299-E25-32P	TOX	ppb	04-Apr-90	19		
299-E25-32P	TOX	ppb	19-Jul-91	10	U	
299-E25-32P	TOX	ppb	26-Sep-91	10	U	
299-E25-32P	TOX	ppb	13-Jan-92	10	U	DY
299-E25-32P	TOX	ppb	21-Apr-92	10	U	Y
299-E25-32P	TOX	ppb	29-Jun-92	10	U	Y
299-E25-32P	TOX	ppb	30-Oct-92	10	U	Y
299-E25-32P	TOX	ppb	27-Jan-93	10	U	Y
299-E25-32P	TOX	ppb	27-Apr-93	8	U	Y
299-E25-32P	TOX	ppb	15-Jul-93	8	U	Y
299-E25-32P	TOX	ppb	13-Oct-93	7	U	Y
299-E25-32P	TOX	ppb	19-Apr-94	7		
299-E25-32P	TOX	ppb	19-Jul-94	7		
299-E25-32P	TOX	ppb	11-Oct-94	5	U	
299-E25-32P	TOX	ppb	11-Jan-95	12		
299-E25-32P	TOX	ppb	05-Apr-95	9		
299-E25-32P	TOX	ppb	06-Jul-95	7	U	

Table B-2. TOX for Wells in the 216-A-29 Monitoring Network Since November 1994.

Well	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-26	TOX	ppb	12-Jan-95	8		
299-E25-26	TOX	ppb	12-Jan-95	8		
299-E25-26	TOX	ppb	12-Jan-95	10		
299-E25-26	TOX	ppb	12-Jan-95	10		
299-E25-26	TOX	ppb	06-Apr-95	5	U	
299-E25-26	TOX	ppb	06-Apr-95	7		
299-E25-26	TOX	ppb	06-Apr-95	8		
299-E25-26	TOX	ppb	06-Apr-95	14		
299-E25-28	TOX	ppb	13-Jan-95	5	U	G
299-E25-28	TOX	ppb	13-Jan-95	6		G
299-E25-28	TOX	ppb	13-Jan-95	10		G
299-E25-28	TOX	ppb	13-Jan-95	16		R
299-E25-28	TOX	ppb	06-Apr-95	5	U	
299-E25-28	TOX	ppb	06-Apr-95	5		
299-E25-28	TOX	ppb	06-Apr-95	7		
299-E25-28	TOX	ppb	06-Apr-95	9		
299-E25-32P	TOX	ppb	11-Jan-95	8		
299-E25-32P	TOX	ppb	11-Jan-95	8		
299-E25-32P	TOX	ppb	11-Jan-95	14		R
299-E25-32P	TOX	ppb	11-Jan-95	18		R
299-E25-32P	TOX	ppb	05-Apr-95	8		Q
299-E25-32P	TOX	ppb	05-Apr-95	10		Q
299-E25-32P	TOX	ppb	05-Apr-95	10		Q
299-E25-34	TOX	ppb	13-Jan-95	5	U	
299-E25-34	TOX	ppb	13-Jan-95	5		
299-E25-34	TOX	ppb	13-Jan-95	12		
299-E25-34	TOX	ppb	13-Jan-95	13		
299-E25-34	TOX	ppb	05-Apr-95	5	U	Q
299-E25-34	TOX	ppb	05-Apr-95	7		Q
299-E25-34	TOX	ppb	05-Apr-95	12		Q

Table B-2. TOX for Wells in the 216-A-29 Monitoring Network Since November 1994.

Well	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-34	TOX	ppb	05-Apr-95	14		Q
299-E25-35	TOX	ppb	13-Jan-95	5	U	
299-E25-35	TOX	ppb	13-Jan-95	6		
299-E25-35	TOX	ppb	06-Apr-95	5	U	
299-E25-35	TOX	ppb	06-Apr-95	10		
299-E25-42	TOX	ppb	18-Jan-95	5	U	
299-E25-42	TOX	ppb	18-Jan-95	7		
299-E25-42	TOX	ppb	18-Jan-95	8		
299-E25-42	TOX	ppb	18-Jan-95	11		
299-E25-42	TOX	ppb	10-Apr-95	5	U	
299-E25-42	TOX	ppb	10-Apr-95	7		
299-E25-42	TOX	ppb	10-Apr-95	8		
299-E25-43	TOX	ppb	11-Jan-95	5	U	R
299-E25-43	TOX	ppb	11-Jan-95	8		R
299-E25-43	TOX	ppb	11-Jan-95	9		R
299-E25-43	TOX	ppb	11-Jan-95	15		QR
299-E25-43	TOX	ppb	11-Jan-95	18		R
299-E25-43	TOX	ppb	11-Jan-95	18		R
299-E25-43	TOX	ppb	11-Jan-95	25		QR
299-E25-43	TOX	ppb	11-Jan-95	26		R
299-E25-43	TOX	ppb	10-Apr-95	5	U	
299-E25-43	TOX	ppb	10-Apr-95	9		
299-E25-43	TOX	ppb	10-Apr-95	9		
299-E25-47	TOX	ppb	11-Jan-95	5	U	
299-E25-47	TOX	ppb	11-Jan-95	6		
299-E25-47	TOX	ppb	11-Jan-95	7		
299-E25-47	TOX	ppb	11-Jan-95	15		
299-E25-47	TOX	ppb	10-Apr-95	5	U	
299-E25-47	TOX	ppb	10-Apr-95	5		
299-E25-47	TOX	ppb	10-Apr-95	7		
299-E25-47	TOX	ppb	10-Apr-95	10		

Table B-2. TOX for Wells in the 216-A-29 Monitoring Network Since November 1994.

Well	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
299-E25-48	TOX	ppb	11-Jan-95	5	U	
299-E25-48	TOX	ppb	11-Jan-95	6		
299-E25-48	TOX	ppb	11-Jan-95	10		
299-E25-48	TOX	ppb	11-Jan-95	14		
299-E25-48	TOX	ppb	10-Apr-95	5		
299-E25-48	TOX	ppb	10-Apr-95	5	U	
299-E25-48	TOX	ppb	10-Apr-95	5		
299-E25-48	TOX	ppb	10-Apr-95	6		
299-E26-12	TOX	ppb	18-Jan-95	5		
299-E26-12	TOX	ppb	18-Jan-95	7		
299-E26-12	TOX	ppb	18-Jan-95	9		
299-E26-12	TOX	ppb	18-Jan-95	12		
299-E26-12	TOX	ppb	10-Apr-95	5	U	
299-E26-12	TOX	ppb	10-Apr-95	7		
299-E26-12	TOX	ppb	10-Apr-95	10		
299-E26-13	TOX	ppb	17-Jan-95	7		
299-E26-13	TOX	ppb	17-Jan-95	9		
299-E26-13	TOX	ppb	17-Jan-95	9		
299-E26-13	TOX	ppb	17-Jan-95	11		
299-E26-13	TOX	ppb	10-Apr-95	5	U	
299-E26-13	TOX	ppb	10-Apr-95	6		
299-E26-13	TOX	ppb	10-Apr-95	7		
699-42-43	TOX	ppb	10-Jan-95	5	U	
699-43-43	TOX	ppb	10-Jan-95	8		
699-43-43	TOX	ppb	10-Jan-95	11		
699-43-43	TOX	ppb	05-Apr-95	11		Q
699-43-43	TOX	ppb	05-Apr-95	11		Q
699-43-43	TOX	ppb	05-Apr-95	12		Q
699-43-43	TOX	ppb	05-Apr-95	12		Q
699-43-45	TOX	ppb	11-Jan-95	6		

Table B-2. TOX for Wells in the 216-A-29 Monitoring Network Since November 1994.

Well	Constituent Name	Units	Collect Date	Result	Qualifier	Flag
699-43-45	TOX	ppb	11-Jan-95	7		
699-43-45	TOX	ppb	11-Jan-95	10		
699-43-45	TOX	ppb	11-Jan-95	16		R
699-43-45	TOX	ppb	05-Apr-95	5	U	Q
699-43-45	TOX	ppb	05-Apr-95	8		Q
699-43-45	TOX	ppb	05-Apr-95	8		Q

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APPENDIX C. THE 216-A-29 DITCH SUPPLEMENTAL GROUNDWATER MONITORING PLAN OUTLINE

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APPENDIX C. THE 216-A-29 DITCH SUPPLEMENTAL GROUNDWATER MONITORING PLAN OUTLINE

Chou et al. (1990) presented the first phase of the interim-status groundwater quality assessment program to investigate elevated specific conductance in well 299-E25-35 of the 216-A-29 (A-29) Ditch monitoring network. It has since been determined that the 216-A-29 Ditch is the source of elevated specific conductance in well 299-E25-35 and that the source is nonhazardous. The following supplemental groundwater monitoring plan outline reverts the A-29 Ditch to an indicator parameter evaluation monitoring program in accordance with 40 CFR 265.92 and will be incorporated into a revised *Groundwater Monitoring Plan For The 216-A-29 Facility* (Kasza and Goodwin 1992).

C.1 MONITORING NETWORK

The indicator evaluation groundwater monitoring program will consist of the A-29 groundwater monitoring network as described in Table C-1. The network viability has been tested using the Monitoring Efficiency Model (MEMO)(Wilson et al. 1992), based on the current and projected effluent discharge to 216-B-3C Pond and the TEDF facilities (Figure C-1). The MEMO was run using the A-29 groundwater monitoring network wells and a general groundwater flow to the southwest. The monitoring efficiency is 88.2%.

C.2 SAMPLING AND ANALYSIS

C.2.1 Constituent Lists

The A-29 network wells will be monitored semiannually for TOX, TOC, pH, alkalinity, anions and specific conductance, and annually for ICP metals, and tritium in compliance with 40 CFR 265.92. Phenols will not be included as a groundwater quality parameter because process knowledge indicates that phenols were not added to the A-29 Ditch. This is confirmed by the fact that phenols have never been detected in groundwater samples.

C.2.2 Sampling and Analytical Methods

Sample collection, preservation, chain of custody, and analysis shall proceed according to WHC (1993), or its revision.

C.2.3 Quality Control

The quality control program for Hanford Site RCRA groundwater monitoring is described in WHC (1993) or its current revision.

C.2.4 Data Validation and Reporting

Data reporting requirements for the analytical laboratory are specified in WHC (1993). Data validation and verification are performed by WHC, as described in WHC (1993). Water level and chemical data are reported quarterly in quarterly reports of RCRA data for the Hanford Site (e.g., Freeman 1994a).

C.3 WATER LEVEL MONITORING

Water levels will be measured manually before wells are sampled. They will be measured semiannually and water table maps will be constructed from these data to estimate direction and rate of groundwater flow.

C.4 BACKGROUND VALUES

The background contamination indicator parameter data are based on two upgradient wells, 299-43-43 and 299-43-45 (Table C-2). The most recent four quarters of data (April 1994 - January 1995) have been used to establish these values. Raw data and supplemental statistics used to calculate the background values are presented in Appendix D.

C.5 SCHEDULE

This plan will begin with the October 1995 sampling event and proceed with semiannual sampling.

C.6 REFERENCES

Chou, C. J., G. L. Kasza, and R. B. Mercer, 1990, *Interim Status Groundwater Quality Assessment Plan for the A-29 Ditch*, WHC-SD-EN-AP-031, Westinghouse Hanford Company, Richland, Washington. ECN 618167

Freeman, 1994a, "216-A-29 Ditch" in *Quarterly Report of RCRA Groundwater Monitoring Data for Period October 1 through December 31,1994*, DOE/RL-94-36-4, U.S. Department of Energy, Richland Field Office, Richland, Washington..

Freeman, P.B., 1994b, "216-A-29 Ditch" in *Annual Report for RCRA Groundwater Monitoring Projects at Hanford Site Facilities for 1993*, DOE/RL-93-88, U.S. Department of Energy, Richland Field Office, Richland, Washington.

WHC, 1993, *Quality Assurance Project Plan for RCRA Groundwater Monitoring Activities*, WHC-SD-EN-QAPP-001, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

Wilson, C. R., C.M. Einberger, R. L. Jackson, R. B. Mercer, 1992, *Design of Groundwater Monitoring Networks Using The Monitoring Efficiency Model (MEMO)*, Groundwater, Vol. 130, No. 6, pgs 965-970.

Table C-1. Monitoring Wells for the 216-A-29 Ditch.

Well	Aquifer	Sampling frequency	Water levels	Well standard	Other network
299-E25-26^{85}	Top of unconfined	SA	SA	RCRA	--
299-E25-28^{86}	Deep unconfined	SA	SA	RCRA	--
299-E25-32P^{88}	Top of unconfined	SA	SA	RCRA	--
299-E25-34^{88}	Top of unconfined	SA	SA	RCRA	--
299-E25-35^{88}	Top of unconfined	SA	SA	RCRA	--
299-E25-48^{92}	Top of unconfined	SA	SA	RCRA	--
299-E26-12^{91}	Top of unconfined	SA	SA	RCRA	--
299-E26-13^{91}	Top of unconfined	SA	SA	RCRA	--
699-43-43^{88}	Top of unconfined	SA	SA	RCRA	B Pond
699-43-45^{89}	Top of unconfined	SA	SA	RCRA	B Pond

[1]Shading denotes upgradient wells.
[2]Superscript following well number denotes the year of installation.
NON = well was constructed prior to RCRA specified standards.
SA = frequency on a semiannual basis.
A = frequency on an annual basis.
RCRA = well is constructed to RCRA specified standards.

Table C-2. Critical Means Table for 52 Comparisons--Background Contamination Indicator Parameter Data for the 216-A-29-Ditch a,b

Constituent (Unit)	n	df	tc	Average background	Standard deviation	Critical mean	Upgradient/ Downgradient Comparison Value
Specific Conductance (µmho/cm)	8	7	6.352	217.75	28.382	409.0	409.0
Field pH	8	7	7.234	7.792	0.308	[5.43, 10.16]	[6.08, 9.79][d]
TOC[c] (ppb)	8	7	6.352	499.375	98.758	1,164.7	1,252
TOX (ppb)	8	7	6.352	5.964	2.509	22.9	22.9

[a]Data collected from April 1994 to January 1995 for upgradient wells 6-43-43 and 6-43-45. Values calculated based on 52 comparisons.
[b]The following notations are used in this table:
df = degrees of freedom (n-1).
n = number of background replicate averages.
t_c = Bonferroni critical t-value for appropriate df and 52 comparisons.
[c]Calculated critical mean is less than the limit of quantitation. The upgradient/downgradient comparison value for TOC is the limit of quantitation (DOE 1995).
[d]Upgradient/downgradient comparison values for pH were calculated using data collected from April 1994 to July 1995 (wells 6-43-43 and 6-43-45) because the critical range calculated using only four quarters of data is too large to be meaningful.
N. C. = not calculated.

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APPENDIX D. BACKGROUND CONTAMINATION INDICATOR PARAMETER DATA FOR THE 216-A-29 DITCH

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APPENDIX D. BACKGROUND CONTAMINATION INDICATOR PARAMETER DATA FOR THE 216-A-29 DITCH

Table D-1. Background Contamination Indicator Parameter Data for the 216-A-29 Ditch.

Well Name	Sample Date	Dupl. Sample Number	Specific Conductance µmho/cm	Field pH	TOC ppb	TOX ppb
6-43-43	04/20/94	1	214	7.21	600^{L}	9.9
		2	213	7.18	600^{L}	12.2
		3	215	7.15	500^{L}	14.1
		4	215	7.15	500^{L}	6.6^{U}
6-43-43	07/19/94	1	200	8.03	600^{L}	5.0^{U}
		2	200	8.03	600^{L}	5.2
		3	200	8.03	700^{L}	9.0
		4	200	8.03	600^{L}	11.2
6-43-43	10/06/94	1	214	7.94	600^{L}	5.0^{U}
		2	210	7.92	600^{L}	5.0^{U}
		3	208	7.92	700^{L}	5.0^{U}
		4	207	7.92	600^{L}	5.0^{U}
6-43-43	01/10/95	1	169	8.26	500^{L}	8.2
		2	169	8.08	600^{L}	5.0^{U}
		3	169	8.09	500^{L}	10.9
		4	169	8.11	600^{L}	5.0^{U}
6-43-45	04/20/94	1	234	7.69	400^{L}	9.7
		2	234	7.70	400^{L}	10.1
		3	235	7.71	400^{L}	5.0^{U}
		4	233	7.71	400^{L}	6.4
6-43-45	07/19/94	1	260	7.95	330^{L}	5.0^{U}
		2	258	7.95	400^{L}	6.8
		3	257	7.95	350^{L}	5.2
		4	256	7.96	600^{L}	6.8

Table D-1. Background Contamination Indicator Parameter Data for the 216-A-29 Ditch.

Well Name	Sample Date	Dupl. Sample Number	Specific Conductance µmho/cm	Field pH	TOC ppb	TOX ppb
6-43-45	10/06/94	1	248	7.84	400[L]	5.0[U]
		2	248	7.86	400[L]	5.0[U]
		3	248	7.84	400[L]	5.0[U]
		4	249	7.88	500[L]	5.0[U]
6-43-45	01/11/95	1	210	7.50	400[L]	6.8
		2	209	7.57	400[L]	9.6
		3	209	7.59	400[L]	16.0[R]
		4	208	7.61	400[L]	5.6

Table D-2. Average Replicate Statistics--Background Indicator Parameter Data for the 216-A-29 Ditch Well 699-43-43.

Constituent (Unit)	Well Name	Sample Date	n	Average	Standard Deviation	C.V. (%)
Specific Conductance (µmho/cm)	6-43-43	04/20/94	4	214.25	0.957	0.45
	6-43-43	07/19/94	4	200.00	0	0
	6-43-43	10/06/94	4	209.75	3.096	1.48
	6-43-43	01/10/95	4	169.00	0	0
Field pH	6-43-43	04/20/94	4	7.172	0.029	0.40
	6-43-43	07/19/94	4	8.030	0	0
	6-43-43	10/06/94	4	7.925	0.010	0.13
	6-43-43	01/10/95	4	8.135	0.084	1.04
TOC[a] (ppb)	6-43-43	04/20/94	4	550[L]	57.735	10.5
	6-43-43	07/19/94	4	625[L]	50.000	8.0
	6-43-43	10/06/94	4	625[L]	50.000	8.0
	6-43-43	01/10/95	4	550[L]	57.735	10.5
TOX[a] (ppb)	6-43-43	04/20/94	4	9.875	4.708	47.67
	6-43-43	07/19/94	4	6.975	3.879	55.61
	6-43-43	10/06/94	4	2.5[U]	N.A.	N.A.
	6-43-43	01/10/95	4	6.025	4.217	69.99

[a]statistics were calculated by replacing not detected values with half of the respective MDL. Actual reported values were used.
N.A. = not available.
C.V. = coefficient of variation.

Table D-3. Average Replicate Statistics--Background Indicator Parameter Data for the 216-A-29 Ditch Well 699-43-45.

Constituent (Unit)	Well Name	Sample Date	n	Average	Standard Deviation	C.V. (%)
Specific Conductance (µmho/cm)	6-43-45	04/20/94	4	234.00	0.816	0.35
	6-43-45	07/19/94	4	257.75	1.708	0.66
	6-43-45	10/06/94	4	248.25	0.500	0.20
	6-43-45	01/11/95	4	209.00	0.816	0.39
Field pH	6-43-45	04/20/94	4	7.702	0.010	0.12
	6-43-45	07/19/94	4	7.952	0.005	0.06
	6-43-45	10/06/94	4	7.855	0.019	0.24
	6-43-45	01/11/95	4	7.568	0.048	0.63
TOC (ppb)	6-43-45	04/20/94	4	400[L]	0	0
	6-43-45	07/19/94	4	420[L]	123.558	29.42
	6-43-45	10/06/94	4	425[L]	50.000	11.76
	6-43-45	01/11/95	4	400[L]	0	0
TOX[a] (ppb)	6-43-45	04/20/94	4	7.175	3.530	49.20
	6-43-45	07/19/94	4	5.325	2.029	38.10
	6-43-45	10/06/94	4	2.50[U]	N.A.	N.A.
	6-43-45	01/11/95	3	7.333[b]	2.053[b]	27.99[b]

[a]statistics were calculated by replacing not detected values with half of the respective MDL.
[b]excluded data flagged by "R".
N.A. = not available.
C.V. = coefficient of variation.

Table D-4. Background Statistics[a]--Contamination Indicator Parameter Data for the 216-A-29 Ditch.

Constituent	Units	n	Background average	Background standard deviation	Background C.V. (%)
Specific conductance	µmhos/cm	8	217.750	28.382	13.03
Field pH		8	7.792	0.308	3.95
TOC	ppb	8	499.375	98.758	19.78
TOX	ppb	8	5.964	2.509	42.07

[a]Background summary statistics for TOX were calculated using values below MDL.

Table D-5. Critical Means Table for 36 Comparisons--Background Contamination Indicator Parameter Data for the 216-A-29-Ditch. [a,b]

Constituent (Unit)	n	df	tc	Average background	Standard deviation	Critical mean	Upgradient/ Downgradient Comparison Value
Specific Conductance (µmho/cm)	8	7	5.976	217.75	28.382	397.6	397.6
Field pH	8	7	6.699	7.792	0.308	[5.60, 9.98]	[6.16, 9.71][d]
TOC[c] (ppb)	8	7	5.976	499.375	98.758	1,125.3	1,252
TOX (ppb)	8	7	5.976	5.964	2.509	21.9	21.9

[a]Data collected from April 1994 to January 1995 for upgradient wells 6-43-43 and 6-43-45. Values were calculated based on 36 comparisons.

[b]The following notations are used in this table:
- df = degrees of freedom (n-1).
- n = number of background replicate averages.
- t_c = Bonferroni critical t-value for appropriate df and 36 comparisons.

[c]Caculated critical mean is less than the limit of quantitation. The upgradient/downgradient comparison value for TOC is the limit of quantitation (DOE 1995).

[d]Upgradient/downgradient comparison values for pH were calculated using data collected from April 1994 to July 1995 (wells 6-43-43 and 6-43-45) because the critical range calculated using only four quarters of data is too large to be meaningful.