This document was too large to scan as a single document. It has been divided into smaller sections.

Section 2 of 2

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ATTACHMENT 3

LETTER FROM WASHINGTON STATE DEPARTMENT OF ECOLOGY TO U.S. DEPARTMENT OF ENERGY, RICHLAND OPERATIONS OFFICE REGARDING REACTOR COMPARTMENT COMPLIANCE WITH LAND DISPOSAL RESTRICTIONS

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1315 W. 4th Avenue • Kennewick, Washington 99336-6018 • (509) 735-7581

February 28, 1996

Mr. James E. Rasmussen
U.S. Department of Energy
Richland Operations Office
P.O. Box 550
Richland, WA 99352

Dear Mr. Rasmussen:

Re: Reactor Compartments Disposal Packages Meet Disposal Requirements

The Washington State Department of Ecology (Ecology) has reviewed your January 12, 1996, letter, Request for Concurrence that Reactor Compartment Disposal Packages Comply with Amended Disposal Regulations Regarding Residual Liquids.

Ecology understands the Reactor Compartment Disposal Packages are a unique waste form and agrees the proposed disposition of these packages is environmentally protective and in compliance with WAC 173-303, provided the following conditions are satisfied.

- Liquids in the Reactor Compartment Disposal Packages shall be removed to the maximum extent practical considering As Low As Reasonably Achievable principles for controlling worker radiation exposure.

- Liquids existing in piping systems external to the forward and aft bulkhead shall be removed by draining from existing valves at low points, dismantling of the piping systems, or equivalent method.

- Liquids existing in piping systems internal to the forward and aft bulkheads shall be removed by draining from existing valves at low points, pumping out, "blowing down," using compressed gas, or equivalent method.

- Liquids in the reactor vessel and primary shield water tanks shall be removed to the maximum extent practical by pumping or equivalent method. A non-biodegradable sorbent shall be added to reactor vessels and primary water shield tanks (as internal configuration permits) to absorb any liquids remaining.

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Mr. James Rasmussen
February 28, 1996
Page 2

In the event a Reactor Compartment Disposal Package does not meet the criteria listed above, Ecology should be contacted prior to disposal to determine compliance with WAC 173-303. If you have any questions, please call me at 736-3048.

Sincerely,

Norman T. Hepner, P. E.
Nuclear Waste Program

NH:mf

cc: Mark French, USDOE
Jim Wrzeski, PSNS

ATTACHMENT 4

PREDICTION OF PITTING CORROSION PERFORMANCE OF SUBMARINE REACTOR COMPARTMENTS AFTER BURIAL AT TRENCH 94, HANFORD, WASHINGTON

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DEPARTMENT OF THE NAVY
NAVAL CIVIL ENGINEERING LABORATORY
PORT HUENEME, CA 93043-5003

IN REPLY REFER TO:
3900
Ser L43/0256

25 MAR 1992

From: Commanding Officer, Naval Civil Engineering Laboratory, Port Hueneme
To: Commander, Puget Sound Naval Shipyard, Bremerton, WA 98314-5000 (Code 2300.1)

Subj: CORROSION OF BURIED SUBMARINE REACTOR COMPARTMENTS

Encl: (1) NCEL Report "Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington" - March 1992

1. Enclosure (1) is a final report on an effort by the Naval Civil Engineering Laboratory (NCEL) to predict the corrosion behavior of decommissioned submarine reactor compartments that are to be buried at Hanford, Washington. The report was prepared at the request of the Nuclear Engineering Department, Code 2300.1, Puget Sound Naval Shipyard (PSNS) and is based upon both the evaluation of historical corrosion data from the literature and an NCEL inspection of steel structures exhumed from the vicinity of the burial site. This report completes the NCEL effort on this project.

2. Based upon a conservative evaluation of both the historical corrosion data from the literature and from the evaluation of structures exhumed from the vicinity of the burial site, a maximum penetration of 0.350 inches over a 100 year burial period was projected. A more realistic maximum penetration of 0.100 inches in 100 years can be achieved through the use of select backfill adjacent to the reactor compartments and the installation of a moisture barrier cover over the trench.

PAUL A. CHAPLA

RECEIVED MAR 31 1992

Prediction of Pitting Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington

March 1992

NCEL
Naval Civil Engineering Laboratory
Port Hueneme, CA 93043-5003

Author: Jim Jenkins

RECEIVED MAR 2 1 1992

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PREDICTION OF PITTING CORROSION PERFORMANCE OF SUBMARINE REACTOR COMPARTMENT AFTER BURIAL AT TRENCH 94, HANFORD, WASHINGTON

I. PURPOSE

The intent of this review is to provide a prediction of the maximum penetration which can be expected to occur due to pitting corrosion of Submarine Reactor Compartments during a 100 year period of burial in Trench 94 at Hanford, Washington. This information is needed to determine the need for controlling corrosion of the reactor compartments during the post burial period.

II. BACKGROUND

No site specific corrosion testing has been performed for reactor compartments buried in Trench 94. However, corrosion in Trench 94 soil can be related to experience with corrosion at other sites when comparisons are made based on chemical content, resistivity, aeration and method of burial. This relationship permits long range estimation of corrosion performance in Trench 94 using historical data from the other sites.

This method of predicting corrosion is supported by the results of a study on the conditions of underground fuel storage tanks exhumed at Hanford[1]. Thus, based on an investigation of testing conducted at various sites by the National Institute of Standards and Technology (NIST), formerly National Bureau of Standards, and correlating the results with the corrosion of fuel storage tanks at Hanford, it was possible to establish a conservative estimate of the corrosion of reactor compartments buried in Trench 94 over a 100 year period.

III. CONCLUSIONS

The predicted maximum pitting corrosion penetration for a 100 year period is 0.350 inches for the reactor compartments buried in Trench 94 at Hanford, Washington. The actual amount of pitting corrosion is likely to be considerably less than the estimated maximum penetration for the following reasons:

The HY80 steel used for the submarine hull and the MIL-S-22698 Grade DE-36, CL-U steel used for fabrication of the containment bulkheads on the ends of the compartments are more resistant to corrosion than the open hearth carbon steel used in the NIST corrosion tests.

The reactor compartments will be buried with native soil prepared to provide properties which will give corrosion rates lower than for unprepared native soils. The Hanford soil will be graded to remove stones greater than a half inch to create a uniform backfill that will prevent differential environments that can create galvanic cells that accelerate corrosion. The NIST test data and most of the data from the fuel storage tanks is for steel buried in native soil.

Moisture content of the soil in Trench 94 will be lower since a cover compliant with the requirements of the Resource Conservation and Recovery Act (RCRA) will be installed that reduces moisture incursion into the soil. The NIST test data and the fuel storage tank data are from sites that did not have such a cover. Even without a RCRA cover the moisture content would be lower in Trench 94 since the reactor compartments will be buried 10 to 40 feet underground as compared to NIST testing that was accomplished at 5 feet where the moisture content is higher.

Soil characteristics at Trench 94 are less corrosive than NIST test sites because of the comparable chloride and sulfate content and higher resistivity.

The estimation of the upper limit of corrosion is based on a linear projection of corrosion data which results in a conservative prediction of long term corrosion performance, since actual corrosion rates usually decrease over time.

IV. DISCUSSION

A review of historical corrosion data from studies previously accomplished at Hanford revealed that the conditions affecting corrosion and the materials investigated in most of these studies are not comparable to the reactor compartments buried in Trench 94. (as discussed in Appendix A). Thus, it was concluded that corrosion rates derived from these studies should not be used to predict corrosion rates for reactor compartments in Trench 94.

On the other hand, investigation of corrosion data from tests conducted by the NIST at various sites, and corrosion data from exhumed fuel storage tanks at Hanford, identified conditions more representative of the burial conditions for the reactor compartments in Trench 94 at Hanford, allowing the maximum depth of penetration to be confidently predicted for the 100 year post burial period.

Review of National Institute of Standards and Technology Corrosion Test Data

The use of historical data from other sites to predict corrosion rates at Hanford requires that the soil characteristics be comparable. The characteristics of soil which have the most significant effect on the corrosion performance of buried steel are the resistivity, chloride ion content, sulfate ion content, aeration, and pH.

Extensive soil analysis conducted in Trench 94 by Ebasco Services Incorporated[2X3] confirm that soil characteristics are very comparable with values normally used to describe Hanford[1X3]. Testing did identify an isolated area in Trench 94 with undesirable amounts of chloride and sulfate. However, as reported by Ebasco, these samples were obtained from a thin layer of clay in the trench side and are not representative of the soils in Trench 94.

NIST has conducted extensive corrosion studies on uncoated metals exposed to soil at many test sites[4]. While none of these tests were performed at the Hanford site, the data from several NIST test sites can be used to establish a probable corrosion rate for Trench 94 since the soil characteristics are similar. Soil characteristics and corrosion rates at several of the NIST test sites, and typical soil characteristics for Hanford are given in Table 1. All of the NIST sites have well aerated soils as does Hanford.

While soil characteristics of the NIST test sites are similar to those of Trench 94, the resistivity, which is the predominant factor in terms of corrosivity in these types of soils, is much higher at Trench 94. Therefore, higher corrosion rates are likely to result at the NIST test sites than will be experienced by the reactor compartments buried in prepared backfill in Trench 94. The data from the least corrosive NIST test site, Salt Lake City, indicates a penetration rate of 0.00229 inches per year based upon a test duration of 17.4 years. A projection of the data from the Salt Lake City data is shown in Figure 1. This projection gives a maximum penetration of 0.230 inches in 100 years and establishes a more realistic prediction of long term corrosion of the reactor compartments at Trench 94.

Prediction of long term corrosion performance from short term corrosion data, using a linear projection as discussed above, is imprecise because the corrosion rate varies with time. The corrosion rate for carbon steel generally decreases with time giving a curve which is concave downward as depicted in Figure 2. If the data is from a sufficiently long period, the corrosion data from intermediate periods of exposure can be used to project a realistic, but conservative estimate of long term corrosion performance. This is demonstrated by a linear projection, tangent to the curve for corrosion penetration versus time shown as the line to point A in Figure 2. Linear projection of long term performance from only one data point, a secant projection, will result in a very conservative estimate of long term corrosion performance shown as the line to point B in Figure 2. This secant projection results in a higher estimate of long term corrosion from the same corrosion data. Thus the linear projection used in this study to predict corrosion of reactor compartments is considered conservative

Data from Hanford Underground Storage Tanks

In the period between 1989 and 1991, 16 carbon steel fuel storage tanks, buried for as long as 46 years, were exhumed from the Hanford Site in the vicinity of Trench 94. An evaluation of the external corrosion of these tanks was performed[1] and established a maximum pitting corrosion rate of 0.0035 inches per year. The conclusions of this study are in agreement with results obtained using the NIST test data from other sites for predicting corrosion attributed to soil conditions at Hanford.

Of all the corrosion studies conducted at Hanford, the study of the buried fuel storage tanks most closely relates to the conditions under which the reactor compartments will be buried in Trench 94. The fuel storage tanks were buried in soils and backfill representative of the general characteristics of the Hanford Site[1] as described in Table 1. From inspections of the backfill adhering to the fuel storage tanks, it was apparent that some of the tanks were buried using select backfill (sand), while others had been buried using backfill which had not been prepared, containing both very fine material and large rocks. The tanks buried with unprepared backfill exhibited the worst cases of pitting corrosion due to large stones being in contact with the tank. This created galvanic cells that accelerated the corrosion rate at the point of contact. In comparison, the maximum pitting corrosion rate for the fuel storage tanks buried in prepared backfill was significantly less and ranged between 0.0013 and 0.0019 inches per year.

The corrosion data from the evaluation of the fuel storage tanks is considered to be applicable for establishing an upper limit on the pitting corrosion of the reactor compartments at Trench 94. A linear projection of the highest pitting corrosion rate gives a conservative estimate of 0.350 inches of pitting corrosion penetration over a 100 year period. For the reactor compartments, lower corrosion rates will be achieved by using prepared native soil, providing an environment which is free from stones or other debris which can cause differential cells that accelerate corrosion. In addition, a lower moisture content will be achieved by installation of a RCRA cover.

V. SUMMARY

In estimating an upper limit for the corrosion of reactor compartments buried in Trench 94 at Hanford, Washington, both historical test data from similar sites and data from excavated material buried in the vicinity of Trench 94 were assessed. In all cases assumptions made in assessing the data were conservative and result in a projection of corrosion penetration higher than that which is realistically anticipated. An estimate of 0.350 inches of penetration of the reactor compartments over a 100 year period is projected as a conservative upper limit considering the assumptions used in the evaluation of the corrosion data. However, a penetration of 0.100 inches in 100 years is expected due to the benign conditions which will be established in the controlled burial of reactor compartments in Trench 94.

Table 1

Soil Characteristics
and Pitting Corrosion Data for
the National Institute of Standards and Technology[4]
Corrosion Test Sites
Compared to Hanford[3X2]

Site	Resistivity (ohm-cm)	Chloride (mg-eq/100g)	Sulfate (mg-eq/100g)	pH	Maximum Penetration Rate (Inches/yr.)
Springfield Ohio	2,980	0.03	0.12	7.3	0.00255
Los Angeles California	2,600	0.06	0.35	7.3	0.00338
Salt Lake City, Utah	1,700	0.06	0.48	7.6	0.00229
Hanford Washington	5,000	0.01	0.10	8.2	—
Trench 94 Hanford Washington	31,000	0.08	0.21	8.2	—

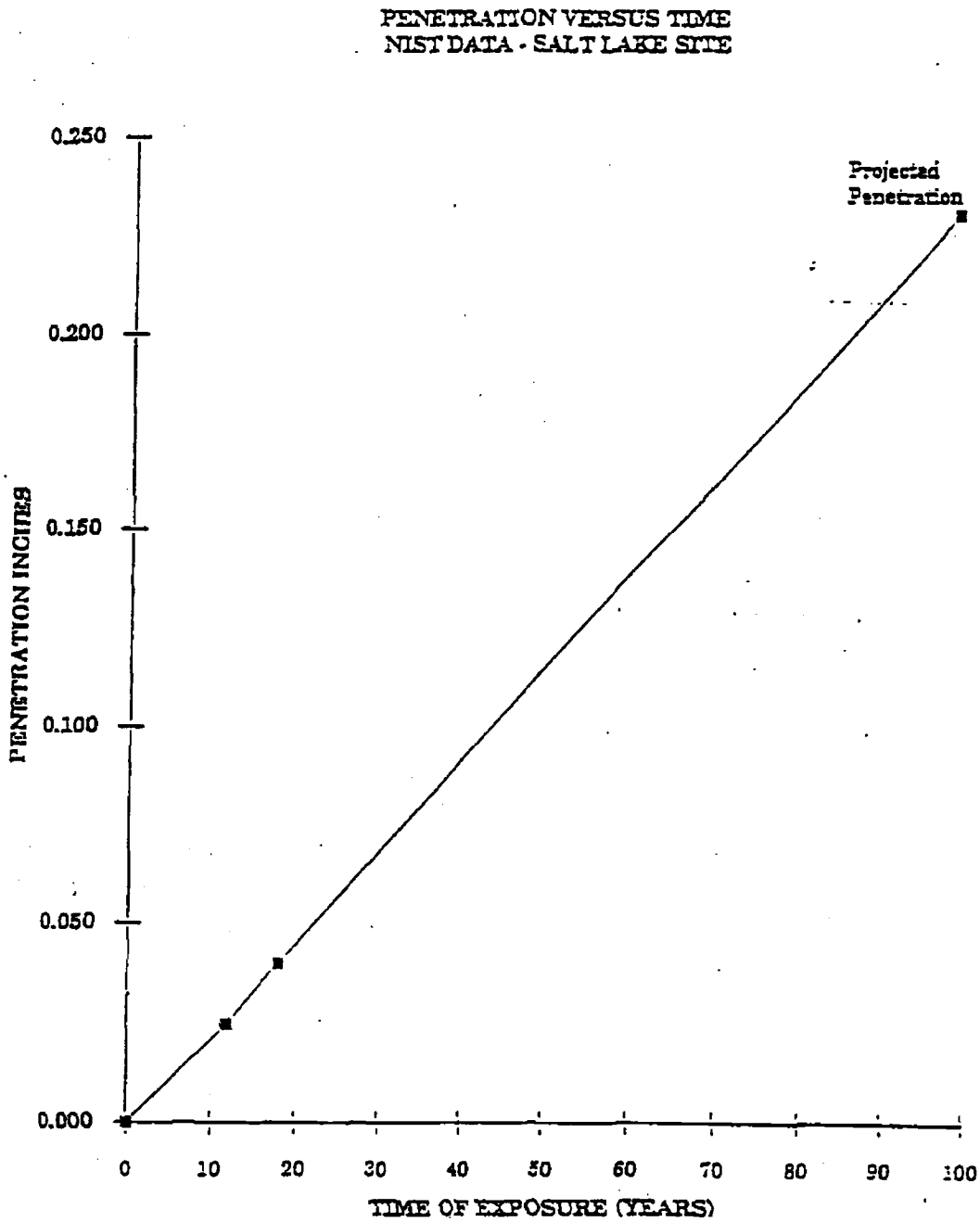

Figure 1. Projection of NIST Salt Lake City Pitting Corrosion

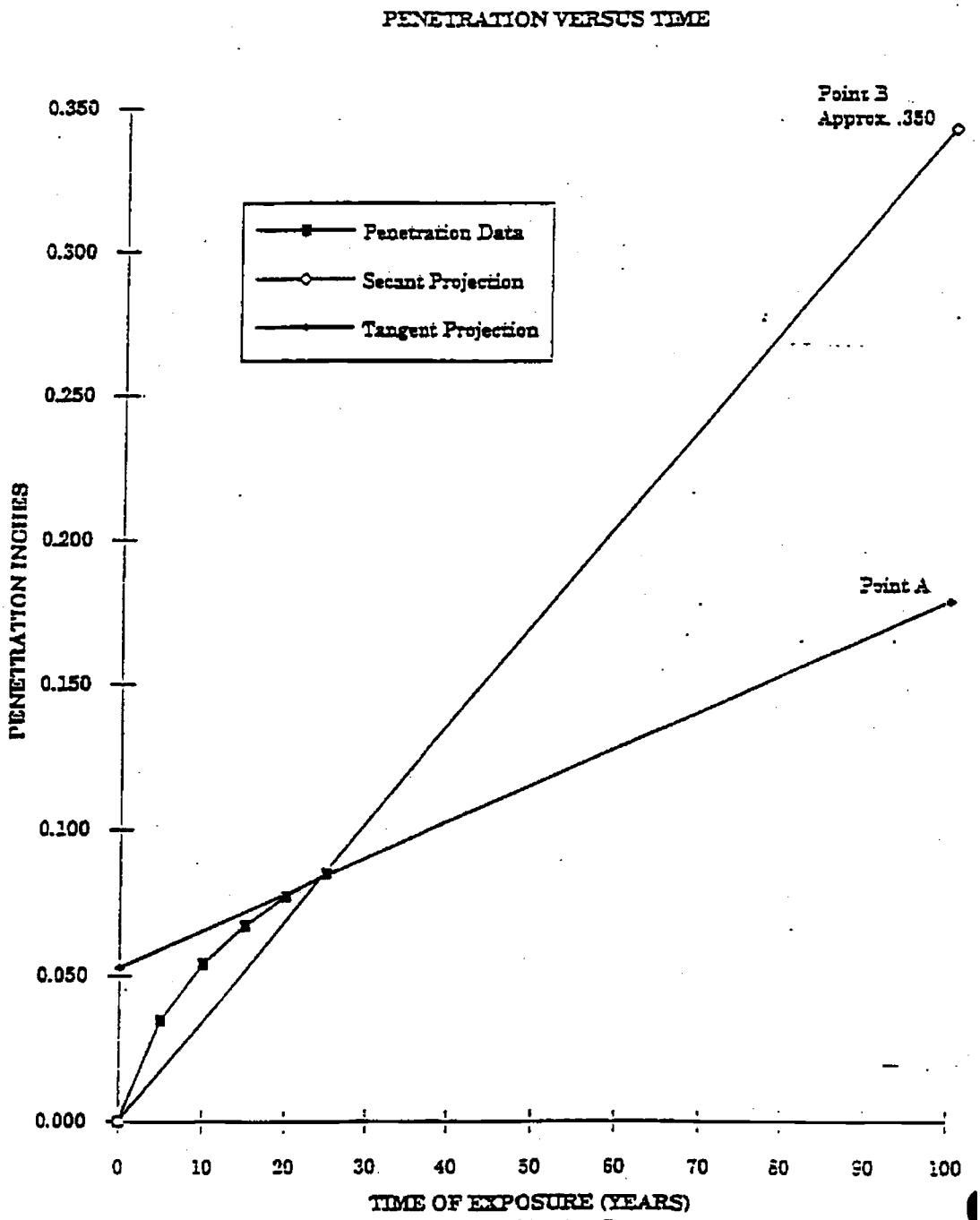

Figure 2. Comparison of Actual Pitting Corrosion Data to Single Point Data Projection (using simulated data)

References

1. "Underground Fuel Storage Tank Corrosion Study" by W.C. Carlos, WHC-EP-0507, Westinghouse Hanford Company, February 1992.

2. "Report on Soils in Naval Trench 94" by Ebasco Services Incorporated, September 4, 1991.

3. "Supplemental Report on Soils in Naval Trench 94" by Ebasco Services Incorporated, October 29, 1991.

4. "Underground Corrosion" by Melvin Romanoff, National Bureau of Standards Circular 579, April 1957.

5. "A Review of the Hanford Site Soil Corrosion Applicable to Solid Waste containers" by J. R. Divine, WHC-EP-0408, Pacific Northwest Laboratory, May 1991.

6. "Corrosion in Waste Drums from the 183H Solar Evaporation Basin Cleanout Project" by D. R. Duncan, WHC-IP-0716. Westinghouse Hanford Company, January 16, 1991.

7. "Inspection of Retrievably Stored Transuranic Waste Containers" by R. C. Morton, SD-WM-TRP-002. Rockwell Hanford Operations, July 15, 1982

8. "Evaluation of Soil Corrosion at Hanford Atomic Products Operation - Summary Report - Underground Pipeline and Structure Corrosion Study Program" by R. T. Jaske, General Electric, April 15, 1955.

9. "Corrosion Behavior of Selected Stainless Steels in Soil Environments" by E. Escalante, National Bureau of Standards Circular NBS-IR-81-2228 (NBS).

Appendix A

Summary of Previous Corrosion Studies as They Relate to Burial of Submarine Reactor Compartments in Trench 94

Prior to the underground fuel storage tank corrosion study [1], corrosion studies at the Hanford Site have been performed, mainly to determine the estimated service life of drum type waste containers and underground utilities. Previous Hanford Site data is based primarily on visual observation, as opposed to that obtained using more accurately measured data and well documented data gathering techniques[5]. Thus, existing data is considered only approximate and is limited in scope.

Many corrosion studies previously performed at Hanford have limited applicability since they document specific burial conditions that accelerated the rate of corrosion beyond that occurring in native Hanford soil. These conditions include elevated corrosivity of waste internal to the container[6], excessive humidity in the disposal environment[7] and elevated temperatures of soil with mineral or chemical content not representative of native Hanford soil[8]. Therefore, a close examination of the burial conditions is necessary before information from a specific study can be used to predict corrosion rates of materials at Hanford. In particular, none of the burial conditions discussed in these studies are representative of the conditions that will exist for the reactor compartments buried in Trench 94.

The corrosion data from NIST studies conducted at the Toppenish[9] site is commonly used in the projection of the corrosion behavior of steel at the Hanford site. However, as shown in Table A-1, the soil characteristics at the other three sites are considered more representative of Hanford than Toppenish. The chloride and sulfate levels at Toppenish are significantly higher than Hanford and the other NIST tests sites. The only soil characteristic at Toppenish that is comparable to the Hanford Site is pH.

Values for pH between 7 and 11 are normally considered mildly alkaline. Consequently, it is concluded that a higher corrosion rate at Toppenish results from the higher chloride and sulfate levels. It appears that the decision to use corrosion rates for Toppenish to predict corrosion at Hanford was very conservative because of the higher chloride and sulfate content of the Toppenish soil, as indicated by previous studies[5].

In summary, these earlier reports document corrosion rates which are higher and not solely a result of exposure to native Hanford soil as will be the condition for the reactor compartments in Trench 94 at Hanford. In fact, little existing Hanford corrosion data is considered useful in the accurate prediction of corrosion performance of reactor compartments in Trench 94 and studies with more comparable conditions and materials, such as the exhumed fuel storage tank study, should be utilized.

TABLE A-1
Soil Characteristics
and Pitting Corrosion Data for
the National Institute of Standards and Technology[4]
Corrosion Test Sites
Compared to
Toppenish[9] and Hanford[8,12]

Site	Resistivity (ohm-cm)	Chloride (mg-eq/100g)	Sulfate (mg-eq/100g)	pH	Maximum Penetration Rate (Inches/yr)
Springfield Ohio	2,980	0.03	0.12	7.3	0.00355
Los Angeles California	2,600	0.06	0.35	7.3	0.00338
Salt Lake City, Utah	1,700	0.06	0.48	7.6	0.00229
Toppenish Washington	6,000	0.93	0.45	8.8	0.00890
Hanford Washington	5,000	0.01	0.10	8.2	—
Trench 94 Hanford Washington	31,000	0.08	0.21	8.7	—

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ATTACHMENT 5

LETTER REPORT FROM E.N. PUGH (NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY) TO G.R. YOUNT (PUGET SOUND NAVAL SHIPYARD) REGARDING REVIEW OF "PREDICTION OF PITTING CORROSION PERFORMANCE OF SUBMARINE REACTOR COMPARTMENTS AFTER BURIAL AT TRENCH 94, HANFORD, WASHINGTON"

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NIST

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

April 16, 1992

Capt. G.R. Yount, U.S. Navy
Commander
Puget Sound Naval Shipyard
Code 100
Bremerton, WA 98814-5000

Dear Capt. Yount,

As requested in your Order For Work And Services number N00251-92-WR-20230, attached is our letter report on the review of the Naval Civil Engineering Laboratory document entitled "Prediction of Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington".

Sincerely,

Dr. E.N. Pugh, Chief
Metallurgy Division

NIST

UNITED STATES DEPARTMENT OF COMMERCE
National Institute of Standards and Technology
Gaithersburg, Maryland 20899

April 16, 1992

Capt. G. R. Yount, U.S. Navy
Commander
Puget Sound Naval Shipyard
Code 100
Bremerton, WA 98814-5000

Dear Capt. Yount,

This is a letter report on our review of the document entitled "Prediction of Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington" by Jim Jenkins [1]. Jenkins examined the results of NBS (now renamed NIST) underground corrosion tests with soils similar to Trench 94 at Hanford [2,3] and the results of examinations of tanks buried for up to 46 years at a site near Trench 94 at Hanford [4] and concluded that the expected pitting corrosion rate of steel in the trench would be approximately 0.001 inches per year and that the maximum corrosion penetration after 100 years would be less than 0.350 inches. After careful review of Jenkins' report, the report on tanks buried at Hanford and the original NIST data, we conclude that Jenkins utilized conservative procedures for developing these estimates and, in our opinion, the corrosion rates for the reactor compartments in Trench 94 will be within these figures.

This opinion is based on the following conditions. The first is that the corrosion behavior of the NIST samples at the NIST sites with soils identified as similar to Trench 94 will be representative of the behavior of the reactor components. The second is that the processes that determined that corrosion behavior during the exposure periods used for the NIST study (~17 years) will continue to limit the corrosion rate in a similar manner in Trench 94 for 100 years. The third is that the soils in contact with all of the steel surfaces will be essentially the same as that given in the specification for Trench 94 soil. The fourth, is that in using the maximum penetration data from the tanks buried at Hanford, it is assumed that the corrosion behavior of these tanks was similar to that observed in the NIST studies.

To evaluate the condition that soils at the NIST sites are representative of the soil in Trench 94, we examined the original data on the characteristics of the soils at the NIST sites identified by Jenkins. In Table 1 of his report, Jenkins specifies three soils at NIST sites as similar to soils at Trench 94 in Hanford. These are site #26 in Springfield OH, site #35 in Los Angeles CA, and site #47 in Salt Lake City UT. In

Table A1, appendix A, he also lists NIST site A in Toppenish WA as of interest because of its proximity to Hanford, but not necessarily similar to the Hanford soils [2]. References in his document identify NIST sites #12 in Los Angeles, site #20 in Cleveland OH, and site #32 in Rochester NY as similar to soils in the Hanford complex, but not necessarily at Trench 94 [3]. We agree with Jenkins that, except for the Toppenish site, these soils are similar to that reported for Trench 94. To evaluate the validity of using the Toppenish site to estimate the behavior in Trench 94, we went back to the original measurements of the soil characteristics and found that the values given in reference [3] and cited by Jenkins are correct. This is important as the chloride content of the Toppenish soil is more than ten times that given for Trench 94 and, therefore, this site should not be considered representative of conditions expected for Trench 94. The other sites are reasonable choices, but underground corrosion is a complex issue and the use of corrosion data from one site to predict corrosion behavior at another site has not been thoroughly evaluated scientifically and, in some cases [6], has failed to provide accurate estimates.

To develop a corrosion penetration estimate from the NIST data for comparison to Jenkins' estimate, we combined all of the average maximum penetration data from the NIST sites identified by Jenkins as similar to Trench 94, excepting the Toppenish site, and performed a linear regression analysis, figure 1. This approach assumes that the variations in the soil characteristics and the corrosion rates at these NIST sites should encompass the variations at Trench 94. Linear regression analysis of this data estimates the expected maximum penetration in samples buried at the NIST sites for 100 years as 0.218±0.103 inches with a 99% confidence interval. While this corresponds to an estimated penetration rate of 0.00198±0.00054 inches which is greater than the 0.001 inches per year determined by Jenkins, the maximum penetration estimated by this technique with a 99.5% confidence is 0.321 inches which is below Jenkins' maximum penetration estimate of 0.350 inches.

To evaluate the validity of using a linear model for the maximum penetration (a constant corrosion rate), we examined the exponent, n, determined by Romanoff [3] by fitting the NIST data to the relationship

$$P=Kt^n$$

For a constant corrosion rate as required for linear behavior, the value determined for this exponent would be one and, if the corrosion rate decreases with time, the value of this exponent will be less than one. Romanoff's results are given in Table 1 and, by examining this table, it can be seen that for all of the sites identified by Jenkins as having soil characteristics similar to Trench 94, the exponent, n, was less than one and, in most cases, significantly less than one. Therefore, Romanoff's results demonstrate that using 1 as the exponent for estimating the maximum corrosion penetration is a conservative estimate.

z

In our discussion, we have used the term maximum penetration rate to represent the maximum wall thinning that occurs at the bottom of the corrosion pits that form when steel corrodes in soils. We avoided using the term "pitting corrosion" to describe this form of attack because we did not want to confuse this type of attack with the pitting corrosion that is observed on passive metals such as stainless steels when they are exposed to solutions containing halide ions. For pitting of steels in soils, the pits result from variations in the environment in contact with the surface of the samples which cause local variations in the corrosion rate and, as corrosion products accumulate on the surface, the rate of pit propagation decreases as shown by Romanoff.

Jenkins uses five additional arguments explain why the maximum penetration at Trench 94 would be less than that observed at the NIST test sites. Our comments on each of these is as follows:

1) Jenkins states that the HY 80 steel and the Grade DH-36, CL-U steel are more resistant to underground corrosion than steels used by NIST. Although 3.5 % Ni and 0.9% Cr are added to the HY80 alloy to enhance low temperature toughness and the low carbon improves weldability, these slight variations from a plain carbon steel would provide only minimal improvement of the underground corrosion performance of alloy HY 80 for the time frame of interest. Similarly, the Grade DH-36 CL-U Steel has a slightly elevated Mn and Si compared to a plain carbon steel, but again, these modifications will not significantly improve its corrosion performance in an underground environment.

2) Jenkins states that by using prepare backfill with no stones larger than 0.5 inches the soils will be less corrosive than similar NIST soils. We believe that removal of large stones from the Trench 94 backfill makes the Trench 94 backfill more similar to the NIST soils. None of the NIST test site soils contain the large (10 inch), oblong stones found at trench 94. The largest (2 inch) stones at any NIST site are found at Site B in Baltimore, and they are relatively few in number compared to Trench 94. Jenkins statement is more appropriate for the tanks buried at Hanford where the maximum penetrations were higher for the tanks buried with unprepared native soil than the tanks buried with prepared backfill.

3) We agree that a continuous, unperforated plastic cover at Trench 94 will reduce moisture intrusion from the soil surface. It is also true that the water table at most NIST sites is considerably higher than that found at Trench 94, because water tables are closer to the soil surface and in general, rainfall is greater. Since the deterioration rate of the plastic cover is unknown, it cannot be factored into the estimates.

4) We agree that the resistivity of soil at Trench 94 is generally higher than that found at any of the NIST underground test sites, and in this respect is expected to be less corrosive than the NIST soils. Chloride and sulfate content at Trench 94 and the NIST sites identified by Jenkins are very similar, and would not be expected to have a significant effect on relative corrosivity of these soils.

5) We agree that a linear projection of maximum pit penetration as performed by Carlos, provides a conservative estimate of the corrosion penetration. There is an uncertainty associated with any extrapolation beyond existing data and conservative approaches are required.

In summary, it is our opinion that Jenkins' conclusion, that the maximum penetration of steels buried in these environments will be less than 0.350 inches after 100 years and the expected or average pitting corrosion rate will be 0.001 inches per year, is reasonable given the conservative estimation procedures he employed, our existing knowledge of corrosion mechanisms, the environmental conditions expected at Trench 94, and the existing NIST data on corrosion behavior of similar steels at similar sites.

Sincerely,

Edward Escalante
Corrosion Group

Richard E. Ricker, Ph.D.
Group Leader
Corrosion Group

References

1) J. Jenkins, "Prediction of Corrosion Performance of Submarine Reactor Compartments After Burial at Trench 94, Hanford, Washington, (DRAFT), Naval Civil Engineering Laboratory, Port Hueneme, CA, January 1992.

2) W.F. Gerhold, "Corrosion Behavior of Ductile Cast-Iron Pipe in Soil Environments", J. American Water Works Assoc., v68, n12, December 1976.

3) M. Romanoff, "Underground Corrosion", National Bureau of Standards Circular 579, April 1957, reprinted by the National Association of Corrosion Engineers, Houston, TX, 1989.

4) W.C. Carlos, "Underground Fuel Starage Tank Corrosion Study", Westinghouse Hanford Co., WHC-EP-0507, February 1992.

5) R.E. Walpole, R.H. Myers, "Probability and Statistics for Engineers and Scientists", The Macmillan Co., New York, 1972.

6) W. J. Schwerdtfeger, "Soil Resistivity as Related to Underground Corrosion and Cathodic Protection," J. Res. of NBS, v69c, n1, January-March 1965.

Table 1 - Mean values of constants $k_{5.3}$ and n and their standard errors. [3]

Site No.	Soil Type	$k_{5.3}$	$\sigma_{k5.3}$	n	σ_n
12	Hanford fine sandy loam	51.2	14.0	0.13	0.73
20	Mahoning silt loam	34.4	2.7	0.42	0.09
26	Miami silt loam	45.7	7.1	0.41	0.22
32	Ontario loam	44.8	2.6	0.33	0.07
35	Ramona loam	26.5	1.3	0.25	0.08
47	Unidentified silt loam	20.1	1.2	0.32	0.08

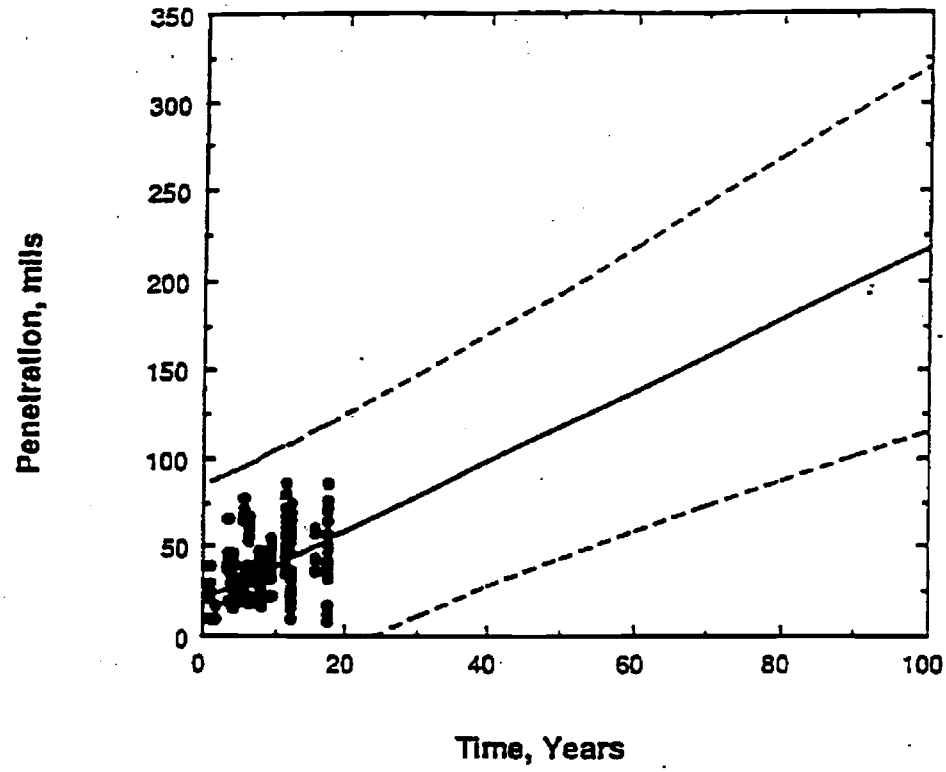

Figure 1 - Linear regression analysis of the average maximum penetration data obtained at all of the sites identified by Jenkins as having soils similar to Trench 94. The dashed lines represent the upper and lower limits of the expected values at the 99% confidence level based on the linear growth rate assumption.

ATTACHMENT 6

LETTER FROM D.R. HELGESON (CORROSION CONTROL SPECIALISTS) TO C.L. REAUME (PUGET SOUND NAVAL SHIPYARD) REGARDING SOIL RESISTIVITY TESTING, HANFORD, WASHINGTON

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CCS CORROSION CONTROL SPECIALISTS

R & B Corporate Park, Suite P101
6617 South 193rd Place
Kent, Washington 98032
(206) 251-8075

June 29, 1990

Puget Sound Naval Shipyard
Officer In Charge of Construction
Public Works Dept. Code 460
Bremerton, Washington

Attn: Cheryl L. Reaume

Ref: Soil Resistivity Testing
Hanford, Washington
Contract No. N62474-90-M-6478

Dear Ms. Reaume,

On Wednesday June 27,1990 CCS completed the testing as directed by the referenced contract. The preliminary results were faxed to your office on June 28, 1990. The following is a summary of the procedures used and a brief analysis of the data.

Test Procedures

The test procedure followed was that described by The ASTM Standard Method G-57-78, " Field Measurements of Soil Resistivity Using The Wenner Four electrode Method ". The testing was completed using a Nilsson Model 400 soil resistivity meter Certified and Calibrated on June 26, 1990. A sketch is attached depicting the general arrangement of the meter, electrodes, and wiring.

Testing was witnessed by William Carlos (Westinghouse) and by G.L. Ecklund (U.S. Navy). Testing was done at six locations. One test was completed on each side of the existing excavation for Trench 94 and one test for each of two spoil piles. Testing was done at each location with pin spacings of 10, 20, 30, 40, and 50 feet.

Prior to leaving the site copies of the raw data collected was provided to William Carlos.

The Wenner four pin test procedure provides the average resistivity of the soil to a depth equal to the pin spacing. Therefore testing was completed at several depth in addition to the 50 foot spacing requested to better characterize the soil. Moreover the data may be enhanced by processing the data with formulations developed by H.E. Barnes. The Barnes formulations provides an approximation of soil resistivities for depth layers. The data collected for these test were processed in this manner. The data is tabulated on the attached data sheets.

The data is useful in both evaluating the potential for corrosion activity and for designing cathodic protection. However in evaluating the potential for corrosion activity of a site, it should not be done using soil resistivities alone. Soil resistivities should be combined with the other parameters, as you have scheduled for testing, including conductivity, sulfides, sulfates, chlorides, moisture content, and pH.

Results and Analysis

The soil resistivity data collected at this site is generally classified as high and not very corrosive but it does show some stratification. Further the Barnes layer calculations on the north side of the trench would indicate a more aggressive environment for buried steel. However in analyzing soil resistivities by themselves, caution should be used in drawing any firm conclusions regarding the potential for corrosion. The National Association of Corrosion Engineers (NACE) in their basic short courses provide a guideline for the relative amount of corrosion in the absence of mitigating measures. Those guidelines are as follows:

Soil Resistivity		Relative Corrosion Rate
Below 500	ohm-cm	Very Corrosive
500 to 1000	ohm-cm	Corrosive
1000 to 2000	ohm-cm	Moderately Corrosive
2000 to 10,000	ohm-cm	Mildly Corrosive
Above 10,000	ohm-cm	Progressively less Corrosive

NACE does not suggest that in high resistivity soils that there is no corrosion but only that the rates of corrosion in general decrease. The conceptual cathodic protection design package being evaluated by the Navy for the SRC site provides a reference in Attachment 3 to H.C. Van Nouhuys. Van Nouhuys classifies and evaluates soils in

high ranges that extend up to a million ohm-cm. The majority of his conclusions were arrived at by collecting pipeline leak histories in high resistivity soils. His work is supported by many others working with underground pipelines and tanks.

Thus it is our recommendation that cathodic protection be applied to the SRC's even though the soil resistivities are classified as high with relativity low corrosion rates. The basis for this recommendation is based on the present plan to maintain the integrity of the SRC in excess of 100 years.

Also in reviewing the conceptual design being prepared it would appear the Navy is desirous of a galvanic system. This is the most desirable type of cathodic protection system in nearly all applications. However, to make the installation of a galvanic system effective in high resistivity soils economically feasible, the current requirement must be low. Based on my casual inspection of the SRC's while on site, it is my opinion the quality of coating may need to be upgraded to achieve that end. It would be my recommendation the a detailed coating inspection of each SRC be completed prior to formalizing the selection of a galvanic anode design.

CCS would be pleased to assist the Navy with this project as it proceeds. If we can clarify any of the above please contact our office.

Sincerely

Dennis R. Helgeson, P.E.

ıC Site (Trench 94)
ınford, Washington
-84

D. Helgeson
6/27/90
Nilsson (Model 400)
S/N 40-2291

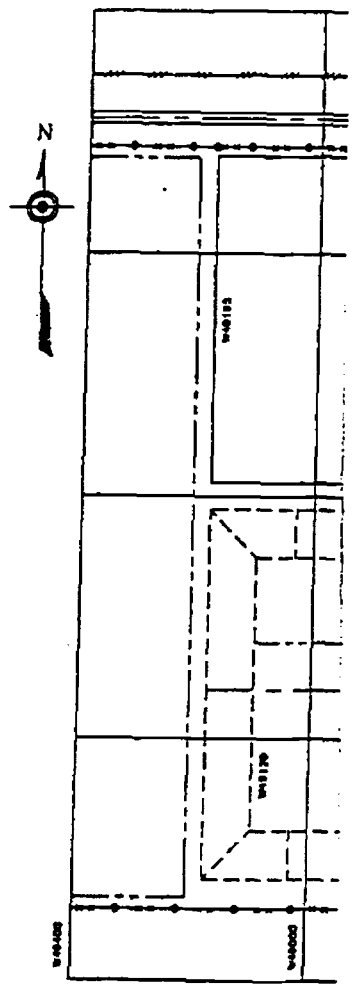
Soil Resistivity Data
Wenner four Pin Method

Test Site	Location	Pin Spacing (ft)	Soil Resistivity (ohm-cm)	Barnes Layer Resistivity (ohm-cm)
1	East side of trench	10	36,385	--
		20	65,110	309,270
		30	22,980	10,017
		40	37,534	**
		50	41,173	67,247
2	South side of trench	10	70,855	--
		20	103,410	191,309
		30	166,305	**
		40	72,004	26,634
		50	41,173	15,177
3	Spoil pile to south of trench	10	23,938	--
		20	22,980	22,096
		30	34,470	**
		40	35,236	37,753
		50	54,578	**
4	West side of trench	10	107,240	--
		20	91,920	80,432
		30	97,665	111,616
		40	91,920	78,131
		50	85,218	65,975

Page 1 of 2
Corrosion Control Specialists

Test Site	Location	Pin Spacing (ft)	Soil Resistivity (ohm-cm)	Barnes Layer Resistivity (ohm-cm)
5	North side of trench	10	21,065	--
		20	10,140	**
		30	25,283	114,182
		40	21,448	14,194
		50	14,363	6,187
6	Spoil pile to north of trench	10	36,385	--
		20	32,385	30,087
		30	41,939	92,481
		40	29,108	15,178
		50	53,620	**

** The Barnes layer calculation is not valid for these layers



SITE I

NOTES:

1. S.R.C. STANDS FOR SUBMARINE REACTOR COMPARTMENT.
2. SOIL RESISTIVITY TESTS, WENNER FOUR-ELECTRODE METHOD ASTM-G 57-78 (1984).

RESISTIVITY TEST TABLE

TEST NO.	LOCATION
1.	EAST SIDE OF TRENCH, FIRST PIN LOCATED 88.5' FROM ℄ OF CANTON AVE., IN-LINE WITH SOUTH SIDE OF SRC NO. 1. (PIN ALIGNMENT N-S)
2.	SOUTH SIDE OF TRENCH, FIRST PIN LOCATED 35' DUE WEST OF POWER POLE. (PIN ALIGNMENT E-W)
3.	TOP OF SOUTH SPOIL AREA, FIRST PIN LOCATED 70' DUE SOUTH OF TEST 2. (PIN ALIGNMENT E-W)
4.	WEST SIDE OF TRENCH, FIRST PIN LOCATED 20' DUE WEST OF EDGE OF TRENCH, IN-LINE WITH SOUTH SIDE OF SRC NO. 1. (PIN ALIGNMENT N-S)
5.	NORTH SIDE OF TRENCH, FIRST PIN LOCATED AT EDGE OF PIT. (PIN ALIGNMENT E-W)
6.	TOP OF NORTH SPOIL AREA, FIRST PIN LOCATED AT EDGE OF PIT. (PIN ALIGNMENT E-W)

U.S. DEPARTMENT OF ENERGY

NAVAL SRC
TRENCH 94
SOIL RESISTIVITY TEST

SK-2-240

BEST AVAILABLE COPY

APPENDIX 4E

SITE INVESTIGATION REPORT

Transmitted from DOE-RL to Ecology.

Reference: Low-Level Burial Grounds Dangerous Waste Permit Application Supplement 2: Design Documentation for Mixed Waste Nondragoff Land Disposal Facility (DOE/RL-88-20, Supplement 2, Revision 0).

Site Investigation Report: WHC-SD-W025-SE-001, Revision 0.

Correspondence Number: 90-PPB-186, September 20, 1990.

APPENDIX 4F

9090A TEST RESULTS

Transmitted from DOE-RL to Ecology.

Reference:	A Final Report: Laboratory Testing of Geomembrane for Waste containment Environmental Protection Agency Method 9090
Document Number:	9090 Test Results, WHC-SD-WM-TRP-237, Revision 0.
Correspondence Number:	96-SWT-333, November 7, 1996.

APPENDIX 4G

SOIL LINER PERFORMANCE CALCULATIONS

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APPENDIX 4G

SOIL LINER PERFORMANCE CALCULATIONS

Assume Net Infiltration = Total precip - evapotrans (no run-off)

[From WHC 1992 (Project W-025 Design Report), Appendix C.1, page 44]:

Precip	=	"7.08"
Evapotrans	=	5.46
Net Infiltration	=	1.62"

Assume landfill is open for 10 years.

Assume no flexible membrane liner, no holding time/storage for precipitation.

$\therefore$ Head on soil liner after 10 years = 10 x 1.62 = 16.2"

Average head = 16.2"/2 = 8.1"

Darcy's Law: q = KiA

and q/A = V

$\therefore$ V = Ki where K = hydraulic conductivity = 10^{-7} cm/sec
i = pressure gradient = 8.1"/36" = 0.225

$\therefore$ V = 0.225 x 10^{-7} cm/sec.

In 10 years, penetration = 0.225 x 10^{-7} cm/sec x 3600 sec/hr x 24 hr/day x 365 day/yr x 10 years
= 7.1 cm
= 2.8 in.

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APPENDIX 5A

SELECTED GROUNDWATER CONTAMINANT PLUME MAPS IN THE 200 AREAS

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APPENDIX 5A

SELECTED GROUNDWATER CONTAMINANT PLUME MAPS IN THE 200 AREAS

This appendix contains groundwater contaminant plume maps for the 200 East and 200 West Areas based on data collected in fiscal year 2001 and presented in PNNL-13788.

5A.1 200 East Area

Figures 5A-1 through 5A-5 show plume maps for major groundwater contaminants in the 200 East Area. The lowest concentration contours shown are for the following:

- 1 pCi/L for iodine-129 (drinking water standard)
- 20 mg/L for nitrate as NO_3 (approximately one-half of the 45 mg/L maximum contaminant level)
- 450 pCi/L for technetium-99 (one-half of the 900 pCi/L drinking water standard)
- 2,000 pCi/L for tritium (one-tenth of the 20,000 pCi/L drinking water standard)
- 30 ug/L uranium (maximum contaminant level).

5A.2 200 West Area

Figures 5A-6 through 5A-11 are plume maps for the 200 West Area. The lowest concentration contours shown are for the following:

- 5 µg/L for carbon tetrachloride (maximum contaminant level)
- 1 pCi/L for iodine-129 (drinking water standard)
- 20 mg/L for nitrate as NO_3 (approximately one-half of the 45 mg/L maximum contaminant level)
- 450 pCi/L for technetium-99 (one-half of the 900 pCi/L drinking water standard)
- 2,000 pCi/L for tritium (one-tenth of the 20,000 pCi/L drinking water standard)
- 30 µg/L for uranium (maximum contaminant level).

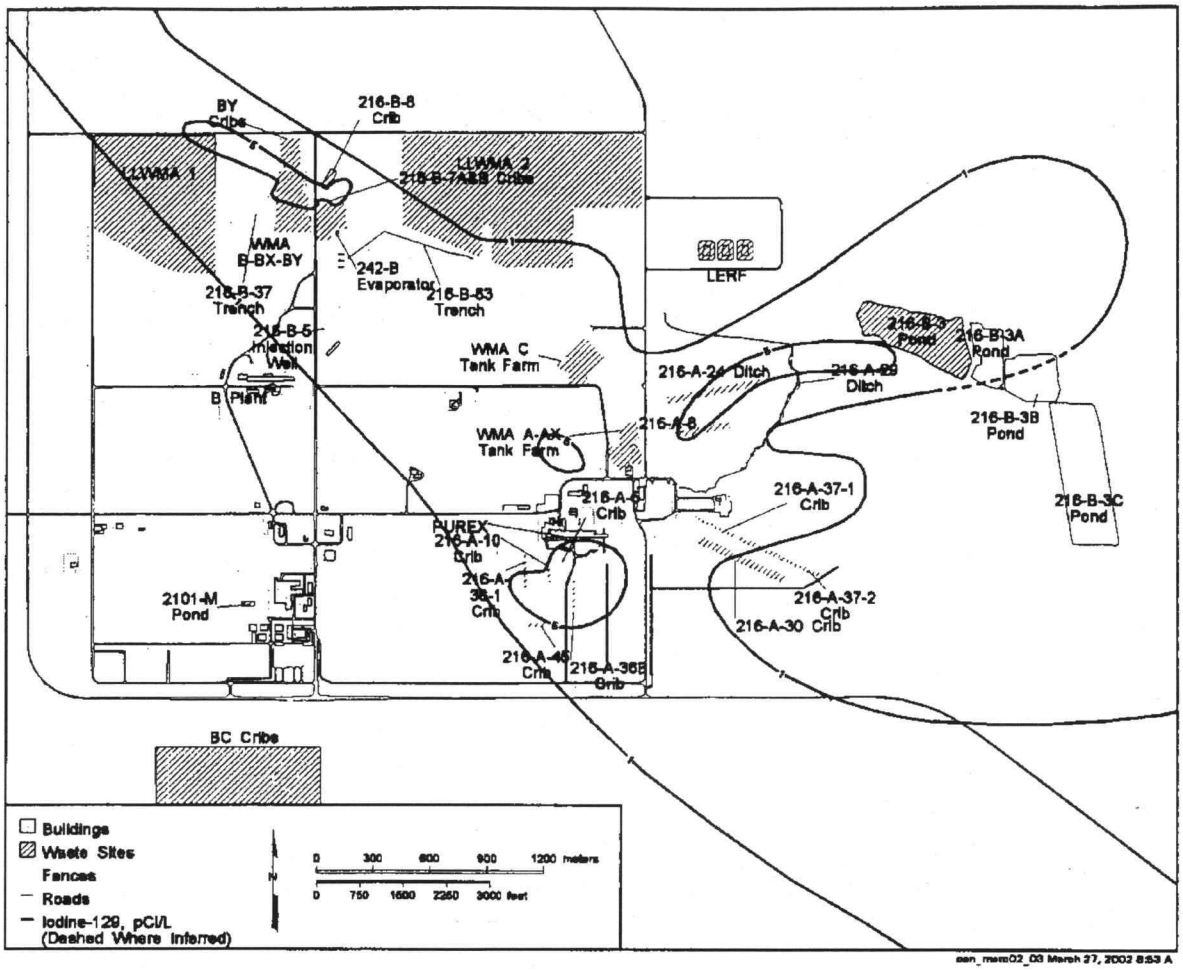

Figure 5A-1. Distribution of Iodine-129 at the Top of the Unconfined Aquifer, Fiscal Year 2001.

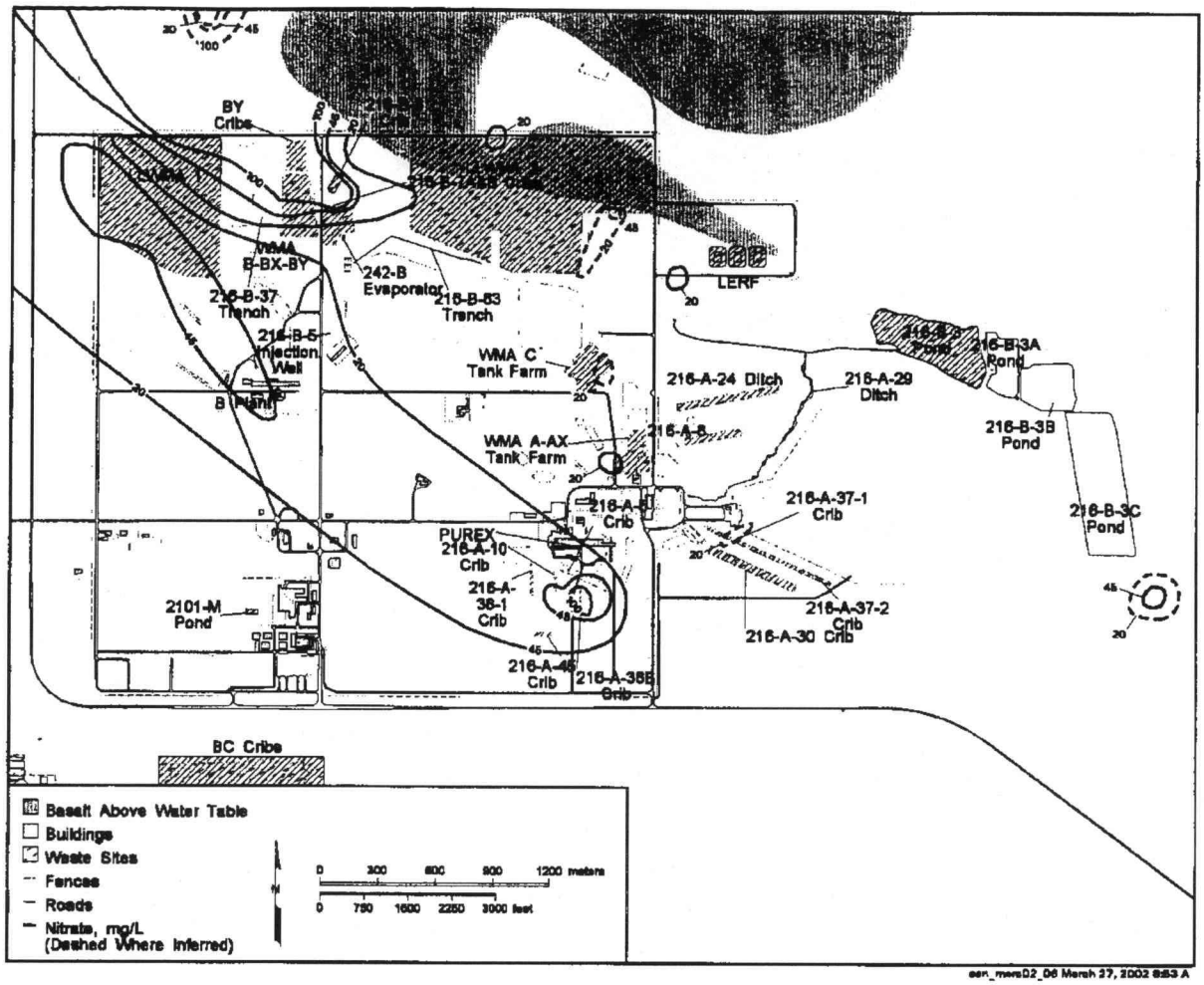

Figure 5A-2. Distribution of Nitrate at the Top of the Unconfined Aquifer, Fiscal Year 2001.

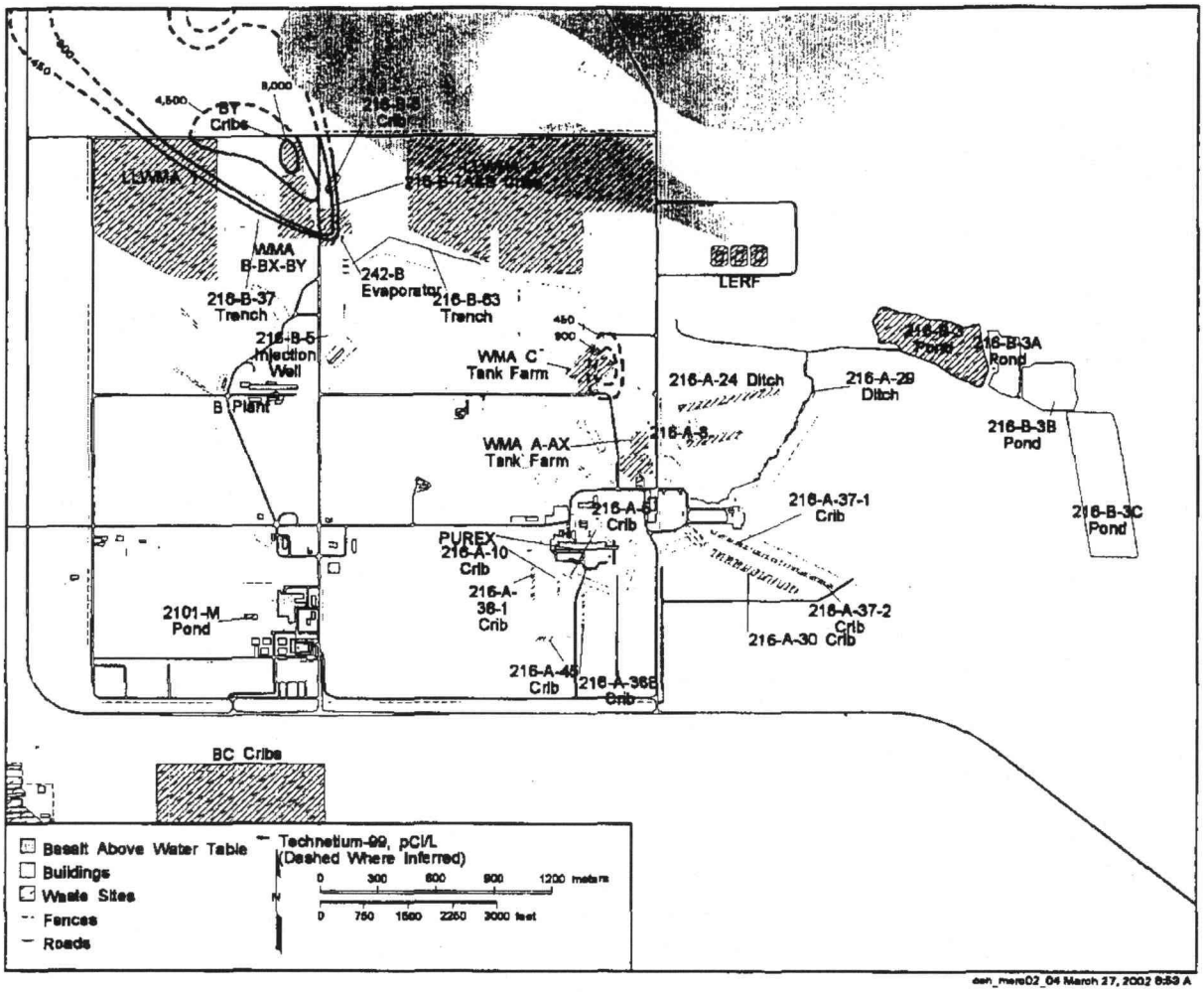

Figure 5A-3. Distribution of Technetium-99 at the Top of the Unconfined Aquifer, Fiscal Year 2001.

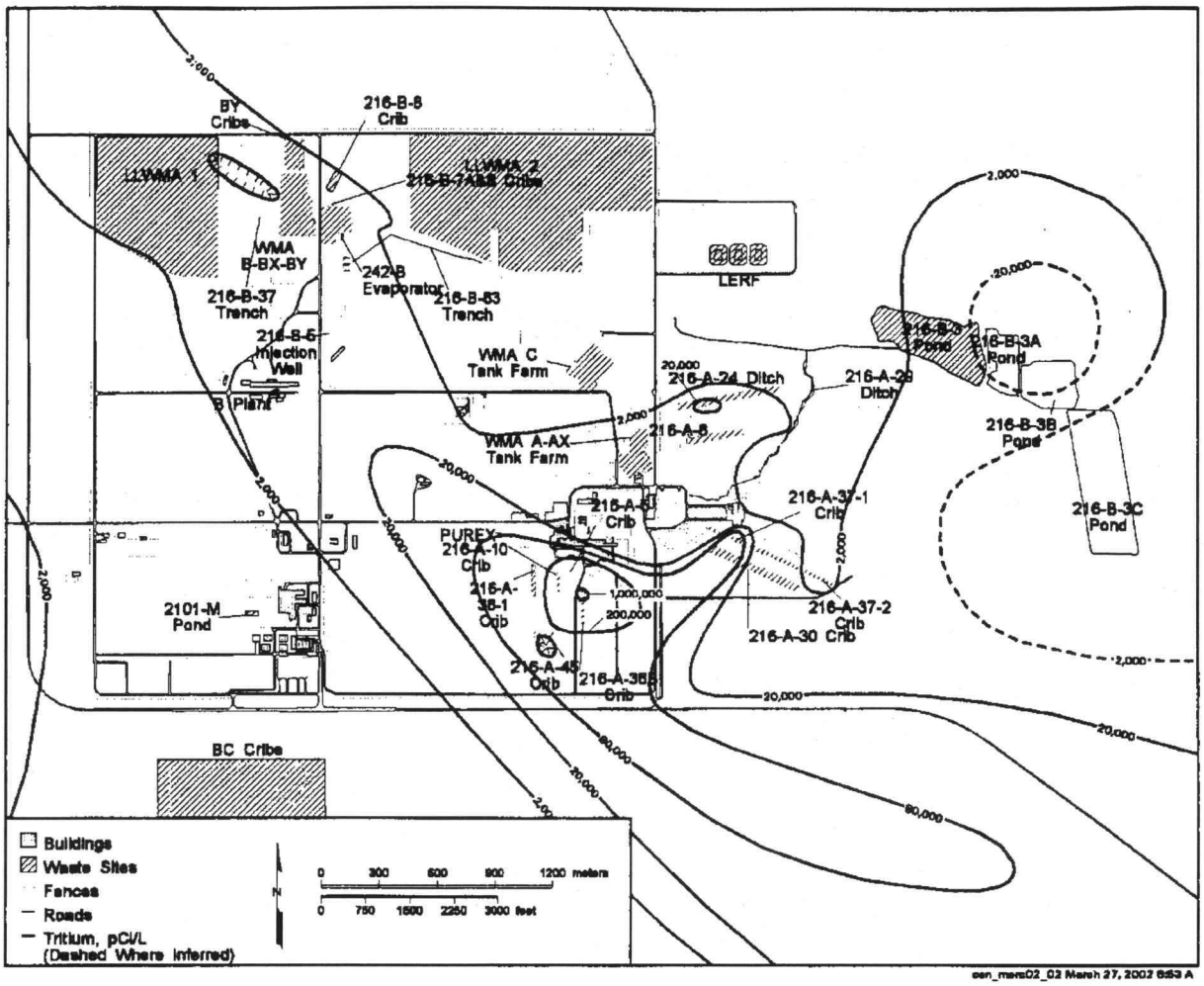

Figure 5A-4. Distribution of Tritium at the Top of the Unconfined Aquifer, Fiscal Year 2001.

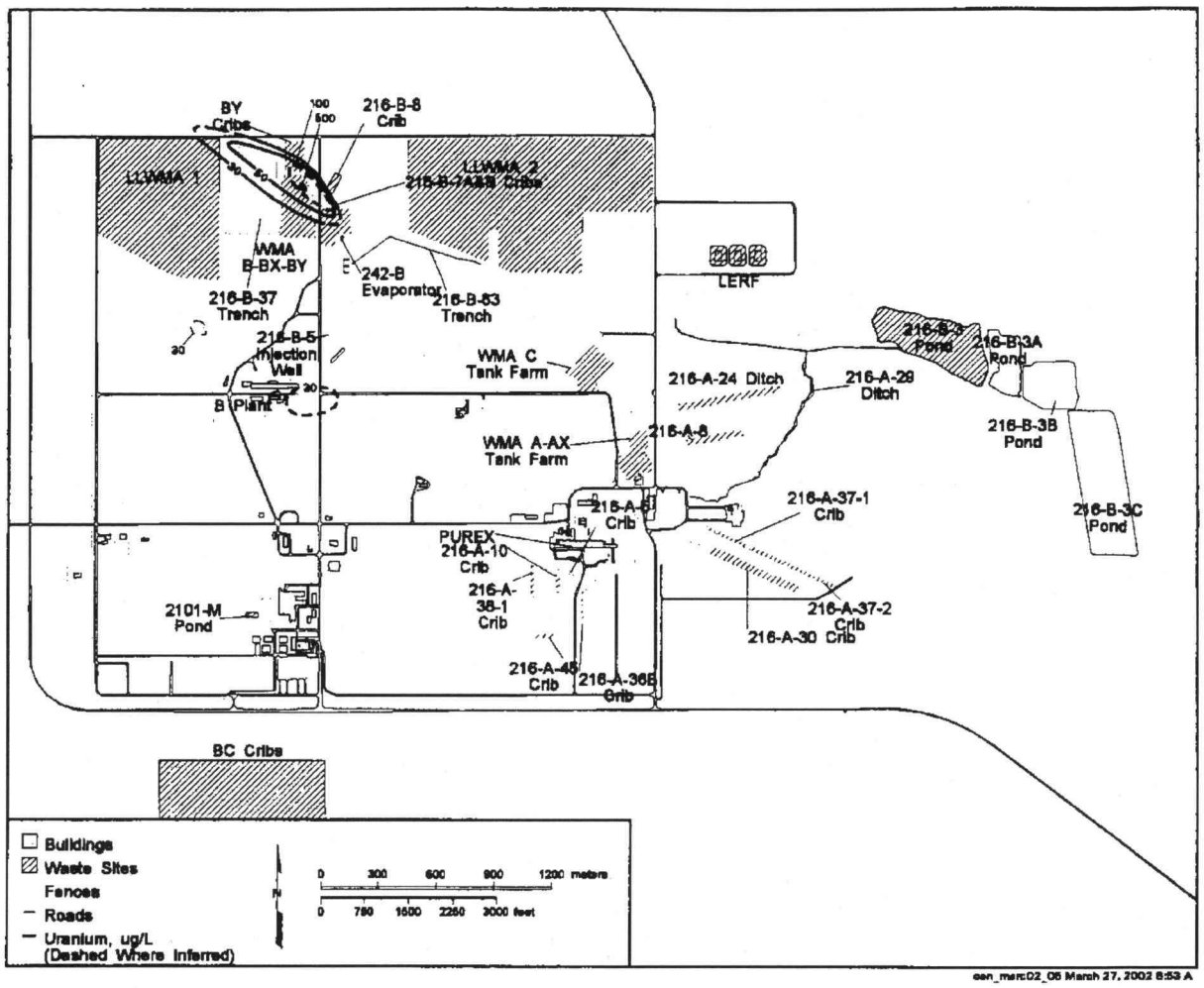

Figure 5A-5. Distribution of Uranium at the Top of the Unconfined Aquifer, Fiscal Year 2001.

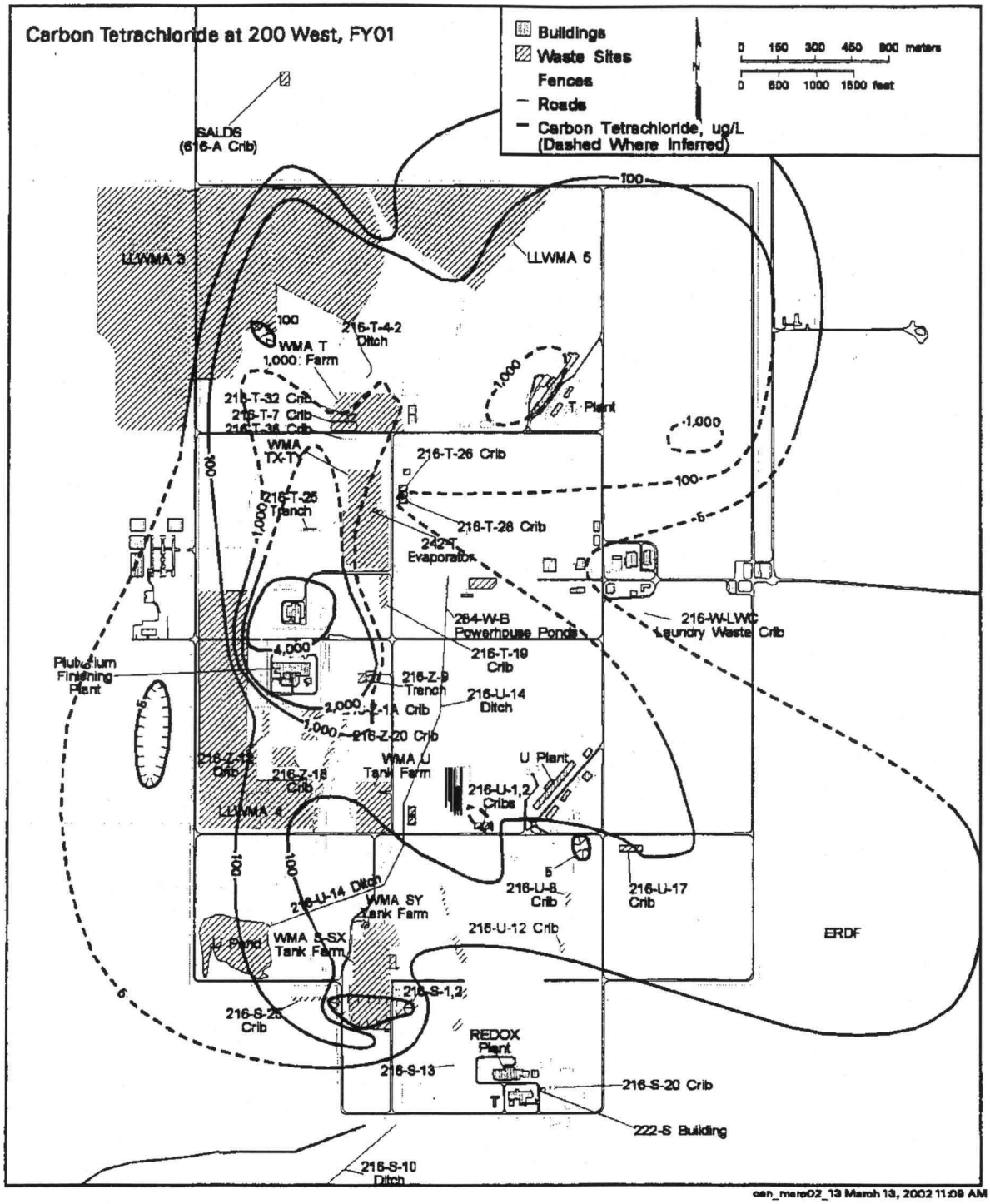

Figure 5A-6. Distribution of Carbon Tetrachloride at the Top of the Unconfined Aquifer, Fiscal Year 2001.

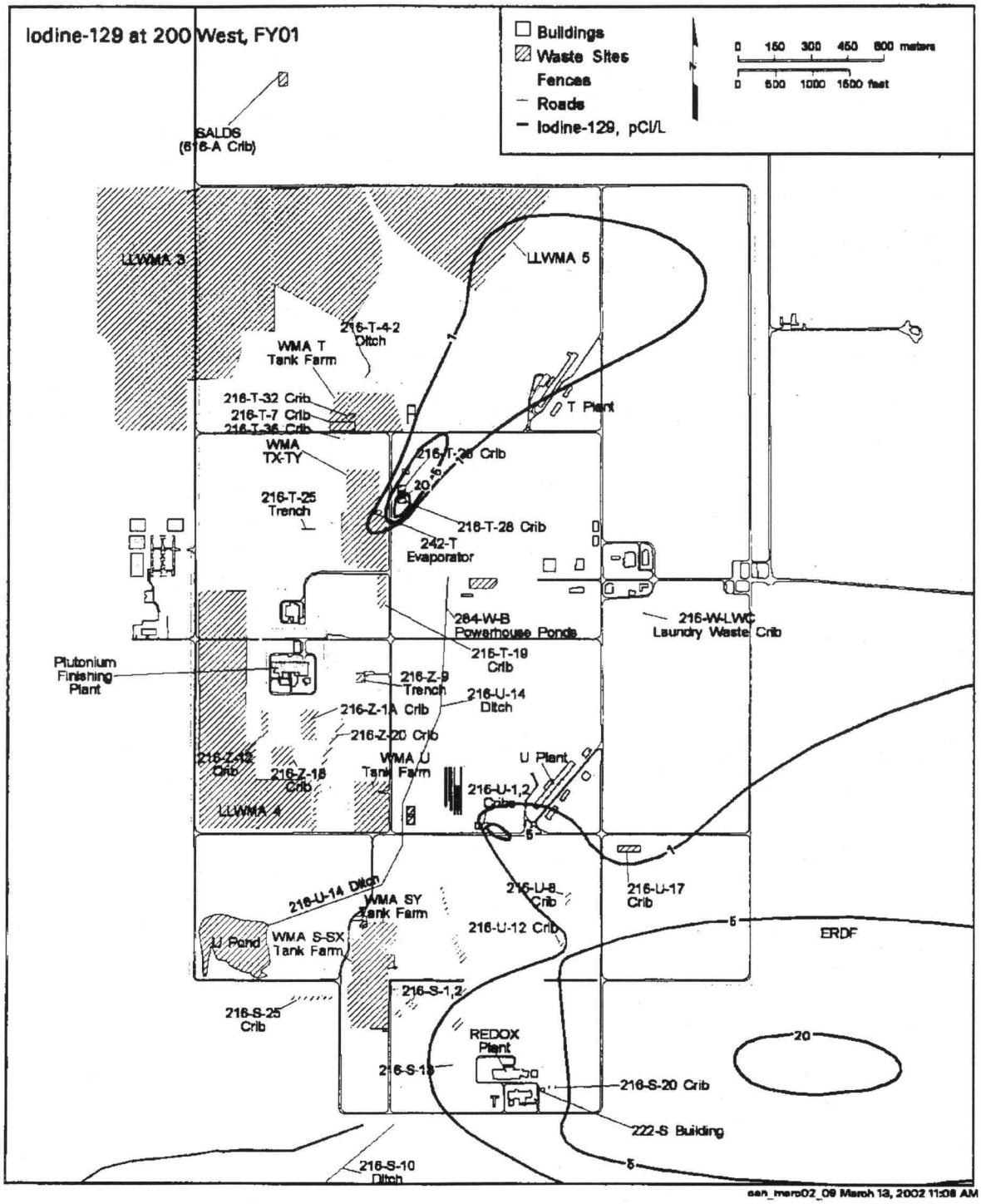

Figure 5A-7. Distribution of Iodine-129 at the Top of the Unconfined Aquifer, Fiscal Year 2001.

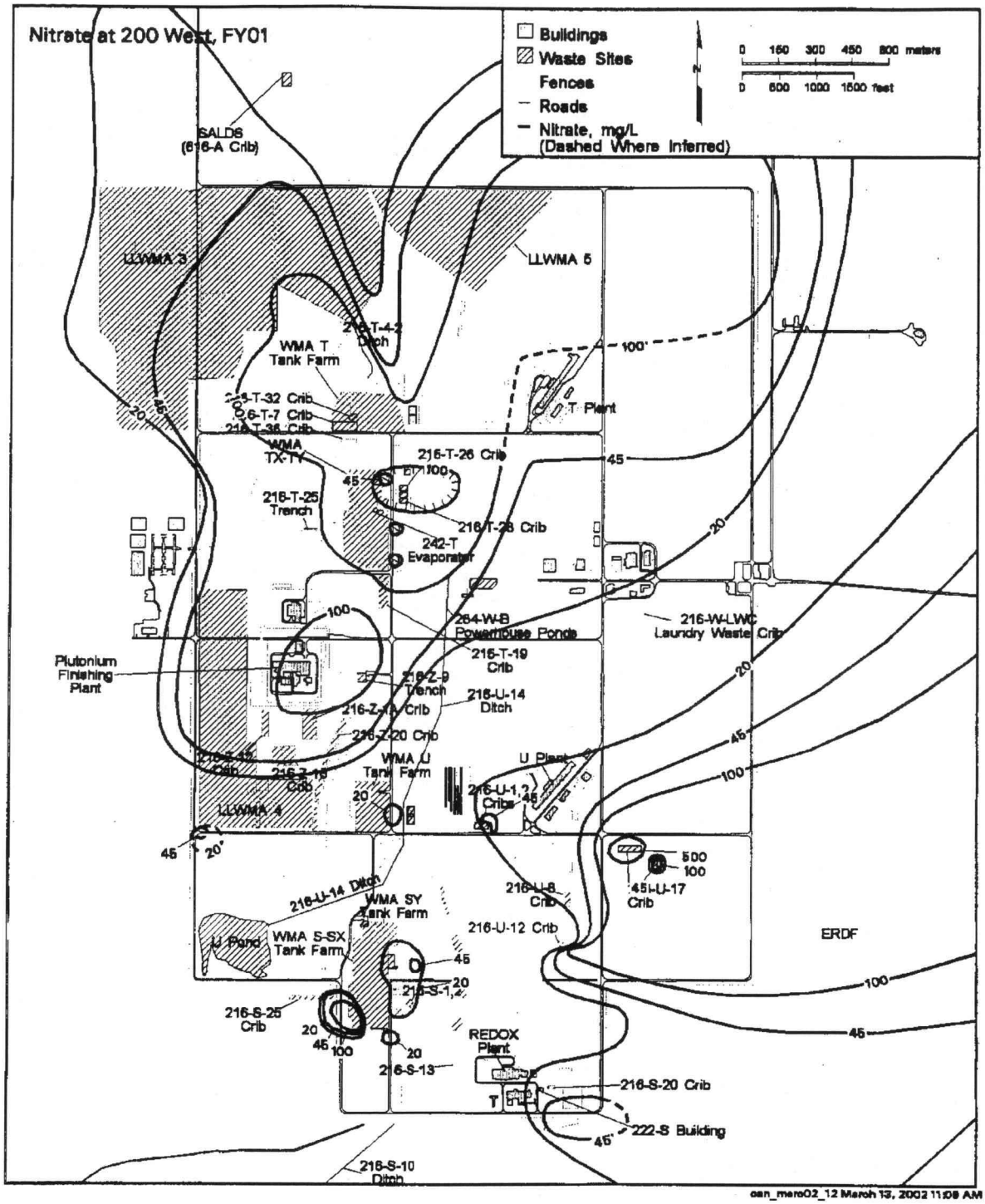

Figure 5A-8. Distribution of Nitrate at the Top of the Unconfined Aquifer, Fiscal Year 2001.

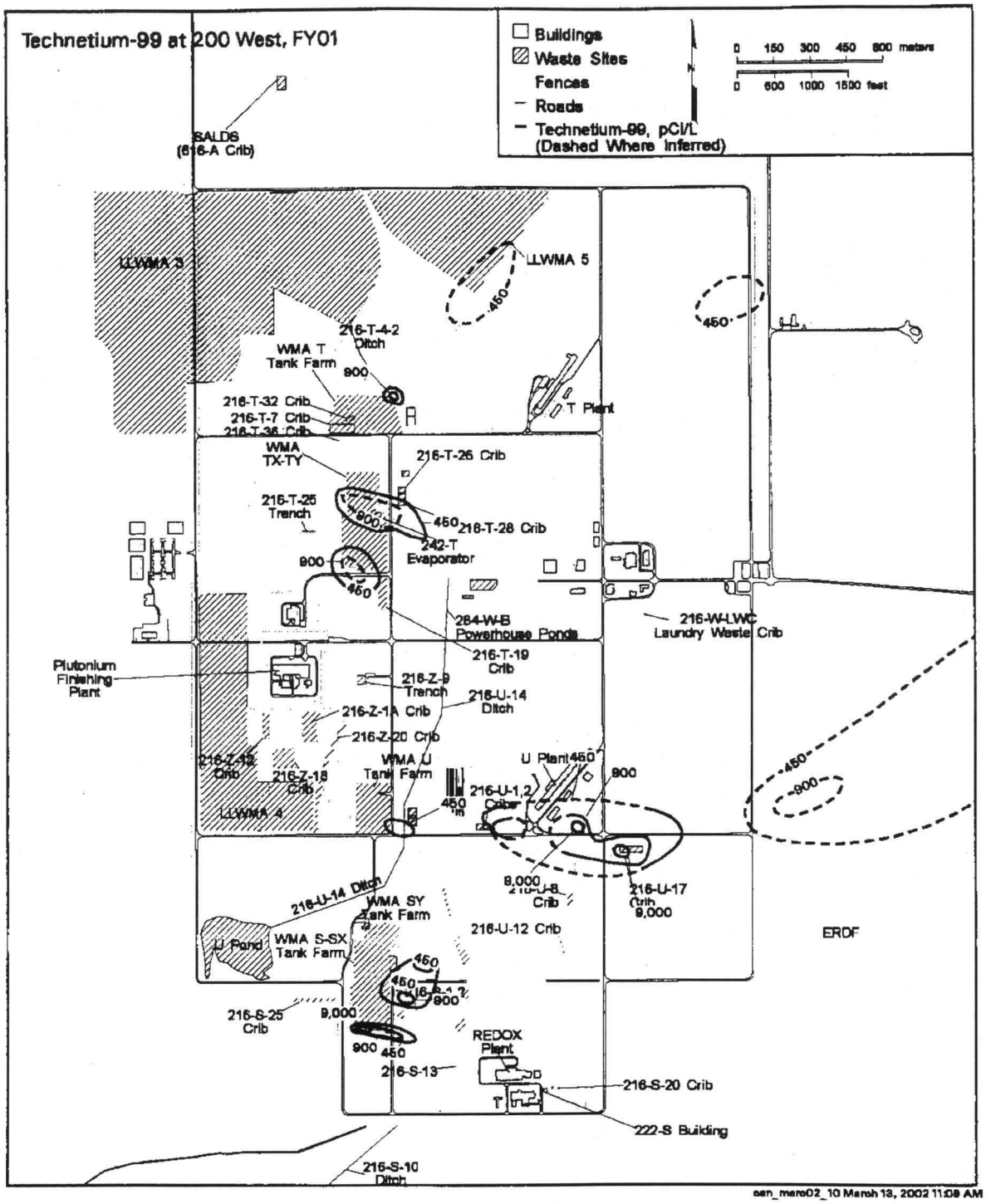

Figure 5A-9. Distribution of Technetium-99 at the Top of the Unconfined Aquifer, Fiscal Year 2001.

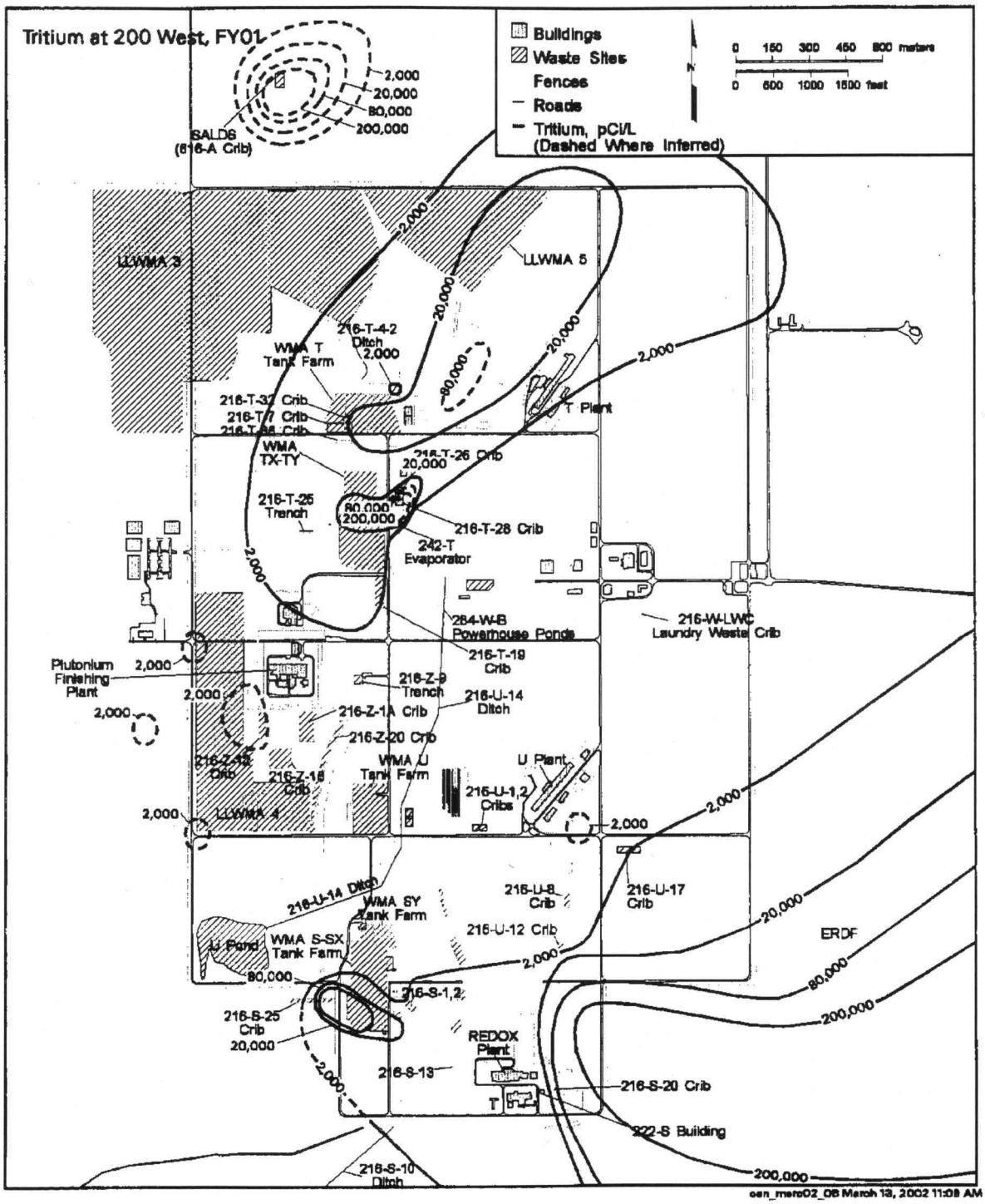

Figure 5A-10. Distribution of Tritium at the Top of the Unconfined Aquifer, Fiscal Year 2001.

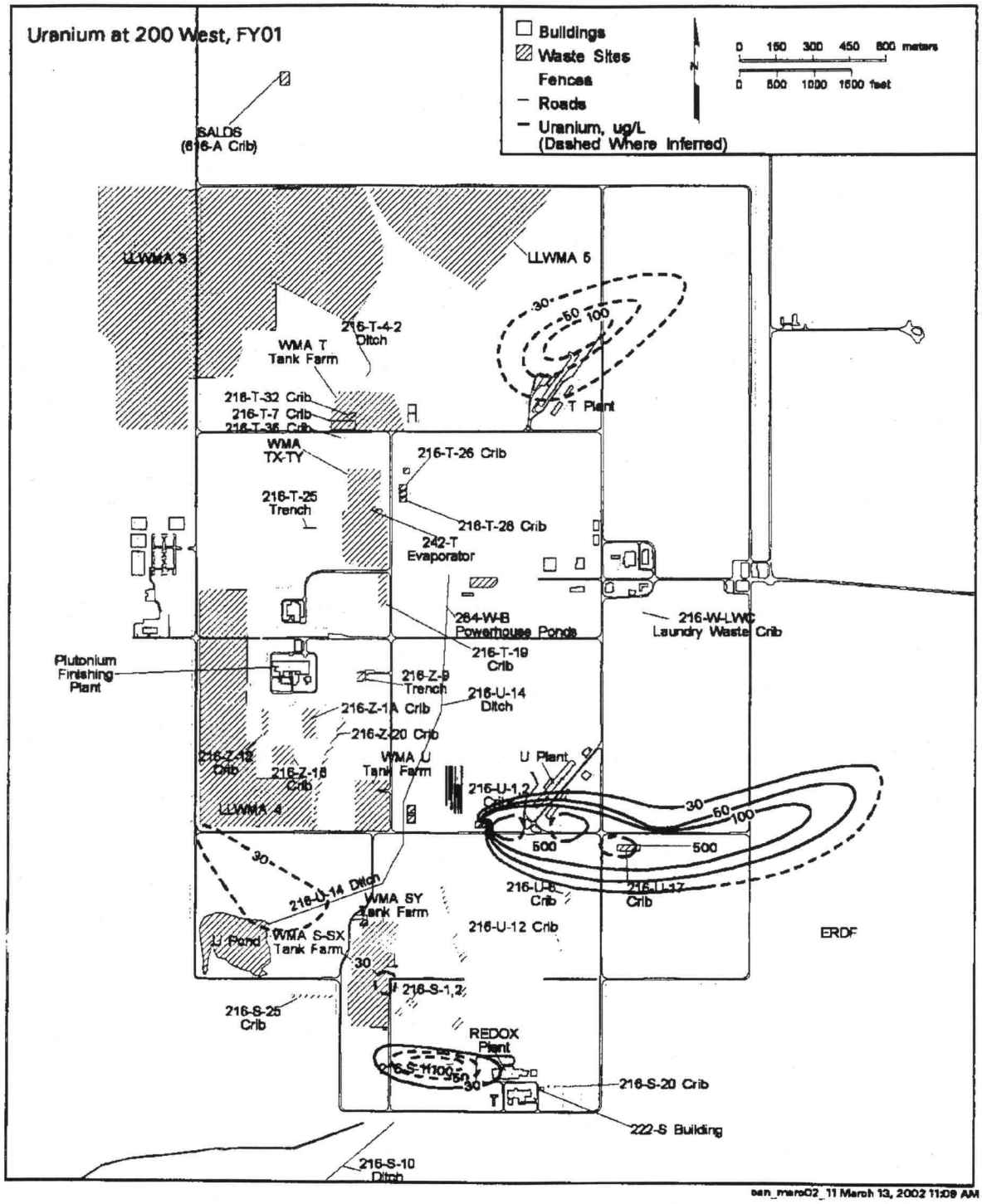

Figure 5A-11. Distribution of Uranium at the Top of the Unconfined Aquifer, Fiscal Year 2001.

APPENDIX 5B

SUMMARIZED RESULTS OF GROUNDWATER MONITORING (1988 – 2001)

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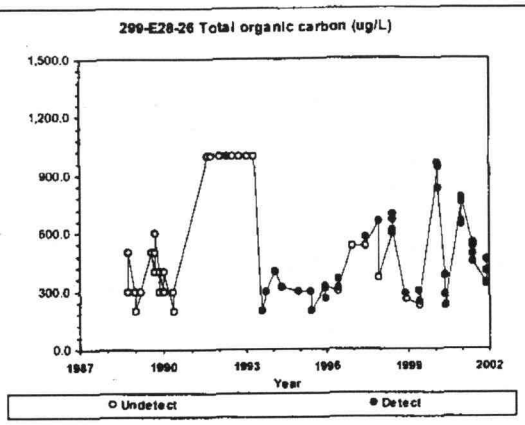
APPENDIX 5B

SUMMARIZED RESULTS OF GROUNDWATER MONITORING (1988 – 2001)

This appendix includes graphs showing data collected during interim-status groundwater monitoring. The graphs include three contamination indicator parameters (specific conductance, total organic carbon, and total organic halides) and chromium. Another indicator parameter, pH, is not included because it is of limited use in groundwater monitoring at the LLBG. Chromium is included because it is proposed as a statistical indicator during final status monitoring. pH and other data are available in the HEIS database.

Graphs are presented for each well in the current (2002) interim-status monitoring network. Data for wells previously monitored but now dry are available in HEIS. For Low-Level Waste Management Area 4, graphs are provided for proposed supplemental wells if data are available.



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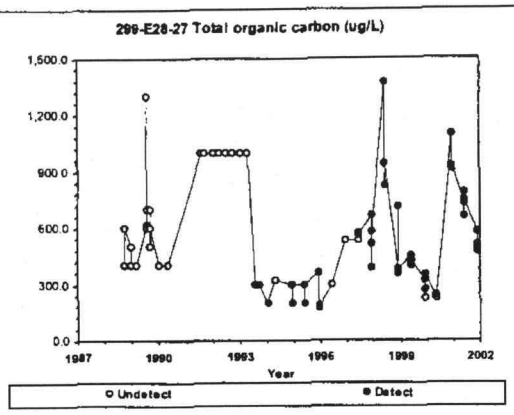

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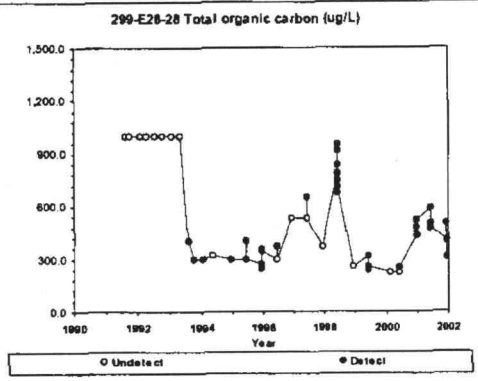

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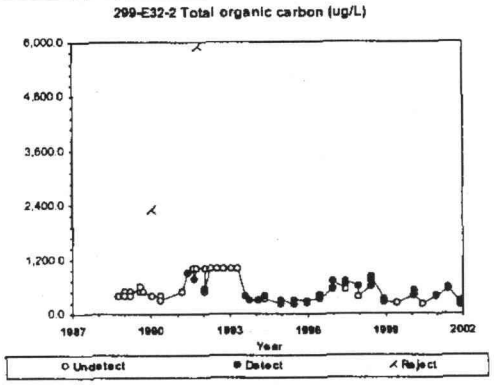

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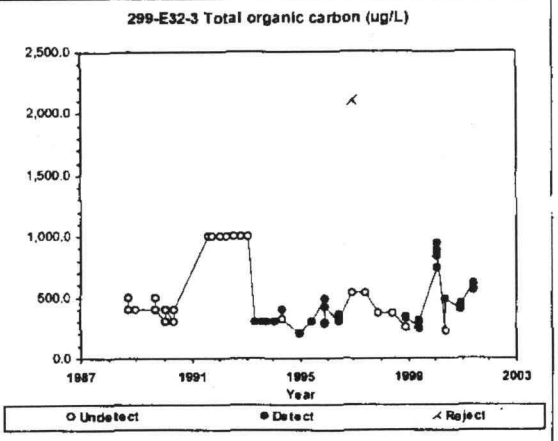

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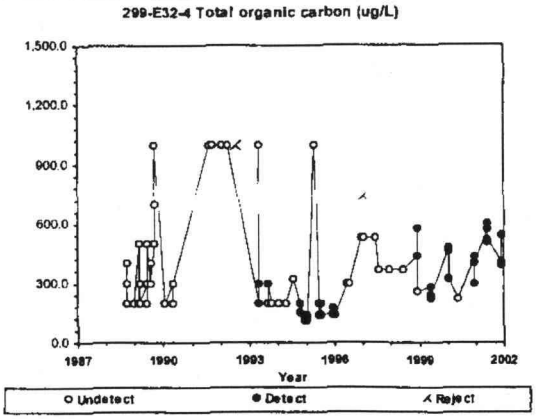

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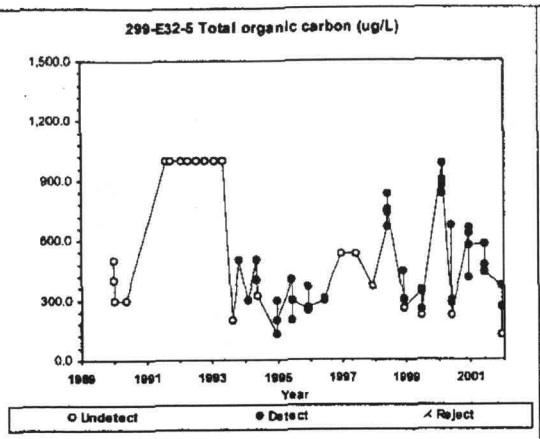

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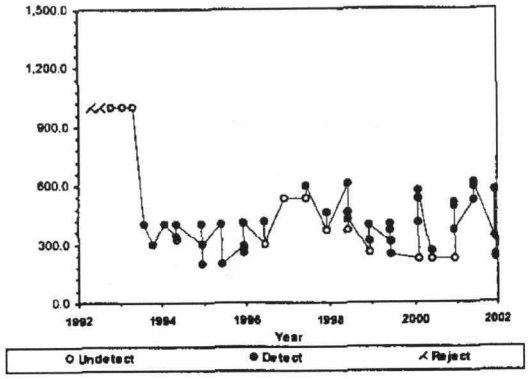

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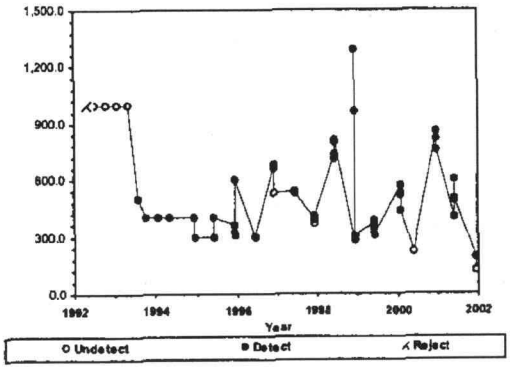

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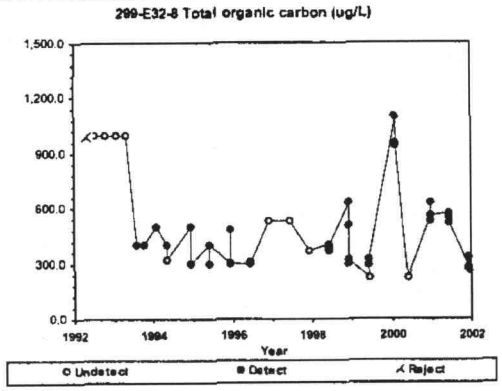

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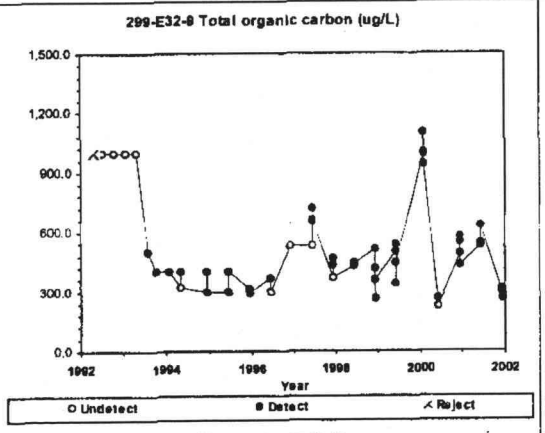

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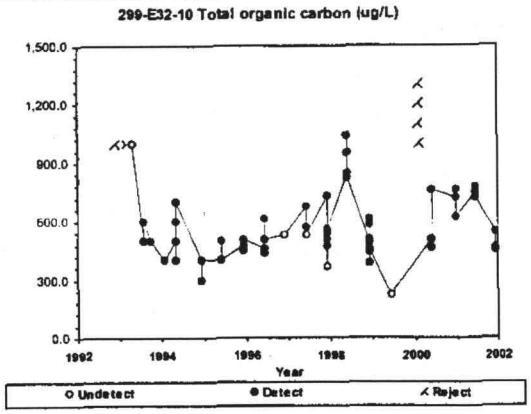

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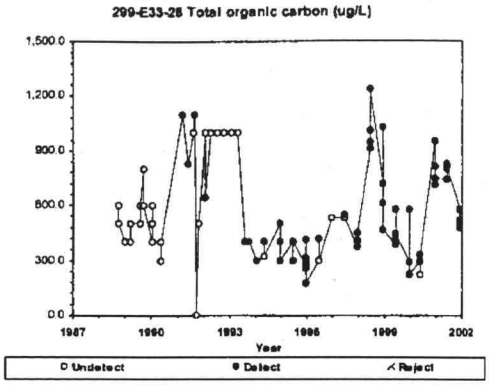

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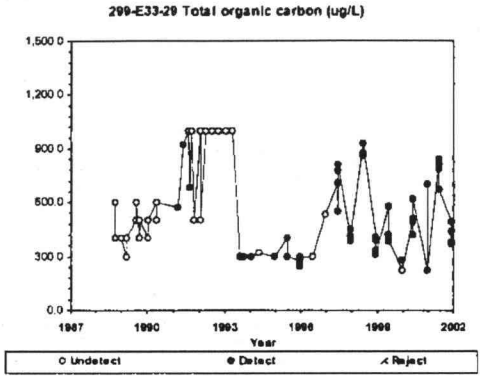

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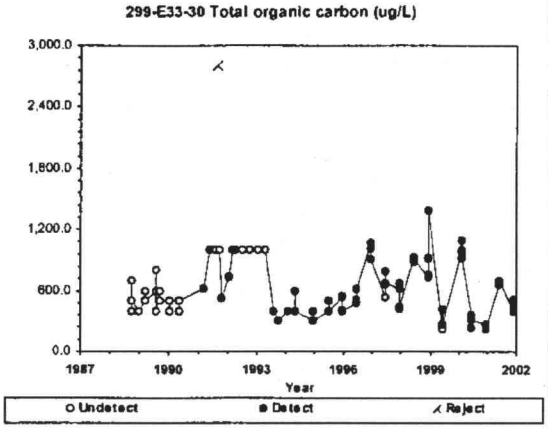

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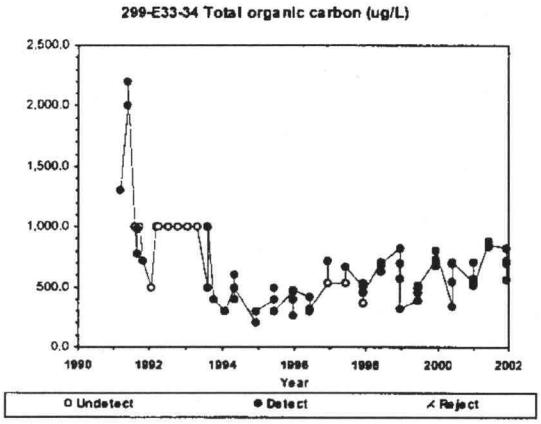

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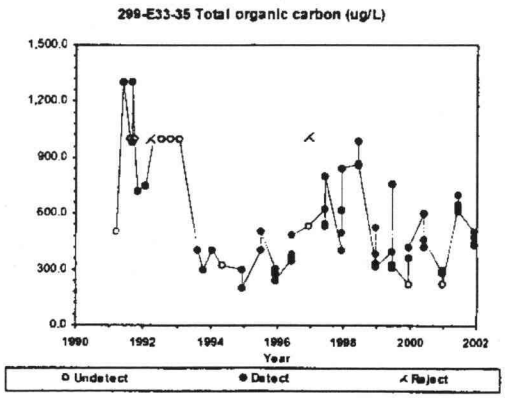

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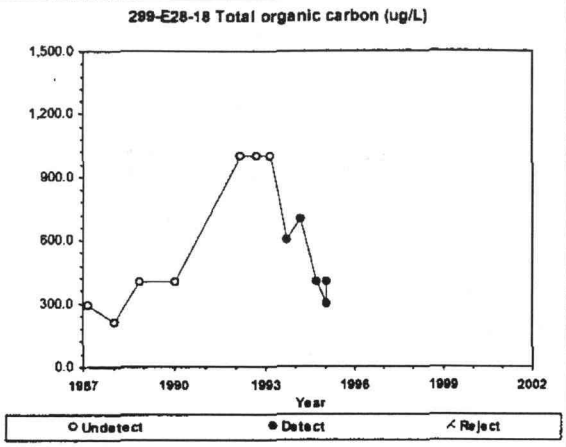
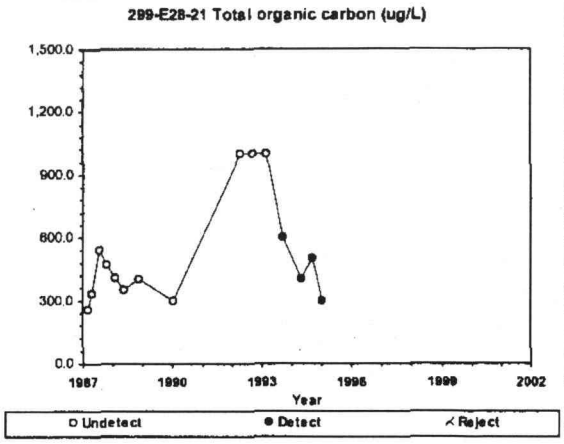
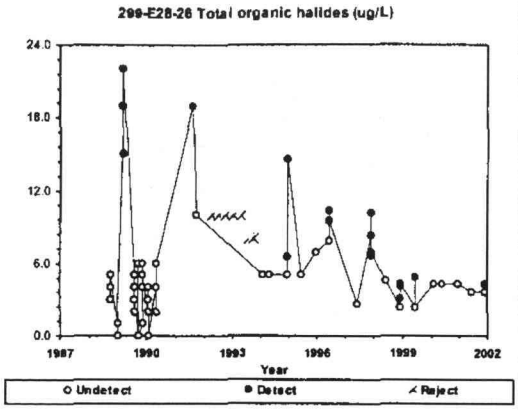


216-B-62 Crib TOC



216-B-62 Crib TOC



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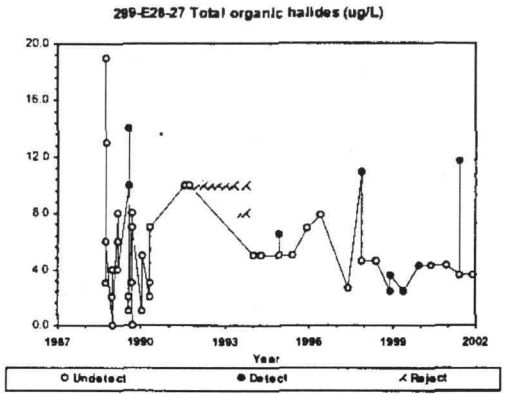

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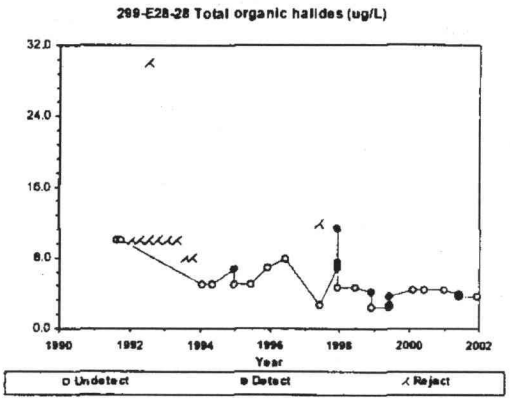

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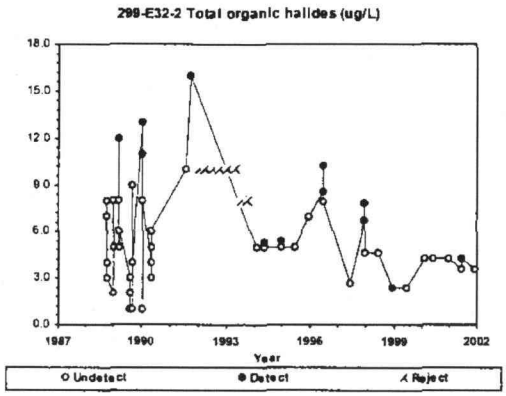

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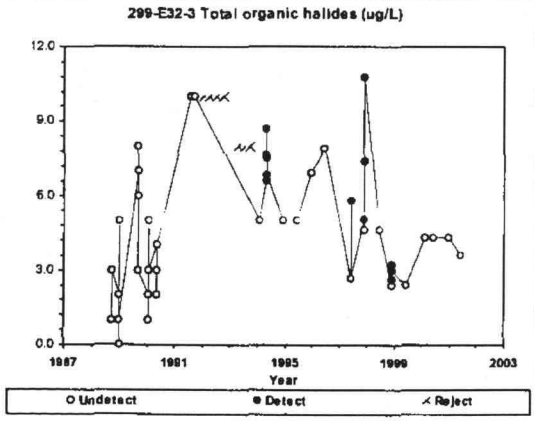

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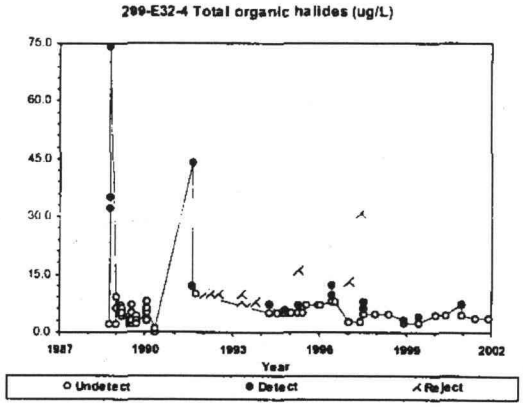

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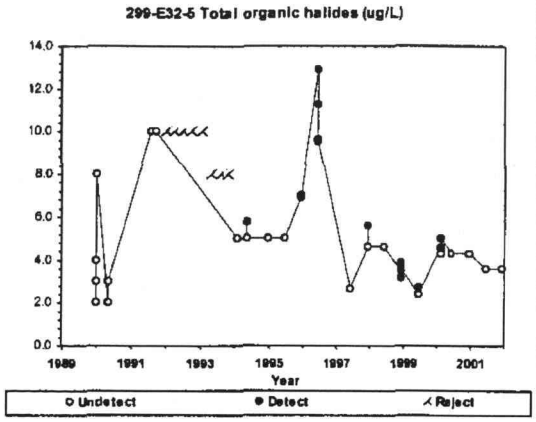

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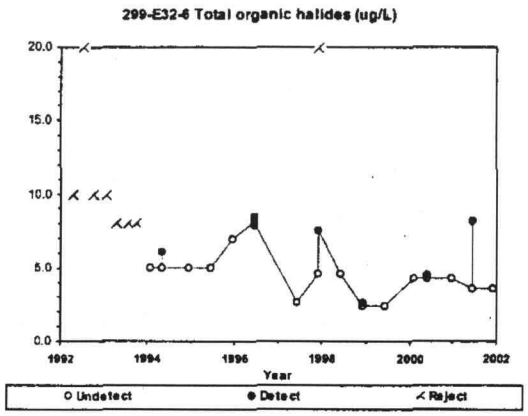

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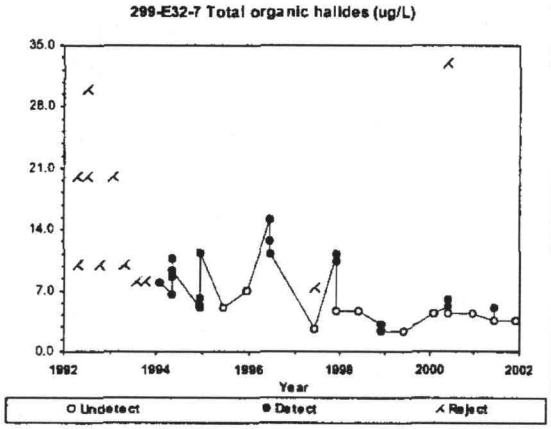

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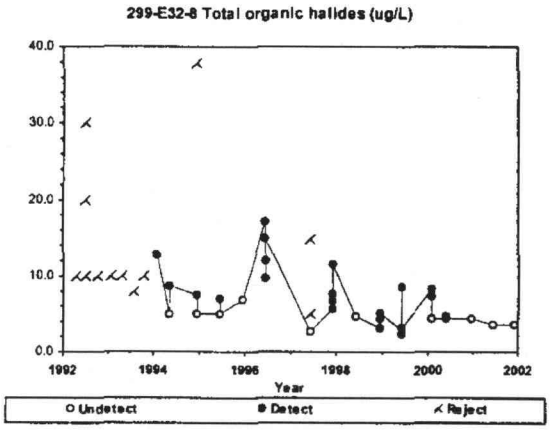

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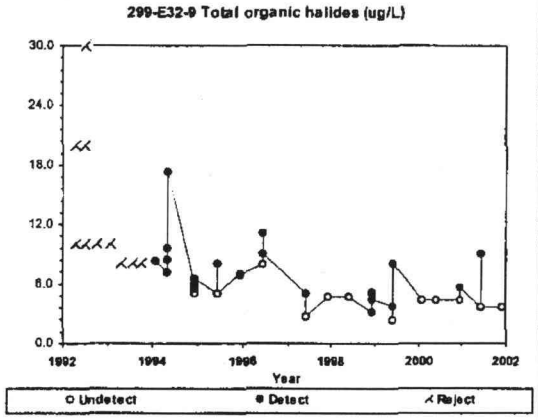

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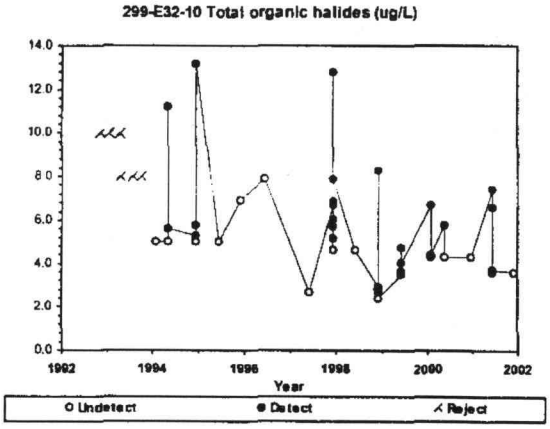

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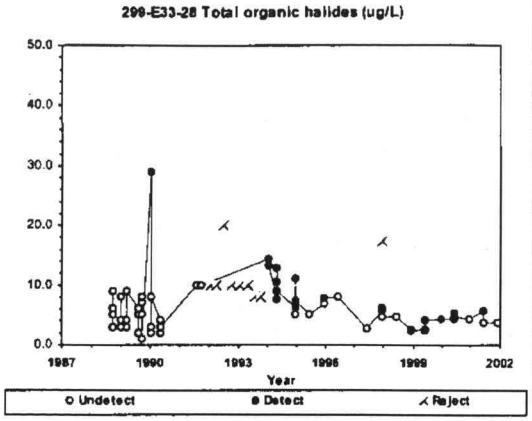

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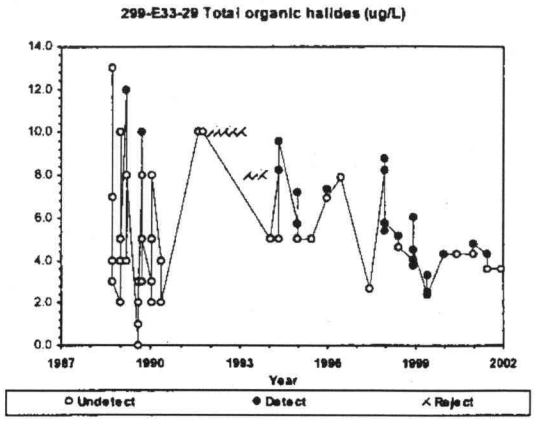

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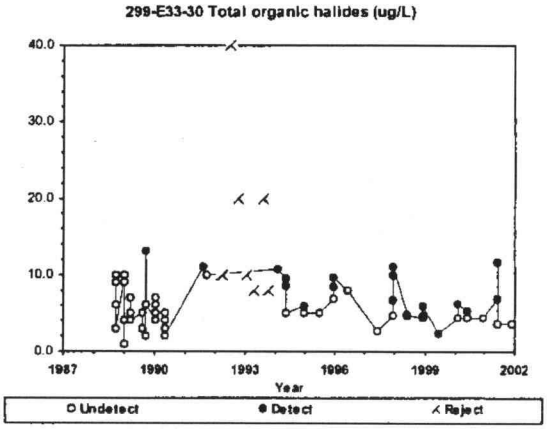

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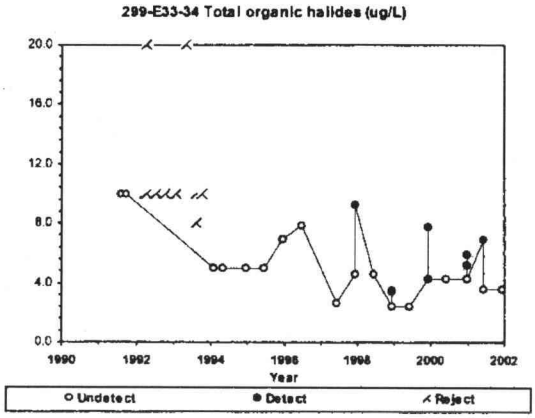

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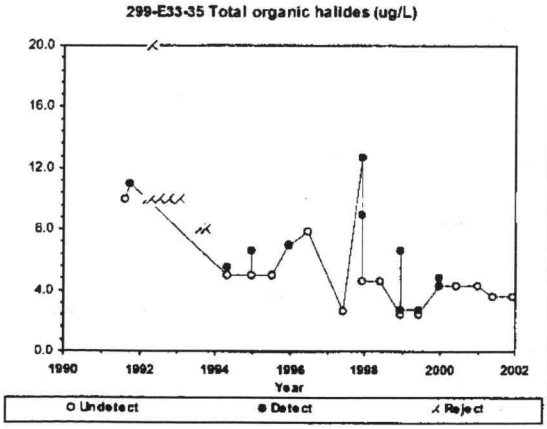

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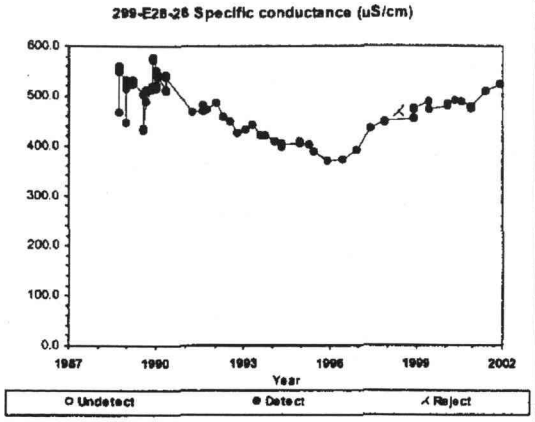

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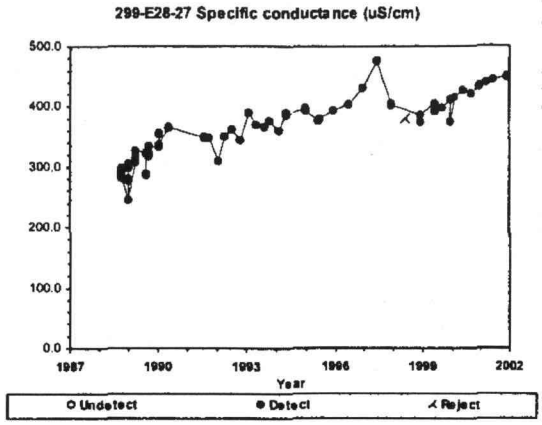

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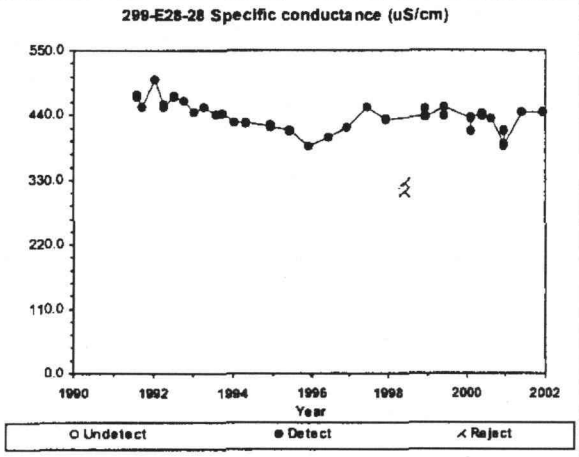

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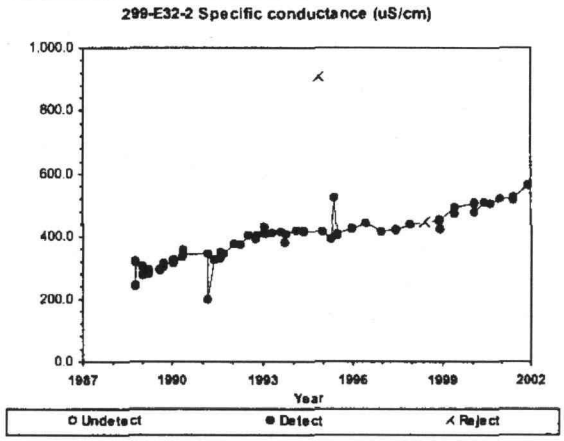

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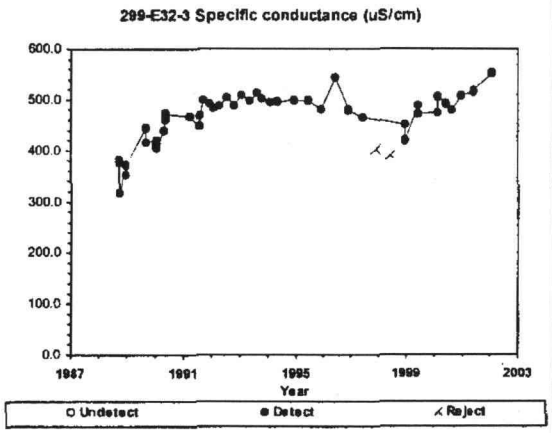

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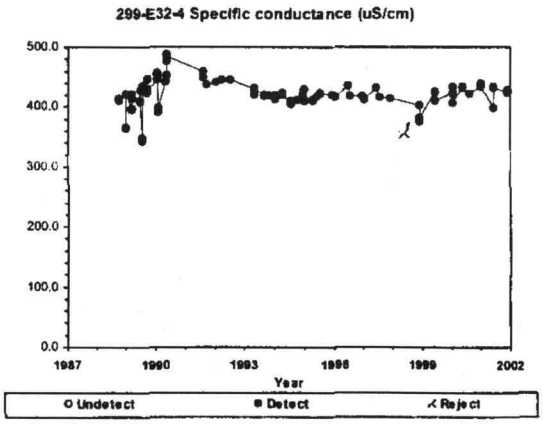

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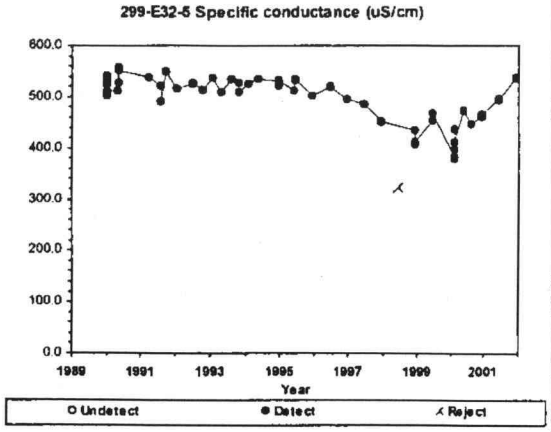

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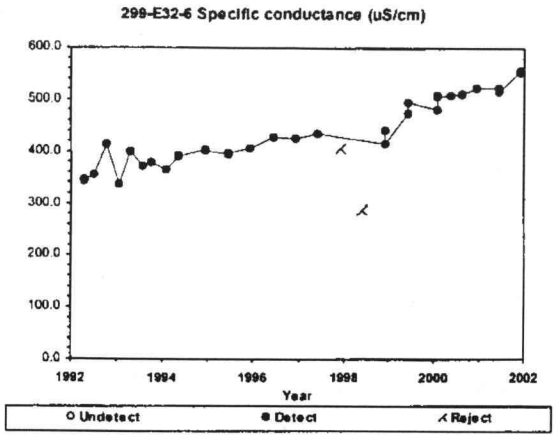

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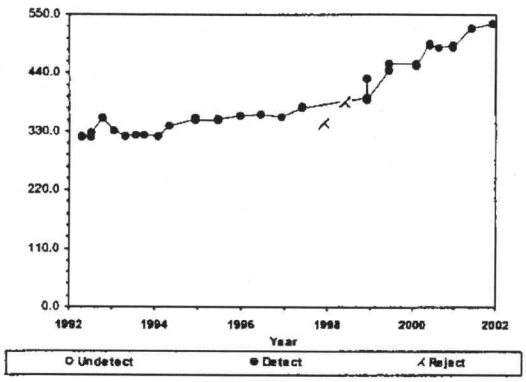

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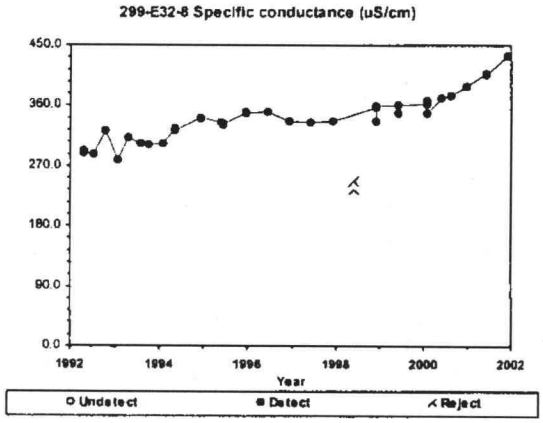

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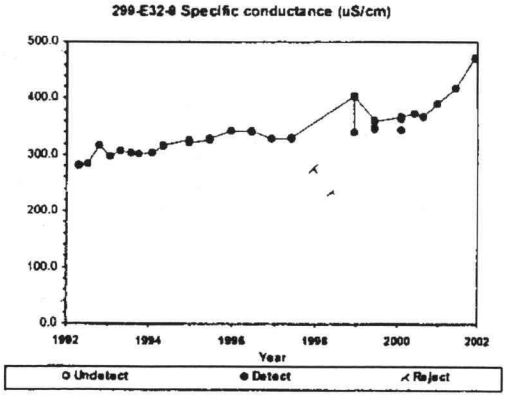

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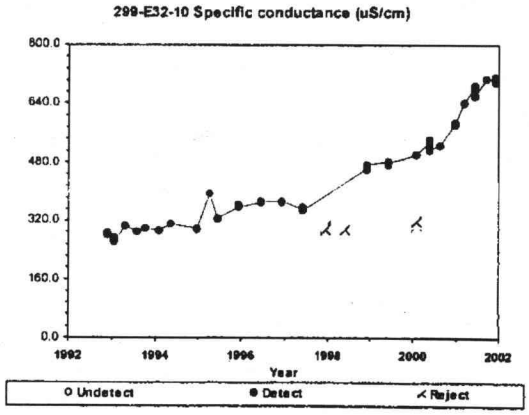

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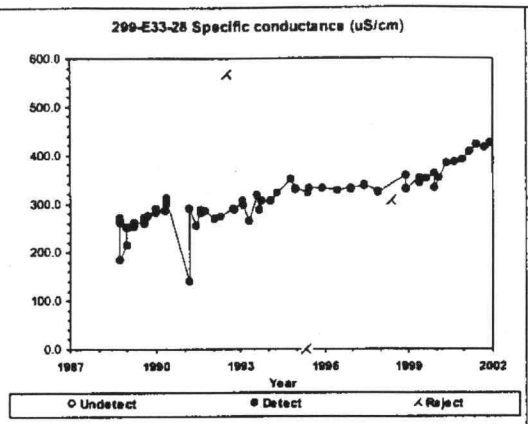

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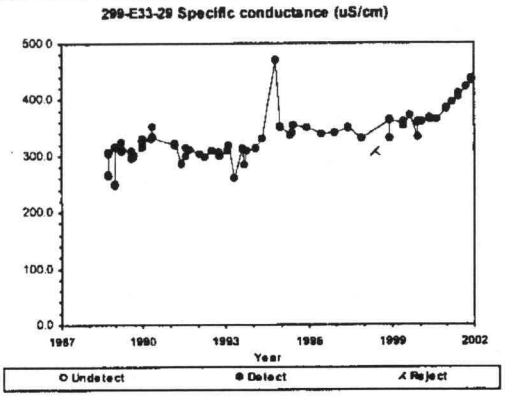

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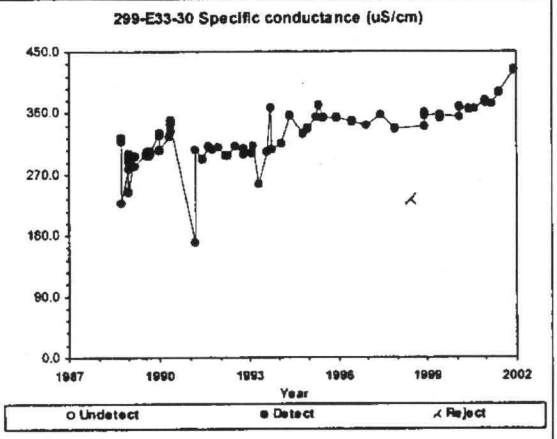

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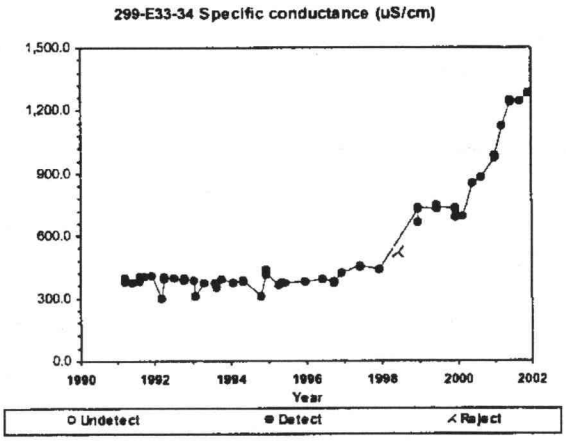

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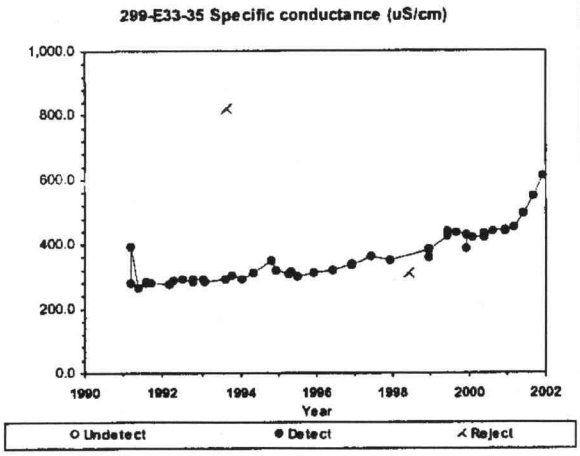

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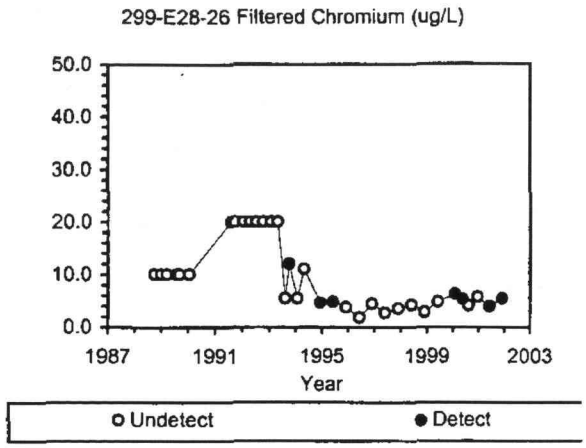

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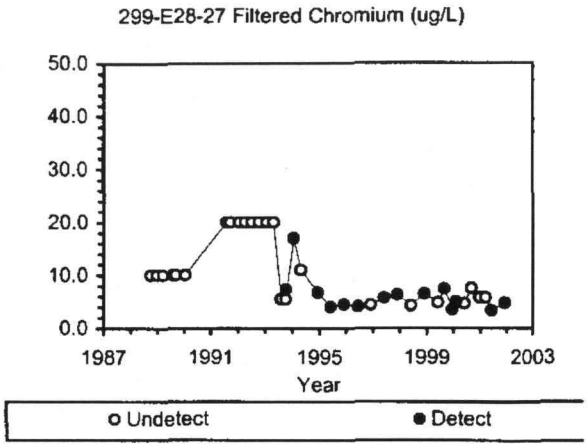

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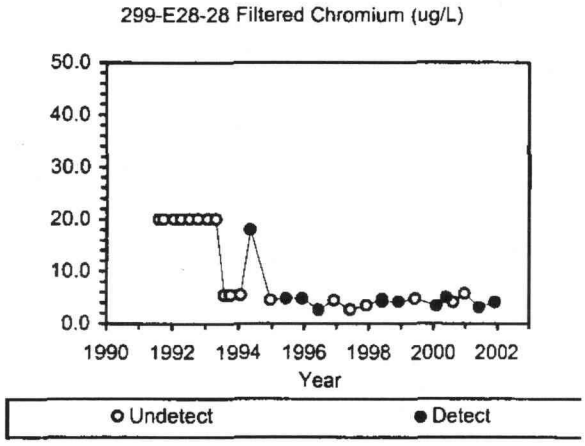

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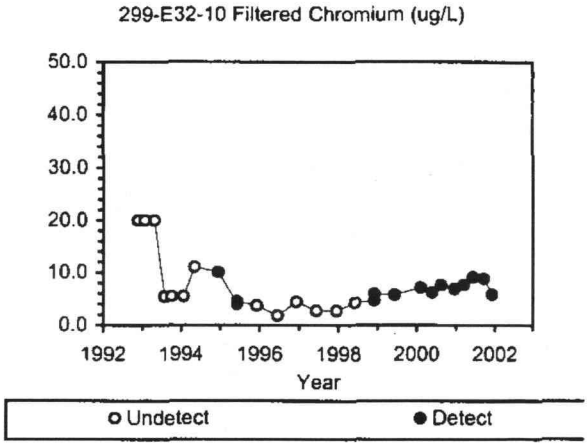

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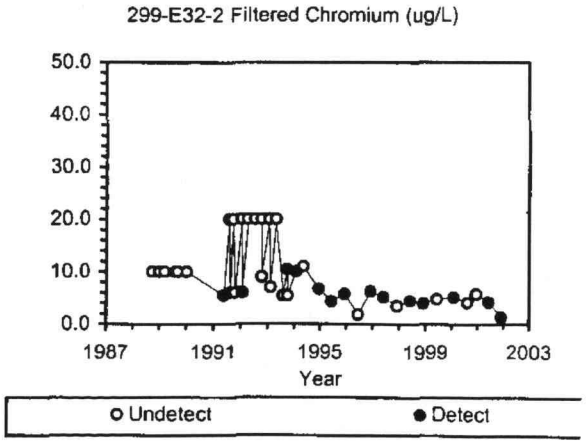

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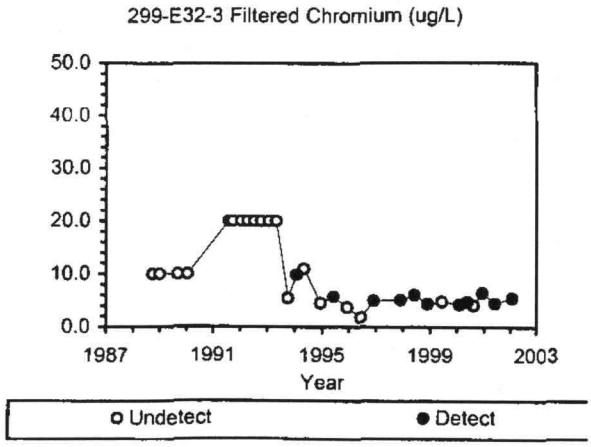

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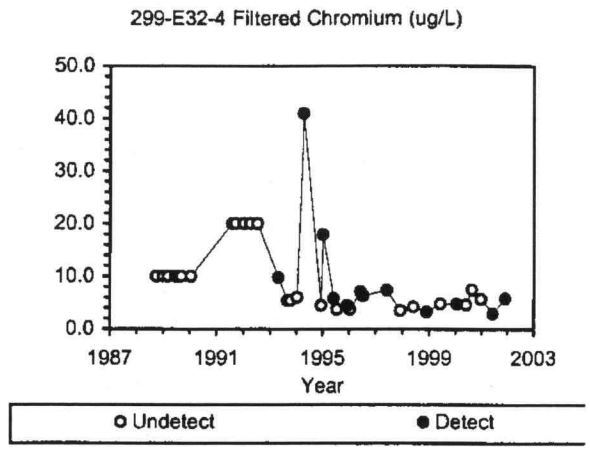

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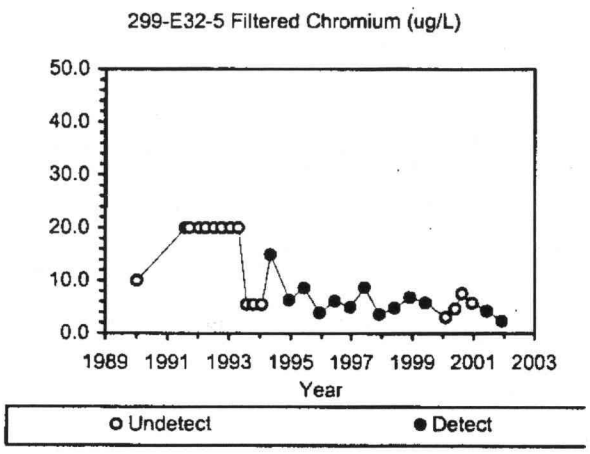

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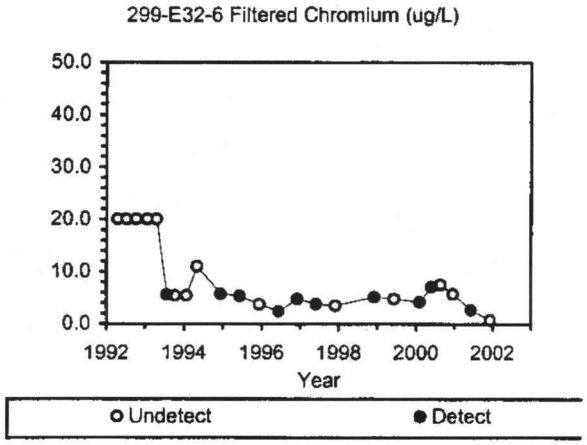

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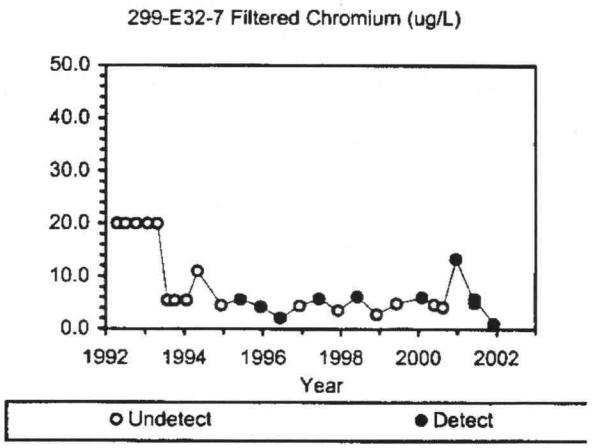

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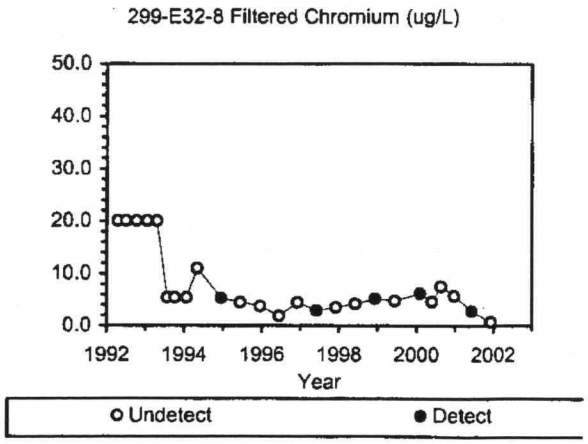

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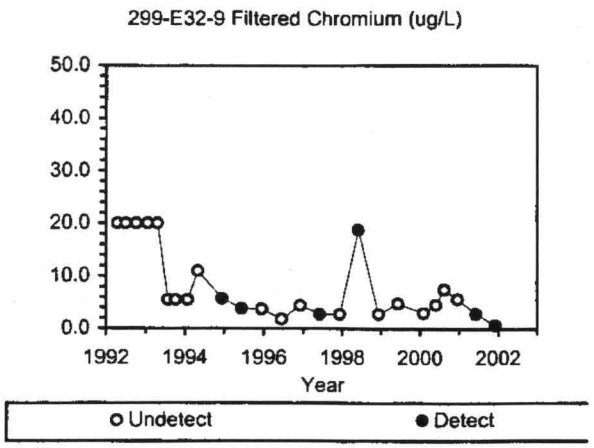

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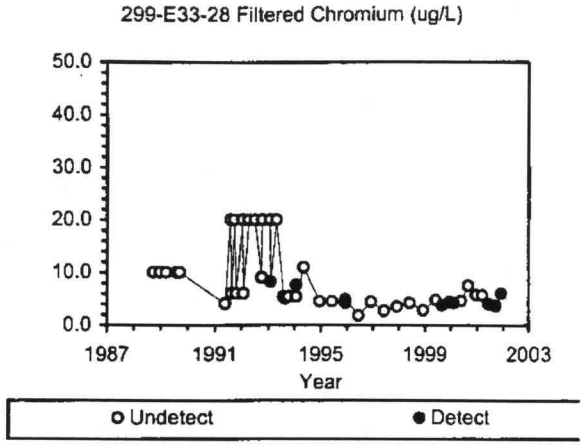

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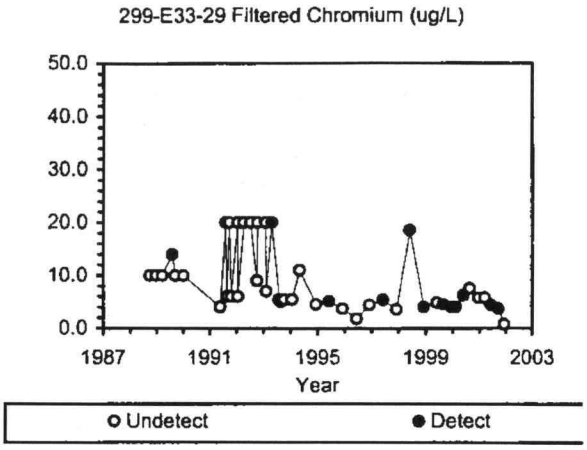

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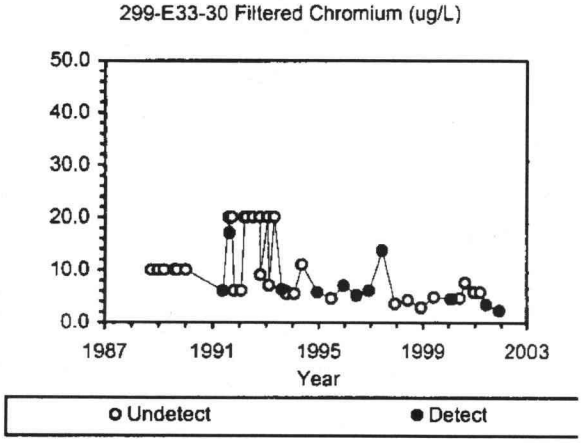

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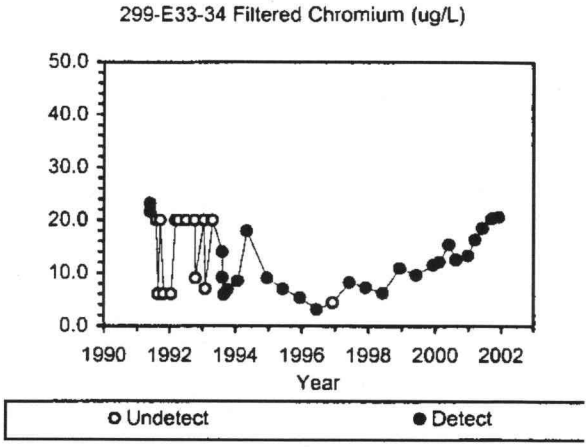

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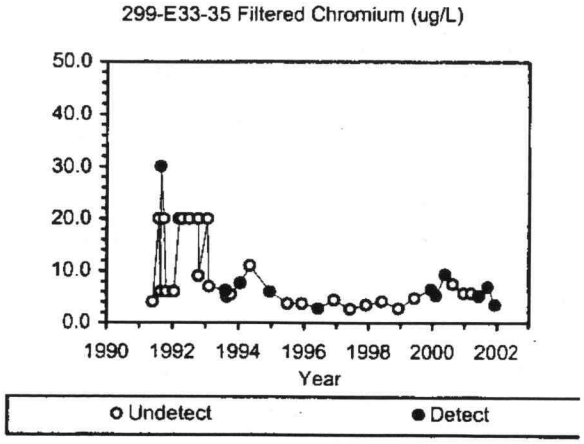

LLWMA-1, Chromium

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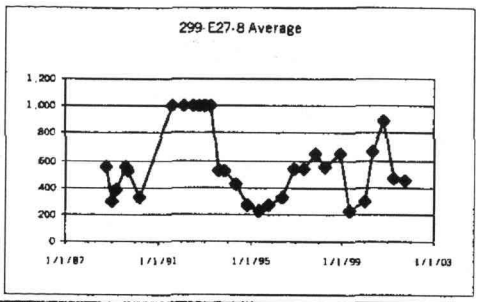

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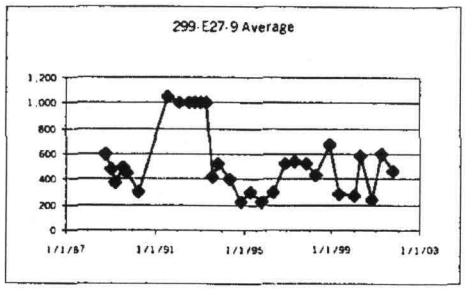

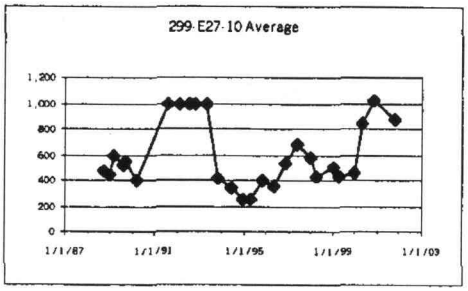

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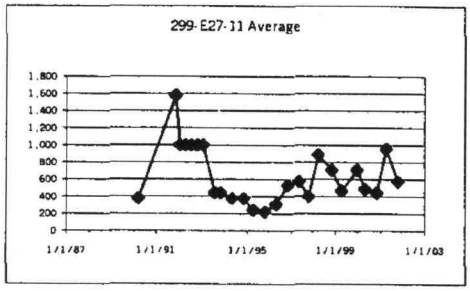

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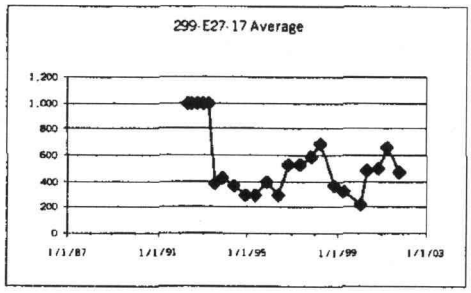

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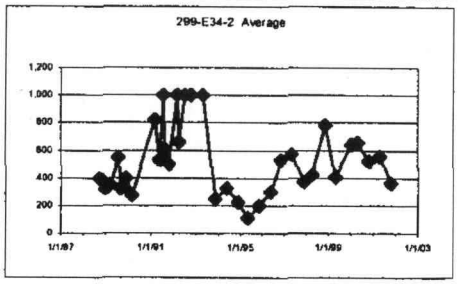

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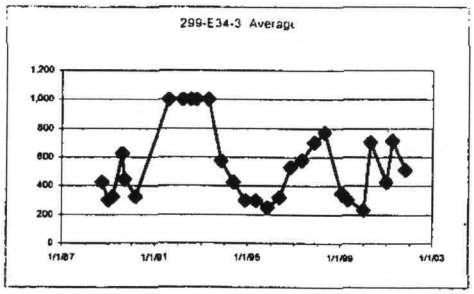

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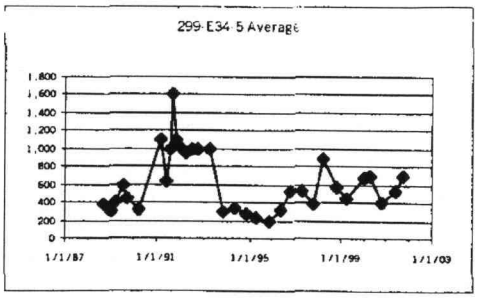

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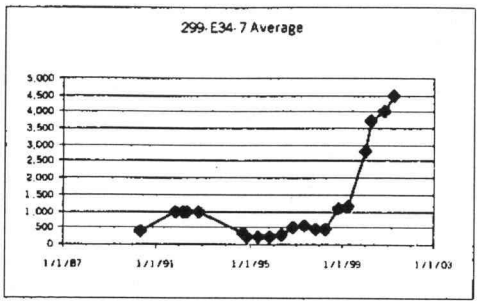

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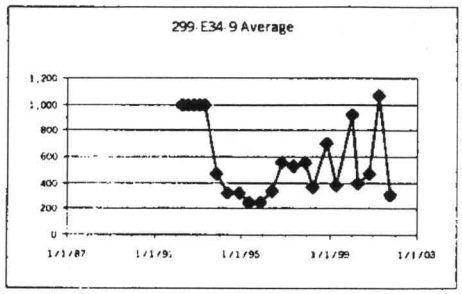

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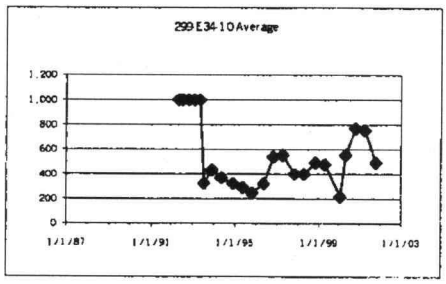

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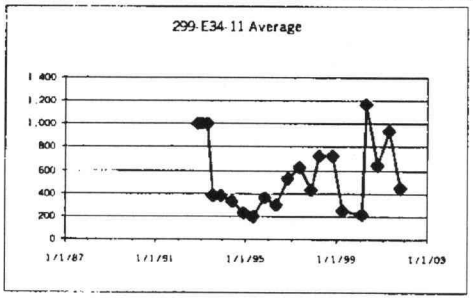

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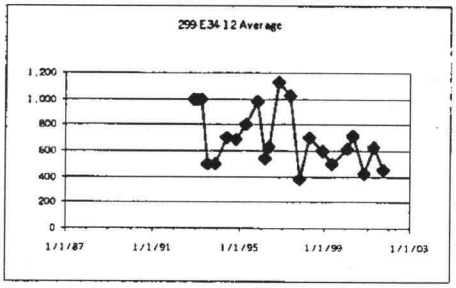

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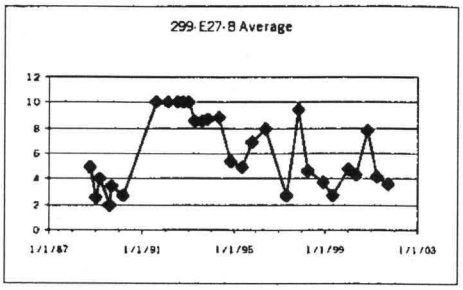

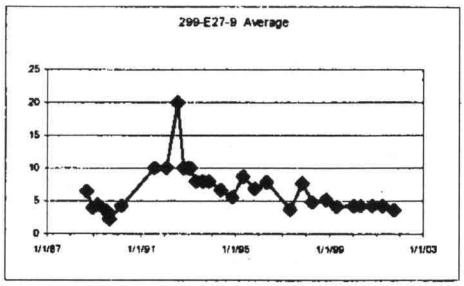

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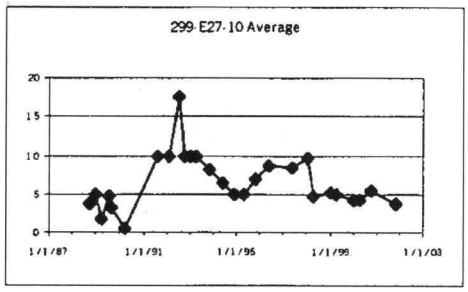

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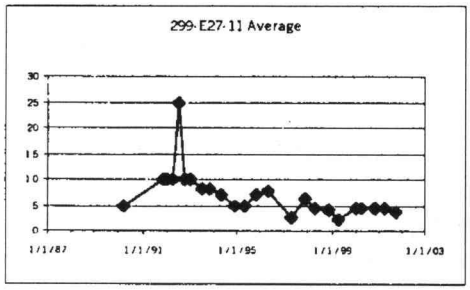

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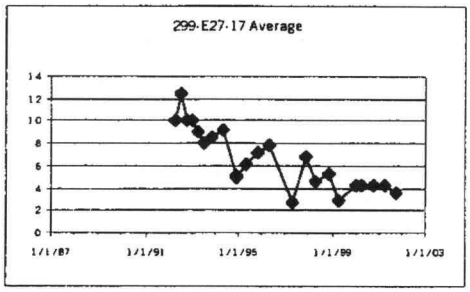

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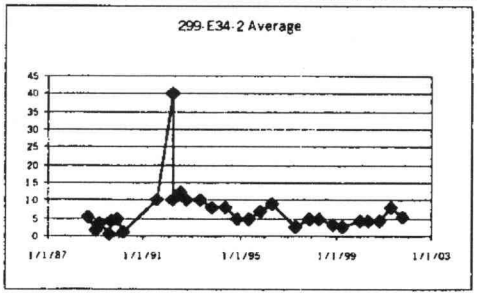

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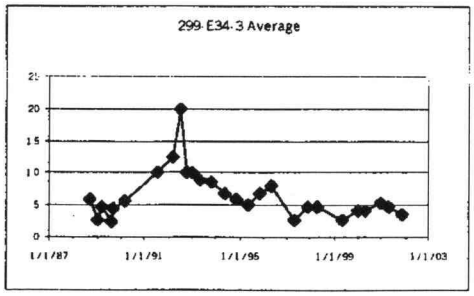

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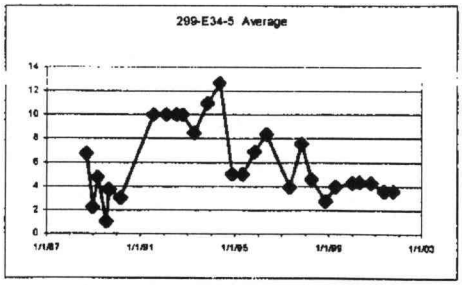

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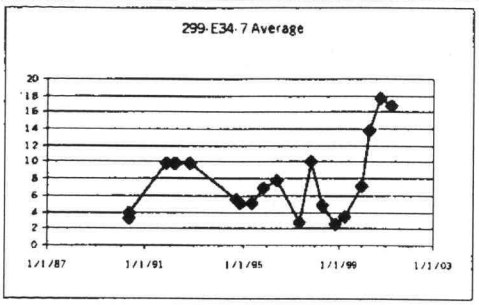

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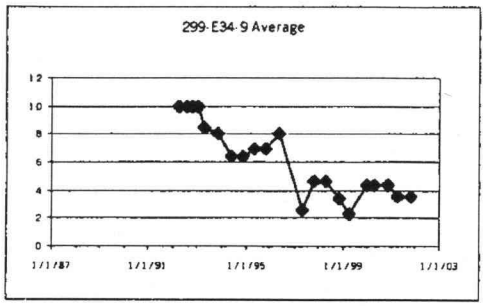

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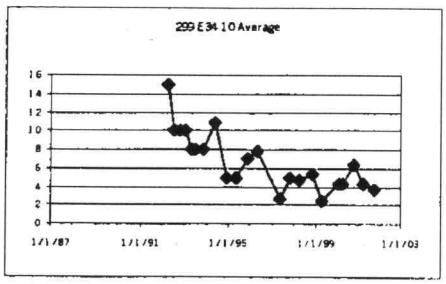

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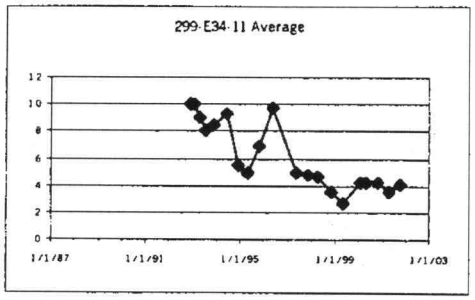

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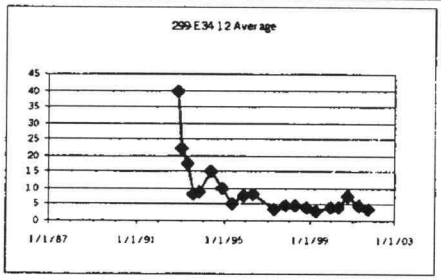

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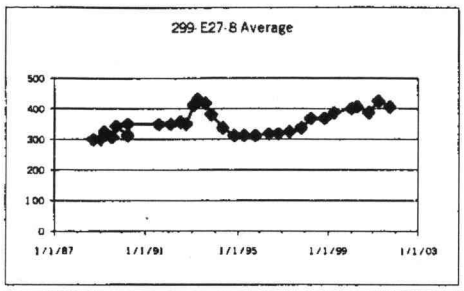

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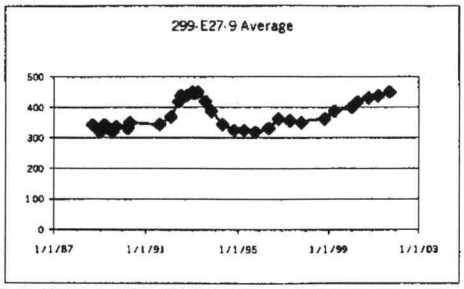

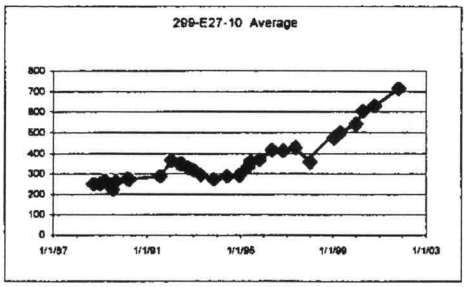

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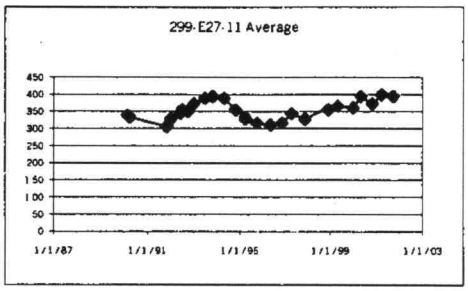

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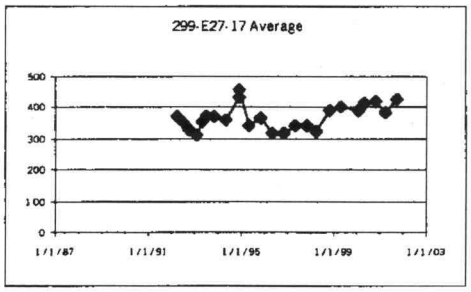

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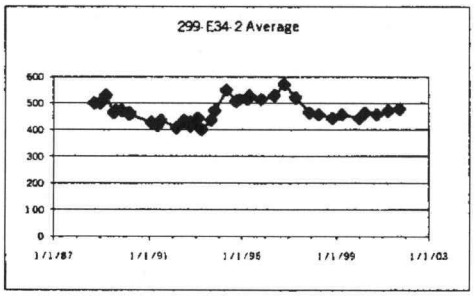

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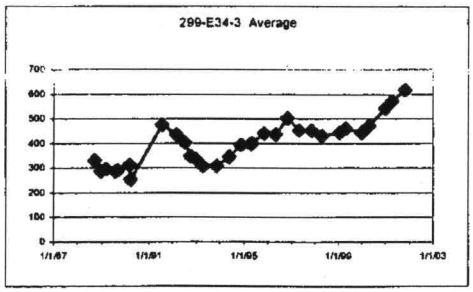

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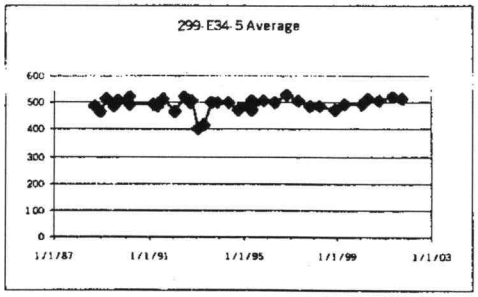

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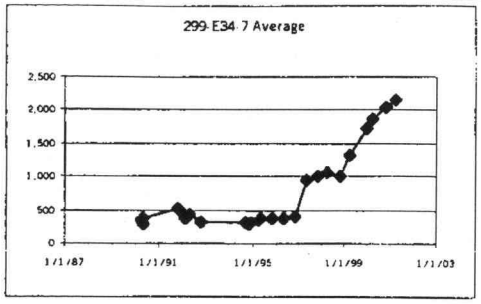

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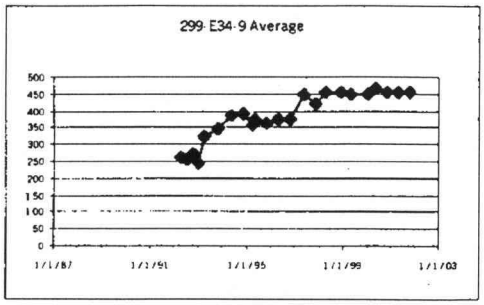

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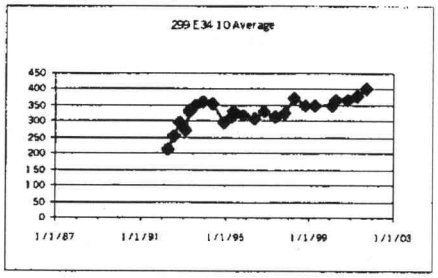

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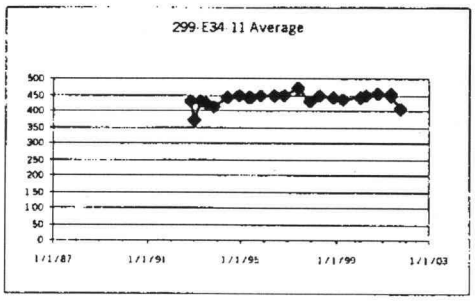

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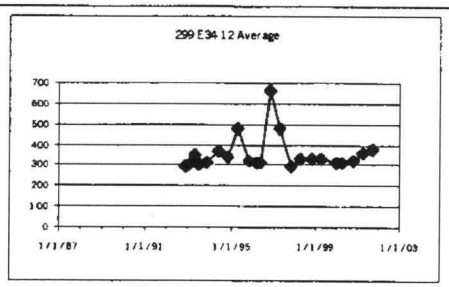

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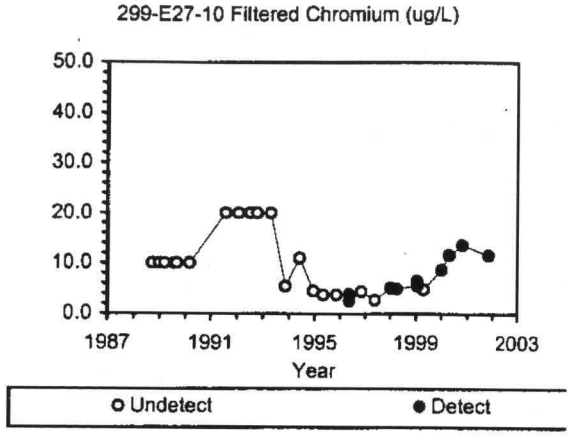

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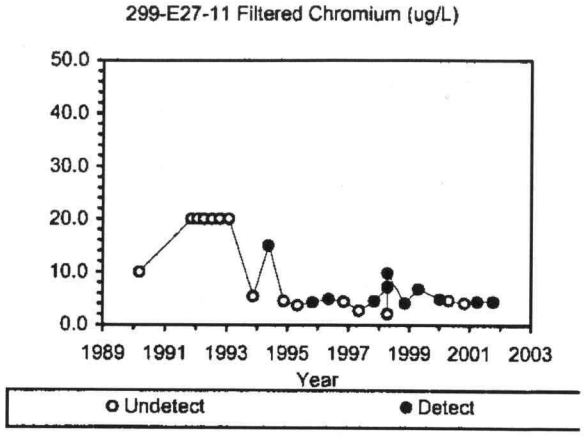

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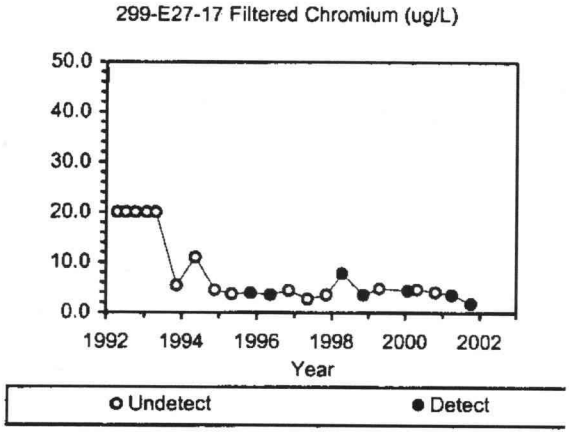

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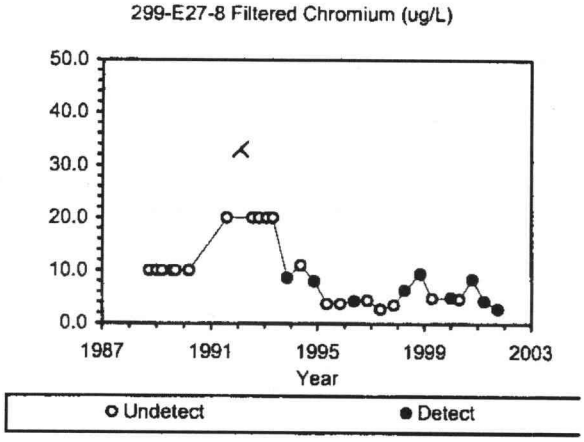

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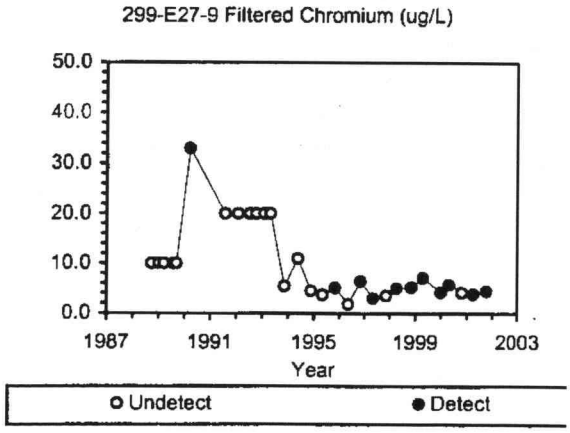

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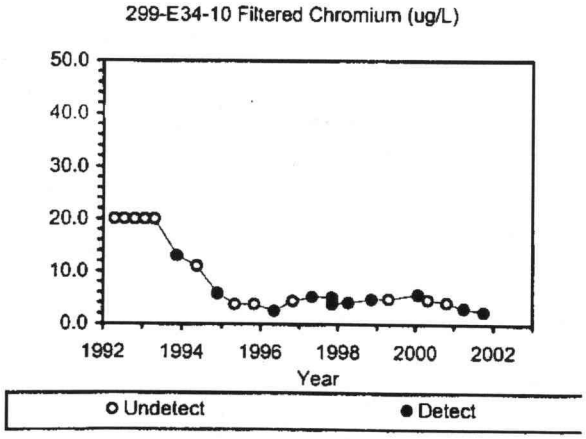

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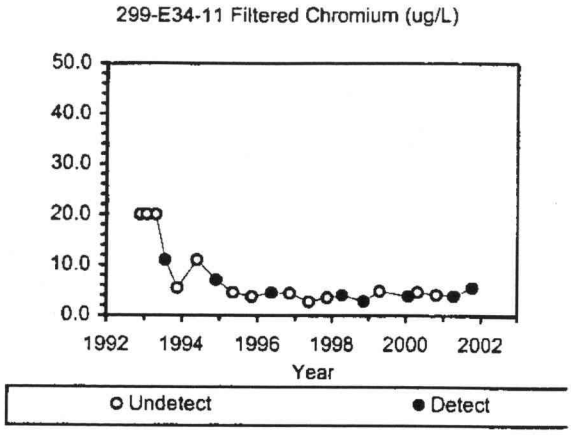

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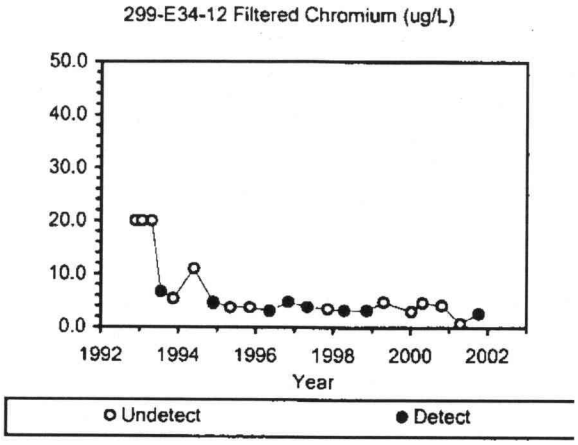

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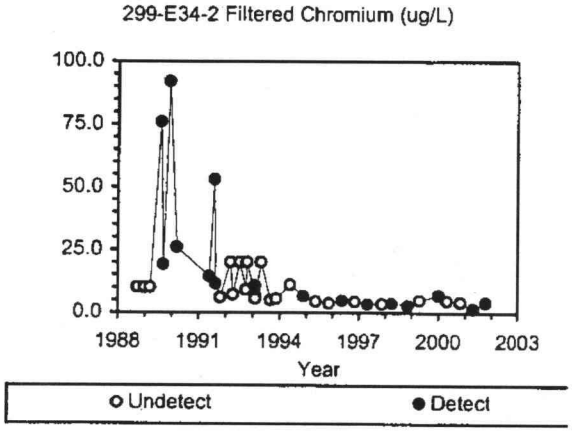

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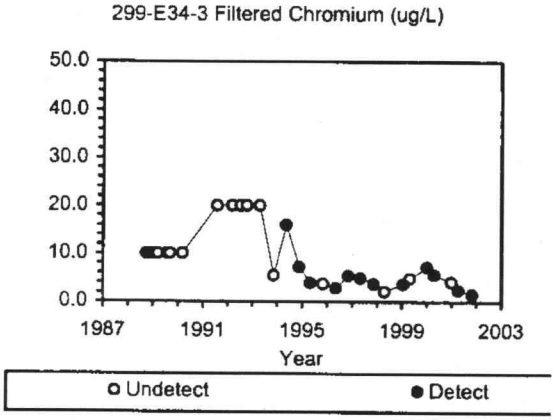

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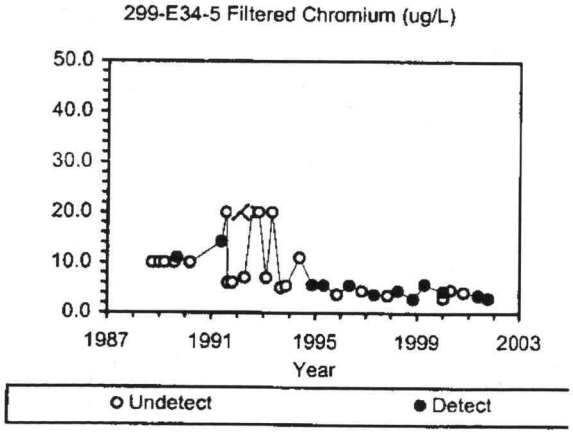

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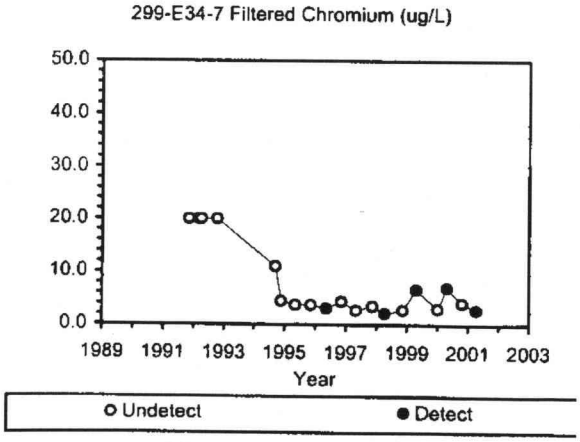

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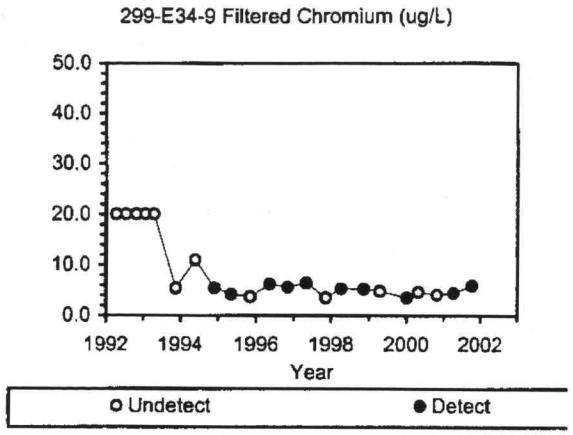

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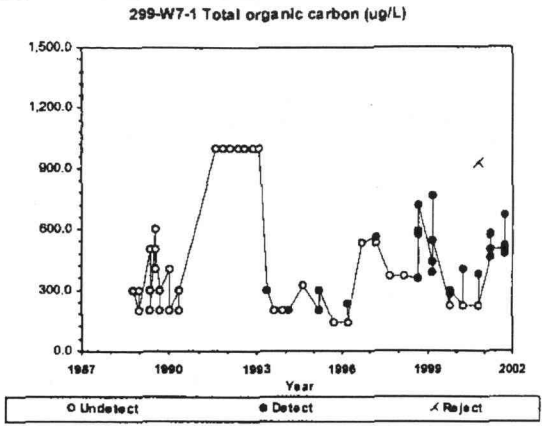

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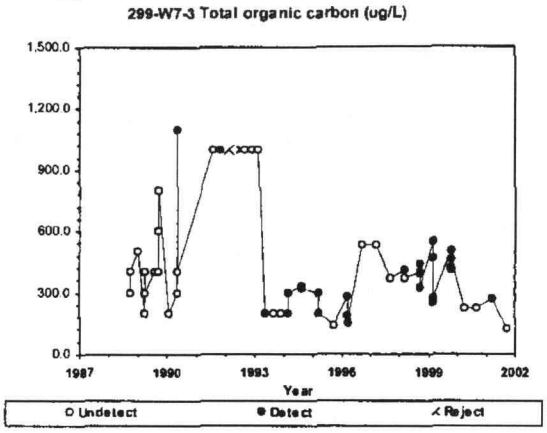

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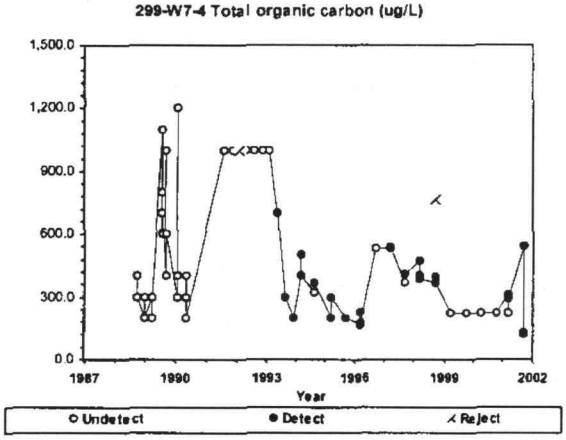

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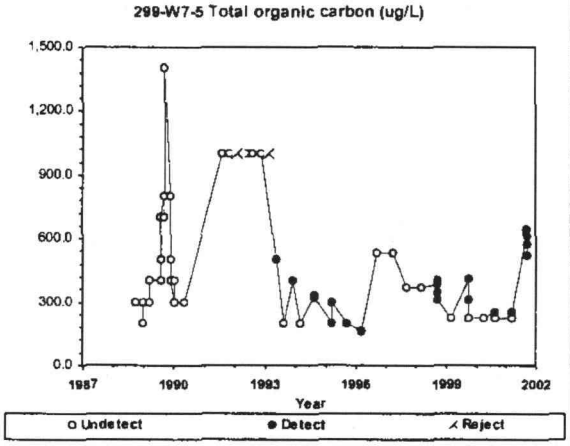

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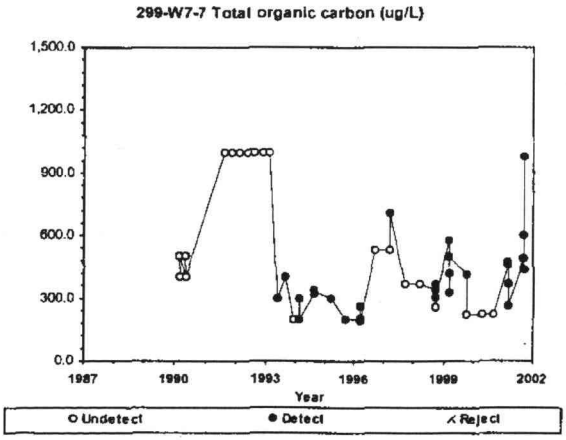

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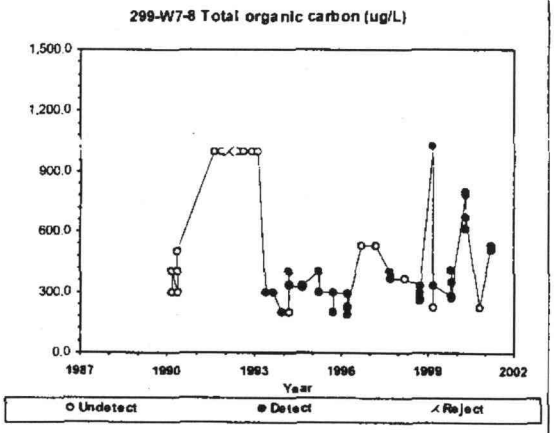

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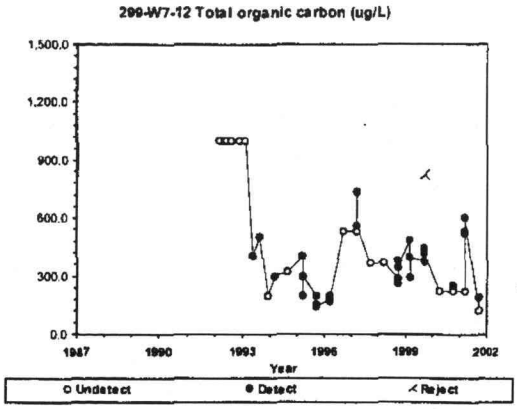

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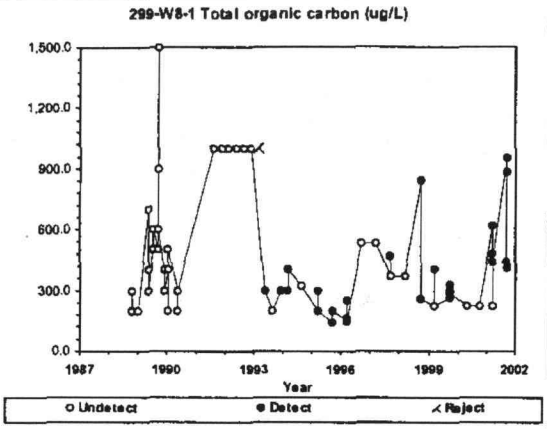

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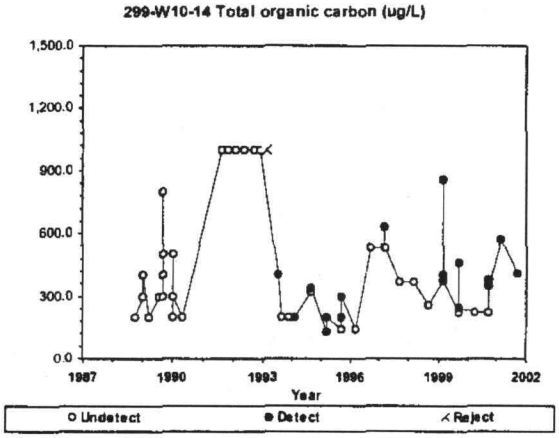

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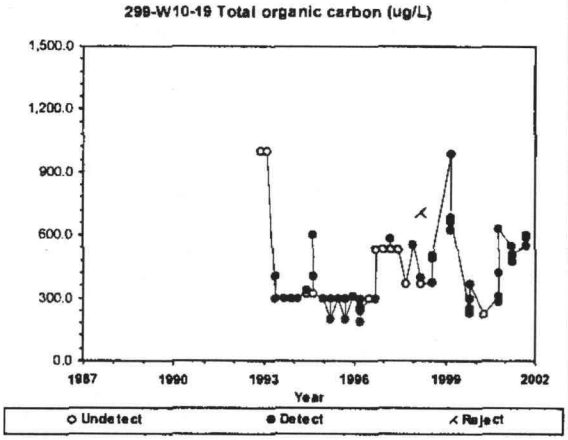

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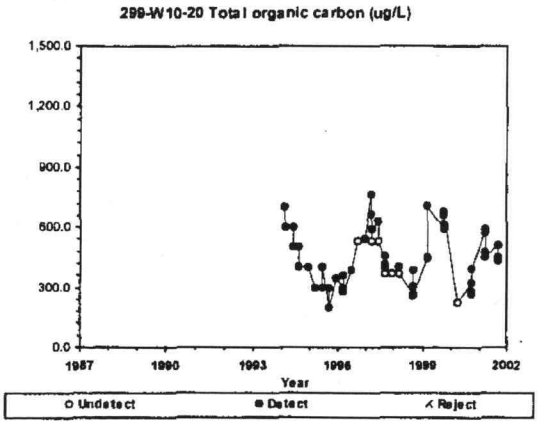

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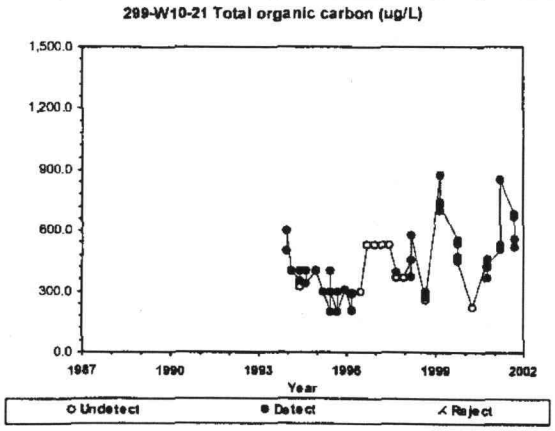

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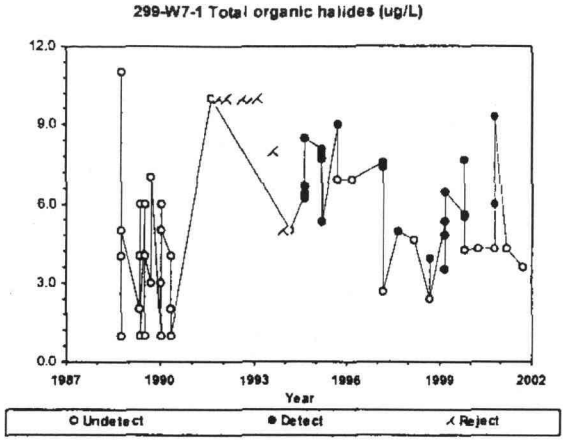

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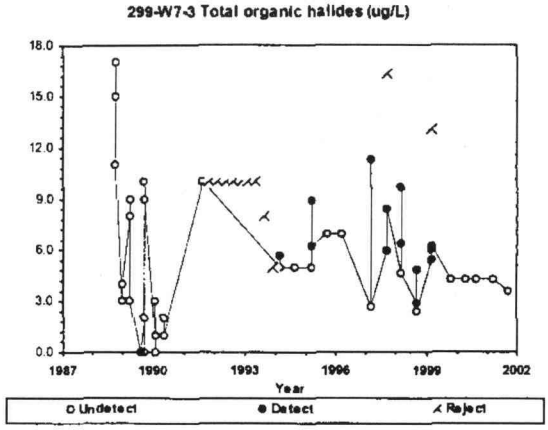

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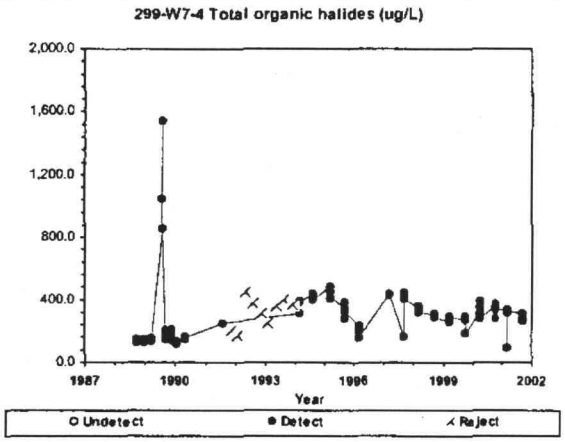

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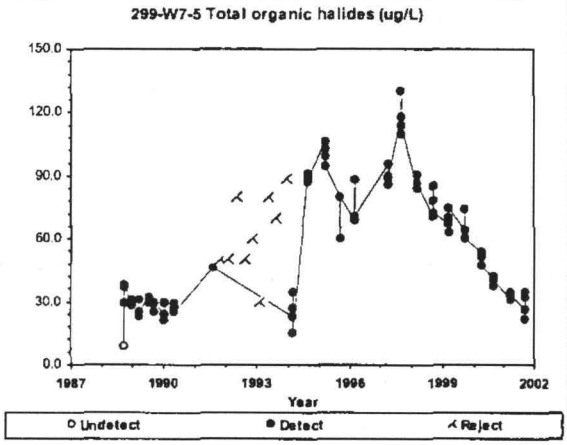

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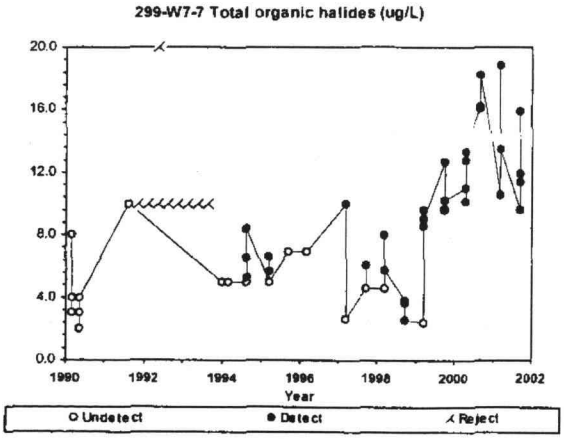

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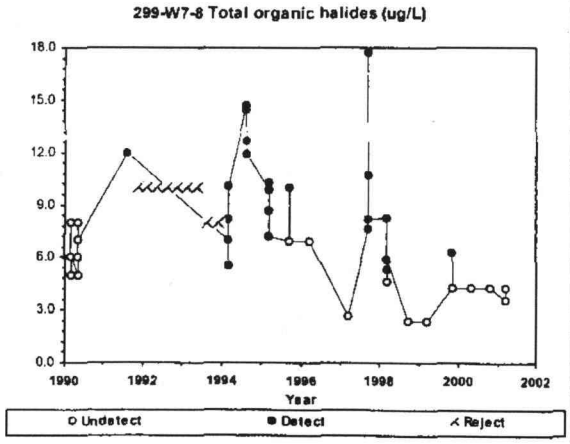

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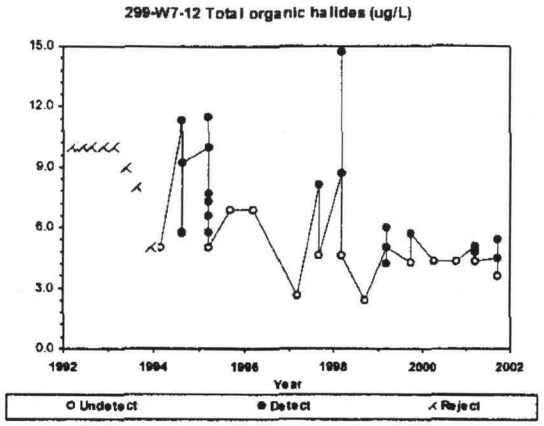

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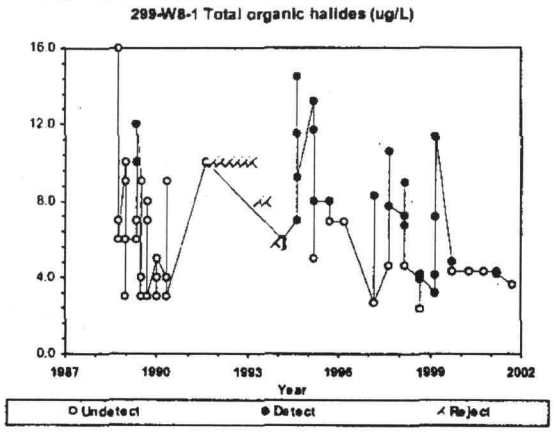

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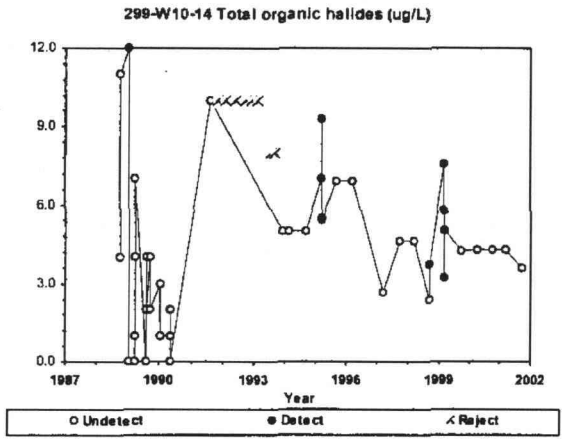

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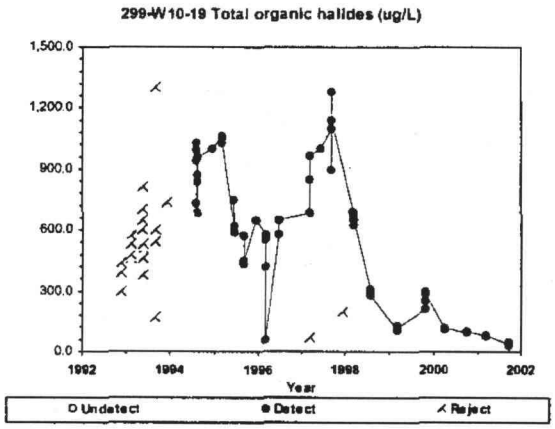

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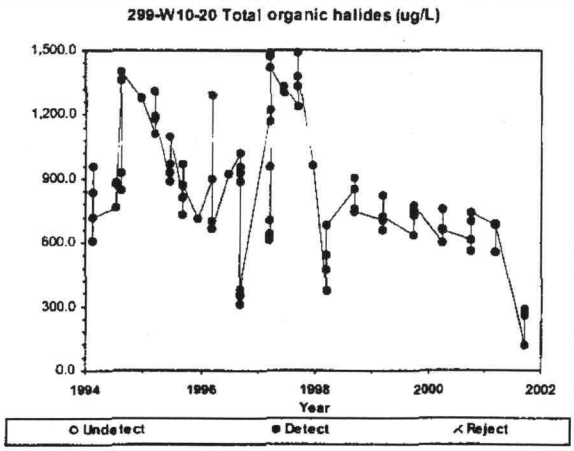

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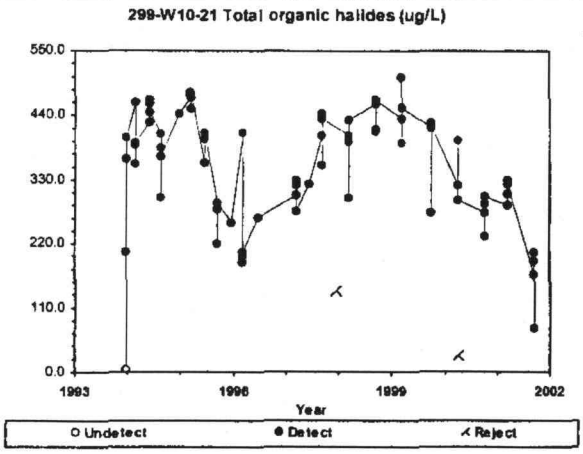

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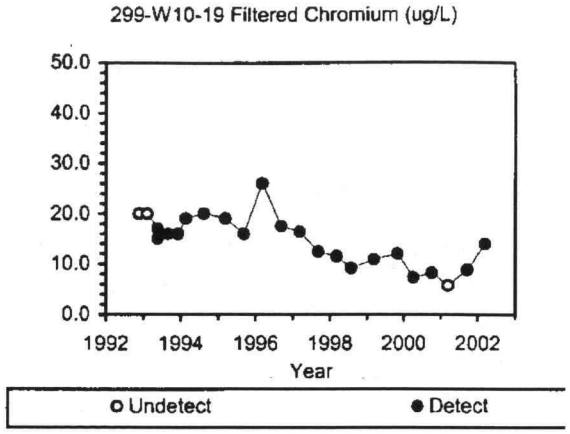
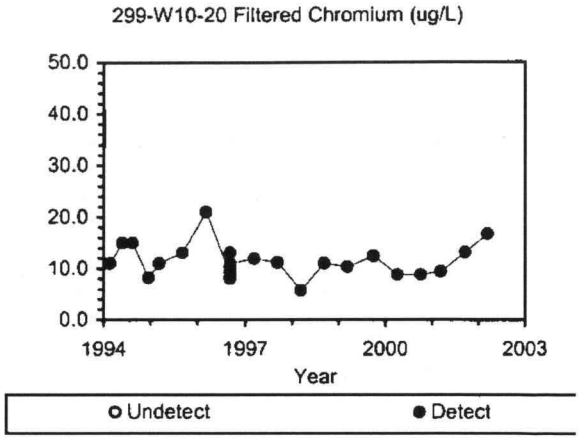


LLWMA-3, Chromium



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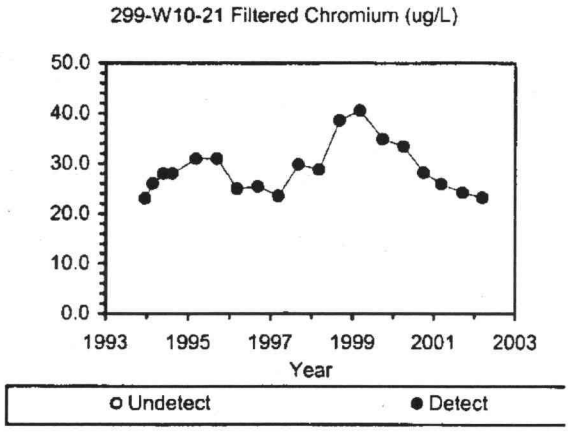

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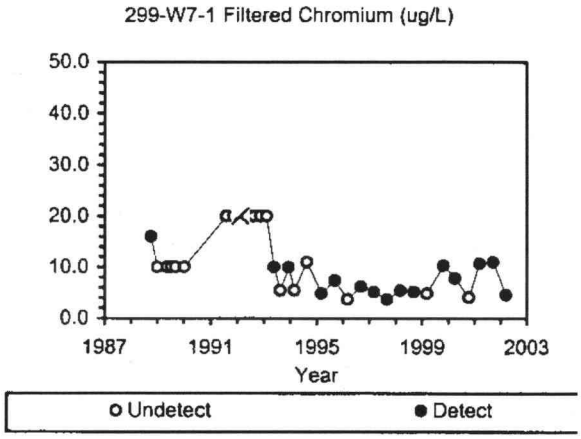

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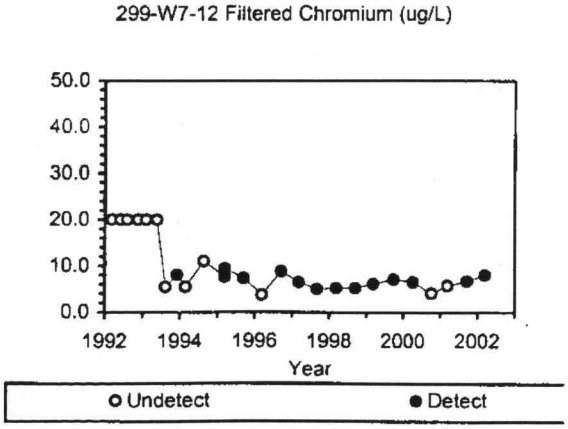

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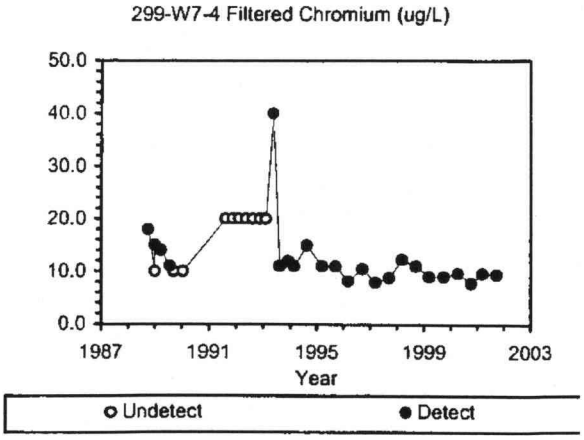

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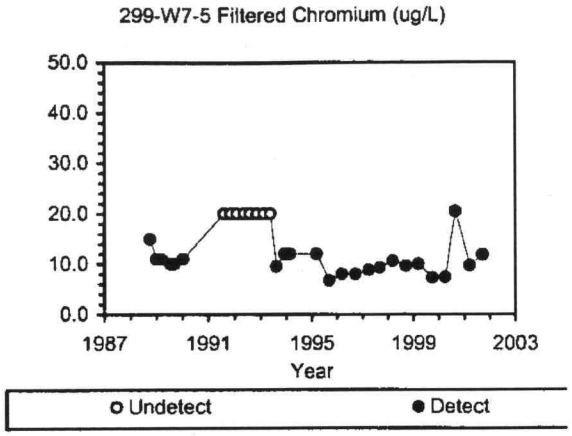

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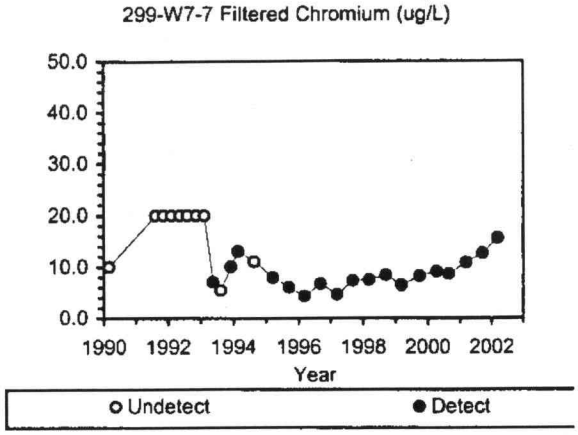

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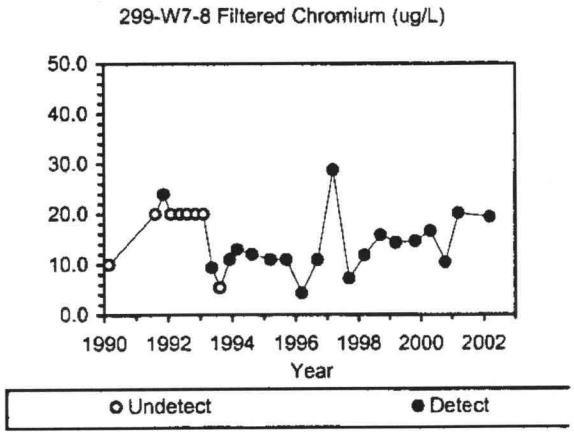

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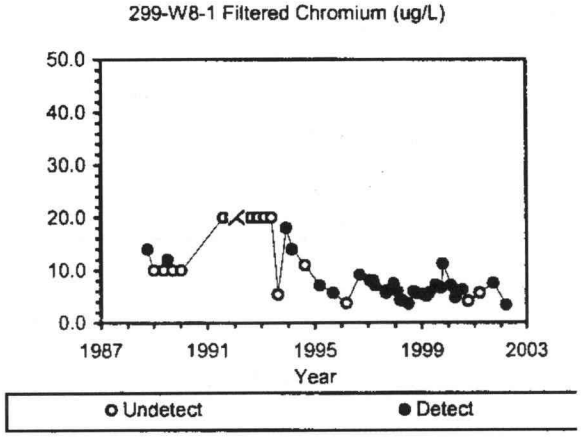

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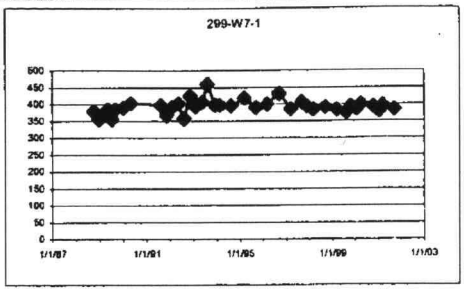
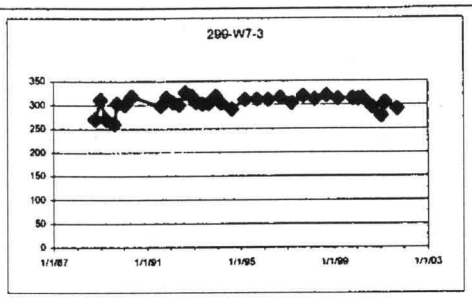


LLWMA-3, Specific Conductance



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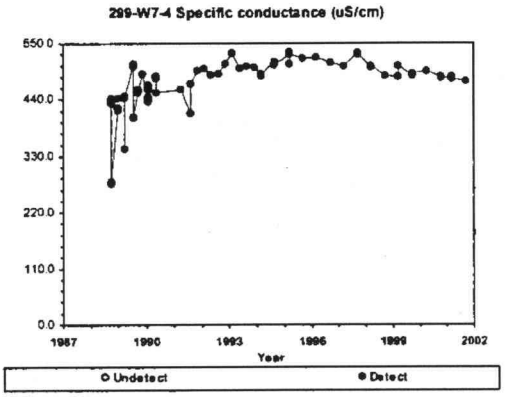

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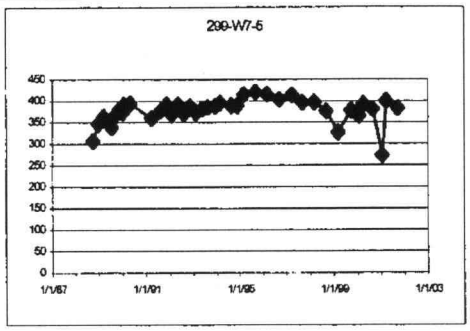

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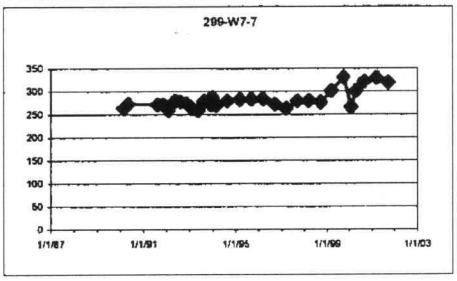

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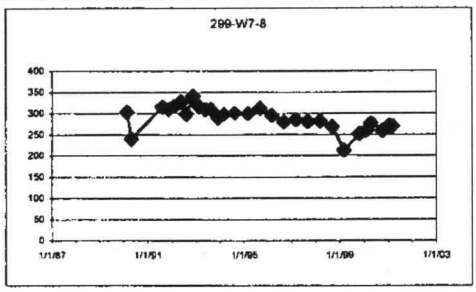

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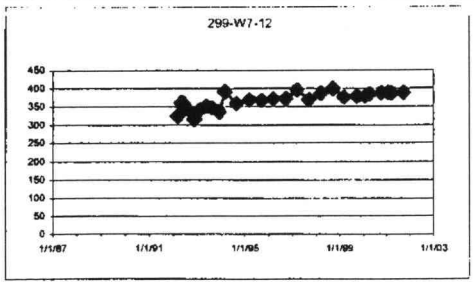

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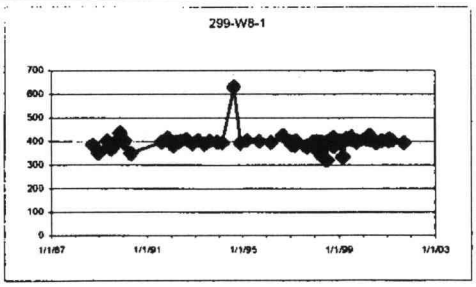

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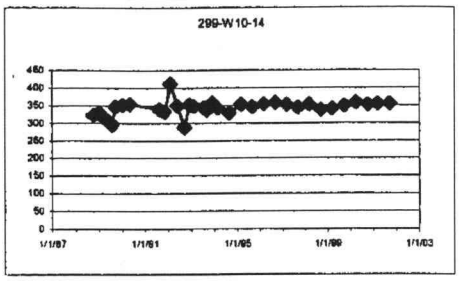

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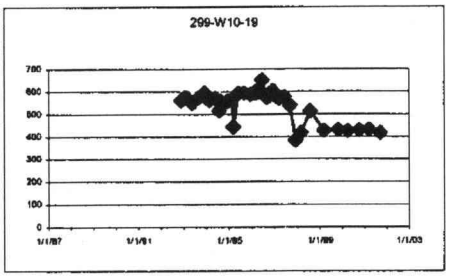

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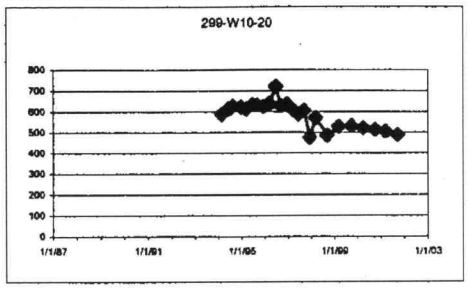

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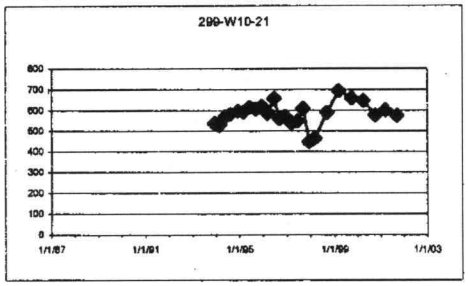
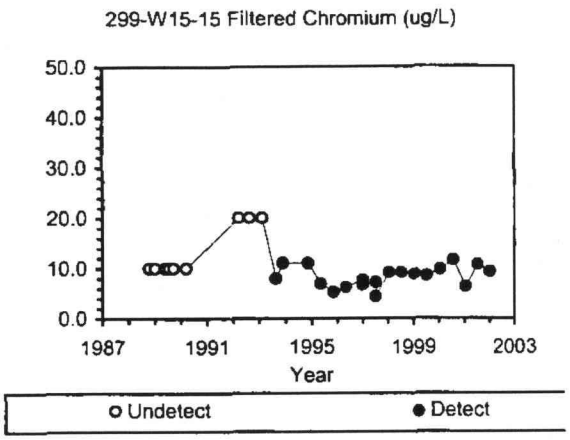
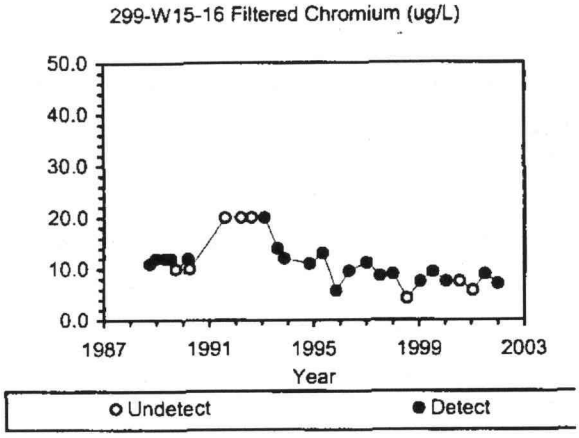


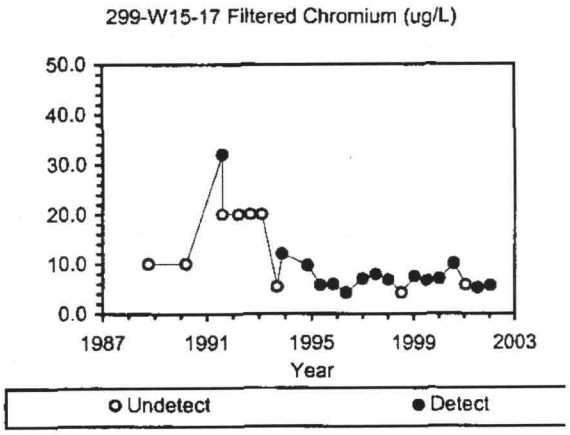
LLWMA-3, Specific Conductance



LLWMA-4, Chromium



LLWMA-4, Chromium



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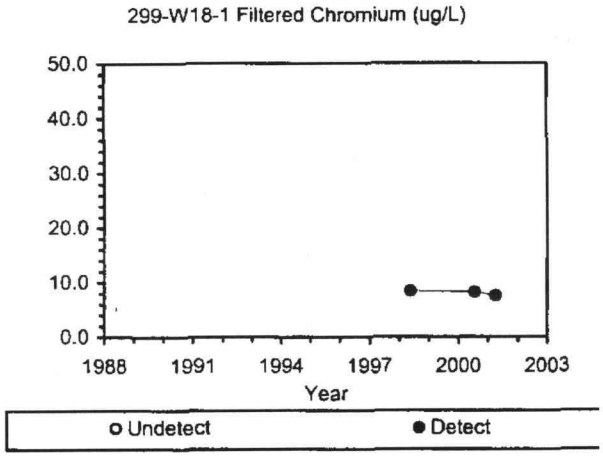
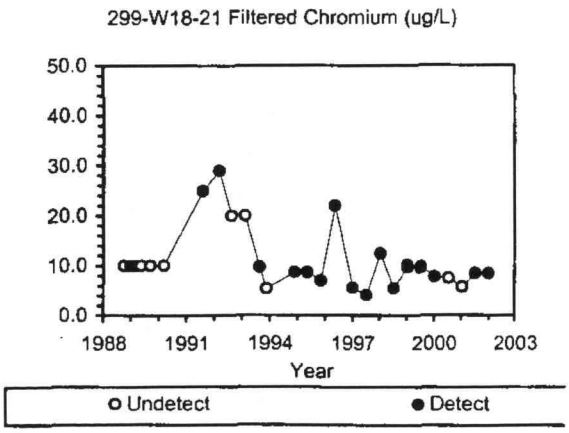
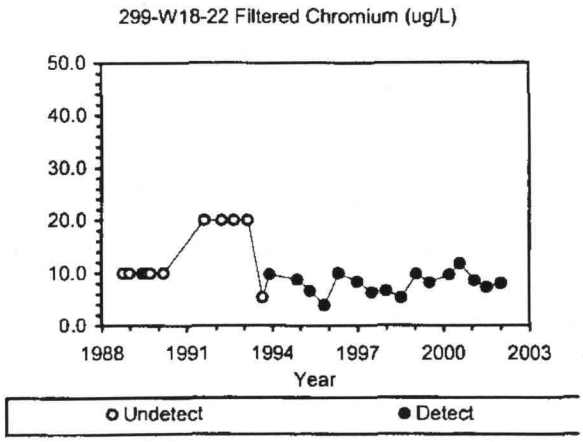


LLWMA-4 Supplemental, Chromium



LLWMA-4, Chromium



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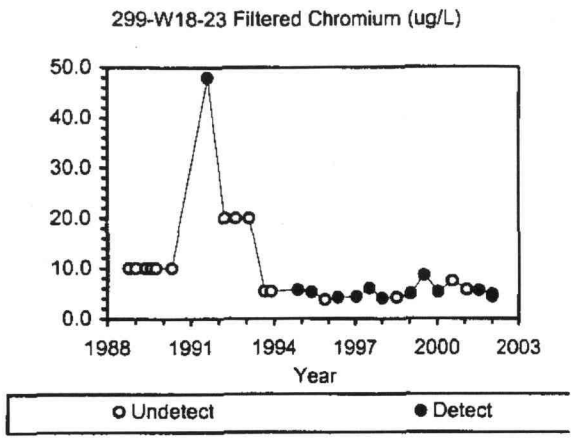

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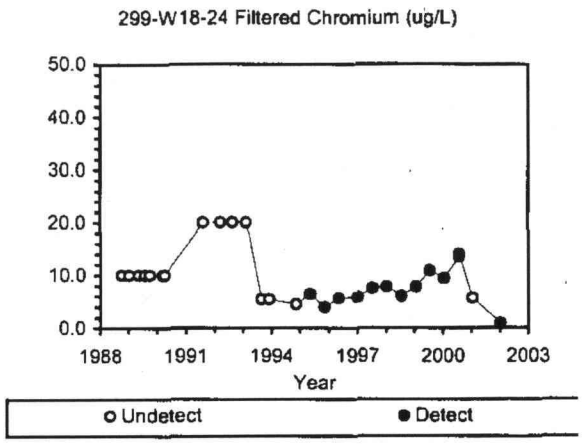

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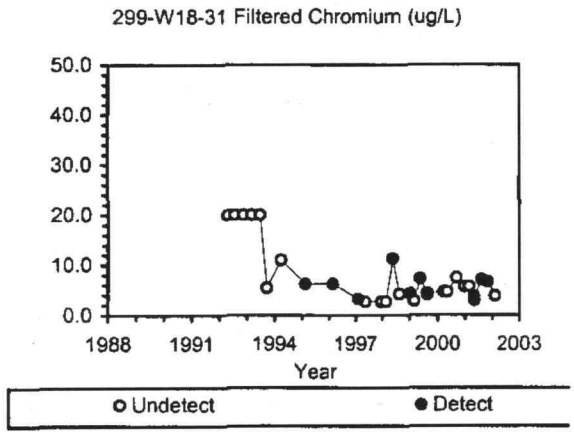

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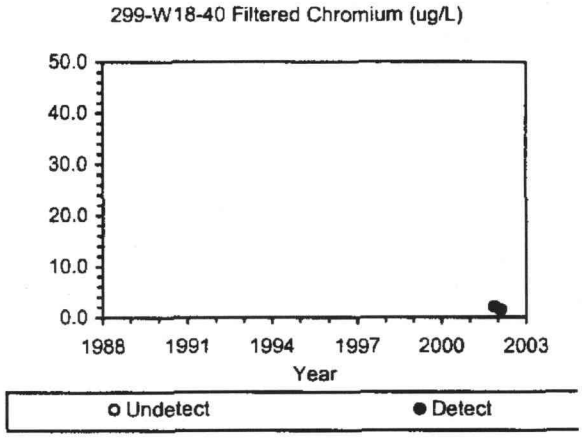
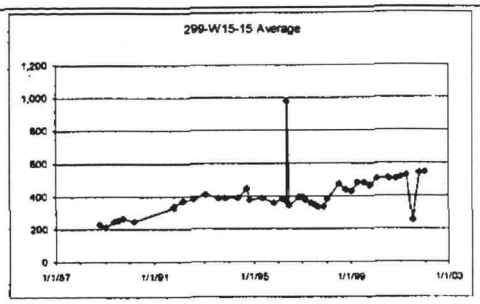
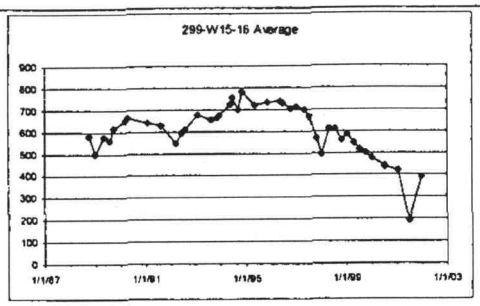


LLWMA-4 supplemental, Chromium

Note: No chromium data for supplemental well 299-W15-31.



LLWMA-4, Specific Conductance



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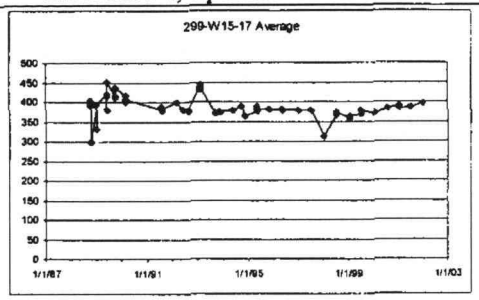

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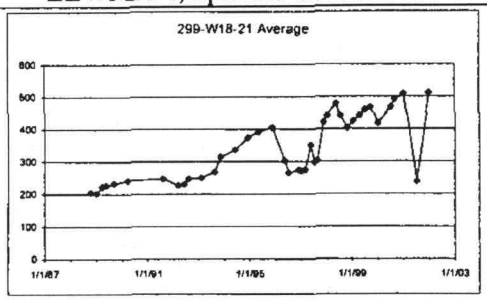

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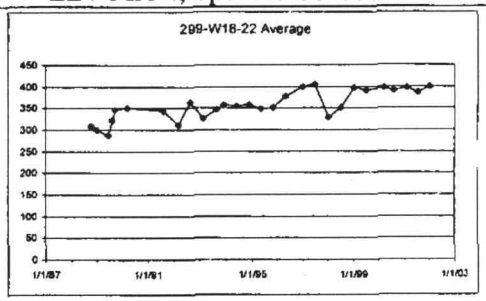

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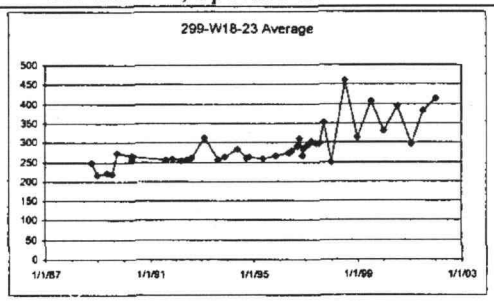

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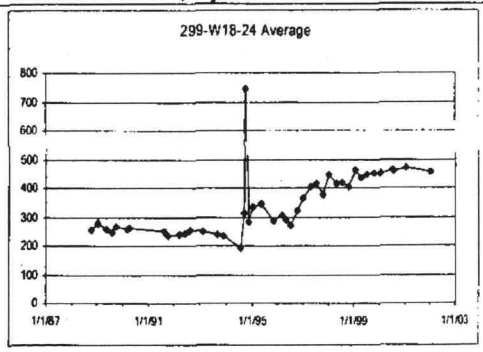

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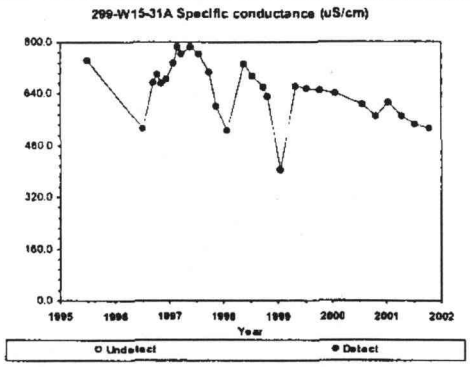
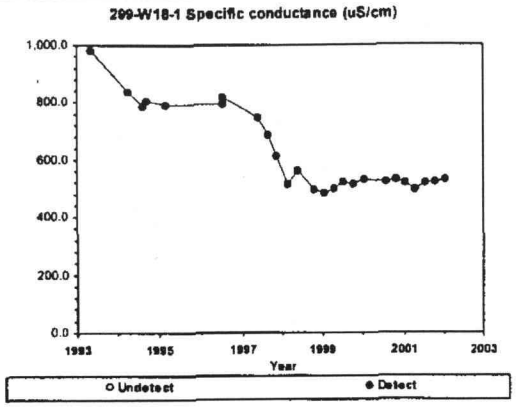
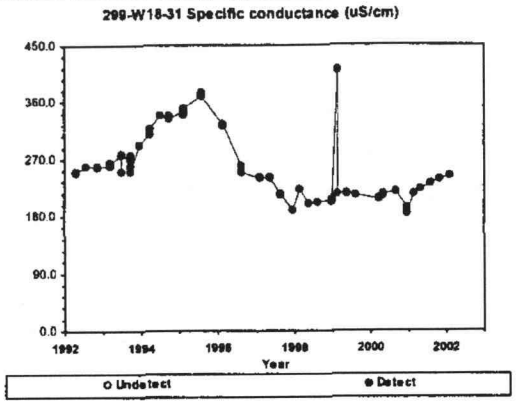


LLWMA-4 Supplemental, Specific Conductance



LLWMA-4 Supplemental,
Specific Conductance



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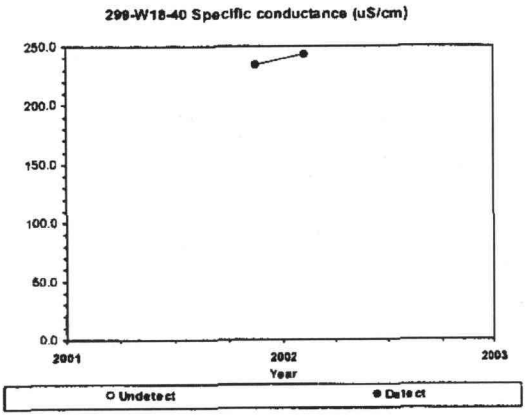
Specific Conductance



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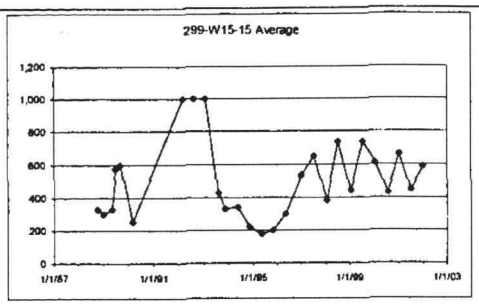
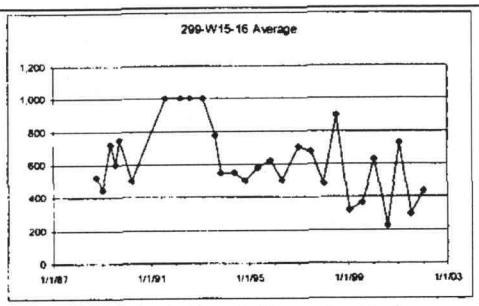
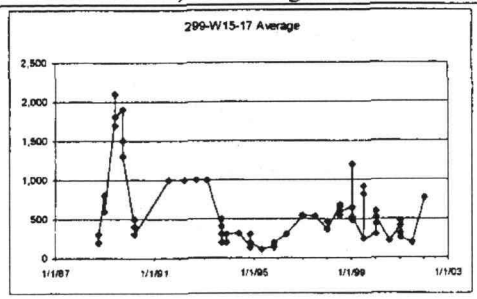
Specific Conductance



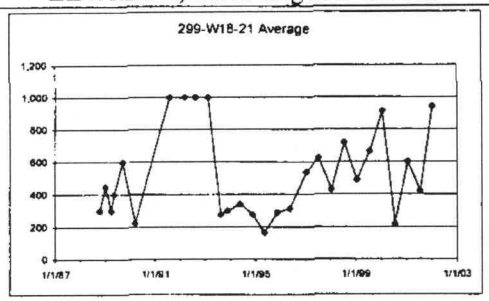
LLWMA-4, Total Organic Carbon



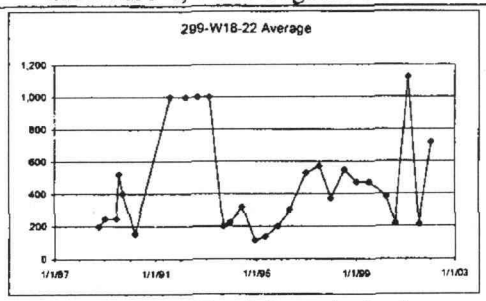
LLWMA-4, Total Organic Carbon



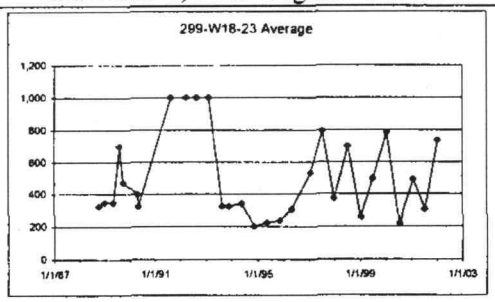
LLWMA-4, Total Organic Carbon



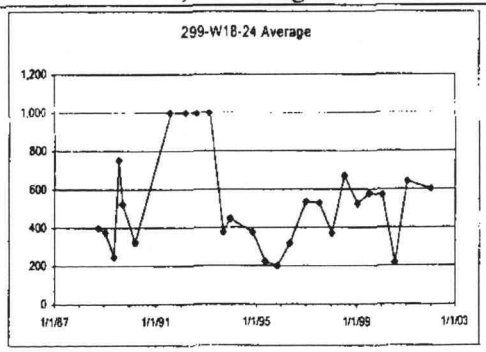
LLWMA-4, Total Organic Carbon



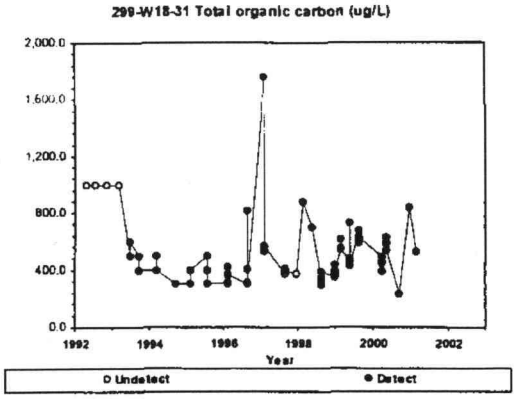
LLWMA-4, Total Organic Carbon



LLWMA-4, Total Organic Carbon

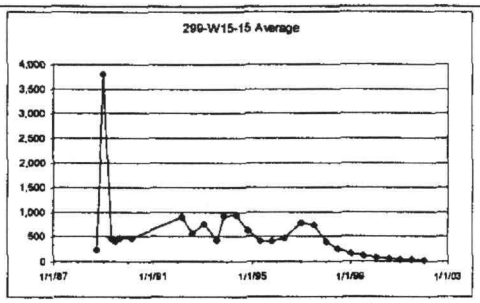


LLWMA-4, Total Organic Carbon

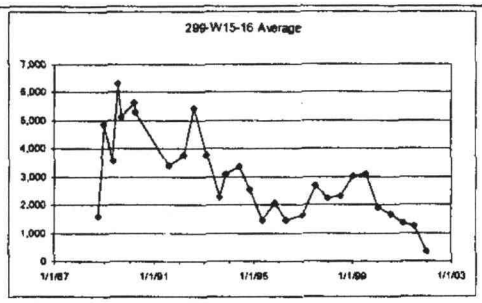


LLWMA-4, Total Organic Carbon

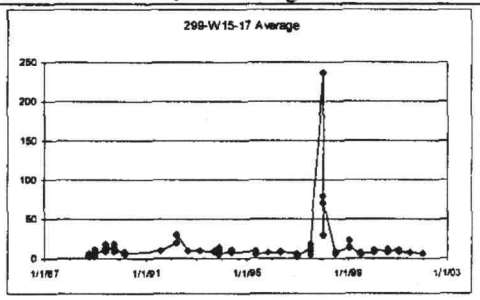
Note: No total organic carbon data for supplemental wells 299-W15-31A, 299-W18-1, or 299-W18-40.



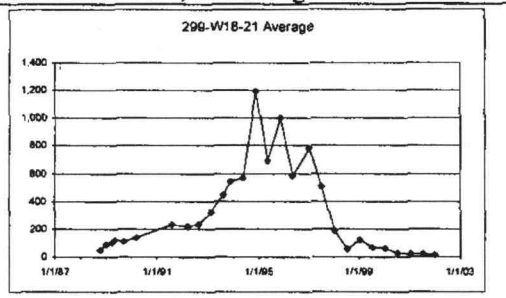
LLWMA-4, Total Organic Halides



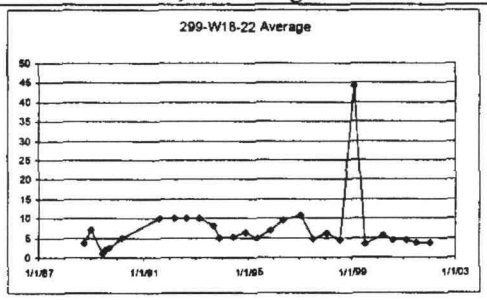
LLWMA-4, Total Organic Halides



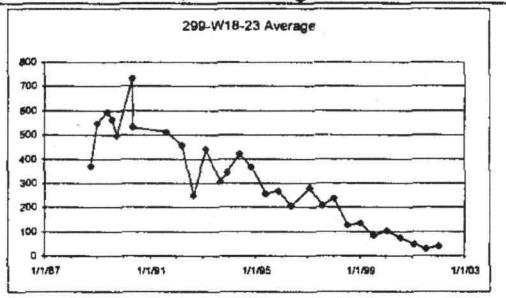
LLWMA-4, Total Organic Halides



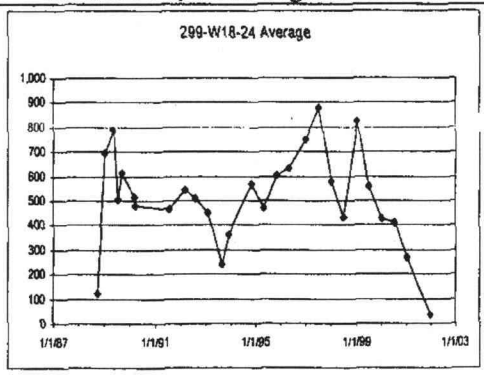
LLWMA-4, Total Organic Halides



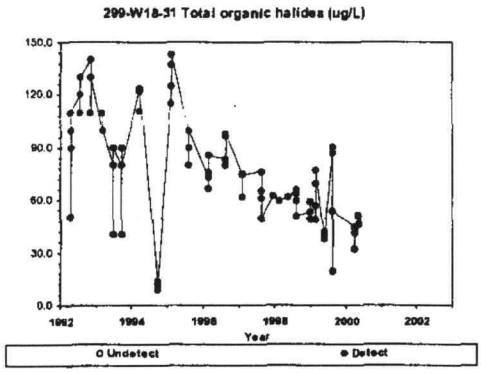
LLWMA-4, Total Organic Halides



LLWMA-4, Total Organic Halides



LLWMA-4, Total Organic Halides



LLWMA-4 Supplemental,
Total Organic Halides

Note: No total organic halides data for supplemental wells 299-W15-31A, 299-W18-1, or 299-W18-40.

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APPENDIX 5C

WELL CONSTRUCTION DATA (AS-BUILT DIAGRAMS)

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APPENDIX 5C

WELL CONSTRUCTION DATA (AS-BUILT DIAGRAMS)

This appendix contains well construction data (as-built diagrams) for monitoring network wells at the LLBG and includes wells in the interim-status and final-status networks.

Depth and casing diameters on these diagrams are expressed in English units (feet and inches) as these were tracked during well drilling and completion. Depths were measured from the ground surface. Elevations are expressed in feet above the National Vertical Geodetic Datum of 1929 (NGVD29), which was the site standard when the wells were drilled. Water levels discussed in the body of this report are expressed in meters above the North American Vertical Datum of 1988 (NAVD88), which is ~1 meter higher than NGVD29.

5C.1 Low-Level Waste Management Area 1

The following diagrams show wells in the monitoring network for Low-Level Waste Management Area 1.

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: C. Walmsley
Drilling Company: Kaiser Engineers
Date Started: 17Sep87

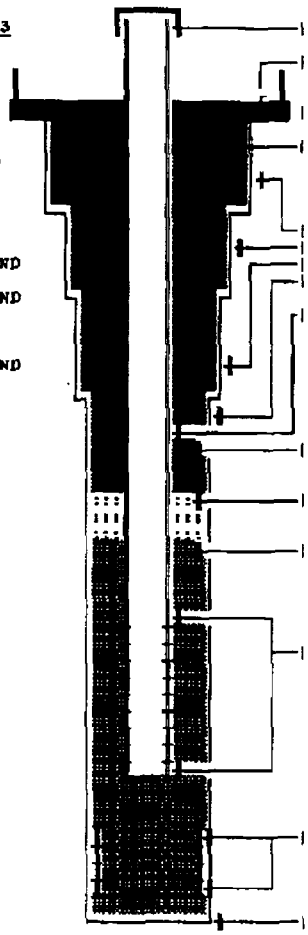
Sample Method: Drive barrel
Additives Used: Hard tool
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 06Nov87

WELL NUMBER: 299-E28-26
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,446 E/W N 55,606
State Coordinates: N 449,605 E 2,239,605
Start Card #: Not documented T R S
Elevation Ground surface: 684.84-ft (Brass cap)

Depth to water: 279.3-ft Oct87
(Ground surface) 283.0-ft 25Jun93

GENERALIZED STRATIGRAPHY Log
Geologist's
sl = slightly

0-25 Silty, sandy GRAVEL
25-30: Sandy GRAVEL
30-35: sl silty sl gravelly SAND
35-70: Silty sandy GRAVEL
70-75: sl silty gravelly SAND
75-80: SAND
80-85: sl gravelly SAND
85-100: sl silty SAND
100-110: sl silty sl gravelly SAND
110-135: sl silty SAND
135-145: sl silty sl gravelly SAND
145-160: SAND
160-165: sl silty SAND
165-170: SAND
170-175: sl silty sl gravelly SAND
175-180: Silty sandy GRAVEL
180-190: SAND
190-200: Silty sandy GRAVEL
200-205: Sandy GRAVEL
205-210: sl silty SAND
210-215: SAND
215-220: sl silty SANDd GRAVEL
220-225: Silty SAND
225-247: Silty sandy GRAVEL
247-255: No sample
255-290: Silty sandy GRAVEL
290-295: No sample
295-315: Silty sandy GRAVEL
315-320: sl silty gravelly SAND
320-326: Silty sandy GRAVEL
326-328.5: BASALT



Elevation of reference point: [687.26-ft] (top of casing)
Height of reference point above ground surface [2.4-ft]
Depth of surface seal [3-271.1-ft]
Type of surface seal: Bentonite crumbles to 271.1-ft 4-ft x 4-ft x 6-in surface pad to 3-ft
Hole diameter, 0-79.8-ft, 17-in nominal
79.8-165.0-ft, 13-in nominal
163.8-238.1-ft, 11-in nominal
238.1-328.5-ft, 9-in nominal
4-in ID stainless steel casing, +2.4-279.0-ft
Bentonite crumbles, 3-271.1-ft
Volclay pellets, 271.1-276.2-ft
Silica sand pack, 276.2-293-ft, 20-30-mesh
293-299-ft, 10-30-mesh
299-328.5-ft, 20-30-mesh
4-in stainless steel screen, 278.8-298.8-ft, #20-slot
8-in stainless steel telescoping screen, 315.1-325.1-ft, #30-slot
Borehole drilled depth: [328.5-ft]

Drawing By: RKL/2E28-26.ASB
Date : 10Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: Murphy/Robinson
Drilling Company: Kaiser Engineers
Date Started: 02Sep87

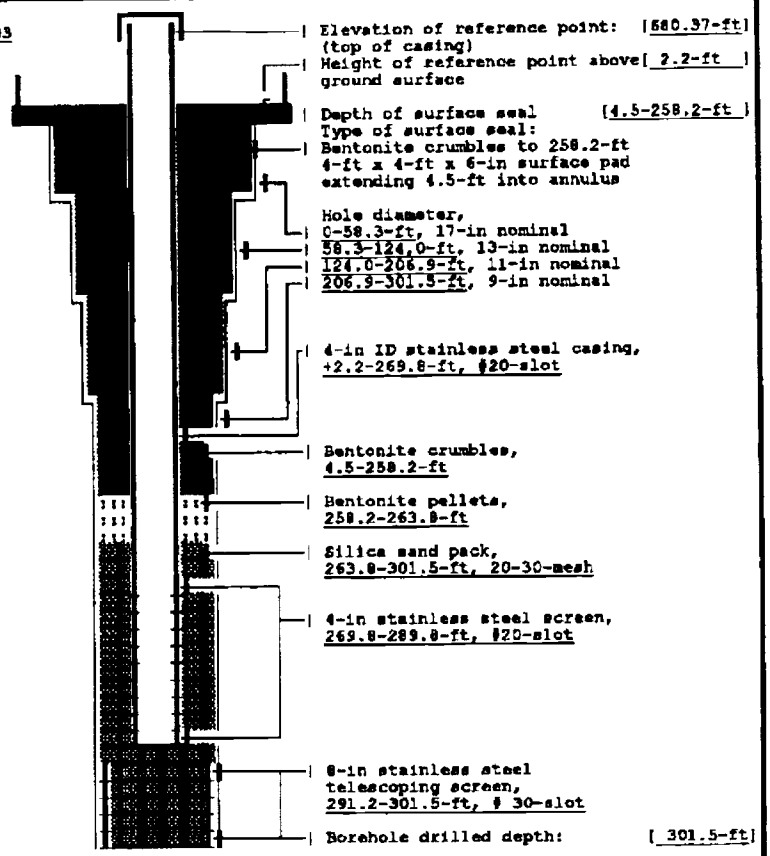
Sample Drive barrel Method: Hard tool
Additives Used: Not documented
WA State Lic Nr:
Company Location: Hanford
Date Complete: 29Sep87

WELL NUMBER: 299-E28-27
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,595 E/W W 54,670
State Coordinates: N 449,756 E 2,240,541
Start Card #: Not documented T R S
Elevation Ground surface: 678.18-ft (Brass cap)

Depth to water: 273.2-ft Sep87
(Ground surface) 276.4-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log

0-10 Silty, sandy GRAVEL
10-15: Sandy GRAVEL
15-55: Silty sandy GRAVEL
55-60: Sandy GRAVEL
60-65: Silty gravelly SAND
65-70: SAND
70-80: Gravelly SAND
80-90: Silty SAND
90-95: Silty gravelly SAND
95-100: SAND
100-110: Gravelly SAND
110-115: Silty gravelly SAND
115-120: Gravelly SAND
120-125: SAND
125-140: Gravelly SAND
140-145: SAND
145-150: Gravelly SAND
150-185: SAND
185-190: Silty gravelly SAND
190-195: Silty SAND and GRAVEL
195-210: Sandy GRAVEL
210-220: SILT, SAND and GRAVEL
220-225: Gravelly SAND
225-230: Silty SAND
230-240: Gravelly SAND
240-290: GRAVEL, SAND and SILT
290-295: SAND
295-300: Silty sandy GRAVEL
300-301: Gravelly SAND



Drawing By: RXL/2E28-27.ASB
Date : 10Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E28-28	TEMPORARY WELL NO: E10-MW1
Drilling Fluid Used: 200E Area Water	Additives Used: None	Hanford Coordinates: N/S N 44,724	E/W W 56,056
Driller's Name: L. Watkins	WA State Lic Nr: Not documented	State Coordinates: N 449,882	E 2,239,154
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #:	T ___ R ___ S ___
Date Started: 02Jan90	Date Complete: 17Apr90	Elevation Ground surface: 683.55-ft (Brass cap)	

Depth to water: 279.7-ft Feb90
(Ground surface) 281.8-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log

0-10: Sandy GRAVEL
10-25: Muddy sandy GRAVEL
25-35: Sandy GRAVEL
35-40: Gravelly SAND
40-45: Sandy GRAVEL
45-60: Gravelly SAND
60-70: Sandy GRAVEL
70-85: Slightly gravelly SAND
85-95: SAND
95-100: Slightly gravelly SAND
100-105: Gravelly SAND
105-120: Slightly gravelly SAND
120-130: SAND
130-135: Slightly gravelly SAND
135-145: Slightly muddy SAND
145-160: SAND
160-170: Sandy GRAVEL
170-175: Gravelly SAND
175-190: Gravelly SAND
190-200: Slightly gravelly slightly muddy SAND
200-205: SAND
205-215: Sandy GRAVEL
215-220: Silty muddy GRAVEL
220-235: Sandy GRAVEL
235-275: Muddy sandy GRAVEL
275-280: No recovery
280-285: Muddy sandy GRAVEL
285-290: Gravelly SAND
290-296: Slightly gravelly SAND

- Elevation of reference point: [686.55-ft] (top of 4-in casing)
- Height of reference point above ground surface [3.0-ft]
- Depth of surface seal [2.5-20.0-ft]
  Type of surface seal:
  Cement grout to 20.0-ft
  4 x 4-ft x 6-in surface pad
  4 equidistant protective posts
  Pad extends 2.5-ft into annulus
- Hole diameter,
  0-128-ft, 11-in nominal
  128-296.0-ft, 9-in nominal
- 4-in ID T304 stainless steel casing, +ND-275.0-ft
- Bentonite crumbles, 20.0-267.0-ft, 8-20-mesh
- 3/8-in Volclay tablets, 267.0-271.5-ft
- Silica sand pack, 271.5-294.8-ft, 20-40-mesh
- 4-in stainless steel screen, 275.0-295.0-ft, #10-slot w/channel pack
- Depth to bottom, 295.9-ft, 06Nov91
- Backfill, 294.8-296.0-ft
- Borehole drilled depth: [296.0-ft]

Drawing By: RKL/2E28-28.ASB
Date : 10Sep93
Reference : HANFORD WELLS

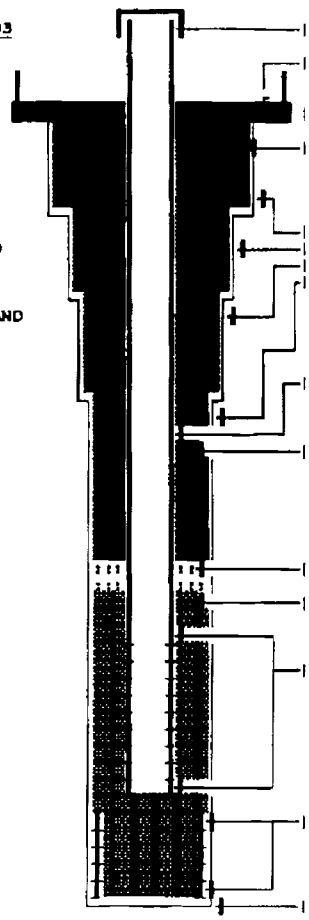
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E32-2
Drilling Fluid Used: 200 E Water Supply	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: C. Walmsley L. Watkins/L. Cordon	WA State Lic Nr:	Hanford Coordinates: N/S N 45,904 E/W W 56,565
Drilling Company: Kaiser Engineers	Company Location: Hanford	State Coordinates: N 451,061 E 2,238,642
Date Started: 14Aug87	Date Complete: 30Sep87	Start Card #: Not documented T R S
		Elevation Ground surface: 667.91-ft (Brass cap)

Depth to water: 262.3-ft Sep87
(Ground surface) 266.2-ft 25Jun93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl = Slightly

0-10 Silty sandy GRAVEL
10-15: Sl silty SAND
15-55: Silty sandy GRAVEL
55-65: Silty gravelly SAND
65-70: Silty sandy GRAVEL
70-80: SAND
80-85: Slilty sandy GRAVEL
85-95: Sl silty sl gravelly SAND
95-115: Sl gravelly SAND
115-140: Sl silty SAND
140-150: Silty SAND
150-155: Sl silty sl gravelly SAND
155-190: Sl silty SAND
190-200: Silty sandy GRAVEL
200-210: Sl silty SAND
210-245: Silty sandy GRAVEL
245-250: Sl silty gravelly SAND
250-275: Silty sandy GRAVEL
275-280: Silty gravelly SAND
280-285: Silty SAND
285-287: Silty gravelly SAND
287-289: BASALT



Elevation of reference point: [670.06-ft]
(top of casing)
Height of reference point above ground surface [2.2-ft]

Depth of surface seal [5-246.9-ft]
Type of surface seal:
Bentonite crumbles to 246.9-ft
4-ft x 4-ft x 6-in surface pad
extending 5-ft into annulus

Hole diameter,
0-56.6-ft, 17-in nominal,
56.6-125.0-ft, 13-in nominal,
125.0-184.3-ft, 11-in nominal,
184.3-289.0-ft, 9-in nominal

[4-in]

4-in ID stainless steel casing,
+2.2-257.8-ft

Bentonite crumbles,
5.0-246.9-ft

Bentonite pellets,
246.9-251.9-ft

Silica sand pack,
251.9-289.2-ft, 20-30-mesh

4-in stainless steel screen,
257.8-277.8-ft, #20-slot

8-in stainless steel
telescoping screen,
279.2-289.2-ft, #30-slot

Borehole drilled depth: [289.2-ft]

Drawing By: RKL/2E32-02.ASB
Date : 10Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: N. Thoreson O. Amos/D. St George
Drilling Company: Kaiser Engineers
Date Started: 14Aug87

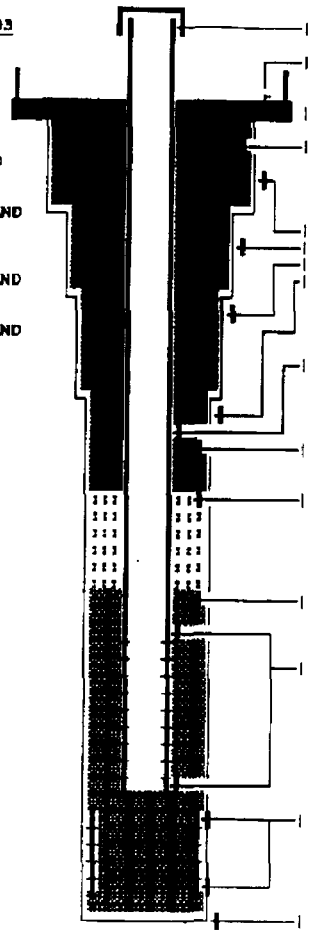
Sample Drive barrel Method: Hard tool
Additives Used: Not documented
WA State Lic Nr:
Company Location: Hanford
Date Complete: 30Sep87

WELL NUMBER: 299-E32-3
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,631 E/W W 56,721
State Coordinates: N 450,787 E 2,236,487
Start Card #: Not documented T R S
Elevation Ground surface: 675.32-ft (Brass cap)

Depth to water: 269.0-ft Sep87
(Ground surface) 273.6-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl = Slightly

0-65 Silty sandy GRAVEL
65-75: Sl silty gravelly SAND
75-80: Sl silty sl gravelly SAND
80-90: Sl silty gravelly SAND
90-105: Sl gravelly SAND
105-110: Sl silty sl gravelly SAND
110-120: Sl silty SAND
120-125: Silty SAND
125-130: Gravelly SAND
130-135: Sl silty sl gravelly SAND
135-140: Sl silty SAND
140-147: Silty SAND
147-150: Sl silty sl gravelly SAND
150-180: Sl silty SAND
180-195: SAND
195-200: Sandy GRAVEL
200-275: Silty sandy GRAVEL
275-280: Sl silty gravelly SAND
280-285: Silty sandy GRAVEL
285-290: SAND
290-295: Sl silty SAND
295-300: Silty sandy GRAVEL
300-303: Sl silty gravelly SAND
303-304: Gravelly SAND



Elevation of reference point: [676.51-ft] (top of casing)
Height of reference point above ground surface [1.2-ft]
Depth of surface seal [3.4-255.7-ft]
Type of surface seal: Bentonite crumbles to 255.7-ft 4-ft x 4-ft x 6-in surface pad extending 3.4-ft into annulus
Hole diameter,
0-60.4-ft, 17-in nominal
60.4-125.9-ft, 13-in nominal,
125.9-186.5-ft, 11-in nominal
186.5-304.0-ft, 9-in nominal
4-in ID stainless steel casing, +1.2-266.2-ft
Bentonite crumbles, 3.4-246.9-ft
Volclay tablets, 246.9-262.0-ft
Silica sand pack 262.0-304.0-ft, 20-30-mesh
4-in stainless steel screen, 266.2-286.2-ft, #20-slot
6-in stainless steel telescoping screen, 291-301.0-ft, #30-slot
Borehole drilled depth: [304.0-ft]

Drawing By: RKL/2E32-03.ASB
Date : 10Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200E Area Water
Driller's Name: O Amos/L Cordon
Drilling Company: Kaiser Engineers
Date Started: 28Aug87

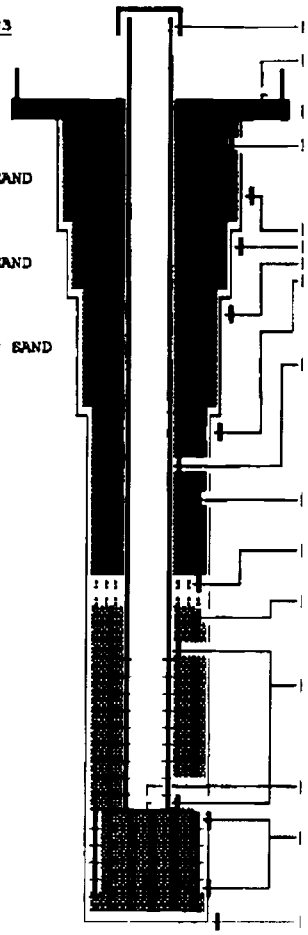
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 30Sep87

WELL NUMBER: 299-E32-4
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,985 E/W W 56,713
State Coordinates: N 450,141 E 2,238,497
Start Card #: T R S
Elevation Ground surface: 684.64-ft (Brass cap)

Depth to water: 280.3-ft Sep87
(Ground surface) 283.0-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log

0-5: Gravelly sandy SILT
5-55: Silty sandy GRAVEL
55-60: Silty gravelly SAND
60-70: Slightly silty gravelly SAND
70-75: Gravelly SAND
75-80: Slightly gravelly SAND
80-85: Slightly silty SAND
85-90: SAND
90-95: Slightly silty gravelly SAND
95-105: Slightly gravelly SAND
105-130: SAND
130-135: Slightly gravelly SAND
135-140: Gravelly SAND
140-145: Slightly silty gravelly SAND
145-150: Gravelly SAND
150-160: Slightly gravelly SAND
160-165: Gravelly SAND
165-175: SAND
175-185: Gravelly SAND
185-190: Slightly silty, slightly gravelly SAND
190-200: Gravelly SAND
200-205: Silty sandy GRAVEL
205-210: No recovery
210-215: Sandy GRAVEL
215-220: Gravelly SAND
220-225: Sandy GRAVEL
225-230: SAND
230-235: Sl silty SAND
235-260: Silty sandy GRAVEL
260-265: GRAVEL
265-285: Silty sandy GRAVEL
285-295: Sandy GRAVEL
295-310: Silty sandy GRAVEL
310 : Sandy GRAVEL



Elevation of reference point: [685.88-ft] (top of casing)
Height of reference point above ground surface [1.2-ft]
Depth of surface seal [3.0-265.7-ft]
Type of surface seal: Bentonite crumbles to 265.7-ft. Concrete 4x4-ft surface pad extending 3-ft into annulus.
Hole diameter,
0-58.2-ft, 17-in nominal,
58.2-122.6-ft, 13-in nominal,
122.6-201.0-ft, 11-in nominal
201.0-311.0-ft, 9-in nominal
4-in ID T304 stainless steel casing, +1.2-278.1-ft
Bentonite crumbles, 3.0-265.7-ft
Bentonite pellets, 265.7-272.0-ft
Silica sand pack, 272.0-311.0-ft, 20-30-mesh
4-in T304 stainless steel screen, 278.1-298.1-ft, #20-slot
Depth to bottom, 06Nov91 299.0-ft
8-in T304 stainless steel telescoping screen, 298.0-302.2-ft, #30-slot
Borehole drilled depth: [311.0-ft]

Drawing By: RKL/2E32-04.ASB
Date : 10Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: L. Cordon
Drilling Company: Basin and Range
Date Started: 27Sep89

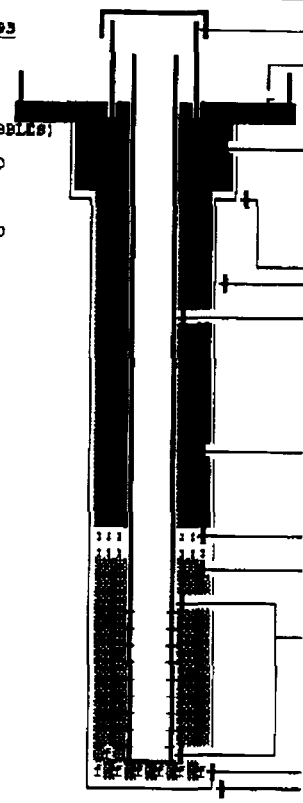
Sample Method: Bard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 09Nov89

WELL NUMBER: 299-E32-5
TEMPORARY WELL NO: E10-MW2
Hanford Coordinates: N/S N 45,306 E/W W 56,725
State NAD83 137,285.4m 572,589.9m
Coordinates: N 450,462 E 2,238,484
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 679.12-ft Brass cap

Depth to water: 274.2-ft Oct89
(Ground surface) 277.4-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl = slightly

0-40: Muddy sandy GRAVEL (tr COBBLES)
40-45: Sl muddy gravely SAND
45-50: Sl gravelly sl muddy SAND
50-55: Sl gravelly SAND
55-65: Sl muddy gravelly SAND
65-90: Sl gravelly SAND
90-95: Sl gravelly sl muddy SAND
95-100: SAND
100-110: Sl gravelly SAND
110-185: SAND
185-190: Muddy SAND
190-195: Sandy GRAVEL
195-200: Gravelly SAND
200-205: SAND
205-225: Sandy GRAVEL
225-285: Muddy sandy GRAVEL
285-290: Sandy GRAVEL
290-293.6: SAND



Elevation of reference point: [682.14-ft]
(top of 6-in casing)
Height of reference point above ground surface [3.02-ft]

Depth of surface seal [2-20.2-ft]
Type of surface seal:
Cement grout, 2.0-20.2-ft, concrete 4-ft x 4-ft x 6-in surface pad extending 2-ft into annulus

Hole diameter,
0-20.1-ft, 13-in nominal
20.1-293.6-ft, 9-in nominal

4-in ID stainless steel casing, +2.1-270.8-ft

Bentonite crumbles, 20.1-261.4-ft

-in Volclay pellets, 261.4-265.6-ft

Silica sand pack, 265.6-291.2-ft, 20-40-mesh

4-in stainless steel screen, 270.8-291.8-ft, #10-slot w/channel pack and bottom cap

Fill, 291.2-293.6-ft

Borehole drilled depth: [293.6-ft]

Drawing By: RKL/2E32-05.ASB
Date : 10Sep93
Reference : WHC-MR-0204

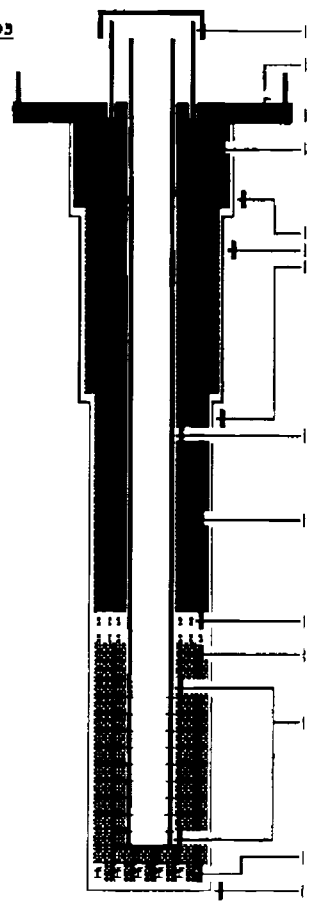
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Drive barrel Method: Hard tool	WELL NUMBER: 299-E32-6 / TEMPORARY WELL NO:
Drilling Fluid Used: Raw water	Additives Used: None	Hanford Coordinates: N/S N 46,060.0 E/W W 56,721.5
Driller's Name: K Olson/J Carpenter	WA State Lic Nr: Not documented	State NAD83 N 137,515.1m E 572,600.4m
Drilling Company: Kaiser Engineers	Company Location: Hanford	Coordinates: N 451,216 E 2,238,485
Date Started: 18Jun91	Date Complete: 01Aug91	Start Card #: Not documented T R S
		Elevation Ground surface: 663.94-ft (Brass cap)

Depth to water: 258.9-ft Jul91
(Ground surface) 262.0-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-20: Sandy GRAVEL
20-50: Gravelly SAND
50-55: Sl gravelly SAND
55-60: Gravelly SAND
60-70: SAND
70-75: Sl gravelly SAND
75-85: Gravelly SAND
85-90: Sl gravelly SAND
90-95: Gravelly SAND
95-115: SAND
115-130: SAND w/trace GRAVEL
130-170: SAND
170-190: SAND w/trace SILT
190-195: Silty SAND
195-200: SAND w/trace SILT
200-210: SAND w/trace GRAVEL
210-215: Gravelly SAND
215-250: Sandy GRAVEL
250-255: Silty gravelly SAND
255-265: Sandy GRAVEL
265-270: Sandy clayey GRAVEL
270-278.8: Sandy GRAVEL



Elevation of reference point: [667.45-ft] (top of casing)
Height of reference point above ground surface [3.51-ft]
Depth of surface seal [2.1-20.9-ft]
Type of surface seal: Cement grout, 2.1-20.9-ft. 4x4-ft x 6-in concrete surface pad extends 2.1-ft into annulus
Hole diameter,
2.1-21.6-ft, 13-in nominal
21.6-157.9-ft, 11-in nominal
157.9-278.8-ft, 9-in nominal
4-in ID stainless steel casing, +1.1-254.5-ft
Bentonite crumbles 20.9-244.0-ft, 8-20-mesh
-in bentonite pellets 244.0-250.0-ft
Silica sand pack, 250-278.3-ft, 10-20-mesh
4-in T304 stainless steel screen, 254.5-275.5-ft, #20-slot
Fill, 278.3-278.8-ft
Borehole drilled depth: [278.8-ft]

Drawing By: RKL/2E32-06.ASB
Date : 10Sep93
Reference :

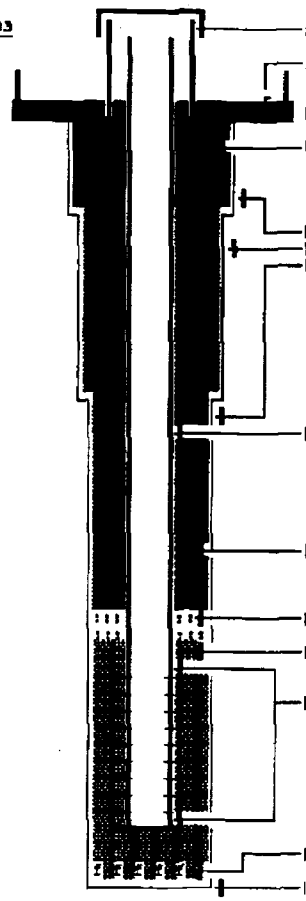
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel / Hard tool	WELL NUMBER: 299-E32-7 / TEMPORARY WELL NO:
Drilling Fluid Used: Raw water	Additives Used: None	Hanford Coordinates: N/S N 46,493 E/W W 56,720
Driller's Name: L Bultena	WA State Lic Nr: Not documented	State NAD83 N 137,647.05m E 572,600.36m
Drilling Company: Kaiser Engineers	Company Location: Hanford	Coordinates: N 451,649 E 2,230,486
Date Started: 23May91	Date Complete: 26Jul91	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 654.89-ft (Brass cap)

Depth to water: 250.6-ft Jun91
(Ground surface) 252.9-ft 25Jun93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl=slightly

0-10: Silty sandy GRAVEL
10-15: Sandy GRAVEL
15-20: Sl silty sandy GRAVEL
20-25: Silty sandy GRAVEL
25-30: Sandy GRAVEL
30-35: Gravelly SAND
35-40: Silty SAND
40-45: Gravelly SAND
45-60: Sl silty SAND
60-65: Sandy GRAVEL
65-75: Gravelly SAND
75-95: Sl gravelly SAND
95-105: SAND
105-145: Sl silty SAND
145-150: Silty SAND
150-155: Sl silty SAND
155-165: Sandy SILT
165-185: Silty SAND
185-190: Sl silty SAND
190-195: SAND
195-220: Sandy GRAVEL
220-235: Silty sandy GRAVEL
235-265: Sandy GRAVEL
265-270: Silty sandy GRAVEL
270-273.8: Silty GRAVEL



- Elevation of reference point: [658.42-ft] (top of casing)
- Height of reference point above [3.53-ft] ground surface
- Depth of surface seal [3.0-21.7-ft]
- Type of surface seal: Cement grout, 3.0-21.7-ft Concrete 4x4-ft x 6-in surface pad extends 3.0-ft into annulus
- Hole diameter, 3.0-20.9-ft, 13-in nominal
- 20.9-168.9-ft, 11-in nominal
- 168.9-273.8-ft, 9-in nominal
- 4-in ID stainless steel casing, +1.0-245.6-ft
- Bentonite crumbles, 21.7-235.7-ft, 8-20-mesh
- -in bentonite pellets, 235.7-242.3-ft
- Silica sand pack, 242.3-270.6-ft
- 4-in T304 stainless steel screen, 245.6-266.6-ft, #20-slot
- Fill, 270.6-273.8-ft
- Borehole drilled depth: [273.8-ft]

Drawing By: RKL/2E32-07.ASB
Date : 10Sep93
Reference :

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: None
Driller's Name: D Ludtke/J Carpenter
Drilling Company: Kaiser Engineers
Date Started: 22May91

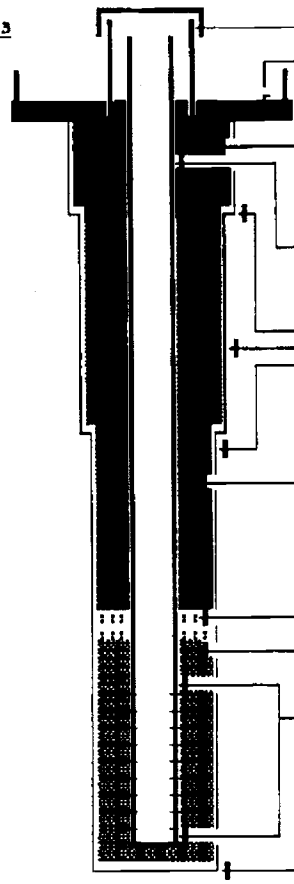
Sample Method: Drive barrel
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 10Jun91

WELL NUMBER: 299-E32-8
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 46,802 E/W W 56,513
State NAD83 N 137,741.47m E 572,663.39m
Coordinates: N 451,959 E 2,238,692
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 642.13-ft (Brass cap)

Depth to water: 238.4-ft Jun91
(Ground surface) 240.2-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-21: Sandy GRAVEL
21-40: SAND
40-55: Gravelly SAND
55-70: SAND
70-80: Gravelly SAND
80-95: SAND
95-100: Gravelly SAND
100-110: Silty SAND
110-115: Gravelly SAND
115-166: SAND
166-180: Sandy GRAVEL
180-197: Gravelly SAND
197-200: Gravelly silty SAND
200-256.7: Sandy GRAVEL



Elevation of reference point: [645.59-ft] (top of casing)
Height of reference point above ground surface [3.46-ft]
Depth of surface seal [3.0-21.6-ft]
Type of surface seal: Cement grout, 3.0-21.6-ft, 4-ft x 4-ft x 6-in concrete pad extends 3-ft into annulus
4-in ID stainless steel casing, +1.0-234.7-ft
Hole diameter,
3.0-19.6-ft, 13-in nominal
19.6-167.2-ft, 11-in nominal
167.2-256.7-ft, 9-in nominal
Bentonite crumbles, 21.6-224.3-ft, 8-20-mesh
4-in bentonite pellets, 224.3-230.5-ft
Silica sand pack, 230.5-256.7-ft, 10-20-mesh
4-in T304 stainless steel screen, 234.7-255.3-ft, #20-slot
Borehole drilled depth: [256.7-ft]

Drawing By: RKL/2E32-08.ASB
Date : 10Sep93
Reference :

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Raw water
Driller's Name: K Olson/J Carpenter
Drilling Company: Kaiser Engineers
Date Started: 22May91
Date Complete: 12Jul91

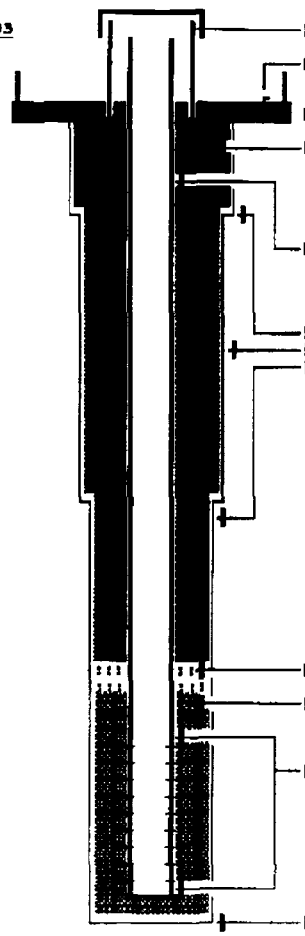
Sample Method: Drive barrel / Hard tool
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Hanford

WELL NUMBER: 299-E32-9
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 46,802 E/W W 56,081
State NAD83 N 137,741.69m E 572,795.11m
Coordinates: N 451,960 E 2,239,124
Start Card #: Not documented T___ R___ S___
Elevation Ground surface: 639.80-ft (Brass cap)

Depth to water: 235.9-ft Jun91
(Ground surface) 237.8-ft 25Jun93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl=slightly

0-39: Sandy GRAVEL
39-40: SILT lens w/interbedded PEBBLES and SAND
40-55: Gravelly SAND
55-60: Sl silty SAND
60-70: Gravelly SAND
70-75: Sandy GRAVEL
75-80: SAND
80-85: Sl gravelly SAND
85-100: Gravelly SAND
100-120: SAND
120-140: Sl gravelly SAND
140-170: SAND
170-175: Silty SAND
175-180: SAND
180-195: Sandy GRAVEL
195-200: Silty sandy GRAVEL
200-205: Gravelly SAND
205-235: Sandy GRAVEL
235-240: Gravelly SAND
240-254.6: Sandy GRAVEL



Elevation of reference point: [643.33-ft] (top of casing)
Height of reference point above ground surface [3.53-ft]
Depth of surface seal [2.5-21.6-ft]
Type of surface seal: Cement grout, 2.5-21.6-ft, 4-ft x 4-ft x 6-in concrete pad extends 3-ft into annulus
4-in ID stainless steel casing, +1.0-230.7-ft
Hole diameter,
2.5-18.7-ft, 13-in nominal
18.7-168.4-ft, 11-in nominal
168.4-254.6-ft, 9-in nominal
3-in bentonite pellets, 221.8-227.2-ft
Silica sand pack, 227.2-254.6-ft, 10-20-mesh
4-in T304 stainless steel screen, 230.7-251.3-ft
Borehole drilled depth: [254.6-ft]

Drawing By: RKL/2E32-09.ASB
Date : 10Sep93
Reference :

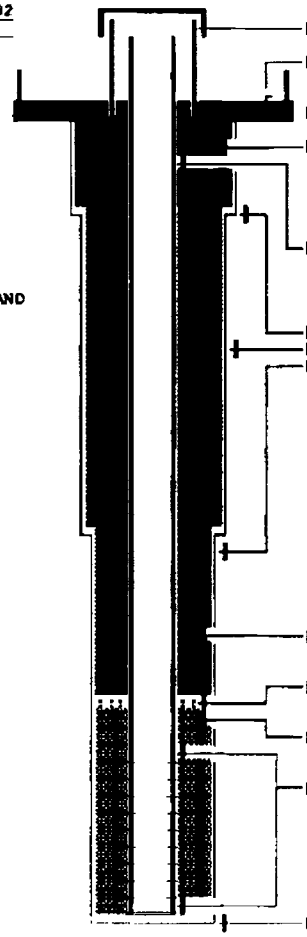
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E32-10 / TEMPORARY WELL NO:
Drilling Fluid Used: Raw water	Additives Used: None	Hanford Coordinates: N/S N 46,800.2 E/W W 55,568.7
Driller's Name: H. Baker/G. Howel	WA State Lic Nr: Not documented	State NAD83 N 137,741.69m E 572,951.13m
Drilling Company: Kaiser Engineers	Company Location: Hanford	Coordinates: N 451,959 E 2,239,636
Date Started: 02Jan92	Date Complete: 15Apr92	Start Card #: Not documented T ___ R ___ S ___
		Elevation Ground surface: 634.88-ft (Brass cap)

Depth to water: 232.2-ft 03Feb92
(Ground surface) Not documented

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-4: Not documented
4-35: Silty sandy GRAVEL
35-50: Sandy GRAVEL
50-60: Gravelly SAND
60-74: Sl gravelly SAND
74-75: GRAVEL
75-140: SAND
140-145: Sl gravelly SAND
145-155: Sandy GRAVEL
155-160: SAND
160-165: Sl silty sl gravelly SAND
165-195: Silty SAND
195-205: Gravelly SAND
205-215: Sandy GRAVEL
215-235: Silty sandy GRAVEL
235-240: Sl silty sandy GRAVEL
240-247: Sandy GRAVEL
247-248.5: BASALT



- Elevation of reference point: [637.93-ft] (top of casing)
- Height of reference point above ground surface [3.05-ft]
- Depth of surface seal [1.8-20.7-ft]
  Type of surface seal:
  Cement grout, 1.8-20.7-ft,
  4-ft x 4-ft x 6-in concrete pad extends 1.8-ft into annulus
- 4-in ID stainless steel casing, +0.9-225.0-ft
- Hole diameter,
  1.8-19.1-ft, 13-in nominal
  19.1-162.4-ft, 11-in nominal
  162.4-248.5-ft, 9-in nominal
- Bentonite crumbles 20.7-217.0-ft, 8-20-mesh
- -in bentonite pellets, 217.0-220.8-ft
- Silica sand pack, 220.8-245.8-ft, 10-20-mesh
- 4-in T304 stainless steel screen, 225.0-245.3-ft, #20-slot
- Borehole drilled depth: [245.8-ft]

Drawing By: RKL/2E32-10.ASB
Date : 10Sep93
Reference : WHC-SD-EN-DP-049

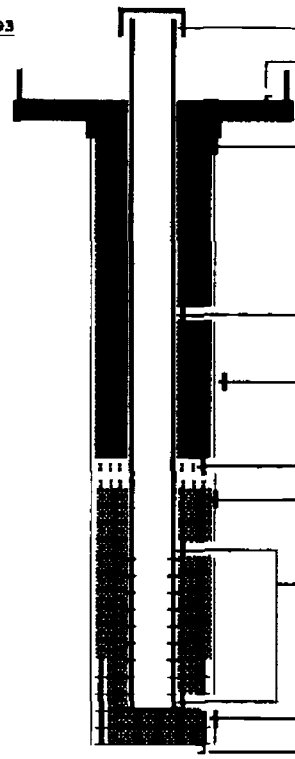
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E33-28
Drilling Fluid Used: 200 E Water Supply	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: Watkins/Cordon	NA State Lic Nr: 1271/0079	Hanford Coordinates: N/S N 45,596 E/W W 54,668
Drilling Company: Kaiser Engineers	Company Location: Hanford	State Coordinates: N 450,758 E 2,240,540
Date Started: 24Sep87	Date Complete: 15Oct87	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 662.66-ft (Brass cap)

Depth to water: 257-ft Oct87
(Ground surface) 260.8-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
(Sl=Slightly)

5-40: Silty sandy GRAVEL
40-50: Gravelly SAND
50-60: Sl gravelly, sl silty SAND
60-75: Sl silty gravelly SAND
75-80: Sl gravelly SAND
80-85: Gravelly SAND
85-90: SAND
95-105: Sl gravelly SAND
105-110: SAND
110-115: Silty SAND
115-120: Sl gravelly silty SAND
120-130: Sl GRAVELLY, sl silty SAND
130-135: Sl silty gravelly SAND
135-160: SAND
160-165: Sl silty gravelly SAND
165-170: Sl gravelly, sl silty SAND
170-175: Sl silty gravelly SAND
175-185: Silty sandy GRAVEL
185-210: SAND
210-245: Silty sandy GRAVEL
245-250: Sl silty gravelly SAND
250-265: Silty sandy GRAVEL
265-270: Sl silty gravelly SAND
270-275: Silty sandy GRAVEL



Elevation of reference point: [664.23 ft] (top of casing)

Height of reference point above ground surface [1.6-ft]

Depth of surface seal [3.8-241.5-ft]
Type of surface seal: Bentonite crumbles, 3.8-241.5-ft
Has 4-ft x 4-ft x 6-in concrete pad extending 3.8-ft into annulus

4-in ID stainless steel casing, +1.6-255.7-ft

Hole diameter, 9-in nominal 3.8-278.3-ft

Voclay pellets 241.5-247.8-ft

Silica sand pack, 247.8-278.3-ft, 20-30-mesh

4-in stainless steel screen, 255.7-275.7-ft, #20-slot

8-in stainless steel telescoping screen, 268.0-278-ft, #30-slot

Borehole drilled depth: [278.3-ft]

Drawing By: RKL/2E33-28.ASB
Date : 13Sep93
Reference : HANFORD WELLS

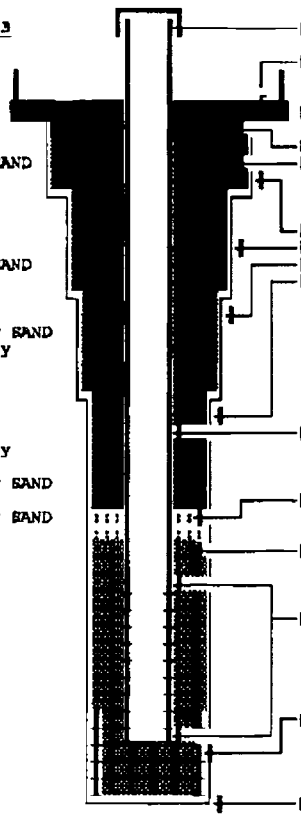
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E33-29
Drilling Fluid Used: 200 E Water Supply	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: Murphy/Robinson	WA State Lic Nr:	Hanford Coordinates: N/S N 45,124 E/W W 54,665
Drilling Company: Kaiser Engineers	Company Location: Hanford	State Coordinates: N 450,285 E 2,240,544
Date Started: 17Aug87	Date Complete: 30Sep87	Start Card #: Not documented T R S
		Elevation Ground surface: 671.53-ft (Brass cap)

Depth to water: 265.7-ft 8sep87
(Ground surface) 269.7-ft 25Jun93

GENERALIZED STRATIGRAPHY Log Geologist's

0-5: GRAVEL
5-55: Silty sandy GRAVEL
55-60: Slightly silty gravelly SAND
60-70: Slightly silty, slightly gravelly SAND
70-75: Slightly silty SAND
75-80: Slightly gravelly SAND
80-85: Gravelly SAND
85-90: Slightly silty gravelly SAND
90-95: SAND
95-105: Slightly gravelly SAND
105-120: SAND
120-125: Slightly silty gravelly SAND
125-130: Slightly silty, slightly gravelly SAND
130-135: Slightly silty SAND
135-140: SAND
140-145: Slightly silty SAND
145-150: Slightly gravelly SAND
150-160: Slightly silty, slightly gravelly SAND
160-165: Slightly silty gravelly SAND
165-180: Slightly gravelly SAND
180-185: Slightly silty gravelly SAND
185-205: SAND
205-215: Sandy SILT
215-250: Silty sandy GRAVEL
250-255: Sandy GRAVEL
255-280: Silty sandy GRAVEL
280-285: SAND
285-290: GRAVEL
290 : BASALT



Elevation of reference point: [673.77-ft] (top of casing)
Height of reference point above ground surface [2.2-ft]
Depth of surface seal [0-252.2-ft]
Type of surface seal
Portland cement to 5.0-ft
Bentonite crumbles, 5-252.2-ft
Hole diameter
0-57.4-ft, 17-in nominal
57.4-134.5-ft, 13-in nominal
134.5-204.2-ft, 11-in nominal
204.2-290.5-ft, 9-in nominal
4-in ID stainless steel casing, +2.2-252.2-ft
Bentonite pellets, 252.2-257.0-ft
Silica sand pack, 257.0-290.5-ft, 20-30 mesh
4-in stainless steel screen, 262.8-282.8-ft, #20-slot
8-in stainless steel telescoping screen, 279.5-289.5-ft, #30-slot
Borehole drilled depth: [290.5-ft]

Drawing By: RKL/2E33-29.ASB
Date : 13Sep93
Reference : HANFORD WELLS

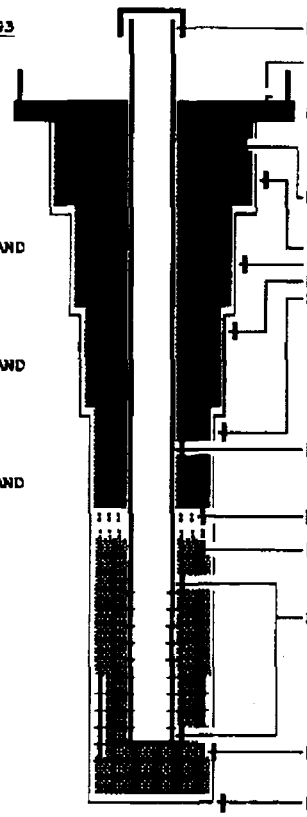
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel / Hard tool	WELL NUMBER: 299-E33-30
Drilling Fluid Used: 200 E Water / Supply	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: L. Watkins/C. Wamsley	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 45,803 E/W W 55,660
Drilling Company: Kaiser Engineers	Company Location: Hanford	State Coordinates: N 451,062 E 2,239,547
Date Started: 29Aug87	Date Complete: 30Sep87	Start Card #: Not documented T ___ R ___ S ___
		Elevation Ground surface: 661.92-ft Brass cap

Depth to water: 257.6-ft Sep87
(Ground surface) 260.1-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl = slightly

0-60: Silty sandy GRAVEL
60-80: Gravelly SAND
80-100: SAND
100-105: Sl gravelly SAND
105-115: SAND
115-125: Sl silty gravelly SAND
125-130: Sl gravelly SAND
130-150: SL silty sl gravelly SAND
150-160: SAND
160-180: Sl silty SAND
180-185: Silty SAND
185-203: Sl silty SAND
203-205: Sandy SILT
205-210: Sl silty gravelly SAND
210-215: Sl silty sl gravelly SAND
215-225: Sl gravelly SAND
225-230: Fine SAND
230-260: Silty sandy GRAVEL
260-265: Sandy GRAVEL
265-270: Sl silty SAND
270-275: Silty sandy GRAVEL
275-277: Sl silty sl gravelly SAND
277-281: BASALT



Elevation of reference point: [663.70-ft]
(top of casing)
Height of reference point above ground surface [1.8-ft]

Depth of surface seal [-4.0--245-ft]
Type of surface seal:
Portland cement surface pad, 4-ft x 4-ft x 6-in to 2.5-ft
Bentonite crumbles, 4--245-ft

Hole diameter,
0-58.0-ft, 17-in nominal
58.0-123.5-ft, 13-in nominal
123.5-200.0-ft, 11-in nominal
200.0-280.1-ft, 9-in nominal

4-in ID stainless steel casing, +1.8-255.0-ft

Bentonite pellets, -245.0-251.5-ft

Silica sand pack, 251.5-280.1-ft, 20-30-mesh

4-in stainless steel screen, 255.0-275.0-ft, #20-slot

8-in stainless steel telescoping screen 266.8-277-ft, #30-slot

Borehole drilled depth: [280.1-ft]

Drawing By: RKL/2E33-30.A8B
Date : 13Sep93
Reference : HANFORD WELLS

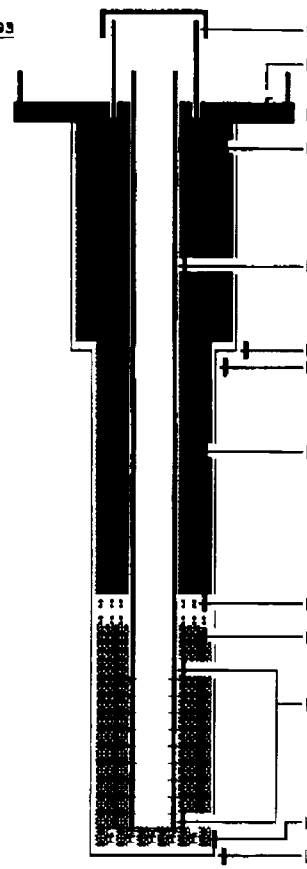
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Drive barrel Method: Hard tool	WELL NUMBER: 299-E33-34
Drilling Fluid Used: 200 W Water Supply	Additives Used: None	TEMPORARY WELL NO: E10-MW7
Driller's Name: G. Lydin	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 46,796 E/W W 55,065
Drilling Company: Kaiser Engineers	Company Location: Hanford	State NAD83 N 137,740.72m E 573,104.63m
Date Started: 02Jan90	Date Complete: 23Apr90	Coordinates: N 451,956 E 2,240,140
		Start Card #: Not documented T ___ R ___ S ___
		Elevation Ground surface: 630.39-ft (Brass cap)

Depth to water: 225.6-ft Mar90
(Ground surface) 228.7-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-10: Muddy sandy GRAVEL
10-20: Sandy GRAVEL
20-35: SAND
35-40: Gravelly SAND
40-75: Sl gravelly SAND
75-80: SAND
80-90: Sl gravelly SAND
90-120: SAND
120-125: Sl gravelly SAND
125-140: SAND
140-160: Gravelly SAND
160-175: SAND
175-195: Sl muddy SAND
195-200: Muddy SAND
200-205: Gravelly SAND
205-215: Sandy GRAVEL
215-225: Muddy sandy GRAVEL
225-230: (No recovery)
230-237: Muddy sandy GRAVEL
237-240: SAND
240 : BASALT



Elevation of reference point: [633.33-ft] (top of casing)
Height of reference point above ground surface [2.94-ft]
Depth of surface seal [3.0-19.8-ft]
Type of surface seal:
Cement grout to 19.8-ft, has concrete 4x4-ft x 6-in surface pad extending 3-ft into annulus
4-in ID stainless steel casing, +0.5-219.0-ft
Hole diameter,
0-147.0-ft, 11-in nominal
147.0-240.0-ft, 9-in nominal
Bentonite crumbles, 19.8-212.4-ft, 8-20-mesh
-in Volclay tablets 212.4-216.6-ft
Silica sand pack, 216.6--239.3-ft, 20-40-mesh
4-in stainless steel screen, 219.0-239.3-ft, #10-slot w/channel pack
Fill ~239.3-240-ft
Borehole drilled depth: [240.0-ft]

Drawing By: RKL/2E33-34.ASB
Date : 13Sep93
Reference : WHC-MR-0205

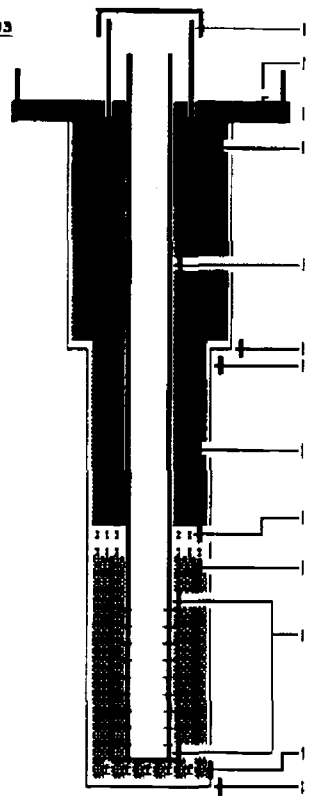
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E33-35	TEMPORARY WELL NO: E10-MW8
Drilling Fluid Used: 200 W Water / Supply	Additives Used: None	Hanford Coordinates: N/S N 46,351	E/W W 54,685
Driller's Name: C. Wamsley	WA State Lic Nr: Not documented	State NAD83 N 137,605.40m	E 573,220.98m
Drilling Company: Kaiser Engineers	Company Location: Hanford	Coordinates: N 451,512	E 2,240,521
Date Started: 02Jan90	Date Complete: 17Apr90	Start Card #: Not documented	T ___ R ___ S ___
		Elevation Ground surface: 640.05-ft (Brass cap)	

Depth to water: 235.4-ft Feb90
(Ground surface) 238.2-ft 25Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-10: Muddy sandy GRAVEL
10-15: Gravelly SAND
15-20: SAND
20-25: Gravelly SAND
25-35: Sandy GRAVEL
35-50: Sl gravelly SAND
50-60: SAND
60-65: Sl gravelly SAND
65-70: SAND
70-80: Gravelly SAND
80-100: SAND
100-105: Sl gravelly SAND
105-110: Gravelly SAND
110-140: SAND
140-155: Gravelly SAND
155-180: Sl gravelly SAND
180-185: Gravelly SAND
185-200: SAND
200-205: Muddy SAND
205-210: Gravelly SAND
210-235: Muddy sandy GRAVEL
235-245: Sandy GRAVEL
245-248: Muddy sandy GRAVEL
248-250: SAND
250 : BASALT



- Elevation of reference point: [643.01-ft] (top of casing)
- Height of reference point above ground surface [2.96-ft]
- Depth of surface seal [2.5-20.5-ft]
  Type of surface seal: Cement grout to 20.5-ft, has concrete 4x4-ft x 6-in surface pad extending 2.5-ft into annulus
- 4-in ID stainless steel casing, +1.9-228.3-ft
- Hole diameter, 0-152.7-ft, 11-in nominal
- 152.7-250.0-ft, 9-in nominal
- Bentonite crumbles, 20.5-221.6-ft, 8-20-mesh
- ¾-in Volclay tablets, 221.6-224.8-ft
- Silica sand pack, 224.8--249.2-ft, 40-100-mesh
- 4-in stainless steel screen, 228.3-249.3-ft, #05-slot w/channel pack
- Fill, ~249.2-250.0-ft
- Borehole drilled depth: [250.0-ft]

Drawing By: RKL/2E33-35.ASB
Date : 13Sep93
Reference : WHC-MR-0205

5C.2. Low-Level Waste Management Area 2

The following diagrams show wells in the monitoring network for Low-Level Waste Management Area 2.

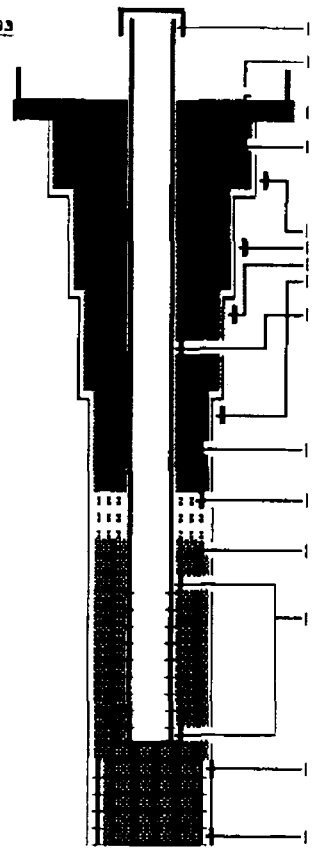
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel / Hard tool	WELL NUMBER: 299-E27-8 / TEMPORARY WELL NO:
Drilling Fluid Used: 200 E Water / Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 44,496 E/W W 49,642
Driller's Name: Murphy/Robinson	WA State Lic Nr:	State Coordinates: N 449,670 E 2,245,569
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T ___ R ___ S ___
Date Started: 01Aug87	Date Complete: 30Sep87	Elevation Ground surface: 634.64-ft (Brass cap)

Depth to water: 229.5-ft Aug87
(Ground surface) 232.8-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log

0-25: Silty, sandy GRAVEL
25-30: Silty gravelly SAND
30-50: Silty sandy GRAVEL
50-55: Silty gravelly SAND
55-70: Silty sandy GRAVEL
70-80: Silty gravelly SAND
80-95: Silty sandy GRAVEL
95-100: Gravelly silty SAND
100-110: Silty sandy GRAVEL
110-115: Silty gravelly SAND
115-120: Gravelly SAND
120-137: Silty gravelly SAND
137-140: Gravelly SAND
140-145: Silty gravelly SAND
145-150: Gravelly SAND
150-155: Silty gravelly SAND
155-170: Gravelly SAND
170-175: Silty sandy GRAVEL
175-190: Sandy GRAVEL
190-195: Gravelly SAND
195-200: Silty gravelly SAND
200-240: Silty sandy GRAVEL
240-250: Gravelly SAND
250-256.5: Sandy GRAVEL
256.5-257: BASALT



- Elevation of reference point: [637.83-ft] (top of casing)
- Height of reference point above ground surface [3.2-ft]
- Depth of surface seal [4.5-216-ft]
- Type of surface seal: Granular bentonite, portland cement 4-ft x 4-ft x 6-in concrete pad extends 4.5-ft into annulus
- Hole diameter
  - 0-40-ft, 17-in nominal
  - 40-104-ft, 13-in nominal
  - 104-165.8-ft, 11-in nominal
  - 165.8-257.0-ft, 9-in nominal
- 4-in ID stainless steel casing, +3.2-225.5-ft
- Granular bentonite, 4.5-216-ft
- Bentonite pellets, 216-221-ft
- Silica sand pack, 221-257-ft, #20-mesh
- 4-in stainless steel screen, 225.5-245.5-ft, #20-slot
- 8-in stainless steel telescoping screen, 247-257-ft, #30-slot
- Borehole drilled depth: [257.0-ft]

Drawing By: RKL/2E27-08.ASB
Date : 09Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: Cordon/Cordon/Watkins
Drilling Company: Kaiser Engineers
Date Started: 21Jul87

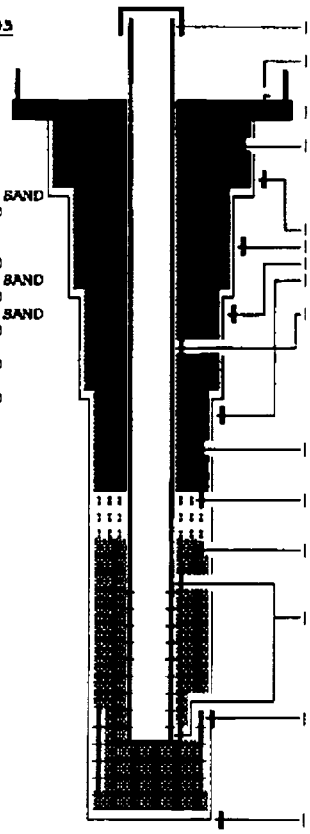
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 31Aug87

WELL NUMBER: 299-E27-9
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,484 E/W W 49,122
State Coordinates: N 449,660 E 2,246,089
Start Card #: Not documented T R S
Elevation Ground surface: 627.31-ft (Brass cap)

Depth to water: 221.1-ft Aug87
(Ground surface) 225.4-ft 23Jun93

GENERALIZED STRATIGRAPHY Geologist's Log

0-80: Silty sandy GRAVEL
80-85: Silty gravelly SAND
85-90: Sandy GRAVEL
90-100: Silty sandy GRAVEL
100-120: Sl. silty sl. gravelly SAND
120-125: Sl. silty gravelly SAND
125-130: Gravelly SAND
130-135: Sandy GRAVEL
135-140: Sl. silty gravelly SAND
140-145: Sl. silty sl. gravelly SAND
145-155: Sl. silty gravelly SAND
155-160: Sl. silty sl. gravelly SAND
160-165: Sl. silty gravelly SAND
165-175: Silty sandy GRAVEL
175-185: Sl. silty gravelly SAND
185-205: Silty sandy GRAVEL
205-226: Sl. silty gravelly SAND
226-245: Silty sandy GRAVEL
245 : BASALT



Elevation of reference point: [629.21-ft] (top of casing)
Height of reference point above ground surface [1.9-ft]
Depth of surface seal [2.3-203.3-ft]
Type of surface seal: Bentonite crumbles, w/Portland cement 4-ft x 4-ft x 6-in surface pad extending 2.3-ft into annulus
Hole diameter,
0-40.7-ft, 17-in nominal
40.7-105.3-ft, 13-in nominal
105.3-177.2-ft, 11-in nominal
177.2-242.2-ft, 9-in nominal
4-in ID stainless steel casing, +1.9-219.8-ft
Bentonite crumbles, 2.3-203.3-ft
Bentonite pellets, 203.3-210.5-ft
Silica sand pack, 210.5-245.2-ft, 20-30 mesh
4-in stainless steel screen, 219.8-239.1-ft, #20-slot
8-in stainless steel telescoping screen, 233.4-244.3-ft, #20-slot
Borehole drilled depth: [245.2-ft]

Drawing By: RKL/2E27-09.ASB
Date : 09Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: F Murphy/R Robinson
Drilling Company: Kaiser Engineers
Date Started: 15Jul87

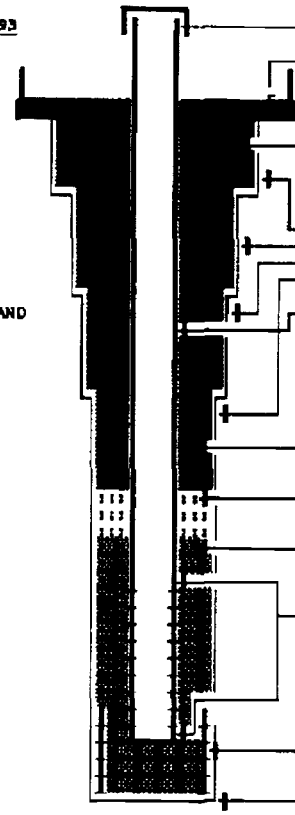
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 19Aug87

WELL NUMBER: 299-E27-10
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,520 E/W W 48,522
State Coordinates: N 449,697 E 2,246,689
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 622.42-ft (Brass cap)

Depth to water: 217.2-ft Jul87
(Ground surface) 220.3-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl = Slightly

0-15: Silty sandy GRAVEL
15-30: Sandy GRAVEL
30-126: Silty sandy GRAVEL
126-143: Sl silty gravelly SAND
143-160: Silty sandy GRAVEL
160-170: Silty gravelly SAND
170-175: Sl gravelly SAND
175-185: Silty sandy GRAVEL
185-190: Silty gravelly SAND
190-195: Silty sandy GRAVEL
195-205: Sl silty gravelly SAND
205-210: Sl silty sl gravelly SAND
210-215: Sl silty SAND
215-220: Gravelly silty SAND
220-230: Silty sandy GRAVEL
230-233: SAND
233-240: Sandy GRAVEL
240 : BASALT



Elevation of reference point: [624.47-ft]
(top of casing)
Height of reference point above ground surface [2.05-ft]

Depth of surface seal [2-200-ft]
Type of surface seal:
Bentonite crumbles w/Portland cement
4-ft x 4-ft x 6-in surface pad
extending 2.0-ft into annulus

Hole diameter
0-40.8-ft, 17-in nominal
40.8-105.8-ft, 15-in nominal
105.8-167.3-ft, 11-in nominal
167.3-240.0-ft, 9-in nominal

4-in ID stainless steel casing,
+2.0-212.1-ft

Bentonite crumbles,
2-200-ft

Volclay pellets,
200.0-206.6-ft

Silica sand pack,
206.6-240.1-ft, 20-30 mesh

4-in stainless steel screen
212.1-232.4-ft, #20-slot

8-in stainless steel
telescoping screen,
229.1-240.1-ft, #30-slot

Borehole drilled depth: [240.1-ft]

Drawing By: RKL/2E27-10.ASB
Date : 09Sep93
Reference : HANFORD WELLS

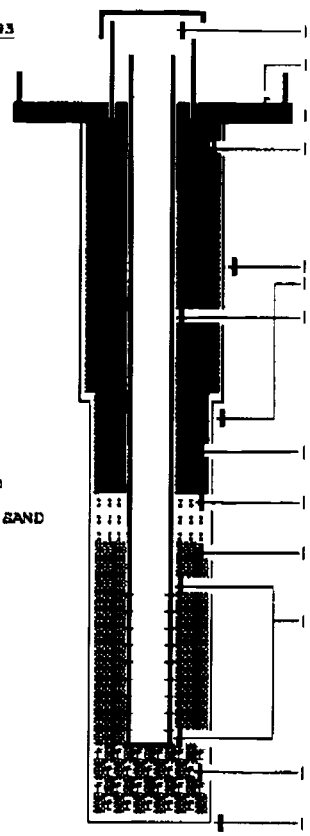
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E27-11
Drilling Fluid Used: 200 E Water Supply	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: Garcia	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 44,557.6 E/W W 49,990.3
Drilling Company: Kaiser Engineers	Company Location: Hanford	State NAD83 N 137,063.0m E 574,653.2m
Date Started: 27Jun89	Date Complete: 18Oct89	Coordinates: N 449,731 E 2,245,221
		Start Card #: Not documented T ___ R ___ S ___
		Elevation Ground surface: 640.34-ft (Brass cap)

Depth to water: 234.4-ft Jul89
(Ground surface) 238.6-ft 23Jun93

GENERALIZED STRATIGRAPHY Log — Geologist's

0-15: Sl. muddy gravelly SAND
15-20: Muddy sandy GRAVEL
20-25: Sandy GRAVEL
25-30: Sl. muddy gravelly SAND
30-35: Muddy sandy GRAVEL
35-40: Sandy GRAVEL
40-50: Muddy sandy GRAVEL
50-55: Sl. gravelly SAND
55-60: Gravelly SAND
60-65: SAND
65-85: Gravelly SAND
85-90: Sl. gravelly SAND
95-100: Sl. gravelly SAND
100-105: SAND
105-120: Sandy GRAVEL
120-125: Gravelly SAND
125-135: Sandy GRAVEL
135-155: Gravelly SAND
155-160: Sl. gravelly SAND
160-165: Gravelly SAND
165-175: Sandy GRAVEL
175-185: Sl. muddy gravelly SAND
185-195: Gravelly SAND
195-200: Sl. gravelly sl. muddy SAND
205-210: Muddy sandy GRAVEL
210-215: Sandy GRAVEL
215-220: Muddy sandy GRAVEL
220-245: Sandy GRAVEL
245-250: Sl. gravelly SAND
250-255: Muddy SAND
255-260: SAND
260-262: GRAVEL
262-264.7: BASALT



- Elevation of reference point: [643.29-ft] (top of 6-in casing)
- Height of reference point above ground surface [2.95-ft]
- Depth of surface seal [2-19.5-ft]
- Type of surface seal: Cement grout to 19.5-ft w/Portland cement 4-ft x 4-ft x 6-in surface pad extending 2.0-ft into annulus
- Hole diameter, 2-143.9-ft, 11-in nominal; 143.9-264.7-ft, 9-in nominal
- 4-in ID stainless steel casing, +1.9-230.4-ft
- Bentonite crumbles, 19.5-223.5-ft
- 3/8-in Volclay pellets, 223.5-227.4-ft
- Silica sand pack, 227.4-251.4-ft, 20-40 mesh
- 4-in stainless steel screen, 230.4-251.4-ft, #10-slot w/channel pack
- Backfill, 251.4-264.7-ft
- Borehole drilled depth: [264.7-ft]

Drawing By: RKL/2E27-11.ASB
Date : 09Sep93
Reference : WRC-MR-0204

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Raw water
Driller's Name: J Johnson
Drilling Company: Jensen
Date Started: 19Sep91

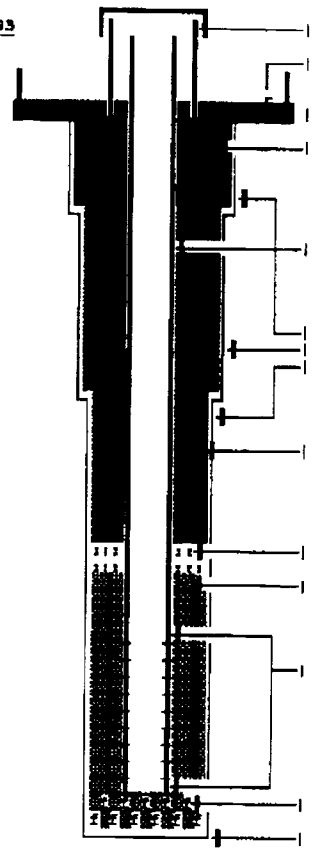
Sample Drive barrel Method: Hard tool
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 11Nov91

WELL NUMBER: 299-E27-17
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,752.1 E/W W 50,337.1
State NAD83 N 137,122.01m E 574,547.31m
Coordinates: N 449,926 E 2,244,873
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 631.75-ft (Brass cap)

Depth to water: 226.9-ft Nov91
(Ground surface) 229.7-ft 23Jun93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl=slightly

0-20: Sandy silty GRAVEL
20-50: Sandy GRAVEL
50-80: Gravelly SAND
80-105: Silty SAND
105-120: Gravelly SAND
120-150: SAND
150-185: Silty SAND
185-195: Silty sandy GRAVEL
195-200: SILT
200-210: Silty SAND
210-215: Silty sandy GRAVEL
215-220: Sandy GRAVEL
220-225: Silty sandy GRAVEL
225-240: Sandy GRAVEL
240-245: Silty sandy GRAVEL
245-246.2: Sandy GRAVEL
246.2 : BASALT



Elevation of reference point: [634.72-ft] (top of casing)
Height of reference point above ground surface [3.47-ft]
Depth of surface seal [2.1-18.9-ft]
Type of surface seal: Cement grout, 2.1-18.9-ft, w/concrete 4x4-ft x 6-in surface pad extending 2.1-ft into annulus
4-in ID stainless steel casing, +ND-223.2-ft
Hole diameter,
2.1-18.4-ft, 13-in nominal
18.4-169.1-ft, 11-in nominal
169.1-246.2-ft, 9-in nominal
Bentonite crumbles 18.9-214.4-ft, 8-20-mesh
Bentonite pellets, 214.4-217.7-ft
Silica sand pack, 217.7-244.2-ft, 10-20-mesh
4-in T304 stainless steel screen, 223.2-244.2-ft, #20-slot
Fill, 244.2-246.2-ft
Borehole drilled depth: [246.2-ft]

Drawing By: RKL/2E27-17.ASB
Date : 09Sep93
Reference :

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: Amos/St. George
Drilling Company: Kaiser Engineers
Date Started: 18Jul87

Sample Drive barrel Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: ND/1224
Company Location: Hanford
Date Complete: 30Sep87

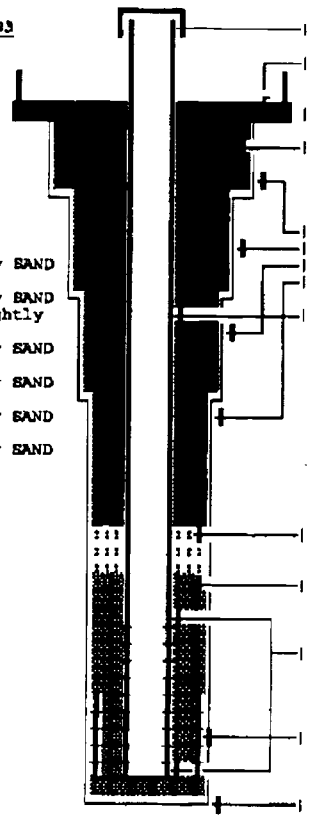
WELL NUMBER: 299-E34-2
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,076 E/W W 50,048
State Coordinates: N 450,249 E 2,245,161
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 629.03-ft (Brass cap)

Depth to water: 223.5-ft Jul87
(Ground surface) 227.0-ft 28Jun93

GENERALIZED STRATIGRAPHY Log

Geologist's Log

0-12: Silty sandy GRAVEL
12-50: Sandy GRAVEL
50-60: Silty sandy GRAVEL
60-70: Sandy GRAVEL
70-75: Silty sandy GRAVEL
75-95: Sandy GRAVEL
95-120: Gravelly SAND
120-125: Sandy GRAVEL
125-130: Slightly silty gravelly SAND
130-135: Gravelly SAND
135-140: Slightly silty gravelly SAND
140-145: Slightly gravelly, slightly silty SAND
145-155: Slightly silty gravelly SAND
155-170: Gravelly SAND
170-180: Slightly silty gravelly SAND
180-185: Gravelly SAND
185-190: Slightly silty gravelly SAND
190-195: Silty sandy GRAVEL
195-210: Slightly silty gravelly SAND
210-240: Silty sandy GRAVEL
240-241: Slightly silty SAND
241 : BASALT



Elevation of reference point: [630.80-ft] (top of casing)
Height of reference point above ground surface [1.8-ft]

Depth of surface seal [0-205.4-ft]
Type of surface seal: Bentonite crumbles to 205.4-ft, has 4-ft x 4-ft x 6-in surface pad extending 3-ft into annulus

Hole diameter,
0-40.1-ft, 17-in nominal
40.1-105.5-ft 13-in nominal
105.5-166.4-ft, 11-in nominal
166.4-241.0-ft, 9-in nominal

4-in ID stainless steel casing, +1.8-219.9-ft

Bentonite pellets, 205.4-212.8-ft

Silica sand pack, 212.8-241.5-ft, 20-30 mesh

4-in stainless steel screen, 219.9-239.9-ft, #20-slot

8-in stainless steel telescoping screen, 230.2-240.4-ft, #30-slot

Borehole drilled depth: [241.5-ft]

Drawing By: RKL/2E34-02.ASB
Date : 13Sep95
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: L Cordon/L Watkins
Drilling Company: Kaiser Engineers
Date Started: 14Jul87

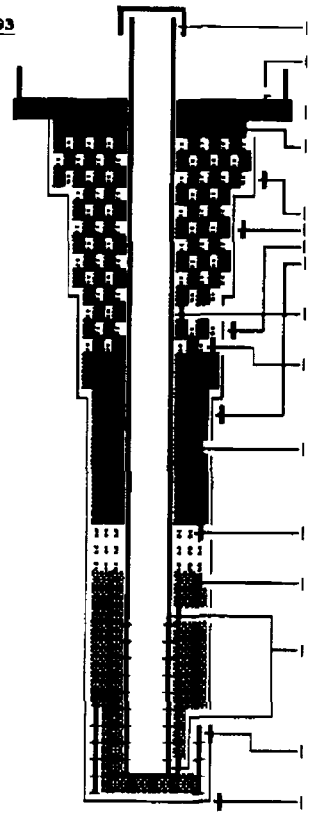
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 19Aug87

WELL NUMBER: 299-E34-3
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,337 E/W N 48,488
State Coordinates: N 450,514 E 2,246,721
Start Card #: Not documented T R S
Elevation Ground surface: 609.48-ft (Brass cap)

Depth to water: 203.1-ft Aug87
(Ground surface) 207.5-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=Slightly

0-30: Silty sandy GRAVEL
30-35: Sandy GRAVEL
35-55: Silty sandy GRAVEL
55-65: Sandy GRAVEL
65-80: Silty sandy GRAVEL
80-90: Sandy GRAVEL
90-96: Silty sandy GRAVEL
96-100: SAND
100-110: Sl gravelly SAND
110-120: Gravelly SAND
120-125: Sl gravelly SAND
125-130: Gravelly SAND
130-135: Sl silty gravelly SAND
135-155: Sandy GRAVEL
155-160: Silty sandy GRAVEL
160-165: Sandy GRAVEL
165-195: Silty sandy GRAVEL
195-200: Sandy GRAVEL
200-205: Gravelly SAND
205-210: Silty sandy GRAVEL
210-213: Sandy GRAVEL
213-213.9: BASALT



Elevation of reference point: [611.52-ft]
(top of casing)
Height of reference point above ground surface [2.04-ft]

Depth of surface seal [0-165-ft]
Type of surface seal:
Cement grout to 5.0-ft, has 4-ft x 4-ft x 6-in concrete pad

Hole diameter,
0-40.2-ft, 17-in nominal
40.2-95.3-ft, 13-in nominal
95.3-167.0-ft, 11-in nominal
167.0-213.9-ft, 9-in nominal

4-in ID stainless steel casing, +2.0-193.0-ft

Volclay grout, 5.0-165-ft

Bentonite crumbles, 165-177.0-ft

Bentonite pellets, 177.0-184.0-ft

Silica sand pack, 184.0-213.9-ft, 20-30 mesh

4-in stainless steel screen, 193.0-213.0-ft, #20-slot

8-in telescoping stainless steel screen, 203.5-213.8-ft, #30-slot

Borehole drilled depth: [213.9-ft]

Drawing By: RKL/2E34-03.ASB
Date : 13Sep93
Reference : HANFORD WELLS

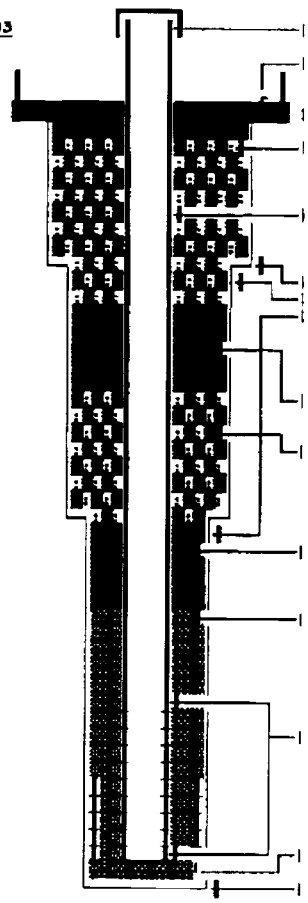
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Hard tool	WELL NUMBER: 299-E34-5 / TEMPORARY WELL NO:
Drilling Fluid Used: 200 E Water Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 46,791 E/W W 50,014
Driller's Name: L. Watkins/Len Cordon Lin Cordon	WA State Lic Nr:	State Coordinates: N 451,964 E 2,245,191
Drilling Company: Kaiser Engineers	Company Location: Hanford	Start Card #: Not documented T ___ R ___ S ___
Date Started: 27Jun87	Date Complete: 15Aug87	Elevation Ground surface: 589.01-ft (Brass cap)

Depth to water: 182.7-ft Jul87
(Ground surface) 186.0-ft 28Jun93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl = Slightly

0-25 Silty sandy GRAVEL
25-30: Silty gravelly SAND
30-35: Sl gravelly silty SAND
35-40: Silty SAND
40-45: Silty gravelly SAND
45-50: Silty sandy GRAVEL
50-55: Sandy GRAVEL
55-65: Silty sandy GRAVEL
65-70: GRAVEL
70-75: Silty sandy GRAVEL
75-85: GRAVEL
85-90: Sandy GRAVEL
90-95: GRAVEL
95-103: Sandy GRAVEL
103-105: Silty sandy GRAVEL
105-110: Sandy GRAVEL
110-135: Silty sandy GRAVEL
135-150: Sandy GRAVEL
150-155: Sl silty gravelly SAND
155-160: Silty sandy GRAVEL
160-170: Sandy GRAVEL
170-175: Sl silty gravelly SAND
175-185: Silty sandy GRAVEL
185-190: Gravelly SAND
190-190.5: BASALT



Elevation of reference point: [590.79-ft]
(top of casing)
Height of reference point above ground surface [1.8-ft]

Depth of surface seal [1.5-79.0-ft]
Type of surface seal:
Bentonite grout to 79.0-ft
4-ftx4-ftx6-in concrete pad extends 1.5-ft into annulus

4-in ID stainless steel casing, +1.8-170.5-ft

Hole diameter,
0-59.6-ft, 17-in nominal
59.6-145.8-ft, 13-in nominal
145.8-192.0-ft, 9-in nominal

Bentonite granules, 79-106-ft

Volclay grout, 106-146-ft

Bentonite granules, 146.0-158.0-ft

Silica sand pack, 158.0-192.0-ft, 20-30-mesh

4-in stainless steel screen, 170.5-190.5-ft, #20-slot

8-in stainless steel telescoping screen, 180.5-190.5-ft, #30-slot

Borehole drilled depth: [192.0-ft]

Drawing By: RKL/2E34-05.ASB
Date : 13Sep93
Reference : HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 E Water Supply
Driller's Name: P. Johnson/R. Ferry
Drilling Company: Basin and Range
Date Started: 03Aug89

Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 17Oct89

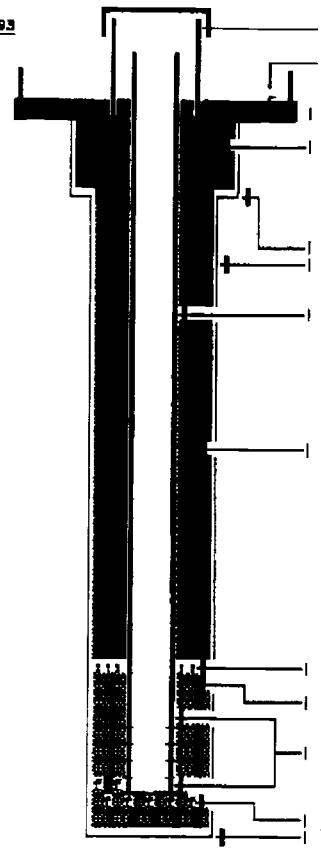
WELL NUMBER: 299-E34-7
Hanford Coordinates: N/S N 45,520 E/W W 47,949
State NAD83 Coordinates: N 137,358.0m E 575,274.4m
N 450,699 E 2,247,259
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 601.14-ft Brass cap

TEMPORARY WELL NO: E12-MW9

Depth to water: 195.2-ft Aug89
(Ground surface) 199.0-ft 11Mar93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl = slightly

0-10: Gravelly SAND
10-20: Sandy GRAVEL
20-40: Muddy sandy GRAVEL
40-60: Sandy GRAVEL
60-70: Muddy sandy GRAVEL
70-100: Sandy GRAVEL
100-105: Muddy sandy GRAVEL
105-110: Sandy GRAVEL
110-115: Muddy sandy GRAVEL
115-125: Sandy GRAVEL
125-130: Muddy sandy GRAVEL
130-150: Sandy GRAVEL
150-155: Muddy sandy GRAVEL
155-160: Sandy GRAVEL
160-165: Muddy sandy GRAVEL
165-175: Sandy GRAVEL
175-185: Muddy sandy GRAVEL
185-190: Sandy GRAVEL
190-195: Muddy sandy GRAVEL
195-205: Sandy GRAVEL
205-205.5: BASALT



Elevation of reference point: [604.25-ft]
(top of 6-in casing)
Height of reference point above ground surface [3.11-ft]

Depth of surface seal [2-20.2-ft]
Type of surface seal:
Cement grout to 20.2-ft, has 4-ft x 4-ft x 6-in surface pad extending 2.0-ft into annulus

Hole diameter,
0-19.8-ft, 13-in nominal
19.8-205.5-ft, 9-in nominal

4-in ID stainless steel casing,
+1.5-193.9-ft

Bentonite crumbles,
20.2-186.3-ft, 8-20-mesh

-in Volclay tablets,
186.3-189.3-ft

Silica sand pack,
189.3-204.1-ft, 20-40-mesh

4-in stainless steel screen,
193.9-204.6-ft, #10-slot

Fill,
204.1-205.5-ft
Borehole drilled depth: [205.5-ft]

Drawing By: RKL/2E34-07.ASB
Date : 13Sep93
Reference : WHC-MR-0204

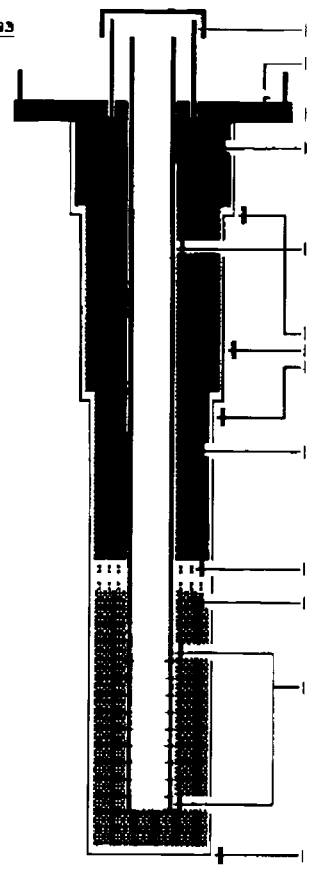
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E34-9 / TEMPORARY WELL NO:
Drilling Fluid Used: Raw water	Additives Used: None	Hanford Coordinates: N/S N 45,765.4 E/W W 51,519.8
Driller's Name: J Johnson/S McKinon	WA State Lic Nr: Not documented	State NAD83 N 137,429.82m E 574,186.02m
Drilling Company: Jensen Drilling	Company Location: Not documented	Coordinates: N 450,935 E 2,243,688
Date Started: 19Sep91	Date Complete: 05Nov91	Start Card #: Not documented T___ R___ S___
		Elevation Ground surface: 625.97-ft (Brass cap)

Depth to water: 221.2-ft Nov91
(Ground surface) 224.0-ft 23Jun93

GENERALIZED STRATIGRAPHY Log
Sl=slightly

0-15: Silty GRAVEL
15-50: Sandy GRAVEL
50-55: SAND
55-60: Sl gravelly SAND
60-75: SAND
75-95: Sl gravelly SAND
95-105: Gravelly SAND
105-120: Sl gravelly SAND
120-150: SAND
150-155: Gravelly SAND
155-165: Sl gravelly SAND
165-170: SAND
170-185: SL gravelly SAND
185-195: Gravelly SAND
195-197: Sl gravelly SAND
197-200: SAND
200-215: Sandy GRAVEL
215-220: Silty sandy GRAVEL
220-234: Sandy GRAVEL
234-234.5: Silty sandy GRAVEL
234.5 : BASALT



Elevation of reference point: [628.69-ft] (top of casing)
Height of reference point above ground surface [2.72-ft]
Depth of surface seal [2.0-18.5-ft]
Type of surface seal: Cement grout to 18.5-ft, has 4x4-ftx6-in concrete pad extending 2.0-ft into annulus
4-in ID stainless steel casing, +1.5-212.6-ft
Hole diameter,
2.0-19.0-ft, 13-in nominal
19.0-158.0-ft, 11-in nominal
158.0-234.5-ft, 9-in nominal
Bentonite crumbles, 18.5-201.6-ft, 8-20-mesh
Bentonite pellets, 201.6-205.1-ft
Silica sand pack, 205.1-234.5-ft, 10-20-mesh
4-in T304 stainless steel screen, 212.6-233.7-ft, #20-slot
Borehole drilled depth: [234.5-ft]

Drawing By: RKL/2E34-09.ASB
Date : 13Sep93
Reference :

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Raw water
Driller's Name: J Johnson
Drilling Company: Jensen Drilling
Date Started: 19Sep91

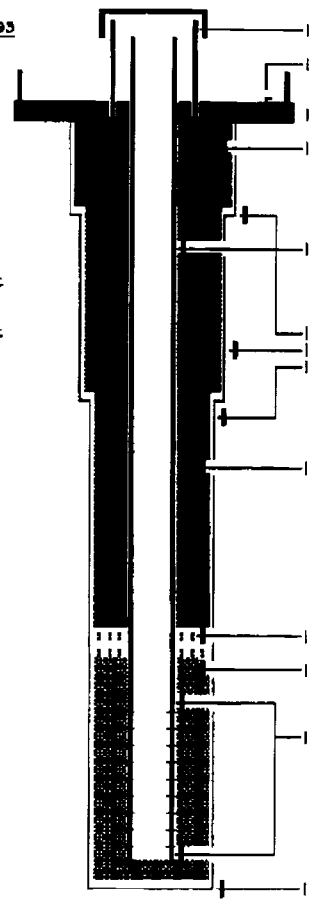
Sample Hard tool Method: Drive barrel
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 29Oct91

WELL NUMBER: 299-E34-10
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 45,091.0 E/W W 51,198.8
State NAD83 N 137,224.57m E 574,284.40m
Coordinates: N 450,261 E 2,244,011
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 637.01-ft (Brass cap)

Depth to water: 233.1-ft Oct91
(Ground surface) 234.9-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-15: Sl silty sandy GRAVEL
15-45: Sandy GRAVEL
40-55: Silty sandy GRAVEL
55-65: Sl gravelly SAND
65-100: SAND
100-115: Sl gravelly SAND
115-125: SAND
125-135: Sl gravelly SAND
135-165: SAND
4-in SILT lens @ 163-ft
165-165: Sl gravelly SAND
165-175: Sl gravelly SAND
2-in SILT lens @ 166-ft
175-202: SAND
202-203: Sandy GRAVEL
203-203.8: SILT
203.6-206: SAND
206-225: Gravelly SAND
225-240: Sandy GRAVEL
240-245: Sl gravelly SAND
245-249: Sandy GRAVEL
249 : GRAVEL (BASALT rock?)



Elevation of reference point: [639.77-ft] (top of casing)
Height of reference point above ground surface [2.76-ft]
Depth of surface seal [2.0-18.9-ft]
Type of surface seal: Cement grout to 18.9-ft, has 4x4-ftx6-in concrete pad extending 2.0-ft into annulus
4-in ID stainless steel casing, +1.1-225.3-ft
Hole diameter,
2.0-19.0-ft, 13-in nominal
19.0-169.4-ft, 11-in nominal
169.4-249.0-ft, 9-in nominal
Bentonite crumbles, 18.9-218.2-ft, 8-20-mesh
Bentonite pellets, 218.2-222.1-ft
Silica sand pack, 222.1-249.0-ft, 10-20-mesh
4-in T304 stainless steel screen, 225.3-246.4-ft, #20-slot
Borehole drilled depth: [249.0-ft]

Drawing By: RKL/2E34-10.ASB
Date : 13Sep93
Reference :

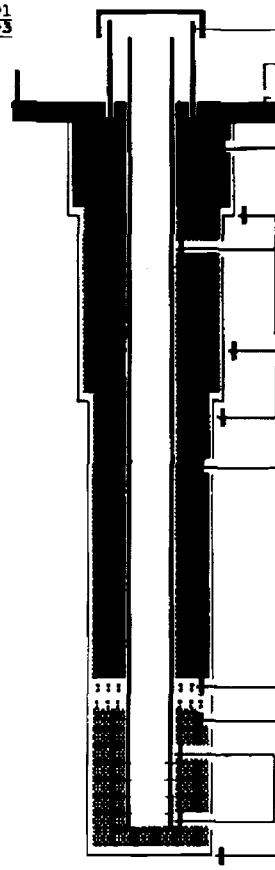
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-E34-11	TEMPORARY WELL NO:
Drilling Fluid Used: None	Additives Used: None	Hanford Coordinates: N/S N 46,264.2	E/W W 51,550.7
Driller's Name: D. Ludtke	WA State Lic Nr: Not documented	State NAD83 N 137,581.76m	E 574,176.16m
Drilling Company: Kaiser Engineers	Company Location: Hanford	Coordinates: N 451,434	E 2,243,656
Date Started: 07Dec91	Date Complete: 20Dec91	Start Card #: Not documented	T ___ R ___ S ___
		Elevation Ground surface: 614.79-ft (Brass cap)	

Depth to water: 210.1-ft 18Dec91
(Ground surface) 212.7-ft 23Jun93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-5: Surface SOIL
5-20: SAND, w/trace GRAVEL
20-50: Sandy GRAVEL
50-55: Sl gravelly SAND
55-65: SAND
65-80: Gravelly SAND
80-125: Sl gravelly SAND
125-130: SAND w/trace GRAVEL
130-140: SAND
140-155: Gravelly SAND
155-185: SAND
185-190: Sandy GRAVEL
190-195: GRAVEL
195-205: Sl gravelly SAND
205-216: GRAVEL w/COBBLES
216-219.3: BASALT



Elevation of reference point: [617.95-ft] (top of casing)
Height of reference point above ground surface [3.16-ft]
Depth of surface seal [1.5-19.5-ft]
Type of surface seal: Cement grout to 19.5-ft, has 4x4-ftx6-in concrete pad extending 1.5-ft into annulus
4-in ID stainless steel casing, +1.0-207.5-ft
Hole diameter,
1.5-19.9-ft, 13-in nominal
19.9-147.6-ft, 11-in nominal
147.6-219.3-ft, 9-in nominal
Bentonite crumbles, 19.5-198.5-ft, 8-20-mesh
Bentonite pellets, 198.5-202.1-ft
Silica sand pack, 202.1-219.3-ft, 20-40-mesh
4-in T304 stainless steel screen, 207.5-217.9-ft, #10-slot
Borehole drilled depth: [219.3-ft]

Drawing By: RKL/2E34-11.ASH
Date : 13Sep93
Reference : WHC-SD-EN-DP-049

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Raw water
Driller's Name: H. Baker/D. Ludtke
Drilling Company: Kaiser Engineers
Date Started: 16Dec91

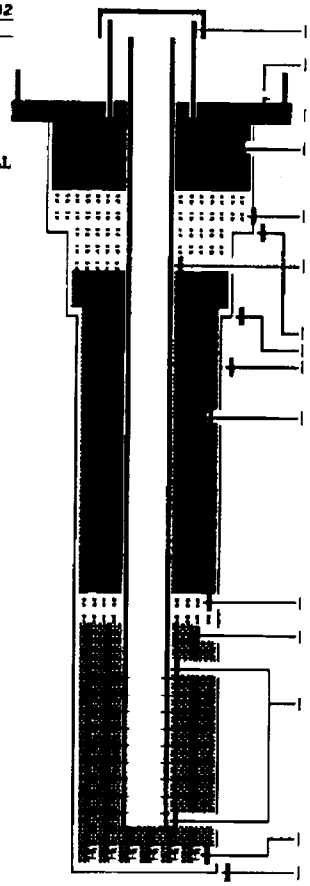
Sample Method: Drive barrel
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 15Apr92

WELL NUMBER: 299-E34-12
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 44,907.0 E/W W 50,783.0
State NAD83 N 137,168.80m E 574,411.31m
Coordinates: N 450,078 E 2,244,427
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface: 635.86-ft (Brass cap)

Depth to water: 236.0-ft 15Apr92
(Ground surface)

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-7: Sl silty sl gravelly SAND
7-10: SAND
10-12.3: Sl silty sl sandy GRAVEL
12.3-25: SAND
25-29.3: Sl gravelly SAND
[Perched water @ 26.8-ft]
29.3-30.1: SILT lens
30.1-40: Gravelly SAND
40-47: Sl gravelly SAND
[Perched water @ 44.1-ft]
47-48.5: Sandy CLAY
48.5-195: SAND
195-200: Sandy GRAVEL
200-207: SAND
207-210: Clayey sandy GRAVEL
210-230: Sandy GRAVEL
230-240: GRAVEL
240-245: Sl gravelly SAND
245-246: SAND
246-247.9: BASALT



Elevation of reference point: [638.83-ft]
(top of casing)
Height of reference point above [2.97-ft]
ground surface
Depth of surface seal [1.1-19.2-ft]
Type of surface seal:
Cement grout to 19.2-ft, has
4x4-ftx6-in concrete pad
extending 1.1-ft into annulus
Bentonite hole plug, 19.2-54.1-ft
19.2-54.1-ft
4-in ID stainless steel casing,
+0.9-223.9-ft
Hole diameter,
1.1-29.6-ft, 17-in nominal
29.6-67.8-ft, 13-in nominal
67.8-247.9-ft, 11-in nominal
Bentonite crumbles,
54.1-217.0-ft, 8-20-mesh
-in bentonite pellets
217.0-220.8-ft
Silica sand pack,
220.8-245.3-ft, 10-20-mesh
4-in T304 stainless steel screen,
223.9-244.5-ft, #20-slot
Fill,
245.3-247.9-ft
Borehole drilled depth: [247.9-ft]

Drawing By: RKL/2E34-12.ASB
Date : 13Sep93
Reference : WHC-SD-EN-DP-045

5C.3 Low-Level Waste Management Area 3

This section includes well construction data (as built diagrams) for monitoring network wells at Low-Level Waste Management Area 3.

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: W. Moomaw
Drilling Company: Omnego Drilling Co
Date Started: 01Jun87

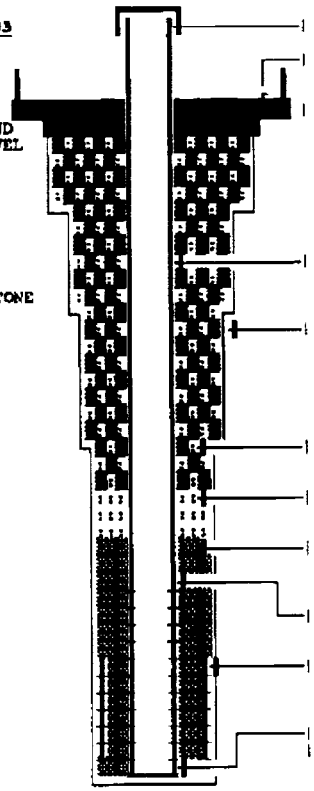
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 30Jul87

WELL NUMBER: 299-W7-1
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,551 E/W W 78,601
State Coordinates: N 451,622 E 2,217,821
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 688.55 (Brass cap)

Depth to water: 226.0-ft Jul87
(Ground surface) 229.9-ft 24Mar93

GENERALIZED STRATIGRAPHY Log — Geologist's

5-6: Slightly silty gravelly SAND
10-11: Slighlty silty sandy GRAVEL
14-30: Silty sandy GRAVEL
30-64: Sandy GRAVEL
64-73: Silty SAND
73-79: Sandy silty CALICHE
79-82: CALICHE and SAND
82-99: Silty SAND
99-130: Coarse SAND
130-135: Slightly gravelly SAND
135-139: SAND w/calcareous MUDSTONE and CLAY layers
139-142: SAND
142-190: Silty sandy GRAVEL
190-194: Gravelly SAND
194-244: Silty sandy GRAVEL
244-245: Gravelly silty SAND



Elevation of reference point: [690.71-ft] (top of casing)
Height of reference point above ground surface [2.16-ft]

Depth of surface seal [0-20-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 3.0-ft 4 equidistant protective posts Volclay grout 3-212-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0-10-ft, 17-in nominal
10-63.4-ft, 13-in nominal
63.4-157.1-ft, 11-in nominal
157.1-245-ft, 9-in nominal

Type of filler, 3-217-ft Volclay grout

Depth top of seal: [212.0-ft]
Type of seal: Volclay pellets

Depth top of sand pack: [217-ft]
20-30-mesh silica sand

Depth top of screen: [224.0-ft]
4-in, #20-slot, continous wrap 304 stainless steel

Telescoping screen, 233-243-ft 8-in, #30-slot, continous wrap 304 stainless steel

Depth bottom of screen: [245.0-ft]
Depth bottom of borehole:

Drawing By: RKL/2W07-01.A9B Date: 15Apr93
Reference:

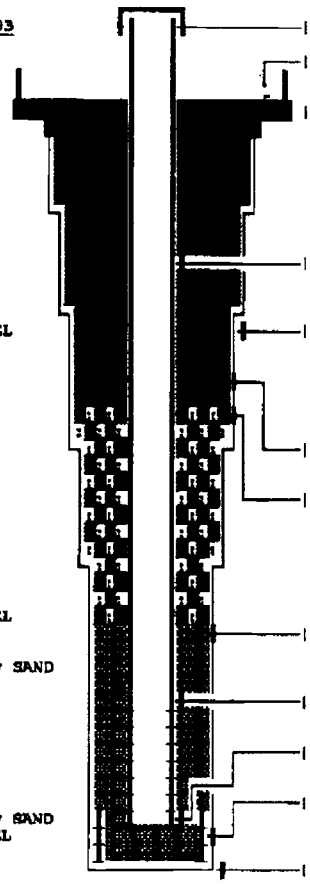
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Hard tool	WELL NUMBER: 299-W7-3
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	TEMPORARY WELL NO: None
Driller's Name: W. Moomaw	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 46,520 E/W W 77,420
Drilling Company: Omrego Drilling Co	Company Location: Kennewick, WA	State Coordinates: N 451,623 E 2,217,786
Date Started: 27Jul87	Date Complete: 23Nov87	Start Card #: Not documented T ___ R ___ S ___
		Elevation Ground surface (ft): 673.71 (Brass cap)

Depth to water: 211.7-ft Sep87
(Ground surface) 217.4-ft 24Mar93

GENERALIZED STRATIGRAPHY Log — Geologist's

0-5: GRAVEL (Backhoe to 8-ft)
10-35: Silty sandy GRAVEL
35-40: Gravelly silty CLAY
40-45: Silty sandy GRAVEL
45-50: Gravelly sandy SILT
50-65: Silty sandy GRAVEL
65-85: Gravelly silty SAND
85-95: Gravelly SAND
95-100: SAND
100-110: Gravelly SAND
110-120: Silty sandy GRAVEL
120-125: Silty gravelly SAND
125-145: Silty sandy-sandy GRAVEL
145-140: Silty gravelly SAND
140-175: Silty sandy GRAVEL
175-180: Silty gravelly SAND
180-185: Sandy GRAVEL
185-195: Gravelly SAND
195-205: Sandy GRAVEL
205-220: Silty gravelly SAND
220-235: Sandy GRAVEL
235-255: Slightly silty-slightly gravelly SAND
255-262: SAND w/CLAY 259-261-ft
262-280: Sandy GRAVEL
280-285: Gravelly SAND
285-310: Sandy GRAVEL-GRAVEL
315-320: Gravelly SAND
320-325: GRAVEL
325-345: Silty sandy-sandy GRAVEL
345-350: Gravelly SAND
350-355: Silty sandy GRAVEL
355-370: Gravelly silty-gravelly SAND
370-380: SAND
380-390: Silty sandy GRAVEL
390-400: Gravelly SAND
400-405: Sandy GRAVEL
405-410: Gravelly silty SAND
410-415: Silty sandy GRAVEL
415-420: Gravelly silty SAND
420-435: Sandy GRAVEL
435-445: Gravelly-gravelly silty SAND
445-465: Silty sandy-sandy GRAVEL
465-473: SAND-sandy GRAVEL
473-476.7: BASALT



- Elevation of reference point: [676.14-ft] (top of casing)
- Height of reference point above ground surface [2.43-ft]
- Depth of surface seal [0-20-ft]
  Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 5.0-ft
  4 equidistant protective posts
  Dry bentonite 5-20-ft
- I.D. of riser pipe: [4-in]
  Type of riser pipe: Stainless steel
- Diameter of borehole,
  0-48-ft, 21-in nominal
  48-147-ft, 17-in nominal
  147-230-ft, 13-in nominal
  230-350-ft, 11-in nominal
  350-476.7-ft, 9-in nominal
- Type of filler, 20-196-ft: Bentonite slurry
- Depth top of seal: [196.0-ft]
  Type of seal: Volclay grout
- Depth top of sand pack: [427.0-ft]
  20-30-mesh silica sand
- Depth top of screen: [449.0-ft]
  4-in, #20-slot, continous wrap
  304 stainless steel
- Depth bottom of screen: [470.0-ft]
- Telescoping screen, ~470-476.7-ft
  8-in, #30-slot, continous wrap
  304 stainless steel (damaged)
- Depth to bottom of borehole: [476.7-ft]

Drawing By: RKL/2W07-03.A9B Date: 16Apr93

Reference: _____

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: R. Vance
Drilling Company: Omrego Drilling Co
Date Started: 29Sep87

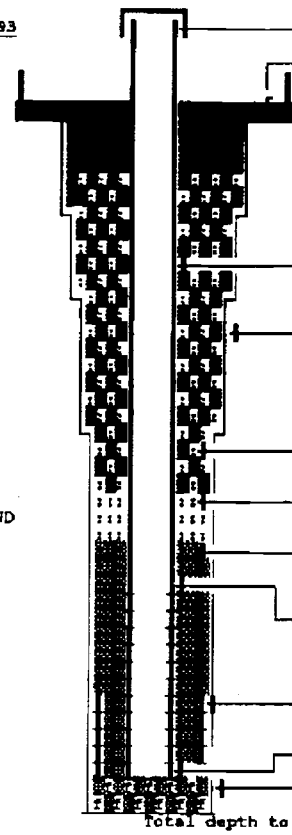
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 19Nov87

WELL NUMBER: 299-W7-4
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 45,435 E/W W 77,040
State Coordinates: N 448,140 E 2,219,238
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 669.02 (Brass cap)

Depth to water: 205-ft Nov87
(Ground surface) 209.8-ft 24Mar93

GENERALIZED Geologist's STRATIGRAPHY Log

5: Slightly silty GRAVEL
10: Sandy GRAVEL
15: GRAVEL
19-20: Sandy GRAVEL
25,30: GRAVEL
35-50: Sandy GRAVEL
55: Silty sandy GRAVEL
60-85: Gravelly SAND
60: Gravelly SILT/CLAY
65: Gravelly sandy SILT
70: Gravelly silty SAND
75: Gravelly SAND
80-100: SAND
105,110: Gravelly SAND
115,120: Sandy GRAVEL
125: Silty sandy GRAVEL
130-140: Sandy GRAVEL
145-160: Silty sandy GRAVEL
165: Sandy GRAVEL
170: Silty sandy GRAVEL
175: Clayey sandy GRAVEL
180-205: Silty sandy GRAVEL
210,215: Silty gravelly SAND
220: Slightly silty gravelly SAND
225-235: Silty sandy GRAVEL



Elevation of reference point: [671.69-ft]
(top of casing)
Height of reference point above ground surface [2.67-ft]

Depth of surface seal [0-12-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad
4 equidistant protective posts
Dry bentonite 3-12-ft

I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel

Diameter of borehole,
0-20.0-ft, 17-in nominal
20.0-50.7-ft, 13-in nominal
50.7-150.3-ft, 11-in nominal
150.3-238.0-ft, 9-in nominal

Type of filler, 12-190-ft
Bentonite slurry

Depth top of seal: [190.0-ft]
Type of seal: Volclay pellets

Depth top of sand pack: [194-ft]
10-20-mesh silica sand

Depth top of screen: [203.0-ft]
4-in, #10-slot
stainless steel

Telescoping screen, 223-233-ft
9-in stainless steel, #30 slot

Depth bottom of screen [233.0-ft]

Fill 233-235-ft

Total depth to bottom of borehole: [235.0-ft]

Drawing By: RKL/2W07-04.ASB Date: 16Apr93
Reference: ___

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: H. Joy/D. Garcia
Drilling Company: Omrego Drilling Co
Date Started: 30Sep87

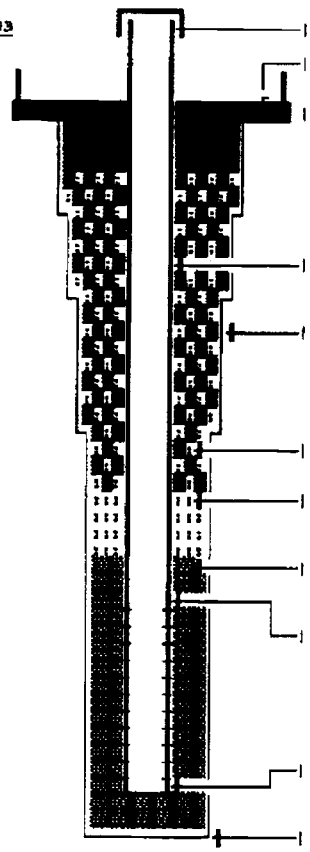
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 19Nov87

WELL NUMBER: 299-W7-5
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,509 E/W W 76,816
State Coordinates: N 445,614 E 2,218,405
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 670.41 (Brass cap)

Depth to water: 211-ft Nov87
(Ground surface) 213.5-ft 24Mar93

GENERALIZED STRATIGRAPHY Log Geologist's

5,10: GRAVEL
10: Sandy GRAVEL
15-25: Sandy GRAVEL
30-45: Silty sandy GRAVEL
50,55: Silty gravelly SAND
60: Gravelly silty SAND
65-75: Silty gravelly SAND
80-105: Sandy GRAVEL
110-125: Silty sandy GRAVEL
130-150: Sandy GRAVEL
155-185: Silty sandy GRAVEL
190-200: silty gravelly SAND
205: Silty sandy GRAVEL
210: Silty gravelly SAND
215: Gravelly SAND
220: Sandy GRAVEL
225: Silty/clayey SAND



Elevation of reference point: (673.05-ft)
(top of casing)
Height of reference point above ground surface: [2.64-ft]

Depth of surface seal [0-5-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad
4 equidistant protective posts
Dry bentonite 2-5-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0-10.0-ft, 17-in nominal
10.0-50.8-ft, 13-in nomnal
50.8-154.6-ft, 11-in nominal
154.6-229.0-ft, 9-in nominal

Type of filler, 5-190-ft
Bentonite slurry

Depth top of seal: [190.0-ft]
Type of seal: Dry bentonite, 190-197-ft
Volclay pellets, 197-200-ft

Depth top of sand pack: [200-ft]
10-20-mesh silica sand

Depth top of screen: [207.0-ft]
4-in, #20-slot
stainless steel

Depth bottom of screen [227.7-ft]

Depth to bottom of borehole: [229.0-ft]

Drawing By: RKL/2WD7-05.ASB Date: 16Apr93
Reference:

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: L. Cordon
Drilling Company: Basin & Range Drill
Date Started: 23Oct89

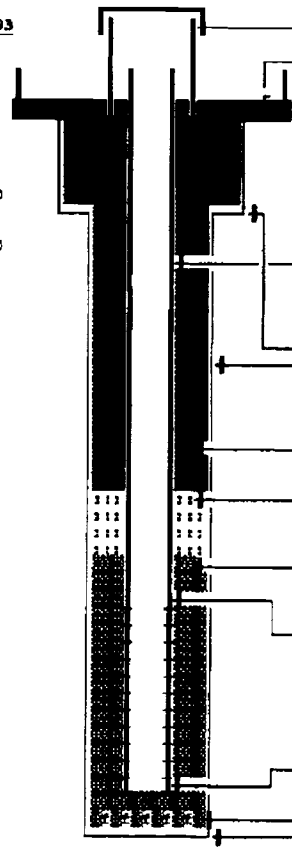
Sample Drive barrel Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 27Nov89

WELL NUMBER: 299-W7-7
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,509.3 E/W W 76,518.7
State NAD83 Coordinates: N 137,636.3m 451,615 E 566,567.1m 2,218,687
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 671.96 (Brass cap)

Depth to water: 211.8-ft Nov89
(Ground surface) 215.0-ft 24Mar93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl=slightly

0-30: Muddy sandy GRAVEL
30-35: Gravelly sandy MUD
35-45: Gravelly muddy SAND
45-50: Muddy sandy GRAVEL
50-55: Sl gravelly sl muddy SAND
55-60: SAND
60-65: Sl gravelly SAND
65-70: Sl gravelly sl muddy SAND
70-75: Gravelly SAND
75-90: Sandy GRAVEL
90-105: Muddy sandy GRAVEL
105-110: Sl muddy gravelly SAND
110-135: Sandy GRAVEL
135-145: Muddy sandy GRAVEL
145-155: Sandy GRAVEL
155-230: Muddy sandy GRAVEL



Elevation of reference point: [674.94-ft]
(top of casing)
Height of reference point above ground surface [2.98-ft]
Depth of surface seal [2-17.4-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 2-ft
4 equidistant protective posts
Cement grout-Portland Cement with gypsum, 2.0-17.4-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-20.2-ft, 13-in nominal
20.2-227.8-ft, 9-in nominal
Type of filler, 17.4-198-ft
Bentonite crumbles
Depth top of seal: [198.0-ft]
Type of seal: 3/8-in Volclay pellets
Depth top of sand pack: [202.7-ft]
20-40-mesh silica sand
Depth top of screen: [207.1-ft]
4-in, #10-slot, stainless steel with channel pack
Depth bottom of screen [227.8-ft]
Fill 229.6-230.8-ft
Depth to bottom of borehole: [230.8-ft]

Drawing By: RKL/2W07-07.ASB Date: 16Apr93
Reference: WHC-MR-0204

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: L. Cordon
Drilling Company: Basin & Range Drill
Date Started: 19Oct89
Date Complete: 13Dec89

Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented

WELL NUMBER: 299-W7-8
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,509.8 137,637.0m
E/W W 76,880.1 566,761.7m
State NAD83 Coordinates: N 451,614 E 2,218,326
Start Card #: Not documented T___ R___ S___
Elevation Ground surface (ft): 684.40 (Brass cap)

Depth to water: 229.2-ft Nov89
(Ground surface) 228.8-ft 24Mar93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl-slightly

0-20: Sandy GRAVEL (trace COBBLES)
20-28.5: Muddy sandy GRAVEL
28.5-35: Sandy MUD
35-39.5: Muddy SAND (trace CALICHE)
39.5-46: Sandy GRAVEL (fines 47-48-ft)
46-51: Sl gravelly SAND
51-57: Muddy sandy GRAVEL
57-59: Gravelly SAND
59-70: SAND
70-85: Gravelly SAND
85-110: Sandy GRAVEL (trace COBBLES)
110-120: SAND
120-130: Sandy GRAVEL
130-235: Muddy sandy GRAVEL
235-240: Sl muddy gravelly SAND
240-244.5: Muddy sandy GRAVEL

Elevation of reference point: (top of casing) [687.35-ft]
Height of reference point above ground surface [2.95-ft]
Depth of surface seal [2-18.7-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 2-ft
4 equidistant protective posts
Cement grout-Portland Cement with gypsum, 2.0-18.7-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-18.7-ft, 13-in nominal
18.7-244.5-ft, 9-in nominal
Type of filler, 18.7-215-ft
8-20 mesh bentonite
Depth top of seal: [215.0-ft]
Type of seal: 1/4-in Volclay tablets
Depth top of sand pack: [217.3-ft]
20-40-mesh silica sand
Depth top of screen: [219.8-ft]
4-in, #10-slot, stainless steel with channel pack
Depth bottom of screen [240.6-ft]
Fill 243.4-244.5-ft
Depth to bottom of borehole: [240.6-ft]

Drawing By: RKL/2W07-08.ASB Date: 16Apr93
Reference: WHC-MR-0204

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: T. Gifford
Drilling Company: Kaiser Engineers
Date Started: 10Apr91

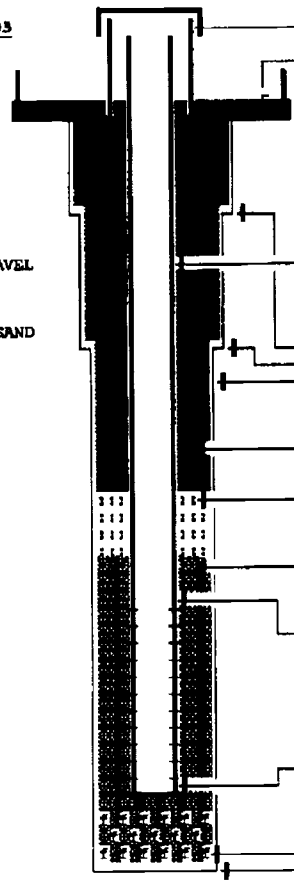
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: 0867
Company Location: Hanford
Date Complete: 28May91

WELL NUMBER: 299-W7-12
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 46,514 E/W W 78,246
State NAD83 N 137,636.3m E 566,040.8m
Coordinates: N 451,615 E 2,216,960
Start Card #: Not documented T R S
Elevation Ground surface (ft): 684.64 (Brass cap)

Depth to water: 224.0-ft Jun91
(Ground surface) 226.0-ft 24Mar93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-5: Sandy GRAVEL
5-10: Gravelly SAND
10-30: Silty sandy GRAVEL
30-35: Sl silty sandy GRAVEL
35-50: Silty sandy GRAVEL
50-56: Sl silty sandy GRAVEL
56-60: Silty SAND
60-63: Sandy SILT
63-65: Cemented silty, sandy GRAVEL
65-75: Silty SAND
75-80: Sl silty sandy GRAVEL
80-110: Sl gravelly silty SAND
110-115: Sl silty, sl gravelly SAND
115-120: Sl gravelly SAND
120-125: Sl silty gravelly SAND
125-135: Silty gravelly SAND
135-140: Sl silty gravelly SAND
140-160: Sl sandy silty GRAVEL
160-190: Silty GRAVEL
190-225: Sandy GRAVEL
225-230: Gravelly SAND
230-245: Sandy GRAVEL



Elevation of reference point: [687.93-ft]
(top of casing)
Height of reference point above ground surface [3.29-ft]
Depth of surface seal [1.9-22.1-ft]
Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 1.9-ft
4 equidistant protective posts
Cement grout, 1.9-22.1-ft
I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel
Diameter of borehole,
0-21.4-ft, 13-in nominal
21.4-164.5-ft, 11-in nominal
164.5-245.0-ft, 9-in nominal
Type of filler, 22.1-207.8-ft
8-20 mesh bentonite crumbles
Depth top of seal: [207.8-ft]
Type of seal:
1/4-3/8-in Volclay pellets
Depth top of sand pack: [214.6-ft]
10-20-mesh silica sand
Depth top of screen: [219.3-ft]
4-in, #20-slot,
T304 stainless steel
Depth bottom of screen [240.0-ft]
Fill, 240.5-245.0-ft
Depth to bottom of borehole: [245.0-ft]

Drawing By: RKL/2W07-12.ASB Date: 16Apr93
Reference:

WELL CONSTRUCTION AND COMPLETION SUMMARY

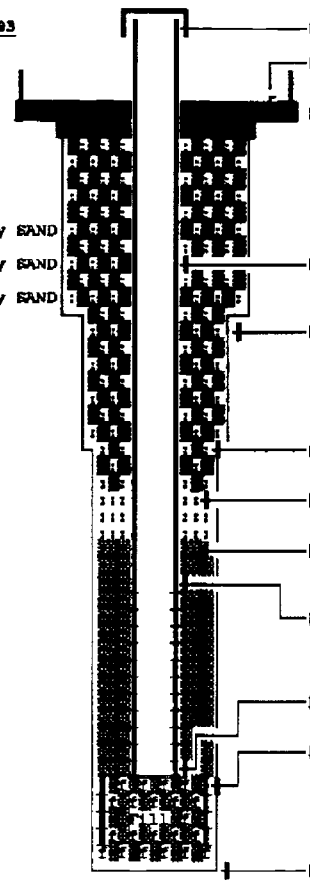
Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: L. Bultena
Drilling Company: Omrego Drilling Co
Date Started: 09Jun87
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 23Jul87

WELL NUMBER: 299-W8-1
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 46,551 E/W W 79,200
State Coordinates: N 451,650 E 2,248,987
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 699.45 (Brass cap)

Depth to water: 239.6-ft Sep88
(Ground surface) 240.4-ft 24Mar93

GENERALIZED Geologist's STRATIGRAPHY Log

0-5: Backfill
5-65: Sandy GRAVEL
65-80: Gravelly SAND
80-90: Gravelly sandy SILT
90-95: Silty sandy GRAVEL
95-105: Sandy GRAVEL
105-110: Slightly silty gravelly SAND
110-115: Slightly gravelly SAND
115-135: Slightly gravelly silty SAND
135-145: Silty SAND
145-155: Slightly gravelly silty SAND
155-165: Silty gravelly SAND
165-180: Sandy sandy GRAVEL
180-195: Sandy GRAVEL
195-200: Silty sandy GRAVEL
200-205: Silty/clayey GRAVEL
205-210: Gravelly silty SAND
210-270.5: Silty sandy GRAVEL



Elevation of reference point: [701.33-ft] (top of casing)
Height of reference point above ground surface [1.88-ft]
Depth of surface seal [0-206-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 3.0-ft
4 equidistant protective posts
Volclay bentonite grout 3-206-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-62.7-ft, 13-in nominal
62.7-156.8-ft, 11-in nominal
156.8-270.5-ft, 9-in nominal
Type of filler, 3-206-ft
Volclay bentontite grout
Depth top of seal: [206.0-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [210.5-ft]
20-30-mesh silica sand
Depth top of screen: [236.2-ft]
4-in, #20-slot, continous wrap
304 stainless steel
Depth bottom of screen: [256.5-ft]
Telescoping screen, 257-267.7-ft
8-in, #30-slot, continous wrap
304 stainless steel
Depth to bottom of borehole: [270.5-ft]

Drawing By: RKL/2W08-01.ASB Date: 16Apr93
Reference:

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: R. Boley
Drilling Company: Omnego Drilling Co
Date Started: 29Jul87

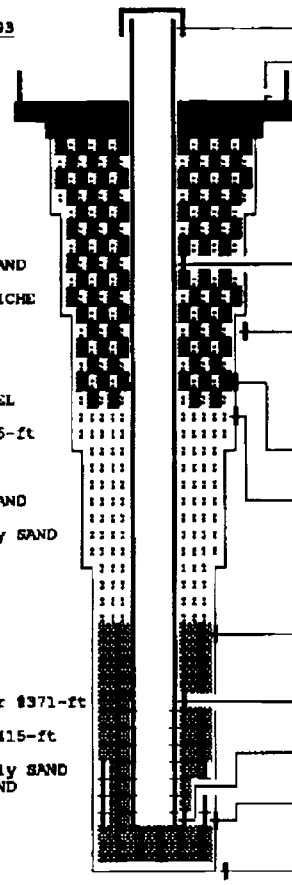
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 18Nov87

WELL NUMBER: 299-W10-14
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 43,143 E/W W 78,330
State Coordinates: N 448,244 E 2,216,884
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 697.09 (Brass cap)

Depth to water: 229.5-ft Aug87
(Ground surface) 235.1-ft 24Mar93

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl = slightly

0-20: SAND (Backhoe to 20-ft)
20-25: Gravelly SAND
25-80: SAND
80-85: Sl gravelly SAND
85-100: Silty sandy GRAVEL
100-105: Sandy GRAVEL
105-115: Silty sandy GRAVEL
115-120: Gravelly SAND
120-130: Sl gravelly sl silty SAND
130-137: Silty SAND
137-145: Sl gravelly SAND w/CALICHE
145-150: Sandy GRAVEL
150-155: Gravelly SAND
154-155: Silty SAND
155-164: Sandy GRAVEL
164-165: Silty SAND
165-185: Sandy-silty sandy GRAVEL
185-205: Silty gravelly SAND
Chloritized zone, Ringold -195-ft
205-210: Gravelly SAND
210-220: Sandy GRAVEL
220-230: Gravelly SAND
230-245: Silty gravelly-silty SAND
245-255: Silty sandy GRAVEL
255-270: Gravelly-silty gravelly SAND
270-280: Silty sandy GRAVEL
280-305: SAND, gravelly @300-ft
305-310: Silty sandy GRAVEL
310-325: Sandy GRAVEL
325-330: SAND
330-340: Silty gravely SAND
340-355: Gravelly SAND
355-365: SAND-gravelly SAND
365-371: SAND-silty SAND
371-385: Clayey SAND, CLAY layer @371-ft
385-410: SAND
410-420: Gravelly SAND, CLAY @ 415-ft
420-425: SAND
425-440: Clayey gravelly-gravelly SAND
440-448: SAND-silty gravelly SAND
448-455: Clayey gravelly SAND
455-460: Sandy CLAY
460-462: CLAY



Elevation of reference point: [699.43-ft]
(top of casing)
Height of reference point above ground surface [2.34-ft]

Depth of surface seal [0-210-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad to 3.0-ft
4 equidistant protective posts
Dry bentonite 3-6-ft
Bentonite slurry 6-210-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0-50-ft, 21-in nominal
50-147.5-ft, 17-in nominal
147.5-244-ft, 13-in nominal
244-351-ft, 11-in nominal
351-462-ft, 9-in nominal

Type of filler, 6-210-ft
Bentonite slurry

Depth top of seal: [210.0-ft]
Type of seal: Volclay grout

Depth top of sand pack: [416.0-ft]
20-30-mesh silica sand

Depth top of screen: [427.0-ft]
4-in, @20-slot, continous wrap
304 stainless steel
Depth bottom of screen: [447.0-ft]

Telescoping screen, 437-447-ft
8-in, @30-slot, continous wrap
304 stainless steel

Depth to bottom of borehole: [462.0-ft]

Drawing By: RKL/2W10-14.ASB Date: 16Apr93
Reference: HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Raw water
Driller's Name: H. Baker
Drilling Company: Kaiser Engineers
Date Started: 15Jan92

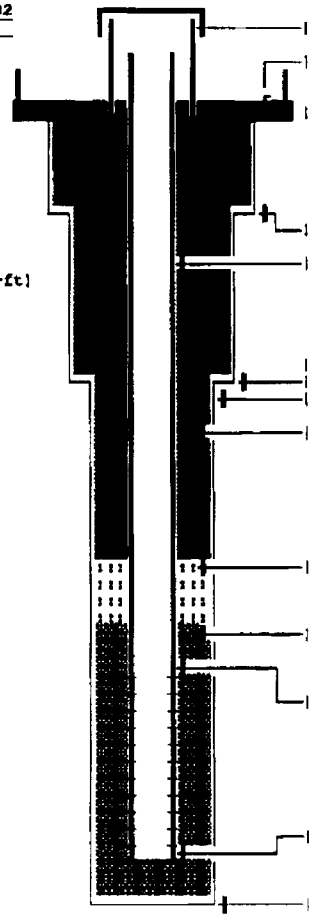
Sample Method: Drive barrel Hard tool
Additives Used: None
WA State Lic Nr: Not documented
Company Location: Hanford
Date Complete: 24Jul92

WELL NUMBER: 299-W10-19
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 44,545.4 E/W W 77,248.7
State NAD83 N 137,037.14m E 566,346.19m
Coordinates: N 449,649 E 2,217,962
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 680.04 Brass cap

Depth to water: 217.9-ft 03Jun92 (Ground surface)

GENERALIZED STRATIGRAPHY Log
Geologist's
Sl=slightly

0-9: SAND
9-10.5: Silty SAND
10.5-40: Sandy GRAVEL
40-55: GRAVEL
55-75: Silty sandy GRAVEL
75-77.5: GRAVEL
77.5-83: Gravelly SAND
83-87.5: SILT
87.5-97: Silty SAND
(CALICHE nodules 90-97-ft)
97-110: Sl gravelly SAND
110-117: SAND
117-120: Silty sandy GRAVEL
120-130: Sandy GRAVEL
130-140: Silty sandy GRAVEL
(BOULDER @ 137-ft)
140-170: Sandy GRAVEL
170-175: Gravelly SAND
175-195: Sandy GRAVEL
195-200: Gravelly SAND
200-205: Sandy GRAVEL
205-210: Silty sandy GRAVEL
210-215: Gravelly SAND
215-225: Silty sandy GRAVEL
225-238.3: Gravelly SAND



Elevation of reference point: [682.99-ft] (top of casing)
Height of reference point above ground surface [2.95-ft]
Depth of surface seal [2.0-9.8-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 2.0-ft
4 equidistant protective posts
Cement grout, 2.0-9.8-ft
13-in nominal hole to 20.2-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
20.2-127.7-ft, 11-in nominal
127.7-238.3-ft, 9-in nominal
Type of filler, 9.8-206.0-ft
8-20 mesh bentonite crumbles
Depth top of seal: [206.0-ft]
Type of seal: -in bentonite pellets
Depth top of sand pack: [210.5-ft]
20-40-mesh silica sand
Depth top of screen: [214.4-ft]
4-in, #10-slot, continous wrap
T-304 stainless steel,
with 0.3-ft end cap
Depth bottom of screen [234.5-ft]
Depth to bottom of borehole: [238.3-ft]

Drawing By: RKL/2W10-19.ASB Date: 30Jun93
Reference: WHC-SD-EN-DP-049

0500519

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W18-30
Drilling Fluid Used:	Air	Additives Used:	None	TEMPORARY WELL NO:	A8439 None
Driller's Name:	C. Sheilds	WA State Lic Nr:	Not Available	Coordinates: N	Not documented
Drilling Company:	PC Exploration	Company Location:	Richland, WA	Coordinates: E	Not documented
Date Started:	23Jun93	Date Completed:	18Nov93	Start Card #:	Not Available
				Elevation Ground Surface:	

Depth to Water: 222.9 ft 18Nov93
(Ground surface) 223.12 ft 18Nov93

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 10 ft.

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY Geologist's Log

0 - 2 ft : Sandy Gravel
2 - 7 ft : Silty Sand
7 - 25 ft : Sandy Gravel

25 - 33 ft : Sandy Gravel
33 - 60 ft : Sandy Gravel

60 - 78 ft : Sandy Gravel

78 - 91 ft : Gravelly Sand

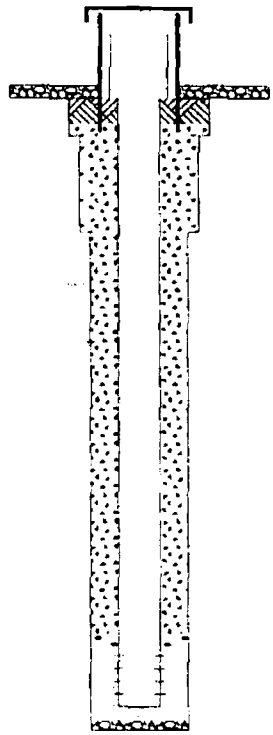
91 - 97 ft : Silty Sand
97 - 101 ft : Silt
101 - 104.5 ft : Silty Sand
104.5 - 108.5 ft : Sand
108.5 - 117.5 ft : Sand
117.5 - 130 ft : Sandy Gravel

130 - 132 ft : Silty Sandy Gravel
132 - 178 ft : Sandy Gravel

178 - 183 ft : Sandy Gravel
183 - 213 ft : Sandy Gravel

213 - 214 ft : Sandy Gravel
214 - 215 ft : Slightly Silty Gravelly Sand
215 - 232 ft : Sandy Gravel

232 - 238 ft : Sandy Gravel
238 - 243 ft : Sand
243 - 251 ft : Sandy Gravel



251 ft : Borehole drilled depth

0 - 15 ft : 13-in. 12-3/4" CS Temp Casing
15 - 53.22 ft : 11-in. 10-3/4" CS Temp. Casing
53.22 - 251 ft : 9-in. 8-5/8" CS Temp. Casing

Fill	*Casing*	*Screen*
0 - 10 ft : 13-inch hole Cement	0 - 15 ft : 13 inch 12-3/4" CS Temp. Casing	
10 - 15 ft : 13-inch hole Bentonite Crumbles	0 - 221.7 ft : 4 inch 4" Perm. Casing	
15 - 53.22 ft : 11-inch hole Bentonite Crumbles	15 - 53.22 ft : 11 inch 10-3/4" CS Temp. Casing	
	53.22 - 251 ft : 9 inch 8-5/8" CS Temp. Casing	
53.22 - 212.7 ft : 9-inch hole Bentonite Crumbles		
212.7 - 218.6 ft : 9-inch hole 3/8" Bentonite Pellets		221.7 - 241.6 ft : 4 inch 4" .020 SS Wire Wrap Pipe Size
218.6 - 241.9 ft : 9-inch hole 10-20 Silica Sand	241.6 - 241.9 ft : 4 inch End Camp	
241.9 - 244.5 ft : 9-inch hole 10-20 Silica Sand		
244.5 - 247.5 ft : 9-inch hole 8-12 Silica Sand		
247.5 - 251 ft : 9-inch hole Slough		

Drawing By: DLF
Reference: Hanford Wells
Revision: 0
Revision Date: 29Dec97
Print Date: 29Dec97

Report Form: WELLS Project File: WELLS.GPJ

0500379

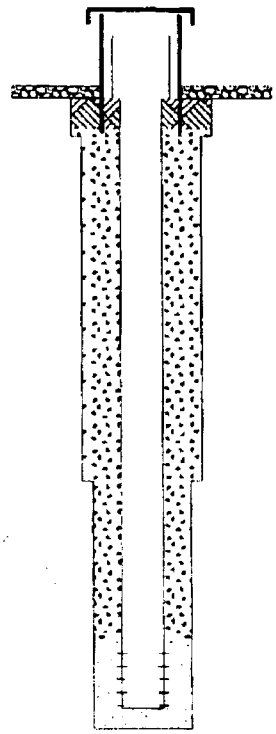
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Air Rotary	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W10-31 AS440
Drilling Fluid Used:	Air	Additives Used:	None	TEMPORARY WELL NO:	None
Driller's Name:	C. Shields	WA State Lic Nr:	Not Available	Coordinates: N	Not documented
Drilling Company:	PC Exploration	Company Location:	Richland, WA	Coordinates: E	Not documented
Date Started:	24Jun93	Date Completed:	27Aug93	Start Card #:	Not Available
				Elevation Ground Surface:	

Depth to Water: 211.97 ft 24Jun93
(Ground surface)

GENERALIZED STRATIGRAPHY Geologist's Log

0 - 4 ft : Silty Sand
4 - 15 ft : Sandy Gravel
15 - 34 ft : Sandy Gravel
34 - 36 ft : Gravelly Sand
36 - 41 ft : Sandy Gravel
41 - 55 ft : Sandy Gravel
55 - 61.5 ft : Sandy Gravel
61.5 - 62 ft : Silty Sand
62 - 66.9 ft : Sandy Gravel
66.5 - 67 ft : Gravelly Sandy Silt
67 - 69.8 ft : Sandy Gravel
69.8 - 77 ft : Slightly Silty Sand
77 - 83 ft : Slightly Silty Sand
83 - 85 ft : Gravelly Sand
85 - 92.5 ft : Sand
92.5 - 93.5 ft : Silty Sand
93.5 - 106 ft : Sand
106 - 115 ft : Sandy Gravel
115 - 144 ft : Sandy Gravel
144 - 175 ft : Sandy Gravel
175 - 180 ft : Silty Sand
180 - 213 ft : Sandy Gravel
213 - 234 ft : Gravelly Sand
234 - 237.38 ft : Gravelly Silty Sand



237.38 ft : Borehole drilled depth

0 - 14 ft : 13-in. 12-3/4" CS Temp. Casing
14 - 143.85 ft : 11-in. 10-3/4" CS Temp. Casing
143.85 - 273.38 ft : 9-in. 8-5/8" CS Temp. Casing

Elevation of Reference Point: m

Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 11.4 ft.

Type of Surface Seal: 4x4 Concrete Pad

Fill	*Casing*	*Screen*
0 - 11.4 ft : 13-inch hole Cement	0 - 14 ft : 13 inch 12-3/4" CS Temp. Welded Csg.	
11.4 - 14 ft : 13-inch hole Bentonite Crumbles	0 - 209.25 ft : 4 inch 4" Perm. Casing	
	14 - 143.85 ft : 11 inch 10-3/4" CS Temp. Welded Csg.	
14 - 143.85 ft : 11-inch hole Bentonite Crumbles		
	143.85 - 237.38 ft : 9 inch 8-5/8" CS Temp. Casing	
143.85 - 201.2 ft : 9-inch hole Bentonite Crumbles		
201.2 - 204.9 ft : 9-inch hole 1/4" Bentonite Pellets		209.25 - 229.25 ft : 4 inch 4" .010 SS Wire Wrap Pipe Size
204.9 - 229.58 ft : 9-inch hole 20-40 Silica Sand	229.25 - 229.58 ft : 4 inch 4" PVC Cap	
229.58 - 233.1 ft : 9-inch hole 20-40 Silica Sand		
233.1 - 237.1 ft 9-inch hole Bentonite Plug		
237.1 - 237.38 ft : 9-inch hole Slough		

Drawing By: DLF
Reference: Hanford Wells
Revision: 0
Revision Date: 22Dec97
Print Date: 22Dec97

Report Form WELLS Project File WELLS.GPJ

5C.4 Low-Level Waste Management Area 4

This section provides well construction data (as built diagrams) for monitoring network wells at Low-Level Waste Management Area 4.

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: B. Boyley
Drilling Company: Onwego Drilling Co
Date Started: 14Jul87
Date Complete: 02Sep87

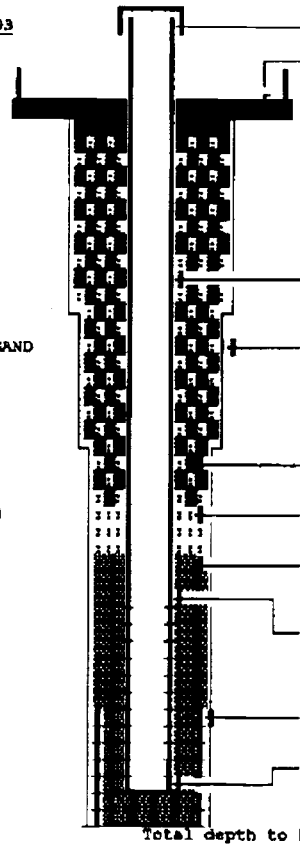
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA

WELL NUMBER: 299-W15-15
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 40,330 E/W W 78,103
State Coordinates: N 445,431 E 2,217,119
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 695.74 (Brass cap)

Depth to water: 226.0-ft Aug87
(Ground surface) 232.1-ft 11Mar93

GENERALIZED Geologist's STRATIGRAPHY Log
sl. = slightly

0-5: SILT/CLAY
5-10: SAND
10-15: Sandy GRAVEL
15-20: Gravelly SAND
20-35: SAND
35-40: Gravelly SAND
40-45: Silty SAND
45-50: SAND
50-55: Sl. gravelly SAND
55-60: Silty sandy GRAVEL
60-65: Gravelly SAND
65-85: Silty sandy GRAVEL
85-90: Gravelly silty SAND
90-100: Sl. gravelly sl. silty SAND
100-105: Silty SAND
105-110: Sl. silty SAND
110-115: Silty SAND
115-120: SAND
120-130: Silty SAND
130-140: Sl. silty SAND
140-145: Sandy SILT
145-150: Silty CLAY
150-170: Gravelly sandy SILT
170-175: Sl. gravelly silty SAND
175-180: Sandy GRAVEL
180-200: Silty sandy GRAVEL
200-205: Sandy GRAVEL
205-220: Silty sandy GRAVEL
220-230: Sandy GRAVEL
230-245: Silty sandy GRAVEL
245-255: Sandy GRAVEL



Elevation of reference point: (top of casing) [697.96-ft]
Height of reference point above ground surface [2.22-ft]
Depth of surface seal [0-208-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad to 4-ft 4 equidistant protective posts Volclay grout to 208-ft
I.D. of surface casing: If present) [Removed]
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole, 0-52.5-ft, 13-in nominal 52.5-165.10-ft, 11-in nominal 165.1-255.0-ft, 9-in nominal
Type of filler: Volclay grout
Depth top of seal: [208.0-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [213.7-ft]
10-12-mesh silica sand
Depth top of screen: [223.0-ft]
4-in, #20-slot stainless steel
Telescoping screen, 245-255-ft 8-in stainless steel, #30 slot
Depth bottom of screen [253.0-ft]
Total depth to bottom of borehole: [255.0-ft]

Drawing By: RKL/2W15-15.ASB Date: 19Apr93
Reference: HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: D. Ludtke
Drilling Company: Omrego Drilling Co
Date Started: 29Jul87

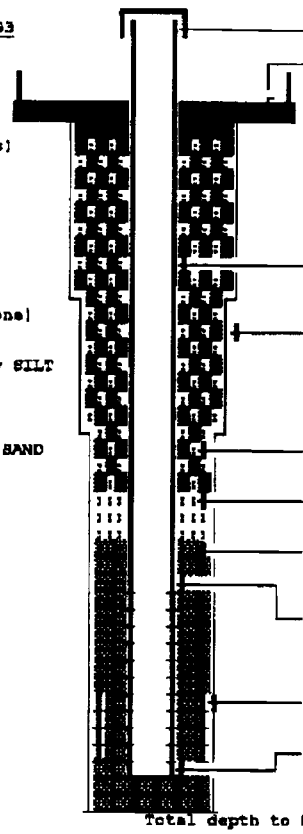
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 10Sep87

WELL NUMBER: 299-W15-16
TEMPORARY WELL NO: None
Hanford Coordinates: N/S N 40,269 E/W W 77,387
State Coordinates: N 445,372 E 2,217,835
Start Card #: Not documented T ___ R ___ S ___
Elevation Ground surface (ft): 682.62 (Brass cap)

Depth to water: 214.5-ft Sep87
(Ground surface) 218.3-ft 11Mar93

GENERALIZED STRATIGRAPHY Geologist's Log

*4-5: Slightly silty SAND
9-10: SAND (= Backhoe samples)
10-15: Sandy GRAVEL
15-20: SAND
20-35: Sandy GRAVEL
35-75: SAND
75-80: Sandy GRAVEL
80-85: Gravelly SAND
85-110: Sandy GRAVEL
110-115: Gravelly SAND
115-120: SAND to sandy GRAVEL (Lost drilling water zone)
120-135: Sandy GRAVEL
135-140: Sandy clayey GRAVEL
140-145: Slightly gravelly sandy SILT
145-160: Gravelly silty SAND and CALICHE
160-165: Gravelly silty SAND
165-170: Silty SAND
170-175: Slightly gravely silty SAND
175-180: Silty sandy GRAVEL
180-185: Slightly gravelly SAND
185-200: Silty sandy GRAVEL
200-205: Sandy GRAVEL
205-225: Silty sandy GRAVEL
225-235: Sandy GRAVEL
235-240: Slightly sandy GRAVEL
240-243.5: Sandy GRAVEL



Elevation of reference point: [684.89-ft] (top of casing)
Height of reference point above ground surface [2.27-ft]
Depth of surface seal [0-2-ft]
Type of surface seal: Pre-mix concrete 4x4-ft x 6-in surface pad 4 equidistant protective posts
I.D. of surface casing: [Removed] If present)
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole, 0-62.6-ft, 13-in nominal 62.6-154.75-ft, 11-in nominal 154.75-243.5-ft, 9-in nominal
Type of filler: Bentonite slurry
Depth top of seal: [196.5-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [202-ft]
10-20-mesh silica sand
Depth top of screen: [208.0-ft]
4-in, #20-slot stainless steel
Telescoping screen, 227.5-237.5-ft 8-in stainless steel, #10 slot
Depth bottom of screen [238.0-ft]
Total depth to bottom of borehole: [243.5-ft]

Drawing By: RKL/2W15-16.ASB Date: 19Apr93
Reference: HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

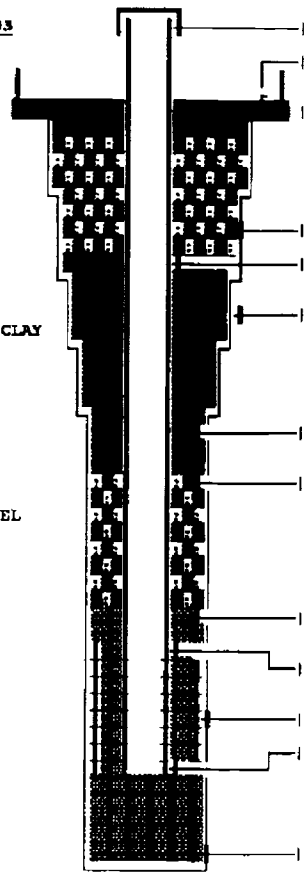
Drilling Method: Cable tool	Sample Method: Hard tool
Drilling fluid Used: 200 W Water Supply	Additives Used: Not documented
Driller's Name: D. Garcia	WA State Lic Nr: Not documented
Drilling Company: Omwego Drilling Co	Company Location: Kennewick, WA
Date Started: 08Jul87	Date Complete: 28Oct87

WELL NUMBER: 299-W15-17	TEMPORARY WELL NO:
Hanford Coordinates: N/S N 40,221	E/W W 77,387
State Coordinates: N 445,324	E 2,217,835
Start Card #: Not documented	T R S
Elevation Ground surface (ft): 682.85 (Brass cap)	

Depth to water: 221.6-ft Aug87
(Ground surface) 218.8-ft 11Mar93

GENERALIZED STRATIGRAPHY Geologist's Log

0-5: Gravelly SAND
5-10: SAND
10-15: Gravelly SAND
15-25: SAND
25-30: Sandy GRAVEL
30-75: SAND
75-95: Sandy GRAVEL
95-100: Silty sandy GRAVEL
100-115: Sandy GRAVEL
115-120: GRAVEL
120-136: Sandy GRAVEL
136-140: SILT
140-165: Silty SAND w/CALICHE & CLAY
165-175: Silty clayey SAND
175-180: Silty gravelly SAND
180-185: Sandy GRAVEL
185-220: Gravelly SAND
220-340: Silty gravelly SAND
340-345: Silty SAND
345-370: Silty gravelly SAND
370-380: Gravelly silty SAND
380-390: Gravelly clayey SAND
390-405: Silty gravelly SAND
405-410: Silty/clayey sandy GRAVEL
410-435: Silty gravelly SAND
435-450: Sandy CLAY
450 : CLAY



- Elevation of reference point: [684.64-ft] (top of casing)
- Height of reference point above ground surface [1.79-ft]
- Depth of surface seal [0-87-ft]
  Type of surface seal: Concrete 4x4-ft x 6-in surface pad to 3-ft
  4 equidistant protective posts
  Bentonite slurry 3-87-ft
- Volclay bentonite slurry 3-87-ft
- I.D. of riser pipe: [4-in]
  Type of riser pipe: Stainless steel
- Diameter of borehole,
  0-47.0-ft, 21-in nominal
  47.0-140.5-ft, 17-in nominal
  140.5-220.8-ft, 13-in nominal
  220.8-323.0-ft, 11-in nominal
  323.0-450.0-ft, 9-in nominal
- Type of filler, 87-190-ft
  Dry bentonite & bentonite slurry
- Depth top of seal: [190.0-ft]
  Type of seal: Volclay grout
- Depth top of sand pack: [410.5-ft]
  10-20-mesh silica sand
- Depth top of screen: [422.5-ft]
  4-in, stainless steel #20-slot
- Telescoping screen, 422.5-432.5-ft
  8-in stainless steel, #30 slot
- Depth bottom of screen [432.5-ft]
- Depth to bottom of borehole: [450.0-ft]

Drawing By: RXL/2W15-17.ASB Date: 19Apr93

Reference: HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

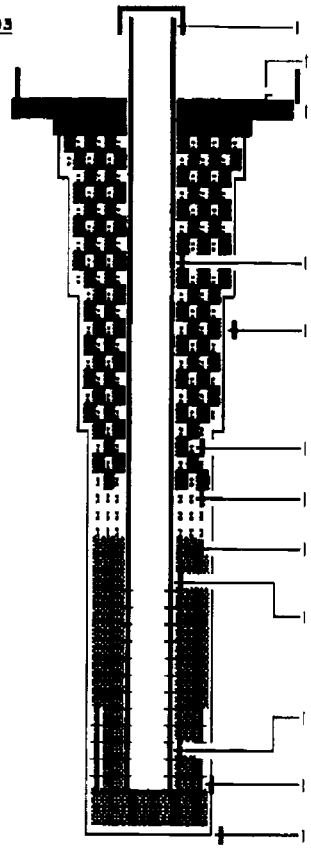
Drilling Method: Cable tool	Sample Drive barrel Method: Hard tool
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented
Driller's Name: D. Ludtke	WA State Lic Nr: Not documented
Drilling Company: Omwego Drilling Co	Company Location: Kennewick, WA
Date Started: 02Jun87	Date Complete: 29Jul87

WELL NUMBER: 299-W18-21	TEMPORARY WELL NO:
Hanford Coordinates: N/S N 37,794	E/W W 78,080
State Coordinates: N 442,895	E 2,217,148
Start Card #: Not documented	T R S
Elevation Ground surface (ft): 666.50 (Brass cap)	

Depth to water: 197.5-ft Jul87
(Ground surface) 202.7-ft 11Mar93

GENERALIZED STRATIGRAPHY Log — Geologist's Log

0-9: SAND
9-10: Sandy SILT and CLAY lens
10-20: SAND
20-22: Gravelly SAND
22-23: Silty SAND lens
23-35: SAND
35-40: Gravelly SAND
40-42: Slightly gravelly SAND
42-50: Sandy GRAVEL
50-55: Silty sandy GRAVEL
55-59: GRAVEL
59-68: Silty sandy GRAVEL
68-104: Silty SAND
104-109: Clayey silty SAND
109-124: Slightly silty SAND
124-139: Clayey/silty SAND
139-144: Silty SAND
144-164: Silty sandy GRAVEL
164-169: Sandy GRAVEL
169-174: Silty, sandy GRAVEL
174-194: Sandy GRAVEL
194-208: Gravelly silty SAND
208-210: Sandy GRAVEL
210-214: Gravelly SAND
214-227: Silty gravelly SAND



Elevation of reference point: (top of casing) [668.62-ft]

Height of reference point above ground surface [2.12-ft]

Depth of surface seal [0-186-ft]

Type of surface seal: Portland cement
4-ft x 4-ft x 6-in surface pad to 3-ft
4 equidistant protective posts
Volclay grout, 3-185.8-ft

I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel

Diameter of borehole,
0-19.2-ft, 17-in nominal
19.2-83.3-ft, 13-in nominal
83.3-165.9-ft, 11-in nominal
164.9-227-ft, 9-in nominal

Type of filler: Volclay grout

Depth top of seal: [185.8-ft]
Type of seal: Volclay pellets

Depth top of sand pack: [187.3-ft]
20-30-mesh silica sand

Depth top of screen: [195.5-ft]
4-in, stainless steel #20-slot

Depth bottom of screen: [225.5-ft]

Telescoping screen, 215.5-225.5-ft
8-in stainless steel, #30-slot

Depth bottom of borehole: [227.0-ft]

Drawing By: RKL/2W18-21.ASB Date: 19Apr93

Reference: HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: K. Olsen
Drilling Company: Omrego Drilling Co
Date Started: 12Jun87

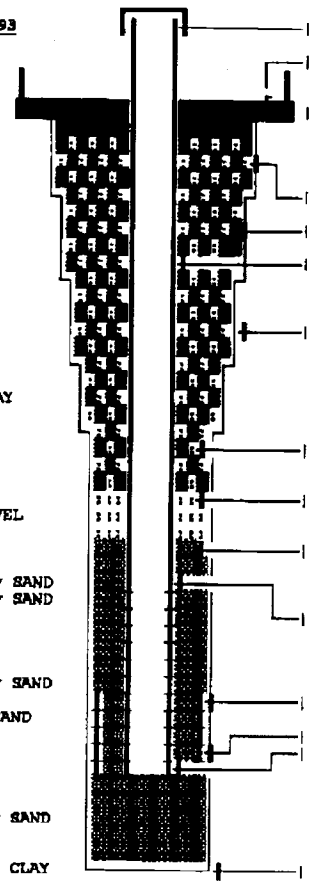
Sample Method: Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 25Sep87

WELL NUMBER: 299-W18-22
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 37,831 E/W W 78,109
State Coordinates: N 442,932 E 2,217,119
Start Card #: Not documented T R S
Elevation Ground surface (ft): 666.49 (Brass cap)

Depth to water: 199.0-ft Aug87
(Ground surface) 203.3-ft 11Mar93

GENERALIZED Geologist's STRATIGRAPHY Log

0-20: SAND
20-25: Sandy GRAVEL
25-35: Slightly silty SAND
35-40: Slightly gravelly SAND
40-45: Sandy GRAVEL
45-50: Silty sandy GRAVEL
50-55: Sandy GRAVEL
55-60: GRAVEL
60-65: Sandy GRAVEL
65-75: Slightly silty GRAVEL
75-90: Silty SAND
90-95: Sandy SILT
95-110: Sandy SILT/CLAY
110-115: Silty/clayey SAND
120-130: Sandy SILT
130-135: SILT
135-145: Gravelly sandy SILT/CLAY
145-150: Silty sandy GRAVEL
150-155: Sandy GRAVEL
155-175: Silty sandy GRAVEL
175-190: Sandy GRAVEL
190-195: Gravelly silty SAND
195-200: Silty sandy GRAVEL
200-205: Silty/clayey sandy GRAVEL
205-235: Silty sandy GRAVEL
235-245: Silty gravelly SAND
245-250: Gravelly SAND
250-255: Slightly silty gravelly SAND
255-265: Slightly gravelly silty SAND
265-275: Slightly gravelly slightly silty SAND
275-280: Slightly gravelly SAND
280-285: Gravelly SAND
285-290: Slightly gravelly silty SAND
295-305: Silty gravelly SAND
305-330: Silty/clayey gravelly SAND
330-335: Gravelly silty SAND
335-340: Gravelly SAND
340-355: Silty gravelly SAND
355-385: Gravelly silty SAND
385-415: Silty SAND
415-430: Slightly gravelly silty SAND
430-447: Silty gravelly SAND
447-450: Brownish/gray CLAY
450-455: Slightly gravelly sandy CLAY
455 : CLAY



Elevation of reference point: [668.49-ft] (top of casing)
Height of reference point above ground surface [2.00-ft]
Depth of surface seal [0-3-ft]
Type of surface seal: Concrete 4x4-ft x 6-in surface pad
4 equidistant protective posts
Dry bentonite 3-15-ft
Volclay bentonite slurry 15-189-ft
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-50.5-ft, 21-in nominal
50.5-150.1-ft, 17-in nominal
150.1-250.9-ft, 13-in nominal
250.9-342.5-ft, 11-in nominal
342.5-455.0-ft, 9-in nominal
Type of filler, 189-404-ft Bentonite grout
Depth top of seal: [404.0-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [410-ft]
10-20-mesh silica sand
Depth top of screen: [416.5-ft]
4-in, #20-slot stainless steel
Telescoping screen, top [437.5-ft]
8-in stainless steel, #30 slot
Telescoping screen, bottom [447.5-ft]
Depth bottom of screen [447.5-ft]
Depth to bottom of borehole: [455.0-ft]

Drawing By: RKL/2W18-22.ASB Date: 19Apr93
Reference: HANFORD WELLS

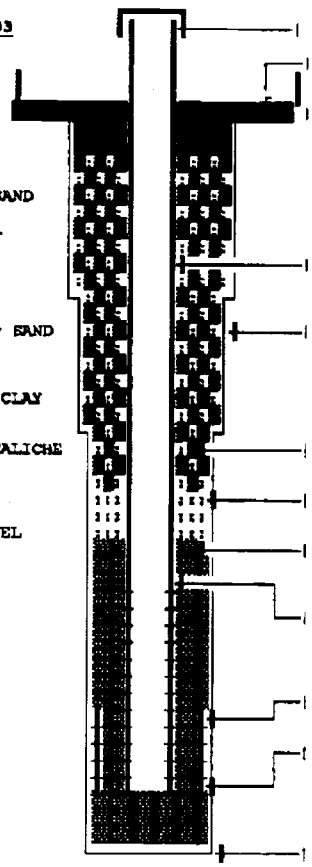
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Drive barrel Method: Hard tool	WELL NUMBER: 299-W18-23 / TEMPORARY WELL NO:
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	Hanford Coordinates: N/S N 38,987 E/W W 78,120
Driller's Name: D. Garcia	WA State Lic Nr: Not documented	State Coordinates: N 445,088 E 2,217,103
Drilling Company: Omwego Drilling Co	Company Location: Kennewick, WA	Start Card #: Not documented T ___ R ___ S ___
Date Started: 20May87	Date Complete: 01Jul87	Elevation Ground surface (ft): 694.75 (Brass cap)

Depth to water: 224.0-ft Jun87
(Ground surface) 230.6-ft 11Mar93

GENERALIZED Geologist's STRATIGRAPHY Log

0-14: Silty gravelly SAND
14-19: Gravelly SAND
19-24: Slightly silty SAND
24-34: Silty SAND
34-39: Slightly gravelly silty SAND
39-44: Silty SAND
44-49: Silty SAND w/trace GRAVEL
49-54: Silty SAND
54-59: Silty sandy GRAVEL
59-64: Silty gravelly SAND
64-109: Silty sandy GRAVEL
109-119: Gravelly silty SAND
119-129: Slightly gravelly silty SAND
129-149: Silty SAND
149-159: Sandy SILT/CLAY
159-164: SILT/CLAY w/trace SAND
164-169: Slightly gravelly SILT/CLAY and CALICHE
169-174: Slightly gravelly silty/clayey SAND and CALICHE
174-184: Silty SAND w/CALICHE
184-189: Silty sandy GRAVEL
189-234: Sandy GRAVEL
234-239: Silty gravelly SAND
239-244: Silty/clayey sandy GRAVEL
244-249: Sandy GRAVEL
249-255: Silty sandy GRAVEL
255 : Silty gravelly SAND



- Elevation of reference point: [696.81-ft] (top of casing)
- Height of reference point above ground surface [2.06-ft]
- Depth of surface seal [0-210-ft]
  Type of surface seal: Premix concrete 4-ft x 4-ft x 6-in surface pad to 3-ft 4 equidistant protective posts Volclay grout, 3-210-ft
- I.D. of riser pipe: [4-in]
  Type of riser pipe: Stainless steel
- Diameter of borehole, 0-62.3-ft, 13-in nominal; 62.3-145.5-ft, 11-in nominal; 145.5-255.0-ft, 9-in nominal
- Type of filler: Volclay grout
- Depth top of seal: [210.0-ft]
  Type of seal: Volclay pellets
- Depth top of sand pack: [215.8-ft]
  20-30-mesh silica sand
- Depth top of screen: [220.3-ft]
  4-in, stainless steel, #20-slot
- Telescoping screen, 241.0-251.0-ft 8-in stainless steel, #30-slot
- Depth bottom of screen: [251.0-ft]
- Depth bottom of borehole: [255.0-ft]

Drawing By: RKL/2W18-23.ASB Date: 19Apr93

Reference: HANFORD WELLS

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: 200 W Water Supply
Driller's Name: R. Vance
Drilling Company: Omrego Drilling Co
Date Started: 21May87

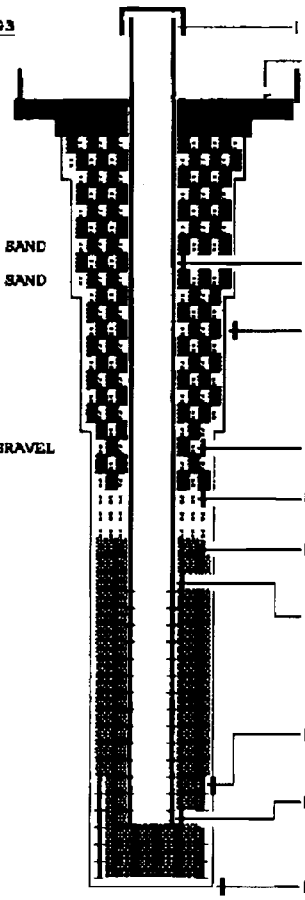
Sample Method: Drive barrel Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Kennewick, WA
Date Complete: 10Aug87

WELL NUMBER: 299-W18-24
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 38,998 E/W W 77,180
State Coordinates: N 444,102 E 2,218,045
Start Card #: Not documented T R S
Elevation Ground surface (ft): 682.18 (Brass cap)

Depth to water: 213-ft Aug87
(Ground surface) 217.6-ft 11Mar93

GENERALIZED Geologist's STRATIGRAPHY Log

0-17: Slightly silty SAND
17-20: Slightly gravelly SAND
20-38: SAND
38-45: Gravelly SAND
45-50: Slightly gravelly SAND
50-55: Slightly silty, slightly gravelly SAND
55-65: Slightly silty, gravelly SAND
65-80: SAND
80-85: Slightly silty, gravelly SAND
85-90: Slightly silty SAND
90-112: Silty SAND
112-120: Sandy GRAVEL
120-125: GRAVEL
125-135: Sandy GRAVEL
135-150: Silty SAND
150-160: Sandy GRAVEL
160-170: SAND
170-175: Sandy GRAVEL
175-190: Slightly silty, sandy GRAVEL
190-195: Sandy GRAVEL
195-205: Silty sandy GRAVEL
205-210: Sandy GRAVEL
210-215: Gravelly silty SAND
215-220: Slightly sandy GRAVEL
220-240: Sandy GRAVEL



Elevation of reference point: (top of casing) [684.35-ft]
Height of reference point above ground surface [2.2-ft]
Depth of surface seal [0-5 ft]
Type of surface seal: Portland cement
4-ft x 4-ft x 6-in surface pad
4 equidistant protective posts
I.D. of surface casing: (If present) 16-in [Removed]
I.D. of riser pipe: [4-in]
Type of riser pipe: Stainless steel
Diameter of borehole,
0-10.5-ft, 17-in nominal
10.5-70.2-ft, 13-in nominal
70.2-153.2-ft, 11-in nominal
153.2-240-ft, 9-in nominal
Type of filler: Volclay grout
Depth top of seal: [191-ft]
Type of seal: Volclay pellets
Depth top of sand pack: [198-ft]
20-30-mesh silica sand
Depth top of screen: [205.5-ft]
4-in, #20-slot
stainless steel
Telescoping screen, 230.0-240.0-ft
8-in, 10-slot, stainless steel
Depth bottom of screen: [235.5-ft]
Depth bottom of borehole: [240 ft]

Drawing By: RKL/2W18-24.ASB Date: 19Apr93
Reference: HANFORD WELLS

WELL SUMMARY SHEET

Borehole or Well No. 299-W15-314

Sheet 1 of 2

Location West of 231-Z Bldg.

Project 200-ZP-1 Pump/Treat Wells

Prepared By Mark Durrach / Mark Durrach (Sign/Print Name) Date 6/8/95

Reviewed By G. Kelty / G. Kelty (Sign/Print Name) Date 6/19/95

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
8" carbon steel permanent casing from 0'-206.49		5 5	NOTE: THIS WELL WAS NOT LOGGED DUE TO ITS PROXIMITY TO THE 299-W15-31 WELL. PLEASE REFER TO RECORDS FOR THE 31 WELL FOR LITHOLOGIC DATA	See 299-W15-31 Well for lithologic data.
Portland Cement 0'-13'		10 10		
		15 15		
Bentonite Crumbles 13'-203.90'		20 20		
		25 25		
12.75" hole from carbon steel threaded temporary casing/shoe		30 30		
		35 35		
		40 40		
		45 45		
		50 50		
		55 55		
		60 60		
		65 65		
		70 70		
		75 75		
		80 80		
		85 85		
		90 90		
		95 95		
		100 100		
		105 105		
		110 110		
		115 115		
		120 120		
		125 125		
		130 130		
		135 135		
		140 140		
		145 145		
		150 150		
		155 155		
		160 160		

A-6000-384 (01/95)

WELL SUMMARY SHEET

Boring or Well No. 299-W15-31A

Sheet 2 of 2

Location: West of 231Z Bldg.

Project: 200-ZP-1 Pump/Treat Wells

Prepared By: Mark Darnell / Mark Darnell (Sign/Print Name) Date: 6/9/95

Reviewed By: K. Kelly / K. Kelly (Sign/Print Name) Date: 6/19/95

CONSTRUCTION DATA		Depth in Feet	GEOLOGIC/HYDROLOGIC DATA	
Description	Diagram		Graphic Log	Lithologic Description
		165		
		170		RECORD COPY
		175		
		180		
		185		
		190		
		200		
Bentonite Pellets 203.8 → 207.1		205		
6" stainless steel 6.99' blank from		210		
206.49 – 212.48		215		Static Water Level @ 215.6' 8/26/95
.020 continuous wrap stainless		220		
steel screen 212.48 → 252.41		225		
10-20 mesh silica sand pack from		230		
207.1 → 258.64		235		
		240		
		245		
		250		
Stainless steel end cap 252.41 – 257.92		255		
slough 258.64 → 259'		260		
drilled depth 269.0'			SEE WELL 299-W15-31 FOR LITHOLOGIC INFORMATION	THE 31A WELL WAS NOT LOGGED DUE TO PROXIMITY TO 31

A-6000-384 (01/93)

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool
Drilling Fluid Used: Water
Driller's Name: H. Osborn/K. Smith
Drilling Company: Not documented
Date Started: 17Nov58

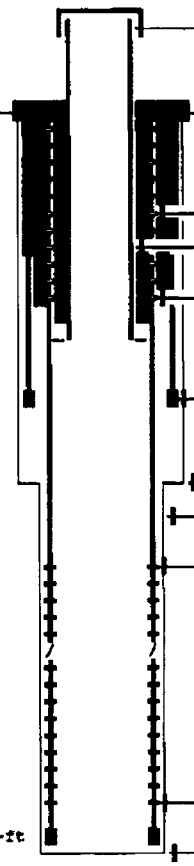
Sample Method: Drive barrel
Hard tool
Additives Used: Not documented
WA State Lic Nr: Not documented
Company Location: Not documented
Date Complete: 12Jan59

WELL NUMBER: 299-W18-1
TEMPORARY WELL NO:
Hanford Coordinates: N/S N 39,388 E/W W 77,013
State Coordinates: N 444,492 E 2,218,211
Start Card #: Not documented T R S
Elevation Ground surface (ft): 677.4 Estimated

Depth to water: 209-ft Dec58 (Ground surface)

GENERALIZED STRATIGRAPHY — Driller's Log

0-34: SAND
34-40: SAND and COBBLESTONES
40-45: BOULDERS-SAND and GRAVEL
45-104: SAND
104-124: SAND and GRAVEL
124-133: Brown SILT
133-140: GRAVEL and SAND
140-146: COBBLESTONES-GRAVEL & SAND
146-170: SAND
170-184: SILT-BOULDERS
184-187: SAND
187-195: SAND & GRAVEL
195-205: GRAVEL & SAND
205-215: COBBLESTONES-BOULDERS SAND & GRAVEL
215-220: BOULDERS & SAND
220-235: BOULDERS & CLAY
235-255: COBBLESTONES-GRAVEL & CLAY
255-265: Sandy CLAY & GRAVEL
265-281: GRAVEL & sandy CLAY
281-282: SAND
282-295: COBBLESTONES & SAND
295-300: SAND
300-305: COBBLESTONES & SAND
305-309: BOULDERS-SAND-CLAY
309-311: SAND
311-325: COBBLESTONES-SAND-GRAVEL and a little CLAY
325-327: BOULDERS, CLAY & GRAVEL
327-328: SAND
328-337: BOULDERS, CLAY and SAND
337-342: Reddish brown CLAY
342-345: GRAVEL & SAND
345-356: COBBLESTONES, SAND & CLAY
356-357: SAND
357-360: COBBLESTONES, & CLAY
360-381: GRAVEL, SAND & CLAY
381-389: SAND
389-408: CLAY-GRAVEL & SAND
408-423: Sandy SILT
423-427: GRAVEL, SAND & CLAY
REMEDIATION: 05-06Jun67, by Hatch
Cleaned well and set screen 371-427-ft
Screen plugged @ 422-ft.
26Jul67, by Hatch - Pulled screen



Elevation of reference point: [680.00-ft] (top of casing)
Height of reference point above ground surface [2.6-ft]
Depth of surface seal [ND]
Type of surface seal: None documented
I.D. of riser pipe: [8-in]
HANFORD WELLS documents 6-in liner to 139-ft, grouted. Installation not otherwise documented.
Perforation not documented, assumed
Type of riser pipes: All carbon steel
10-in casing pulled back from 165-ft. Casing parted. Bottom @ 147-ft, top @ 72-ft
11-in nominal hole to ~165-ft
Borehole diameter, 165-427-ft [9-in nom]
Depth to top of perforations: [195-ft]
Description of perforations: 195-236-ft, 6 holes/ft; 8-in casing parted @ 238-ft; 240-425-ft, 6 holes/ft
Depth bottom of perforations: [425-ft]
Depth bottom of perforations: [427.0-ft]
Depth bottom of borehole: [427.0-ft]

Drawing By: RKL/2W18-01.ASB Date: 19Apr93
Reference: HANFORD WELLS

Note: Depth to bottom measured 369.7 feet below top of casing in October 1999.

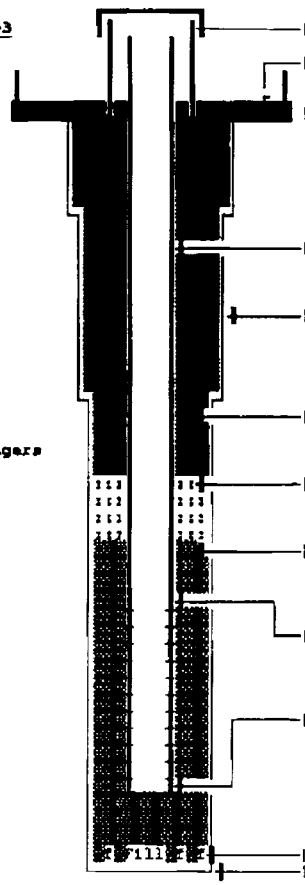
WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method: Cable tool	Sample Method: Drive barrel	WELL NUMBER: 299-W18-31
Drilling Fluid Used: 200 W Water Supply	Additives Used: Not documented	TEMPORARY WELL NO:
Driller's Name: H. Baker	WA State Lic Nr: Not documented	Hanford Coordinates: N/S N 38,105.3 E/W W 76,032.1
Drilling Company: Kaiser Engineers	Company Location: Hanford	State NAD83 N 135,075.47m E 566,721.83m
Date Started: 06Sep91	Date Complete: 11Dec91	Coordinates: N 443,212 E 2,219,195
		Start Card #: Not documented T R S
		Elevation Ground surface (ft): 660.73 (Brass cap)

Depth to water: 181.2-ft Dec91
(Ground surface) 185.4-ft 26Mar93

GENERALIZED Geologist's STRATIGRAPHY Log
Sl=slightly

0-5: Gravelly silty SAND
5-10: Sl silty SAND
10-20: Gravelly silty SAND
20-25: Silty sandy GRAVEL
25-30: Sl silty SAND
30-35: Silty SAND
35-45: Sl silty SAND
45-50: SAND
50-55: Silty SAND
55-60: Sl silty gravelly SAND
60-65: SAND
65-70: Sl silty SAND
70-75: Silty SAND
75-80: SAND
80-85: Silty SAND
85-95: Sl silty SAND
95-110: Silty SAND
110-118: Sl silty SAND
118-119: CLAY, calcareous
119-130: Silty SAND w/CLAY stringers
130-131: CALICHE
131-132: Silty GRAVEL
132-140: Silty gravelly SAND
140-155: Silty sandy GRAVEL
155-160: GRAVEL
160-180: Sandy GRAVEL
180-200: Silty sandy GRAVEL
200-210: GRAVEL
210-220: Silty sandy GRAVEL
220-227.6: Sandy GRAVEL



Elevation of reference point: [664.16-ft]
(top of casing)

Height of reference point above ground surface [3.43-ft]

Depth of surface seal [2.0-18.0-ft]

Type of surface seal: Pre-mix concrete
4x4-ft x 6-in surface pad
4 equidistant protective posts
Cement grout 2.0-18.0-ft

I.D. of riser pipe: [4-in]
Type of riser pipe:
Stainless steel

Diameter of borehole,
0-19.0-ft, 13-in nominal
19.0-127.4-ft, 11-in nominal
127.4-227.6-ft, 9-in nominal

Type of filler, 18.0-178.8-ft
8-20-mesh bentonite crumbles

Depth top of seal: [178.8-ft]
Type of seal:
3/8-in bentonite pellets

Depth top of sand pack: [181.5-ft]
20-40-mesh silica sand

Depth top of screen: [187.3-ft]
4-in, #10-slot, continous wrap
T304 stainless steel with
filter pack

Depth bottom of screen: [222.3-ft]

Fill, 226.0-227.6-ft
Depth to bottom of borehole: [227.6-ft]

Drawing By: RKL/2W18-31.ASB Date: 19Apr93

Reference:

0540435

WELL CONSTRUCTION AND COMPLETION SUMMARY

Drilling Method:	Cable Tool/Air Rotary	Sample Method:	Grab/Split Spoon	WELL NUMBER:	299-W18-40 C3385
Drilling Fluid Used:	Air/None	Additives Used:	None	TEMPORARY WELL NO:	Not Allowed
Driller's Name:	G. Howell, K. Olsen, M. Gomez	WA State Lic Nr:	1930, 1217, NA	Coordinates: N	Not documented
Drilling Company:	RSI	Company Location:	Woodland, Ca.	Coordinates: E	Not documented
Date Started:	13Aug01	Date Completed:	28Sep01	Start Card #:	R037815
				Elevation Ground Surface:	

Depth to Water: 214.6 ft 27Sep01
(Ground surface)

Elevation of Reference Point: na

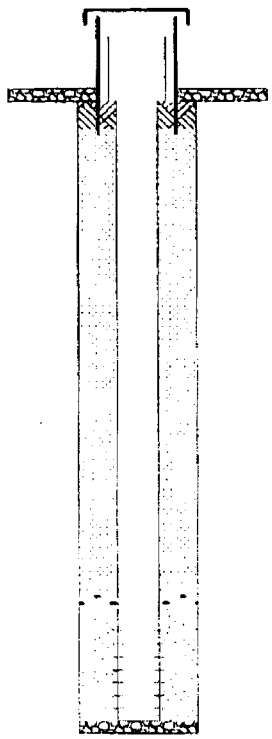
Height of Reference Point Above Ground Surface:

Depth of Surface Seal: 11.6 ft

Type of Surface Seal: 4x4 Concrete Pad

GENERALIZED STRATIGRAPHY Geologist's Log

0 - 10 ft : Fill Material
10 - 17 ft : Silty Sandy Gravel (msG)
17 - 19 ft : Gravelly Sand (Gs)
19 - 23 ft : Sandy Gravel (sG)
23 - 27 ft : Slightly Silty Sandy Gravel
27 - 30 ft : Silty Sand (mS)
30 - 47 ft : Sand (S)
47 - 53 ft : Silty Sandy Gravel (msG)
53 - 56 ft : Gravelly Sand (gS)
56 - 69.5 ft : Silty Sandy Gravel (msG)
69.5 - 119 ft : Sand (S) w/silt layer at 81 ft
119 - 132.5 ft : Sandy Silt (sM)
132.5 - 138 ft : Silty Sandy Gravel with caliche
138 - 144 ft : Silty Sandy Gravel (msG)
144 - 180 ft : Sandy Gravel (sG)
180 - 220.5 ft : Silty Sandy Gravel (msG)
220.5 - 222.5 ft : Cemented Silty Sandy Gravel
222.5 - 250 ft : Silty Sandy Gravel (msG)
250 - 252.5 ft : Cemented Silty Sandy Gravel
252.5 - 260 ft : Silty Sandy Gravel (msG)



Fill	*Casing*	*Screen*
0 - 11.6 ft : 11-inch hole Cement Surface Seal	0 - 218.27 ft : 4 inch 304L SS sch 5 csg	
11.6 - 202 ft : 11-inch hole Granular Bentonite		
202 - 207.8 ft : 11-inch hole Bentonite Pellets		218.27 - 253.28 ft : 4 inch 304L SS Wire Wrap .020 slot scrn
207.8 - 255.28 ft : 11-inch hole 10/20 Silica Sand		
255.28 - 260 ft : 11-inch hole Slough	253.28 - 255.28 ft : 4 inch 304L SS Sump	

260 ft : Borehole drilled depth

0 - 260 ft : 11-in. Temp 10-3/4" CS csg drl to 147' w/Cable Tool, advanced to 176 w/Air Rotary, Cable Tooled to 260 ft.

Drawing By: JEA
Reference: Hanford Wells
Revision: 0
Revision Date: 18Oct01
Print Date: 08Nov01

Report Form: WELLS Project File: WELLS.GPJ

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APPENDIX 5D

MONITORING EFFICIENCY MODEL OUTPUT

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APPENDIX 5D

MONITORING EFFICIENCY MODEL OUTPUT

This appendix provides results of computer modeling used as one tool to evaluate the theoretical spatial coverage provided by the existing well network and to optimize well coverage under different groundwater flow scenarios. Hydrologic data summarized in Section 5.3 was used as input to the model.

5D.1 Model Description

The model is a numerical tool referred to as the MEMO, which was developed to assist in design of monitoring well networks (Wilson et. al. 1992). The model uses a two-dimensional plume generation routine to compute the size and shape of a plume from hypothetical source locations uniformly distributed within a source area (i.e., waste management area). The model assumes the contaminant is released as a continuous line source into a uniform or homogeneous aquifer. If a contaminant occurrence is more of a short-term transient event, there is likelihood to overstate the computed monitoring efficiency because less lateral spreading will occur than with a continuous release source.

Major input parameters include groundwater flow direction, longitudinal and transverse dispersivities, velocity, buffer zone, and well locations. The X-Y coordinates are entered to define well locations, the waste management area boundary, and the buffer zone. The buffer zone is used to allow the hypothetical plume to expand to some point beyond the source area boundary. The farther away the buffer boundary is set, the greater the lateral spreading that will occur in the vicinity of the line of compliance where the wells are located. Thus, there is a trade off between number of wells needed to eliminate areas of non-coverage and the elapsed time when a contaminant plume would be detected. With a narrow buffer zone (boundary set close to the well locations), detection of hypothetical contaminant plumes would occur earlier but requires more wells.

5D.2 Simulations

Longitudinal and transverse dispersivities, the parameters that control the extent of plume spreading, were estimated based on results of evaluations from the 200 West and 200 East Areas as well as other non-Hanford sites with similar aquifer types.[1] Dispersivity is directly related to the scale of interest, and most of the studies evaluated areas larger than the LLBG. The researchers plotted dispersivity values from these studies versus scale of measurement on a log-lot plot. The researchers identified a linear relationship and fitted lines to the data, giving more weight to the site-specific data. Researchers were able to extrapolate transverse and longitudinal dispersivity values for the scale of interest of the LLBG, assumed to be 1,000 feet (305 meters).

Other input parameters and the values used for the computer iterations are defined as follows:

- X-Y coordinates: State Plane, meters

[1] Golder Associates. 1990. Low-level Waste Burial Grounds RCRA Part B Permit Application, Section 5: Groundwater Monitoring, 903-1201, Prepared for SAIC, Richland, Washington, by Golder Associates Inc., Redmond (Seattle), Washington.

- C_D/C_0: Dilution contour where C_D is the detection standard selected as the limiting concentration to be detected by a monitoring well, and C_0 is the source concentration in groundwater at the location of origin within the WMA. To provide adequate early warning of a release, the model should be based on a dilution contour for the more mobile potential contaminants at the site. A dilution contour of 0.001 was chosen for this evaluation (Golder Associates 1990, page 99)

- ldisp. Longitudinal dispersivity, meters. A value of 8.5 meters was used based on various studies on and off the Hanford Site (Golder Associates 1990, page 102)

- tdisp. Transverse dispersivity, meters. A value of 2.4 meters was used based on various studies on and off the Hanford Site (Golder Associates 1990, page 102)

- diffc. Effective molecular diffusion coefficient (insignificant for this application so set to zero)

- source width, meters. The length in meters of the initial source dimension (modeled as a line source of the same length spaced evenly over the entire source area). A line source length of 6 meters was used. Although larger widths might be justified to simulate a larger release, the 6-meter width is considered to be conservative (i.e., a source that starts with a wider cross section will spread to a greater width at the point of compliance and would result in the need for fewer wells to provide full coverage).

- lmb. First order decay constant. This term was set to zero because decay is negligible.

5D.2.1 Low-Level Waste Management Area 1

Figure 5D-1 shows results of MEMO using the proposed final-status network for this waste management area. The shaded areas indicate hypothetical source areas that would not be detected by the network. Monitoring efficiency is estimated at 96% with most of the undetected areas along the boundaries where there is no waste in place.

5D.2.2 Low-Level Waste Management Area 2

Low-Level Waste Management Area 2 has a lower efficiency, 58% (Figure 5D-2). The northern part of this waste management area is unmonitored because there is no unconfined aquifer in that area (basalt is above the water table). A portion of the southwestern Low-Level Waste Management Area 2 also is unmonitored, but there is no waste currently in that area.

5D.2.3 Low-Level Waste Management Area 3

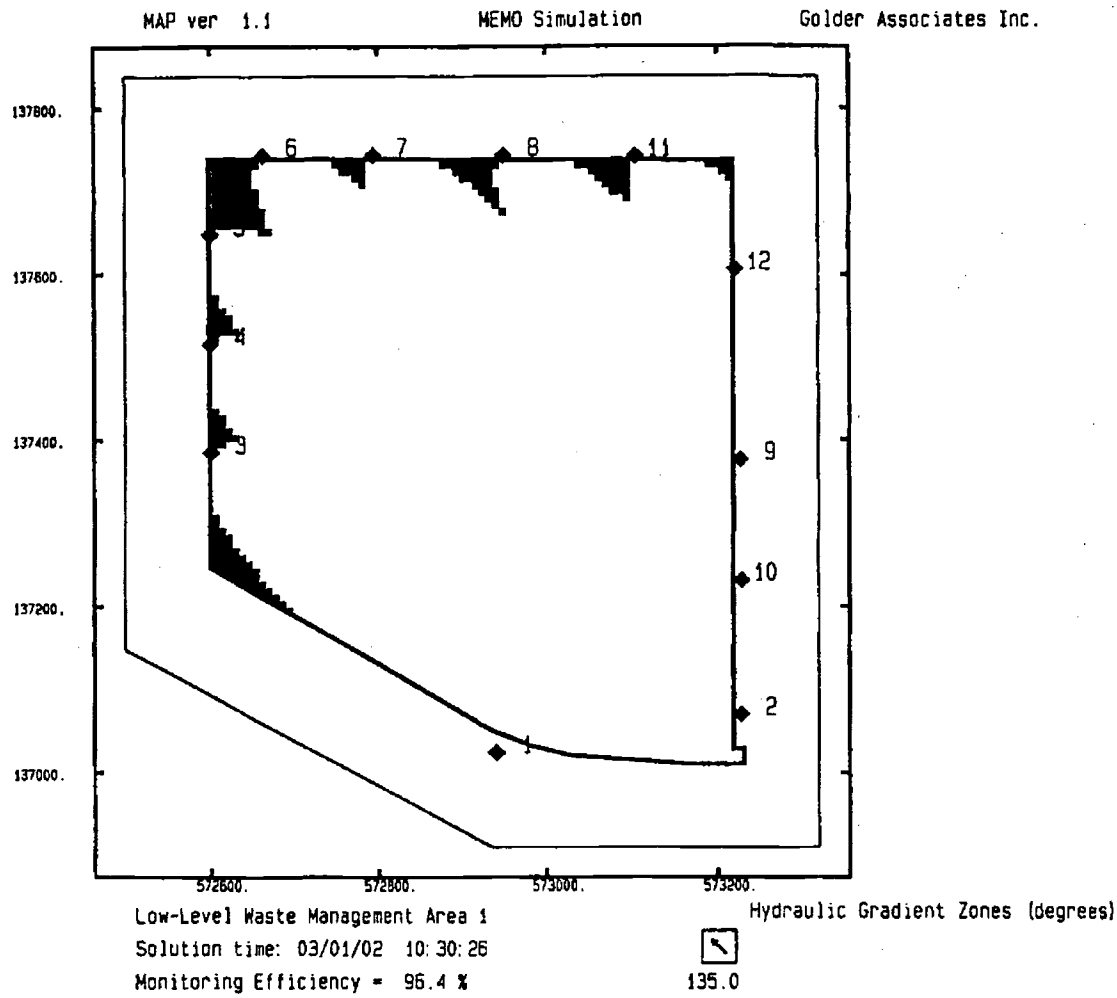
Figure 5D-3 shows MEMO output for Low-Level Waste Management Area 3 using existing wells and assuming groundwater flow toward the east-northeast (current flow). Monitoring efficiency is only 65%. Figure 5D-4 shows the same network with flow toward the east (expected future flow). Efficiency decreases to 56%.

Figure 5D-5 shows MEMO output using the proposed monitoring network, including 13 new wells for Low-Level Waste Management Area 3 with a groundwater flow toward the east-northeast. Figure 5D-6 shows the same network with flow toward the east. Monitoring efficiency increases from ~90% to ~98% as flow shifts to the east.

5D.2.4 Low-Level Waste Management Area 4

Figure 5D-7 shows that using the existing wells for Low-Level Waste Management Area 4, monitoring efficiency is only 19%. Adding four existing wells that are located downgradient of the site, the coverage increases to 72% (Figure 5D-8). Using the proposed network of existing wells and 10 new wells (without the supplemental wells), monitoring efficiency is ~98% (Figure 5D-9).

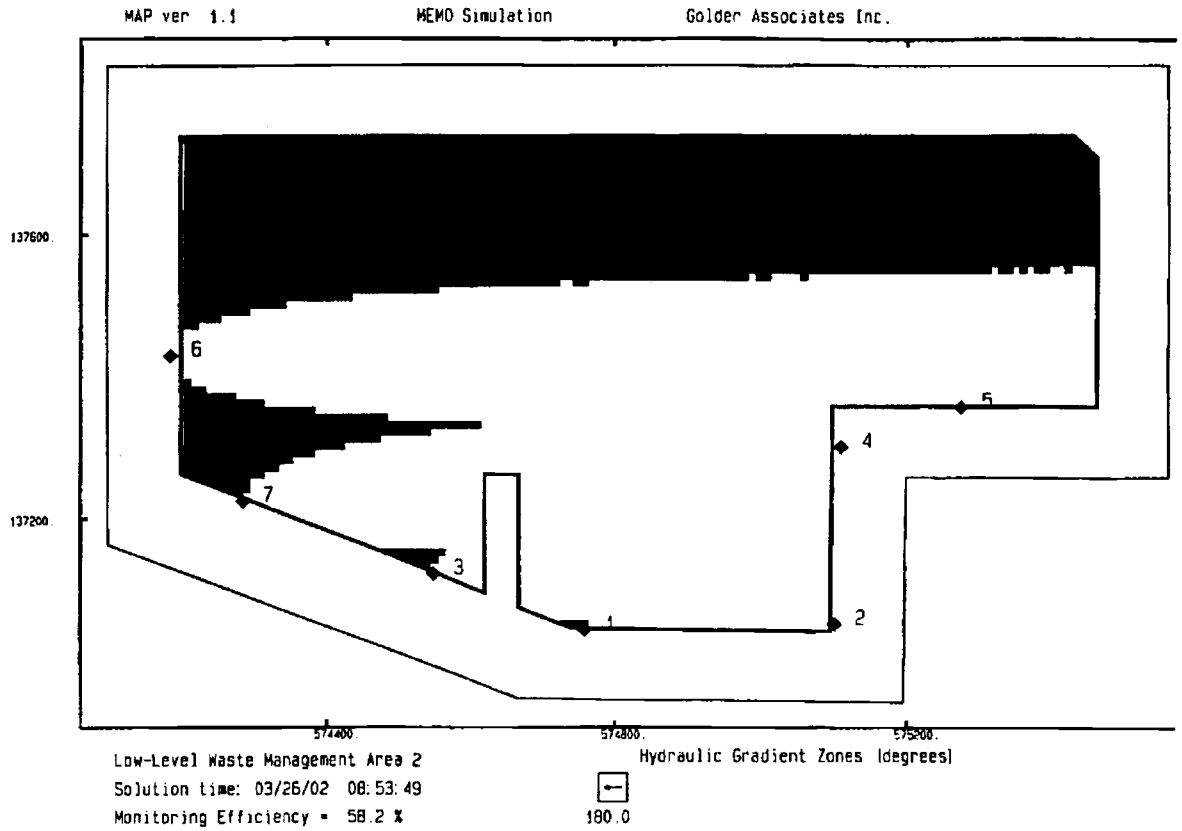
These simulations assume a downgradient buffer boundary width of about 100 meters downgradient of the line of compliance, except for Figure 5D-8. In that case, the buffer zone was expanded to 200 meters to encompass the supplemental wells.



Well numbers on figure correspond to actual well numbers as follows:

1	299-E28-26	7	299-E32-9
2	299-E28-27	8	299-E32-10
3	299-E32-3	9	299-E33-28
4	299-E32-6	10	299-E33-29
5	299-E32-7	11	299-E33-34
6	299-E32-8	12	299-E33-35

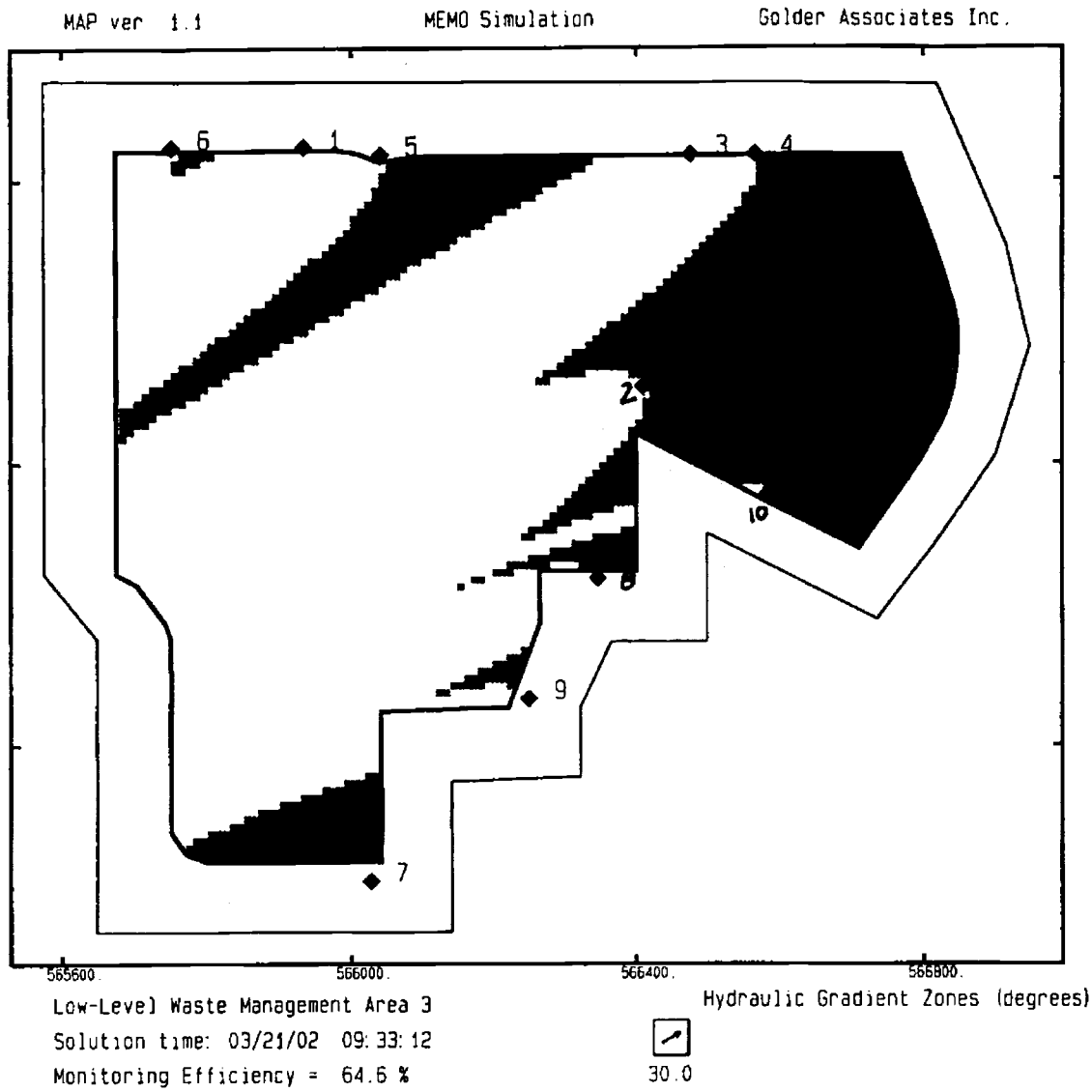
Figure 5D-1. MEMO Results for Low-Level Waste Management Area 1 Proposed Network.



Well numbers on figure correspond to actual well numbers as follows:

1	299-E27-8	5	299-E34-7
2	299-E27-10	6	299-E34-9
3	299-E27-17	7	299-E34-10
4	299-E34-3		

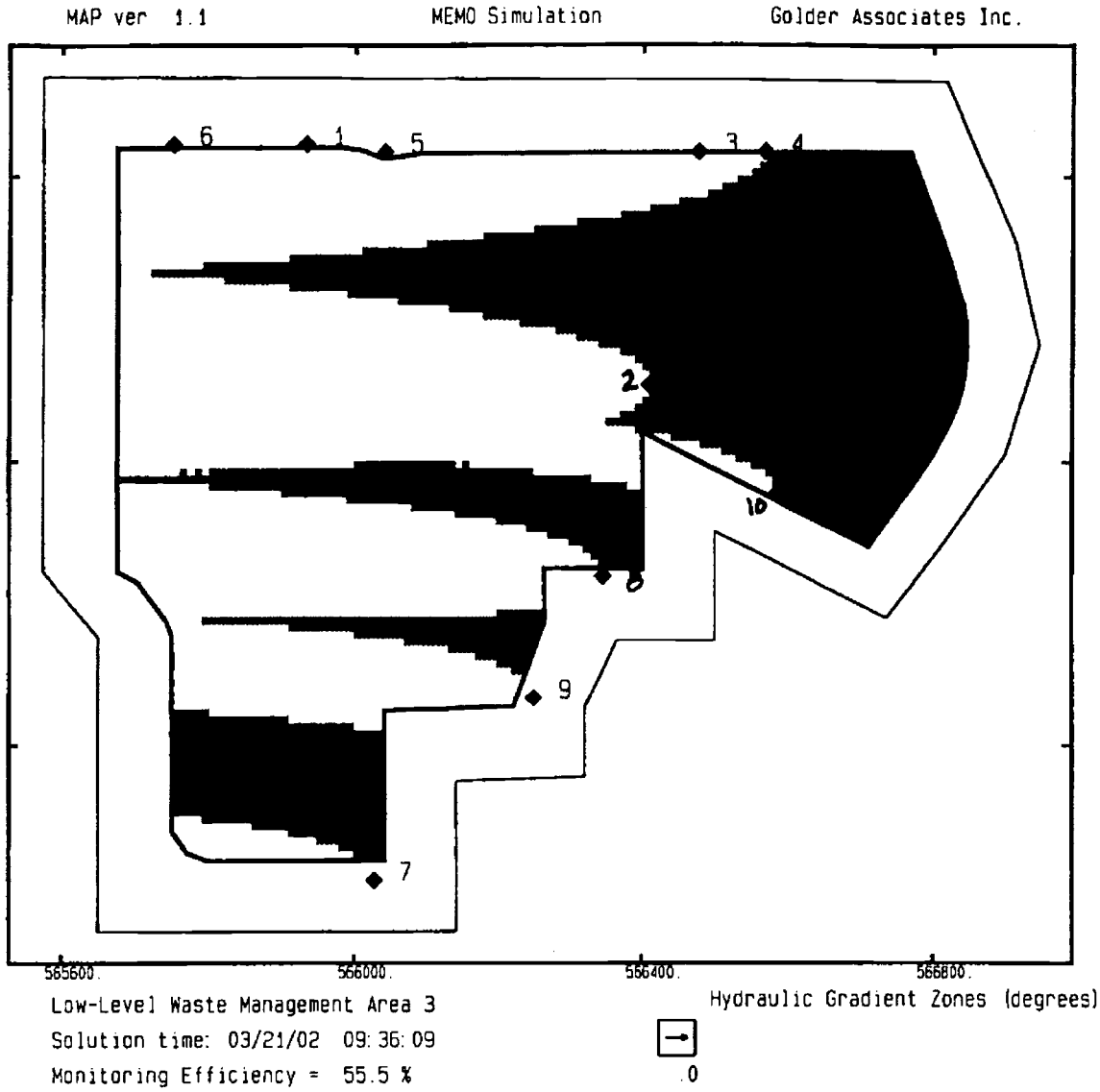
Figure 5D-2. MEMO Results for Low-Level Waste Management Area 2 Proposed Network.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W7-1	6	299-W8-1
2	299-W7-4	7	299-W10-14
3	299-W7-5	8	299-W10-19
4	299-W7-7	9	299-W10-20
5	299-W7-12	10	299-W10-21

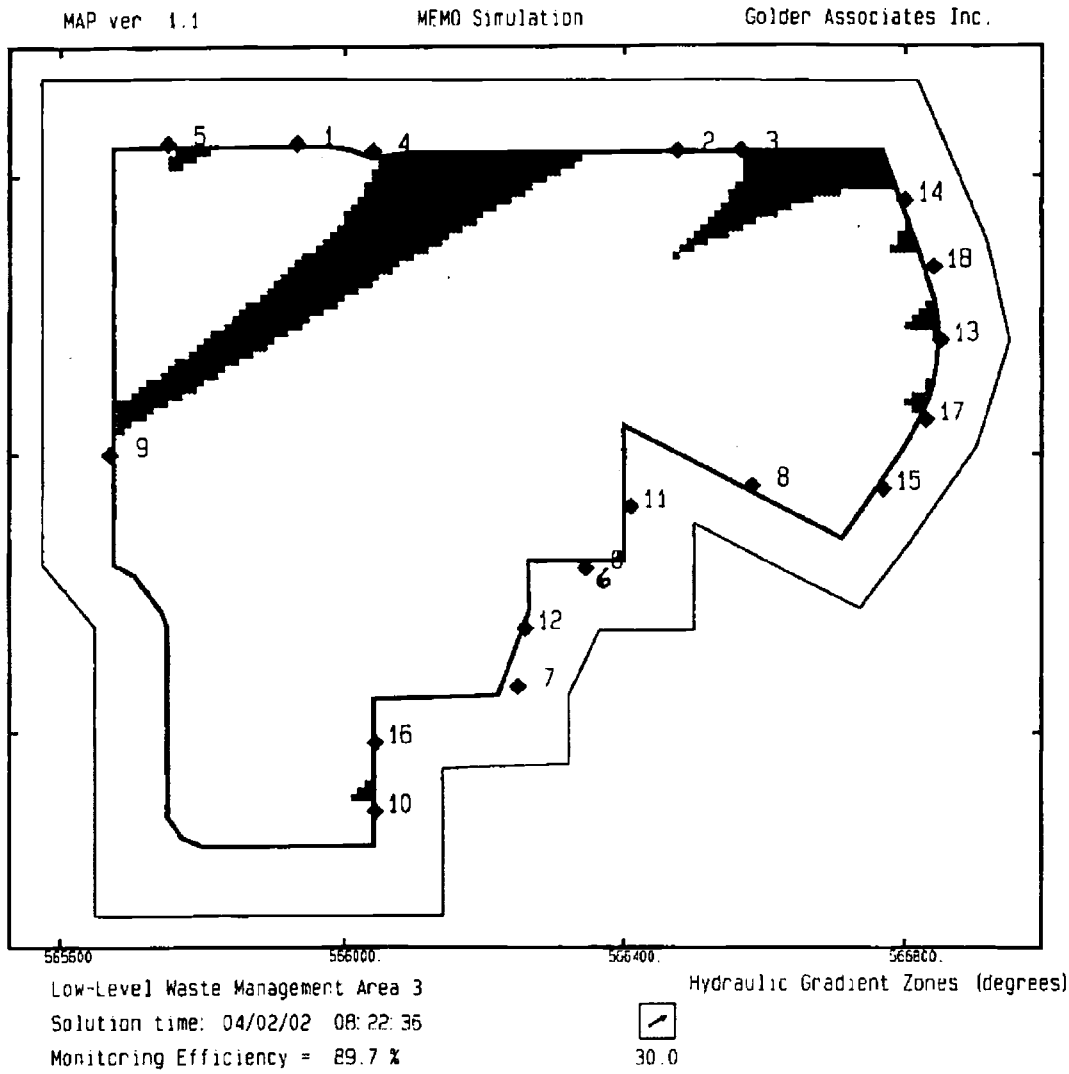
Figure 5D-3. MEMO results for Low-Level Waste Management Area 3 using existing wells and flow to the east-northeast.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W7-1	6	299-W8-1
2	299-W7-4	7	299-W10-14
3	299-W7-5	8	299-W10-19
4	299-W7-7	9	299-W10-20
5	299-W7-12	10	299-W10-21

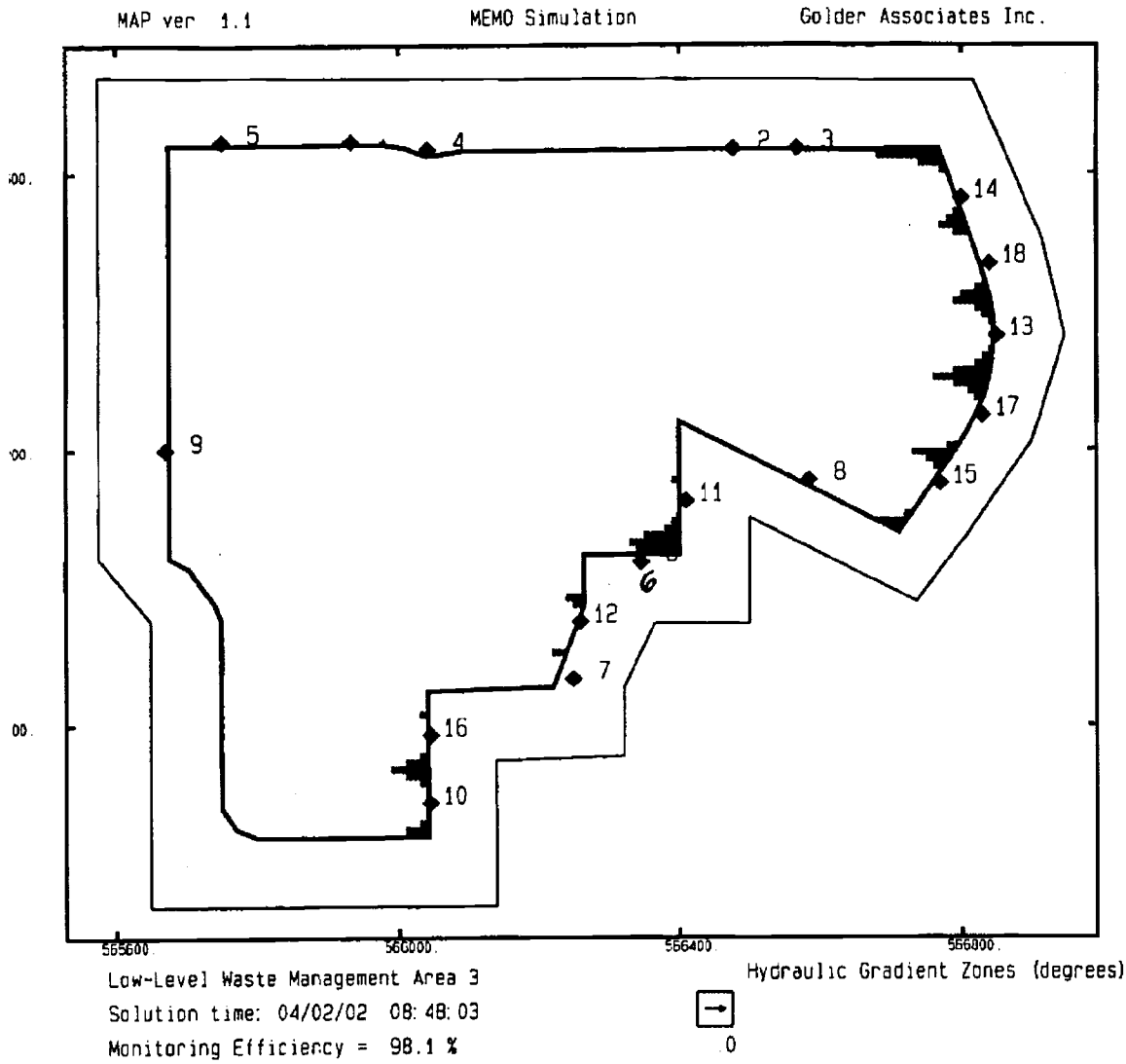
Figure 5D-4. MEMO results for Low-Level Waste Management Area 3 using existing wells and flow to the east.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W7-1	6	299-W10-19 (or replacement)
2	299-W7-7 (or replacement)	7	299-W10-20
3	299-W7-5 (or replacement)	8	299-W10-21
4	299-W7-12	9	new upgradient
5	299-W8-1	10-18	new downgradient

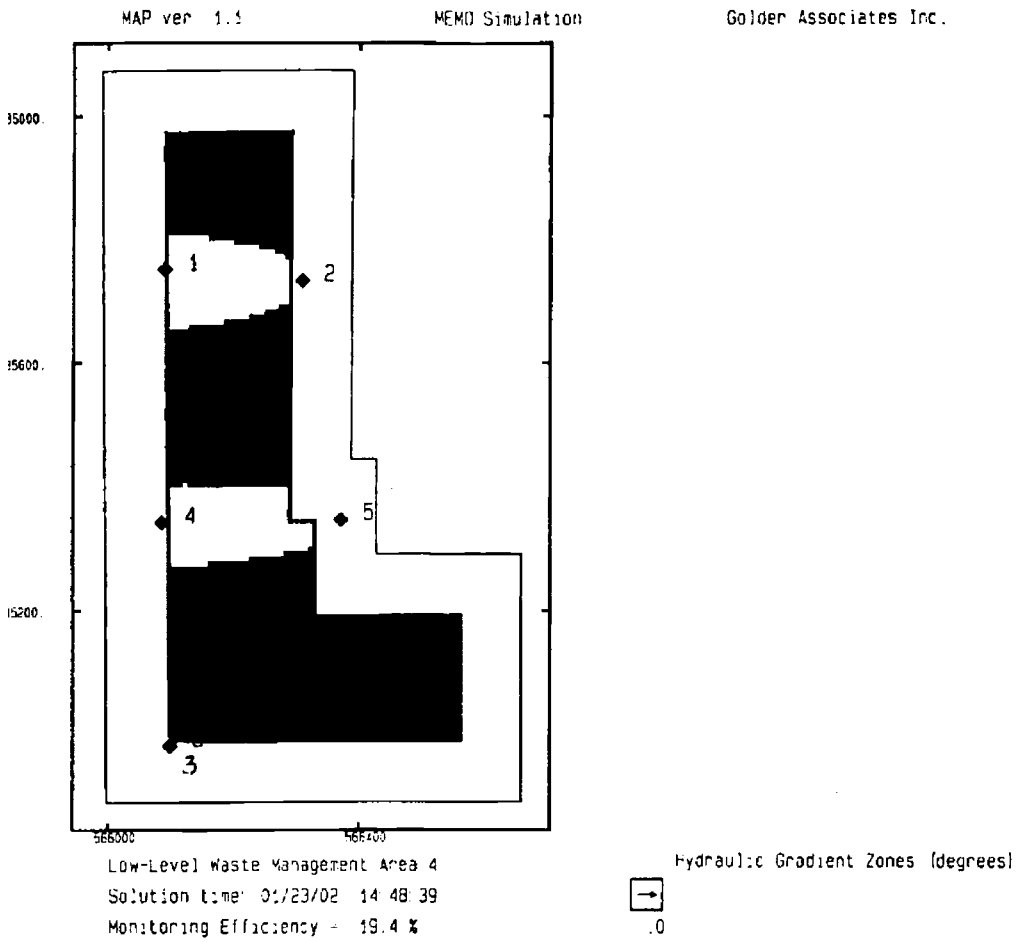
Figure 5D-5. MEMO results for Low-Level Waste Management Area 3 using proposed network (including new wells) with flow to east-northeast. Wells 2, 3, and 6 will be replaced if they go dry.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W7-1	6	299-W10-19 (or replacement)
2	299-W7-7 (or replacement)	7	299-W10-20
3	299-W7-5 (or replacement)	8	299-W10-21
4	299-W7-12	9	new upgradient
5	299-W8-1	10-18	new downgradient

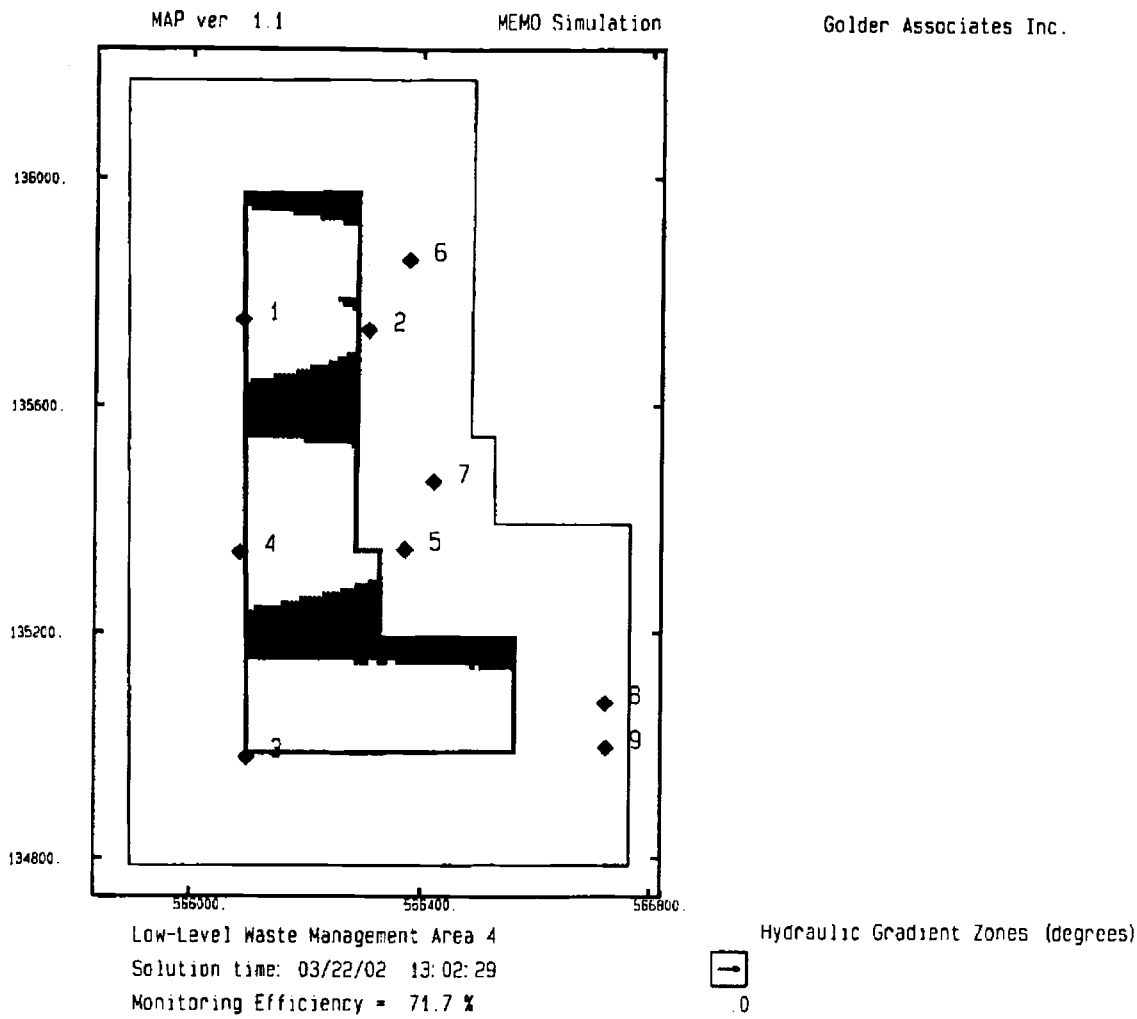
Figure 5D-6. MEMO results for Low-Level Waste Management Area 3 using proposed network (including new wells) with flow to east.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W15-15	4	299-W18-23
2	299-W15-16	5	299-W18-24
3	299-W18-21		

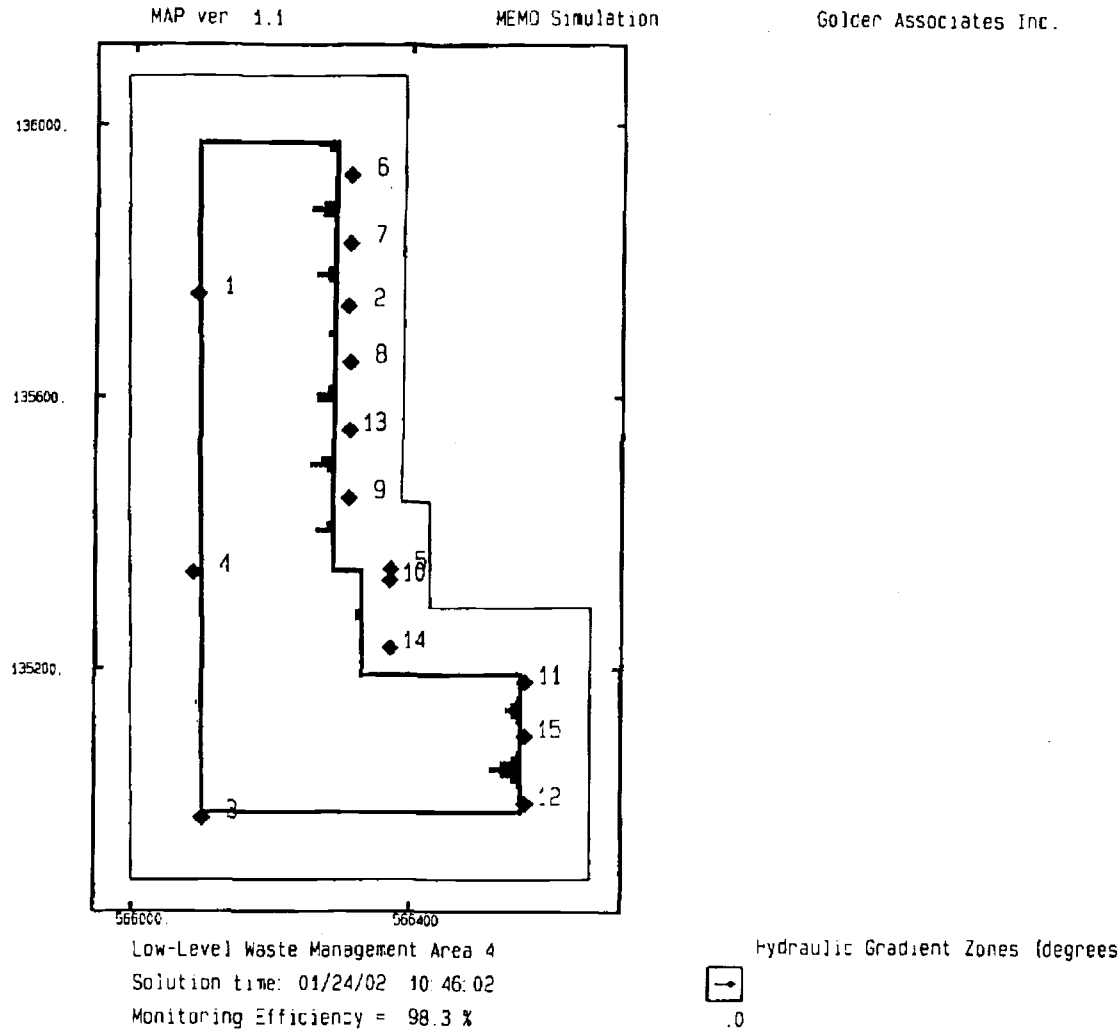
Figure 5D-7. MEMO results for Low-Level Waste Management Area 4 using existing wells.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W15-15	6	299-W15-31A
2	299-W15-16	7	299-W18-1
3	299-W18-21	8	299-W18-31
4	299-W18-23	9	299-W18-40
5	299-W18-24		

Figure 5D-8. MEMO results for Low-Level Waste Management Area 4 using existing wells and supplemental wells.



Well numbers in this figure correspond to the following Hanford well numbers.

1	299-W15-15	4	299-W18-23
2	299-W15-16	5	299-W18-24
3	299-W18-21	6-15	new downgradient

Figure 5D-9. MEMO results for Low-Level Waste Management Area 4 using proposed network (including 10 new wells).

APPENDIX 5E

LETTER FROM WASHINGTON STATE DEPARTMENT OF ECOLOGY

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APPENDIX 5E

LETTER FROM WASHINGTON STATE DEPARTMENT OF ECOLOGY

This appendix consists of a copy of a letter from Dib Goswami, Washington State Department of Ecology, to Marvin Furman, U. S. Department of Energy, Richland Operations Office, dated May 7, 2001. The subject of the letter is "Statistical Assessment for the 300 Area Resource Conservation and Recovery Act of 1976 (RCRA) Ground Water Monitoring Plan." Guidance provided in this letter also is applicable to the choice of statistical evaluation methods for the LLBG.

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1315 W. 4th Avenue • Kennewick, Washington 99336-6018 • (509) 735-7581

May 7, 2001

Mr. Marvin Furman
U.S. Department of Energy
Richland Operations Office
P.O. Box 550, MSIN A5-13
Richland, Washington 99352

Dear Mr. Furman:

Re: Statistical Assessment for the 300 Area Resource Conservation and Recovery Act of 1976 (RCRA) Ground Water Monitoring Plan

The Washington State Department of Ecology (Ecology) has evaluated the proposal presented by the United States Department of Energy (USDOE) requesting "variance" from applying interim status regulations at B-Pond and other Treatment, Storage, and Disposal (TSD) units, and their request to apply the Shewhart-CUSUM control limits for the 300 Area Process Trenches (APT). The purpose of this letter is to present regulatory guidance regarding the proposed "variance" from applying interim status regulations and to denote the requirements for achieving acceptable control limits for the 300 APT. This letter does not negate the current status of the site, but allows for variance.

B-Pond - "Variance" from applying interim status regulations. The following guidance is provided to the USDOE regarding the request for "variance" from applying interim status regulations for the RCRA monitoring network at B Pond monitored under interim indicator evaluation status. The appropriate indicators of ground-water contamination and statistical evaluation methods will be proposed by Pacific Northwest National Laboratory (PNNL) and submitted for approval by Ecology on a case-by-case basis.

The following criteria must be met prior to receiving approval of a variance from applying interim status regulations.

1. Identification of appropriate indicators of ground-water contamination and suitable statistical evaluation methods will be achieved by utilizing best professional judgement (i.e., waste source terms, conceptual models), expertise, and site-specific knowledge to: (a) determine the best technical approach based on hydrogeology and (b) tailor statistical approach to each individual site as necessary (i.e., consider type of monitoring, the nature of the data, the proportions of non-detects, spatial and temporal variations in the selection of appropriate statistical methods). A list of the appropriate indicators will be provided to Ecology for approval prior to implementation of the proposed plan.

Mr. Marvin Furman
May 7, 2001
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2. The selection of quality background data and data sets for identification of an appropriate baseline period. Once baseline data has been obtained, outliers will be properly addressed to avoid substantial bias in the statistical analysis.

3. American Society for Testing and Materials (ASTM) guidance will be utilized for circumstances regarding non-detects and outliers.

4. The utilization of probability plots in order to maintain normal distribution of data.

5. Input parameter values (e.g., k, h, and SCL) will be proposed and submitted to Ecology for approval prior to implementation of this plan.

6. Variance from applying interim status requirements for the RCRA monitoring network at B Pond and other TSD units currently monitored under interim indicator evaluation status will be allowed for a period to cover four sampling events. Upon completion of the four sampling events and statistical evaluation of the data, the submitted proposal shall be reevaluated by Ecology for subsequent approval.

300 Area Process Trenches (300-APT) – Calculation of control limits. The following table depicts the control limits and special conditions to be applied for each constituent of concern at the 300-APT as proposed in the USDOE/Ecology meeting held December 11, 2000.

Table 1. Summary of Various Control Limits at the 300 APT

Constituent of Concern	Shewhart CUSUM Parameter Value	Control Limit (µg/L)
Well # 3-1-16A		
cis-DCE (µg/L)	4.5	0.803
TCE (µg/L)	4.5	1.72
Well # 3-1-16B		
cis-DCE (µg/L)	4.5	[39, 262][b]
TCE (µg/L)	NA	5
Well # 3-1-17A		
Uranium (µg/L)	4[a]	[7, 218]
Well # 3-1-17B		
Uranium (µg/L)	4.5	0.67

[a] Use 4 sigma because there are 16 data points in the baseline period (ASTM 1996).
[b] Numbers in brackets indicate upper and lower limits.

Mr. Marvin Furman
May 7, 2001
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Specific procedures to be used are as follows:

1. For wells where the Maximum Contamination Level (MCL) has been and still is exceeded, quarterly monitoring will be conducted. One sample will be collected from each well during each sampling event and compared to the agreed upon control limits for each identified constituent of concern (i.e., cis-DCE, TCE, and uranium). If a control limit is exceeded (proof by verification sampling), a notification process will be followed.

2. For wells where the MCL has not been exceeded, semiannual monitoring will be conducted. One sample will be collected from each well during each sampling event and compared to the agreed upon control limits for each identified constituent of concern (i.e., cis-DCE, TCE, and uranium). A notification process will be followed after a confirmed exceedance (by verification sampling).

3. Currently tetrachloroethene (PCE) is not detected in the 300 APT wells. However, it has been detected in the past. PNNL will continue to monitor PCE and report detected results.

The proposed statistical approach shall be in effect for a period of two years or four sampling events. Based on the results of this trial application, Ecology would decide whether to continue, modify, or abandon the proposed approach in these facilities or to apply the approach to other facilities. The USDOE is therefore requested not to apply this variance or similar procedures/methods at other facilities with out Ecology's prior approval.

If further discussion is necessary, please contact Deborah Singleton at (509) 736-5722 or me at (509) 736-3015.

Sincerely,

Dib Goswami, PhD
Nuclear Waste Program

DG:lkd

cc: Doug Hildebrand, USDOE
John Morse, USDOE
Charissa Chou, PNL
Stuart Luttrell, PNL

APPENDIX 5F

DETAILED GROUNDWATER FLOW CHARACTERIZATION WITHIN LOW-GRADIENT AREAS: INITIAL RESULTS FOR LOW-LEVEL WASTE MANAGEMENT AREA 1

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Battelle
. . . Putting Technology To Work

Project No. F19026

Date December 12, 2000

To R.B. Mercer

From F.A. Spane

Subject Detailed Groundwater-Flow Characterization Within Low-Gradient Areas: Initial Results for LLWMA-1

Internal Distribution
D.B. Barnett
C.J. Chou
P.E. Dresel
J.S. Fruchter
M.J. Hartman
F.N. Hodges
V.G. Johnson
S.P. Luttrell
J.P. McDonald
S.M. Narbutovskih
D.R. Newcomer
M.D. Sweeney
P.D. Thorne
W.D. Webber
File/LB

This letter report presents recommendations for detailed lateral groundwater-flow characterization (i.e., groundwater-flow direction and hydraulic gradient determination) within low-gradient areas (e.g., ≤ 0.0001), and provides initial results for the Low Level Waste Management Area 1 (LLWMA-1), in the Hanford Site 200 East Area. Most of the discussion pertaining to analytical methods described in this letter report was taken primarily from Spane (1999).

The results of this study indicate that within low-gradient areas such as the LLWMA-1, barometric pressure fluctuations can impose significant effects on well water-level measurements used to characterize lateral groundwater-flow conditions. These temporal changes in barometric pressure make it imperative that all well water-level measurements be measured closely in time to minimize errors in groundwater-flow characterization. In addition, for low-gradient sites exhibiting variable vadose zone characteristics (i.e., thickness, pneumatic diffusivity), barometric pressure fluctuations can cause temporal changes in lateral groundwater-flow direction and gradient. Discrete water-level measurements, therefore, used to determine the average or long-term groundwater-flow conditions may provide non-representative results. This would also be true of discrete measurements obtained using direct, in-well, groundwater-flow measurement methods (e.g., flowmeters, colloidal boroscope). To ascertain whether barometric effects can impose discernable changes in groundwater-flow characteristics, detailed barometric response analysis should be performed for each LLWMA monitor well, which is a candidate for use in detailed groundwater-flow characterization. This requires monitoring well water-level responses and barometric pressure fluctuations over a ~7-day period (i.e., for general Hanford Site conditions). Calculation of the barometric response characteristics for individual wells provides

the basis for removing the temporal effects of barometric pressure fluctuations from monitor well measurements, so that long-term, average groundwater-flow pattern behavior can be determined.

Initial results of trend-surface analysis of areal hydraulic head conditions for LLWMA-1 provided fairly consistent groundwater-flow characterization results. Analysis results for six different measurement dates/data sets over the past 5-year period (1995 - 2000) indicate that the temporal groundwater-flow directions ranged between 90 ° to 160°, and averaged 119° (0° = East; 90° = North); while hydraulic gradient conditions ranged between 7.77E-06 and 7.51E-05, and averaged 3.21E-05 across the entire site. The calculated average north-northwest groundwater-flow direction is consistent with the inferred long-term north-northwest groundwater-flow direction, which is suggested by existing contaminant plume patterns proximate to the site, as reported in Hartman and Dresel (1998).

Introduction

Groundwater-flow characterization is important for accurate prediction and monitoring of groundwater contaminant migration at the Hanford Site. Accurate delineation of local groundwater-flow direction and hydraulic gradient conditions within study areas of small size and/or having low-gradient conditions, however, can be difficult because of the small differences in measured water-level elevation. A method that facilitates groundwater-flow characterization in such areas is the use of trend-surface analysis of representative monitoring well water-level measurements, which is discussed in Spane (1999). Previous reports that have utilized this method for Hanford Site groundwater-flow characterization, however, were for areas having a larger hydraulic gradients (i.e., >0.0001) than reported for the LLWMA-1 (e.g., 0.00006; Hartman and Dresel, 1998). Because of these extremely low-gradient conditions, additional requirements are needed for accurate groundwater-flow characterization. These additional requirements are discussed later in the report.

Groundwater-flow direction and hydraulic gradient are commonly based on the areal analysis of well water-level measurements. Various factors, however, can affect the accuracy of well water-level measurements and how they are used to determine hydraulic head and to infer groundwater-flow directions within an aquifer. These factors include measurement error, well fluid-column density conditions, and external stress effects. Measurement error includes the cumulative effect of instrument and measuring point elevation errors, borehole deviation, and random measurement factors, such as operator error. As discussed in Spane (1999), systematic components of measurement error can be evaluated qualitatively by assessing the relative influence of individual well water-level measurements on the calculated groundwater-flow characteristics. This is accomplished by using sensitivity analysis (i.e., "jack-knife" analysis), wherein each well's measurement is removed individually from the selected well data set, and then the remaining wells are subjected to trend-surface analysis. Wells having a significant impact on the trend-surface

analysis results can, therefore, be identified by comparison of the individual sensitivity analysis run results. Based on the limited sensitivity analysis performed as part of this letter report's investigation, two wells (299-E32-4 and -E33-35) were identified as strongly influencing groundwater-flow characterization results. As a consequence, well water-level measurements for these two wells were not included in the quantitative LLWMA-1 groundwater-flow characterization.

Well fluid-column density conditions relate to factors that affect the height of a fluid column in a well above a known elevation datum. Factors that can affect fluid-column density include fluid temperature, salinity, pressure, dissolved gas content, multiphase conditions, and gravitational acceleration effects. Generally, these factors are only significant for deep or thick aquifers having long fluid-column lengths, which was not the case for this investigation.

Natural external stresses that can influence well water-level measurements include barometric effects, tidal or river-stage fluctuations, and earth tides. Earlier papers have addressed these effects on well water-level measurements within confined and unconfined aquifer systems (e.g., Jacob 1940; Ferris 1963; Bredehoeft 1967; Weeks 1979; Hsieh et al. 1988; Erskine 1991). Only recently, however, has the importance of removing external stress factor effects from water-level measurements for wells monitoring shallow unconfined aquifer systems been recognized (see Rasmussen and Crawford 1997, Spane 1999, and Spane and Thorne 2000). As will be discussed in this letter report, barometric fluctuations can have a significant impact on temporal groundwater-flow conditions (flow velocity, flow direction) within unconfined aquifers that exhibit low hydraulic gradient conditions and variable vadose zone properties (e.g., 200-East Area of the Hanford Site). This is due to the areal variation in transmission of atmospheric pressure to the water-table surface, which is part of the total hydraulic head pattern governing groundwater flow.

Of the aforementioned factors affecting well measurements, only the effects of external stresses are quantitatively considered in this report analysis. Specifically, this letter report focuses on:

- evaluating possible barometric effects on well water-level measurements within low-gradient areas (i.e., causing miscalculation of groundwater-flow conditions)
- assessing temporal barometric effects on actual groundwater-flow conditions (flow direction, gradient)
- determining existing groundwater-flow conditions from available historical well water-level elevation measurements within the LLWMA-1, and
- provides recommendations for improving monitoring of groundwater-flow characteristics in the LLWMA-1 and other low-gradient areas

Results from this letter report will be useful not only for groundwater-flow characterization, but also for the design and placement of future monitoring wells in this area of the Hanford Site.

Barometric Effects in Low-Gradient Areas

Areal well water-level elevations are commonly used in hydrologic studies for determining groundwater-flow direction and hydraulic gradient conditions within monitored aquifers. The reliable use of well water-level elevations for groundwater-flow characterization, however, assumes that the atmospheric pressure is uniform at the top of the aquifer or that the effects of barometric pressure variation are insignificant in comparison to the existing hydraulic gradient conditions. As discussed in Spane (1999), this is due to the fact that total hydraulic head (i.e., sum of the water-table elevation and the atmospheric pressure at the water-table surface), and **not** well water-level elevation, is the hydrologic parameter controlling groundwater-flow within the aquifer.

Barometric pressure fluctuations can have a significant impact on well water-level measurements that monitor unconfined aquifers; particularly for sites having significant water-table depths below land surface (e.g., >25 m) or relatively low vadose zone vertical pneumatic diffusivities. In low-gradient areas and/or sites exhibiting areally-variable vadose zone characteristics (i.e., thickness and pneumatic diffusivity), these barometric effects may lead to erroneous indications of groundwater-flow direction and hydraulic gradient conditions within the aquifer, i.e., if adjustments or removal of these barometric effects from the well measurements are not made. This is particularly true for lateral groundwater-flow calculations based on well water-level elevations not measured at the same moment in time (i.e., susceptible to temporal barometric effects).

To demonstrate the impact of barometric pressure fluctuations on groundwater-flow characterization within low-gradient areas, two hypothetical examples are considered. The first examines the miscalculation of flow direction and gradient conditions due to well measurements obtained at different times in the presence of temporal barometric pressure fluctuations, while the second illustrates temporal variations in actual groundwater flow imposed by barometric fluctuations and variations in vadose zone characteristics.

The first example is appropriate for the LLWMA-1, since most routine well water-level measurement surveys for this area have been completed over a several-day period. To illustrate the effect of temporal barometric fluctuations on the "miscalculation" of groundwater-flow direction and hydraulic gradient, a simple "three-point" problem was examined for hydrologic conditions believed representative of the LLWMA-1 site. For this example, a constant hydraulic gradient of 0.00005 was assumed, and a due East flow direction selected for ease of flow direction comparison. The two perimeter wells assigned in the three-point analysis were located 1000 m due north and east, respectively from the central (south) control well location. The well response to barometric fluctuations was calculated using WBAR program described in Spane (1999). A uniform vadose zone thickness of 80 m and a pneumatic diffusivity of 0.20 m^2/s were assumed for the calculations. The

pneumatic diffusivity value is consistent with the value determined for a neighboring 200-East monitor well (299-E33-41), as reported in Spane (1999). Three incremental atmospheric pressure step changes of +0.05 m were applied in the simulation for the given well/aquifer system, with individual step changes occurring at elapsed times of 0.25, 0.50, and 0.75 days. At an elapsed time of 1.0 day, an atmospheric pressure step of -0.15 m was applied, bringing the net applied barometric pressure back to zero for the given well/aquifer system. To examine the potential severity in miscalculating the groundwater-flow characteristics, well water-level elevation values for the central (south) well were assumed to be measured at a time 3-hr after the north well measurement, while the east well water-level measurement was obtained 6-hr after the north well measurement. Figure 1 shows the miscalculated groundwater-flow direction from the actual due East (zero degrees) direction versus the time of the measurement at the north well (X-axis). Note that the error in calculated flow direction depends on the timing of the measurements relative to the atmospheric pressure fluctuations. Likewise, Figure 2 displays miscalculations in hydraulic gradient from the assigned value of 0.00005 versus the time of the measurement at the north well. As shown for the example considered, areal well water-level elevation measurements obtained at different times during periods of significant temporal barometric pressure fluctuations, can produce considerable miscalculations for groundwater-flow direction (up to 180 degrees) and hydraulic gradient (within a factor of 4) over actual site conditions. It should be noted that the step change in barometric pressure likely contributes to some of the variability exhibited in the plot figures; however, the relative magnitude of pressure change is within the daily range recorded at the Hanford Site (e.g., greatest daily barometric pressure of change = 0.35 m; Hoitink et al. 1999).

While the first example illustrates how groundwater-flow characteristics can be miscalculated by using areal well water-level elevations not measured at the same time, barometric fluctuations can also cause significant temporal variations in actual groundwater-flow characteristics when vadose zone conditions are not uniform (e.g., thickness, pneumatic diffusivity) within the low-gradient area. To demonstrate the magnitude of possible groundwater-flow changes, the same simulated atmospheric pressure step changes were utilized in this example. Vadose zone pneumatic diffusivities of 0.15 m^2/s (Central/South well), 0.20 m^2/s (East well), and 0.25 m^2/s (North well) were assigned for the three-wells used in the three-point flow characterization analysis. It is not known whether this amount of areal variability is realistic over the LLWMA-1; however, a recent study by Spane and Thorne (2000) in the 200-West Area indicated well/vadose zone barometric response characteristics ranging over a factor of two over a similar size area. In addition, vadose zone thickness conditions vary by approximately 20% over the LLWMA-1, and were fixed at a uniform 80 m for the simulation. Keeping the vadose zone thickness constant decreases the effect of barometric fluctuations on actual groundwater-flow changes within the LLWMA-1.

Figure 3 shows the actual changes in groundwater-flow direction within the aquifer from the initial due East direction, due to barometric pressure fluctuations and variations in vadose zone characteristics. It should be noted that the groundwater-flow direction changes were based on well water-level measurements recorded for the same moment in time. As indicated, actual groundwater-flow directions within the aquifer varied by over 60 degrees over the two-day period, while the

hydraulic gradient (not shown) varied by less than a factor of two from 0.000043 to 0.00007. Greater variation in flow direction (and hydraulic gradient) could have been realized by increasing the magnitude and period of barometric pressure change, which can occur during extended periods of high or low-pressure activity at the Hanford Site. The results of this analysis indicate that discrete well measurements used for groundwater-flow characterization will not be indicative of long-term groundwater-flow conditions, but highly reflective of the temporal aquifer conditions that are significantly influenced by transient barometric pressure fluctuations. Long-term groundwater-flow conditions, however, can be determined by removing the temporal barometric effects from the well response, as described in Spane (1999) and Spane and Thorne (2000) for well-test analysis. This requires determination of the barometric response characteristics for each well used in the groundwater-flow characterization, and removal of short-term barometric effects using either the multiple-regression deconvolution method or the vadose zone analytical model which are described in Rasmussen and Crawford (1997) and Spane (1999).

The analysis results also suggest that groundwater-flow characterization within low-gradient areas using other direct, in-well, measurement techniques, e.g., such as flowmeters, colloidal boroscopes, are also highly susceptible to barometric effects that significantly influence temporal groundwater-flow conditions. Determination of long-term groundwater-flow characteristics using these in-well measurement techniques, therefore, would likely require extended periods of in-well measurement (e.g., weeks, months) for determination of average, long-term groundwater-flow behavior.

LLWMA-1 Groundwater-Flow Conditions

To characterize existing groundwater-flow within the LLWMA-1 study area, well water-level measurements from RCRA monitoring wells were evaluated. Figure 4 shows the locations of monitoring wells having historical water-level data. A review of well completion and current monitoring conditions for the RCRA wells indicates that all monitoring wells evaluated are completed in the upper 2.4 to 3.9 m of the aquifer. As noted in Spane (1999), groundwater-flow direction and hydraulic gradient can be determined by standard trend-surface-fitting methods (or three-point problems) using total head measurements obtained from monitoring wells that meet the following criteria:

- are along the same hydrologic flow plane (i.e., planar potential surface)
- are measured close in time (e.g., within 1 to 4 hr for low-gradient areas)
- monitor similar depth intervals within the respective hydrogeologic unit
- display similar dynamic well-response characteristics (e.g., to barometric fluctuations)
- are not significantly affected by well-skin effects.

To evaluate the sensitivity of groundwater-flow direction and hydraulic gradient determinations within the LLWMA-1, standard frequency (e.g., quarter-annual) Hanford Site water-level data over the 1995 to 2000 yr time period were analyzed. This site was identified in Hartman and Dresel (1998) as being a low-hydraulic gradient area (<0.00006), with a highly uncertain groundwater-flow direction (i.e., based on well water-level elevation measurements).

Available RCRA monitoring well data were quantitatively evaluated for groundwater-flow characterization using some of the screening criteria listed previously. Because data needed for detailed barometric response analysis were not available for any of the RCRA wells, a general evaluation of the temporal water-level-response characteristics for wells completed within similar areas of the WMA was performed for data collected during calendar years 1995 through mid-2000. Figure 5 shows the similarity in dynamic well-response characteristics exhibited for nine monitoring wells within the northern part of the WMA, while Figure 6 displays the well response characteristics for ten monitoring wells within the southern region of the WMA (note: two wells 299-E32-2 and –E33-30 are common to both north and south areas). As indicated in Figures 5 and 6, an overall declining water-level elevation trend pattern is exhibited, which is consistent with the general pattern of a declining water table associated with decreases in total wastewater disposal activities within the 200 Areas.

To facilitate quantitative determination of groundwater-flow direction and hydraulic gradient conditions, the commercially available WATER-VEL (In-Situ, Inc. 1991) software program was utilized. Water-level elevation and calculated total head values were used with the WATER-VEL program to calculate groundwater-flow direction and hydraulic gradient conditions over the measurement period. The program fits a linear, two-dimensional trend surface (least squares) to randomly located hydraulic head or water-level elevation input data. This technique is accurate as long as the two-dimensional linear approximation is applicable (i.e., no significant vertical groundwater-flow gradients exist within the aquifer). This method is similar also to the linear approximation technique described by Abriola and Pinder (1982) and Kelly and Bogardi (1989). A report that demonstrates the use of the WATER-VEL program for calculation of groundwater-flow velocity and direction is presented in Gilmore et al. (1992) and Spane (1999).

Because well water-level measurements were collected, in some cases, over a period of several days, the effects of barometric pressure fluctuations may exert a discernible influence on calculated groundwater-flow direction and hydraulic gradient. Figure 7 shows the relationship of well water-level elevation measured at the 15 different LLWMA-1 monitoring wells and the barometric pressure fluctuation pattern over the field measurement period (June 3 - 9, 1999). As shown, the barometric pressure varied by 0.11 m during the actual period of well measurements, which compares with a maximum 0.05 m water-level elevation difference between wells. Because barometric pressure variations can exceed actual areal well water-level elevation differences during protracted measurement periods, only those historical well data sets for measurements completed during one-day were used for detailed trend-surface analysis. As noted in Spane (1999), to

minimize the effects of barometric pressure fluctuations within low-gradient areas, all well water levels should be measured over a short-period of time (i.e., within 1 to 4 hrs), with more emphasis placed on measurements obtained during summer months, when diurnal barometric pressure fluctuations are relatively small.

To quantitatively assess groundwater-flow characteristics within the LLWMA-1 over the time period of 1995 - 2000, both observed well water-level elevation measurements and calculated total head values were analyzed (i.e., as expressed in relationship to long-term Hanford Site barometric value of 10.087 m reported in Spane 1999). Trend-surface analysis was applied to three different monitor well data sets: one for wells within the northern LLWMA-1, the second for wells within the southern LLMA-1, and a third for all wells across the entire area. Table 1 lists the results of quantitative trend-surface analysis for the eight northern LLWMA-1 wells (wells 299-E32-2, -E32-6, -E32-7, -E32-8, -E32-9, -E32-10, -E33-30, and -E33-34) for six (1-day) measurement periods over the five-year time period (1995 - 2000). It should be noted that sensitivity analysis indicated that well 299-E33-35 most significantly influenced the results for wells within the north, and for that reason data for this well were not used in the quantitative analysis for conditions within the northern LLWMA. As indicated in Table 1, only a small water-level elevation and hydraulic head difference (≤ 0.060 m) were evident across the northern LLWMA for the data sets selected for analysis, with only minor variations in barometric pressure occurring during most of the well measurement periods. The trend-surface analysis results provided similar results when using either water-level elevation or hydraulic head data. Hydraulic head analysis results for the six 1-day measurement data sets indicate that the temporal groundwater-flow direction ranged between 103 ° to 138°, and averaged 126° (0° = East; 90° = North); while hydraulic gradient conditions ranged between 5.58E-05 and 1.05E-04, and averaged 7.33E-05. Only slightly different groundwater-flow characteristics were evident for the one multi-day measurement data set (June 7 - 9, 1999), which was examined for comparison purposes.

Table 2 lists the results of quantitative trend-surface analysis for the nine southern LLWMA-1 wells (wells 299-E28-26, E28-27, -E26-28, -E32-2, -E32-3, -E32-5, -E33-28, -E33-29, and -E33-30) for five (1-day) measurement periods over the five-year time period (1995 - 2000). It should be noted that sensitivity analysis indicated that well 299-E32-4 most significantly influenced the results for wells within the south, and for that reason data for this well were not used in the quantitative analysis for conditions within the southern LLWMA. As indicated in Table 2, only a small water-level elevation and hydraulic head difference (≤ 0.110 m) were evident across the southern LLWMA for the data sets selected for analysis, with only minor variations in barometric pressure occurring during most of the well measurement periods. Results of trend-surface analyses for the southern wells exhibited more variability for both water-level elevation and hydraulic head data than results obtained from the northern well analyses. Hydraulic head analysis results for the five 1-day measurement data sets indicate that the temporal groundwater-flow direction ranged between 79 ° to 334°, and averaged 159° (0° = East; 90° = North); while hydraulic gradient conditions ranged between 1.23E-06 and 9.19E-05, and averaged 4.02E-05.

Most of this variability, however, is attributed to the results obtained for the March 21, 2000 data set. The reason for the greater variability is not known at this time; however, it should be noted that extremely low gradient conditions (1.23E-06) were calculated for the March 2000 data set. The extremely low gradient conditions for the March 2000 measurement makes groundwater flow calculations highly questionable, due to the influence of measurement error. For example, if data for well 299-E28-27 is not included in the trend-surface analysis, a northwest flow direction (116°) is indicated. Greater differences for groundwater-flow characteristics were also evident for the one multi-day measurement data set (June 3 - 8, 1999).

To examine groundwater-flow characteristics across the entire WMA facility, detailed trend-surface analysis was implemented for the same six 1-day measurements for all fifteen wells (note 2 wells were common for the northern and southern area analyses). Table 3 lists the results of quantitative trend-surface analysis for the entire LLWMA-1 well set. As indicated in Table 3, only a small water-level elevation and hydraulic head difference (≤ 0.12 m) were evident across the LLWMA for the data sets selected for analysis, with only minor variations in barometric pressure occurring during most of the well measurement periods. The trend-surface analysis results provided similar results when using either water-level elevation or hydraulic head data. Hydraulic head analysis results for the six 1-day measurement data sets indicate that the temporal groundwater-flow direction ranged between 90 ° to 160°, and averaged 119° (0° = East; 90° = North); while hydraulic gradient conditions ranged between 7.77E-06 and 7.51E-05, and averaged 3.21E-05. A significant difference in groundwater-flow characteristics was evident for the one multi-day measurement data set (June 3 - 9, 1999); however, a much closer correspondence was achieved when limited to a 3-day measurement period (June 7 - 9, 1999) indicating the important influence of barometric effects. As indicated, barometric pressure fluctuations were twice the observed areal water-level elevation differences across the LLWMA during the extended multi-day measurement period.

Recommendations

Based on the results of this study, the following recommendations are provided for improving the characterization of groundwater-flow conditions within the LLWMA-1 and other low-gradient areas:

- efforts should be initiated to characterize and remove the effects of measurement error (e.g., borehole deviation/gyroscopic surveys) from well water-level measurements used to characterize groundwater-flow conditions within the LLWMA
- water levels within the LLWMA monitoring wells should be measured on the same day, and preferably within a 1 to 4-hr period to minimize the impact of barometric fluctuation effects

- trend-surface analysis methods should be used for delineating groundwater-flow direction/gradient conditions
- trend-surface analysis results should be considered more reliable for measurements obtained during time periods when diurnal barometric fluctuations are low (e.g., summer months)
- detailed barometric response analysis should be performed for each LLWMA monitor well, which is a candidate for use in detailed groundwater-flow characterization. This requires hourly measurements of well water-level responses and barometric pressure fluctuations over a ~7-day period. Determination of the barometric response characteristics for individual wells allows for removing the temporal effects of barometric pressure fluctuations at individual well sites so that total head calculations can be determined for all representative monitor wells at the same "moment in time", and to support the assessment of long-term groundwater-flow behavior within the area.

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Figure 1. Miscalculation of Groundwater-Flow Direction Caused by Barometric Pressure Fluctuations in Low-Gradient Areas Using Well Measurements Not Collected at the Same Time

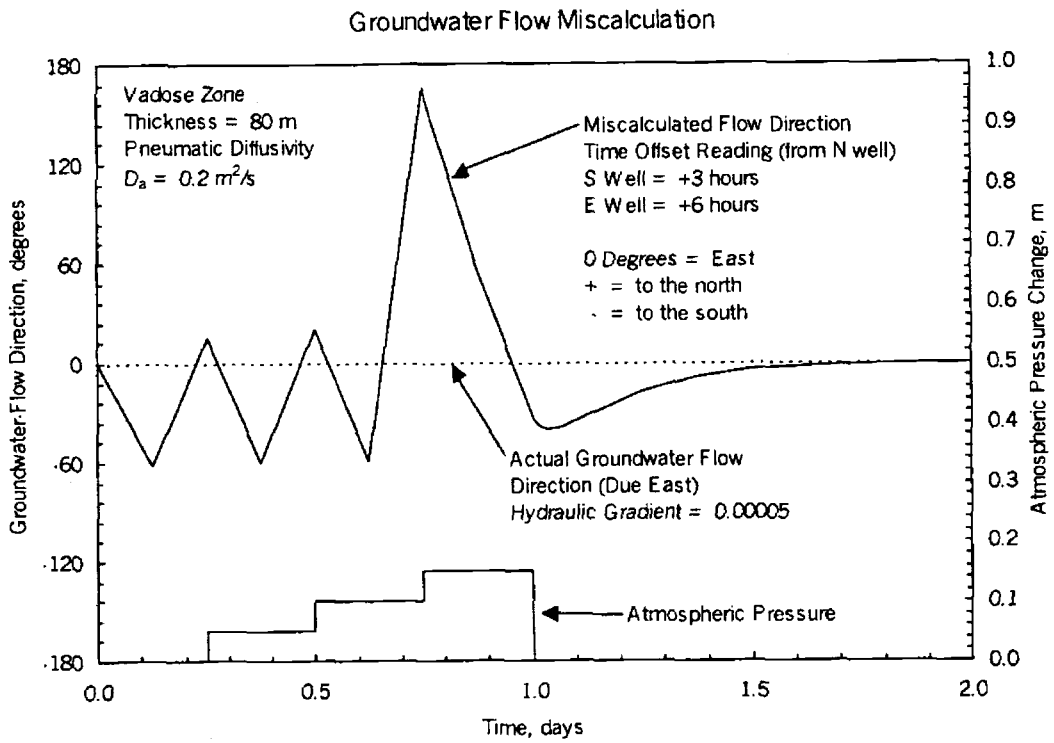

Figure 2. Miscalculation of Hydraulic Gradient Caused by Barometric Pressure Fluctuations in Low-Gradient Areas Using Well Measurements Not Collected at the Same Time

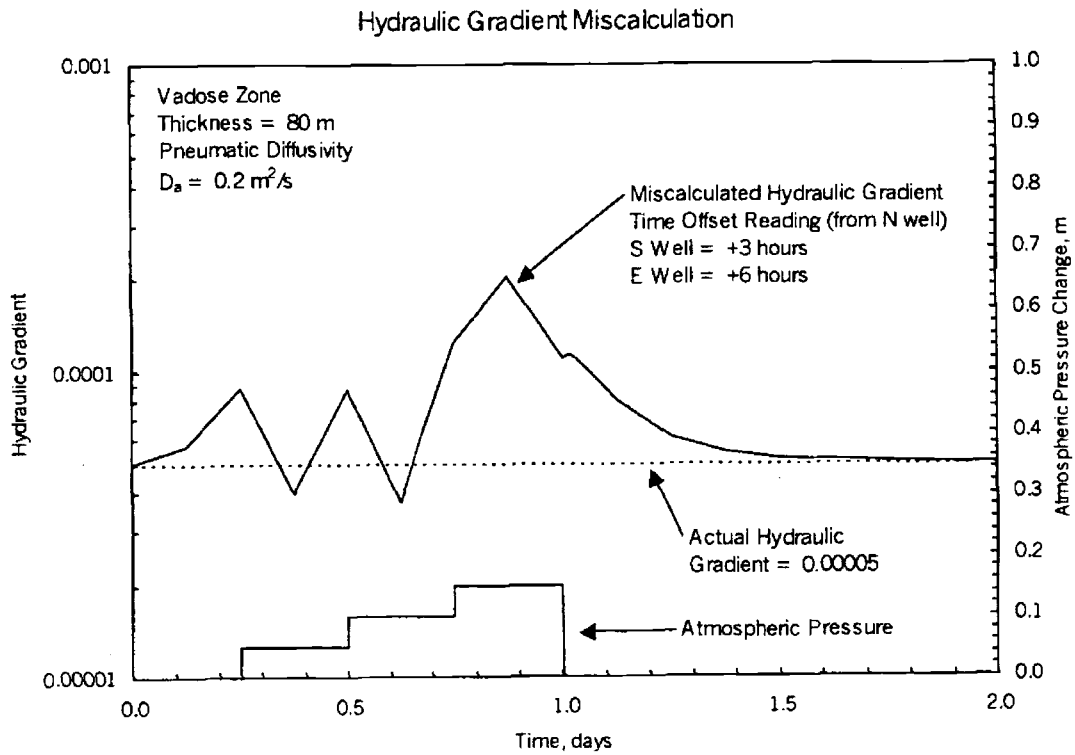

Figure 3. Temporal Variations in Groundwater-Flow Direction Induced by Barometric Pressure Fluctuations in Low-Gradient Areas Having Variable Vadose Zone Characteristics

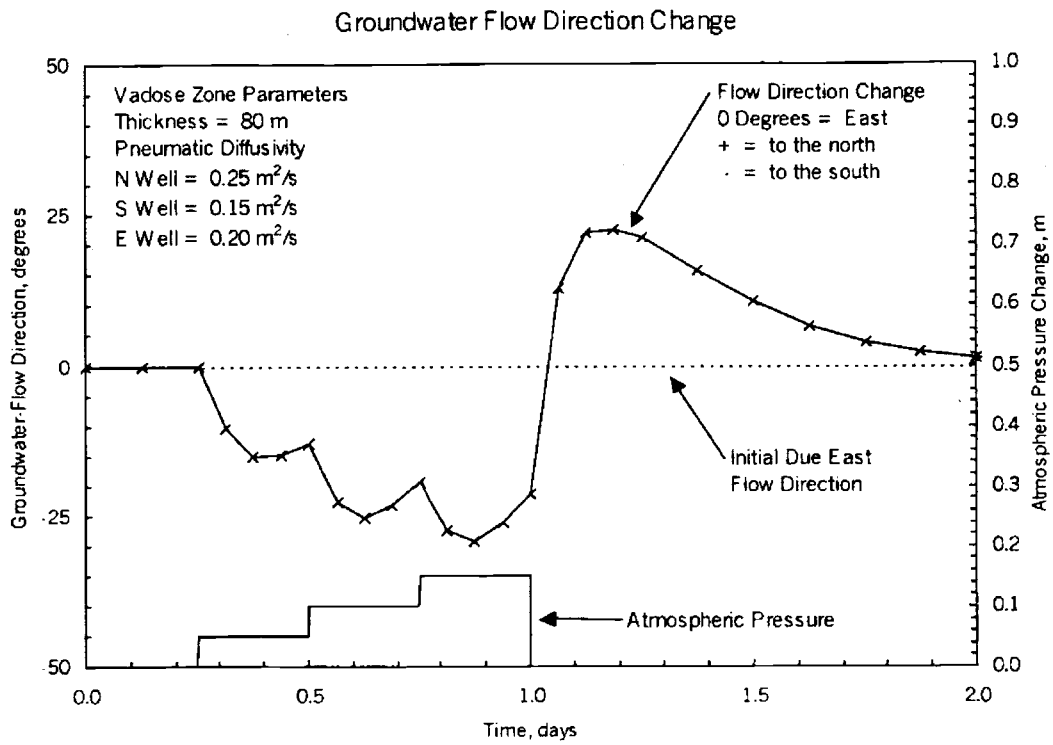

Figure 4. Location Map of Wells Monitoring the LLWMA-1.

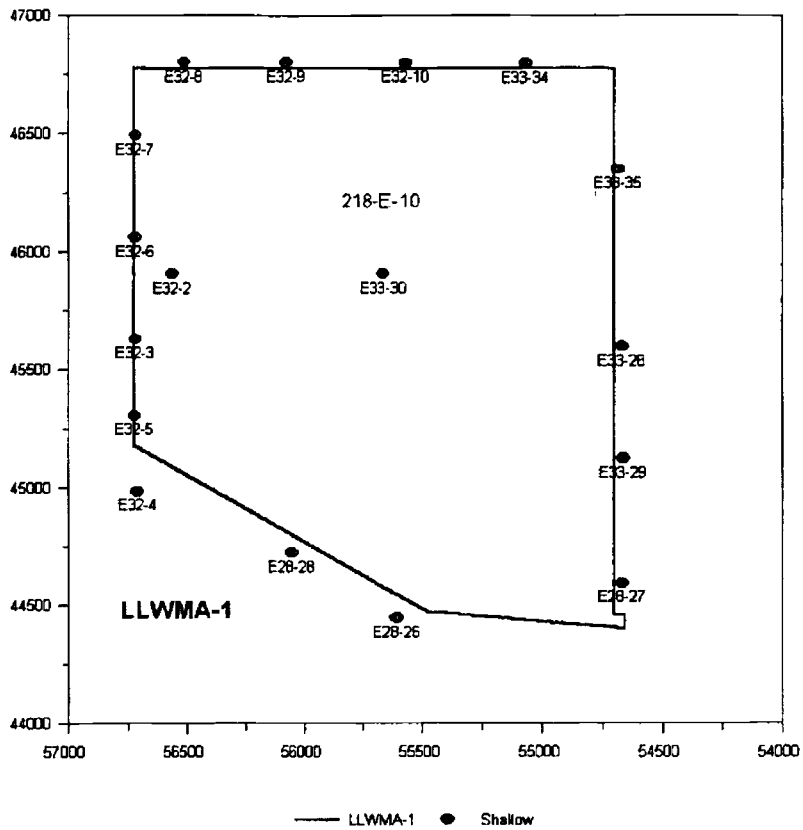

Figure 5. Comparison of Well Water-Level Elevation Response for Selected Northern LLWMA-1 Monitor Wells

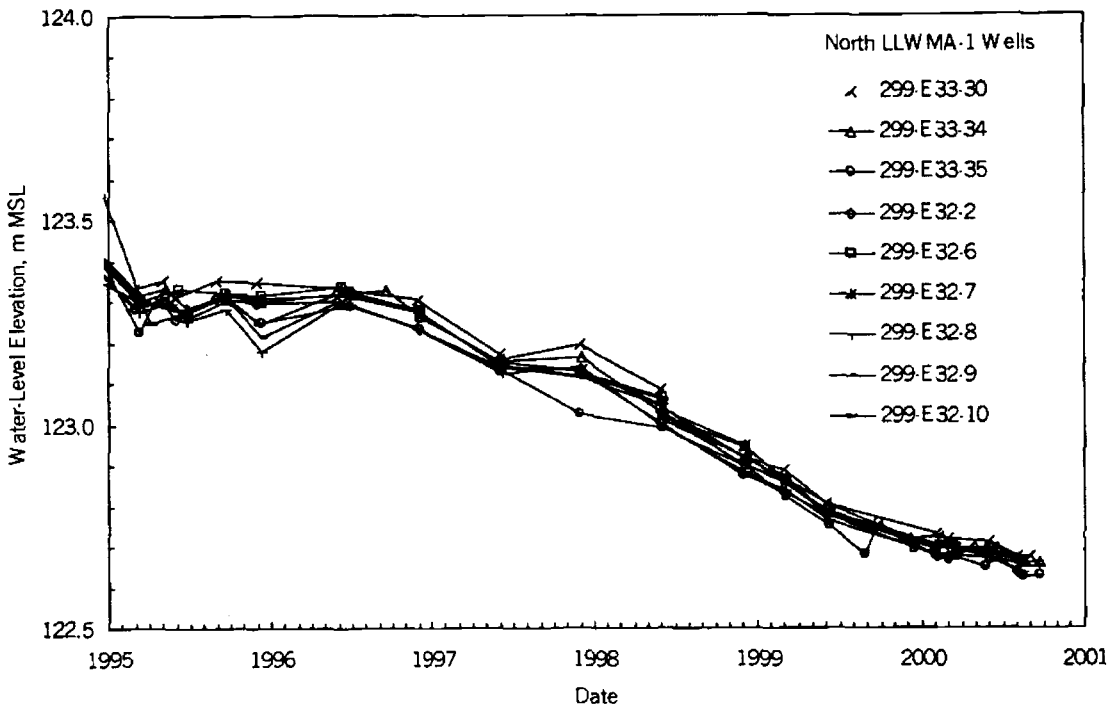

Figure 6. Comparison of Well Water-Level Elevation Response for Selected Southern LLWMA-1 Monitor Wells

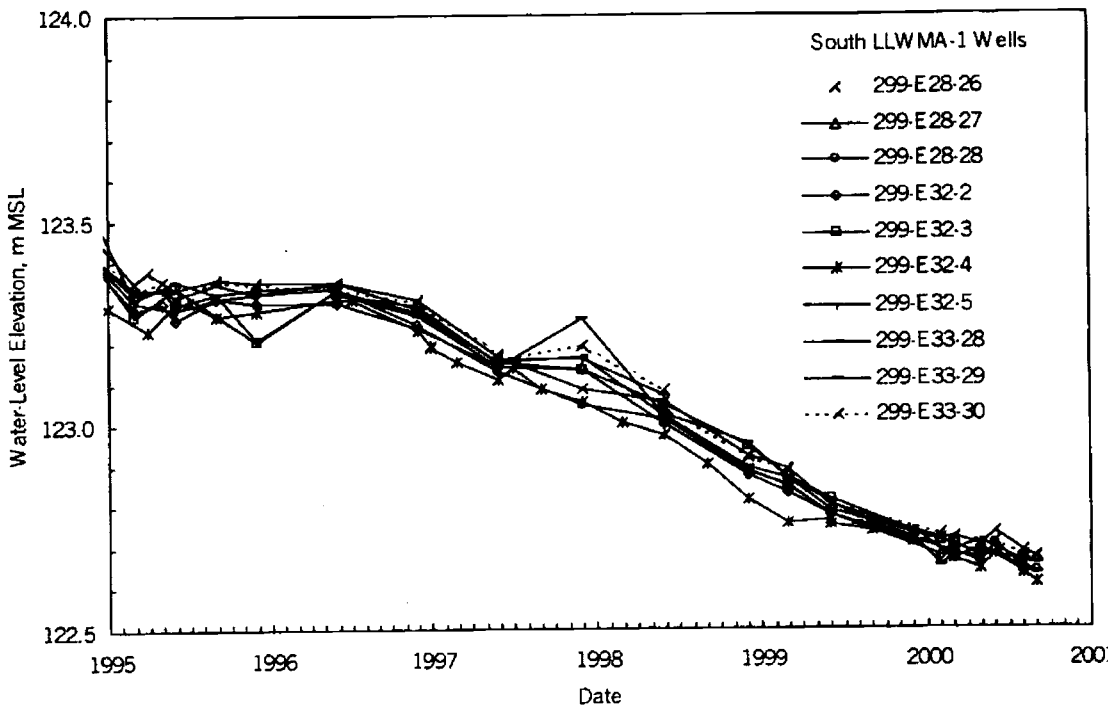

Figure 7. Comparison of Well Water-Level Elevation and Atmospheric Pressure for LLWMA Monitor Wells, June 3 - 9, 1999

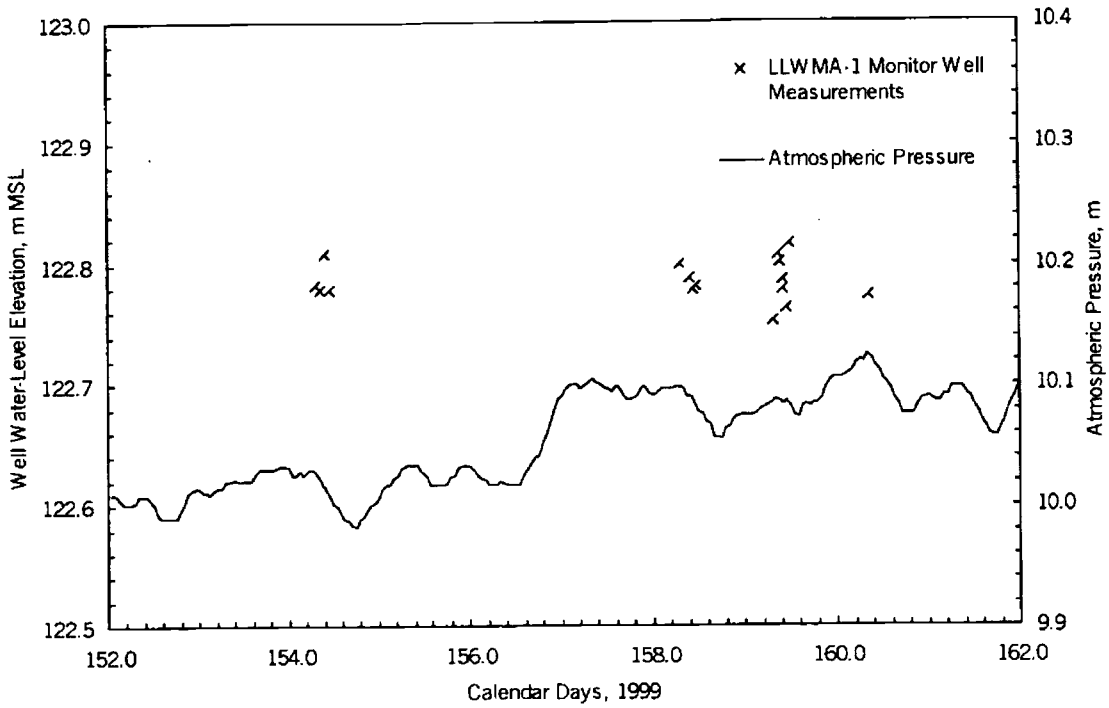

Table 1. Trend-Surface Hydraulic Gradient and Groundwater-Flow Direction Determinations for Northern RCRA Wells Monitoring the Low Level Waste Management Area 1[a]

Date	Flow Direction, (0° = E; 90° = N)		Hydraulic Gradient (m/m)		Maximum Observed Difference, m: Water-Level Elevation/Total Head/Barometric Head
	Water-Level Elevation	Total Head	Water-Level Elevation	Total Head	
March 13, 1995	140°	131°	8.83E-05	1.05E-04	0.052 / 0.060 / 0.011
June 9, 1997[b]	114°	118°	8.27E-05	7.38E-05	0.038 / 0.035 / 0.004
June 5, 1998[c]	132°	138°	6.61E-05	5.58E-05	0.047 / 0.043 / 0.004
March 4, 1999	129°	129°	8.32E-05	7.68E-05	0.055 / 0.051 / 0.004
June 7-9, 1999	134°	149°	8.82E-05	8.72E-05	0.044 / 0.046 / 0.035
March 21, 2000	138°	138°	6.66E-05	7.14E-05	0.050 / 0.050 / 0.002
August 15, 2000[d]	110°	103°	7.86E-05	5.71E-05	0.037 / 0.035 / 0.017
Average Values[e] (Standard Deviation)	127° (± 12°)	126° (± 14°)	7.76E-05 (± 9.23E-06)	7.33E-05 (± 1.78E-05)	0.047 / 0.046 / 0.007

(a) Northern monitoring well set: 299-E32-2, -E32-6, -E32-7, -E32-8, -E32-9, -E32-10, -E33-30, and -E33-34.
(b) Well 299-E32-2 not included (anomalous reading)
(c) Well 299-E33-34 not included (anomalous reading)
(d) Well 299-E32-2 not included (measured on different day)
(e) Does not include June 1999 analysis results, which include measurements collected over a 3-day period

Table 2. Trend-Surface Hydraulic Gradient and Groundwater-Flow Direction Determinations for Southern RCRA Wells Monitoring the Low Level Waste Management Area 1[a]

Date	Flow Direction, (0° = E; 90° = N)		Hydraulic Gradient (m/m)		Maximum Observed Difference, m: Water-Level Elevation/Total Head/Barometric Head
	Water-Level Elevation	Total Head	Water-Level Elevation	Total Head	
March 13, 1995	144°	142°	8.63E-05	9.19E-05	0.084 / 0.094 / 0.010
June 9, 1997[b]	78°	79°	7.57E-05	7.15E-05	0.110 / 0.110 / 0.002
June 5, 1998[c]	136°	131°	3.46E-05	2.43E-05	0.051 / 0.044 / 0.013
March 4, 1999	124°	107°	1.11E-05	1.21E-05	0.057 / 0.058 / 0.005
June 3, 7-8, 1999	266°	327°	3.38E-05	9.90E-05	0.037 / 0.108 / 0.084
March 21, 2000	65°	334°	1.80E-05	1.23E-06	0.055 / 0.050 / 0.010
August 15, 2000[d]	-	-	-	-	-
Average Values[e] (Standard Deviation)	109° (± 36°)	159° (± 101°)	4.51E-05 (± 2.90E-05)	4.02E-05 (± 3.94E-05)	0.071 / 0.071 / 0.008

(a) Southern monitoring well set: 299-E28-26, -E28-27, -E28-28, -E32-2, -E32-3, -E32-5, -E33-28, -E33-29, and -E33-30
(b) Well 299-E32-2 not included (anomalous reading)
(c) Well 299-E28-26 not included (measured on different day)
(d) No trend-surface analysis performed; only 3 wells measured on August 15, 2000
(e) Does not include June 1999 analysis results, which include measurements collected over a 6-day period

Table 3. Trend-Surface Hydraulic Gradient and Groundwater-Flow Direction Determinations for All RCRA Wells Monitoring the Low Level Waste Management Area-1[a]

Date	Flow Direction, (0° = E; 90° = N)		Hydraulic Gradient (m/m)		Maximum Observed Difference, m: Water-Level Elevation/Total Head/Barometric Head
	Water-Level Elevation	Total Head	Water-Level Elevation	Total Head	
March 13, 1995	154°	147°	6.93E-05	7.51E-05	0.084 / 0.094 / 0.014
June 9, 1997	87°	90°	4.47E-05	3.60E-05	0.116 / 0.110 / 0.006
June 5, 1998	154°	160°	2.33E-05	1.16E-05	0.051 / 0.047 / 0.014
March 4, 1999	110°	103°	1.99E-05	1.94E-05	0.057 / 0.058 / 0.005
June 3, 7-9, 1999	135°	315°	1.35E-05	6.60E-05	0.053 / 0.109 / 0.106
(June 7-9, 1999)		(143°)		(6.15E-05)	
March 21, 2000	85°	104°	1.13E-05	7.77E-06	0.055 / 0.050 / 0.010
August 15, 2000	117°	110°	6.71E-05	4.27E-05	0.037 / 0.035 / 0.017
Average Values[b] (Standard Deviation)	118° (± 31°)	119° (± 28°)	3.93E-05 (± 2.50E-05)	3.21E-05 (± 2.51E-05)	0.067 / 0.066 / 0.011

(a) Total monitoring well set: 299-E28-26, -E28-27, -E28-28, -E32-2, -E32-3, -E32-5, -E32-6, -E32-7, -E32-8, -E32-9, -E32-10, -E33-28, -E33-29, -E33-30, and -E33-34

(b) Does not include June 1999 analysis results, which include measurements collected over a 7-day period

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APPENDIX 7A

BUILDING EMERGENCY PLAN FOR LOW-LEVEL BURIAL GROUNDS

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This plan covers the following: 200 West Area Burial Grounds, 200 East Area Burial Grounds, and the MO-223 (200 West Area Burial Ground Trailer).

Approved:

Facility Management	Date
Environmental Compliance Officer	Date
Hanford Fire Department	Date
Fluor Hanford Emergency Preparedness	Date

This document will be reviewed at least annually and updated if necessary by Facility Management unless Hanford Facility RCRA Permit coordination requirements provide otherwise. The Building Emergency Director has the authority to carry out the provisions of this plan.

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ATTACHMENT A 34

1.0 GENERAL INFORMATION

The Low-Level Burial Grounds (LLBG) are located on the Hanford Site, a 560-square mile (1,450-square kilometer) U.S. Department of Energy (DOE) operational site in southeastern Washington State. The LLBG are located in both the 200 East and 200 West Areas near the center of the Hanford Site. The Hanford Site Emergency Preparedness Program is based on the incident command system that allows a graded approach for response to emergency events. This plan contains a description of unit-specific emergency planning and response and is used in conjunction with DOE/RL-94-02, *Hanford Emergency Management Plan*. Response to events is performed using facility specific and/or Hanford Site level emergency procedures.

1.1 FACILITY NAME:

U.S. Department of Energy
Hanford Site
Low-Level Burial Grounds

1.2 FACILITY LOCATION:

Benton County, Washington within both the 200 East and 200 West Areas.

Buildings/facilities covered by this plan are: 200 East Area Burial Grounds (218-E-10 and 218-E-12B); 200 West Area Burial Grounds (218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C,218-W-5, and 218-W-6); MO-223 Trailer.

1.3 OWNER:

U.S. Department of Energy
Richland Operations Office
825 Jadwin Avenue
Richland, Washington 99352

FACILITY MANAGER:

Fluor Hanford
P.O. Box 1000
Richland, Washington 99352-1000

1.4 DESCRIPTION OF THE FACILITY AND OPERATIONS

The LLBG consist of eight burial grounds located in the 200 East Area and 200 West Area. The 218-E-10 and 218-E-12B are located in the 200 East Area and the 218-W-3A, 218-W-3AE, 218-W-4B, 218-W-4C, 218-W-5, and 218-W-6 are located in the 200 West Area.

The 218-E-10, 218-E-12B, 218-W-3A, 218-W-3AE, 218-W-4C, and 218-W-6 Burial Grounds are classified as a landfill and the 218-W-5 Burial Ground is classified as a landfill and for greater-than-90-day container storage. The LLBG consist of various sizes and depths of lined and unlined disposal trenches.

The following provides a brief description and identifies the generic types of waste disposed in the LLBG. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location.

- The 218-E-10 Burial Ground is approximately 89 acres in size and began receiving waste in 1960. Examples of waste placed in this burial ground include failed equipment, rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987 RCRA and state-only designated mixed waste.

- The 218-E-12B Burial Ground is approximately 168 acres in size and began receiving waste in 1967. Examples of waste placed in this burial ground include defueled reactor compartments (trench 94), low-level waste, and retrievable transuranic waste.

- The 218-W-3A Burial Ground is approximately 50 acres in size and began receiving waste in 1970. Examples of waste placed in this burial ground include ion exchange resins, failed equipment, tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, accessories, retrievable transuranic waste, and post-August 19, 1987, RCRA and state-only designated mixed waste.

- The 218-W-3AE Burial Ground is approximately 49 acres in size and began receiving waste in 1981. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987, RCRA and state-only designated mixed waste.

- The 218-W-4B Burial Ground is approximately 8.6 acres in size and began receiving waste in 1968. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, alpha caissons, and retrievable transuranic waste.

- The 218-W-4C Burial Ground is approximately 49 acres in size and began receiving waste in 1978. Examples of waste placed in this burial ground include contaminated soil, decommissioned pumps, pressure vessels, post-August 19, 1987, RCRA and state-only designated mixed waste, and retrievable transuranic waste.

- The 218-W-5 Burial Ground is approximately 92 acres in size and began receiving waste in 1986. Examples of waste placed in this burial ground include rags, paper, rubber gloves, disposable supplies, broken tools, and post-August 19, 1987, RCRA and state-only designated mixed waste. This burial ground currently contains double-lined mixed waste trenches (trenches 31 and 34). Trench 31 is available for use as a greater-than-90-day container storage area and Trench 34 is designated as a mixed waste disposal facility. Waste to be placed in Trench 31 for storage purposes predominately will be macro-encapsulated long-length contaminated equipment and other containerized waste. Adjacent to the double-lined mixed waste trenches are leachate collection tanks. The leachate collection tanks are aboveground, carbon steel tanks, internally coated with an amine-cured epoxy. The leachate collection tanks are located adjacent to the disposal trenches and are provided with secondary containment. Secondary containment exists for all feed piping. The leachate collection tanks have a current design capacity of 37,850 liters.

- The 218-W-6 Burial Ground is approximately 40 acres in size, has not received any waste, and is reserved for future mixed waste disposal.

1.5 BUILDING EVACUATION ROUTING

Figures 1 and 2 provide identification of the primary and secondary staging areas and a general layout of the LLBG. Alternate evacuation routes will be used on a case-by case basis, based on meteorological conditions at the time of the event.

2.0 PURPOSE

This plan describes both the facility hazards and the basic responses to upset and/or emergency conditions within the LLBG. These events may include spills or releases caused by processing, fires and explosions, transportation activities, movement of materials, packaging, storage of hazardous materials, and natural and security contingencies. When used in conjunction with DOE/RL-94-02, this plan meets the requirements for contingency planning as required by WAC 173-303.

3.0 FACILITY/BUILDING EMERGENCY RESPONSE ORGANIZATION

The LLBG maintains a weekly on-call list for technical expert notification. Upon notification, the on-call person will notify the primary or alternate Building Emergency Director (BED) to respond to the scene in person as necessary. The on-call technical expert will maintain contact with the on-scene Incident Commander (IC) until arrival of LLBG personnel.

3.1 BUILDING EMERGENCY DIRECTOR

Emergency response will be directed by the BED until the Incident Commander (IC) arrives. The incident command system (ICS) and staff with supporting on-call personnel fulfill the responsibilities of the Emergency Coordinator as discussed in WAC 173-303-360. During events, LLBG personnel perform response duties under the direction of the BED. The Incident Command Post (ICP) is managed by either the senior Hanford Fire Department member present or senior Hanford Patrol member present on the scene (security events only). These individuals are designated as the IC and as such have the authority to request and obtain any resources necessary for protecting people and the environment.

The BED becomes a member of the ICP and functions under the direction of the IC. In this role the BED continues to manage and direct LLBG operations.

A listing of BEDs by title, work location and work telephone numbers is contained in section 13.0 of this plan. The BED is on the premises or is available through an 'on-call' list 24 hours a day. Names and home telephone numbers of the BEDs are available from the Patrol Operations Center (POC) in accordance with *Hanford Facility RCRA Permit*, Dangerous Waste Portion, General Condition II.A.4.

3.2 OTHER MEMBERS

As a minimum, the Facility Management appoints and ensures training is provided to individuals to perform as Personnel Accountability Aides and Staging Area Managers. The Personnel Accountability Aides are responsible for facilitating the implementation of protective actions (evacuation or take cover) and facilitating the accountability of personnel after protective actions have been implemented. Staging Area Managers are responsible for coordinating and conducting activities at the staging area. In addition, the BED can identify additional support personnel [radiological control, maintenance, engineering, hazardous material coordinators, etc.] to be part of the Facility/Building Emergency Response Organization.

The complete Facility/Building Emergency Response Organization listing of positions, names, work locations and telephone numbers for the LLBG is maintained in a separate location in a format determined appropriate by LLBG management. Copies are distributed to appropriate LLBG locations and to Emergency Preparedness.

4.0 IMPLEMENTATION OF THE PLAN

The BED ensures that trained personnel identify the character, source, amount and areal extent of the release, fire, or explosion to the extent possible. Identification of waste can be made by activities that can include, but are not limited to, visual inspection of involved containers, sampling activities in the field, reference to inventory records, or by consulting with facility personnel. Samples of materials involved in an emergency might be taken by qualified personnel and analyzed as appropriate. These activities must be performed with a sense of immediacy and shall include available information.

The BED shall use the following guidelines to determine if an event has met the requirements of WAC 173-303-360(2)(d):

1. The event involved an unplanned spill, release, fire, or explosion,

AND

2.a The unplanned spill or release involved a dangerous waste, or the material involved became a dangerous waste as a result of the event (e.g., product that is not recoverable), or

2.b The unplanned fire or explosion occurred at the LLBG or transportation activity subject to RCRA contingency planning requirements,

AND

3. Time-urgent response from an emergency services organization was required to mitigate the event, or a threat to human health or the environment exists.

As soon as possible, after stabilizing event conditions, the BED shall determine, in consultation with the FH Site contractor environmental single-point-of-contact, if notification to Ecology is needed to meet WAC-173-303-360(2)(d) reporting requirements. If all of the conditions under 1, 2, and 3 are met, notifications are to be made to Ecology. Additional information is found in DOE/RL-94-02, *Hanford Emergency Management Plan*, section 4.2.

If review of all available information does not yield a definitive assessment of the danger posed by the incident, a worst-case condition will be presumed and appropriate protective actions and notifications will be initiated. The BED is responsible for initiating any protective actions based on their best judgement of the incident.

The BED must assess each incident to determine the response necessary to protect the personnel, facility, and the environment. If assistance from Hanford Patrol, Hanford Fire Department, or ambulance units is required, the Hanford Emergency Response Number (911) must be used to contact the POC and request the desired assistance. To request other resources or assistance from outside the LLBG, the POC business number is used (373-3800).

5.0 FACILITY HAZARDS

Hazards at the LLBG potentially include industrial hazards, hazardous materials, radiological materials, radioactive and/or mixed waste, physical hazards, and biological hazards.

5.1 HAZARDOUS MATERIALS

Hazardous materials might include (but might not be limited to) the following: spray adhesive, sorbent, diesel fuel, hydraulic oil, propane, road salt, industrial cleaner and degreaser, and unleaded gasoline. The use, storage, and inventory of hazardous materials are controlled. Hazardous material inventories and material safety data sheets are maintained in MO-720.

5.2 INDUSTRIAL HAZARDS

Industrial hazards could include transportation incidents, moving equipment accidents, subsidence (cave-ins), exposure to spilled waste or chemicals, or from radiological or chemical exposure from spills. Potential material handling mishaps are associated with forklift or crane operations. These include potential rupture of packages due to misalignment of the forklift tines or a load dropped during a crane operation.

5.3 DANGEROUS/MIXED WASTE

The LLBG are designed for disposal of bulk and containerized waste.

5.4 RADIOACTIVE MATERIALS

Low-level radioactive materials are disposed or can be stored in both the 200 East and 200 West Area burial grounds. All mixed waste must meet LDR requirements before disposal.

5.5 CRITICALITY

Criticality has been evaluated as being 'incredible,' less than one chance in a million in a year, in the authorization basis. Therefore, there are no LLBG specific actions required.

6.0 POTENTIAL EMERGENCY CONDITIONS

Potential emergency conditions, under both WAC 173-303 and the DOE, may include one of three basic categories: 1) operations (process upsets, fires and explosions, loss of utilities, spills, and releases), 2) natural phenomena (earthquakes), and 3) security contingencies (bomb threat, hostage situation, etc.). The following are conditions that may lead to an emergency at the LLBG.

6.1 FACILITY OPERATIONS EMERGENCIES

6.1.1 Loss of Utilities

- Electrical power is required for trenches 31 and 34 of the 218-W-5 burial ground operations, however, loss of electricity does not constitute an emergency, but must be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.

- Loss of Water - N/A.
- Loss of Ventilation - N/A.
- Loss of Steam - N/A.
- Loss of Air - N/A.

6.1.2 Major Process Disruption/Loss of Plant Control

N/A.

6.1.3 Pressure Release

N/A.

6.1.4 Fire and/or Explosion

Potential fire hazards include smoke inhalation, burns, damage to equipment and/or structures, and release of hazardous materials, radioactive and/or mixed waste constituents.

6.1.5 Hazardous Material Spill

Low-level radioactive waste and mixed waste are placed in the LLBG. Spills or releases could result in the following conditions.

- Spill of Hazardous Material. Hazards associated with a spill include potential exposure to radioactive and/or dangerous constituents as well as potential environmental damage. Because most waste in the LLBG is solid, spill procedures primarily are applicable to liquids that might have been improperly received.
- Any dangerous waste spills would involve accumulated leachate that would be contained within the leachate collection tank(s) and valve gallery secondary containment area, and spill procedures would be applicable (Trenches 31 and 34 of the 218-W-5 Burial Ground). EXCEPTION: A pumping spray spill that could result in a release of leachate to the environment.

- During the transfer of leachate from the leachate collection tank(s) to a transport tanker, spills could result in a release of leachate to the environment.

- Toxic Fumes Hazards. Mixed waste disposed in the LLBG could produce airborne radioactive contamination. Volatilization of solids during a fire might generate toxic fumes.

- Waste acceptance criteria require that the offsite generators and onsite generating units document waste with gas-generating potential and that the requirement for gas recombiners be specified on the waste tracking forms.

- Fires or Explosions Involving Hazardous Material. A fire or chemical reaction in the LLBG could result in the release of dangerous and/or radioactive constituents to the air or soil.

- Reactive Chemical/Corrosive Material Hazards. N/A.

- Thermal Reactions/Hazards. N/A.

- Flammable Material/Liquids Hazards. Although the LLBG does not dispose of these types of materials, operating equipment requires these materials (e.g., gasoline, hydraulic fluids, oils, etc.) for operation. These materials, if ignited could result in the release of dangerous and/or radioactive constituents to the air or soil.

- Asbestos Release. Asbestos might be released during tornadoes, high winds, fires, or other events that damage or destroy the packaging material.

6.1.6 Dangerous/Mixed Waste Spill

The potential exists for pressurized or bulging containers to rupture resulting in a release to the air or soil.

6.1.7 Transportation and/or Packaging Incidents

Potential consequences of transportation and/or packaging incidents are spills or spread of radioactive contamination, chemical contamination, or personnel contamination. A forklift-damaged container could result in a release to the environment.

6.1.8 Radiological Material Release

- Gaseous Effluent Discharges (stack release) - N/A.
- Liquid Effluent Discharges - N/A.
- Significant Contamination Spread/Releases. Significant contamination spread or release might involve hazards resulting from exposure to radioactive and/or mixed waste. The major potential cause of spread or a release includes damaged containers, high winds, or a fire that might disperse contaminated airborne particles.

6.1.9 Criticality

Fissionable materials located in the LLBG exist in a form or distribution that ensures a critical mass cannot be attained.

6.2 NATURAL PHENOMENA

Natural phenomena are discussed in the following sections.

6.2.1 Seismic Event

Depending on the magnitude of the event, severe structural damage could occur resulting in serious injuries or fatalities and the release of hazardous materials to the environment. Damaged electrical circuits and wiring could result in the initiation of fires.

6.2.2 Volcanic Eruption/Ashfall

Though not expected to cause structural damage, the ash resulting from a volcanic eruption could cause shorts in electrical equipment and plug ventilation system filters.

6.2.3 High Winds/Tornados

High winds or tornados might cause structural damage to systems containing hazardous materials, resulting in a release to the environment.

6.2.4 Flood

Flooding can cause the release of hazardous materials depending on the type of storage containers. Floods can also cause short circuits in electrical wiring located at or below ground level. This may then result in an increased likelihood of fires.

6.2.5 Range Fire

The hazards associated with a range fire are the same as those associated with a building fire plus potential site access restrictions and travel hazards such as poor visibility.

6.2.6 Aircraft Crash

In addition to the potential for serious injuries or fatalities, an aircraft crash could result in the direct release of hazardous materials to the environment or cause a fire that could lead to the release.

6.3 SECURITY CONTINGENCIES

Security contingencies are discussed in the following sections.

6.3.1 Bomb Threat/Explosive Device

A bomb threat might be received by anyone who answers the telephone or receives mail. The major effect on the LLBG is that personnel will need to perform emergency shutdown of the facility before evacuation. If an explosive device detonates, the effects are the same as those discussed under fire and explosion.

6.3.2 Hostage Situation/Armed Intruder

A hostage situation or the entry of an armed hostile intruder(s) in your building or facility can pose an emergency if either of these conditions has the potential to adversely affect facility operations. This can result in a loss of facility control or the coercion of an employee to take some malevolent action.

6.3.3 Suspicious Object

If a suspicious object is discovered, the major effect on the LLBG is that personnel will need to perform an emergency shutdown of the facility before evacuation.

7.0 INCIDENT RESPONSE

The initial response to any emergency is to immediately protect the health and safety of persons in the affected area. Identification of released material is essential to determine appropriate protective actions. Containment, treatment, and disposal assessment will be the secondary responses.

The following sections describe the process for implementing basic protective actions as well as descriptions of response actions for the events listed in Section 6.0 of this plan. DOE/RL-94-02, Section 1.3, provides concept of operations for emergency response on the Hanford Site.

This section provides a discussion of protective action responses, response to facility operations emergencies, response to natural phenomena, and response to security contingencies. In addition, a section addressing prevention of secondary release, fires or explosions, is provided.

7.1 PROTECTIVE ACTIONS RESPONSES

Protective action responses are discussed in the following sections. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events.

7.1.1 Evacuation

If an evacuation is ordered or the evacuation siren sounds in the area of the LLBG, personnel shall proceed to the staging areas depicted in Figures 1 and 2.

The BED or Staging Area Manager directs evacuations; however, to ensure that evacuations can be conducted promptly and safely, all personnel must be familiar with the correct evacuation procedure. The order to evacuate will normally be passed via the site Crash Alarm Telephone system.

Area evacuations are rapid or controlled, as pointed out in the following steps. When possible, these steps must be performed concurrently.

AREA EVACUATION PROCEDURE
Halt any operations or work and place equipment and structures in a safe condition. Use emergency shutdown procedures for rapid evacuation.
Use whatever means are available (portable radios, bullhorns, runners, etc.) to pass the evacuation information to personnel.
Evacuate personnel to the staging area; group personnel as follows: potentially contaminated protective clothing, keys immediately available for vehicles, those needing rides. Assist personnel that are temporary/permanently disabled.
Conduct personnel accountability. If unable to account for personnel, report personnel accountability results to the Hanford-Emergency Operations Center (Hanford-EOC).
Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed, etc.) once the IC arrives at the ICP.
Relay pertinent evacuation information (routes, destination etc.) to drivers.
Dispatch vehicles as soon as the vehicles are loaded.
Report status to the Hanford-EOC, request additional transportation if required, and report if any personnel remain who are performing late shutdown duties.

NOTE: If feasible, classified matter shall be secured in a security container and, if applicable, the intrusion detection system activated. If the emergency is life threatening, the health and safety of personnel shall take precedence over the need to secure classified matter. Security containers, vaults, and vault type rooms shall be inspected on return to the facility to determine whether classified information has been compromised or if any classified matter is missing.

7.1.2 Take Cover

When the Take Cover Alarm is activated, personnel shall take cover in the nearest building or trailer.

Normally, the LLBG will be alerted via the Area Crash Alarm Telephone System at MO-223. A message followed by the Take Cover siren will be transmitted over the area emergency sirens. Portable, hand-held radios are used throughout the LLBG for communication. The following actions must be taken or considered:

- Shut doors and windows and wait for further instructions
- Secure ventilation system
- Follow normal exit procedures from radiological areas
- Lock up classified documents and prepare for a possible evacuation
- Report your location to the Accountability Aid or the BED
- Accountability Aides will provide accountability status to the Staging Area Manager for LLBG personnel during an event
- Inform IC of any potentially affected personnel (i.e., injured, contaminated, exposed, etc.) once the IC arrives at the ICP.

7.2 RESPONSE TO FACILITY OPERATIONS EMERGENCIES

Depending on the severity of the event, the BED reviews the site-wide and LLBG emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.2.1 Loss of Utilities

A case-by-case evaluation is required for each event to determine loss of utility impacts. When a BED determines a loss of utility impact, actions are taken to ensure dangerous and/or mixed waste is being properly managed, to the extent possible given event circumstances. As necessary, the BED will stop operations and take appropriated actions until the utility is restored.

- Loss of Electricity. Electricity in the trailers is for lighting, heating, and cooling only. Loss of electricity will not impair functions or constitute an emergency.

Electrical power is required for Trenches 31 and 34 of the 218-W-5 Burial Ground operations; however, loss of electricity does not constitute an emergency, but must be restored as soon as possible. Electricity supplies power to the sump pumps used to remove accumulated leachate from the primary and secondary liners.

- Loss of Water - N/A.
- Loss of Ventilation - N/A.
- Loss of Steam - N/A.
- Loss of Air - N/A.

7.2.2 Major Process Disruption/Loss of Plant Control

N/A.

7.2.3 Pressure Release

N/A.

7.2.4 Fire and/or Explosion

In the event of a fire, the discoverer activates a fire alarm (pull box); calls 911 (373-3800 if using a cellular phone) or verifies that 911 has been called. Automatic initiation of a fire alarm (through the smoke detectors and sprinkler systems) is also possible.

- Unless otherwise instructed personnel shall evacuate the area/building by the nearest safe exit and proceed to the designated staging area for accountability.
- On actuation of the fire alarm, ONLY if time permits, personnel should shut down equipment, secure waste, and lock up classified materials (or hand carry them out). The alarm automatically signals the Hanford Fire Department.
- The BED proceeds directly to the ICP, obtains all necessary information pertaining to the incident, and sends a representative to meet Hanford Fire Department
- The BED provides a formal turnover to the IC when the IC arrives at the ICP.

- The BED informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste, mixed waste or radioactive material quantities released to the environment).

- If operations are stopped in response to a fire, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.

- Hanford Fire Department firefighters extinguish the fire as necessary.

NOTE: *Following a fire and/or explosion, 40 CFR 265.196 will be addressed for the less-than-90-day Leachate Storage Tank regarding fitness for use.*

7.2.5 Hazardous Material, Dangerous and/or Mixed Waste Spill

Spills can result from many sources including process leaks, container spills or leaks, damaged packages or shipments, or personnel error. Spills of mixed waste are complicated by the need to deal with the extra hazards posed by the presence of radioactive materials.

- The discoverer notifies the BED and initiates SWIMS response:

  - Stops work
  - Warns others in the vicinity
  - Isolates the area
  - Minimizes the spill if possible
  - Requests the BED Secure ventilation.

- The BED determines if emergency conditions exist requiring response from the Hanford Fire Department based on classification of the spill and injured personnel, and evaluates need to perform additional protective actions.

- If the Hanford Fire Department resources are not needed, the spill is mitigated with resources identified in section 9.0 of this plan and proper notifications are made.

- If the Hanford Fire Department resources are needed, the BED calls 911 (373-3800 if using a cellular phone).

- The BED sends a representative to meet the Hanford Fire Department.

- The BED provides a formal turnover to the IC when the IC arrives at the ICP.

- The BED informs the Hanford Site Emergency Response Organization as to the extent of the emergency (including estimates of dangerous waste, mixed waste, or radioactive material quantities released to the environment).

- If operations are stopped in response to the spill, the BED ensures that systems are monitored for leaks, pressure buildup, gas generation, and ruptures.

- Hanford Fire Department stabilizes the spill.

NOTE: For response to leaks or spills and disposition of leaking or unfit-for-use tank systems, refer to 40 CFR 265.196.

7.2.5.1 Damaged or Unacceptable Shipments

In accordance with WAC 173-303-350(3)(b), when an offsite shipment of dangerous waste arrives at the LLBG and the shipment is unacceptable for receipt, the damaged shipment should not be moved.

If a damaged shipment or transfer results in a spill or otherwise presents a hazard, the following action is performed in addition to the actions identified in section 7.2.5 of this plan.

Notify the organization generating the waste of the damaged shipment or transfer, and request any information necessary to assist in responding to the spill or hazard that is presented.

7.2.6 Radiological Material Release

- Radioactive Gaseous Liquid Effluent Discharge. Air sampling will be performed using the appropriate equipment any time a worker is likely to be exposed to 10 percent of the isotopes Derived Air Concentration (DAC). Tritium oxide (HTO) has a DAC value of 20 microcuries per cubic meter (µCi/m3).

  All personnel possibly exposed to HTO will have a tritium bioassay performed as soon as possible (must be within 30 days of exposure).

- Liquid Effluent Discharge. If collected leachate is released, the liquid will be contained by secondary containment.

- Significant Contamination Spread. There are no continuous air monitors in the LLBG. Monitoring is performed by RC personnel. If monitoring reveals a significant contamination spread, stop work activities and immediately exit the area. RC will survey and provide contamination status. Notify immediate manager and the BED.

7.2.7 Criticality

Transuranic waste is present in the LLBG. As a Limited Control Facility, the form or distribution of fissionable material precludes a criticality accident.

7.3 PREVENTION OF RECURRENCE OR SPREAD OF FIRES, EXPLOSIONS, OR RELEASES

The BED, as part of the ICS, takes the steps necessary to ensure that a secondary release, fire, or explosion does not occur. The BED will take measures, where applicable, to stop processes and operations; collect and contain released wastes and remove or isolated containers. The BED shall also monitor for leaks, pressure buildups, gas generation, or ruptures in valves, pipes or other equipment, whenever this is appropriate.

7.4 RESPONSE TO NATURAL PHENOMENA

Depending on the severity of the event, the BED reviews sitewide and LLBG emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.4.1 Seismic Event

The Hanford Site Emergency Organization's primary role in a seismic event is coordinating the initial response to injuries, fires, and fire hazards; and acting to contain or control radioactive and/or hazardous materials releases.

Individuals should remain calm and stay away from windows, steam lines, and hazardous material storage locations. Once the shaking has subsided, individuals should evacuate carefully and assist personnel needing help. The location of any trapped individuals should be reported to the BED or is reported to 911 (373-3800 if using a cell phone).

The BED takes whatever actions are necessary to minimize damage and personnel injuries. Responsibilities include the following:

Coordinating searches for personnel and potential hazardous conditions (fires, spills, etc.)

Conducting accountability

•

• Arranging rescue efforts, and notifying 911 (373-3800 if using a cellular phone) for

• Determining if hazardous materials, radioactive and/or mixed waste were released

Determining current local meteorological conditions

•

materials pose an immediate danger

•

possible.

7.4.2

When notified of an impending ashfall, the BED will implement measures to minimize the impact of the ash fall. BED actions include the following:

Installing filter media or protective coverings on outdoors equipment that may be adversely affected by the ash (diesel generators, equipment rooms etc.).

Shutting down some or all operations and processes

•

If other emergency conditions arise as a result of the ashfall (e.g., fires due to electrical shorts or lightning), response is as described in other sections of this plan.

7.4.3 High Winds/Tornados

Upon notification of impending high winds, the BED takes steps necessary to secure all outdoor waste, hazardous material containers, and storage locations. All doors and windows are shut, and personnel are warned to use extreme caution when entering or exiting the building. Ventilation, utilities and operations will be shut down as appropriate to lessen the severity of the impact.

7.4.4 Flood

N/A.

7.4.5 Range Fire

Responses to range fires are handled by preventive measures (i.e., keeping hazardous material and waste accumulation areas free of combustible materials such as weeds and brush). If a range fire breaches the LLBG boundaries, the response is as described in Section 7.2.4.

7.4.6 Aircraft Crash

The response to an aircraft crash is the same as that for responding to a fire and/or explosion (Section 7.2.4).

7.5 SECURITY CONTINGENCIES

Depending on the severity of the event, the BED reviews the sitewide and LLBG emergency response procedure(s) and, as required, categorizes and/or classifies the event. If necessary, the BED initiates area protective actions and Hanford Site Emergency Response Organization activation. The steps identified in the following description of actions do not have to be performed in sequence because of the unanticipated sequence of incident events. Attachment A provides a list of procedures.

7.5.1 Bomb Threat/Explosive Device

Response to a bomb threat/explosive device is discussed in the following sections.

7.5.1.1

Individuals receiving telephoned threats try to gain as much information as possible from the caller (using the bomb threat checklist if available). Upon conclusion of the call, notify

reporting a bomb threat/explosive device unless beyond 300 feet from the suspected object).

The BED evacuates the LLBG and questions personnel at the staging area regarding

7.5.1.2 Written Threat

Receivers of written threats handle the letter as little as possible. Notify the BED and Hanford Patrol by calling 911 (do not use a cellular phone or hand-held radio for reporting a bomb

of the letter, the BED might evacuate the affected locations. The letter is turned over to Hanford Patrol and their instructions are followed.

Hostage Situation/Armed Intruder

The discoverer of a hostage situation or of an armed intruder reports the incident to 911

Hanford Patrol, might covertly evacuate areas not observable by the hostage taker(s)/intruder. No alarms will be sounded.

Hostage Negotiating Team if necessary.

7.5.3

The discoverer of a suspicious object reports this object to the BED and to 911 (do not use a cellular phone or hand-held radio for reporting a bomb threat/explosive device unless beyond

The BED will evacuate the LLBG and (based on the description provided by the discoverer) attempt to determine the identity or owner of the object. Questioning personnel at the

If the identity/ownership of the object cannot be determined, then Hanford Patrol will assume command of the incident. The canine unit will be used to determine if the package contains explosives. If there is a positive indication of explosives or it cannot be assured that there are no explosives, then an Explosive Ordnance Disposal Team will be dispatched to properly dispose of the object.

8.0 TERMINATION OF EVENT, INCIDENT RECOVERY, RESTART OF OPERATIONS

DOE/RL-94-02, Section 9.0, describes actions for event termination, incident recovery, and restart of operations. The extent by which these actions are employed is based upon the incident classification of each event. In addition, DOE/RL-94-02 also contains actions for the management of incompatible wastesthat might apply.

8.1 TERMINATION OF EVENT

For events where the Hanford Emergency Operations Center (Hanford-EOC) is activated, the RL/ORP Emergency Manager has the authority to declare event termination. This decision is based on input from the BED, IC, and other emergency response organization members. For events where the Hanford-EOC is not activated, the ICS and staff will declare event termination.

8.2 INCIDENT RECOVERY AND RESTART OF OPERATIONS

A recovery plan is developed when necessary in accordance with DOE/RL-94-02, Section 9.2. A recovery plan is needed following an event where further risk could be introduced to personnel, the LLBG, or the environment through recovery action and/or to maximize the preservation of evidence.

If this plan was implemented according to section 4.0 of this plan, the Washington State Department of Ecology must be notified before operations can resume. DOE/RL-94-02, Section 5.1, discusses different reports to outside agencies. This notification is in addition to those required reports and must include the following statements:

- There are no incompatibility issues with the waste and released materials from the incident.
- All the equipment has been cleaned, fit for its intended use, and placed back into service.

The notification required by WAC 173-303-360(2)(j) may be made via telephone conference. Additional information that Ecology requests regarding these restart conditions will

For emergencies not involving activation of the Hanford-EOC, the BED ensures that conditions are restored to normal before operations are resumed. If the Hanford Site Emergency

organization could be appointed at the discretion of the RL to restore conditions to normal. This process is detailed in RL and contractor emergency procedures. The makeup of this organization

appointed by the appropriate contractor's management.

8.3

After an event, the BED or the onsite recovery organization ensures that no waste that might be incompatible with the released material is treated, stored, and/or disposed of until cleanup

DOE/RL-94-02, Section 9.2.3, describes actions to be taken.

Waste from cleanup activities is designated and managed as newly generated waste. A

placed in the same container. Containers of waste are placed in approved storage areas appropriate for their compatibility class.

organization ensures that the cause is corrected.

8.4

DECONTAMINATION

All equipment used during an incident is decontaminated (if practicable) or disposed of as

subsequent use. Consumables and disposed materials are restocked. Fire extinguishers are recharged or replaced.

operations are resumed. Depleted stocks of neutralizing and absorbing materials are replenished and protective clothing is cleaned or disposed of and restocked, etc.

9.0 EMERGENCY EQUIPMENT

Hanford Site emergency resources and equipment are described and listed in DOE/RL-94-02, Appendix C. Emergency resources and equipment for the LLBG are presented in this section.

9.1 FIXED EMERGENCY EQUIPMENT

None.

9.2 PORTABLE EMERGENCY EQUIPMENT

PORTABLE EMERGENCY EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Fire extinguishers	In motorized equipment (e.g., trucks, etc.), nearby structures (e.g., change trailers, storage buildings, etc.,).	Use on any Class A, B, or C fires. (Note: Some are only B and C.) Do NOT use on sodium.
Radiological Emergency Response Equipment	MO-438	Equipment for response to facility radiological events.[1]

9.3 COMMUNICATIONS EQUIPMENT/WARNING SYSTEMS

COMMUNICATIONS EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Hand-held radios	Portable	Communication

[1]This equipment is for radiological emergency response purposes only and is not subject to the permit modification process.

9.4 PERSONAL PROTECTIVE EQUIPMENT

PERSONAL PROTECTION EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Full-face respirator	271-T Mask Station	Protection from respiratory hazards
PPE Clothing	MO-289	Protection from specific exposure hazards

9.5 SPILL CONTROL AND CONTAINMENT SUPPLIES

In the event of a nonradioactive hazardous materials spill, control equipment to be used for an emergency and/or recovery phase is identified as follows:

SPILL KITS AND SPILL CONTROL EQUIPMENT		
TYPE	**LOCATION**	**CAPABILITY**
Absorbents	CWC Emergency Response Trailer	Contain or clean up spills
Overpack containers	CWC	Provide containment for leaking or damaged containers
Shovels	CWC Emergency Response Trailer	Clean up hazardous material spills
Chemical transfer pumps	Central Waste Complex	Move hazardous materials
Spill kit	Trench 34, CWC Emergency Response Trailer	Clean up hazardous material spills

INCIDENT COMMAND POST

Emergency resource materials are stored at each location. The IC could activate the Hanford Fire

10.0

RL has established a number of coordination agreements, or memoranda of

incidents involving the Hanford Site. A description of the agreements is contained in DOE/RL-

11.0

Post-incident written reports are required for certain incidents on the Hanford Site. The

Facility management must note in the TSD-unit operating record, the time, date and

this plan). Within fifteen (15) days after the incident, a written report must be submitted to

12.0

Copies of this plan are maintained at the following locations:

MO-223
MO-720 Conference room (ICP).
MO-438
MO-720 Regulatory File.

DOE/RL-94-02, Section 14.3.1.1.

13.0

BUILDING EMERGENCY DIRECTOR

LLBG BEDs		
	LOCATION	PHONE
	MO720 Complex	372-3066

(373-3800), in accordance with the Hanford Facility RCRA Permit, Dangerous Waste Portion, General Condition II.A.4.

14.0 REFERENCES

U.S. Department of Energy, Washington D.C.

DOE/RL-94-02,

WAC 173-303, "Washington State Dangerous Waste Regulations,"
Code, Washington State Department of Ecology, Olympia, Washington.

Recovery Act Permit for the Treatment, Storage, and Disposal of Dangerous Waste, Permit Number WA7890008967, Washington State Department of Ecology, Olympia, Washington.

Figure 1. Burial Grounds, 200 East Area

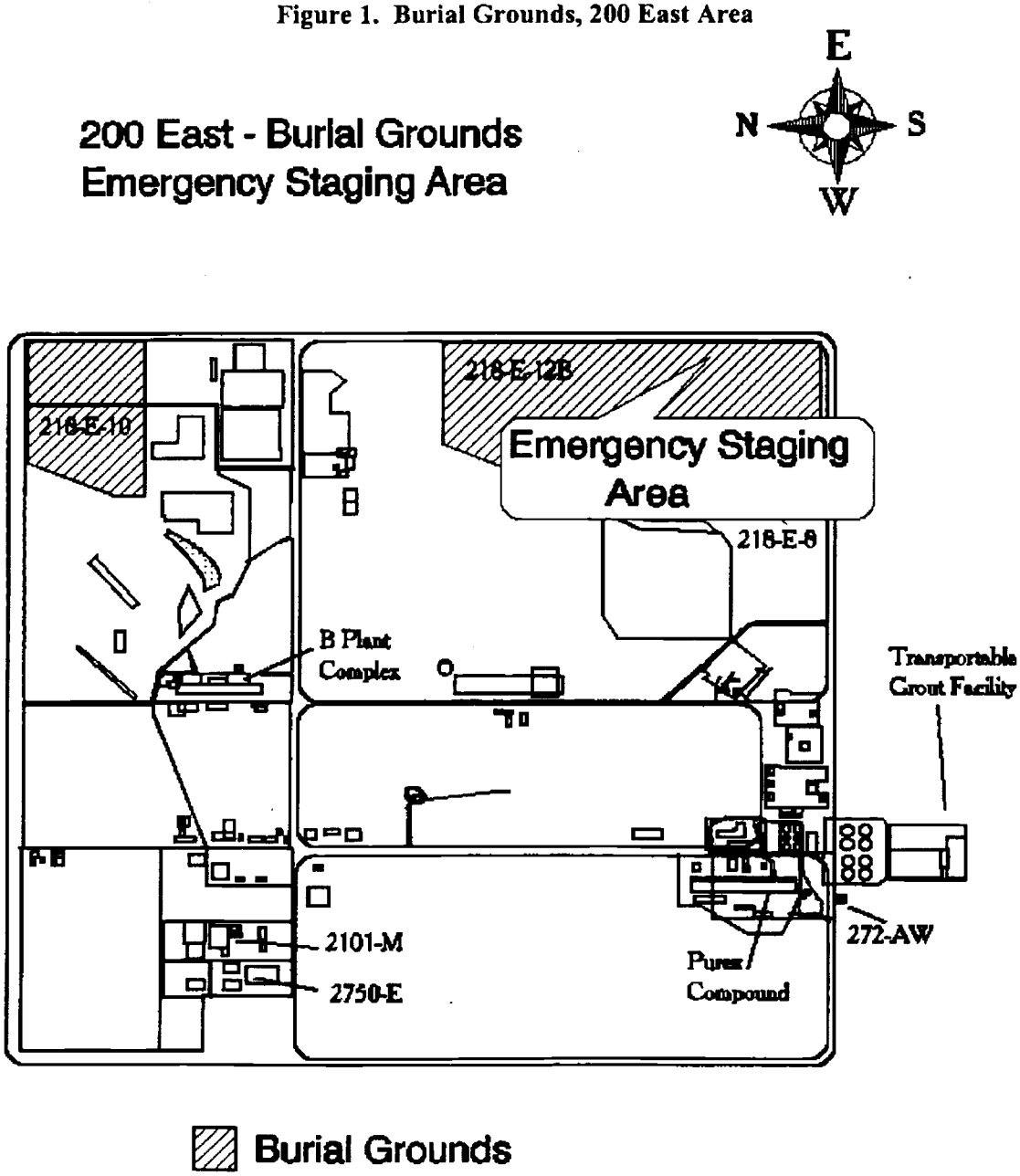
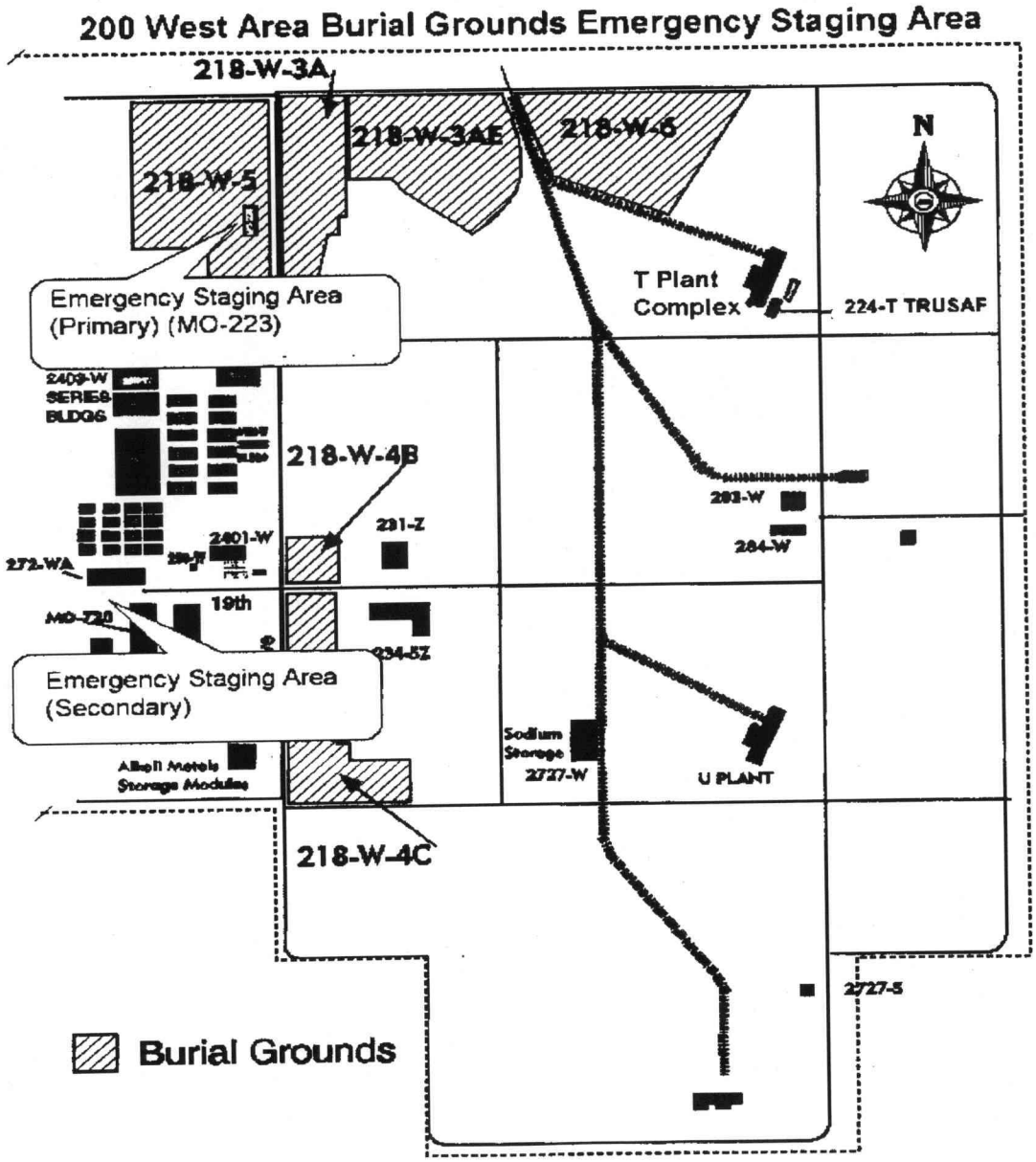


Figure 2. Burial Grounds, 200 West Area.



ATTACHMENT A

Listing of Procedures

DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 3.4, "Emergency Termination, Reentry, and Recovery"

DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 1.1, "Hanford Incident Command System and Event Recognition and Classification"

DOE-0223, *Emergency Plan Implementing Procedures*, RLEP 1.0, "Recognizing and Classifying Emergencies," Appendix 1-2.D.

Facility Specific Emergency Response Procedures

SW-ERP-003, *Respond to Spill/Release*
SW-ERP-004, *Respond to Fire or Explosion*

0075058

Department of Energy
Richland Operations Office
P.O. Box 550
Richland, Washington 99352

DEC 1 9 2007

08-AMCP-0063

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EDMC

Ms. J. A. Hedges, Program Manager
Nuclear Waste Program
State of Washington
Department of Ecology
3100 Port of Benton
Richland, Washington 99354

Dear Ms. Hedges:

HANFORD FACILITY DANGEROUS WASTE PART B PERMIT APPLICATION, LOW-LEVEL BURIAL GROUNDS (LLBG) DOE/RL-88-20, REVISION 2

The purpose of this letter is to provide resolutions that close Notice of Deficiencies (NODs) on the Hanford Facility Dangerous Waste Part B Permit Application, Low-Level Burial Grounds (LLBG) DOE/RL-88-20, Revision 2. The U.S. Department of Energy, Richland Operations Office (RL) letter (02-RCA-0411) dated June 27, 2002, provided the State of Washington Department of Ecology (Ecology) a working draft of a permit application for the Low-Level Burial Grounds. Ecology and RL held workshops to resolve these NODs. During the October 2007 Tri-Party Agreement Project Manager Meeting, Ecology and RL agreed to close the NODs based on these resolutions. The NODs and resolutions are enclosed in two parts; the first part pertains to non-groundwater and the second to groundwater. 0067440

If you have any questions, please contact me, or your staff may contact Mark French, of my staff, on (509) 373-9863.

Sincerely,

Matthew S. McCormick, Assistant Manager
for the Central Plateau

AMCP:MSC

Enclosures

cc: See Page 2

cc w/encls:
G. Bohnee, NPT
L. Buck, Wanapum
N. Ceto, EPA
S. Harris, CTUIR
R. Jim, YN
S. L. Leckband, HAB
A. G. Miskho, FHI
K. Niles, ODOE
J. F. Ollero, Ecology
R. E. Piippo, FHI
D. G. Singleton, Ecology
J. G. Vance, FFS
Administrative Record (LLBG: D-2-9)
Environmental Portal

Enclosure 1

Responses to Ecology Non-Groundwater comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
2-1	**Page 2-1, Lines 2-3:** Regarding receipt of mixed waste from off-site generators, Ecology staff expect additional direction from Ecology's upper management and the Washington State Attorney General's office, prior to issuance of the Low-Level Burial Ground final status permit conditions, as to the acceptability of off-site waste at the Low-Level Burial Grounds. However, until such direction is received, the language can remain as written. **Requirement:**	Closed 2/13/03
	DOE-RL/FH Response: Noted. No response required.	---
2-2	**Page2-1, Lines 25-26:** Delete last sentence. The LLBG, as described in the Part A, is a regulated unit. **Requirement:** WAC 173-303-040, 803.	RL/FH to discuss response 3/27/03 Action Deferred
	DOE-RL/FH Response:	
2-3	**Page 2-1, Line 32:** Specify "other regulatory alternatives" or delete. **Requirement:** WAC 173-303-140.	Closed 2/13/03
	DOE-RL/FH Response: Accept. The sentence will be changed to: "All mixed waste destined for disposal meets land disposal restriction (LDR) requirements [WAC 173-303-140, 40 CFR 268, and RCW-70.105] or other regulatory alternatives as described in Appendix 3A." Appendix 3A (Section 1.1, page 1-1, line 32) specifies which sections describe the regulatory alternatives.	---
2-4	**Page 2-4, Lines 2-4:** Identify specific information concerning releases from SWMU's. Rather than making reference to DOE/RL-91-28, reiterate exact language. (The DOE/RL-91-28 has undergone several revisions, and is again in revision, so simple reference is not sufficient.) **Requirement:** WAC 173-303-645, 806(4).	5/1/03 Revisit during Chapter 11 discussions
	DOE-RL/FH Response: Reject. Based on previous operating unit permitting application structure, it is appropriate to reference DOE/RL-91-28 for this information. DOE/RL-91-28, section 2.5, and Appendix 2D contain the information used to meet WAC-173-303-860(4)(a)(xxiii). **Yes, DOE-RL and FH agree that DOE/RL-91-28 has undergone revision and currently is being rewritten, however, until such time as DOE-RL and Ecology agree how DOE/RL-91-28 will be referenced, the text will remain the same.**	
3-1	**Page 1-3, Lines 37-41:** The text states that stored mixed waste will meet LDR requirements with the exception of containerized waste where treatment in trench will be performed. This assumes that treatment in the trench has already been authorized. What if in trench treatment is not allowed? What are the alternative plans for this containerized waste? **Requirement:** Ensure that in trench treatment is acceptable.	Closed 9/11/03
	DOE-RL/FH Response: If treatment in the trench is not approved, storage in the mixed waste trenches would be limited to the language in the current Part A, Form 3. The current Part A Form 3 limits storage to waste that is Land Disposal Restrictions (LDR) compliant. **Alternative plans for large container waste would be to have this waste remain in storage at another TSD unit until capability is developed to perform treatment.**	

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
3-2	**Page 1-4, Lines 3-5:** The term "bulk load" has been added to this WAP as an alternative to container. It has been verbally stated that this was done as a cost savings issue. However, the text doesn't provide elaboration on the inclusion of this newly added acceptable waste tracking unit. **Requirement:** Include additional text briefly explaining the basis for specifying bulk loads as an acceptable waste tracking unit.	Closed 9/11/03
	DOE-RL/FH Response: Bulk load was added to the WAP as an option after seeing these operations performed at the Environmental Restoration Disposal Facility (ERDF). Additional text regarding the basis for bulk loads does not appear to be necessary because the waste acceptance process addresses bulk loads the same as containers	
3-3	**Page 1-4, Line 27:** Editorial comment **Requirement:** Change the word "addresses" to "addressed".	Closed 9/11/03
	DOE-RL/FH Response: Accept.	
3-4	**Page 1-5, Line 1:** The term "newly generated" waste has been added to this WAP as a result of the Mod E process. This new designation is very explicit and should be defined. **Requirement:** Include additional information to define "newly generated" waste. This can either be accomplished within the text, or with a footnote.	8/23/2007 Will be addressed in future WAP discussions.
	DOE-RL/FH Response:	
3-5	**Page 2-4, Lines 48-49:** The text states that waste might be stored in the TSD unit while awaiting analytical results for LDR requirements or while awaiting treatment in trench 31 or 34. Once again, is this assuming that in trench treatment has been authorized for these two trenches? **Requirement:** Ensure that in trench treatment is acceptable.	Closed 9/11/03
	DOE-RL/FH Response: Comment noted. Refer to response to NOD 3-1.	
3-6	**Page 2-9, Lines 18-19:** The text states that chemical screening is not required for small containers of waste in overpacked containers (labpacks)... What is the justification of this exemption? What if the waste in the labpacks represent a "not accepted for disposal" category listed on page 1-2, line 39 to page 1-3, line 19? **Requirement:** Provide information on the basis for the exception of labpack chemical testing.	Closed 9/25/03
	DOE-RL/FH Response: Refer to response to NOD 3-8.	
3-7	**Page 2-13, Line 25, General:** This section should note that all non-conformance issues will be documented and maintained in the facilities operating record.	Closed 9/11/03
	DOE-RL/FH Response: Accept. The following sentence will be added to Page 2-13 line 27: "Conformance issue resolution documentation will be maintained in accordance with Section 8.0."	
3-8	**Page 2-15, Lines 10-11:** The text states that for waste shipments with unresolved conformance issues that exceed 90 days, this TSD unit shall contact Ecology at least once per calendar quarter. However, the stated requirement falls short of indicating what the ultimate plan will be for these waste shipments. Will the nonconformance issues be corrected, and then will a follow-up report to Ecology be made? **Requirement:** Include additional detail of the planned actions for these waste shipments with unresolved conformance issues.	Closed 9/25/03
	DOE-RL/FH Response: The language in the WAP was negotiated as part of Mod E for the CWC and WRAP WAPs.	

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(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
3-9	**Page 3-3, Lines 46-48:** The text states that failure of a chemical screening test is defined as a chemical screening result that is inconsistent with the associated shipping documentation. The section then goes on to provide the specific failure criteria for each chemical test. This is useful information. However, the text does not provide information on what actions will be taken if and when a chemical test failure occurs. **Requirement:** Include an "Action Item" for each test that will be completed if failure of that chemical screening test occurs.	Closed 9/11/03
	DOE-RL/FH Response: On page 3-1 lines 5-6, the WAP states conformance issues are managed in accordance with section 2.4.3. Section 2.4.3 describes the resolution process. Due to the need for flexibility in determining how to resolve conformance issues, additional text appears inappropriate. Furthermore, if conformance issues pertain to more than one chemical screening parameter, the resolution process must factor in another layer of complexity.	
3-10	**Page 5-2, Lines 10-12:** The text states that laboratory inspections are performed by the TSD unit. Is there a pre-set frequency for these inspections, or are they prompted by certain QA/QC findings in the data? **Requirement:** Provide more information on the inspection process.	Closed 10/02/03
	DOE-RL/FH Response: For on-site laboratories, we use the audits/inspections performed by and for the FH quality assurance organization. These inspections have no preset frequency, but occur approximately once per year. The Waste Sampling and Characterization Facility received its last inspection in March 2003. The 222-S Laboratory received its last inspection in February 2002 and is due for another inspection soon. Inspections can also be prompted by issues with data quality assurance. Off-site laboratory inspections are performed and managed by DOE. **The text on page 5-2 lines 10-12 will be revised as follows: "Activity based laboratory inspections. Inspections are performed by the TSD unit. Inspections verify that specific guidelines, specifications, or procedures for the activities are completed successfully. Inspections are performed on a periodic basis and could be prompted by issues with data quality assurance."**	
3-11	**Page 5-3, Line 5:** The text states that data validation is not required. It is the opinion of this reviewer that data validation by an independent laboratory is recommended on at least a small percentage of the data. **Requirement:** Re-evaluate why data validation, at the minimum internal, is not needed. Include the rationale within the text.	Closed 9/11/03
	DOE-RL/FH Response: The sentence in the WAP is based on a premise that data validation is a term reserved for CERCLA activities. According to the 1996-1997 waste analysis plan workshops with Ecology, it was agreed that data validation is not required for RCRA processes. For RCRA activities, the phrase "data assessment or evaluation" was considered appropriate as stated on page 5-3 line 6. DOE/FH do not know of a requirement to have an independent laboratory perform data validation. **The sentence on page 5-3 lines 5-6 will be replaced with the following: "The TSD unit is responsible to ensure that data assessment or evaluation is completed. The activities performed to complete the data assessment or evaluations are different from the activities used to perform data validation under CERCLA."**	

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
3-12	**Page 7-2, Lines 25-26:** The text states that when stored mixed waste does not meet treatment standards, treatment in the trench will be performed. Once again, has this been authorized? **Requirement:** Ensure that in trench treatment is acceptable.	Closed 9/11/03
	DOE-RL/FH Response: Comment noted. Refer to response to NOD 3-1.	
3-13	**Page 7-2, line 47 thru Page 7-3, Line 4:** To better understand the applicable regulations, it would benefit both DOE and Ecology to work through an example before this language is captured in the LLBG WAP. Ecology requests a hypothetical EHW, destined for the burial grounds, be introduced and designated for our understanding. **Requirement:** Ensure everyone's interpretation of the regulations is in line.	Closed 10/02/03
	DOE-RL/FH Response: To illustrate this concept for mixed waste EHW, the following three examples are provided: **1. A mixed waste is designated as WP01, EHW and has radiological disposal requirements to bury the waste in a high integrity container. The disposal package is designed to meet the high integrity container requirements. Because the As Low As Reasonably Achievable standard precludes unnecessary exposure, no additional processing of the waste is performed and the waste is disposed as WP01.** **2. A mixed waste is designated as WT01, EHW and no additional disposal requirements apply. Because the As Low As Reasonably Achievable standard precludes unnecessary exposure, no additional processing of the waste is performed and the waste is disposed as WT01.** **3. A proper designation (complete designation) results in a F001-F005 waste designation. Even though the mixed waste possesses properties that would assign WT01 as a waste code, the waste designation processes in WAC 173-303-070 do not require assignment of the WT01 waste code. The EHW LDR does not apply to the waste because the WT01 waste code is not part of a proper waste designation.**	
3-14	**Page 7-3, Lines 32-33 & 43-44:** Incorporate into text the following language: "for review and approval by Ecology". Example: The Permittee can propose, for review and approval by Ecology, other techniques as a Class 3 permit modification downgraded to a 1-prime modification. **Requirement:** Distinguish Ecology to which the proposal will be sent to for approval.	Closed 9/11/03
	DOE-RL/FH Response: Accept.	
4-1	**Page 4-1, Lines 16-17:** Delete first sentence. It is a negative of the proceeding sentence. **Requirement:** n/a	Closed 2/13/03
	DOE-RL/FH Response: Replace the first sentence with: "In general, containers of mixed waste disposed in the LLBG do not contain free liquids and are greater than or equal to 90 percent full."	---
4-2	**Page 4-2, Line 17:** Delete word "typically" or describe instances where mixed waste containers would not be removed to an onsite treatment and/or storage unit or other permitted location before being opened. **Requirement:** WAC 173-303-141, 630(5).	Closed 3/06/03

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
	DOE-RL/FH Response: Accept. Delete the word 'typically'. However, the following will be added to end of sentence on lines 16-18. "However, the LLBG operating organization needs the flexibility to determine on a case-by-case basis when a container needs to be moved. Decisions on whether or not to move waste containers are based on exposure concerns, weather conditions, complexity of operations, risks to human health and the environment, etc. Scenarios where containers might be opened at the LLBG include void space filling and grouting."	
4-3	**Page 4-2, Line 40:** Describe the actions to be taken if the spill or release is radioactive in nature, i.e., if the waste meets LDR but is highly radioactive, then DOE may need to take some action rather than stabilize and leave in place. Also, does DOE expect all waste accepted for storage at LLBG to meet LDR requirements? **Requirement:** WAC 173-303-145(3).	Closed 3/06/03
	DOE-RL/FH Response: Reject. Section 4.1.3 provides the requested information, as the text describes the actions that could be taken. **Yes, the DOE-RL and FH expect waste accepted for storage at LLBG to meet LDR requirements. The Part A, Form 3, found in Chapter 1 of this Part B permit application states, "The greater-than-90-day container storage capability in mixed waste trenches 31 and 34 of the 218-W-5 Burial Ground provides a location to store various sized containers of treated mixed waste in a RCRA-compliant manner other than the Central Waste Complex. Mixed waste will meet land disposal restriction requirements...."**	---
4-4	**Page 4-2, Lines 43-44:** In the event of a spill "solely in the storage configurations" actions are performed, is this to say that nothing will be done in the event of a spill if the trench is in the "disposal configurations"? This is unclear to distinguish between storage configurations and disposal configurations for actions taken for spills. Line 38 on page 4-3 states: "Within a trench, storage and disposal of waste could take place at the same time". Explain the need to delineate between storage configurations and disposal configurations for actions taken for spills. **Requirement:** WAC 173-303.	Closed 3/06/03
	DOE-RL/FH Response: (NOTE: The text of NOD incorrectly references page 4-3, line 38; the correct reference is page 4-2, line 38.) **Specific areas of concern with regard to spills are the storage areas, the truck unloading areas, and the disposal areas. Precautions taken and responses to spills in the truck unloading areas are described in Section 4.5.3.1.11, *Truck Unloading Area Liner System*; 4.5.6 *Liner System, Leachate Collection and Removal System*; and 4.5.7.4 *Maintenance Procedures for Leachate Collection and Removal Systems.*** **Yes, there are no requirements to address actions for releases from disposed containers. Any actions will be determined based on other requirements outside of RCRA.** **To correctly describe conditions at the LLBG, DOE-RL and FH will change the second sentence on page 4-2, line 38 to "Waste could be ~~stored~~ staged temporarily in a trench during the acceptance process."**	—
4-5	**Page 4-3, Lines 25:** Describe criteria for deciding when soil samples would be taken to verify cleanup activity. **Requirement:** WAC 173-303-145(3).	Closed 2/13/03

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
	DOE-RL/FH Response: Accept. The following phrase will be added to the beginning of line 25 on page 4-3. "In the event complete cleanup cannot be demonstrated through visual means, soil samples might be taken..."	---
4-6	**Page 4-3, Line 28:** Please reapply the following language that incorporates an action to support what is to be performed in the event of a spill or release at the LLBG: "When soil sampling techniques have verified cleanup, the LLBG supervisor signs the operating logbook, indicating that the waste was removed from the containment system and cleanup activities are completed". This language is found in both the 1997 Part B application, page 4-3 lines 40-43, and the 2000 MWDU Part B Revision, page 4-3 lines 16-18. **Requirement:** WAC 173-303.	Closed 2/13/03
	DOE-RL/FH Response: Accept. This information will be added as Item 7 in Section 4.1.3.	---
4-7	**Page 4-6, Lines 1-3:** DOE requests an exemption from liner system requirements for mixed waste received for disposal in unlined trenches since August 1987. Ecology denies this request; however, since installation of a compliant liner system for these unlined trenches is unreasonable, Ecology will work with DOE via this permitting process to develop corrective actions and/or other final status conditions that would serve to protect human health and the environment since the liner requirements cannot be achieved. **Requirement:** WAC 173-303-665(2).	3/06/03 Action: revisit during Chapter 11 discussions
	DOE-RL/FH Response: DOE-RL and FH agree that installation of a compliant liner system for these locations is unreasonable and look forward to working with Ecology to establish the appropriate conditions to address this circumstance.	---
5-1 thru 5-13	**Chapter 5, GROUNDWATER MONITORING FOR LAND BASED UNITS [D-10]:** See separate file for 13 Chapter 5 comments.	
6-1	**Page 6-3, Lines 6-7:** Add information as to criteria for implementing immediate remedial actions with respect to the need for protection of human health and the environment. That is, ALARA considerations, availability of supplies, equipment, and personnel are important factors, but the need to protect human health the environment must be factored in as well. **Requirement:** WAC 173-303-320(3).	Closed 3/27/03
	DOE-RL/FH Response: The sentence will be revised to state "Immediate remediation actions are implemented based on protection of human health and the environment, ALARA considerations, and availability of supplies, equipment, and personnel."	—
6-2	**Page 6-3, Lines 27:** The regulations are written as < 30". Change to match units used in the regulations. Be consistent with units throughout permit application. **Requirement:** WAC 173-303-630(5).	Closed 3/06/03
	DOE-RL/FH Response: WAC 173-303-630(5)(c) requires a minimum thirty-inch separation between aisles. The sentence will be revised to include "(30 inches)" immediately following the metric units. Hanford is required by Public Law 100-418 and Executive Order 12770 to use the metric system.	---
6-3	**Page 6-8, Lines 32-33:** Please replace the following sentence: "No ignitable or reactive is be stored in mixed waste trenches." with "No ignitable or reactive waste is to be stored in the mixed waste trenches." **Requirement:** Clarification	Closed 3/06/03
	DOE-RL/FH Response: Accept. The sentence will be removed and replaced with: "No ignitable or reactive waste subject to 40 CFR 268 is to be stored in the mixed waste trenches."	

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
6-4	**Page T6-1:** Table 6-1 – Reiterate types of problems as identified in WAC. (See attached example from draft WRAP permit). Add references to applicable WAC regulations. **Requirement:** WAC 173-303-320, -395, - 630.	Closed 5/1/03
	DOE-RL/FH Response: Additional detail regarding the types of problems is found in Section 6.2.3. The following change to text will be made: The third column in Tables 6-1, 6-2, and 6-3 (all entitled "Types of Problems") will be marked with the footnote.: "Refer to Section 6.2.3." **Retitle Table 6-3 to 'General Inspections'.** **In addition the word "or" will be changed to "of" on page 6-2, line 29 to read "... types of problems..".**	
7-1	**APP 7A-i, BEP, Page 11, Section 6.1.1:** "Loss of Utilities"- Need to explain a contingency plan or the next step if power is not restored and the leachate accumulation is in excess. Generators?? **Requirement:** WAC 173-303.	Closed 3/06/03
	DOE-RL/FH Response: Section 6.1.1 is not an enforceable section of the Building Emergency Plan. See response to 7-2.	---
7-2	**APP 7A-i, BEP, Page 18, Section 7.2.1:** "Loss of Utilities"- Need to explain a contingency plan or the next step if power is not restored and the leachate accumulation is in excess. Generators?? **Requirement:** WAC 173-303.	Closed 3/06/03
	DOE-RL/FH Response: Accept. The following sentence will be added to the <u>Loss of Electricity</u> bullet: "In the event of a loss of electrical power and the leachate accumulation is in excess, a generator will be used to provide temporary power."	---
7-3	**APP 7A-i, BEP, Page 21, Section 7.2.5.1:** Damage or Unacceptable Shipments [III.8.B.f.1 settlement agreement]- What Ecology would like to see in this Section: During the course of receiving dangerous and/or mixed waste at LLBG, an unanticipated event could be discovered resulting in a discrepancy concerning the waste. In some cases, the discrepancy will result from receiving an off-site shipment, manifested pursuant to Hanford Facility RCRA Permit, condition II.P.1 or WAC 173-303-370 that is damaged or otherwise presents a hazard and cannot be transported. Damaged or unacceptable shipments resulting from onsite transfers are not subject to WAC 173-303-370 however discrepancies must be resolved in order to maintain proper records. Regardless of whether the waste is received as an off-site shipment or on-site transfer, the following actions are taken: • Operations management is notified of the damaged or unacceptable waste to be received. • If the discrepancy results in a spill or release, actions described in section 7.2.5 are taken. • The generating organization is notified of the discrepancy. • An operations representative, in conjunction with the generating organization, determines the course of action to resolve the discrepancy. **Requirement:** WAC 173-303.	Closed 3/06/03
	DOE-RL/FH Response: Accept.	---

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

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NOD Comments		
Comment No.	Comment	Closed on
7-4	**APP 7A-i, BEP, Page 28, Section 9.2:** "Portable Emergency Equipment" – For the footnote, within the table contained in Section 9.2 under the Capability heading, at the bottom of Page 28. Ecology would make the recommendation that it reads: "This equipment is for radiological emergency response purposes only. Though it is not required under regulatory authority to be a part of the permit modification process it will be provided within the Building Emergency Plan as to maintain an up-to-date plan." **Requirement:** WAC 173-303.	Closed 3/27/03
	DOE-RL/FH Response: Accept. The change will be made by placing an asterisk after the equipment in the left hand column of the table. The asterisk will refer to the following text: "This equipment is for radiological emergency response purposes only. It is not Ecology's intent to regulate radionuclides. However, it is necessary to maintain an up-to-date complete BEP."	---
7-5	**APP 7A-i, BEP, Page 29, Section 9.4:** "Personal Protective Equipment"- Where is MO-289? **Requirement:** WAC 173-303.	Closed 7/24/03
	DOE-RL/FH Response: MO-289 is located in the CWC Complex in 200 West Area. MO-289 is directly east of 2401-W and next to Dayton Ave. The text in the table will be changed to state: "CWC/LLBG Emergency Response Trailers". **In addition, the following changes to enforceable sections are noted and have been incorporated into Revision 11 of the Building Emergency Plan for the Low-Level Burial Grounds** • **Section 3.1, 2nd sentence, capitalize the words "Incident Command System".** • **Section 3.1, 4th sentence, reword to read: "The Incident Command Post (ICP) is managed by the senior Hanford Fire Department official, unless the event is determined to primarily be a security event, in which case the Hanford Fire Department and Hanford Patrol will operate under a unified command system with Hanford Patrol making all decisions pertaining to security."** • **Section 4.0, third paragraph, last sentence, removed *"Hanford Emergency Management Plan"*** • **Section 7.1.1, 'AREA EVACUATION PROCEDURE' table, removed note** • **Section 7.1.2, second paragraph, first line, removed 'at MO-233'** • **Section 7.2.4, first bullet, added comma after 'Unless otherwise instructed'** • **Section 9.1, information converted to table format** • **Section 9.4, changed 'Full-faced respirators' to 'Respirators'; changed '271-T Mask Station' to 'MO-721'; changed 'MO-289' to 'CWC/LLBG Emergency Response Trailers'** • **Section 9.5, changed all 'CWC Emergency Response Trailers' to 'CWC/LLBG Emergency Response Trailers'** • **Figure 1, updated.** **In addition, text from Sections 8.2, 8.3, 8.4, 9.6, 11.0, 12.0 13.0, inadvertently omitted in original transmittal has been provided.**	
8-1	**General:** The text of this "Unit-specific Chapter 8.0" is too general to be called unit-specific. **Requirement:** Rewrite Chapter 8.0, making it specific to the LLBG unit, as indicated in Ecology Comments below.	Closed 7/24/03

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Comment No.	Comment	Closed on
	DOE-RL/FH Response: Chapter 8 terminology is consistent with the units in Part III of the Hanford Facility RCRA permit, including for the Waste Treatment Plant (WTP). With the exception of the WTP, training plan documentation is not attached to the Hanford Facility RCRA Permit. In addition, the text in LLBG Chapter 8 is consistent with the text in DOE/RL-91-28 Chapter 8 (also referred to as Attachment 33 of the Hanford Facility RCRA permit depending on whether the document is considered a permit application or a permit attachment). The Chapter 8 text is designed for any operating unit at the Hanford Facility. **The development of the information contained in Chapter 8 a few years ago resulted in Class 1 permit modifications being agreed to by Ecology for the Part III units (except WTP). The details of the text were negotiated during the 222-S Laboratory Complex NOD process. Since completion of the 222-S Laboratory Complex NOD process and the Class 1 Permit modifications, similar text has been used for CWC and WRAP settlement agreement processes as well as T Plant NOD processes. Within FH, the LLBG is part of a four unit organization structure sometimes referred to as the "solid waste units" (CWC, WRAP, T Plant, and LLBG). Consistency between these four TSD units, as well as across all FH units is critical to maintaining compliance from a programmatic perspective.**	
8-2	**Page 8-1, Line 18-19:** Line 18 uses "TSD unit" in the singular, and Line 19 uses it in the plural. At the Hanford Facility, the LLBG is considered a single TSD unit. Also, see Ecology Comment #1. **Requirement:** Change "the TSD unit(s)" on Lines 18-19" to "the LLBG TSD unit".	Closed 7/24/03
	DOE-RL/FH Response: The context of the singular and the plural is proper in the context of the two sentences. See response to comment 8-1.	
8-3	**Page 8-1, Lines 25-32:** These bulleted objectives should be specific to the LLBG unit. See Ecology Comment #1. **Requirement:** Line 25 – Replace "Hanford Facility personnel" with "LLBG unit personnel", and "Hanford Facility's" with "LLBG unit's". Line 28 – Replace "Hanford Facility personnel" with "LLBG unit personnel". Line 32 – Replace Hanford Facility personnel" with "LLBG unit personnel".	Closed 7/24/03
	DOE-RL/FH Response: The term Hanford Facility personnel is appropriate because the LLBG is subject to condition II.C that discusses requirements for Hanford Facility personnel See response to comment 8-1.	
8-4	**Page 8-1, Lines 36-44:** See Ecology Comment #1. **Requirement:** Line 36 – Insert "LLBG" in front of "TSD unit-specific training". Line 38 – Insert "The LLBG" in front of "TSD unit-specific training". Line 38-39 – replace "Hanford Facility personnel" with "LLBG unit personnel". Line 40 – replace "Hanford Facility personnel" with "LLBG unit personnel". Lines 42-43 – replace "Hanford Facility" with "LLBG unit".	Closed 7/24/03
	DOE-RL/FH Response: See response to comment 8-1 and comment 8-3.	
8-5	**Page 8-2, Lines 3-25:** See Ecology Comment #1. **Requirement:** Rewrite the sections on Contingency Plan, Emergency Coordinator and Operations training making them specific to the LLBG unit.	Closed 7/24/03

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NOD Comments		
Comment No.	Comment	Closed on
	DOE-RL/FH Response: See response to comment 8-1.	
8-6	**Page 8-2, Line 6:** The "description of actions" reference needs to be more specific. **Requirement:** Insert ",as indicated on Table 7-1," after "Appendix 7A".	Closed 7/24/03
	DOE-RL/FH Response: Reference to table 7-1 is not necessary because line 6 already references to chapter 7 and Appendix 7A. See response to comment 8-1.	
8-7	**Page 8-2, Line 17:** Is the use of "unit-by-unit" here in reference to TSD unit, or to dangerous waste management unit as defined in WAC 173-303-040? **Requirement:** Please clarify.	Closed 7/24/03
	DOE-RL/FH Response: Unit refers to the definition of "unit" in the Hanford Facility RCRA permit. The definition states: "The term "Unit" (or "TSD unit"), as used in Parts I through VI of this Permit, means the contiguous area of land on or in which dangerous waste is placed, or the largest area in which there is a significant likelihood of mixing dangerous waste constituents in the same area. A TSD unit, for purposes of this Permit, is a subgroup of the Facility which has been identified in a Hanford Facility Dangerous Waste Part A Permit Application Form 3."	
8-8	**Pages 8-2, Line 17:** The definition of a dangerous waste management unit in WAC 173-303-040 includes container storage areas, not "container management unit". **Requirement:** Change "container management unit" to "container storage area".	Closed 7/24/03
	DOE-RL/FH Response: No change, based on responses to comment 8-7 and that other Part III TSD units manage containers.	
8-9	**Page 8-2, Line 21:** The term "general training" is inconsistent with terminology used in the LLBG Training Plan, and could be confused with General Hanford Facility training. **Requirement:** Change "general training" to "general waste management unit training" to be consistent with your training plan (see Page 3, last paragraph, item #2 (HNF-1221, Rev. 5)).	Closed 7/24/03
	DOE-RL/FH Response: Line 32 'General Hanford Facility Training' refers to DOE/RL-91-28, section 8.1 and not the LLBG training plan.	

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NOD Comments		
Comment No.	Comment	Closed on
8-10	**Page 8-2, Line 20-25 and Page 8-3, Lines 3-8:** There is not enough detail on the "supplemented training" at the TSD unit. In the LLBG Training Plan, the wording "supplement training" is used to describe the type of additional training provided when general waste management unit training curriculum doesn't address the waste management duties for a job title/position (see Page 3, last paragraph, item #3 (HNF-1221, Rev. 5)). Once it is determined existing training curriculum does not address waste management duties for a particular job title/position, two options are available: 1) provide classroom instruction, or 2) provide on-the-job training (OJT) [WAC 173-303-330(1)]. Whichever is provided, both of these types of training need to be defined, and your training plan updated. Please note that the LLBG Training Plan does not define OJT (i.e. there is no description of the objectives to be met, a time period for completing those objectives, a training frequency, nor an indication of how completion of the OJT is documented). Without this information in your training plan, it is unacceptable to refer to OJT as meeting personnel dangerous waste training requirements. Also, see Ecology Comment #1. **Requirement:** In Section 8.2, *Description of Training Design,* explain the process of supplementing training when it's discovered existing training curriculum does not cover waste management duties for a job title/position, addressing both development of new classroom instruction and OJT. Note that until OJT is defined in the LLBG Training Plan, it is unacceptable to reference it here in Chapter 8.0.	Closed 7/24/03
	DOE-RL/FH Response: DOE-RL/FH Response: The level of detail requested for supplemental training at the unit was purposely avoided in the permit application and the training plan documentation. Compliance review on this level of detail is reserved for Ecology compliance inspectors during compliance inspections. Whether FH chooses classroom or OJT provisions to meet training needs for a particular waste management duty is documented in Table 3-2 of the LLBG Dangerous Waste Training Plan (the core document component of the training documentation). FH is prepared on compliance inspections to discuss the rationale how this selection is made. **Regarding the requested level of detail for OJT, it was determined through previous negotiations with Ecology that the level of detail contained in the permit application is appropriate to meet the permit application requirements of WAC 173-303-806(4)(a)(xii). In addition, see response to comment 8-1.**	

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NOD Comments		
Comment No.	Comment	Closed on
8-11	**Page 8-2, Lines 29-30 and Lines 41-44:** Here you assert that continuing training meets the WAC 173-303-330(1)(b) requirements which is "...an annual review of the training provided in the training program.". Further discussion states operations refresher training occurs on many frequencies, and some training occurs one-time only when accompanied by a justification. This assertion is incorrect. Neither Chapter 8.0 nor the LLBG Training Plan describes a documented, annual review of the training provided in the training program with personnel. As a result, training courses offered on a frequency of less than annual do not comply with WAC 173-303-330(1)(b). For clarification, this does not mean all training must be offered and completed annually – it means the training provided in the LLBG Training Program must be reviewed annually to determine if refresher training is required. In addition, note that the LLBG Training Plan does not provide a justification for the one-time only frequency for courses 300410 and 300700. Also, see Ecology Comment #1. **Requirement:** Describe in Chapter 8.0 how you intend to meet WAC 173-303-330(1)(b). For example, this requirement could be met by providing an annual review of the employees training with their manager to determine what areas the employee requires refresher training in. The evaluation should be based on employee past performance and feedback, addition or reduction of waste management duties for their job title/position, and any changes (i.e. additions/reductions) in the curriculum of required training courses. Documentation that this annual review is performed must be maintained to demonstrate compliance.	Closed 7/24/03
	DOE-RL/FH Response: The Ecology suggested interpretation of how "annual" provisions are implemented at Hanford is inconsistent with the compliance history at Hanford from past Ecology compliance inspections during the 1990s. The history shows that Ecology has been concerned with "annual" being the retraining frequency when a course has been identified as annual. This annual provision has received much attention in the past and has resulted with Ecology agreeing to a plus or minus 30-day window on retraining frequency documented in DOE/RL-91-28 Section 8.4 as referenced by Chapter 8, page 8-4 line 18. The text states: **"In administering certain training courses, a retraining date could be set by TSD unit management. The formal retraining date is a date (day/month/year) counting from the most recent initial training date or another baseline date established for the training. The formal retraining date remains the same each year regardless of when retraining is completed. Retraining is to occur within 30 days of the formal retraining date. While it is preferable to complete retraining within the 30 days before the formal retraining date, managers have the ability to authorize personnel for 30 days beyond the formal retraining date, thus allowing a 60-day window in which to satisfy the retraining requirements."** **Refer to response to comment 8-1 regarding the appropriate level of detail for Chapter 8.0.** **The course frequency must be specified in the TSD-unit specific training plan documentation and justified when the frequency is not annual according to Page 8-2 line 42-44. According to the course description information provided for courses 300410 and 300700, DOE/FH agrees that the justification is not provided. The two course descriptions will be reviewed, and as appropriate, revised.**	

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NOD Comments		
Comment No.	Comment	Closed on
8-12	**Page 8-3, Line 10:** Other than the reference on Page 8-2, Lines 9-10 to "emergency coordinator duties in WAC 173-303-360", no other waste management duties are mentioned. Referencing the reader to the entire Section of 8.1 is misleading. **Requirement:** Specifically identify which waste management duties you wish to include here (i.e. waste management duties contained in the LLBG Training Plan, which includes those identified in WAC 173-303-330(1)(d) and -360).	Closed 7/24/03
	DOE-RL/FH Response: It is difficult to determine if the NOD is written against Page 8-3, line 10 or Page 8-2, lines 9-10. The text in both locations is appropriate for the context of the sentences.	
8-13	**Page 8-3, Line 14:** Here you list procedures for using, inspecting, repairing, and replacing emergency and monitoring equipment as a training element of WAC 173-303-330(1)(d) applicable to the LLBG operations. Note that the LLBG Training Plan does not address procedures for inspecting, repairing, and replacing emergency and monitoring equipment, only those procedures for using emergency and monitoring equipment. **Requirement:** The LLBG Training Plan requires updating to address procedures for inspecting, repairing, and replacing emergency and monitoring equipment. Until that is completed, the listing of those procedures here in Chapter 8.0 is unacceptable.	Closed 5/15/03
	DOE-RL/FH Response: **The Dangerous Waste Training Plan will be revised. Table 2-1 of the Dangerous Waste Training Plan will have an asterisk placed at the end of the text contained in the first row, first column. A new footnote will be added to Table 2-1 which states: "Duties relating to inspecting, repairing, or replacing emergency monitoring equipment are outside the scope of the RCRA training program, but these duties are met based upon the Hanford Emergency Management Plan, DOE/RL-94-02 Sections 11.3 and 11.4."** **The requirements in WAC 173-303-330(1)(d) as described in permit application documentation have been implemented as "emergency" related duties. The words "inspecting, repairing, or replacing" are not considered to be emergency response duties and therefore are considered not applicable according to WAC 173-303-330(1)(d). The LLBG DWTP (the core document) does not address these terms because they are not considered emergency duties. See LLBG DWTP Section 2.1 title "Emergency Response" and Table 3-2 Operations Program first subsection "Emergency Response [contingency plan duties from WAC 173-303-330(1)(d)]." Because they have not been considered emergency duties, they have not been discussed in the training documentation. See the enforceable sections of the Hanford Emergency Management Plan (DOE/RL-94-02) that make up the RCRA contingency plan. Section 11.2, Emergency Equipment of DOE/RL-94-02 is enforceable but Sections 11.3, Maintenance and Testing of Alarm And Communication Systems and 11.4, Inventory of Emergency Equipment are not.**	

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NOD Comments		
Comment No.	Comment	Closed on
8-14	**Page 8-3, Lines 10-17:** Pursuant to WAC 173-303-330(1)(d)(vi) and Table 3-2 of the LLBG Training Plan (HNF-1221, Rev. 5) [Note: see Table 3-2 *LLBG Waste Management Duty Crosswalk*, "Operations Program", "Understand key parameters for automatic waste feed cut-off systems". Course 300085 qualifies the NCO on the systems of the Mixed Waste Trenches, and Course 300090 qualifies and certifies the NCO to operate the Mixed Waste Trenches.], "Key parameters for automatic waste feed cut-off systems" should be included in this bulleted list, since it applies to the operation of mixed waste trenches. **Requirement:** Include "Key parameters for automatic waste feed cut-off systems" as a bullet in this list.	Closed 5/7/03, based on new text
	DOE-RL/FH Response: The leachate tank system is managed under the generator provisions. The training documentation addresses both generator and TSD unit provisions together. The NCO does perform these duties and is trained according to the generator provisions. It is inappropriate to add generator duties to a permit application based on WAC 173-303-600(3)(d). This WAC 173-303-330(1)(d) duty does not appear in the permit application because the duty is associated with tank system operations. Key parameters for automatic waste feed cut-off systems and the shutdown of operations duty does not apply to container management activities or to landfill activities. This determination is consistent with other FH/Part III TSD units	
8-15	**Page 8-3, Lines 10-17:** Pursuant to WAC 173-303-330(1)(d)(vi) and Table 3-2 of the LLBG Training Plan (HNF-1221, Rev. 5) [Note: see Table 3-2 *LLBG Waste Management Duty Crosswalk*, "Operations Program", "Shutdown operations". Course 300085 qualifies the NCO on the systems of the Mixed Waste Trenches, and Course 300090 qualifies and certifies the NCO to operate the Mixed Waste Trenches.], "Shutdown of operations" should be included in this bulleted list, since it applies to the operation of mixed waste trenches. In addition, shutdown of operations is also applicable to container storage and accumulation areas. For example, in an emergency, procedures for container storage and accumulation areas should address ensuring individual containers and container storage and accumulation areas are secured (i.e., lids are restored to any open containers and the container storage or accumulation area is locked to prevent unauthorized access). **Requirement:** Include "Shutdown of operations" as a bullet in this list.	Closed 5/7/03
	DOE-RL/FH Response: Refer to response to comment 8-14.	
8-16	**Page 8-3, Lines 27-29:** The statement is made that Training Plan documentation is maintained outside of the Hanford Facility Dangerous Waste Part B Permit Application and the HF RCRA Permit, and therefore, changes made to the training plan documentation are not subject to the HF RCRA Permit modification process. This statement is incorrect. In accordance with WAC 173-303-830, Appendix 1 *Modifications*, changes in the training plan that effect the type or decrease the amount of training given to employees is a Class 2 permit modification. All other changes are a Class 1 permit modification. **Requirement:** Add the following qualifier: "therefore, changes made to the training plan documentation are not subject to the HF RCRA Permit modification process, to the extent that those changes do not affect the type or decrease the amount of training given to employees, or do not cause a modification to information contained in Chapter 8.0, *Personnel Training*."	Closed 5/15/03

NOD Comments		
Comment No.	Comment	Closed on
	DOE-RL/FH Response: DOE/FH agrees that changes to the training plan documentation must be maintained so that the documentation complies with the training outline contained in the permit application. DOE/FH bear the responsibility to ensure that the training documentation is consistent with the Permit. The existing language has been deemed sufficient to meet this objective through previous negotiations. The Class 2 modification provisions are applied to Table 8-1.	
8-17	**Page 8-3, Lines 32-35:** This entire paragraph on "documentation" is too general to be clearly understood. Rather than specifying what exactly that documentation is, you include the generic sentence "The training plan documentation consists of one or more documents and/or a training database with all the components identified in the core document." This outline of the training program must be specific to the LLBG unit. In addition, you assert that all the components of the training plan documentation are identified in the core document. The "core document" is never identified. **Requirement:** Specifically identify what documentation is used to meet the requirements of WAC 173-303-330. Indicate (for each) if that documentation is maintained in hard copy, electronic media, or both. For example, you could begin the paragraph with "Documentation prepared to meet the training plan requirements consists of the LLBG Training Plan (hard copy), and the Training Records Database (electronic).	Closed 5/7/03
	DOE-RL/FH Response: Documentation to meet the requirements of WAC 173-303-330 is broader than the permit application requirements contained in WAC 173-303-806(4)(a)(xii). Because the Chapter 8.0 language has been negotiated for previous TSD units and the language must be implementable for all co-operators on the Hanford Facility, the language in the permit application is appropriate. Within FH, the LLBG Dangerous Waste Training Plan is considered the 'core document' for this unit. The LLBG Dangerous Waste Training Plan provides reference to other training documentation components. DOE/FH must maintain a level of flexibility to make improvements to the training program without unnecessary permit modifications. The existing text of the permit application strikes this balance. FH is prepared to answer questions concerning what media information is maintained during compliance inspections.	
8-18	**Page 8-3, Lines 47-49:** Here you state "Only names of Hanford Facility personnel who carry out job duties relating to TSD unit waste management operations at the LLBG are maintained." Pursuant to WAC 173-303-200(1)(e), you are also required to maintain names of personnel at the LLBG unit who perform >90 day accumulation activities. **Requirement:** Delete the word "Only".	Closed 5/15/03
	DOE-RL/FH Response: Regarding the requirement to maintain names, DOE/FH agrees that generator operations and TSD unit operations are subject to WAC 173-303-330(3)(a) requiring that names are maintained. Because generator activities are not subject to the permit process based on WAC 173-303-600(3)(d), information about generator activities is not included in the permit application. During the NOD workshops Ecology clarified that the comment refers to less than 90 Day accumulation and not greater than 90 day storage.	
8-19	**Page 8-3, Lines 48-49:** The text "Names are maintained within the training plan documentation." is too general. Again, you have not defined training plan documentation (see Ecology Comment #17). **Requirement:** Specify where the names are maintained, and if they are maintained in hard copy, electronic copy, or both.	Closed 5/7/03

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NOD Comments		
Comment No.	Comment	Closed on
	DOE-RL/FH Response: Refer to response to comments 8-17 and 8-18. Within FH, names are maintained within a database called the Integrated Training Electronic Matrix (ITEM). On page 4 of 22 of Rev 5 of the LLBG Dangerous Waste Training Plan, Section 3.0 discusses how names are maintained and the format by which the names are maintained.	
8-20	**Page 8-4, Lines 1-2:** In reference to requisite skills, education, other qualifications for job titles/positions" See Ecology Comments #17 and #19. **Requirement:** Specify where this information is maintained, rather than using the example "human resources".	**Closed 5/15/03**
	DOE-RL/FH Response: Refer to response to comments 8-1, 8-17, 8-18, and 8-19. On page 5 of 22 of the LLBG Dangerous Waste Training Plan, the text states that FH Human Resources department maintains this information.	
8-21	**Page 8-4, Lines 9-12:** This paragraph asserts that both the type and amount of training is specified in the training plan documentation as shown in Table 8-1. This is too general, and as to the assertion that the amount of training is shown in Table 8-1, incorrect. **Requirement:** Specifically identify what training plan documentation you are referring to.	**Closed 5/15/03**
	DOE-RL/FH Response: The training plan documentation for FH is explained in response to comment 8-17. The structure of Table 8-1 in conjunction with the training plan documentation has been established in previous TSD unit negotiations with Ecology; refer to response to comment 8-1.	
8-22	**Page T8-1, Table 8-1. *LLBG Training Matrix*:** The training matrix is too general, and doesn't completely match Table 3-2 *LLBG Waste Management Duty* Crosswalk (HNF-1221, Rev. 5), causing a couple of problems. First, the "Operations Program" title from Table 3-2 does not clearly correspond to Table 8-1. Second, because the categories on Table 8-1 are listed generally, it is impossible to tell what training from that category each job title/position is required to have without looking at the training plan. For example, according to Table 8-1, the NCO is required to have "General Waste Management" training. Because the amount of training isn't specified on Table 8-1, the assumption is that the NCO is required to complete any training related to "General Waste Management". When Table 3-2 is reviewed, it is clear that the NCO only needs part of the "General Waste Management" training for the duties he/she is required to perform. Table 8-1, in its current format, prohibits Ecology from performing its obligation to control, through your RCRA permit, changes that affect the type or decrease the amount of training being offered to personnel (WAC 173-303-830, Appendix 1). **Requirement:** Decide on a consistent title, either "Operations Program" or "Emergency Response (contingency plan), for clarity within LLBG Waste Management Duty Crosswalk comparison to Table 8-1 Training Matrix. Revise the format of Table 8-1, providing enough detail for Ecology to determine the amount of training required for each job title/position in each training category.	**Closed 6/5/03**

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Comment No.	Comment	Closed on
	DOE-RL/FH Response: To improve the correlation between the Table 8-1 columns and the LLBG Dangerous Waste Training Plan, a new row covering the last five columns will be added to Table 8-1 with the words 'Operations Program'. The level of detail in Table 8-1 is constructed purposefully at a level of detail that is less than Table 3-2 of the LLBG DWTP in order to provide the appropriate level of control while still maintaining the appropriate level of flexibility to prevent excessive permit modifications. Based on previous agreements that established this level of detail, Ecology compliance inspectors during compliance inspections will compare the Permit information to the training documentation, question appropriate personnel during the inspection, request appropriate documentation during the compliance inspection, and determine if personnel are trained properly for the duties they perform.	
9-1 10-1	**Chapters 9 and 10:** No comment.	
	DOE-RL/FH Response: Noted.	
Revisit NOD 4-7 during chapter 11 discussions.		
11-1	**Page 11-1, Lines 1-17, 11.0 CLOSURE AND FINANCIAL ASSURANCE [I]:** The closure and postclosure activities for trenches within the entire LLBG, TSD unit boundaries must be addressed within the Part B permit application. The radionuclide component of the waste must be addressed as part of the closure action. Integration of SWMU's, RPP units, post-1987 mixed waste closure activities and corrective actions must be described. **Requirement:** TPA, Section 6.3.2, WAC 173-303-665(6)(a), -610(3), -645, -806(4)(a)(xiii).	**Chapter 11 NODs closed 11/4/04 (See workshop minutes) upon DOE commitment to rewrite and resubmit Chapter 11. New Chapter 11 submitted February 2005. Permittees will update Chapter 11 on the next update of the Part B Applciation.**
	DOE-RL/FH Response:	
11-2	**Page 11-1, Lines 3-5:** Delete the following sentence that begins with: "Mixed waste is defined as ....". Mixed waste is defined in WAC 173-303-040. **Requirement:** WAC 173-303-040.	**Closed See 11-1**
	DOE-RL/FH Response:	

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Comment No.	Comment	Closed on
11-3	**Page 11-1, Line 11:** Delete the following sentence that begins with: "The closure process will be the same ...". The requirements for closure may differ depending on the ability to meet the closure performance standards as defined in WAC 173-303-610(2). Landfill closure standards of WAC 173-303-665(6) are appropriate for the compliant mixed waste trenches (trenches 31, 34 and 94); however the remaining trenches do not meet the design and construction requirements. As a result closure requirements may differ. Activities and releases from all trenches must be evaluated and considered. **Requirement:** WAC 173-303-610(2) and (3).	**Closed See 11-1**
	DOE-RL/FH Response:	
11-4	**Page 11-1, Lines 24-25:** Define the unused portions of the LLBG where future mixed waste trench locations are anticipated. **Requirement:** WAC 173-303-803(3)(h).	**Closed See 11-1**
	DOE-RL/FH Response:	
11-5	**Page 11-1, Lines 27-28:** Delete sentence. See comment #35. **Requirement:**	**Closed See 11-1**
	DOE-RL/FH Response:	
11-6	**Page 11-1, Lines 30-34:** In addition to complying with WAC 173-303-665(6) and WAC 173-303-610, and variations for cover designs, additional requirements for closure may be needed depending on activities and releases from all trenches. See comment #37. **Requirement:**	**Closed See 11-1**
	DOE-RL/FH Response:	
11-7	**Page 11-1, Lines 37-39, 11.2 CLOSURE PERFORMANCE STANDARDS [I-1a]:** Ecology agrees that the General Information Portion (DOE/RL-91-28, Chapter 11.0) provides a general discussion of landfill closure, however, detailed information on closure and postclosure activities must be described in the unit specific closure and postclosure permit applications. Detailed information identifying the steps necessary to perform partial and/or final closure of the facility at any point during its active life is required. **Requirement:** WAC 173-303-610(3)(a).	**Closed See 11-1**
	DOE-RL/FH Response:	
11-8	**Page 11-1, Lines 42-46 and Page 11-2, Lines 1-30, 11.3 PRE-CLOSURE ACTIVITIES:** Pre-closure activities must describe in detail, on a trench by trench basis, the integration activities described in comment #35. **Requirement:**	**Closed See 11-1**
	DOE-RL/FH Response:	
11-9	**Page 11-2, Lines 2-3:** Clarify which closure requirements specified in WAC 173-303-610 that USDOE deems appropriate. **Requirement:** WAC 173-303-610.	**Closed See 11-1**
	DOE-RL/FH Response:	
11-10	**Page 11-6, Lines 1-6, 11.7 SCHEDULE FOR CLOSURE [I-1f]:** The schedule for closure should incorporate the time frames associated with the RPP and/or CPP operable unit (OU) activities. In addition, the USDOE shall provide a strategy for partial closure of individual burial grounds including projected closure dates. **Requirement:** TPA 6.3.2 and WAC 173-303-610(4).	**Closed See 11-1**
	DOE-RL/FH Response:	

Responses to Ecology comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Chapter 5 GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
11-11	**Page 11-6, Lines 14-15, 11.9 POSTCLOSURE PLAN [I-3]:** A postclosure permit application is required to be submitted in conjunction with the closure plan per TPA section 6.3.2. The postclosure plan must describe maintenance and inspection activities, groundwater monitoring actions and corrective actions if necessary that will occur during the postclosure period. **Requirement:** TPA 6.3.2 and WAC 173-303-610(3), (7) and (8).	**Closed See 11-1**
	DOE-RL/FH Response:	
12-1	**Page 12-1, Lines 2-38:** Delete chapter 12. For the draft WRAP and CWC permits, Ecology and DOE agreed that the Sitewide permit already contains language that requires compliance with all applicable portions of the RCRA permit which currently includes Attachment 33, General Information Portion and any unit-specific recordkeeping requirements embodied in the other chapters of the individual unit permits. However, if DOE's position is that some of the requirements of the GIP are not applicable, DOE should identify these portions. In this case, exceptions to Attachment 33, Table 12-1, should be noted in Chapter 12 of the permit application. NOTE: The future of the GIP is under consideration and may or may not remain as an attachment to the Sitewide permit. **Requirement:** WAC 173-303-380, -806.	**Closed 3/27/03**
	DOE-RL/FH Response: The text of Chapter 12 will be deleted and replaced with: "LLBG Reporting and Recordkeeping will based upon General Information Portion (DOE/RL-91-28), and any other unit-specific requirements embodied in the chapters that become attached to the Hanford Facility RCRA permit."	
	Chapter 13: No Comment. **Requirement:**	
	DOE-RL/FH Response: Noted.	

Enclosure 2
Responses to Ecology Groundwater comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

Responses to Ecology Groundwater comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Non-GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
5-1	**Chapter 5, GROUNDWATER MONITORING FOR LAND BASED UNITS [D-10]:** Chapter 5 of the above referenced permit application has been reviewed. A Washington State Department of Ecology (Ecology) checklist was completed. Approximately 350 deficiencies were generated. Due to the significance and number of deficiencies, Ecology has summarized below a number of the most significant deficiencies (comments 13-24).	**11/4/04**
	DOE-RL/FH Response: Noted.	
5-2	**Chapter 5:** The groundwater flow directions depicted beneath Low Level Waste Management (LLWMA) units 1 and 2 are not sufficiently supported by groundwater data and/or aquifer testing. Annual groundwater monitoring reports indicate a very flat potentiometric surface with varying potentiometric surface readings that do not consistently support the identified groundwater flow direction. For example, in the vicinity of LLWMA 1, from the 2001 annual groundwater report, it may be concluded that the direction of groundwater flow is due south or northeast, or even radial. As another example, from the 2000 annual groundwater report, it may be also be concluded that the direction of groundwater flow is due east, northeast, northwest, or radial. In summary, the water level measurements associated with LLWMAs 1 and 2 neither consistently reflect the same potentiometric surface nor reflect a potentiometric surface gradient that provides confidence of accurate groundwater flow direction determinations. Sufficient data must be provided to support groundwater flow direction(s) which allow an identification of upgradient and down gradient monitoring wells.	**11/4/04**
	DOE-RL/FH Response: Further details on the aquifer testing and flow directions in LLWMA-2 will be incorporated as noted below. As stated in the application, the gradient is extremely low in the 200 East Area. The low gradient means that the declining water levels are expected to continue to affect flow directions. In addition, the low gradient will lead to high variability in flow due to minor fluctuations in relative water levels and barometric effects. This will have the effect of increasing dispersion. These low and variable gradients are one reason intra-well statistics are recommended rather than upgradient-downgradient comparisons. Ongoing evaluation of flow direction through site closure and post closure monitoring will be needed. **As stated in the application, trend-surface analysis for LLWMA-1 supports the flow direction to the northwest. In addition, the FY02 groundwater report (PNNL-14187) presents a new analysis of water-level data which relies on multiple 3-point calculation of water table surfaces. This technique has the advantage of providing a measure of the mean flow direction and an indication of the variability introduced by the measurement process. The FY02 analysis supports a flow direction towards the northwest. The calculated flow direction toward the northwest is also consistent with the shape of contaminant plumes from other sources in the vicinity. The distribution of monitoring wells around LLWMA-1 provides sufficient**	

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	coverage to detect contamination even given the variation and uncertainties in gradient. The last paragraph of section 5.3.1.1 (p. 5-5 lines 8-22) will be modified to read: The groundwater flow direction in this portion of the 200 East Area is believed to be toward the northwest, with estimated groundwater-flow velocities of less than 0.5 meter per day (Hartman et al. 2002, Table A.2). Water levels in Low-Level Waste Management Area 1 monitoring wells are all within 0.1 meter of each other and these data indicate low hydraulic gradient conditions (i.e., ~0.1m/km) across the waste management area. Uncertainties caused by borehole deviation from vertical and limits of measurement precision restrict the use of water-level data for quantitative determination of groundwater-flow characteristics in low-gradient areas. Trend surface analysis, which indicates flow over a larger area by fitting a plane to a set of water-level data, indicated flow toward the northwest beneath Low-Level Waste Management Area 1. Results of this analysis are included in Appendix 5F. The distribution of contaminant plumes also indicates flow to the northwest, at least in the past. Eventually flow will probably revert toward the southeast, which is believed to be the pre-Hanford flow direction. While trend-surface and contaminant plume analyses provide large-scale inferences concerning groundwater-flow characteristics, local in-well flow direction measurements were also attempted in recent colloidal borescope flowmeter surveys (Section 2.9.1.1 Hartman et al. 2001). The study included some wells on the northern and eastern boundaries of LLWMA-1, and wells in the B-BX-BY tank farms, east of this waste management area. Results indicated a wide variation for in-well flow directions, ranging from southwest to southeast. The representativeness of these local, in-well measurements for delineating areal groundwater-flow conditions, however, is considered questionable. **The configuration of the basalt subsurface topography and lack of water table aquifer under much of LLWMA 2 limits possible flow directions. The gradient seen between wells along the southern side of LLWMA 2 indicates that groundwater flow is generally towards the west. In partial response to Ecology's comments, trend surface analysis was performed on water level measurements from 1997 through 2003. The flow directions obtained were consistent and averaged 228 +/- 10.7 degrees. Due to the configuration of the basalt surface, which rises above the water table in the northern part of LLWMA 2, this flow direction cannot be uniform across the area. Thus, the flow is shown as more directly toward the west in the eastern portion of the burial ground and transitions toward the southwest in the western part of the area. This evaluation result will be incorporated into section 5.3.1.2 (p. 5-5 lines 25-49) which now reads:** The Hanford formation is the sole suprabasalt unit beneath Low-Level Waste Management Area 2. The Hanford formation beneath this area is similar to that	

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	under Low-Level Waste Management Area 1 and ranges from 57 to 80 meters thick. The top of the basalt is above the water table in the northern part of the waste management area and gently dips to the south. The top of the basalt represents an erosional surface, scoured by Pleistocene cataclysmic floods, and is gently undulating with enclosed depressions 3 to 4.5 meters deep. A much deeper depression in the basalt, ~12 meters deep, is inferred to exist to the north of the site (Graham et al. 1984; Last et al. 1989). The water table beneath Low-Level Waste Management Area 2 is 62 to 72 meters beneath the surface. The saturated aquifer thickness ranges from 0 in the north and east to 7.5 meters in the south. Groundwater flow beneath this waste management area has been determined using trend surface analysis. The analysis was performed on water-level data between 1997 and 2003 and provided a consistent flow direction to the southwest of 222 +/- 10.7 degrees (Table 5-1); note: 0 degrees = East; 90 degrees = North. The high permeability of the Hanford sediments in the vasdose zone mean that they equilibrate rapidly to changing barometric pressure and it is not necessary to apply a barometric correction to the water-level measurements that are collected relatively close in time. The rapid transmission of barometric pressure to the water table in the 200-East Area, and corrective measures within low-gradient areas are discussed in Spane (1999, 2002). Previously groundwater-flow direction was believed to be toward the west, which was the predominant direction when the B Pond system was active. The groundwater flow velocity is estimated to be ~0.05 to ~0.8 meters per day (Hartman et al. 2002, Table A.2). The water table beneath this area is flat, and flow is influenced by the presence of basalt structures that extend above the water table. The basalt surface in the northern part of Low-Level Waste Management Area 2 forms a no-flow boundary for the unconfined aquifer. Because of the presence and influence of the top of basalt surface, it is clear that the flow cannot be uniformly toward the southwest for the entire unconfined aquifer beneath the waste management area. This means that there is a component of flow toward the west in the eastern part of the waste management area which then transitions to the southwest. Thus wells in the eastern part of the waste management area should be considered upgradient or cross-gradient from the potential contaminant sources. Trend surface analysis at the nearby 216-B-63 trench (on the southwestern side of Low-Level Waste Management Area 2) also indicated flow toward the southwest (Spane 1999; Section 2.9.1.1 of Hartman et al. 2001). Groundwater flow directions will be re-evaluated at least annually to determine if there is sufficient evidence to revise this interpretation. As the water table beneath the waste management area continues to drop, the area where the basalt is above the water table will expand toward the south. The current rate of decline is ~0.2 meters per year. The basalt beneath this area has a low permeability, indicating it acts as a barrier to downward migration. The	

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	lack of saturated permeable sediment means that groundwater monitoring is not practicable in the northern portion of Low-Level Waste Management Area 2. The upper-basalt confined aquifer in the Rattlesnake Ridge interbed is not believed to be interconnected with the unconfined aquifer system beneath Low-Level Waste Management Area 2. Earlier work reported in Graham et al. 1984 suggested that the Elephant Mountain basalt had been removed by erosion in a small area beneath the northeast corner of the 200-East Area. However, the installation of Low-Level Waste Management Area 2 interim status monitoring wells showed this is probably not the case. Most wells installed for interim status monitoring of Low-Level Waste Management Area 2 were drilled to solid basalt, indicating the presence of a thin unconfined aquifer with laterally continuous low permeability rock below (Figure 5-9). The only well in the northeast corner of the area, 299-E35-1, however, was not clearly drilled to solid basalt, although geologist logs indicate the "presence of gravel-sized pieces that look like they are from solid rock". Spane and Vermeul (1994) reevaluated aquifer tests for upper-basalt confined aquifer wells within this region. Their diagnostic assessment of the test for upper basalt confined aquifer well 699-47-50, located immediately north of Low-Level Waste Management Area 2 indicated that the aquifer exhibited a non-leaky response. This supports the interpretation of a lack of hydraulic communication with the overlying unconfined aquifer in this vicinity. Current interpretation of the basalt surface suggests that basalt is present above the water table in a band through the northeast part of the area (see Figure 5-9) and that the upper basalt confined aquifer is not interconnected with the unconfined aquifer beneath Low-Level Waste Management Area 2. Groundwater flow in the Rattlesnake Ridge interbed upper basalt confined aquifer system beneath Low-Level Waste Management Area 2 is influenced by the remnant of groundwater mounding at B Pond, that transmitted increased hydraulic gradients down into the upper basalt confined aquifer system. Lateral hydraulic gradients are currently very low in the upper basalt confined aquifer due to regional flow from the southwest interacting with the remnants of the groundwater mound at B Pond (Hartman et al., 2003). The horizontal flow direction in this area appears to be generally to the northwest, as reported in Spane and Webber (1995) and Hartman et al. (2003). A downward gradient exists between the unconsolidated Ringold sediments in the immediate vicinity of B Pond as the aquifer reequilibrates after the termination of wastewater discharge. A comparison of water levels in unconfined aquifer well 299-E34-5 with those in upper-basalt confined aquifer well 699-47-50, indicates essentially no vertical gradient between the two aquifers beneath Low-Level Waste Management Area 2 (Figure 5-10). **The recommended network will be modified to reflect this refinement to the flow direction by modification to section 5.5.2.1 (p. 5-15 lines 21-48 and figure 5-13). The text now reads:**	

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	Thirteen wells are currently in the groundwater monitoring network for Low-Level Waste Management Area 2 (see Figure 5-4). These wells monitor the uppermost portion of the unconfined aquifer. The final status groundwater monitoring network for Low-Level Waste Management Area 2 consists of two upgradient well and seven downgradient wells, and one cross-gradient well that represent flow from upgradient but may have a component of flow from the burial grounds. (Table 5-9 and Figure 5-17). The cross-gradient well is 299-E34-7. As discussed in section 5.3.1.2, the eastern part of the waste management area has a component of flow toward the west caused by the location of the basalt above the water table. Thus well 299-E34-7 predominantly samples water from upgradient but a contribution from a part of the Trench 94 in the waste management area cannot be ruled out. Upgradient well 299-E34-5 is likely isolated from the southern part of the Low-Level Waste Management Area by a ridge of basalt so it only provides general indications of upgradient concentrations, unsuitable for statistical comparisons. The other upgradient well is 299-E27-10 in the southeastern corner of the Waste Management Area. Interim status downgradient well 299-E34-11 no longer contains enough water to sample. The proposed statistical method does not rely on upgradient/downgradient comparisons (Section 5.5.4), but upgradient wells are included in the final-status network to help assess changing groundwater chemistry from upgradient sources before it reaches the downgradient wells. As-built diagrams of the wells in the interim and final status networks are provided in Appendix 5C. Two of the wells in the proposed network, 299-E34-5 and 299-E34-7 have less than 1 meter of water remaining. At the current rates of water-level decline, these wells will go dry in 1 to 3 years. It would not be feasible to replace the wells because they are completed at the top of basalt. These wells will be removed from the network when they cannot practically be sampled using the dedicated pumps. The MEMO program was used to evaluate the proposed monitoring network, assuming flow toward the southwest (Appendix 5D). The modeled monitoring efficiency was 90%. Therefore, the network coverage is adequate to monitor the current waste configuration. **Continued groundwater flow evaluations will be made, as part of ongoing monitoring activities. Contaminant plumes from nearby sites provide additional indications of flow direction and support the flow direction determinations. If different flow directions are indicated, then the monitoring system will be modified accordingly. DOE will revise permit application text to include new data regarding flow direction and associated evaluations prior to certification of the Part B Permit Application.**	

Responses to Ecology Groundwater comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

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5-3	**Chapter 5:** Washington Administrative Code (WAC) 806(4) (a)(xx)(B) requires "identification of uppermost aquifer and aquifers hydraulically interconnected beneath the facility property, including ground water flow direction and rate, and the basis for such identification (i.e., the information obtained from hydrogeologic investigations of the facility area)." Regarding LLWMAs 1 and 2, the application appears to rely on a conceptual model and does not describe hydrogeologic investigations performed to determine groundwater flow direction. Similarly, the application does not describe hydrogeologic investigations performed to determine if the uppermost aquifer is interconnected with an underlying aquifer (in the basalt). Similarly, the application does not describe hydrogeologic investigations (water-level trend surface analysis, water-level hydrographs for multiple wells, in-situ flow measurements, barometric pressure influence evaluation, etc.) to accurately determine potentiometric groundwater surface. Instead, the permit application identifies uncertainties associated with groundwater flow direction, aquifer interactions, etc. and relies heavily upon a conceptual model. As such, the application is incomplete.	**11/4/04**
	DOE-RL/FH Response: The uppermost aquifer and aquifers hydraulically interconnected beneath the facility property at LLWMAs 1 and 2 are identified in section in section 5.3.1 per WAC 173-303 806(4)(a)(xx)(B). The primary hydrogeologic investigations are WHC-SD-EN-TI-290 and PNNL-12261. The information in these reports is based on data collected during the long history of drilling in and around the 200 Areas as documented in WHC-SD-EN-DP-044; SD-BWI-DP-039; PNL-6820; WHC-MR-0205; WHC-MR-0204; RHO-ST-23; WHC-SD-EN-DP-049; WHC-SD-EN-DP-086. The conceptual model for LLWMAs 1 and 2 was developed, based on the cited investigations. Hydrogeologic investigations of the potential interconnection between the uppermost basalt confined aquifer and the overlying unconfined aquifer are reported in PNL-10817 and PNNL-14187. Based on information in these reports, the uppermost basalt confined aquifer directly beneath LLWMA 1 and 2 (the uppermost aquifer beneath the unconfined aquifer) is not in direct communication with the uppermost aquifer because it is effectively isolated from the unconfined aquifer by the Elephant Mountain member of the Saddle Mountain Basalt Formation. The aquifer systems, however, are in communication north of the 200 East Area and localized recharge has occurred beneath B Pond (PNNL-10817). However, the vertical hydraulic gradient is currently upward throughout the region surrounding the 200 East Area with the exception of the immediate vicinity of B Pond (PNNL-14187). Further information on hydrologic investigations and the results are provided in the modification to section 5.3 (p. 5-3 line 31- p 5-4 line 5), which now reads: The following sections discuss geology and hydrology for the 200 East and 200 West Areas of the Hanford Site, including site-specific information for the low-level waste management areas. This information, combined with knowledge of waste constituents and contaminant mobility, forms a conceptual model for each of the low-level waste management areas. This section identifies the uppermost	

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	aquifer and aquifers hydraulically interconnected beneath the facility as required under WAC 173-303-806(4)(a)(xx)(B). The Hanford Site lies within the Pasco Basin of the Columbia Plateau. The bedrock in this region is characterized by a thick sequence of flood basalts of the Columbia River Basalt Group. The basalt has been folded and faulted, forming broad structural and topographic basins separated by asymmetric anticlines. The basalt is overlain by sediment that accumulated in the basins. The suprabasalt sediment consists primarily of 1) fluvial-lacustrine clay, sand, silt, and gravel of the Neocene-age Ringold Formation; 2) the Plio-Pleistocene unit made up of alluvial, eolian, and paleosol deposits that may be cemented; and 3) Pleistocene cataclysmic flood deposits of the Hanford formation, composed of unconsolidated gravel, sand, and silt. A thin layer of eolian and alluvial Holocene deposits of silt, sand, and gravel cover much of the Hanford Site. Figure 5-7 presents the generalized stratigraphy of the Hanford Site. The hydrology of the Hanford Site can be divided into two major aquifer systems: the confined basalt system and the Hanford/Ringold aquifer system. The confined basalt aquifer system is composed of a series of rubbly basalt flow tops and, where present, sedimentary interbeds, separated by low-permeability basalt flow interiors. The Rattlesnake interbed makes up the uppermost basalt-confined aquifer within the basalt-sequence. The Hanford/Ringold aquifer system includes the uppermost aquifer beneath the Hanford Site. The aquifer system is generally unconfined, but there are some localized confined or semi-confined units within the Ringold Formation. These generally occur below the Ringold lower mud unit. There are also local zones of perched water in the Ringold Formation, the Plio-Pleistocene unit, and the Hanford formation. **Modifications to section 5.3.1 (p. 5-4 line 9 to p. 5-5 line 49) were also made to address this comment. The section now reads:** The primary references for the geologic interpretation are Lindsey et al. (1994) and Williams et al. (2000). The information in those reports is based on the data collected during the long history of drilling that has taken place in and around the 200 Areas (Tallman et al. 1979; Bjornstad 1984; Last et al. 1989; Barton et al. 1990; Goodwin and Bjornstad 1990; Mercer 1993a, 1993b, 1994b). The suprabasalt sediment in the 200 East Area consists of the Hanford and Ringold Formations. Ringold Formation sediments are generally not present within the northern half of this area where the burial grounds are located. The Elephant Mountain Member of the Saddle Mountains Basalt is the uppermost basalt unit beneath the 200 East Area. The water table beneath most of the 200 East Area is in the Hanford formation.	

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	The base of the uppermost aquifer is the lower mud unit of the Ringold Formation, where present, or the uppermost basalt unit. In some locations, basalt is present above the water table and there is no Hanford/Ringold aquifer. The Hanford/Ringold aquifer system in the 200 East Area is composed of at least two distinct aquifers (Williams et al., 2000): (1) an unconfined aquifer in gravels of the Hanford formation and Ringold unit 5; and (2) a locally confined aquifer occurring in Ringold unit 9, below the Ringold lower mud. Within the 200 East Area Ringold it is often possible to differentiate unit 9 into 3 hydrogeologic units, 9A, 9B, and 9C. Units 9A and 9C have higher permeability than unit 9B (Williams et al. 2000). Testing at the time of borehole installation for the burial grounds was used to determine the hydraulic conductivity values. Most of the tests were constant-discharge pumping tests up to 8 hours in duration, followed by recovery tests. None of the tests in the 200 East Areas created sufficient drawdown to be observed in nearby observation wells. In many cases, testing was inconclusive because there was insufficient drawdown in the pumping well to evaluate the results. Hydraulic conductivity estimates for the other tests ranged from 430 to >1,000 meters per day (Last et al. 1989). Groundwater flow in the 200 East Area is influenced by the past disposal of large quantities of liquid waste to the 216-B-3 pond system (also called B Pond) to the east. A large groundwater mound that developed under B Pond essentially reversed the pre-Hanford (west to east) flow direction in the northern portion of the 200 East Area. B Pond stopped receiving effluent in 1997, and the groundwater mound in the unconfined aquifer has dissipated in recent years. Currently, the water table is flat in the 200 East Area. Flow directions are difficult to determine and are also believed to be changing. North of the 200 East Area near Gable Mountain, geologists have mapped areas where the uppermost confining unit of basalt is absent (Graham et al. 1984; Spane and Webber, 1995). The absence of this layer creates a potential pathway for contaminants to move from the unconfined aquifer into the basalt aquifer system. However, the hydraulic gradient in this region currently is upward, so potential groundwater movement would be from the basalt-confined aquifer into the unconfined aquifer (Section 2.14.1 of Hartman et al. 2002). Beneath the 200-East Area, the uppermost basalt confined aquifer is hydraulically isolated from the unconfined aquifer system, as discussed with respect to the individual waste management areas, below. **Hydrogeology of Low-Level Waste Management Area 1** The suprabasalt sediment in this area consists entirely of the Hanford	

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	formation, which varies in thickness from 70 to 100 meters. The Hanford formation consists of sand or gravelly sand with layers of sandy gravel and silty sand. Basal Ringold Formation Unit 9C deposits are interpreted to be present beneath the southwestern half of this waste management area (Williams et al. 2000). Potential confining layers, the Lower Mud Unit 8, and Basal Ringold fines, Unit 9B are absent so the sediments of the Unit 9C aquifer are hydraulically connected with the uppermost unconfined aquifer in the Hanford sediments and can be treated as part of a single aquifer system. Basalt was encountered in monitoring wells on all sides and in the middle of Low-Level Waste Management Area 1 (Figure 5-8). Thus the uppermost basalt confined aquifer is not interconnected with the uppermost unconfined aquifer beneath the facility. This is in agreement with regional investigations hydrogeologic interpretations discussed above. Data from the boreholes that reach the top of the basalt beneath the burial ground indicate the basalt dips to the west and south. As-built diagrams in Appendix 5C summarize the geology in each well location. The water table is 71 to 87 meters below the ground surface beneath Low-Level Waste Management Area 1. The saturated thickness of the unconfined aquifer ranges from 3 meters in the northeast to 14 meters in the south. The groundwater flow direction in this portion of the 200 East Area is believed to be toward the northwest, with estimated groundwater-flow velocities of less than 0.5 meter per day (Hartman et al. 2002, Table A.2). Water levels in Low-Level Waste Management Area 1 monitoring wells are all within 0.1 meter of each other and these data indicate low hydraulic gradient conditions (i.e., ~0.1m/km) across the waste management area. Uncertainties caused by borehole deviation from vertical and limits of measurement precision restrict the use of water-level data for quantitative determination of groundwater-flow characteristics in low-gradient areas. Trend surface analysis, which indicates flow over a larger area by fitting a plane to a set of water-level data, indicated flow toward the northwest beneath Low-Level Waste Management Area 1. Results of this analysis are included in Appendix 5F. The distribution of contaminant plumes also indicates flow to the northwest, at least in the past. Eventually flow will probably revert toward the southeast, which is believed to be the pre-Hanford flow direction. While trend-surface and contaminant plume analyses provide large-scale inferences concerning groundwater-flow characteristics, local in-well flow direction measurements were also attempted in recent colloidal borescope flowmeter surveys (Section 2.9.1.1 Hartman et al. 2001). The study included some wells on the northern and eastern boundaries of LLWMA-1, and wells in the B-BX-BY tank farms, east of this waste management area. Results indicated a wide variation for in-well flow directions, ranging from southwest to southeast. The representativeness of these local, in-well measurements for delineating areal groundwater-flow conditions, however, is	

NOD Comments		
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	considered questionable. **Hydrogeology of Low-Level Waste Management Area 2** The Hanford formation is the sole suprabasalt unit beneath Low-Level Waste Management Area 2. The Hanford formation beneath this area is similar to that under Low-Level Waste Management Area 1 and ranges from 57 to 80 meters thick. The top of the basalt is above the water table in the northern part of the waste management area and gently dips to the south. The top of the basalt represents an erosional surface, scoured by Pleistocene cataclysmic floods, and is gently undulating with enclosed depressions 3 to 4.5 meters deep. A much deeper depression in the basalt, ~12 meters deep, is inferred to exist to the north of the site (Graham et al. 1984; Last et al. 1989). The water table beneath Low-Level Waste Management Area 2 is 62 to 72 meters beneath the surface. The saturated aquifer thickness ranges from 0 in the north and east to 7.5 meters in the south. Groundwater flow beneath this waste management area has been determined using trend surface analysis. The analysis was performed on water-level data between 1997 and 2003 and provided a consistent flow direction to the southwest of 222 +/- 10.7 degrees (Table 5-1); note: 0 degrees = East; 90 degrees = North. The high permeability of the Hanford sediments in the vasdose zone mean that they equilibrate rapidly to changing barometric pressure and it is not necessary to apply a barometric correction to the water-level measurements that are collected relatively close in time. The rapid transmission of barometric pressure to the water table in the 200-East Area, and corrective measures within low-gradient areas are discussed in Spane (1999, 2002). Previously groundwater-flow direction was believed to be toward the west, which was the predominant direction when the B Pond system was active. The groundwater flow velocity is estimated to be ~0.05 to ~0.8 meters per day (Hartman et al. 2002, Table A.2). The water table beneath this area is flat, and flow is influenced by the presence of basalt structures that extend above the water table. The basalt surface in the northern part of Low-Level Waste Management Area 2 forms a no-flow boundary for the unconfined aquifer. Because of the presence and influence of the top of basalt surface, it is clear that the flow cannot be uniformly toward the southwest for the entire unconfined aquifer beneath the waste management area. This means that there is a component of flow toward the west in the eastern part of the waste management area which then transitions to the southwest. Thus wells in the eastern part of the waste management area should be considered upgradient or cross-gradient from the potential contaminant sources. Trend surface analysis at the nearby 216-B-63 trench (on the southwestern side of Low-Level Waste Management Area 2) also indicated flow toward the southwest (Spane 1999; Section 2.9.1.1 of Hartman et al.	

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	2001). Groundwater flow directions will be re-evaluated at least annually to determine if there is sufficient evidence to revise this interpretation. As the water table beneath the waste management area continues to drop, the area where the basalt is above the water table will expand toward the south. The current rate of decline is ~0.2 meters per year. The basalt beneath this area has a low permeability, indicating it acts as a barrier to downward migration. The lack of saturated permeable sediment means that groundwater monitoring is not practicable in the northern portion of Low-Level Waste Management Area 2. The upper-basalt confined aquifer in the Rattlesnake Ridge interbed is not believed to be interconnected with the unconfined aquifer system beneath Low-Level Waste Management Area 2. Earlier work reported in Graham et al. 1984 suggested that the Elephant Mountain basalt had been removed by erosion in a small area beneath the northeast corner of the 200-East Area. However, the installation of Low-Level Waste Management Area 2 interim status monitoring wells showed this is probably not the case. Most wells installed for interim status monitoring of Low-Level Waste Management Area 2 were drilled to solid basalt, indicating the presence of a thin unconfined aquifer with laterally continuous low permeability rock below (Figure 5-9). The only well in the northeast corner of the area, 299-E35-1, however, was not clearly drilled to solid basalt, although geologist logs indicate the "presence of gravel-sized pieces that look like they are from solid rock". Spane and Vermeul (1994) reevaluated aquifer tests for upper-basalt confined aquifer wells within this region. Their diagnostic assessment of the test for upper basalt confined aquifer well 699-47-50, located immediately north of Low-Level Waste Management Area 2 indicated that the aquifer exhibited a non-leaky response. This supports the interpretation of a lack of hydraulic communication with the overlying unconfined aquifer in this vicinity. Current interpretation of the basalt surface suggests that basalt is present above the water table in a band through the northeast part of the area (see Figure 5-9) and that the upper basalt confined aquifer is not interconnected with the unconfined aquifer beneath Low-Level Waste Management Area 2. Groundwater flow in the Rattlesnake Ridge interbed upper basalt confined aquifer system beneath Low-Level Waste Management Area 2 is influenced by the remnant of groundwater mounding at B Pond, which transmitted increased hydraulic gradients down into the upper basalt confined aquifer system. Lateral hydraulic gradients are currently very low in the upper basalt confined aquifer due to regional flow from the southwest interacting with the remnants of the groundwater mound at B Pond (Hartman et al., 2003). The horizontal flow direction in this area appears to be generally to the northwest, as reported in Spane and Webber (1995) and Hartman et al. (2003). A downward gradient exists between the unconsolidated Ringold sediments in the immediate vicinity of B Pond as the aquifer reequilibrates after the termination of wastewater discharge. A	

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	comparison of water levels in unconfined aquifer well 299-E34-5 with those in upper-basalt confined aquifer well 699-47-50, indicates essentially no vertical gradient between the two aquifers beneath Low-Level Waste Management Area 2 (Figure 5-10). Flow in the Rattlesnake Ridge uppermost confined aquifer system beneath Low-Level Waste Management Area 2 is influenced by the remnant of groundwater mounding at B Pond which transmtted increased gradients down into the interbed. Horizontal gradients are currently very low in the upper basalt confined aquifer due to regional flow from the southwest interacting with the remnants of the groundwater mound at B Pond (Hartman et al., 2003). The horizontal flow direction in this area appears generally to the northwest, according to this report. A downward gradient exists between the unconsolidated Ringold sediments in the immediate vicinity of B Pond as the aquifer reequilibrates after the termination of discharge. Based on a comparison of water levels in unconfined aquifer well 299-E34-5 with uppermost basalt confined aquifer well 699-47-50, the vertical gradient between the two aquifers is nearly 0 beneath Low-Level Waste Management Area 2 (Figure 5-10). **Slight rewording to section 5.3.3.4 is needed to reflect the changes above. P. 5-10 lines 17-35 will be changed to read:** The saturated thickness of the aquifer varies from 0 in the northern part of the waste management area to approximately 7.5 meters at the southern end. The uppermost basalt in this area is generally impermeable to vertical and horizontal groundwater movement. Thus, the only expected transport in groundwater would be in the southern portion of the waste management area. Groundwater-flow direction is expected to change from southwestward to the south-southeast. Direct measurement of flow direction and velocity were made during 2001 at C tank farm, located approximately 400 meters south of the southern fence line of Low-Level Waste Management Area 2. These measurements suggest aquifer flow rates of approximately 2 meters per day toward the south to southwest.[1] Darcy velocity estimates for Low-Level Waste Management Area 2 were 0.8 meters per day (Table A.2 of Hartman et al. 2002) Hypothetical breakthrough of mobile contaminants (e.g., nitrate, chromate, uranium, technetium-99) would travel to the west and spread over 500 meters per year in lateral extent based on the 2 meters per day rate. Groundwater monitoring data to date, however, do not indicate the presence of these contaminants from Low-Level Waste Management Area 2, suggesting that either contaminant	

[1] McDonald, John P.(Pacific Northwest National Laboratory), personal communication with Vernon Johnson (Pacific Northwest National Laboratory), February 2002.

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	migration through the vadose zone has not reached groundwater or that leaching from the waste containers has not occurred. **Additional information on the investigations to evaluate flow directions are provided as stated in the response to 5-2. DOE will revise permit application text to include new data regarding flow direction and associated evaluations prior to certification of the Part B Permit Application.**	
5-4	**Chapter 5:** The lack of saturated thickness of the unconfined aquifer in the vicinity of LLWMA 2 (particularly in the northern part of the unit), and the continued decline of the water table may result in groundwater monitoring not being practicable. In January 2002 (by cover letter from Joel Hebdon, USDOE to Fred Jamison, Ecology dated January 24, 2002), a groundwater evaluation plan for the Liquid Effluent Retention Facility (LERF) was submitted. This evaluation plan identifies LERF-specific monitoring issues and includes descriptions of the geology (including basalt depth, orientation, and characteristics), hydrology, aquifer properties, flow dynamics, well completions, geochemistry, and contaminant chemistry. Most importantly, the plan includes an evaluation approach by which the declining conditions of the aquifer as well as the aquifer conditions at the top of the basalt may be determined/characterized. The evaluation plan provides a sequence of activities by phase. Due to similar aquifer conditions at LLWMA 2, the permit application is required to include a groundwater evaluation plan. It is recommended that the plan be modeled after that of the LERF unit. If the performance of LLBG WMA 2 can not be effectively monitored to assurance with environmental requirements, then vadose zone monitoring should be evaluated, either separately or in combination with groundwater monitoring, as a means of assuring facility compliance.	**11-4-04**
	DOE-RL/FH Response: Because waste characteristics at Low-Level Waste Management Area 2 are sufficiently different from the Liquid Effluent Retention Facility, a groundwater evaluation plan is not of value at the burial ground waste management area. The waste at LERF is liquid while the burial grounds contain a mixture of past-practice solid waste with solid state-listed waste in a unique high-integrity waste package that exceeds the performance requirements for lined trenches. While an increase in liquid in the vadose zone beneath LERF might indicate a loss of integrity of the facility, at Low-Level Waste Management Area 2, any liquid would not suggest a release from the waste form. A sufficient number of wells are projected to remain in service along the southern boundary of the waste management area (hydraulically downgradient and topographically downdip along the basalt surface) providing adequate detection for potential future releases of contaminants from the burial grounds. Otherwise, new wells will be addressed through the M-024 process. In addition, the LLBG portions, except naval reactor compartment disposal locations, are being closed and closure plan documentation is being prepared in conjunction with operable unit activities. The information requested in the NOD is provided in Chapter 5. The M-024 milestone will address the need for new wells as groundwater conditions change.	

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5-5	**Chapter 5:** WAC 806(4)(a)(xx)(B) requires "identification of uppermost aquifer and aquifers hydraulically interconnected beneath the facility property, including ground water flow direction and rate, and the basis for such identification (i.e., the information obtained from hydrogeologic investigations of the facility area)." Regarding LLWMAs 3 and 4, the application appears to rely on a conceptual model and does not describe hydrogeologic investigations performed to determine unit-specific aquifer properties. Similarly, the application does not describe hydrogeologic investigations performed to determine if the geologic features are continuous or if the uppermost aquifer is interconnected with an underlying aquifer (beneath the Ringgold Lower Mud). Similarly, the application does not describe hydrogeologic investigations to determine aquifer properties such as hydraulic conductivity, lateral dispersivity, vertical dispersivity, etc. As such, the application is incomplete especially in the characterization of the aquifer and groundwater quality at depth (below the top 40 ft.) in the unconfined aquifer in the 200 West Area.	**11/4/04**
	DOE-RL/FH Response: The uppermost aquifer and aquifers hydraulically interconnected beneath the facility property at LLWMAs 3 and 4 are identified in section 5.3.2 per WAC 173-303 806(4)(a)(xx)(B). The primary hydrogeologic investigations are WHC-SD-EN-TI-290 and PNNL-12261 as referenced in that section. The information in these reports is based on data collected during the long history of drilling in and around the 200 Areas as documented in RHO-ST-23; SD-ABWI-DP-039; WHC-SD-EN-AP-015; WHC-MR-0205; WHC-MR-204; WHC-SD-EN-DP-044; WHC-SD-EN-DP-049; WHC-SD-EN-DP-086, as referenced in section 5.3.2. **Further information from previous studies of aquifer identification and properties are provided by modifications to section 5.3 and 5.3.2. Section 5.3 (p. 5-4 lines 9-44) now reads:** The following sections discuss geology and hydrology for the 200 East and 200 West Areas of the Hanford Site, including site-specific information for the low-level waste management areas. This information, combined with knowledge of waste constituents and contaminant mobility, forms a conceptual model for each of the low-level waste management areas. This section identifies the uppermost aquifer and aquifers hydraulically interconnected beneath the facility as required under WAC 173-303-806(4)(a)(xx)(B). The Hanford Site lies within the Pasco Basin of the Columbia Plateau. The bedrock in this region is characterized by a thick sequence of flood basalts of the Columbia River Basalt Group. The basalt has been folded and faulted, forming broad structural and topographic basins separated by asymmetric anticlines. The basalt is overlain by sediment that accumulated in the basins. The suprabasalt sediment consists primarily of 1) fluvial-lacustrine clay, sand, silt, and gravel of the Neocene-age Ringold Formation; 2) the Plio-Pleistocene unit made up of alluvial, eolian, and paleosol deposits that may be cemented; and 3) Pleistocene cataclysmic flood deposits of the Hanford formation, composed of unconsolidated	

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	gravel, sand, and silt. A thin layer of eolian and alluvial Holocene deposits of silt, sand, and gravel cover much of the Hanford Site. Figure 5-7 presents the generalized stratigraphy of the Hanford Site. The hydrology of the Hanford Site can be divided into two major aquifer systems: the confined basalt system and the Hanford/Ringold aquifer system. The confined basalt aquifer system is composed of a series of rubbly basalt flow tops and, where present, sedimentary interbeds, separated by low-permeability basalt flow interiors. The Rattlesnake interbed makes up the uppermost basalt-confined aquifer within the basalt-sequence. The Hanford/Ringold aquifer system includes the uppermost aquifer beneath the Hanford Site. The aquifer system is generally unconfined, but there are some localized confined or semi-confined units within the Ringold Formation. These generally occur below the Ringold lower mud unit. There are also local zones of perched water in the Ringold Formation, the Plio-Pleistocene unit, and the Hanford formation. **Section 5.3.2 (p. 5-6 lines 2- p. 5-7 line 35) now reads:** The primary references for the geologic interpretation are Lindsey et al. (1994) and Williams et al. (2002). The information in those reports is based on the data collected during the long history of drilling in and around the 200 Areas (Tallman et al. 1979; Bjornstad 1984; Last et al. 1989; Barton et al. 1990; Goodwin and Bjornstad 1990; Mercer 1993a, 1993b, 1994a). The 200 West Area is underlain, from the ground surface to the top of the basalt, by the Hanford formation, the Plio-Pleistocene unit, and the Ringold Formation. The Plio-Pleistocene unit in this area consists mostly of carbonate-cemented alluvial and eolian facies. Testing at the time of borehole installation for the burial grounds was used to determine the hydraulic conductivity values. Most of the tests were constant-discharge pumping tests up to 8 hours in duration, followed by recovery tests. Only two of the tests in the 200 West Area created sufficient drawdown to be observed in nearby observation wells. Hydraulic conductivity estimates ranged from 0.02 to 61 meters per day (Last et al. 1989). These values are comparable or slightly higher than reported hydraulic conductivity estimates ranging between 0.05 to 28 meters per day, derived from recent hydrologic tests conducted between FY 1999 -2002, as reported in Spane et al. (2001a, b, 2002, 2003). The water table beneath the entire 200 West Area is in the Ringold Formation. The base of the unconfined aquifer is the lower mud unit 8 of the Ringold Formation, which confines the coarse-grained unit 9 of the Ringold Formation	

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	beneath most of the 200 West Area. Where the lower mud is not present, the unit 9 aquifer in the Lower Ringold Formation is unconfined and hydraulically connected to the uppermost unconfined aquifer. Within the 200 West Area, unit 9 is undifferentiated because, in contrast to the 200 East Area, the geologic data do not support subdivision. Groundwater flow in the 200 West Area is influenced by past disposal practices. The pre-Hanford groundwater flow was predominantly west to east. Liquids discharged to the 216-U-10 pond (U Pond; decommissioned in 1984) and other disposal facilities created a substantial groundwater mound in the southern part of the 200 West Area, ~25 meters above the pre-Hanford water table. This mound has since decreased to ~15 meters. Figure 5-11 is a water table map for March 2001. **Hydrogeology of Low-Level Waste Management Area 3** Low-Level Waste Management Area 3 is underlain, from the ground surface to the top of the basalt, by the Hanford formation, the Plio-Pleistocene unit, and the Ringold Formation. The Ringold formation at this location is mostly sand and gravel with minor units of finer-grained sediment. The Ringold lower mud, Unit 8 is absent beneath the northernmost part of the area as shown in Figure 5-12 (Williams et al. 2002). The suprabasalt sediment ranges from 145 to 160 meters thick and generally dips to the south. The Plio-Pleistocene unit rises to within 6 meters of the surface along the northern boundary of this waste management area (Bjornstad 1990). The water table is 67 to 76 meters beneath the surface at this waste management area. The water table beneath Low-Level Waste Management Area 3 is entirely within the upper Ringold Formation unit 5 aquifer. The saturated thickness of the unconfined aquifer system is ~60 meters in the south and 75 meters in the north where the Ringold lower mud unit is absent (Williams, et al. 2002). There is some evidence that there may be a locally confining layer or at least a zone of lower permeability just at the water table. Groundwater beneath Low-Level Waste Management Area 3 flows to the east-northeast, and slightly more eastward in the eastern portion of the area (burial ground 218-W-3AE) (see Figure 5-11). Estimates of groundwater flow rate range from 0.0001 to 0.12 meters per day (Hartman et al. 2002, Table A.2). As the 200 West Area groundwater mound continues to decline, groundwater flow beneath this waste management area may change to a more eastward direction. Disposal of tritium-contaminated water at the State-Approved Land Disposal Site (SALDS) to the north slightly distorts groundwater flow paths, but does not affect groundwater flow beneath Low-Level Waste Management Area 3 significantly.	

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	Hydrogeology of Low-Level Waste Management Area 4 The stratigraphic units beneath Low-Level Waste Management Area 4 are similar to those beneath Low-Level Waste Management Area 3. The Plio-Pleistocene units 2 and 3 underlies the entire area and is up to 12 meters thick, is generally thickest to the north and west, and thins to the east and south. The top of the Plio-Pleistocene unit is very irregular with only a minor overall dip to the south. Perched water may be present locally on carbonate-rich layers in the unit, but because of the presence of numerous discontinuities such as pinch-outs and fractures, the lateral distribution of perched water probably is limited. The entire sedimentary sequence in this area ranges from 165 to 172 meters thick. The water table ranges between 65 and 74 meters beneath the surface at this waste management area and lies within the Ringold Formation unit 5. The saturated thickness of the Ringold Formation unit 5 above the lower mud unit 8 varies from 60 to 70 meters (Williams et al. 2002). The unit 8 mud is ~15 to ~20 m thick beneath Low-Level Waste Management Area 4. This unit forms a continuous low-permeability layer separating the unconfined unit 5 aquifer from the locally confined Lower Ringold unit 9 aquifer. The upward hydraulic gradient and low permeability sediments of intervening unit 8 limit any potential transport of contaminants downward into the confined Ringold unit 9 aquifer within the area of Low-Level Waste Management Area 4. Groundwater currently flows from west to east beneath Low-Level Waste Management Area 4 (see Figure 5-11), at a rate of 0.2 to 0.6 meters per day. Groundwater flow has been influenced by past effluent disposal and current pump-and-treat activities. The groundwater-flow direction at the start of the RCRA monitoring program was east to west, with a northwest component in the northern portion of the area, because of the 200 West Area groundwater mound. The groundwater mound currently is dissipating at a rate of 0.2 to 0.4 meters per year. A pump-and-treat program initiated in August 1996 in the 200-ZP-1 Groundwater Operable Unit extracts groundwater from wells east of the waste management area and injects the treated water west of the area. This program is intended to contain the highest concentrations of the carbon tetrachloride plume beneath the 200 West Area. The injected water contains contaminants that are not removed by the treatment system, affecting groundwater chemistry beneath Low-Level Waste Management Area 4. **DOE will revise permit application text to include new data regarding flow direction and associated evaluations prior to certification of the Part B Permit Application.**	

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NOD Comments		
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5-6	**Chapter 5:** The Monitoring Efficiency Model (MEMO) used to evaluate and design detection groundwater monitoring networks for RCRA sites is used to justify proposed wells. The MEMO input parameters are not provided for any of the model runs. Prior to review of this permit application, Ecology performed a review of groundwater monitoring observations and considered the MEMO model's application to single-shell tank farm Waste Management Areas (WMAs). In a letter dated October 13, 2000, Ecology concluded that "until such time that MEMO output can be validated by the comparison of field-confirmed site-specific input parameters (i.e., transverse dispersion coefficients, longitudinal dispersion coefficients, source concentrations, seepage velocities, etc.) and groundwater contaminant observations, Ecology will promote usage of conservative input parameters and/or the reliance upon closer well spacing." To date, MEMO output has not been validated by the comparison of field-confirmed site-specific input parameters. Ecology has performed an evaluation of well spacing at the LLWMAs. Regarding LLWMAs 3 and 4, due to aquifer property indications of tighter formations resulting in narrow shaped plumes (i.e., lower dispersivities) in the 200 West Area, Ecology's analysis of groundwater monitoring well needs at LLWMAs 3 and 4 has been based on a spacing of approximately 75 to 100 feet. Preliminary evaluation made by Ecology shows that the need for additional wells in these two waste management units could be as high as 90 (approximately). Due to aquifer property indications of higher groundwater flow rates and permeabilities in the 200 East Area, Ecology's analysis has been based on a spacing of approximately 100 to 150 feet. Similarly, the permit application should identify the well need for LLWMA 1 and LLWMA 2. Using a similar approach, Ecology identified approximately 45 additional wells and for LLWMA 1 and LLWMA 2. In summary, either adequate aquifer property testing must be performed to support MEMO modeling or the application should identify a planning basis that relies upon closer well spacing until such time that the MEMO output can be validated by the comparison of field-confirmed site-specific input parameters. Ecology expects a detail process to evaluate these requirements through data quality objectives and finally the network design using required statistical analysis, modeling and other applicable appropriate tools.	**9/27/07**
	DOE-RL/FH Response: DOE will discontinue use of the MEMO model and delete Appendix 5D. Groundwater monitoring will be addressed in conjunction with the new groundwater strategy.	

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5-7	**Chapter 5:** The permit application proposes to use a combined Shewhart-CUSUM control chart method for satisfying WAC 173-303-645(9) (g) requirements. In demonstrating the appropriateness of the Shewhart-CUSUM technique, the owner or operator must distinguish between what is statistically defensible (i.e., meets statistical tests/criteria) and the technical and regulatory objectives to be met to satisfy WAC 173-303-645 (i.e., whether the facility is impacting groundwater). Environmental Protection Agency (EPA) guidance entitled *Statistical Training Course for Ground-Water Monitoring Data Analysis* (EPA 530-R-93-003, 1992) identifies the necessary assumptions when Control Charts are used. The first assumption is that the data at an uncontaminated well (i.e., a well process that is "in control") are normally distributed. The second assumption is that the data are independently distributed from a statistical standpoint. The third assumption is that baseline parameters at the well reflect current background concentration levels. In consideration of the proposed, it is concluded that none of the necessary assumptions are well fitted to the proposed statistical approach. Furthermore, another EPA guidance document entitled *Statistical Analysis Of Ground-Water Monitoring Data At RCRA Facilities Interim Final Guidance* (EPA 530-SW-89-026, 1989) discusses the use of a combined Shewhart-CUSUM control chart in the case where the level of each constituent <u>within a single uncontaminated well</u> is monitored over time. The same EPA guidance document includes a "cautionary note" which states: "Control charts are a useful supplement to other statistical techniques because they are graphical and simple to use. However, it is inappropriate to construct a control chart on wells that have shown evidence of contamination or an increasing trend..." Furthermore, another EPA guidance document entitled *Statistical Analysis Of Ground-Water Monitoring Data At RCRA Facilities Addendum To Interim Final Guidance* (EPA 530-SW-89-026 Addendum, 1992) states: "Since the baseline parameters for a Control Chart are estimated from historical data, this method is only appropriate for initially uncontaminated compliance wells." The proposed Shewhart-CUSUM control chart method is inappropriate for LLWMAs 1-5. As an intra-well comparison technique, the opportunity to compare upgradient and down gradient water quality as an indicator of potential effects of the facility in groundwater is not assured.	**3/20/07**
	DOE-RL/FH Response: DOE proposes to use the statistical approach in WAC 173-303-645(8)(h)(iii). The Permittees will develop a proposal in the revised Chapter 5.0 based on site-specific conditions (e.g., hydrogeology, spatial variability, percentage of non-detects) using this approach to meet the performance standards, as appropriate, in WAC 173-303-645(8)(i).	

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NOD Comments		
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5-8	**Chapter 5:** The application asserts that "RCRA monitoring has shown no evidence of groundwater contamination from the burial grounds." In addition, the application indicates that total organic halides in down gradient well 299-W15-16 have exceeded the upgradient/down gradient comparison value since January 1999. Considering the carbon tetrachloride concentrations measured in riser pipes of trenches 1, 4, and 7 of LLWMA 4 and the soil gas vapor characterization efforts (and results) within the vicinity of these trenches, it can be argued that there is considerable evidence that shows waste constituent releases from the LLWMA 4. Therefore, the application must acknowledge the carbon tetrachloride releases from LLWMA 4. Until such time as the LLWMA 4 releases have been characterized, it is inappropriate to assume that the source is the regional carbon tetrachloride groundwater plume. Considering the deficiencies associated with the groundwater monitoring network, the carbon tetrachloride concentrations measured in riser pipes of trenches 1, 4, and 7 of LLWMA 4, and the soil gas vapor characterization efforts (and results) within the vicinity of these trenches, it can be argued that there is considerable evidence that shows waste constituent releases from the LLWMA 4. As such, it is appropriate that LLWMA 4 be placed in an assessment monitoring program until characterization information indicates the statistical increases associated with well 299-W15-16 irrefutably indicate the source is not LLWMA 4.	**11/12/04**
	DOE-RL/FH Response: RCRA groundwater monitoring has shown no evidence of groundwater contamination from the burial grounds. Wording will be modified to clarify that the groundwater monitoring has not determined the presence of groundwater contamination attributable to the burial grounds. For example, in section 5.2, p. 5-2 lines 20-24 will be modified to read: Over 13 years of RCRA interim-status monitoring data have not demonstrated groundwater contamination with dangerous waste constituents from the low-level burial grounds. Contamination that does exist is attributed to upgradient sources. Data are stored in the Hanford Environmental Information System (HEIS) database and made available to the regulators through that database. Indicator parameters are plotted on graphs in Appendix 5B. Results for each waste management area are discussed below. **Section 5.2.2 (p. 5-2 line 41 to p. 5-3 line 2) will be updated to reflect more recent sampling of well 299-E34-7, indicating a lack of dangerous waste constituents attributable to LLWMA-2:**	

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	Figure 5-4 illustrates the interim-status monitoring network for Low-Level Waste Management Area 2. RCRA interim status monitoring has not indicated any contamination related to waste disposal at the burial grounds. No downgradient exceedances have been confirmed. Upgradient well 299-E34-7 has had significant increases in specific conductance in recent years and is now well over the comparison value. This increase is related primarily to an increase in sulfate. Total organic carbon also has been increasing in this well. Analysis for oil and grease (April 2001) reported 1.7 mg/L but oil and grease were not detected in October 2002. Volatile and semivolatile organic analyses were negative for samples taken from this well with the exception of low-levels of endrin aldehyde (0.08 ug/L) in a sample collected in October 2002. Total organic halides also have shown an increase in this well. The source has not been determined for any of these constituents, but the area of the burial ground near this well does not contain any organic dangerous wastes. **CERCLA investigations have shown the presence of carbon tetrachloride in some of the trenches. Follow-on investigations in the shallow vadose zone detected lower levels of contamination (Rohay, V.G. and D.C. Weekes, 2003. 200-PW-1 Operable Unit Report on Step 1 Sampling and Analysis of the Dispersed Carbon Tetrachloride Plume. CP-13514, Fluor Hanford, Richland Washington). This will be reflected in the application by changing Section 5.4.3 p. 5-12 lines 43-45 to read:** As discussed in Section 5.3.3, contamination could be present in the vadose zone beneath the burial grounds. Limited data are available. Field screening for carbon tetrachloride was made for safety purposes while drilling monitoring wells and no significant contamination was detected. Rohay and Weekes, 2003, report the results of CERCLA investigation into sources of the dispersed carbon tetrachloride vadose zone plume. The investigation included sampling of vent risers and soil gas within the northern part of Low-Level Waste Management Area 4. They concluded, "Relatively high concentrations of carbon tetrachloride (maximum 1,760 ppmv) were detected within the east end of Trench 4 in the 218-W-4C Burial Ground. Carbon tetrachloride concentrations detected in samples collected from the vadose zone three months later were much lower (maximum 62.1 ppmv in August and 45.8 ppmv in September). The highest vadose zone concentrations were in samples collected at site 2, near the location of the elevated concentration within the trench." Further investigation of the dispersed carbon tetrachloride is ongoing under the CERCLA process. **The statement that it is appropriate that LLWMA 4 be placed in an interim status assessment monitoring program is outside the scope of this permit application.**	

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NOD Comments		
Comment No.	Comment	Closed on
5-9	**Chapter 5:** In general, interim status data is neither presented in its entirety nor sufficiently described or analyzed. Although some groundwater monitoring results are summarized (by graph) in Appendix 5B of the application, the application does not include all data. For example, for well 299-W15-16, there were 3,538 "returned results from HEIS" (Hanford Environmental Information System). The majority of the data returned for this well was not provided in Appendix 5B. All data for all wells used in the past (even those wells which have gone dry) for Low-Level Burial Ground (LLBG) interim status monitoring must be provided in the application in a manner that can be easily and effectively evaluated.	**11/12/04**
	DOE-RL/FH Response: Per WAC 173-303-806(4)(a)(xx)(A), a <u>summary</u> of the groundwater monitoring data obtained during the interim status period must be provided. There is no requirement to provide the data in its entirety. The data provided form the basis for the monitoring system presented in the application. All data for the interim status monitoring of LLBGs have been made available to Ecology through HEIS. These data were referenced in the application (p. 5-2 lines 22-23). The information in chapter 5, Section 5.2 and Appendix 5B will be updated to current information prior to certification of the Part B Permit Application.	
5-10	**Chapter 5:** In general, information to support permitting of LLWMA 5 is omitted. The application includes the unit but does not provide supporting information to allow final facility permit conditions to be crafted. Either remove the LLWMA 5 from the application or provide sufficient supporting information (i.e., a complete permit application).	**11/12/04**
	DOE-RL/FH Response: Accepted. Detail about LLWMA-5 will be deleted from the entire chapter. For example, section 5.2.5 and 5.3.2.3 will be deleted along with any text that discusses LLMWA-5. The following text will be added to page 5-1 line 3 after the second sentence: "One waste management area, LLMWA-5, is reserved for future landfill activities and is not discussed. Before construction commences on any TSD unit in LLMWA-5 or at an alternate point agreed upon by the Permittees and Ecology, the Permittees will submit a permit modification to add LLMWA-5 groundwater monitoring information."	

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NOD Comments		
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5-11	**Chapter 5:** The application proposes to filter samples to be analyzed for metals. It is inappropriate to filter samples collected for analyzing metals. As indicated previously in the T and TX-TY Waste Management Areas RCRA groundwater inspection report, all groundwater samples were inappropriately filtered. Ecology recognizes that due to a declining water table, certain groundwater monitoring wells (typically, wells installed in or before early 1990s), are going dry. As the water table drops, yield also declines and turbidity may become a problematic issue. During the T and TX-TY WMA groundwater inspection, in-situ measurements for turbidity were collected. Those measurements are documented in the inspection report. The conclusion reached in the inspection report was that the filtration of groundwater samples after in-situ turbidity measurement criteria had been reached is inconsistent with existing guidance (*RCRA Ground-Water Monitoring Technical Enforcement Guidance Document*, EPA 1986) on this issue. In addition, the groundwater inspection report also concluded that collection of only filtered groundwater samples where in-situ turbidity measurement criteria has not been reached (i.e., in-situ groundwater turbidity measurements are greater than 5 NTUs), is inconsistent with existing guidance on this issue.	**9/27/07**
	DOE-RL/FH Response: Based on the joint Ecology/EPA letter dated August 7, 2007, titled "Field Filtering of Groundwater Samples Prior to laboratory Analysis", and subsequent DOE response letter, Chapter 5 will be revised to reflect the filtering policy.	
5-12	**Chapter 5:** The application includes statements that are not supported by either the data collected from groundwater monitoring wells or adequate groundwater monitoring network configurations. Due to the significant deficiencies associated with the groundwater monitoring networks (i.e., well spacing, uncertainties associated with groundwater flow direction in the 200 East Area, groundwater flow direction reversals in the 200 West Area, inherent deficiencies associated with use of indicator parameters for "detection" monitoring, etc.), conclusions that the LLBGs do not appear to have contaminated groundwater with dangerous waste constituents are unfounded and unsupported.	**11/12/04**
	DOE-RL/FH Response: Document will be revised to say that the interim status monitoring has not provided any evidence of contamination from the LLBGs. For example, section 5.2, p. 5-2 lines 20-24 will be modified to say: Over 13 years of RCRA interim-status monitoring data have not demonstrated groundwater contamination with dangerous waste constituents from the low-level burial grounds. Contamination that does exist is attributed to upgradient sources. Data are stored in the Hanford Environmental Information System (HEIS) database and made available to the regulators through that database. Indicator parameters are plotted on graphs in Appendix 5B. Results for each waste management area are discussed below.	

NOD Comments		
Comment No.	Comment	Closed on
	Section 5.2.2, p. 5-2 lines 42-43 will be modified to read: RCRA interim status monitoring data have not indicated contamination related to waste disposal at the burial grounds. **Section 5.3.3 p. 5-7 line 39 will be changed to:** RCRA interim-status monitoring data have not demonstrated groundwater contamination with dangerous waste constituents from the low-level burial grounds. **Section 5.4 p. 5-12 lines 8-10 will be modified to read:** Past-practice waste sites such as cribs, ponds, ditches, and underground tanks have contaminated groundwater beneath the 200 Areas. Plume maps are included in Appendix 5A.	
5-13	**Chapter 5:** Throughout the application, statements such as the following are made: "Accordingly, any procedures, methods, data, or information provided to Ecology in Hanford Facility Dangerous Waste Permit Applications that relate solely to the radioactive component of mixed waste are for information purposes only and are outside the scope of Ecology's regulatory authority and the Hanford Facility RCRA Permit." Ecology is not endeavoring to regulate radiation hazards posed by the source, byproduct, or special nuclear components of mixed waste through the terms of this permit modification and the authority of chapter 70.105 RCW. Ecology notes, however, that the presence of radionuclides in mixed waste may be implicated in managing the dangerous waste components of such waste without constituting regulation of the radionuclides themselves. For example, tracking radionuclides may serve as a tool for monitoring whether releases of mixed waste have occurred. While such an approach would not constitute regulation of the radioactive component of mixed waste for its hazards, it would create an enforceable provision related to that component. To recognize this potential while addressing Ecology's concerns, the following sentence is recommended en lieu of the above referenced sentence: "Where information regarding treatment, management, and disposal of the radioactive source, byproduct material, and/or special nuclear components of mixed waste (as defined by the Atomic Energy Act of 1954, as amended) has been incorporated into this permit, it is not incorporated for the purpose of regulating the radiation hazards of such components under the authority of this permit and chapter 70.105 RCW."	**11/12/04**

Responses to Ecology Groundwater comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Non-GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
	DOE-RL/FH Response: DOE agrees that the language pertaining to radionuclides in the chapter 5.0 of the permit application requires revision. The proposed changes are consistent with current DOE policy regarding radionuclide text in a Part B Permit Application. In all cases, the text will be deleted. **Page 5-1 lines 45-47: Delete sentence** **Page 5-1 lines 49-50 and page 5-2 lines 1-6: Delete paragraph** **Page 5-7 lines 40-43: delete the two sentences.** **Page 5-8 line 26: delete the words "and radionuclides."** **Page 5-8 line 27-28: delete the words "uranium and neptunium."** **Page 5-8 lines 35-37: delete sentence beginning with "While."** **Page 5-8 line 42: delete the word "TRU."** **Page 5-9 line 32: delete the words "technetium-99, and uranium."** **Page 5-9 lines 34-35: delete the sentence starting with "Nitrate."** **Page 5-9 lines 37-38: delete the words "technetium-99, and uranium."** **Page 5-10 line 30: delete the words "uranium, technetium-99."** **Page 5-11 lines 5-8: delete the two sentences starting with the sentence beginning with the word "Uranium."** **Page 5-11 lines 39, 40, and 50: delete the word "TRU" in three locations.** **Page 5-12 line 2: delete the words "technetium-99 and."** **Page 5-12 lines 15-17: Delete three sentences and replace them to read: "The major chemical groundwater contaminant is nitrate."** **Page 5-12 lines 19-20: Change sentence beginning "Technetium-99 and other contaminants..." to "Nitrate and other contaminants..."** **Page 5-12 lines 24-28: Delete paragraph** **Page 5-12 lines 33-35: Delete sentence beginning with "Groundwater."**	

Responses to Ecology Groundwater comments on LLBG, Part B Permit Application, Working Draft, Rev. 2, DOE/RL-88-20, dated June 27, 2002

(Non-GW comments are in a separate file)

NOD Comments		
Comment No.	Comment	Closed on
	Page 5-12 lines 37-38: Delete the following words "and tritium and iodine-129 have sources." **Page 5-12 line 44: Delete the words "radioactivity and." ; change "were" to "was".** **Page 5-13 lines 44-47: Delete the sentence.** **Page 5-14 line 2: Delete the words "low-level" and "TRU."** **Page 5-19 line 39: Delete the words "Hazardous and radioactive."** **Page 5-25 lines 17-18: Delete reference to DOE Order 435.1** **Page F5-9 through F5-11: Delete radionuclides from the three figures.** **Page T5-1: Delete rows from table pertaining to radioactive constituents.** **In addition to the language pertaining to radionuclides, text appears on Page 5-14 lines 24-25 pertaining to topographic maps that requires correction. Replace the two sentences with: "The requirement of WAC 173-303-806(4)(a)(xx)(C) states that the point of compliance needs to be identified on a topographic map. To meet this requirement, Figures 5-12 through 5-15 are used in conjunction with the topographic map identified in Chapter 2.0."**	

Collins, Michael S

From: Collins, Michael S
Sent: Thursday, October 02, 2008 8:22 AM
To: 'Ollero, Jennifer (ECY)'
Cc: Wang, Oliver S; Mandis, Michelle (ECY); Singleton, Deborah; McKarns, Anthony C (Tony); Collins, Michael S
Subject: RE: LLBG Process Chapter Questions

Jennifer,

I would like to make sure we have the right people and information for you when we meet. Do you have a list of specific questions?

Mike C.

From: Ollero, Jennifer (ECY) [mailto:joll461@ecy.wa.gov]
Sent: Wednesday, October 01, 2008 9:19 AM
To: Collins, Michael S
Cc: Wang, Oliver S; Mandis, Michelle (ECY); Singleton, Deborah; McKarns, Anthony C (Tony)
Subject: LLBG Process Chapter Questions
Importance: High

Mike,

During our review of the Process Chapter of the LLBG Part B Permit Application we have identified several areas where we need more information. I am requesting that we set aside some time with you and appropriate contractor personnel to complete this chapter.

We will have some questions regarding the design/construction elements described in the Chapter. I am not sure if that requires specific personnel, but if possible, having someone who can address the design/construction available at the meeting would be really helpful.

Please let me know when you have some time available to meet.

Thank you,
Jennifer

Collins, Michael S

From: Collins, Michael S
Sent: Monday, February 23, 2009 7:48 AM
To: Singleton, Deborah
Cc: Williams, Joel F Jr; Miskho, Anthony G; Barnes, Brett M; Collins, Michael S
Subject: RE: LLBG permitting

See below.

From: Singleton, Deborah (ECY) [mailto:dsin461@ecy.wa.gov]
Sent: Thursday, February 19, 2009 2:10 PM
To: Collins, Michael S
Subject: LLBG permitting

Mike, the following text is currently in the draft permit. I would like to incude volume requirements or limits for trenches 31, 34 and 94:

The following provides a brief description and identifies the generic types of mixed waste disposed in the LLBG. An electronic database is maintained that documents each waste receipt, type of waste, and disposal location.

- LLBG 218-E-12B, trench 94 is approximately 68 hectares in size (Addendum A, Part A Permit) and receives defueled reactor compartments . The volume limits for this trench is? 1.5 million cubic meters

- LLBG 218-W-5, trenches 31 and 34, approximately 37.2 hectares in size (Addendum A, Part A Permit) began receiving waste for disposal in 1986. Mixed waste may be stored on the asphalt storage pad at the Trenches 31 and 34. Mixed Waste to be moved into trenches 31 and 34 for treatment via macro-encapsulation [40 CFR 268.45 Table 1 for Hazardous Debris and MACRO in 40 CFR 268.42] to meet LDR requirements. Adjacent to trenches 31 and 34 are leachate collection tanks. The volume limits for these trenches are? 120,000 cubic meters each.

Thanks for your assistance

Deborah

ATTACHMENT II

STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
1315 W. 4th Avenue • Kennewick, Washington 99336-6018 • (509) 735-7581

March 6, 1997

Mr. James E. Rasmussen
U.S. Department of Energy
P.O. Box 550, MSIN: A5-15
Richland, WA 99352

Dear Mr. Rasmussen:

Re: Approval of Low-Level Burial Ground (LLBG) Part A, Revision 9

The Washington State Department of Ecology (Ecology) has received the LLBG Part A, Revision 9, dated March 4, 1997. It is Ecology's understanding that there is an urgent need for storage of bulky and long-length mixed waste awaiting disposal at Hanford. Trench 34 provides the necessary safeguards and the most affordable option to safely manage this waste form at Hanford.

Based on the above considerations, Ecology is approving the LLBG Part A, Revision 9. If you have any questions concerning this approval, please contact me at (509) 736-3048.

Sincerely,

for Norman T. Hepner, PE
Nuclear Waste Program

NH:sb
Enclosure

cc: Cliff Clark, USDOE
William Adair, FDH
Sue Price, FDH
Mary Lou Blazek, ODOE
Administrative Record: LLBG

Please print or type in the unshaded areas only
(fill-in areas are spaced for elite type, i.e., 12 character/inch).

FORM 3

DANGEROUS WASTE PERMIT APPLICATION

1. EPA/STATE I.D. NUMBER: W A 7 8 9 0 0 0 8 9 8 7

FOR OFFICIAL USE ONLY

APPLICATION APPROVED	DATE RECEIVED (mo., day, & yr.)	COMMENTS

II. FIRST OR REVISED APPLICATION

Place an "X" in the appropriate box in A or B below (mark one box only) to indicate whether this is the first application you are submitting for your facility or a revised application. If this is your first application and you already know your facility's EPA/STATE I.D. Number, or if this is a revised application, enter your facility's EPA/STATE I.D. Number in Section I above.

A. FIRST APPLICATION *(place an "X" below and provide the appropriate date)*

☐ 1. EXISTING FACILITY *(See instructions for definition of "existing" facility. Complete item below.)*

MO. 0 3 | DAY 2 2 | YR. 4 3 — FOR EXISTING FACILITIES, PROVIDE THE DATE *(mo., day, & yr.)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

* The date construction of the Hanford Facility commenced

☐ 2. NEW FACILITY *(Complete item below)*

MO. | DAY | YR. — FOR NEW FACILITIES, PROVIDE THE DATE *(mo., day, & yr)* OPERATION BEGAN OR IS EXPECTED TO BEGIN

B. REVISED APPLICATION *(place an "X" below and complete Section I above)*

☒ 1. FACILITY HAS AN INTERIM STATUS PERMIT

☒ 2. FACILITY HAS A FINAL PERMIT

III. PROCESSES - CODES AND CAPACITIES

A. PROCESS CODE - Enter the code from the list of process codes below that best describes each process to be used at the facility. Ten lines are provided for entering codes. If more lines are needed, enter the code(s) in the space provided. If a process will be used that is not included in the list of codes below, then describe the process *(including its design capacity)* in the space provided on the *(Section III-C)*.

B. PROCESS DESIGN CAPACITY - For each code entered in column A enter the capacity of the process.

1. AMOUNT - Enter the amount.

2. UNIT OF MEASURE - For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Storage:		
CONTAINER (barrel, drum, etc)	S01	GALLONS OR LITERS
TANK	S02	GALLONS OR LITERS
WASTE PILE	S03	CUBIC YARDS OR CUBIC METERS
SURFACE IMPOUNDMENT	S04	GALLONS OR LITERS
Disposal:		
INJECTION WELL	D80	GALLONS OR LITERS
LANDFILL	D81	ACRE-FEET *(the volume that would cover one acre to a depth of one foot)* OR HECTARE-METER
LAND APPLICATION	D82	*ACRES OR HECTARES*
OCEAN DISPOSAL	D83	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	D84	GALLONS OR LITERS

PROCESS	PROCESS CODE	APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY
Treatment:		
TANK	T01	GALLONS PER DAY OR LITERS PER DAY
SURFACE IMPOUNDMENT	T02	GALLONS PER DAY OR LITERS PER DAY
INCINERATOR	T03	TONS PER HOUR OR METRIC TONS PER HOUR; GALLONS PER HOUR OR LITERS PER HOUR
OTHER (Use for physical, chemical, thermal or biological treatment processes not occuring in tanks, surface impoundments or incinerators. Describe the processes in the space provided; Section III-C.)	T04	GALLONS PER DAY OR LITERS PER DAY

UNIT OF MEASURE	UNIT OF MEASURE CODE
GALLONS	G
LITERS	L
CUBIC YARDS	Y
CUBIC METERS	C
GALLONS PER DAY	U

UNIT OF MEASURE	UNIT OF MEASURE CODE
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H

UNIT OF MEASURE	UNIT OF MEASURE CODE
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	Q

EXAMPLE FOR COMPLETING SECTION III *(shown in line numbers X-1 and X-2 below): A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.*

LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G	
X-2	T 0 3	20	E	
1	D 8 1	174	F	
2	S 0 1	10,000,000	L	
3				
4				

LINE NUMBER	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (enter code)	FOR OFFICIAL USE ONLY
5				
6				
7				
8				
9				
10				

CONTINUE ON REVERSE

Continued from the front.

III. PROCESSES (continued)

C. SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESS (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAPACITY.

Refer to the following page.

IV. DESCRIPTION OF DANGEROUS WASTES

A. DANGEROUS WASTE NUMBER - Enter the four digit number from Chapter 173-303 WAC for each listed dangerous waste you will handle. If you handle dangerous wastes which are not listed in Chapter 173-303 WAC, enter the four digit number(s) that describes the characteristics and/or the toxic contaminants of those dangerous wastes.

B. ESTIMATED ANNUAL QUANTITY - For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.

C. UNIT OF MEASURE - For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:

ENGLISH UNIT OF MEASURE	CODE
POUNDS	P
TONS	T

METRIC UNIT OF MEASURE	CODE
KILOGRAMS	K
METRIC TONS	M

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed dangerous waste: For each listed dangerous waste entered in column A select the code(s) from the list of process codes contained in Section III to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed dangerous wastes: For each characteristic or toxic contaminant entered in Column A, select the code(s) from the list of process codes contained in Section III to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed dangerous wastes that possess that characteristic or toxic contaminant.

Note: Four spaces are provided for entering process codes. If more are needed: (1) Enter the first three as described above; (2) Enter "000" in the extreme right box of Item IV-D(1); and (3) Enter in the space provided on page 4, the line number and the additional code(s).

2. PROCESS DESCRIPTION: If a code is not listed for a process that will be used, describe the process in the space provided on the form.

NOTE: DANGEROUS WASTES DESCRIBED BY MORE THAN ONE DANGEROUS WASTE NUMBER - Dangerous wastes that can be described by more than one Waste Number shall be described on the form as follows:

1. Select one of the Dangerous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.
2. In column A of the next line enter the other Dangerous Waste Number that can be used to describe the waste. In column D(2) on that line enter "Included with above" and make no other entries on that line.
3. Repeat step 2 for each other Dangerous Waste Number that can be used to describe the dangerous waste.

EXAMPLE FOR COMPLETING SECTION IV *(shown in line numbers X-1, X-2, X-3, and X-4 below)* - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

LINE NO.	A. DANGEROUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES 1. PROCESS CODES (enter)	D. PROCESSES 2. PROCESS DESCRIPTION (If a code is not entered in D(1))
X-1	K 0 8 4	900	P	T 0 3 D 8 0	
X-2	D 0 0 2	400	P	T 0 3 D 8 0	
X-3	D 0 0 1	100	P	T 0 3 D 8 0	
X-4	D 0 0 2			T 0 3 D 8 0	Included with above

CONTINUE ON PAGE 3

FORM 3 DANGEROUS WASTE PERMIT APPLICATION
U.S. ENVIRONMENTAL PROTECTION AGENCY/STATE IDENTIFICATION NUMBER WA7890008967

Section III.C., Description of Process Codes listed in Section III.a.

D81

The Low-Level Burial Grounds (LLBG) began waste management operations in January of 1960. The LLBG comprise a landfill disposal unit (D81) and cover a total area of approximately 225 hectares (556 acres). The landfill is divided into eight burial grounds. Six burial grounds are located in the 200 West Area and two in the 200 East Area, as depicted on the attached drawings. The LLBG consist of lined and unlined trenches of various sizes and depths. All mixed waste destined for disposal in lined trenches will meet land disposal restriction requirements. The lined trenches consist of a double-liner leachate collection and removal system.

The process design capacity for mixed waste in the LLBG is 174 hectare-meters (2,275,819 cubic yards) of which 150 hectare-meters (1,961,913 cubic yards) is dedicated solely for the disposal of reactor compartment disposal packages.

S01

The greater-than-90-day container storage capability in mixed waste Trenches 31 and 34 of Burial Ground 218-W-5 provides a location to store various size containers of treated mixed waste in a Resource Conservation and Recovery Act (RCRA) compliant manner other than the Central Waste Complex. The placement of these containers in Trenches 31 and 34 eliminates the need to construct a mixed waste storage pad. This capability also reduces the need to transfer this waste prior to disposal. The process design capacity for storage of containers is estimated to be 10,000,000 liters (2,641,700 gallons).

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: WA7890008987

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	D001	160,000,000	K	D81	Disposal
2	through				
3	D043				
4	WT01				
5	WT02				
6	WP01				
7	WP02				
8	WP03				
9	F001				
10	through				
11	F005				
12	F028				
13	F039				
14	W001				
15	U001				
16	through				
17	U012				
18	U014				
19	through				
20	U039				
21	U041				
22	through				
23	U053				
24	U055				
25	through				
26	U064				

CONTINUE ON REVERSE

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: WA7890008967

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	U066		K	D81	Disposal (Continued)
2	through				
3	U099				
4	U101				
5	through				
6	U103				
7	U105				
8	through				
9	U174				
10	U176				
11	through				
12	U194				
13	U196				
14	U197				
15	U200				
16	through				
17	U223				
18	U225				
19	through				
20	U228				
21	U232				
22	through				
23	U240				
24	U243				
25	through				
26	U249				

CONTINUE ON REVERSE

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: WA7890008987

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	U328		K	D81	Disposal (Continued)
2	U353				
3	U359				
4	P001				
5	through				
6	P018				
7	P020				
8	through				
9	P024				
10	P026				
11	through				
12	P031				
13	P033				
14	P034				
15	P036				
16	through				
17	P051				
18	P054				
19	P056				
20	through				
21	P060				
22	P062				
23	through				
24	P078				
25	P081				
26	P082				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: WA7890089897

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	P084		K	D81	Disposal (Continued)
2	P085				
3	P087				
4	through				
5	P089				
6	P092				
7	through				
8	P099				
9	P101				
10	through				
11	P116				
12	P118				
13	through				
14	P123				Included With Above
15	D004	10,000,000	K	S01	Storage-Container
16	through				
17	D043				
18	WT01				
19	WT02				
20	WP01				
21	WP02				
22	WP03				
23	W001				
24	F001				
25	through				
26	F005				

CONTINUE ON REVERSE.

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	F028		K	S01	Storage-Container (Continued)
2	U001				
3	through				
4	U012				
5	U014				
6	through				
7	U039				
8	U041				
9	through				
10	U053				
11	U055				
12	through				
13	U064				
14	U066				
15	through				
16	U099				
17	U101				
18	through				
19	U103				
20	U105				
21	through				
22	U174				
23	U176				
24	through				
25	U194				
26	U196				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: W A 7 8 9 0 0 0 8 9 6 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	U197		K	S01	Storage-Container (Continued)
2	U200				
3	through				
4	U223				
5	U225				
6	through				
7	U228				
8	U232				
9	through				
10	U240				
11	U243				
12	through				
13	U249				
14	U328				
15	U353				
16	U359				
17	P001				
18	through				
19	P018				
20	P020				
21	through				
22	P024				
23	P026				
24	through				
25	P031				
26	P033				

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: W A 7 8 9 0 0 0 8 9 8 7

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(if a code is not entered in D(1))*
1	P034		K	S01	Storage-Container (Continued)
2	P036				
3	through				
4	P051				
5	P054				
6	P056				
7	through				
8	P060				
9	P062				
10	through				
11	P078				
12	P081				
13	P082				
14	P084				
15	P085				
16	P087				
17	through				
18	P089				
19	P092				
20	through				
21	P099				
22	P101				
23	through				
24	P116				
25					
26					

Continued from page 2.
NOTE: Photocopy this page before completing if you have more than 26 wastes to list.

I.D. NUMBER *(entered from page 1)*: WA7890008987

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

LINE NO.	A. DANGEROUS WASTE NO. *(enter code)*	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE *(enter code)*	D. PROCESSES 1. PROCESS CODES *(enter)*	D. PROCESSES 2. PROCESS DESCRIPTION *(If a code is not entered in D(1))*
1	P118		K	S01	Storage-Container (Continued)
2	through		↓	↓	↓
3	P123		↓	↓	Included With Above
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					

Continued from the front.

IV. DESCRIPTION OF DANGEROUS WASTES (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM SECTION D(1) ON PAGE 3.

The mixed waste disposed in the LLBG will consist of toxicity characteristic waste (D001 through D043), state-only waste (WT01, WT02, WP01, WP02, WP03, and W001), and listed waste from nonspecific sources (F001 through F005 and F039). Currently there is no mechanism in place to treat collected leachate with listed waste numbers other than F001 through F005. However, regulatorily acceptable alternatives for leachate management will allow for the disposal of other listed waste that include all "U," "P," and other "F" dangerous waste numbers. The reactor compartments in the 218-E-12B Burial Ground contain shielding constructed of metallic lead (state-only D008). Mixed waste could consist of up to 25 percent debris; however, this estimate could fluctuate as waste management needs dictate.

The mixed waste stored in the LLBG will consist of toxicity characteristic waste (D004 through D043), state-only waste (WT01, WT02, WP01, WP02, WP03, and W001), and listed waste from nonspecific sources (F001 through F005 and F028). Other waste that may be stored at the LLBG include all "U" and "P" dangerous waste numbers.

V. FACILITY DRAWING Refer to attached drawing(s).

All existing facilities must include in the space provided on page 5 a scale drawing of the facility (see instructions for more detail).

VI. PHOTOGRAPHS Refer to attached photograph(s).

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail).

VII. FACILITY GEOGRAPHIC LOCATION This information is provided on the attached drawing(s) and photograph(s).

LATITUDE (degrees, minutes, & seconds)	LONGITUDE (degrees, minutes, & seconds)

VIII. FACILITY OWNER

[X] A. If the facility owner is also the facility operator as listed in Section VII on Form 1, "General Information", place an "X" in the box to the left and skip to Section IX below.

B. If the facility owner is not the facility operator as listed in Section VII on Form 1, complete the following items:

1. NAME OF FACILITY'S LEGAL OWNER	2. PHONE NO. (area code & no.)

3. STREET OR P.O. BOX	4. CITY OR TOWN	5. ST.	6. ZIP CODE

IX. OWNER CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (print or type)	SIGNATURE	DATE SIGNED
John D. Wagoner, Manager U.S. Department of Energy Richland Operations Office	John D. Wagoner	3/4/97

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME (print or type)	SIGNATURE	DATE SIGNED
SEE ATTACHMENT		

CONTINUE ON PAGE 5

X. OPERATOR CERTIFICATION

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

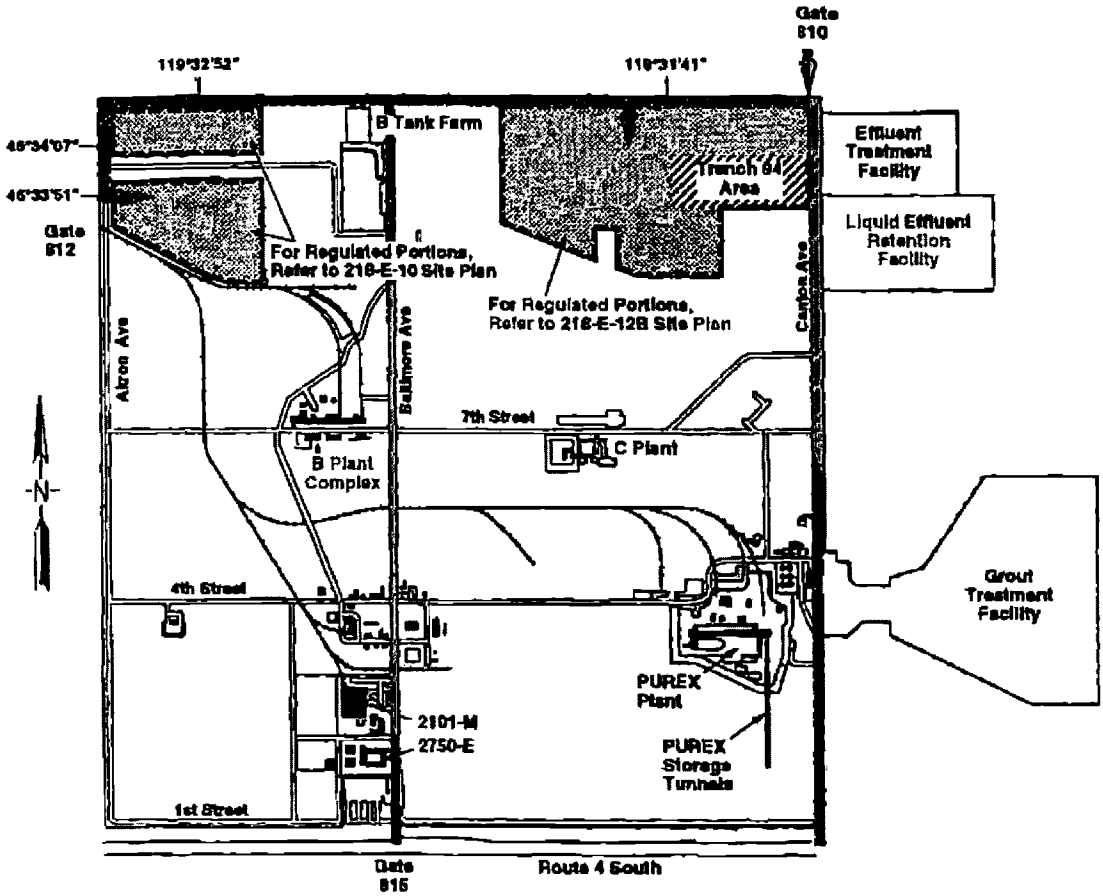
John D. Wagoner

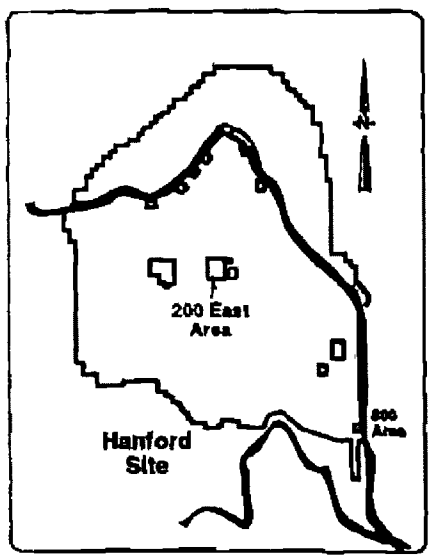
Owner/Operator
John D. Wagoner, Manager
U.S. Department of Energy
Richland Operations Office

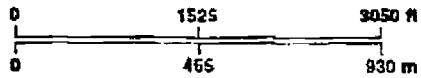
3/4/97
Date

Co-operator
H. J. Hatch,
President and Chief Executive Officer
Fluor Daniel Hanford, Inc.

3/3/97
Date







Regulated Burial Grounds

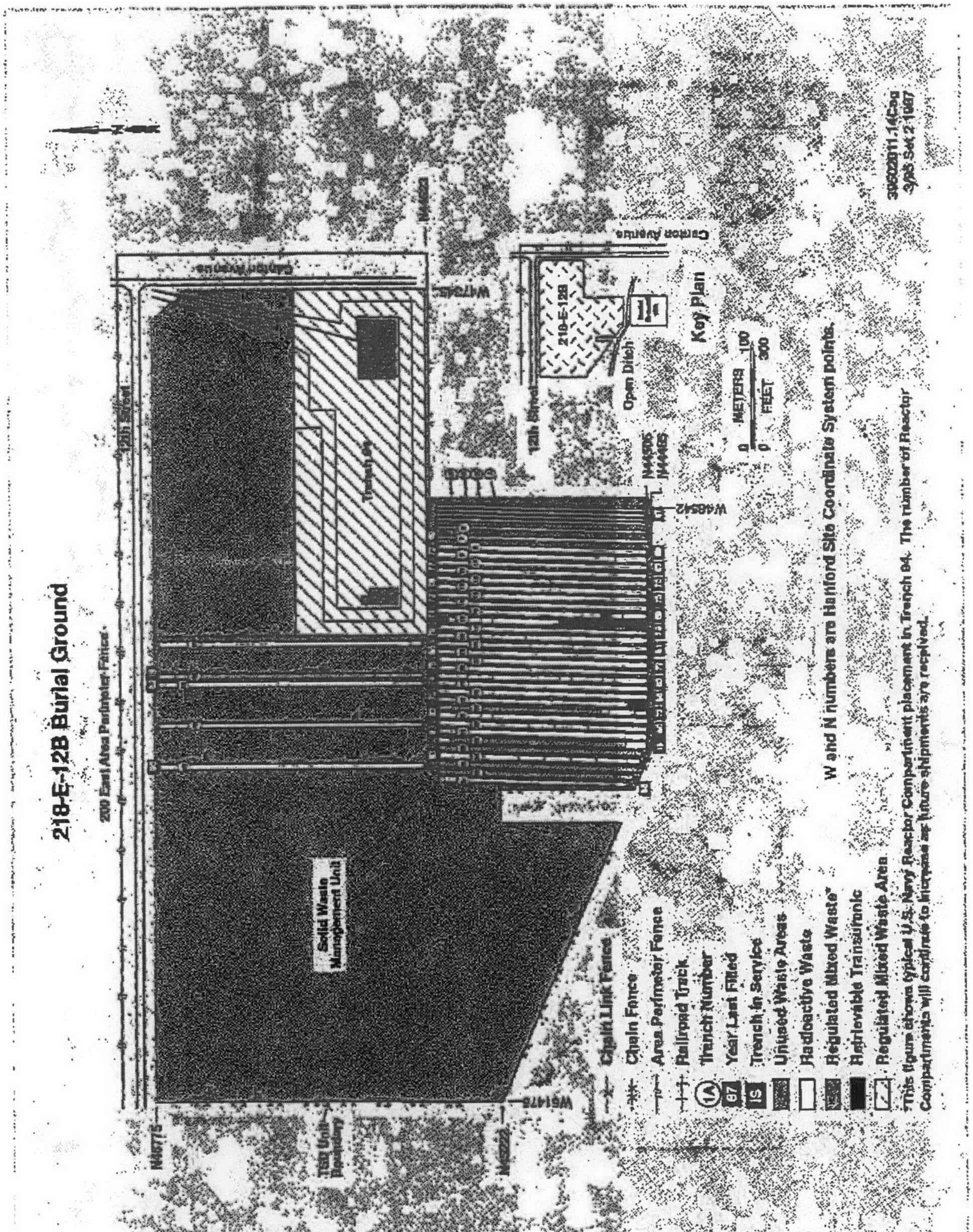
SWMU (Solid Waste Management Unit)

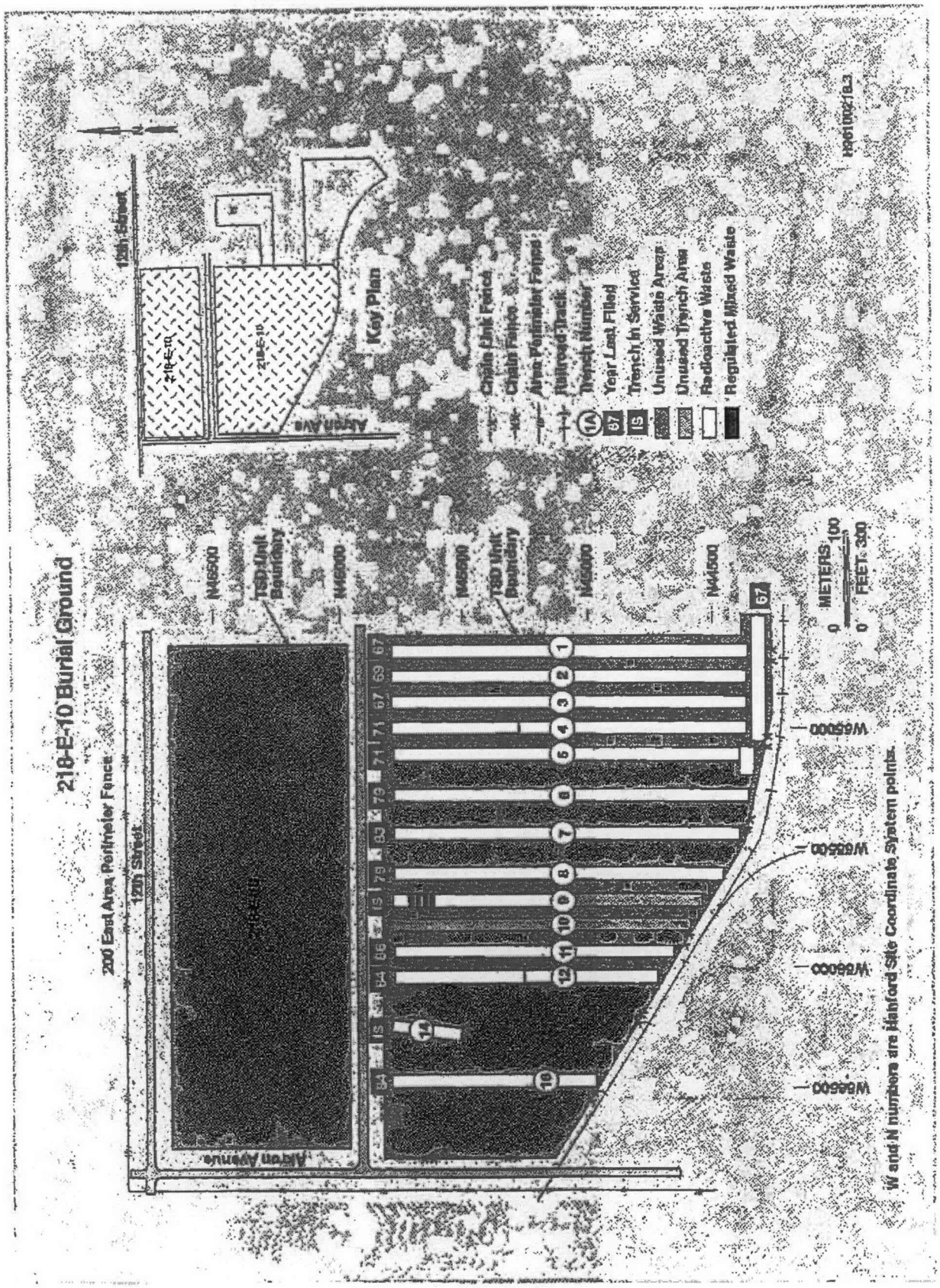
Waste Routes

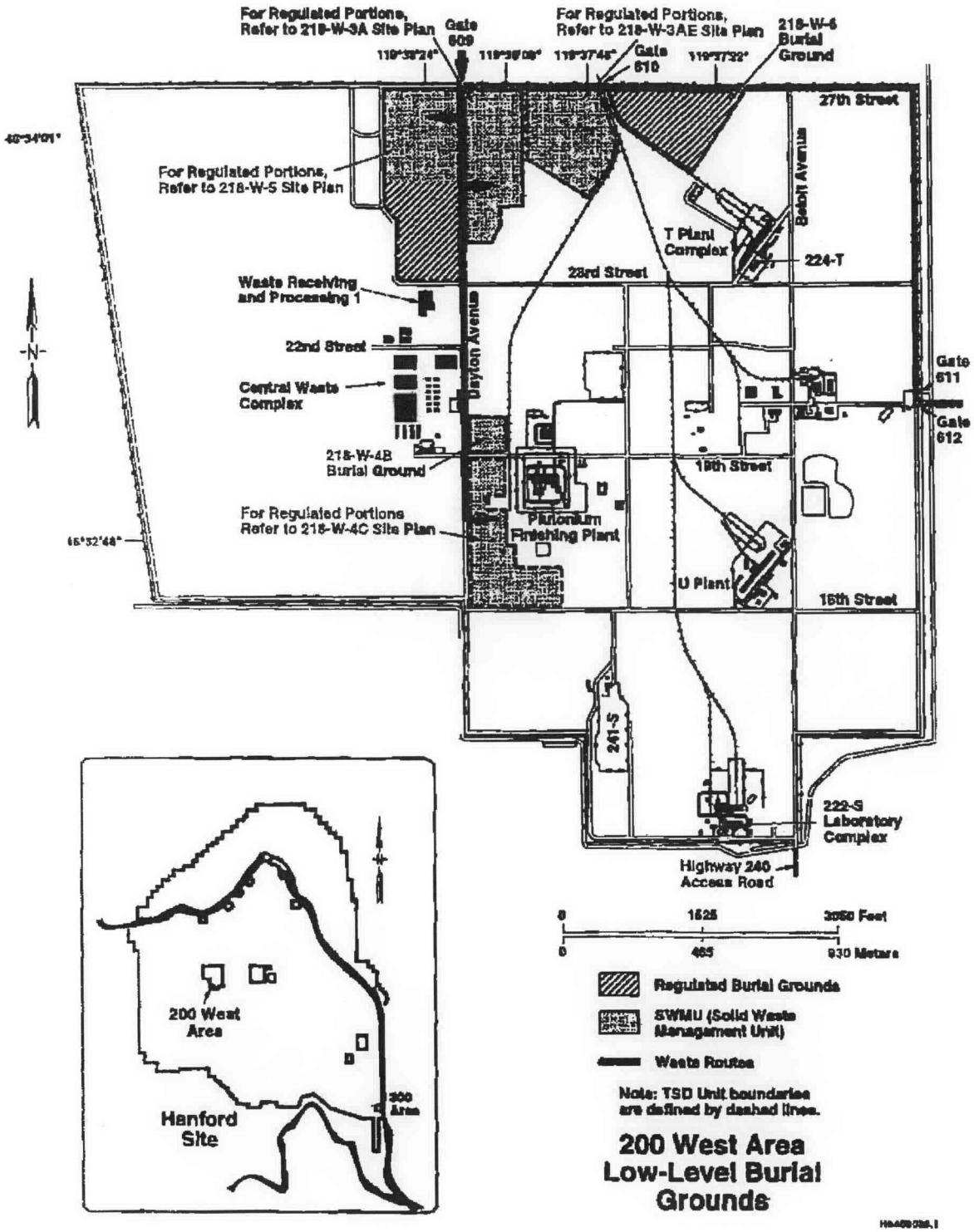
Note: TSD Unit boundaries are defined by dashed lines.

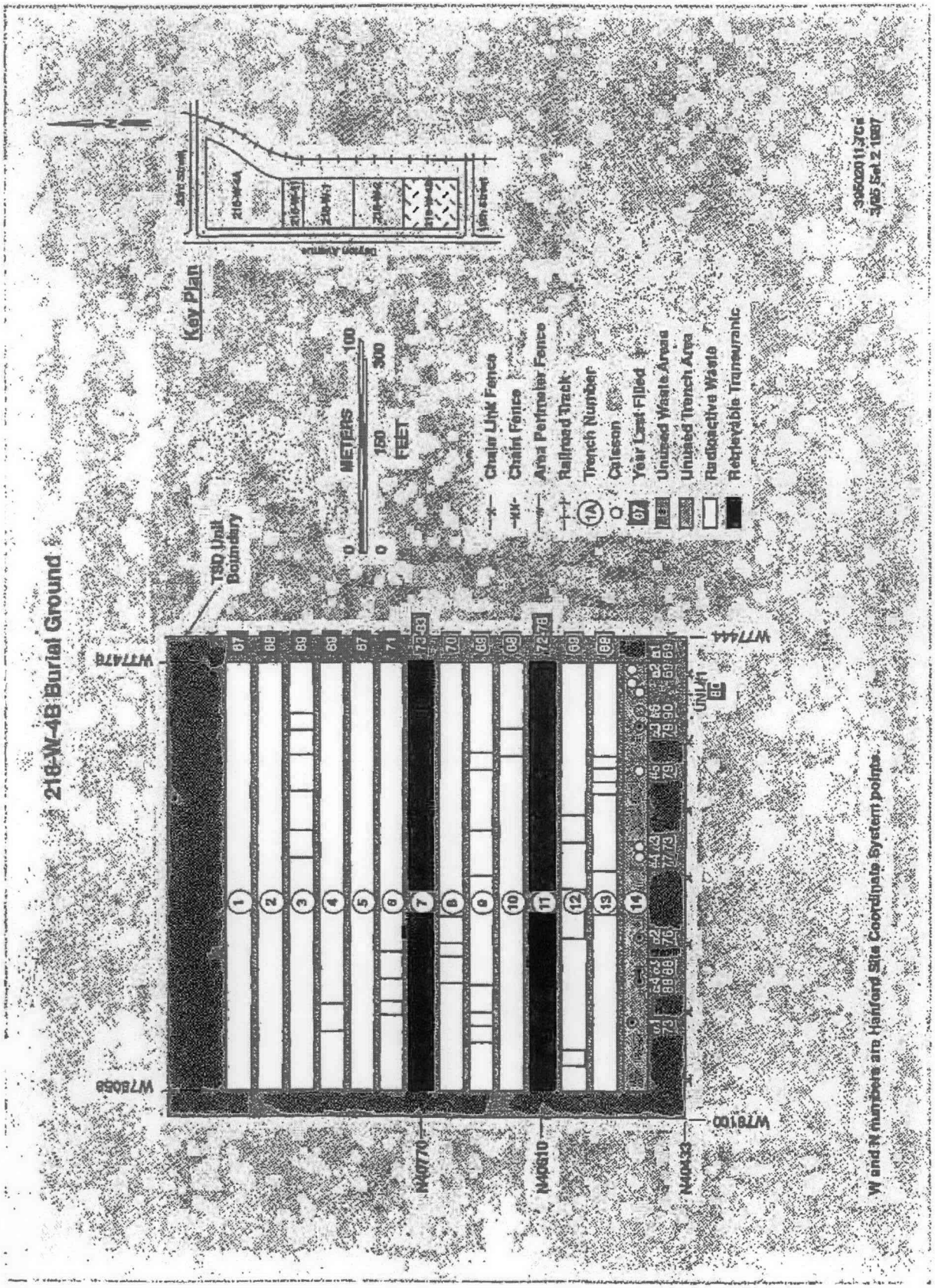
200 East Area Low-Level Burial Grounds

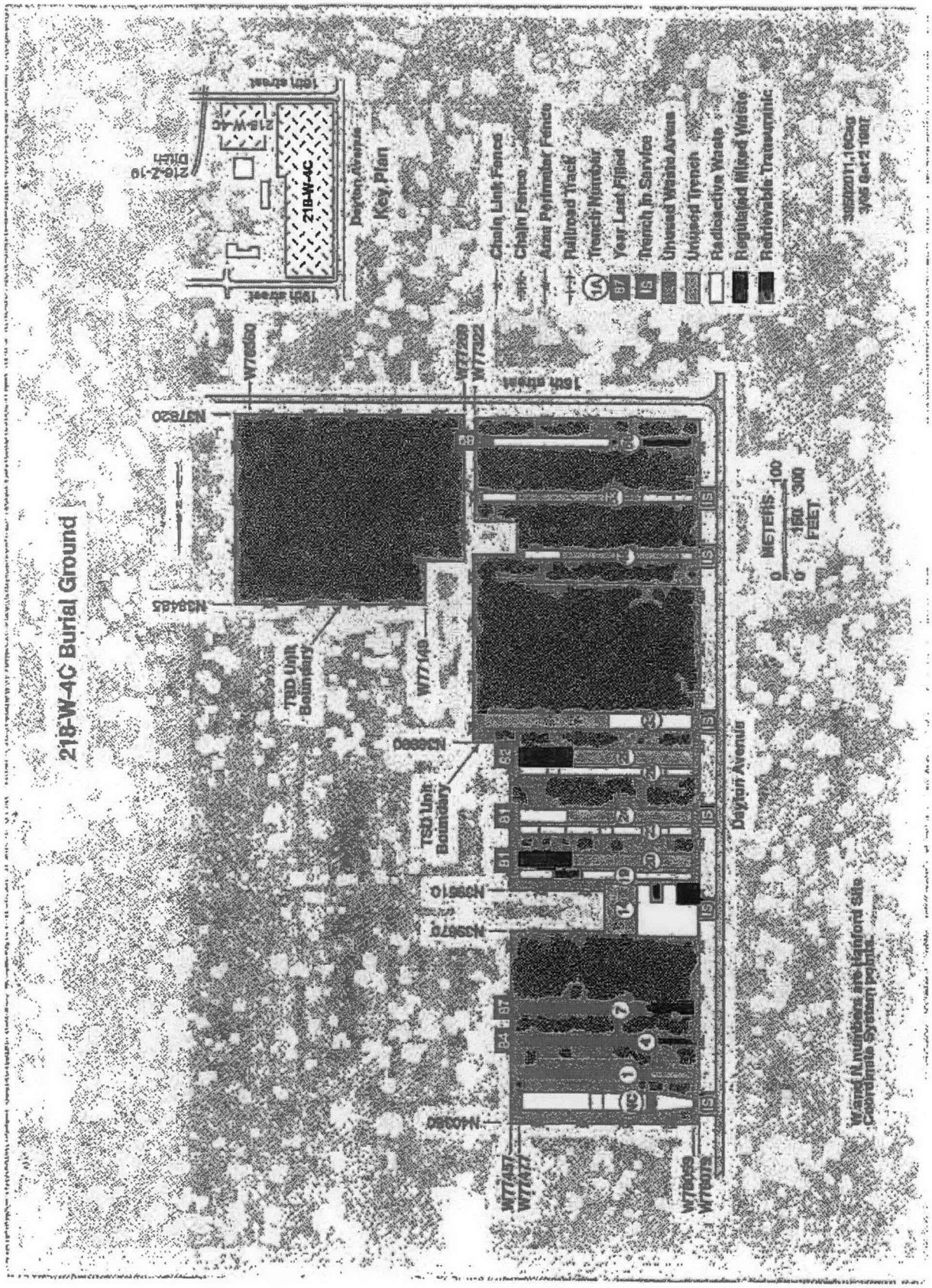
3940711B.4

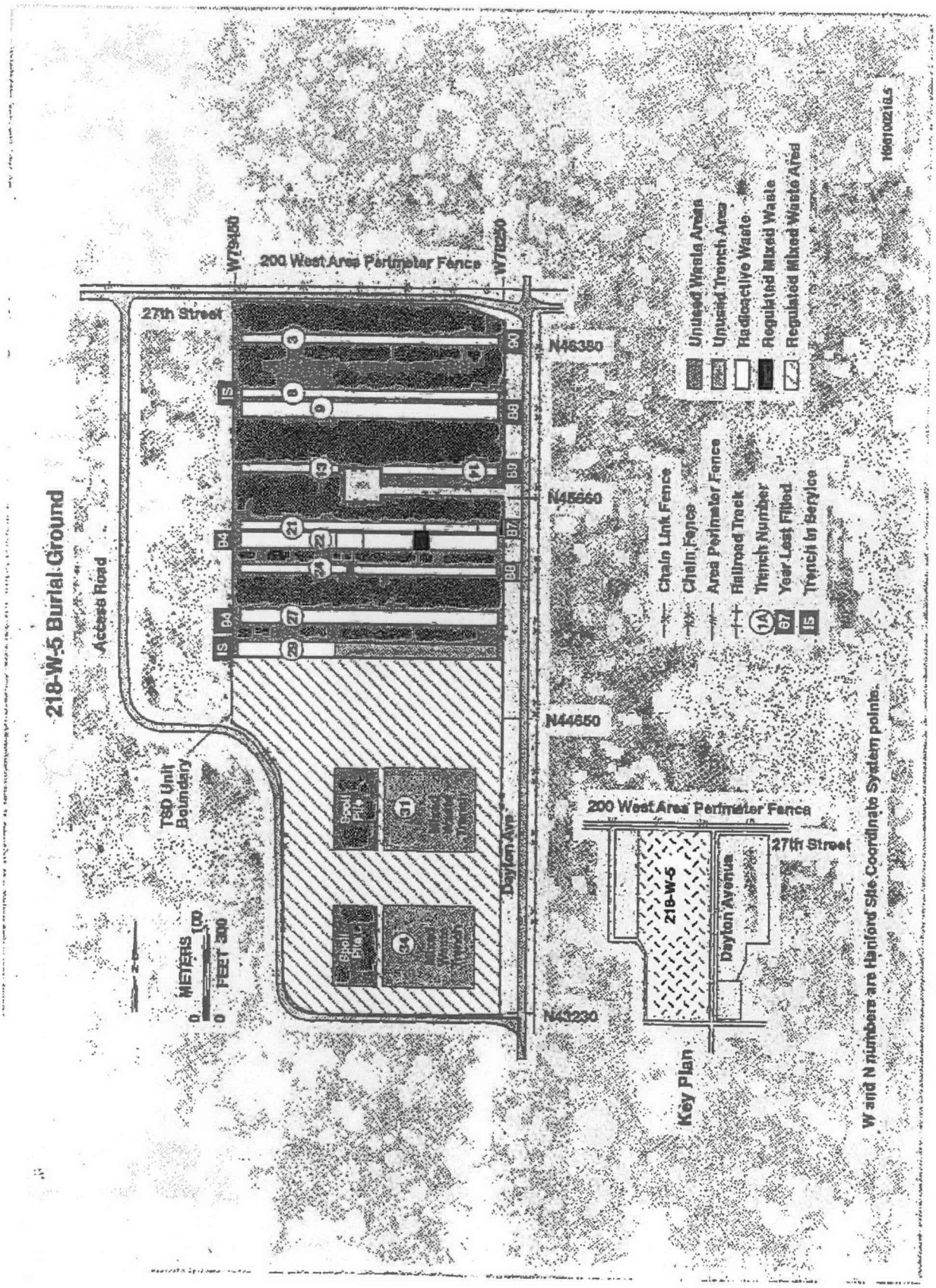

218-E-12B Burial Ground
200 East Area Perimeter Fence
12th Street
Canton Avenue
Trench 94
Solid Waste Management Unit
TSD Unit Boundary
218-E-12B
Open Ditch
Key Plan
METERS
0
100
FEET
0
300
W and N numbers are Hanford Site Coordinate System points.
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench in Service
Unused Waste Areas
Radioactive Waste
Regulated Mixed Waste*
Retrievable Transuranic
Regulated Mixed Waste Area
*This figure shows typical U.S. Navy Reactor Compartment placement in Trench 94. The number of Reactor Compartments will continue to increase as future shipments are received.

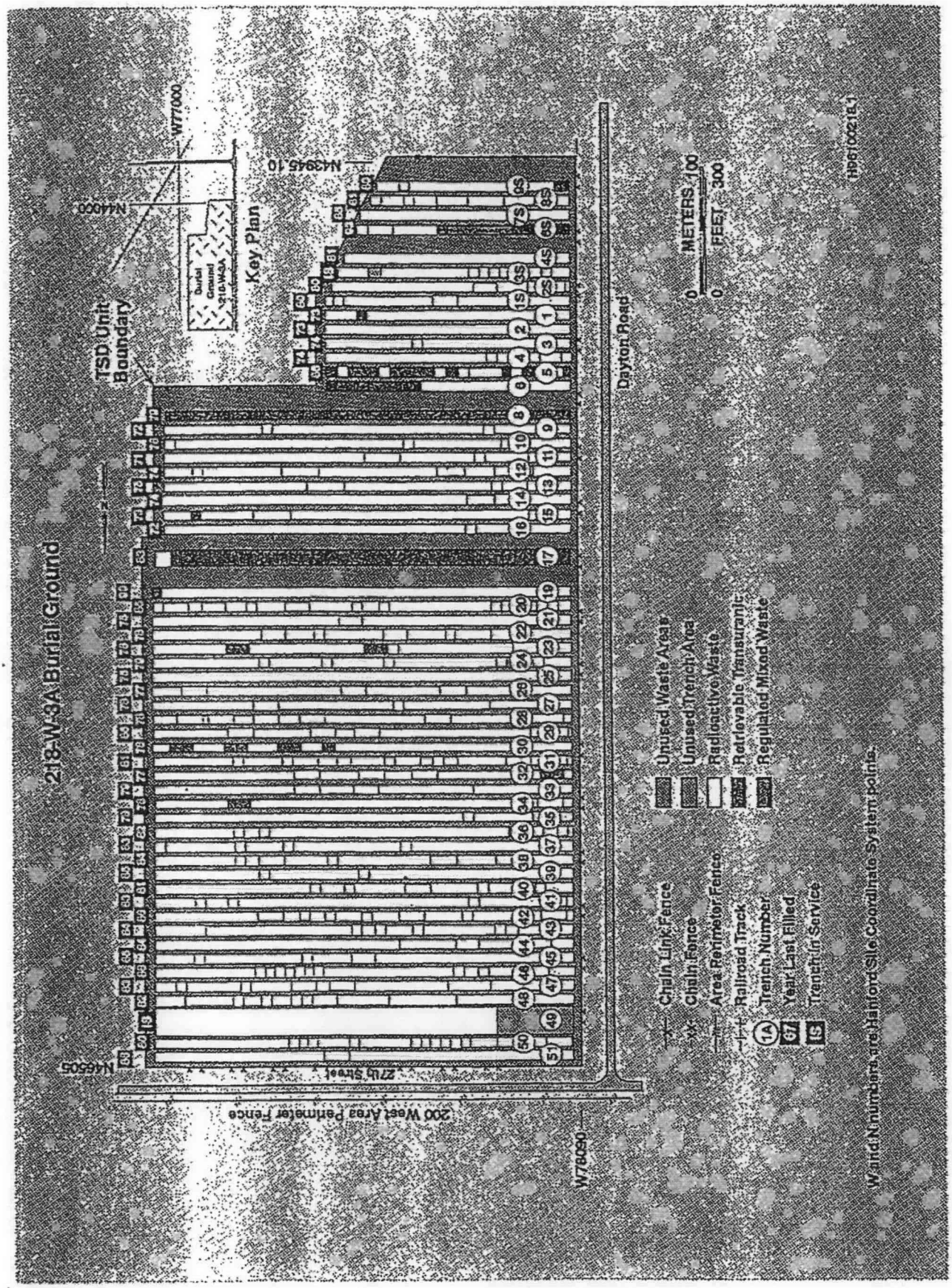

218-E-10 Burial Ground
200 East Area Perimeter Fence
12th Street
Aaron Ave
218-E-10
N4500
TSD Unit Boundary
W66500
W66000
W65500
W65000
Key Plan
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench In Service
Unused Waste Area
Unused Trench Area
Radioactive Waste
Regulated Mixed Waste
METERS 0 100
FEET 0 300
W and N numbers are Hanford Site Coordinate System points.

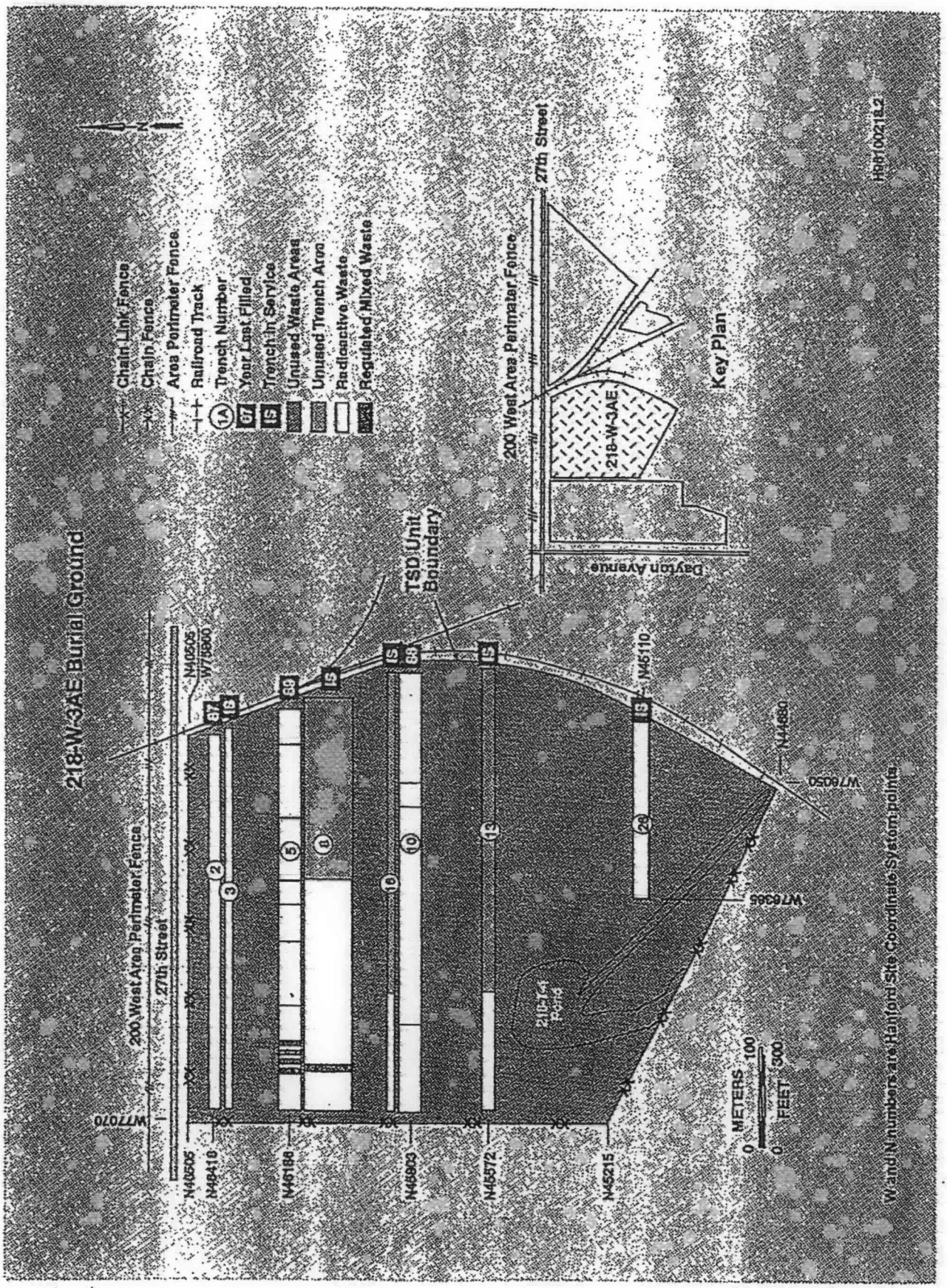

For Regulated Portions, Refer to 218-W-3A Site Plan
Gate 609
For Regulated Portions, Refer to 218-W-3AE Site Plan
218-W-6 Burial Ground
Gate 610
27th Street
For Regulated Portions, Refer to 218-W-5 Site Plan
Beloit Avenue
T Plant Complex
224-T
23rd Street
Waste Receiving and Processing 1
Dayton Avenue
22nd Street
Central Waste Complex
Gate 611
Gate 612
218-W-4B Burial Ground
19th Street
For Regulated Portions Refer to 218-W-4C Site Plan
Plutonium Finishing Plant
U Plant
16th Street
241-S
222-S Laboratory Complex
Highway 240 Access Road
200 West Area
Hanford Site
300 Area
Regulated Burial Grounds
SWMU (Solid Waste Management Unit)
Waste Routes
Note: TSD Unit boundaries are defined by dashed lines.
200 West Area Low-Level Burial Grounds

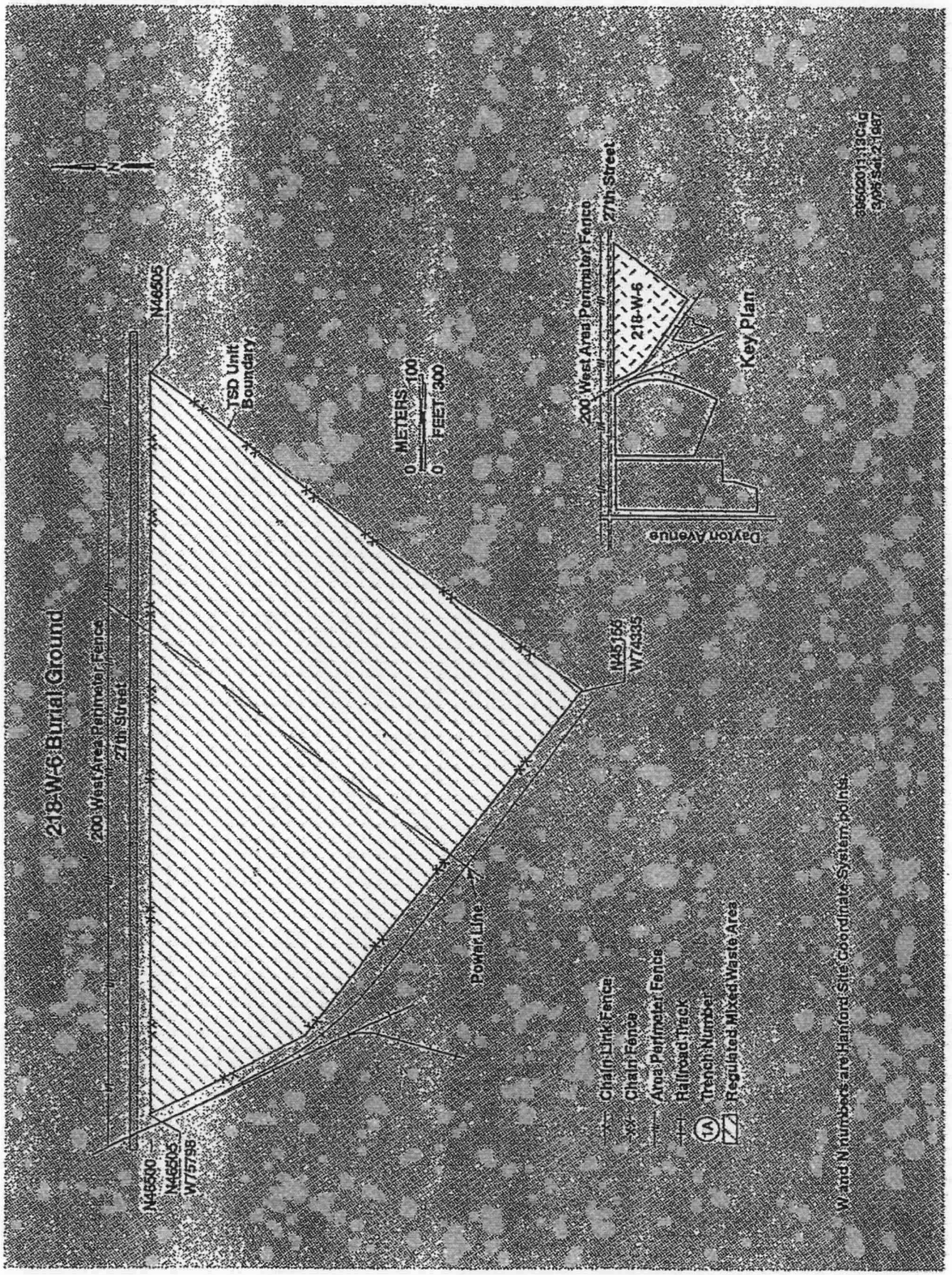

218-W-4B Burial Ground
TSD Unit Boundary
Key Plan
METERS
FEET
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Caisson
Year Last Filled
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Retrievable Transuranic
W and N numbers are Hanford Site Coordinate System points.


218-W-4C Burial Ground
Key Plan
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench In Service
Unused Waste Area
Unused Trench
Radioactive Waste
Regulated Mixed Waste
Retrievable Transuranic
218-W-4C
218-Z-19 Ditch
10th Street
Dayton Avenue
TSD Unit Boundary
W77140
N39430
N39435
N39610
N39570
N40280
W77457
W77477
W78058
W78075
W78080
W77280
W77300
N37820
0 METERS 100
0 150 300 FEET
Wand N numbers are Hanford Site Coordinate System points.

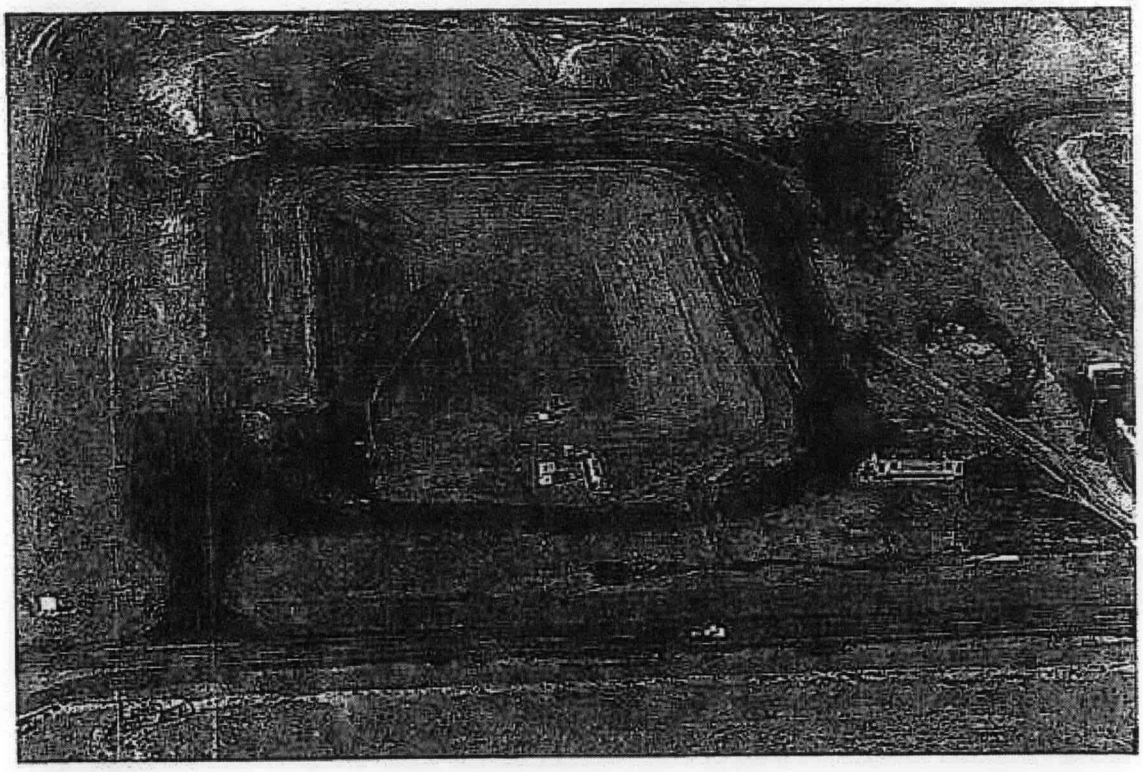

218-W-5 Burial Ground
Access Road
TSD Unit Boundary
27th Street
200 West Area Perimeter Fence
W79450
W78250
N46380
N45660
N44850
N44230
Dayton Ave.
Spoil Pile
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Regulated Mixed Waste
Regulated Mixed Waste Area
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench In Service
METERS 100
FEET 300
Key Plan
218-W-5
Dayton Avenue
W and N numbers are Hanford Site Coordinate System points.


218-W-3A Burial Ground
TSD Unit Boundary
Key Plan
Burial Ground 218-W-3A
W77000
N44000
N43945.10
N46505
W76090
27th Street
200 West Area Perimeter Fence
Dayton Road
0 METERS 100
0 FEET 300
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Retrievable Transuranic
Regulated Mixed Waste
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench in Service
Ward Numbers are Hanford Site Coordinate System points.
HP6100218-1


218-W-3AE Burial Ground
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Year Last Filled
Trench in Service
Unused Waste Areas
Unused Trench Area
Radioactive Waste
Regulated Mixed Waste
200 West Area Perimeter Fence
27th Street
TSD Unit Boundary
Dayton Avenue
218-W-3AE
Key Plan
N40505
W75600
W77070
N40505
N40418
N46188
N46903
N45572
N45215
N45110
N44880
W76050
W76345
2101-T-41 Pond
0 METERS 100
0 FEET 300
W and N numbers are Hanford Site Coordinate System points.
Hber00218.2


218-W-6 Burial Ground
200 West Area Perimeter Fence
27th Street
N46500
N46505
W75798
N46505
TSD Unit Boundary
0 METERS 100
0 FEET 300
N46366
W74335
Power Line
200 West Area Perimeter Fence
27th Street
218-W-6
Key Plan
Dayton Avenue
N
Chain Link Fence
Chain Fence
Area Perimeter Fence
Railroad Track
Trench Number
Regulated Mixed Waste Area
W and N numbers are Hanford Site Coordinate System points.

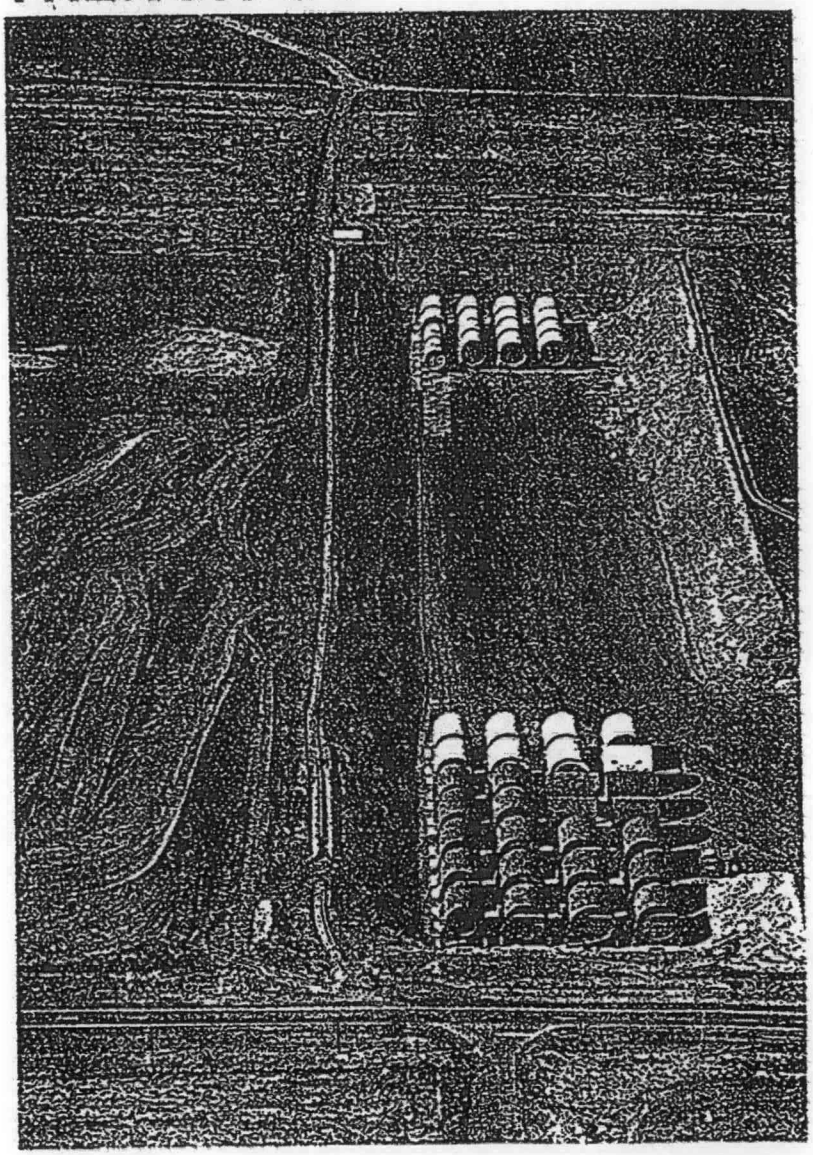
TYPICAL LINED MIXED WASTE TRENCH (TRENCH 34) 218-W-5/200 WEST AREA



46°33'36"
119°38'24"

95030469-44CN
(PHOTO TAKEN 1995)

REACTOR COMPARTMENT TRENCH 94



46°33'58"
119°31'06"

95030469-5CN
(PHOTO TAKEN 1995)

ATTACHMENT III

Collins, Michael S

From: Collins, Michael S
Sent: Tuesday, February 24, 2009 1:34 PM
To: 'Szendre, Steve (ECY)'
Cc: Collins, Michael S; Williams, Joel F Jr; Miskho, Anthony G; McKarns, Anthony C (Tony); Barnes, Brett M; Dixon, Brian J; Engelmann, Richard H
Subject: FW: LLBG TRAINING MATRIX
Attachments: CWC Addendum G Training matrix.doc

Importance: High

Hi Steve,

Hope this helps.

Mike C.

From: Williams, Joel F Jr
Sent: Tuesday, February 24, 2009 10:02 AM
To: Collins, Michael S; Miskho, Anthony G; McKarns, Anthony C (Tony)
Cc: Barnes, Brett M; Dixon, Brian J; Engelmann, Richard H
Subject: FW: LLBG TRAINING MATRIX
Importance: High

Table 8-1. LLBG Training Matrix.

	Training Category*					
Permit Attachment 33 Chapter 8.0 Training Category	General Hanford Facility Training	Contingency Plan Training	Emergency Coordinator Training	Operations Training		
LLBG DWTP implementing category	Orientation Program	Emergency Response (contingency plan)	Emergency Coordinator Training	General Waste Management	Container Management	Landfill Management
Job title/position						
Nuclear Chemical Operator (NCO)	X	X		X	X	X
Operations Team Lead	X	X	X	X		
Operations Manager	X	X	X	X	X	
Environmental Compliance Officer (ECO)	X	X		X	X	
Non-Resident Waste Service Provider	X			X	X	

From: Szendre, Steve (ECY) [mailto:ssze461@ecy.wa.gov]
Sent: Tuesday, February 24, 2009 9:47 AM

To: Barnes, Brett M; Williams, Joel F Jr
Subject: LLBG TRAINING MATRIX

Hi Brett and Joel, Long time no contact! Hope all is well with you two!

I have been asked to put together the Training Addendum for the LLBG Permit. I was wondering if you have a recent training matrix for LLBG personnel? I have attached the CWC training matrix (Addendum G) for you to reference. Does LLBG have something like this that you send and I can use for the LLBG Permit? As you aware we are on a pretty fast track for this Permit, so sooner the better. If I need to contact someone else to get this please let me know.

Thanks,

Steve

PS. Let's get together sometime...!

Steve Szendre
Ecology's Nuclear Waste Program
3100 Port of Benton Blvd.
Richland, WA 99354
509-372-7911
509-372-7971
ssze461@ecy.wa.gov

Please care about **our** environment!

Collins, Michael S

From: Collins, Michael S
Sent: Tuesday, February 24, 2009 1:36 PM
To: 'Szendre, Steve (ECY)'
Cc: Williams, Joel F Jr; Miskho, Anthony G; McKarns, Anthony C (Tony); Dixon, Brian J; Engelmann, Richard H; Collins, Michael S
Subject: FW: LLBG TRAINING MATRIX
Attachments: CWC Addendum G Training matrix.doc

Importance: High

Steve,

One addition to the LLBG Training Matrix I just sent you. See Joel's message below.

Joel,

No problem.

Mike C.

From: Williams, Joel F Jr
Sent: Tuesday, February 24, 2009 10:08 AM
To: Collins, Michael S; Miskho, Anthony G; McKarns, Anthony C (Tony)
Cc: Barnes, Brett M; Dixon, Brian J; Engelmann, Richard H
Subject: FW: LLBG TRAINING MATRIX
Importance: High

Mike/Tony/Tony

The cut and past of the LLBG Training Matrix that I emailed to you did not have the following that needs to be added as a footnote to the Table 8-1

* Refer to the LLBG Dangerous Waste Training Plan for a complete description of coursework in each training category.

Sorry about that ☹

Thanks – Joel ☺

From: Williams, Joel F Jr
Sent: Tuesday, February 24, 2009 10:02 AM
To: Collins, Michael S; Miskho, Anthony G; McKarns, Anthony C (Tony)
Cc: Barnes, Brett M; Dixon, Brian J; Engelmann, Richard H
Subject: FW: LLBG TRAINING MATRIX
Importance: High

Table 8-1. LLBG Training Matrix.

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Permit Attachment 33 Chapter 8.0 Training Category	General Hanford Facility Training	Contingency Plan Training	Emergency Coordinator Training	Operations Training		
LLBG DWTP implementing category	Orientation Program	Emergency Response (contingency plan)	Emergency Coordinator Training	General Waste Management	Container Management	Landfill Management
Job title/position						
Nuclear Chemical Operator (NCO)	X	X		X	X	X
Operations Team Lead	X	X	X	X		
Operations Manager	X	X	X	X	X	
Environmental Compliance Officer (ECO)	X	X		X	X	
Non-Resident Waste Service Provider	X			X	X	

From: Szendre, Steve (ECY) [mailto:ssze461@ecy.wa.gov]
Sent: Tuesday, February 24, 2009 9:47 AM
To: Barnes, Brett M; Williams, Joel F Jr
Subject: LLBG TRAINING MATRIX

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Thanks,

Steve

PS. Let's get together sometime...!

Steve Szendre
Ecology's Nuclear Waste Program
3100 Port of Benton Blvd.
Richland, WA 99354
509-372-7911
509-372-7971
ssze461@ecy.wa.gov

Please care about **our** environment!