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200-ZP-1 Groundwater Sampling and Analysis Plan/Quality Assurance Plan

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1.0 INTRODUCTION

Groundwater sampling and analysis in support of the 200-ZP-1 Operable Unit interim remedial measure (IRM) will be conducted in discrete phases to support activity-specific data quality objectives (DQOs). The phasing of sampling activities is a reflection of IRM investigations, treatment activities, remedial actions, or compliance issues. No single, static monitoring network can meet all the data needs of each of the discrete activities that make up the entire operable unit investigation/remediation. Therefore, this sampling and analysis plan (SAP) provides the rationale for the development of three monitoring network designs (i.e., remedial action, plume periphery, and detection-level assessment networks), the DQOs associated with each design, the specifics for each network (i.e., wells, sampling schedules, and parameters), and supporting work that influences future network modifications. Requirements that address the treatability test groundwater monitoring phase of this investigation are detailed in revision 0 of this SAP. Treatability testing was completed March 31, 1995.

1.1 200-ZP-1 INTERIM REMEDIAL MEASURE OBJECTIVE

The general objective of the 200-ZP-1 IRM plan is to reduce further degradation of groundwater in the 200 West Area of the Hanford Site (Figure 1), as the unconfined aquifer contains elevated concentrations of carbon tetrachloride, chloroform, and trichloroethylene (DOE-RL 1994). Interim remedial actions will focus on removing the contaminant mass and controlling movement of these contaminants in the aquifer.

1.2 MONITORING NETWORK RATIONALE

Three categories of wells have been identified that will accommodate the monitoring objectives of the IRM. These three categories are as follows:

- Remedial action assessment wells
- Plume periphery assessment wells
- Detection-level assessment wells.

Each of these networks is designed to address general and specific DQOs, which are summarized below. The well networks are nested in areas of high contamination (remedial action assessment wells), low contamination (plumes periphery assessment wells), and where no contamination has been detected (detection-level assessment wells). Monitoring wells selected for each category may change over the course of the IRM to reflect remedial action activities. The network closest to the area of highest contamination will likely change the most as the IRM develops.

1.3 MONITORING NETWORK GENERAL OBJECTIVES

The general objectives of each monitoring category are summarized in Table 1.

Figure 1. 200-ZP-1 Operable Unit Location Map.

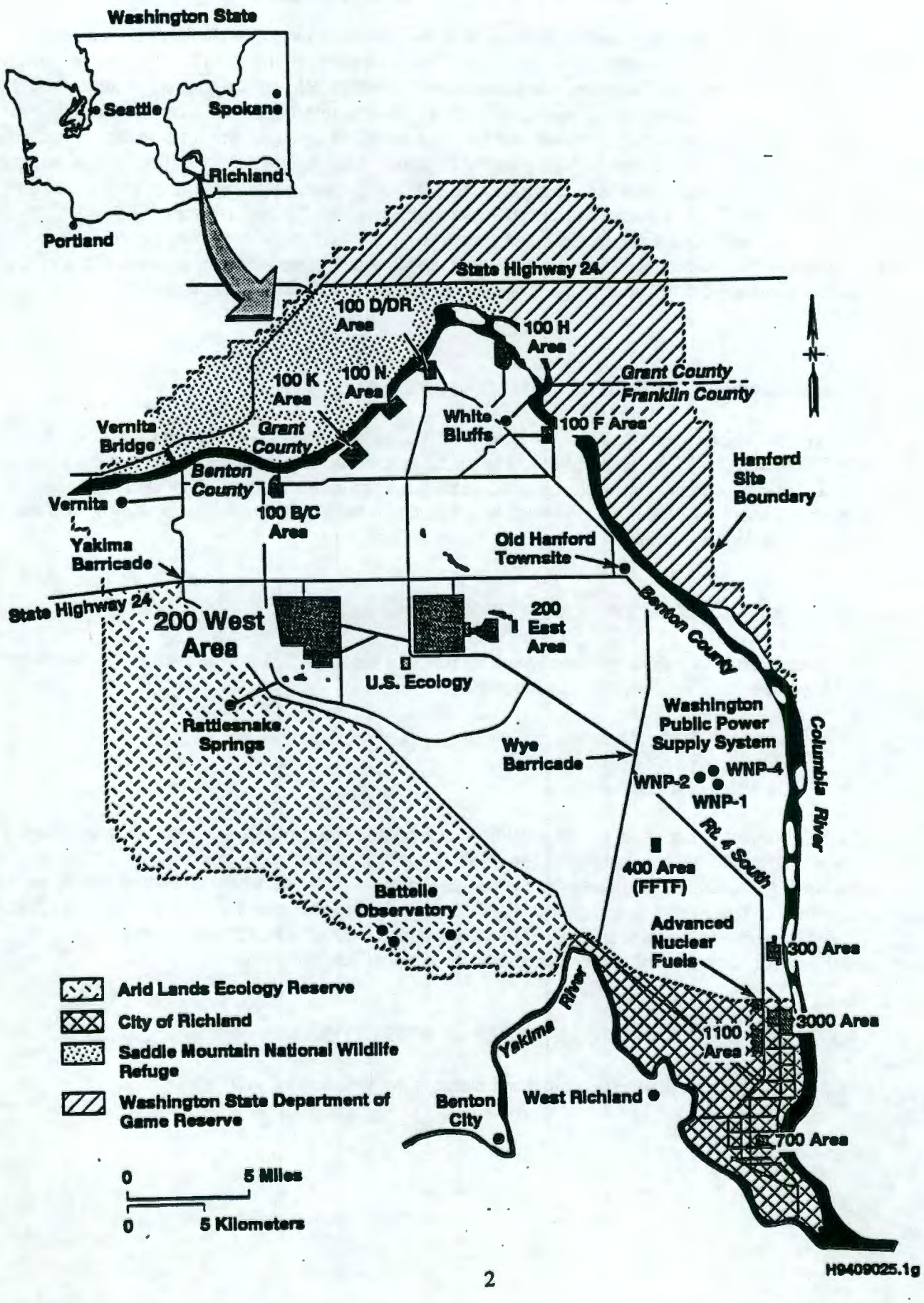


Table 1. Summary of General Monitoring Network Objectives.

Category	General objectives
Remedial action assessment wells	1. Provide baseline information on volatile organic contamination and nitrate in the 2,000-3,000 ppb area of the carbon tetrachloride plume. 2. Monitor/determine the impacts of groundwater remediation on volatile organic contamination and nitrate in the 2,000-3,000 ppb area of the carbon tetrachloride plume. 3. Monitor hydraulic impacts of remediation. 4. Provide data to assist in interim remedial measures.
Plume periphery assessment wells	1. Monitor the movement of volatile organic contamination out of the 200 West Area.
Detection-level assessment wells	1. Monitor for the presence of volatile organic contamination up and downgradient of the plume boundary.

1.4 DATA QUALITY OBJECTIVES

The DQOs are qualitative and quantitative statements that specify the quality of data required to support decisions and are determined based on the end uses (or objectives) of the data to be collected. Each category of monitoring wells has its own set of end uses as outlined in Table 1. Expected users of the test data include (1) U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and Washington State Department of Ecology (Ecology) remedial project managers, and (2) Bechtel Hanford, Inc. (BHI), the area manager and support teams.

To ensure that data collected for each category of monitoring wells are of sufficient quality to support the end uses of the data, category-specific DQOs have been developed. The importance and ramification of the decisions to be made for each category of wells forms the basis for defining the DQOs.

Analyses for each well category include a combination of lower level (I and II) and higher level (III) data sets to obtain the needed information in a technically sound and cost-effective manner. Field screening and field analysis techniques (level I and II analyses) will be used primarily to protect the worker and evaluate progress toward meeting IRM objectives. More limited use will be made of higher level analyses, for confirmatory tests, evaluation of regulatory compliance standards, and final decisions regarding the IRM. Specific DQOs for the individual well network categories are developed in Tables 1 through 4.

Table 2. Data Quality Objectives for Remedial Action Assessment Wells.

Activity: Remedial action assessment groundwater monitoring.

Objectives: To provide remedial design input by:

- Baselining the concentration of primary contaminants and nitrate in the 2000-3000 ppb extent of the carbon tetrachloride plume.
- Monitoring the impacts of remedial activities on primary contaminants and nitrate in the area defined by the 2,000-3,000 pbb carbon tetrachloride plume.
- Monitoring hydraulic impacts of the remedial activity.

Prioritized Data Uses: To support the remedial design process by baselining contaminant concentrations and hydraulic parameter. Also detect changes in baseline conditions that reflect the effects of remedial action activities.

Parameters to be Obtained:

Hydrochemical

- Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) and nitrate.

Hydraulic

- Water level measurements.
- Velocity flowmeter measurements (as needed) in selected wells near extraction wells.

Appropriate Analytical Level or Implementation Guidelines: Primary contaminants and nitrate concentrations will be determined using field screening procedures (level I and II analyses) with offsite verification (level III analysis [e.g., split sampling]). Level I, II, III, IV, or V analyses will also be used to evaluate the success of the remedial activity as part of the final phase of the IRM.

Required Detection or Measurement Limits				
Parameter	Method	RDL (ppb)	Precision	Accuracy
Carbon tetrachloride	Field GC and SW-846 Method 8240 or 8260	5	±20%	±20%
Chloroform	Field GC and SW-846 Method 8240 or 8260	5	±20%	±20%
Trichloroethylene	Field GC and SW-846 Method 8240 and 8260	5	±20%	±20%
Nitrate	Hach Kit and EPA 300	100	±20%	±20%

RDL = Required detection limit GC = Gas chromatography

Critical Samples or Values: When significant progress has been made toward achieving IRM objectives, offsite analysis will be used to determine the distribution and concentration of contaminants in groundwater.

Constraints: Representative groundwater samples are required.

Table 3. Data Quality Objectives for Plume Periphery Assessment Wells.

Activity: Plume periphery groundwater monitoring.

Objectives: Monitor the movement of volatile organic contamination and nitrate from areas of high concentrations out of the 200 West Area.

Prioritized Data Uses: Detection and trending of the movement of contaminants of interest from areas of high contamination. This will provide early warning of movement trends.

Parameters to be Obtained:

Hydrochemical

- Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) and nitrate.
- Water level measurements.

Appropriate Analytical Level or Implementation Guidelines: Primary contaminants and nitrate concentrations will be determined using field screening procedures (level I and II analyses) with offsite verification (level III [e.g., split sampling]). Level I, II, III, IV or V analyses will also be used to evaluate the success of the remedial activity as part of the final phase of the IRM.

Required Detection or Measurement Limits				
Parameter	Method	RDL (ppb)	Precision	Accuracy
Carbon tetrachloride	Field GC and SW-846 Method 8240 or 8260	5	±20%	±20%
Chloroform	Field GC and SW-846 Method 8240 or 8260	5	±20%	±20%
Trichloroethylene	Field GC and SW-846 Method 8240 or 8269	5	±20%	±20%
Nitrate	Hach Kit and EPA 300	100	±20%	±20%

RDL = Required detection limit GC = Gas chromatography

Critical Samples or Values: When significant progress has been made toward achieving IRM objectives, offsite analysis will be used to determine the distribution and concentration of contaminants in groundwater.

Constraints: Representative groundwater samples are required.

Table 4. Data Quality Objectives for Detection-Level Assessment Wells.

Activity: Detection-level groundwater monitoring.

Objectives: Monitor for the presence of volatile organic contamination up and downgradient of the plume boundary.

Prioritized Data Uses: Evaluate volatile organic and nitrate concentrations in the groundwater to identify regulatory exceedances that would initiate compliance actions.

Parameters to be Obtained:

Hydrochemical

- Concentration of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) and nitrate.

Appropriate Analytical Level or Implementation Guidelines: Contaminant concentrations will be determined by offsite laboratory analysis (Level III or IV analyses).

Required Detection or Measurement Limits				
Parameter	Method	RDL (ppb)	Precision	Accuracy
Carbon tetrachloride	SW-846 Method 8240 or 8260	5	±20%	±20%
Chloroform	SW-846 Method 8240 or 8260	5	±20%	±20%
Trichloroethylene	SW-846 Method 8240 or 8260	5	±20%	±20%
Nitrate	EPA 300	100	±20%	±20%

RDL = Required detection limit

Critical Samples or Values: When significant concentration changes are noted in a monitoring well, the sample frequency may be increased.

Constraints: Representative groundwater samples are required.

2.0 GENERAL REQUIREMENTS

2.1 PREREQUISITES

All field personnel working to this sampling and analysis plan will have completed the 40-Hour Hazardous Waste Site Worker Training Program and will perform work in accordance with the following:

- BHI-EE-01, *Environmental Investigations Procedures* (BHI 1994a)
  - EIP 1.10, "Groundwater Measuring and Testing Equipment Calibration"
  - EIP 1.11, "Purgewater Management"
  - EIP 1.5, "Field Logbooks"
  - EIP 2.0, "Sample Event Coordination"
  - EIP 3.0, "Chain of Custody"
  - EIP 3.1, "Sample Packaging and Shipping"
  - EIP 4.1, "Groundwater Sampling"
  - EIP 4.2, "Sample Storage and Shipping Facility"
  - EIP 6.2, "Field Cleaning and/or Decontamination of Equipment"
- *Hanford Site Radiological Control Manual* (HSRCM 1994)
- *Quality Management Plan* (BHI 1994b)
- BHI-QA-02, *Quality Program Procedures* (BHI 1994c)
- BHI-SH-02, *Safety and Health Procedures*, Vol. 2 (BHI 1994d)
- BHI-EE-02, *Environmental Requirements* (BHI 1995)
- Site-specific health and safety plan/radiation work permit/job safety analysis, waste control plan, fall protection plan, confined space permit - as applicable.

3.0 GROUNDWATER MONITORING

Details of the groundwater monitoring program supporting the 200-ZP-1 IRM are discussed in this section.

3.1 REMEDIAL ACTION ASSESSMENT SAMPLING PLAN

Groundwater remedial action impacts will be assessed by sampling and measuring water levels in a network of wells located in the high-concentration areas of the carbon tetrachloride plume. Velocity flowmeter profiling may also be used to assess hydrologic impacts as directed by the task lead. Baseline sampling and water level measurements will be initiated prior to the start of large-scale

remediation activities to refine contaminant distributions for remedial design input. Sampling and evaluation activities will continue during remediation activities at intervals specified in Section 3.1.2.

3.1.1 Well Locations

Remedial action assessment wells are located in the area defined by the 2,000-3,000 ppb carbon tetrachloride groundwater plume. This section of the plume is generally bound to assess the impact of remediation on groundwater quality and monitor the upper 40 ft of the unconfined aquifer. Wells selected for the monitoring network are identified in Table 5 along with pertinent construction information. The location of wells in the remedial action assessment network are shown in Figure 2 relative to the 200 West Area and carbon tetrachloride plume.

Little information is available to address the vertical distribution of contamination in the unconfined aquifer. The monitoring approach may therefore be modified at a later date based on supporting work described in Section 4.0. The number and location of wells used in the remedial action assessment network are also expected to be modified as plume geometry changes and additional extraction/injection wells are constructed to support the IRM.

3.1.2 Schedule

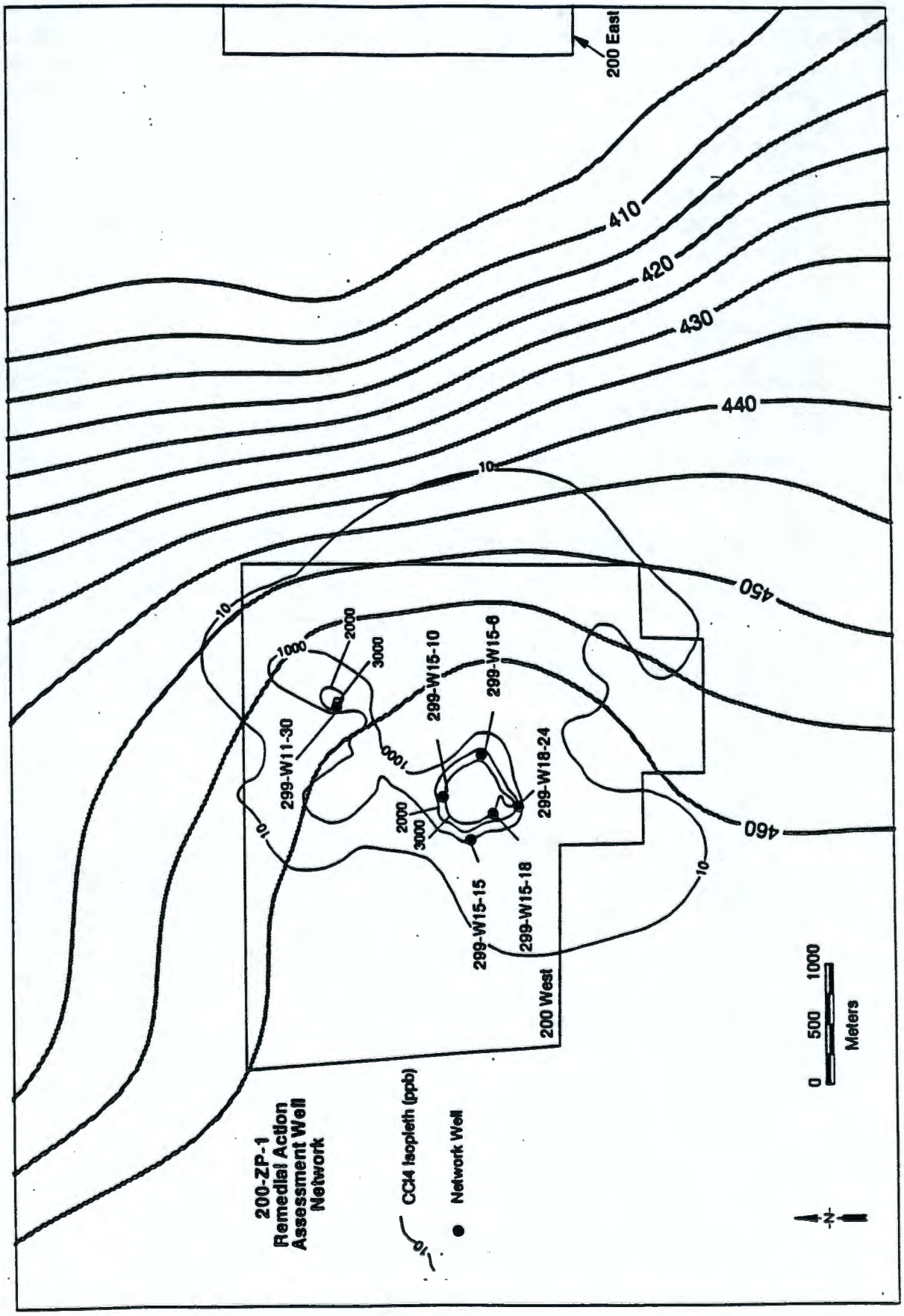
Groundwater sampling and analysis are scheduled to baseline the concentration of primary contaminants and nitrate as well as detect changes in contaminant concentrations as precipitated by remedial action activities. Hydraulic impacts, as evidenced by water level and possibly velocity changes, will also be monitored. Sampling and water level measurements will be conducted semiannually beginning March 1995. The sample frequency for any well in the network may be adjusted as necessary.

Table 5. Summary of Construction Information for Wells in the Remedial Action Assessment Monitoring Network.

Well (299-)	Casing diameter (in.)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
CERCLA Wells						
W11-30	4	SS	280	243-280	247 (12/92)	33
W15-6	8/6	CS	410	175-408	194 (3/92)	214
W15-10	8	CS	300	183-297	214 (12/93)	83
W15-15[a]	4	SS	255	223-253	235 (394)	18
W15-18[a]	4	SS	243	208-238	222 (3/94)	16
W18-24[a]	4	SS	240	206-236	218 (3/94)	18

SS = Stainless steel
CS = Carbon steel
[a]Well is co-sampled with other site programs.

Figure 2. Carbon Tetrachloride Plume and Location Map of Remedial Action Assessment Wells.



3.1.3 Analytes

Analytes of interest are summarized in Table 6. Samples will be collected and handled using the protocols defined in EIP 4.1, "Groundwater Sampling" (BHI 1994a). Primary contaminant (carbon tetrachloride, chloroform, and trichloroethylene) concentrations will be determined using field screening methods (e.g., aqueous head space analysis/level II analysis). Nitrate concentrations will be determined using the Hach Kit (level II analysis) or other appropriate field screening methods.

Quality control samples, specified below, will be analyzed using level II and III methodologies (as applicable). Sample custody will follow procedures as outlined in EIP 3.0, "Chain of Custody" (BHI 1994a).

3.1.4 Quality Assurance/Quality Control Requirements

Data quality is defined by this SAP and the Quality Assurance Project Plan (QAPjP) provided in Appendix A. Where analytical requirements specific to detection limit, precision, and accuracy do not agree in the two documents the former shall take precedent. The quality assurance (QA) documents that cover the test activities are the *Quality Management Plan* (BHI 1994b) and BHI-QA-02, *Quality Program Procedures* (BHI 1994c).

Field quality control (QC) samples should be collected at the following frequency:

- One duplicate per every 20 wells or a minimum of one per sampling event. Duplicate samples will be analyzed using aqueous head space analysis.
- One split per every 20 wells or a minimum of one per sampling event. Split samples will be analyzed using aqueous head space analysis and a higher level analysis.
- One trip blank per cooler.

Table 6. Analytes of Interest for Remedial Action Assessment Monitoring.

Analyte	Method	Holding time	Bottle[a]/ volume[b]	Bottle[a]/ volume[c]
Carbon tetrachloride Chloroform Trichloroethylene	Field GC and SW-846 Method 8240, or 8260	14 days	Gs 1 x 40 mL, HCl to pH<2	Gs 3 x 40 mL, HCl to pH<2
Nitrate	Hach Kit/EPA 300	28 days	G 400 mL	G 400 mL

[a]Bottle/volume requirements may vary depending on availability and laboratory.
[b]field screening
[c]offsite shipments
GC = gas chromatography
Gs = glass w/septum cap
G = glass

3.2 PLUME PERIPHERY ASSESSMENT SAMPLING PLAN

The plume periphery assessment well network is designed to monitor the movement of contaminants out of the 200 West Area. In addition, the network will provide early warning of concentration trends.

3.2.1 Well Locations

The plume periphery assessment network consists of nine wells. The wells are selected based upon their position relative to the 10 ppb isopleth of the carbon tetrachloride plume and location along groundwater flow paths (zones of higher hydraulic conductivity). The wells bracket the 10 ppb contour and monitor the upper 40 ft of the unconfined aquifer. Wells completed deeper in the unconfined aquifer may be added to the network based on the results of supporting work discussed in Section 4.0. Wells selected for the monitoring network are identified in Table 7 along with pertinent construction information. The location of wells in the plume periphery network are shown in Figure 3 relative to the 200 West Area and carbon tetrachloride plume.

3.2.2 Schedule

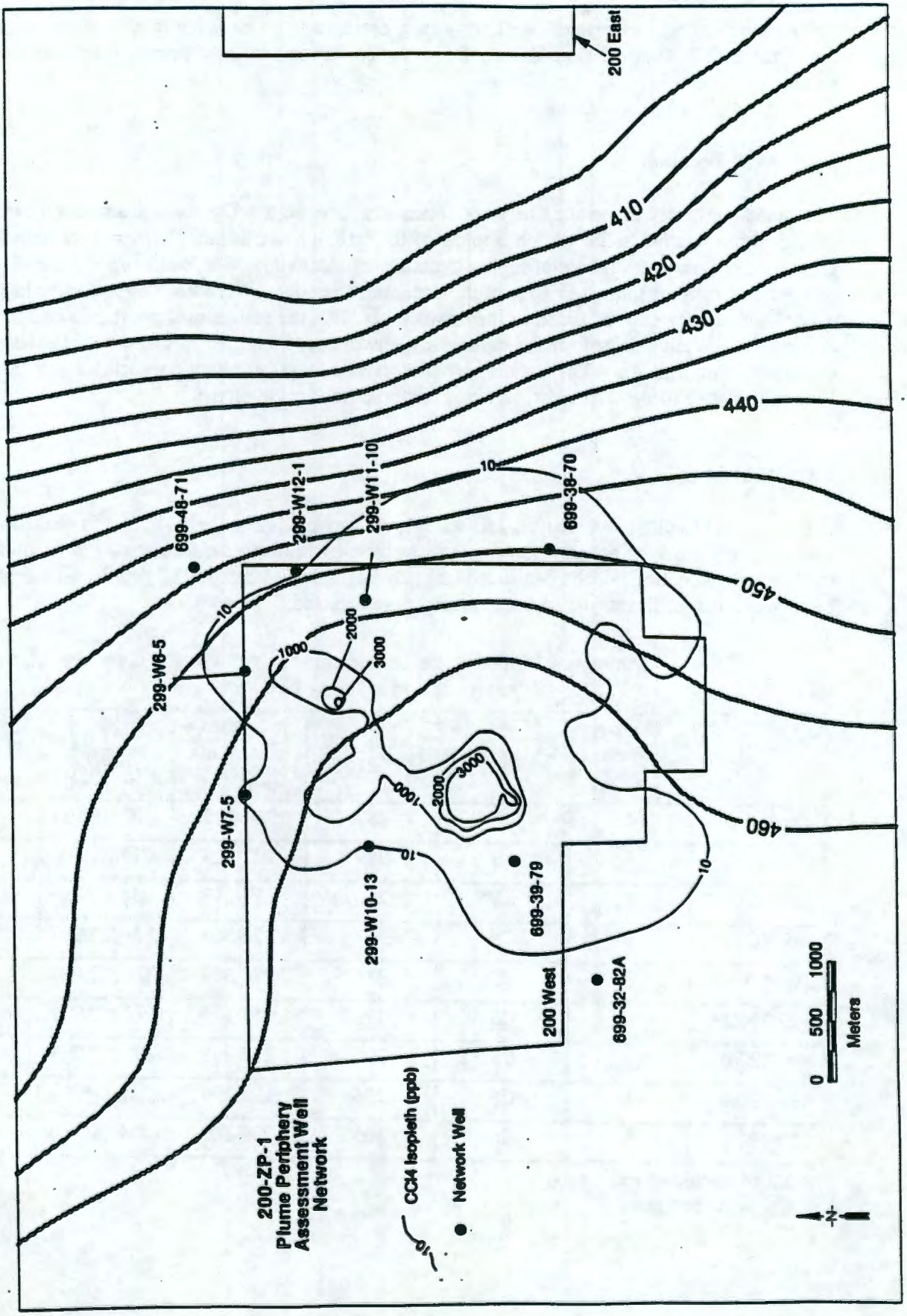
Groundwater sampling and analysis and water level measurements are scheduled to evaluate concentration trends of primary contaminants (carbon tetrachloride, chloroform, and trichloroethylene) and nitrate. Sampling will be conducted annually beginning March 1995. Additional sampling may be required if significant concentration changes are detected.

Table 7. Summary of Construction Information for Wells in the Plume Periphery Assessment Monitoring Network.

Well	Casing diameter (in.)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
299-W6-5	4	SS	287	264-285	256 (10/91)	21
299-W7-5	4	SS	229	207-228	217 (3/94)	11
299-W10-13	4	SS	250	227-247	234 (3/93)	13
299-W11-10	8	CS	307	256-304	275 (12/93)	29
299-W12-1	8	CS	314	274-309	278 (12/93)	31
699-37-82A	8	CS	175	155-175	172 (12/93)	3
699-38-70	8	CS	295	255-295	260 (12/93)	35
699-39-79	8	CS	236	195-236	211 (3/94)	25
699-48-71	8	CS	305	239-302	244 (6/93)	58

SS = stainless steel
CS = carbon steel

Figure 3. Carbon Tetrachloride Plume and Location Map of Plume Periphery Assessment Wells.



3.2.3 Analytes

Analytes of interest are summarized in Table 8. Samples will be collected and handled using the protocols defined in EIP 4.1, "Groundwater Sampling" (BHI 1994a). Primary contaminant (carbon tetrachloride, chloroform, and trichloroethylene) concentrations will be determined using field screening methods (e.g., aqueous head space analysis/level II analysis). Nitrate concentrations will be determined using the Hach Kit (level II analysis) or other appropriate field screening methods. Quality control samples, specified below, shall be analyzed using level II and III methodologies (as applicable). Sample custody will follow procedures as outlined in EIP 3.0, "Chain of Custody" (BHI 1994a).

3.2.4 Quality Assurance/Quality Control Requirements

Data quality is defined by this SAP and the QAPjP provided in Appendix A. Where analytical requirements specific to detection limit, precision and accuracy do not agree in the two documents, the former shall take precedent. The QA documents that cover the test activities are the *Quality Management Plan* (BHI 1994b) and BHI-QA-02, *Quality Program Procedures* (BHI 1994c).

Field QC samples should be collected at the following frequency:

- One duplicate per every 20 wells or a minimum of one per sampling event. Duplicate samples will be analyzed using aqueous head space analysis.
- One split per every 20 wells or a minimum of one per sampling event. Split samples will be analyzed using aqueous head space analysis and a higher level analysis.
- One trip blank per cooler.

Table 8. Analytes of Interest for Plume Periphery Assessment Monitoring.

Analyte	Method	Holding time (days)	Bottle[a]/ volume[b]	Bottle[a]/ volume[c]
Carbon tetrachloride Chloroform Trichloroethylene	Field GC and SW-846 8240, or 8260	14	Gs 1 X 40 mL	Gs 3X40 mL, HCl to pH<2
Nitrate	Hach Kit/EPA 300	28	G 400 mL	G 400 mL

[a]Bottle/volume requirements may vary depending on availability and laboratory.
[b]Field screening requirements
[c]Offsite analysis
GC = gas chromatography
Gs = glass w/septum cap
G = glass

3.3 DETECTION-LEVEL ASSESSMENT SAMPLING PLAN

The detection-level assessment network is designed to monitor for the presence of volatile organic and nitrate up and downgradient of the plume boundary. The analytical results will be evaluated against regulatory standards to determine if compliance action should be initiated.

3.3.1 Well Locations

The network is composed of three wells as listed in Table 9. The wells monitor the upper 40 feet of the unconfined aquifer. The network may be modified to include wells completed deeper in the unconfined aquifer based on the results of supporting work described in Section 4.0. The location of wells in the detection-level monitoring network are shown in Figure 4 relative to the 200 West Area and carbon tetrachloride plume.

3.3.2 Schedule

Groundwater sampling and analysis will be conducted annually beginning March 1995. If contamination is detected and exceeds regulatory limits, resampling shall be required to confirm results. Contamination detected will be addressed as part of a compliance plan.

Table 9. Summary of Construction Information for Wells in the Detection Level Assessment Monitoring Network.

Well (699-)	Casing diameter (in.)	Material	Drill depth (ft)	Screened interval (ft)	Depth to water (ft/date)	Screened water depth (ft)
34-88	8	CS	210	156-210	165 (6/93)	45
47-60	8	CS	278	250-277	251[a] (3/94)	26
51-63	8	CS	185	157-180	168 (12/93)	12

CS = carbon steel
[a]Well 699-47-60 is in a topographically high area.

3.3.3 Analytes

Analytes of interest are summarized in Table 10. Samples will be collected and handled using protocols defined in EIP 4.1, "Groundwater Sampling" (BHI 1994a). The analysis will be conducted by an offsite laboratory (level III analysis). Quality control samples, specified below, will be collected and shipped using level III methodologies. Sample custody will follow procedures as outlined in EIP 3.0, "Chain of Custody" (BHI 1994a).

Figure 4. Carbon Tetrachloride Plume and Location Map of Detection Level Assessment Wells.

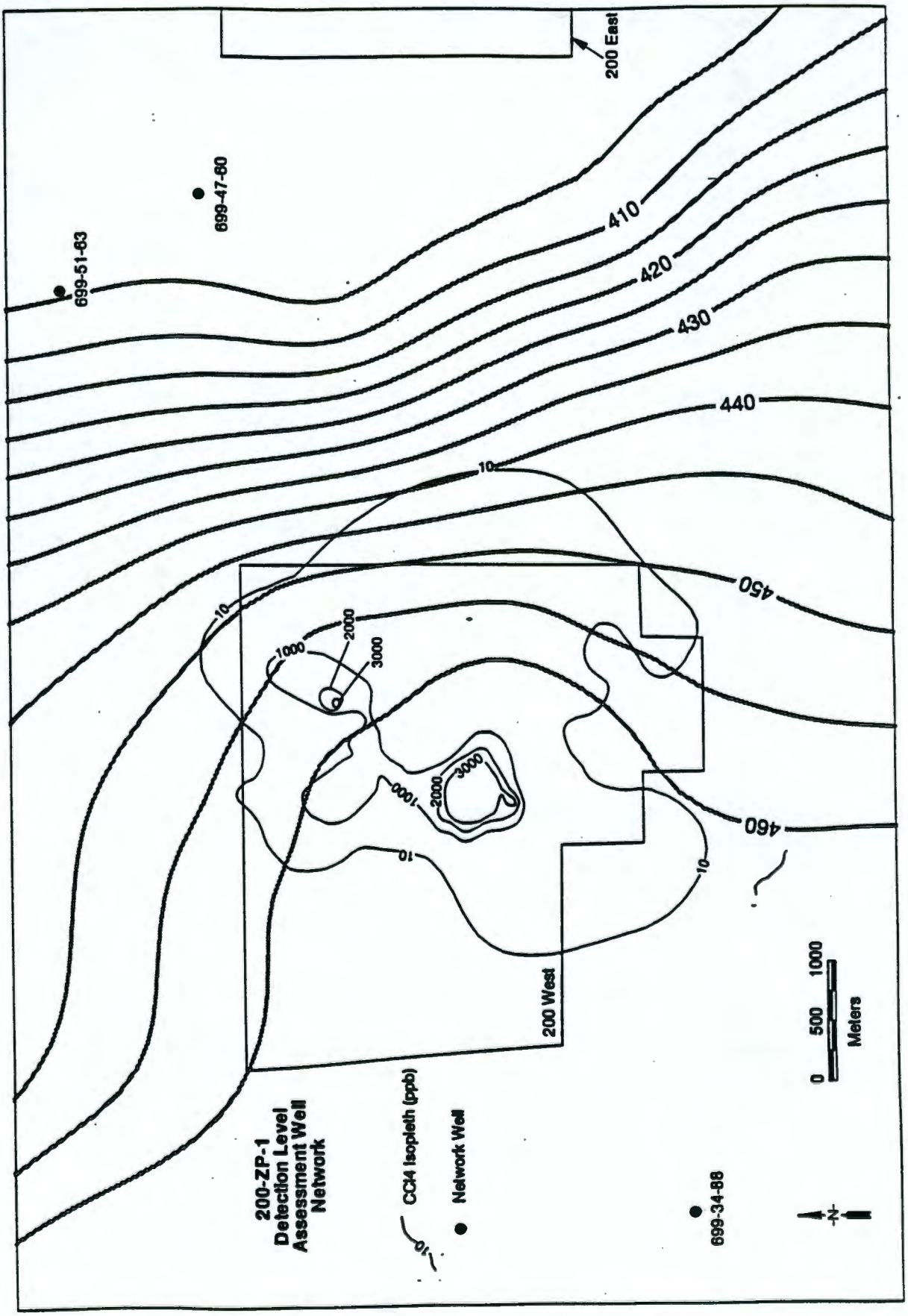


Table 10. Analytes of Interest for Detection-Level Assessment Monitoring.

Analyte	Method	Holding time (days)	Bottle[a]/volume
Carbon tetrachloride Chloroform Trichloroethylene	SW-846 Method 8240 or 8260	14	Gs 3 x 40 mL, HCl to pH<2
Nitrate	EPA 300	28	G 400 mL

GS = glass w/septum cap
[a]Bottle/volume requirements may vary depending on availability and laboratory.

3.3.4 Quality Assurance/Quality Control Requirements

Data quality is defined by this SAP and the QAPjP provided in Appendix A. Where analytical requirements specific to detection limit, precision, and accuracy do not agree in the two documents, the former shall take precedent. The QA documents that cover the test activities are the *Quality Management Plan* (BHI 1994b) and BHI-QA-02, *Quality Program Procedures* (BHI 1994c).

Field QC samples should be collected at the following frequency:

- One duplicate per every 20 wells or a minimum of one per sampling event.
- One split per every 20 wells or a minimum of one per sampling event.
- One trip blank per cooler designated for offsite shipment.

4.0 SUPPORTING WORK

Two supporting studies have been identified that may be conducted to provide remedial design information that will probably necessitate changes to the monitoring networks as proposed in this document. These two studies are mentioned briefly in this section to clarify their relationship to the groundwater monitoring networks. Each study will be detailed in separate descriptions of work (DOW).

4.1 DENSE NON-AQUEOUS PHASE LIQUIDS INVESTIGATION

Unresolved questions exist regarding the distribution and physical state of carbon tetrachloride in the aquifer. Carbon tetrachloride may exist as a dense non-aqueous phase liquid (DNAPL) in the unconfined aquifer and provide a continuing source of dissolved carbon tetrachloride to groundwater. Information regarding the nature and extent of DNAPL in the aquifer is a critical data need for the 200-ZP-1 Operable Unit and will be necessary for the final remedy selection process.

As part of the IRM for 200-ZP-1, an investigation of the presence of DNAPL will be conducted in the area of the 216-Z-9 Trench. Additional information concerning the presence of DNAPL will be gathered as the IRM progresses.

4.2 VERTICAL DISTRIBUTION OF DENSE NON-AQUEOUS PHASE LIQUIDS

Information on the vertical distribution of carbon tetrachloride in the aquifer is a key data need for the 200-ZP-1 Operable Unit. Recent testing has indicated that carbon tetrachloride may be present at depths up to 80 ft beneath the water table (Ford 1995). Data on the vertical extent of contamination will be gathered as new extraction wells are constructed to support the IRM and may be gathered as part of well remediation operations in the area around the 216-Z-9 Trench. Information from these activities will help determine if DNAPL is present in the 200-ZP-1 Operable Unit.

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APPENDIX A

QUALITY ASSURANCE PROJECT PLAN (QAPjP)

GLOSSARY

Accuracy: For the purposes of environmental investigations, accuracy may be interpreted as the measure of the bias in a system. Sampling accuracy is normally assessed through the evaluation of matrix-spiked samples and reference samples.

Audit: For the purposes of environmental investigations, audits are considered to be systematic checks to verify the quality of operation of one or more elements of the total measurement system. In this sense, audits may be of two types: (1) performance audits, in which quantitative data are independently obtained for comparison with data routinely obtained in a measurement system, or (2) system audits, involving a qualitative onsite evaluation of laboratories or other organizational elements of the measurement system for compliance with established quality assurance program and procedure requirements. For environmental investigations at the Hanford Site, performance audit requirements are fulfilled by periodic submittal of blind samples to the primary laboratory, or the analysis of split samples by an independent laboratory. System audit requirements are implemented through the use of standard surveillance procedures.

Bias: Bias represents a systematic error that contributes to the difference between a population mean of a set of measurements and an accepted reference or true value.

Blind Sample: A blind sample refers to any type of sample routed to the primary laboratory for performance audit purposes, relative to a particular sample matrix and analytical method. Blind samples are not specifically identified as such to the laboratory. They may be made from traceable standards, or may consist of sample material spiked with a known concentration of a known compound. See the glossary entry for Audit.

Comparability: For the purposes of environmental investigations, comparability is an expression of the relative confidence with which one data set may be compared with another.

Completeness: For the purposes of environmental investigations, completeness may be interpreted as a measure of the amount of valid data obtained compared to the total data expected under correct normal conditions.

Deviation: For the purposes of environmental investigations, deviation refers to an approved departure from established criteria that may be required as a result of unforeseen field situations or that may be required to correct ambiguities in procedures that may arise in practical applications.

Equipment Blanks: Equipment blanks consist of pure deionized, distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. They are used to verify the adequacy of sampling equipment decontamination procedures, and are normally collected at the same frequency as field duplicate samples.

Field Blanks: Field blanks for water analyses consist of pure deionized, distilled water, transferred to a sample container at the site and preserved with the reagent specified for the analytes of interest. They are used to check for possible contamination originating with the reagent or the sampling environment, and are normally collected at the same frequency as field duplicate samples.

Field Duplicate Sample: Field duplicate samples are samples retrieved from the same sampling location using the same equipment and sampling technique, placed in separate, identically prepared and preserved containers, and analyzed independently. Field duplicate samples are generally used to provide an indication of field and laboratory precision, and reproducibility of analytical data. Field duplicate samples are normally collected at a frequency of 1 in 20 samples or one per sampling event.

Matrix-Spiked Samples: Matrix-spiked samples are a type of laboratory quality control sample. They are prepared by splitting a sample received from the field into two homogenous aliquots (i.e., replicate samples) and adding a known quantity of a representative analyte of interest to one aliquot in order to calculate the percentage of recovery of that analyte. Results of spiked samples are used to provide an indication of laboratory accuracy and potential matrix effects.

Nonconformance: A nonconformance is a deficiency in the characteristic, documentation, or procedure that renders the quality of material, equipment, services, or activities unacceptable or indeterminate. When the deficiency is of a minor nature, does not effect a permanent or significant change in quality if it is not corrected, and can be brought into conformance with immediate corrective action, it shall not be categorized as a nonconformance. If the nature of the condition is such that it cannot be immediately and satisfactorily corrected, however, it shall be documented in compliance with approved procedures and brought to the attention of management for disposition and appropriate corrective action.

Precision: Precision is a measure of the repeatability or reproducibility of specific measurements under a given set of conditions. Precision is a quantitative measure of the variability of a group of measurements compared to their average value. Precision is normally expressed in terms of standard deviation, but may also be expressed as the coefficient of variation (i.e., relative standard deviation) and range (i.e., maximum value minus minimum value). Precision is assessed by means of duplicate/replicate sample analysis.

Quality Assurance: For the purposes of environmental investigations, quality assurance refers to the total integrated quality planning, quality control, quality assessment and corrective action activities that collectively ensure that the data from monitoring and analysis meets all end user requirements and/or the intended end use of the data.

Quality Assurance Project Plan: The quality assurance project plan is an orderly assembly of management policies, project objectives, methods and procedures that defines how data of known quality will be produced for a particular project or investigation.

Quality Control: For the purposes of environmental investigations, quality control refers to the routine application of procedures and defined methods to the monitor and assess performance of sampling, measurement, and analytical processes.

Range: Range refers to the difference between the largest and smallest reported values in a sample, and is a statistic for describing the spread in a set of data.

Reference Samples: Reference samples are a type of laboratory quality control sample prepared from an independent, traceable standard at a concentration other than that used for analytical equipment calibration, but within the calibration range. Such reference samples are analyzed consistent with protocol and procedural requirements associated with a specific method.

Replicate Sample: Replicate samples are two aliquots removed from the same sample container in the laboratory and analyzed independently.

Representativeness: For the purposes of environmental investigations, representativeness may be interpreted as the degree to which data accurately and precisely represent a characteristic of a population parameter, variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of a sampling program.

Split Sample: A split sample is produced through homogenizing a field sample and separating the sample material into two equal aliquots. Field split samples are usually routed to separate laboratories for independent analysis, generally for purposes of auditing the performance of the primary laboratory relative to a particular sample matrix and analytical method. See the glossary entry for Audit. In the laboratory, samples are generally split to create matrix-spiked samples (see the glossary entry).

Volatile Organics Analysis Trip Blanks: Volatile organics analysis trip blanks are a type of field quality control sample, consisting of pure deionized distilled water in a clean, sealed sample container, accompanying each batch of containers shipped to the sampling site and returned unopened to the laboratory. Trip blanks are used to identify any possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions.

Validation: For the purposes of environmental investigations, validation refers to a systematic process of reviewing data against a set of criteria to provide assurance that the data are acceptable for their intended use. Validation methods may include review of verification activities, editing, screening, cross-checking, or technical review.

Verification: For the purposes of environmental investigations, verification refers to the process of determining whether procedures, processes, data, or documentation conform to specified requirements. Verification activities may include inspections, audits, surveillance, or technical review.

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1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPjP) supports data collection activities associated with the 200-ZP-1 groundwater monitoring SAP presented in the first part of this document and may be used in conjunction with other operable unit efforts. The SAP provides requirements that direct data collection and analysis in support of remedial action assessment, plume migration analysis, and detection level monitoring.

This QAPjP applies specifically to field activities and laboratory analyses. The plan describes the means selected to implement the quality assurance program defined in the Bechtel Hanford, Inc. (BHI) *Quality Management Plan* (BHI 1994b), as applicable to environmental investigations, while accommodating the specific requirements for project plan format and content agreed upon in the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990). All procedures included in Environmental Investigations Procedures (BHI 1994a) and this QAPjP are subject to mandatory review and approval by the U.S. Environmental Protection Agency (EPA) and Washington State Department of Ecology. Distribution and revision control of the SAP and the QAPjP will be performed in compliance with BHI document control procedures.

Interim changes to this QAPjP or the SAP are subject to documentation, review, and approval as required by EIP 1.3, "Work Plan Review and Control" (BHI 1994a), and shall be documented in monthly unit managers' meeting minutes/national priority list agreements. The QAPjP distribution shall routinely include all review/approval personnel indicated on the title page of the document and all other individuals designated by the project task lead. All plans and procedures referenced in the QAPjP are available for regulatory review on request at the direction of the task lead.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 200 AREA PROJECT MANAGER

The 200 Area Project Manager has primary responsibility for conducting this investigation.

2.2 200 AREA GROUNDWATER TASK LEAD

The 200 Area Groundwater Task Lead reports to the 200 Area Project Manager. The task lead is responsible for coordinating and providing technical direction for 200-ZP-1 Operable Unit activities.

2.3 200 AREA TASK LEAD/FIELD TEAM

The 200 Area Task Lead is responsible for implementing requirements of the work document and this QAPjP. The task lead prepares work documents, determines data quality objectives, develops budget and schedule, and is in direct contact with management and the field team. Individual field team responsibilities are addressed in governing EIPs.

The task lead shall also evaluate and recommend external participant contractors or subcontractors in compliance with BHI procurement procedures and the BHI *Quality Management Plan*, Part 1, Section A.4 (BHI 1994b). All contractor or subcontractor plans and procedures shall be subject to approval by BHI before use and shall be available for regulatory review.

2.4 QUALITY ASSURANCE OFFICER RESPONSIBILITIES

The Quality Assurance (QA) officer is responsible for coordination and/or oversight of performance to QAPjP requirements by means of internal assessment and surveillance techniques. The QA officer has the necessary organizational independence and authority to identify conditions adverse to quality. The QA officer shall inform the task lead of needed corrective action.

2.5 SAMPLING TEAM/ANALYTICAL LABORATORIES

The BHI field sampling team will be responsible for screening all samples for radioactivity in compliance with the *Hanford Site Radiological Control Manual* (HSRCM 1994).

Samples shall be packaged and shipped in compliance with EIP 3.1, "Sample Packaging and Shipping" (BHI 1994a). If the total activity of a sample is equal to or greater than 200 pCi/L, or if the alpha activity of the sample is equal to or greater than 60 pCi/L, the sample will be routed to a Westinghouse Hanford Company or Hanford Site participant contractor or subcontractor laboratory equipped and qualified to handle the analysis of radioactive samples. Samples that do not exceed either of the above criteria may be routed to any approved participant contractor or subcontractor analytical laboratory.

All analyses shall be coordinated through the Sample Management Organization and shall be performed in compliance with BHI-approved laboratory QA plans and analytical procedures; all analytical laboratories shall be subject to the surveillance controls described by Quality Program Procedures (BHI 1994c). For subcontractors or participant contractors, applicable quality requirements shall be invoked as part of the approved procurement documentation or work order (see Sections 3.0 and 4.1.2 of this QAPjP). Services of alternate qualified laboratories shall be procured for radioactive sample analysis if onsite laboratory capacity is not available, and/or for the performance of split sample analysis at the task lead's discretion. If such an option is selected, the laboratory shall provide objective evidence of appropriate U.S. Nuclear Regulatory Commission (NRC) or state radioactive materials handling licenses. The laboratory shall submit its QA plan and applicable analytical procedures for BHI approval prior to their use, as noted in Section 4.1.2.

2.6 OTHER SUPPORT CONTRACTORS

Procurement of all other field services and supporting items, materials, or equipment shall comply with standard procurement procedures as discussed in Sections 2.3 and 4.1 of this QAPjP. All work shall comply with BHI-approved QA plans and/or procedures, and is subject to the controls of the *Quality Management Plan*, Part 1, Section B, "Assessments" (BHI 1994b). Applicable quality management requirements shall be invoked as part of the approved procurement documentation or work order as noted in Section 4.1.

3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENTS

The rationale for establishing DQOs and data needs for this investigation is presented in Section 1.0 of the SAP. Chemical analyses and QA/QC requirements are presented in Section 3.0 of the SAP, along with analytical method requirements and maximum detection or quantitation limit values and maximum acceptable ranges for precision and accuracy.

Table A-1 contains a list of analytical parameters, cross-referenced to analytical method requirements and maximum detection or quantitation limit values and maximum acceptable ranges for precision and accuracy, in both soil and water matrices. The extensive list of analytes and requirements applicable to soil are provided to allow for unforseen conditions and to support other aspects of the 200-ZP-1 investigation. The values assigned to the CRDL/CRQL and precision/accuracy shall be considered minimum performance standard and shall be incorporated into the agreements for services established with individual BHI, participant contractor, or subcontractor analytical laboratories. Where EPA Contract Laboratory Program (CLP) methods are specified in planning document (e.g., work plans, DOW), the Contract Required Detection Limits (CRDLs) for inorganic parameters, Contract Required Quantitation Limits (CRQLs) for organic parameters, and the maximum precision and accuracy ranges specified for each parameter by the appropriate CLP Statements of Work (SOWs) apply without modification; see U.S. EPA *Contract Laboratory Program Statement of Work for Inorganics Analysis* (EPA 1991a) and U.S. EPA *Contract Laboratory Program Statement of Work for Organics Analysis* (EPA 1991b). CRQLs and precision and accuracy ranges for non-CLP parameters are provided that shall be considered maximum values that can be reliably achieved by analytical laboratories under routine conditions. Any modification of Table A-1 requirements shall be justified by the requestor, and shall be considered a formal modification of this QAPjP and is subject to regulatory review and approval.

Goals for data representativeness will be addressed qualitatively by the specification of sampling depths and intervals in the SAP or other applicable DOWs prepared for this investigation. Sampling locations will be specified in work documents (e.g., DOW, work orders, Sample Authorization Form) issued to the subcontractors or participating contractors responsible for conducting sampling activities. Objectives for the completeness of this investigation shall require that contractually or procedurally established requirements for precision and accuracy be met for at least 90% of the total number of requested determinations. Failure to meet this criterion shall be documented and evaluated in the validation process described in Section 8.0 of this QAPjP; corrective action shall be taken as warranted, as described in Section 13.0. Approved analytical procedures shall require the use of the reporting techniques and units specified in the EPA reference methods specified in Table A-1 in order to facilitate the comparability of data sets in terms of precision and accuracy.

Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 1 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TCL volatile organics[c]	Chloromethane	c	10	c	c	10	c	c
	Bromomethane	c	10	c	c	10	c	c
	Vinyl Chloride	c	10	c	c	10	c	c
	Chloroethane	c	10	c	c	10	c	c
	Methylene Chloride	c	10	c	c	10	c	c
	Acetone	c	10	c	c	10	c	c
	Carbon Disulfide	c	10	c	c	10	c	c
	1,1-Dichloroethene	c	10	c	c	10	c	c
	1,1-Dichloroethane	c	10	c	c	10	c	c
	1,2-Dichloroethene (total)	c	10	c	c	10	c	c
	Chloroform	c	10	c	c	10	c	c
	1,2-Dichloroethane	c	10	c	c	10	c	c
	2-Butanone	c	10	c	c	10	c	c
	1,1,1-Trichloroethane	c	10	c	c	10	c	c
	Carbon Tetrachloride	c	10	c	c	10	c	c
	Bromodichloromethane	c	10	c	c	10	c	c
	1,2-Dichloropropene	c	10	c	c	10	c	c
	Trichloroethene	c	10	c	c	10	c	c
	Dibromochloromethane	c	10	c	c	10	c	c
	1,1,2-Trichloroethane	c	10	c	c	10	c	c

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Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 2 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TCL volatile organics[c] (Cont.)	Benzene	c	10	c	c	10	c	c
	trans-1,3-Dichloropropene	c	10	c	c	10	c	c
	cis-1,3-Dichloropropene	c	10	c	c	10	c	c
	Bromoform	c	10	c	c	10	c	c
	4-Methyl-2-pentanone	c	10	c	c	10	c	c
	2-Hexanone	c	10	c	c	10	c	c
	Tetrachloroethene	c	10	c	c	10	c	c
	Toluene	c	10	c	c	10	c	c
	1,1,2,2-Tetrachloroethane	c	10	c	c	10	c	c
	Chlorobenzene	c	10	c	c	10	c	c
	Ethyl Benzene	c	10	c	c	10	c	c
	Styrene	c	10	c	c	10	c	c
	Xylenes (total)	c	10		c	10	c	c
CLP TCL semi-volatile organics[c]	Phenol	c	330	c	c	10	c	c
	bis(2-Chloroethyl) ether	c	330	c	c	10	c	c
	2-Chlorophenol	c	330	c	c	10	c	c
	1,3-Dichlorobenzene	c	330	c	c	10	c	c
	1,4-Dichlorobenzene	c	330	c	c	10	c	c
	1,2-Dichlorobenzene	c	330	c	c	10	c	c
	2-Methylphenol	c	330	c	c	10	c	c
	2,2'-oxybis (1-Chloropropane)	c	330	c	c	10	c	c

Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 3 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TCL semi-volatiles[c] (cont.)	4-Methylphenol	c	330	c	c	10	c	c
	N-Nitroso-di-n-dipropylamine	c	330	c	c	10	c	c
	Hexachloroethane	c	330	c	c	10	c	c
	Nitrobenzene	c	330	c	c	10	c	c
	Isophorone	c	330	c	c	10	c	c
	2-Nitrophenol	c	330	c	c	10	c	c
	2,4-Dimethylphenol	c	330	c	c	10	c	c
	bis(2-Chloroethoxy) methane	c	330	c	c	10	c	c
	2,4-Dichlorophenol	c	330	c	c	10	c	c
	1,2,4-Trichlorobenzene	c	330	c	c	10	c	c
	Naphthalene	c	330	c	c	10	c	c
	4-Chloroaniline	c	330	c	c	10	c	c
	Hexachlorobutadiene	c	330	c	c	10	c	c
	4-Chloro-3-methylphenol	c	330	c	c	10	c	c
	2-Methylnaphthalene	c	330	c	c	10	c	c
	Hexachlorocyclopentadiene	c	330	c	c	10	c	c
	2,4,6-Trichlorophenol	c	330	c	c	10	c	c
	2,4,5-Trichlorophenol	c	800	c	c	25	c	c
	2-Chloronapthalene	c	330	c	c	10	c	c
	2-Nitroaniline	c	800	c	c	25	c	c
	Dimethylphthalate	c	330	c	c	10	c	c
	Acenaphthylene	c	330	c	c	10	c	c

Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 4 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TCL semi-volatiles[c] (cont.)	2,6-Dinitrotoluene	c	330	c	c	10	c	c
	3-Nitroaniline	c	800	c	c	25	c	c
	Acenaphthene	c	330	c	c	10	c	c
	2,4-Dinitrophenol	c	800	c	c	25	c	c
	4-Nitrophenol	c	800	c	c	25	c	c
	Dibenzofuran	c	330	c	c	10	c	c
	2,4-Dinitrotoluene	c	330	c	c	10	c	c
	Diethylphthalate	c	330	c	c	10	c	c
	4-Chlorophenyl-phenylether	c	330	c	c	10	c	c
	Fluorene	c	330	c	c	10	c	c
	4-Nitroaniline	c	800	c	c	25	c	c
	4,6-Dinitro-2-methylphenol	c	800	c	c	25	c	c
	N-nitrosodiphenylamine	c	330	c	c	10	c	c
	4-Bromophenyl-phenylether	c	300	c	c	10	c	c
	Hexachlorobenzene	c	300	c	c	10	c	c
	Pentachlorophenol	c	800	c	c	25	c	c
	Phenanthrene	c	330	c	c	10	c	c
	Anthracene	c	330	c	c	10	c	c
	Carbazole	c	330	c	c	10	c	c
	Di-n-butylphthalate	c	330	c	c	10	c	c
	Fluoranthene	c	330	c	c	10	c	c
	Pyrene	c	330	c	c	10	c	c

Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 5 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TCL semi-volatiles[c] (cont.)	Butylbenzylphthalate	c	330	c	c	10	c	c
	3-3'-Dichlorobenzidine	c	330	c	c	10	c	c
	Benzo(a)anthracene	c	330	c	c	10	c	c
	Chrysene	c	330	c	c	10	c	c
	bis(2-Ethylhexyl)phthalate	c	330	c	c	10	c	c
	Di-n-octylphthalate	c	330	c	c	10	c	c
	Benzo(b)fluoranthene	c	330	c	c	10	c	c
	Benzo(k)fluoranthene	c	330	c	c	10	c	c
	Benzo(a)pyrene	c	330	c	c	10	c	c
	Indeno(1,2,3-cd)pyrene	c	330	c	c	10	c	c
	Dibenz(a,h)anthracene	c	330	c	c	10	c	c
	Benzo(g,h,i)perylene	c	330	c	c	10	c	c
CLP TCL Pesticides/Aroclors[c]	alpha-BHC	c	1.7	c	c	0.05	c	c
	beta-BHC	c	1.7	c	c	0.05	c	c
	delta-BHC	c	1.7	c	c	0.05	c	c
	gamma-BHC (Lindane)	c	1.7	c	c	0.05	c	c
	Heptachlor	c	1.7	c	c	0.05	c	c
	Aldrin	c	1.7	c	c	0.05	c	c
	Heptachlor epoxide	c	1.7	c	c	0.05	c	c
	Endosulfan I	c	1.7	c	c	0.05	c	c
	Dieldrin	c	3.3	c	c	0.10	c	c

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Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 6 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TCL Pesticides/Aroclors[c] (Cont.)	4,4'-DDE	c	3.3	c	c	0.10	c	c
	Endrin	c	3.3	c	c	0.10	c	c
	Endosulfan II	c	3.3	c	c	0.10	c	c
	4,4'-DDD	c	3.3	c	c	0.10	c	c
	Endosufan sulfate	c	3.3	c	c	0.10	c	c
	4,4'-DDT	c	3.3	c	c	0.10	c	c
	Methoxychlor	c	17.0	c	c	0.50	c	c
	Endrin ketone	c	3.3	c	c	0.10	c	c
	Endrin aldehyde	c	3.3	c	c	0.10	c	c
	alpha-Chlordane	c	1.7	c	c	0.05	c	c
	gamma-Chlordane	c	1.7	c	c	0.05	c	c
	Toxaphene	c	170.0	c	c	5.0	c	c
	Aroclor-1016	c	33.0	c	c	1.0	c	c
	Aroclor-1221	c	33.0	c	c	1.0	c	c
	Aroclor-1232	c	67.0	c	c	2.0	c	c
	Aroclor-1242	c	33.0	c	c	1.0	c	c
	Aroclor-1248	c	33.0	c	c	1.0	c	c
	Aroclor-1254	c	33.0	c	c	1.0	c	c
	Aroclor-1260	c	33.0	c	c	1.0	c	c
CLP TAL Inorganics[c]	Aluminum	c	20	c	c	200	c	c
	Antimony	c	6	c	c	60	c	c
	Arsenic	c	1	c	c	10	c	c

Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 7 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
CLP TAL Inorganics[c] (Cont.)	Beryllium	c	.5	c	c	5	c	c
	Cadmium	c	.5	c	c	5	c	c
	Calcium	c	500	c	c	5000	c	c
	Chromium	c	1	c	c	10	c	c
	Cobalt	c	5	c	c	50	c	c
	Copper	c	2.5	c	c	25	c	c
	Iron	c	10	c	c	100	c	c
	Lead	c	.3	c	c	3	c	c
	Magnesium	c	500	c	c	5000	c	c
	Manganese	c	1.5	c	c	15	c	c
	Mercury	c	.02	c	c	0.2	c	c
	Nickel	c	4	c	c	40	c	c
	Potassium	c	500	c	c	5000	c	c
	Selenium	c	.5	c	c	5	c	c
	Silver	c	1	c	c	10	c	c
	Sodium	c	500	c	c	5000	c	c
	Thallium	c	1	c	c	10	c	c
	Vanadium	c	5	c	c	50	c	c
	Zinc	c	2	c	c	20	c	c
	Cyanide	c	10	c	c	10	c	c

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Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 8 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
Anions	Ammonia as Nitrogen	350.3[d]	N/A	N/A	N/A	30	±20	75-125
	Chloride	EPA 300/modified[e], 325.3[d], or 325.2[d]	N/A	N/A	N/A	10,000	±20	75-125
	Fluoride	EPA 300/modified[e] or 340.2	0.5	±35	75-125	100	±20	75-125
	Nitrate	EPA 300/modified[e], 352.1[d], 353.3[d], 353.2[d], or 354.1[d]	1.0	±35	75-125	100	±20	75-125
	Phosphate	EPA 300/modified[e], 365.1[d], 365.2[d], 365.3[d]	N/A	N/A	N/A	500	±20	75-125
	Sulfate	EPA 300/modified[e], 375.2[d], 375.3[d], 375.4[d]	20.0	±35	75-125	2,000	±20	75-125
	Sulfide	9030[f]	N/A	N/A	N/A	5	±20	75-125
Radionuclides	Hydrogen-3	g	N/A	N/A	N/A	400 pCi/L	±20	75-125
	Carbon-14	g	g	g	g	g	g	g
	Strontium-90	g	1 pCi/g	±35	75-125	10 pCi/L	±20	75-125
	Technetium-99	g	N/A	N/A	N/A	10 pCi/L	±20	75-125
	Alpha Spectrometry (uranium-235, -238; plutonium-239, -240; and americium-241)	g	1 pCi/g	±35	75-125	3 pCi/L	±20	75-125

Table A-1. Analytical Methods, Analytical Parameters, Detection Limits, and Precision and Accuracy Requirements for the 200-ZP-1 Groundwater Operable Unit. (sheet 9 of 9)

Analytical Category	Analytical Parameters	Analytical Method	CRDL or CRQL, soil[a]	Precision[b], Soil	Accuracy[b], Soil	CRDL or CRQL, Water[a]	Precision[b], Water	Accuracy[b], Water
Radionuclides (Cont.)	Gross alpha	g	1pCi/g	±35	75-125	3pCi/L	±20	75-125
	Gross beta	g	4 pCi/g	±35	75-125	4 pCi/L	±20	75-125
	Gamma Spectrometry (report all identifiable and quantifiable isotopes)	g	0.5 pCi/g	±35	75-125	5 pCi/L	±20	75-125
Other groundwater parameters	Alkalinity	310.1[d]	N/A	N/A	N/A	10,000	±20	75-125
	Chemical Oxygen Demand	410.1[d]	N/A	N/A	N/A	1,000	±20	N/A
	Specific Conductance	1	N/A	N/A	N/A	25	±20	N/A
	pH	1	N/A	N/A	N/A	N/A	N/A	N/A
	Temperature	1	N/A	N/A	N/A	N/A	±1°C	N/A
	Dissolved Oxygen	360.1[d]	N/A	N/A	N/A	100	±20	N/A
	Total Dissolved Solids	160.1[d]	N/A	N/A	N/A	10,000	±20	N/A
	Total Organic Carbon	415.1[d]	N/A	N/A	N/A	1,000	±20	75-125
	Total Organic Halides	9020[f]	N/A	N/A	N/A	5	±20	75-125
	Turbidity	180.1[d]	N/A	N/A	N/A	0.05 NTU	±.05 NTU	N/A

[a] For all CLP analytical categories, CRDL refers to the Contract Required Detection Limit specified on the *US EPA Contract Laboratory Program Statement of Work for Inorganics Analysis* (EPA 1991a); CRQL refers to the Contract Required Quantitation Limit specified in the *US EPA Contract Laboratory Program Statement of Work for Organics Analysis* (EPA 1991b). CRQLs are provided for all other (non-CLP) categories, and represent maximum values that can be reliably achieved by analytical laboratories under routine normal conditions. Unless otherwise specified, all inorganic soil values are expressed in mg/Kg, and all organic soil values are expressed as µg/Kg; CLP Target Compound List (TCL) values for inorganic soil CRDLs are the lower of the values specified in the CLP Statement of Work (SOW) (EPA 1991a). All CRDL/CRQL values for water are expressed in µg/L. Laboratory agreements for services shall require updating as necessary to accommodate periodic updates of the CLP SOWs (EPA 1991a and 1991b).

[b] Acceptable ranges for precision and accuracy for EPA Contract Laboratory Program (CLP) TCL organics and TAL inorganic parameters shall be as specified for each analyte by the applicable CLP SOWs; see EPA 1990a and 1990b). For all other parameters, the ranges provided shall be considered maximum values that can be reliably achieved by the laboratories under routine normal conditions. Precision is expressed as Relative Percent Difference (RPD); accuracy is expressed as percent recovery (%R). In all cases, these limits apply to sample results greater than five times the CRDL or CRQL, and shall be considered requirements in the absence of known or suspected interferences which may hinder achieving the limit by the analytical laboratory.

[c] As specified in the CLP SOWs for organic and inorganic analysis; all analytical methods, CRDLs, CRQLs, and precision and accuracy requirements shall be as specified therein without modification.

[d] Methods specified are from *Methods for Chemical Analysis of Water and Wastes* (Kopp and McKee 1983).

[e] Method specified is from *Determination of Inorganic Anions in Aqueous and Solid Samples by Ion Chromatography* (Lindahl 1984), and is a modification of EPA method 300.0.

[f] Methods specified are from *Test Methods for Evaluating Solid Waste* (EPA 1986).

[g] Laboratory specific based on standard methodologies.

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4.0 SAMPLE PROCEDURES

4.1 PROCEDURE APPROVALS AND CONTROL

4.1.1 Bechtel Hanford, Inc., Procedures

The BHI procedures cited in this QAPjP include EIPs from BHI-EE-01, *Environmental Investigations Procedures* (BHI 1994a), *Quality Management Plan* (BHI 1994b), and BHI functional manuals as required. Procedure approval, revision, and distribution control requirements applicable to EIPs are addressed in EIP 1.2, "Preparing, Revising and Canceling Environmental Investigations Procedures" (BHI 1994a); requirements applicable to approval, revision, and distribution of functional procedures are addressed in the BHI *Quality Management Plan*, Section 5, "Documents" (BHI 1994b). All procedures are available for regulatory review on request, at the direction of the project task lead.

4.1.2 Participant Contractor/Subcontractor Procedures

As previously noted in Section 2.1, participant contractor and/or subcontractor services shall be procured under the applicable requirements of the BHI *Quality Management Plan*, Section 4, "Procurement" (BHI 1994b). Submittal requirements of procedures for BHI review and approval before use shall be included in the procurement document or work order, as applicable, when such services require procedural controls. Analytical laboratories shall be required to submit the current version of their internal QA program plans, in addition to analytical procedures. All analytical laboratory plans and procedures shall be subject to review and approval by BHI or other qualified personnel, as directed by the task lead All reviewers shall be qualified under the requirements of EIP 1.12, "Indoctrination, Training, and Qualification" (BHI 1994a). All participant contractor or subcontractor procedures, plans, and/or manuals shall be retained as project records in compliance with *Quality Management Plan*, Section 6, "Records" (BHI 1994b). All such documents are available for regulatory review on request, at the direction of the task lead.

4.2 SAMPLING PROCEDURES

4.2.1 Sample Acquisition

Sample acquisition procedures are described in Sections 2.0 and 3.0 of the SAP.

4.2.2 Sample Container Selection

Recommended sample container types and preservation requirements will be identified through the Sample Event Coordination process defined by EIP 2.0, "Sample Event Coordination." Preparation requirements and special handling requirements are defined in EIP 4.1, "Groundwater Sampling," and EIP 3.1, "Sample Packaging and Shipping" (BHI 1994a).

Guidance and recommended sample container types, preservation requirements, preparation requirements, and special handling requirements are defined in EIP 4.1, "Groundwater Sampling," and EIP 3.1, "Sample Packaging and Shipping" (BHI 1994a). Also see Tables 6, 8, and 10 in Section 3.0 of the SAP for laboratory-specific sample container requirements.

4.3 OTHER SUPPORTING PROCEDURES

Documentation requirements shall be addressed within individual procedures, DOWs, and/or SAPs.

4.4 PROCEDURE CHANGES

Should deviations from established EIPs be required to accommodate unforeseen field situations, they may be authorized by the field team leader/sampler in accordance with the requirements specified in EIP 1.1, "Preparing, Revising, and Canceling Environmental Investigations Procedures" (BHI 1994a). Other types of procedure change requests shall be documented as required by the *Quality Management Plan*, Section 5, "Documents" (BHI 1994b).

5.0 SAMPLE CUSTODY

During the course of the investigation, samples removed from the immediate sampling site for analysis shall be controlled as required by EIP 3.0, "Chain of Custody" (BHI 1994a), from the point of origin to the selected analytical resource. For samples shipped to laboratories, internal chain-of-custody procedures shall be reviewed and approved in compliance with the requirements of Section 4.1 of this QAPjP, and shall ensure the maintenance of sample integrity and identification throughout the analytical process. At the direction of the task lead, requirements for the return of residual sample materials after completion of analysis shall be defined in accordance with procedures described in the procurement documentation to subcontractor or participant contractor laboratories. Chain-of-custody forms shall be initiated for returned residual samples as required by the approved procedures applicable within the laboratory. All analytical results shall be controlled as permanent project quality records as required by Section 6 of the *Quality Management Plan* (BHI 1994b).

6.0 CALIBRATION PROCEDURES

Calibration of all measuring and test equipment, whether in existing inventory or purchased for this investigation, shall be controlled as required by the *Quality Management Plan*, Section 3, "Control of Measuring and Test Equipment" (BHI 1994b), and/or other specific requirements incorporated in SAPs or DOW. Routine operational checks for BHI field equipment shall be as defined within applicable EIPs or procedures; similar information shall be provided in BHI-approved participant contractor or subcontractor procedures or included in the text of applicable DOWs as indicated above. All calibration requirements applicable to analytical laboratory equipment shall be as defined by laboratory QA plans and/or applicable standard analytical methods, subject to BHI review and approval.

7.0 ANALYTICAL PROCEDURES

Analyses shall be performed according to approved and issued BHI or subcontractor procedures. Detection limit values and precision and accuracy ranges shall be consistent with performance criteria identified in the applicable referenced method/procedure (for the sample matrix and relative analyte concentrations at which the performance criteria are defined). Method/procedure references, analytes, and method performance objectives for analytical resources that may support the 200-ZP-1 project (i.e., soil or water) are summarized in Table A-1. To facilitate the comparability of data sets in terms of precision and accuracy, all analytical data shall be reported in the standard units specified in the applicable reference method. The reporting requirements so defined and the applicable requirements of Table A-1 shall be considered minimum performance standards that shall be incorporated into the agreements for services established with individual BHI participant contractors, or subcontractor analytical laboratories. As previously noted in Section 3.0 of this QAPjP, any modification of Table A-1 requirements shall be justified by the requestor, and shall be considered a formal modification of this QAPjP and is subject to regulatory review and approval. All approved procedures used to support this project shall be retained within BHI and shall be available for review on request.

8.0 DATA REDUCTION, VERIFICATION, VALIDATION, AND REPORTING

8.1 DATA REDUCTION AND DATA PACKAGE PREPARATION

Analytical resources used to support the project shall be responsible for preparing a data deliverable to report results of analyses. Data deliverable content shall be consistent with the requirements specified in the work document DOW and the analysis performed. Data reduction schemes shall be documented within the applicable analytical methods and/or QA manuals, submitted for BHI review and approval as discussed in Section 4.1. Completed data deliverables shall be reviewed and approved by the applicable analytical resource QA manager (or field team leader for field screening type analyses) before its submittal to the task lead. Completed data packages shall be submitted to the Sample Management Organization for tracking and data validation functions. The requirements of this section shall be included in procurement documentation or work orders, as appropriate, to comply with BHI procurement control procedures.

8.2 VERIFICATION/VALIDATION

8.2.1 Verification

Verification of completed data packages will be performed to ensure that minimum requirements are met for transmittal to BHI Records Management as a QA record and to document deliverable content. Verification activities shall be performed according to EIP 2.3, "Data Package Administrative Verification," and EIP 2.4, "Data Package Technical Verification."

8.2.2 Validation

Validation of the completed data package will be performed by qualified BHI personnel or by a qualified independent participant contractor. Subcontracted validation responsibilities shall be defined in procurement documentation or work orders as appropriate. All validation shall be performed in compliance with EIP 2.5, "Data Package Validation Process," unless otherwise specified in the applicable work document (e.g., DOW, SAP). Validation of field screening results may not be required unless directed by the project task lead. Validation frequency and level of effort requirements shall be specified in the DOW.

8.3 FINAL REVIEW AND RECORDS MANAGEMENT CONSIDERATIONS

All verification and validation reports and supporting analytical data packages shall be subject to a final technical review by a qualified reviewer at the direction of the task lead, before their submittal to regulatory agencies; prior to entry into the Hanford Environmental Information System (HEIS) in compliance with EIPs 2.0-2.7 under the heading, Sample Management (1994a); or before inclusion in reports or technical memoranda. All verification and validation reports, data packages, and review comments shall be retained as permanent project quality records in compliance with Section 6, "Record," of the *Quality Management Plan* (BHI 1994b).

8.4 REQUIREMENTS FOR HANDLING UNACCEPTABLE OR SUSPECT DATA

The analytical data flow and data management process are described in detail in EIPs 2.0-2.7 under the heading Sample Management (BHI 1994a). Data errors or procedural discrepancies related to laboratory analytical processes shall prompt data requalification by the validator, requests for reanalysis, or other appropriate corrective action by the responsible laboratory as required by site procedures or approved subcontractor data validation procedures. If nonconforming conditions are identified during the sample collection, analysis, and validation processes, the issue shall be formally documented in compliance with approved BHI procedures. Nonconforming conditions shall be brought to the attention of the task lead and QA officer.

If problems are observed with validated data, either as part of the data assessment process described in Section 12.0 of this QAPjP or if separately observed by any of the operable unit managers, the data shall be documented as a nonconformance and corrective action initiated as previously noted; if the data have been entered in the HEIS, the HEIS Data Custodian shall be immediately notified in order that the data may be flagged (in compliance with EIPs 2.0 - 2.7 under the heading Sample Management and *HEIS User's Manual* [WHC 1990]) as directed by the approved disposition.

9.0 INTERNAL QUALITY CONTROL

All analytical samples shall be subject to in-process QC measures in both the field and laboratory. Unless otherwise specified in the approved Statement of Work or work orders for sampling activities, or in applicable EIPs, the following minimum field QC requirements shall apply. These requirements are adapted from *Test Methods for Evaluating Solid Waste* (EPA 1986), as modified by the proposed

rule changes included in the Federal Register, 1989, Volume 54, No. 13, pp 3212-3228, and 1990, Volume 55, No. 27, pp 4440-4445.

- Field duplicate samples. For each shift of sampling activity under an individual sampling subtask, a minimum of 5% of the total collected samples shall be duplicated, or one duplicate shall be collected for every 20 samples, whichever is greater. Duplicate samples shall be retrieved from the same sampling location using the same equipment and sampling technique, and shall be placed into two identically prepared and preserved containers. All field duplicates shall be analyzed independently to assess the magnitude of field variability and the need for more duplicates.

- Split samples. Upon specific BHI or regulator request, and at the task lead's direction, field or field duplicate samples may be split in the field and sent to an alternative laboratory as a performance audit of the primary laboratory. Frequency shall meet the minimum schedule requirements of Chapter 10.0 of this QAPjP or the specific needs of the requesting organization.

- Blind samples. At the task lead's discretion, blind reference samples may be introduced into any sampling round as a QC check of the primary laboratory. Blind sample type shall be as directed by the technical lead; frequency shall meet the minimum schedule requirements in Chapter 10.0 of this QAPjP.

- Field blanks. Field blanks shall consist of pure deionized distilled water, transferred into a sample container at the site and preserved with the reagent specified for the analytes of interest. Field blanks are used as a check on reagent and environmental contamination, and shall be collected at the same frequency as field duplicate samples.

- Equipment rinsate blanks. Equipment blanks shall consist of pure deionized distilled water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples. Equipment blanks are used to verify the adequacy of sampling equipment decontamination procedures, and shall be collected at the same frequency as field duplicate samples where applicable.

- Volatile organic analysis trip blanks. Volatile organic analysis (VOA) trip blanks consist of pure deionized distilled water added to one clean sample container, accompanying each batch (cooler) of containers shipped to the sampling facility. Trip blanks shall be returned unopened to the laboratory, and are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage or site conditions. The trip blank shall be analyzed for VOC only, as shown on EPA's target compound list (TCL; see EPA 1991b). In compliance with standard procurement procedures, requirements for trip blank preparation shall be included in procurement documents of work orders to the sample container supplier and/or preparer.

Unless otherwise specified in BHI-approved analytical methods, internal QC checks performed by analytical laboratories shall meet the following minimum requirements.

- Matrix-spike/matrix-spike duplicate samples. Matrix-spiked samples require the addition of a known quantity of a representative analyte of interest to the sample as a measure of recovery percentage and as a test of analytical precision. The spike shall be made in a replicate of a field duplicate sample. Replicate samples are separate aliquots removed from the same

sample container in the laboratory. Spike compound selection, quantities, and concentrations shall be described in the analytical procedures submitted for WHC review and approval. One sample shall be spiked per analytical batch, or once every 20 samples, whichever is more frequent.

- Quality control reference samples. A QC reference sample shall be prepared from an independent standard at a concentration other than that used for calibration, but within the calibration range. Reference samples are required as an independent check on analytical technique and methodology, and shall be run with every analytical batch, or every 20 samples, whichever is more frequent.

Other requirements specific to laboratory analytical equipment calibration are included in Section 6.0 of this QAPjP. For field screening gas chromatography (GC) analysis, at least one duplicate sample in 20 samples shall be a split. At least one split sample shall be routed to a qualified laboratory as a check on the proper use and functioning of field GC procedures and equipment. Duplicates shall be selected, whenever possible, from samples in which significant readings have been observed during field analysis. The minimum requirements of this section shall be invoked in procurement documents or work orders in compliance with standard procedures as noted in Section 4.1 of this QAPjP.

10.0 PERFORMANCE AND SYSTEM ASSESSMENTS

Assessments and surveillances will be scheduled throughout sampling and analysis activities. Collectively the assessments address quality affecting activities that include, but are not limited to, measurement system accuracy, intramural and extramural analytical laboratory services, field activities, and data collection, processing, validation, and management.

Assessments to ensure the accuracy of laboratory analysis are implemented in accordance with Quality Program Procedure 3.2, "Independent Assessments" (BHI 1994c). Surveillances will be performed regularly throughout the course of the work plan activities in compliance with Quality Program Procedure 3.1, "Surveillances" (BHI 1994c). Additional assessments and system surveillances may be scheduled as a consequence of corrective action requirements or may be performed upon request. All quality affecting activities are subject to surveillance.

All aspects of inter-operable unit activities will also be evaluated as part of routine environmental restoration program-wide QA assessment program in compliance the BHI *Quality Management Plan*, Part 1, Section B.8, "Assessments" (BHI 1994b). Assessments shall be conducted by assessors qualified in accordance with Quality Program Procedure 2.1, "Qualification of Assessors and Lead Assessors" (BHI 1994c).

11.0 PREVENTIVE MAINTENANCE

All measurement and testing equipment used in the field and laboratories that directly affect the quality of the field and analytical data shall be subject to preventive maintenance measures that ensure minimization of measurement system downtime and corresponding schedule delays. Laboratories shall be responsible for performing or managing the maintenance of their analytical equipment.

Maintenance requirements, spare parts lists, and instructions shall be included in individual laboratory QA plans, subject to BHI review and approval. When samples are analyzed using EPA reference methods, the preventive maintenance requirements for laboratory analytical equipment are as defined in the procured laboratory's QA plan(s). BHI field equipment shall be drawn from inventories subject to standard preventive maintenance and calibration procedures. Any field procedures submitted for BHI approval by participant contractors or subcontractors shall contain, as appropriate, provisions for preventive maintenance schedules and spare parts lists to ensure minimization of equipment downtime.

12.0 DATA ASSESSMENT PROCEDURES

All analytical data shall be compiled, reduced, and reviewed by the laboratory prior to presentation to BHI or subcontractor personnel for validation as described in Section 8.0 of this QAPjP. Data assessment procedures shall be documented, signed, dated, and retained as project records in compliance with the *Quality Management Plan*, Part 1, Section A.6, "Records" (BHI 1994b).

13.0 CORRECTIVE ACTION

13.1 GENERAL REQUIREMENTS FOR CORRECTIVE ACTION

Corrective action requests required as a result of surveillance reports, nonconformance reports, program audit activities, or as a result of the specific request of the operable unit manager shall be documented and dispositioned by the task lead and QA officer. Corrective action reports prepared under the *Quality Management Plan*, Section 3, "Quality Improvement" (BHI 1994b), shall identify the affected requirement, the probable cause of the deviation, any data that may have been affected by the deviation, and the corrective action required both to resolve the immediate situation and to reduce or preclude its recurrence. Corrections of plans or procedures related to the overall measurement system that do not constitute nonconformances but may be required as a result of data validation, data assessment, or routine review processes, shall be resolved as required by their governing procedures or shall be referred to the technical lead for resolution and appropriate management action. All documentation related to surveillances, audits, and corrective action shall be maintained in compliance with the applicable EIP and routed to the project quality records upon completion or closure for retention in compliance with Section 3, "Records," of the *Quality Management Plan* (BHI 1994b), and shall be made available for operable unit manager review upon request through the task lead.

13.2 CORRECTIVE ACTION REQUIREMENTS RELATED TO CALIBRATION ERRORS

Field measuring and test equipment found to be out of calibration shall be documented as a nonconformance in compliance with the *Quality Management Plan*, Section C 13.0, "Control of Measuring and Test Equipment" (BHI 1994b). Nonconforming items shall be tagged, removed from service, and segregated pending resolution of the nonconformance and initiation of appropriate corrective action. Calibration errors related to laboratory analytical processes that may be observed in the data validation activities described in Section 8.0 of this QAPjP shall prompt requests for

reanalysis or other appropriate corrective action by the responsible laboratory as required by the BHI or approved subcontractor data validation procedures. If sample holding time requirements are compromised, insufficient sample material is available for reanalysis, or any other condition prevents compliance with governing analytical methods and data validation protocols, the situation shall be initiated in compliance with the requirements the *Quality Management Plan*, Section 3, "Quality Improvement" (BHI 1994b), and brought to the attention of the task lead and QA officer for appropriate action.

13.3 CORRECTIVE ACTION REQUIREMENTS RELATED TO PROCEDURAL DEVIATIONS

Planned deviations from EIP requirements shall be processed in compliance with EIP 1.1, "Preparing, Revising, and Canceling Environmental Investigation Procedures" (BHI 1994a). Unplanned procedural deviations observed during assessments, or surveillance activities shall be documented as nonconformances, findings, or observations in compliance with the procedures described in Section 10, "Performance and System Assessments." Corrective action shall be initiated in compliance with Section 3.2, "Corrective Action," of the *Quality Management Plan* (BHI 1994b).

13.4 CORRECTIVE ACTION REQUIREMENTS RELATED TO PURCHASED MATERIALS, ITEMS, OR EQUIPMENT

Purchased materials, items, and equipment found to be out of compliance with their governing procurement specifications shall be documented as a nonconformance in compliance with the BHI *Quality Management Plan*, Section 3, "Quality Improvement" (BHI 1994b). Nonconforming items shall be tagged and segregated pending resolution of the nonconformance and initiation of appropriate corrective action in compliance with Section 3.2, "Corrective Action," of the *Quality Management Plan* (BHI 1994b).

14.0 QUALITY ASSURANCE REPORTS

As previously stated in Sections 10.0 and 13.0 of this QAPjP, project activities shall be regularly assessed by performance and system assessment surveillances and program audits. Assessment, surveillance, nonconformance, audit, and corrective action documentation shall be routed to the project file upon completion or closure of the activity. A report summarizing corrective action shall be prepared for the task lead by the QA officer at the completion of the field and laboratory investigations. The assessment report shall include an assessment of the overall adequacy of the total measurement system with regard to the DQOs of the investigation.

15.0 REFERENCES

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