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200-CW-1 Operable Unit RI/FS Work Plan and 216-B-3 RCRA TSD Unit Sampling Plan

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July 1999

United States Department of Energy

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
BHI	Bechtel Hanford, Inc.
CERCLA	*Comprehensive Environmental Response, Compensation, and Liability Act of 1980*
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
CRDL	contract required detection limit
DQA	data quality assessment
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
FS	feasibility study
GRA	general response action
HASP	health and safety plan
HPGe	high purity germanium
IDW	investigation-derived waste
msl	mean sea level
MTCA	*Model Toxics Control Act*
OU	operable unit
PCB	polychlorinated biphenyl
PRG	preliminary remediation goal
PUREX	Plutonium/Uranium Extraction
QRA	qualitative risk assessment
RAO	remedial action objective
RAWP	remedial action work plan
RCRA	*Resource Conservation and Recovery Act of 1976*
RDR	remedial design report
RI	remedial investigation
ROD	record of decision
RPP	RCRA past-practice
SAP	sampling and analysis plan
TSD	treatment, storage, and disposal
WAC	*Washington Administrative Code*
WIDS	Waste Information Data System

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1.0 INTRODUCTION

The 200-CW-1 Operable Unit (OU) is located near the center of the Hanford Site in south-central Washington State. This OU consists of 28 waste sites, including 26 *Resource Conservation and Recovery Act of 1976* (RCRA) past-practice (RPP) sites and two RCRA treatment, storage, and disposal (TSD) sites in a single RCRA TSD unit. These sites, mostly trenches and ponds, received predominantly cooling water from various facilities in the 200 East Area, such as the Plutonium/Uranium Extraction (PUREX) Plant, B Plant, the 204-AR Vault, the 241-A-401 Building, the 242-A Evaporator, the 242-B Evaporator, the 244-AR Vault, the 244-BXR Vault, the 244-CR Vault, the 241-BY Tank Farm, the 241-A Aging Waste Ventilation System Complex, the 284-E Powerhouse, and the 283-E Water Treatment Plant. This cooling water carried some chemicals and radionuclides, which contaminated some of the waste sites. Several unplanned releases of radioactive material, including releases associated with equipment failures in the facilities, contributed large amounts of radioactivity to several of the waste sites. Integration of the RPP and RCRA TSD sites in this work plan will streamline the characterization and remediation of the waste sites while satisfying the requirements of the various regulations governing the sites.

The characterization and remediation of waste sites at the Hanford Site is addressed in the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement; Ecology et al. 1996). Also addressed in this agreement is the requirement that the cleanup programs integrate the requirements of the *Comprehensive Environmental Response, Conservation, and Liability Act of 1980* (CERCLA) and RCRA, to provide a standard approach to direct cleanup activities in a consistent manner and ensure that applicable regulatory requirements are met. Details of this integration for the 200 Areas are presented in the *200 Areas Remedial Investigation/Feasibility Study* (FS)*Implementation Plan - Environmental Restoration Program* (Implementation Plan, DOE-RL 1998), and are summarized in Section 1.1 of this work plan.

The schedule of work at the Hanford Site is governed by Tri-Party Agreement milestones. The milestone controlling the schedule for the 200-CW-1 OU is M-13-20, "Submit Gable Mountain/B Pond & Ditch Cooling Water Group Work Plan," April 30, 1999. All characterization work in the 200 Areas is scheduled to be completed by December 31, 2008 (milestone M-15-00C). Milestone M-20-00, "Submit Part B Permit Applications or Closure/Postclosure Plans for All RCRA TSD Units," requires permit applications, closure, and post-closure plans to be submitted to the Washington State Department of Ecology (Ecology) for approval by February 28, 2004.

1.1 200 AREAS IMPLEMENTATION PLAN

The Implementation Plan outlines a strategy that is intended to streamline the characterization and remediation of waste sites in the 200 Areas, including CERCLA sites RPP sites ,and RCRA TSD units. The plan outlines the framework for implementing assessment activities and evaluating remedial alternatives in the 200 Areas to ensure consistency in documentation, level of characterization, and decision making. A regulatory framework is established in the

Implementation Plan to integrate the requirements of RCRA and CERCLA into one standard approach for cleanup activities in the 200 Areas. This approach is illustrated in Figure 1-1.

The Implementation Plan consolidates much of the information normally found in a unit-specific work plan to avoid duplication of this information in each of the 23 OUs in the 200 Areas. The Implementation Plan also lists potential applicable or relevant and appropriate requirements (ARARs), and preliminary remedial action objectives (RAOs), and contains a discussion of potentially feasible remedial technologies that may be employed in the 200 Areas.

This work plan references the Implementation Plan for further details on several topics. Among them is general information on the physical setting and operational history of 200 Area facilities, ARARs, RAOs, and post-work plan activities.

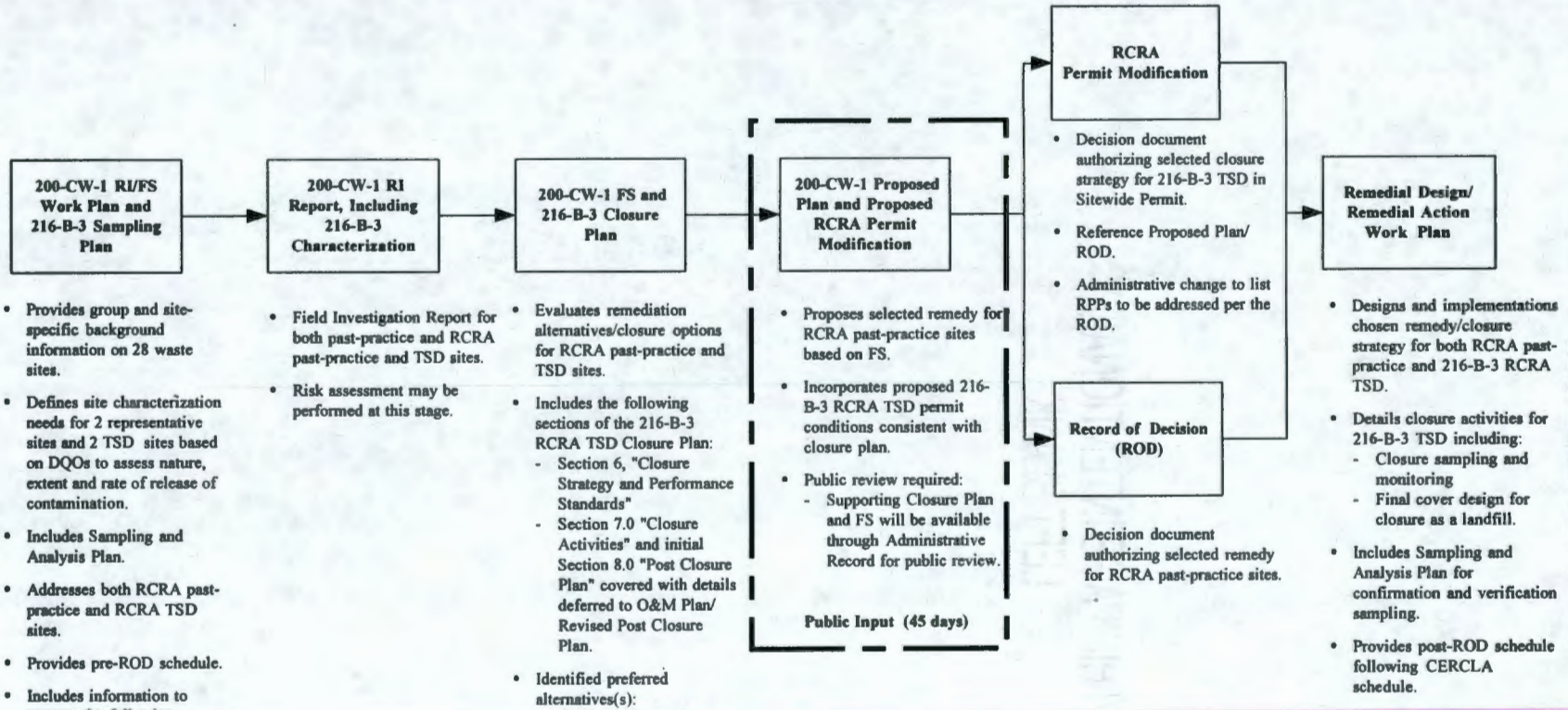
1.2 SCOPE AND OBJECTIVES

This work plan provides details for characterizing chemical, radiological, and physical conditions in soil at four selected waste sites in the 200-CW-1 OU. It also identifies preliminary remedial action alternatives that are likely to be considered for remediation of the OU. Remedial alternatives may be applied at any or all of the waste sites in an OU , and different alternatives may be applied to different waste sites depending on site characteristics. These preliminary remedial alternatives will be further developed and agreed to in the FS/closure plan, the proposed plan/proposed permit modification, and the eventual record of decision (ROD) and Hanford Facility RCRA Permit Modification for this Operable Unit (OU).

The general approach to characterization and evaluation of 200 Area OUs is outlined in the Implementation Plan, but much more detail is presented here. This detail includes background information on the waste sites in this OU; existing data regarding contamination at the waste sites; and the approach that will be used to investigate, characterize, and evaluate the sites. A discussion of the remedial investigation planning and execution process is also included, along with a schedule for the characterization work. Details on sampling, analysis, and field safety are provided in Appendix A, which will guide work in the field. Waste management will be conducted under a waste control plan to be prepared prior to field activities.

After characterization data have been collected, results will be presented in a group-specific remedial investigation (RI) report that includes the specific RCRA TSD unit characterization. The RI report will support the evaluation of remedial alternatives and closure options that will be included in the group-specific FS and specific RCRA TSD unit closure plan. The FS and closure plan will ultimately support a group-specific proposed plan leading to a ROD and a proposed RCRA permit modification leading to a modification of the Hanford Facility RCRA Permit for the RCRA TSD unit. The schedule for assessment activities at the 200-CW-1 OU is presented in Section 6.0.

Figure 1-1. Integrated Regulatory Process for CERCLA, RCRA Past-Practice, and RCRA TSD Unit Closure.



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2.0 BACKGROUND AND SETTING

This section describes the Gable Mountain Pond/B-Pond and Ditch Cooling Water Group and associated waste sites, and the physical setting of the 200 East Area and vicinity. Information in this section is summarized from the following reports:

- *Waste Site Grouping for 200 Areas Soil Investigations* (DOE-RL 1997)
- *200 Areas Remedial Investigation/Feasibility Study Implementation Plan – Environmental Restoration Program* (DOE-RL 1998)
- *B Plant Source Aggregate Area Management Study Report* (DOE-RL 1993a)
- *PUREX Source Aggregate Area Management Study Report* (DOE-RL 1993b)
- 200-*BP-11 Operable Unit RFI/CMS and 216-B-3 Main Pond, 216-B-63 Trench, and 216-A-29 Ditch Work/Closure Plan* (DOE-RL 1995)
- *Groundwater Impact Assessment Report for the 216-B-3 Pond System* (Johnson et al. 1995).

The waste sites in the Gable Mountain Pond/B-Pond and Ditch Cooling Water Group (200-CW-1 OU) are located on the Hanford Site in southeastern Washington State, in and around the northeast portion of the 200 East Area (Figure 2-1). This OU consists of 28 waste sites that received mostly cooling water from a variety of 200 Area operations. Figure 2-2 shows the specific locations of waste sites in the 200-CW-1 OU.

Certain subsections of this section contain information that will be used for portions of the RCRA TSD closure plan. These are as follows:

- Section 2.1, "Physical Setting," - provides closure plan facility description and location
- Section 2.2, "Waste Description and History," - provides closure plan facility description and location and process information.

2.1 PHYSICAL SETTING

The following is a synopsis of the geology and hydrology of the area around the 200-CW-1 OU. More detail on the physical setting of the 200 Areas is provided in Appendix F of the Implementation Plan (DOE-RL 1998).

2.1.1 Topography

Most of the 200 Areas is situated on a plateau that rises approximately 75 m (250 ft) above the Columbia River. The northeastern portion of the 200 East Area, where most of the waste sites in the 200-CW-1 OU are located, slopes generally downward to the northeast. Surface elevations range from approximately 225 m (740 ft) above mean sea level (msl) in the south to

approximately 180 m (590 ft) above msl in the northeast. The land surface continues to slope downward north of the 200 East Area; the area around Gable Mountain Pond, approximately 2,000 m north of the 200 East Area, is approximately 140 m (450 ft) above msl. Gable Mountain Pond and B Pond both occupied topographic depressions so that gravity drainage from the source facilities could be used.

2.1.2 Geology

The 200-CW-1 OU is located in the Pasco Basin on the Columbia Plateau. It is underlain by basalt of the Columbia River Basalt Group and a sequence of suprabasalt sediments. From oldest to youngest, major geologic units of interest are the Elephant Mountain Basalt Member, the Ringold Formation (units A, lower mud, and E), and two facies (gravel-dominated and sand-dominated) of the Hanford formation.

The basalt is overlain by the Ringold Formation in the east, south, and central sections of the 200 East Area. This formation consists of an interstratified sequence of unconsolidated clay, silt, sand, and granule to cobble gravel deposited by the ancestral Columbia River. These alluvial sediments consist of three major facies. From oldest to youngest, these are the fluvial gravel and sand of unit A, buried soil horizons and lake deposits of the lower mud sequence, and fluvial sand and fluvial gravel of unit E.

In the northern part of the area, around Gable Mountain Pond, the Ringold Formation is not present and the Hanford formation overlies basalt. The Hanford formation consists of unconsolidated gravel-dominated and sand-dominated facies deposited by cataclysmic Pleistocene floodwaters. The gravel-dominated facies consists of cross-stratified coarse-grained sands and granule to boulder gravel. The gravel is uncemented and matrix poor. The sand facies consists of well-stratified fine- to coarse-grained sand and granule gravel. Silt in this facies is variable, generally in thin beds, and may be interbedded with the sand. Where the silt content is low, an open-framework texture is common. An upper and lower gravel unit and a middle sand facies are present in the study area.

The cataclysmic floodwaters that deposited sediments of the Hanford formation also locally reshaped the topography of the Pasco Basin. The floodwaters deposited a thick river bar that comprises the higher southern portion of the 200 Areas, informally known as the 200 Area plateau. In the waning stages of the ice age, these floodwaters also eroded a channel north of the 200 Areas in the area currently occupied by Gable Mountain Pond. The floodwaters removed all of the Ringold Formation from this area and deposited Hanford formation sediments directly over basalt.

Holocene-aged deposits overlie the Hanford formation and are dominated by eolian sands that form a thin veneer across the site, except in localized areas where they have been removed by human activity. Surficial deposits consist of very fine- to medium-grained sand to occasionally silty sand. Silty deposits less than 1 m thick have also been documented at waste sites where fine-grained windblown material has settled out through standing water over many years. A generalized stratigraphic column for the area around the 200-CW-1 OU is shown in Figure 2-3. More detail on the geology of this region is presented in Appendix F of the Implementation Plan (DOE-RL 1998).

2.1.3 Vadose Zone

The vadose zone is approximately 104 m (340 ft) thick in the southern section of the 200 East Area and thins to zero seasonally where groundwater rises above the ground surface to form West Lake in the 200 North Area. Sediments in the vadose zone are dominated by the Ringold and Hanford Formations. Because erosion during cataclysmic flooding removed much of the Ringold Formation north of the central part of the 200 East Area, the vadose zone is dominantly composed of Hanford formation sediments between the 200 Areas and Gable Mountain. Areas of basalt also subcrop above the water table north of the 200 East Area. The lower mud sequence is the most important aquitard in the 200 East Area and can be a significant perching layer. Up to 2 m (6 ft) of perched water has been documented above the lower mud sequence in the vicinity of the 216-B-3C Pond lobe, which is one of three expansion ponds to B Pond (Figure 2-2). No wells are completed above the lower mud sequence; therefore, the status of this perched water table is unknown (Barnett and Chou 1998).

Recharge to the unconfined aquifer within the 200 Areas is from artificial and natural sources. Estimates of recharge from precipitation range from 0 to 20 cm/yr, largely dependent on soil texture and the type and density of vegetation (Fayer and Walters 1995). Artificial recharge occurred when effluent such as cooling water was disposed of to the ground. Zimmerman et al. (1986) report that between 1943 and 1980, 6.33×10^{11} L (1.67×10^{11} gal) of liquid wastes were discharged to the soil column in the 200 Areas. The volume of effluent received by each waste site is presented in Section 3.0.

Most sources of artificial recharge have been halted. Those that continue are largely limited to liquid discharges to sanitary sewers, two state-approved land disposal structures, and 140 small-volume uncontaminated, miscellaneous streams. One of the approved land disposal structures is the Treated Effluent Disposal Facility, located northeast of the 216-B-3C Pond lobe, which receives approximately 860 million L (227 million gal) of treated liquid wastes from the 200 East and 200 West Area facilities. It is not related to B Pond operations.

While the liquid waste disposal facilities were operating, many localized areas of saturation or near saturation were created in the soil column, in some cases forming a groundwater mound. With the reduction of artificial recharge in the 200 East Area, the downward flux of moisture in the vadose zone beneath these waste sites decreased, but may continue to be significant for a period of time because of gravity drainage of the saturated/near-saturated soil column. When unsaturated conditions are reached, the moisture flux becomes increasingly less significant because unsaturated hydraulic conductivities decrease with decreasing moisture content. In the absence of artificial recharge, the potential for recharge from precipitation becomes more important as a driving force for any contamination remaining in the vadose zone.

2.1.4 Groundwater

The groundwater in this area occurs in the Hanford formation and Ringold Formation. In the northern part of the study area, the water table is within gravelly and sandy sediments of the Hanford formation, except in areas where basalt extends above the water table. In the central and southern sections of the study area, the water table is located near the contact of the Ringold

Formation and Hanford formation, and the saturated thickness of the aquifer is predominantly within the Ringold Formation.

The groundwater table ranges in depth from very near the surface in the northwest part of this OU to more than 104 m (340 ft) in the southern part. A groundwater mound was created in the 200 East Area by artificial recharge from the 200-CW-1 waste sites, as illustrated in Figure 2-4. Gable Mountain Pond and B Pond were the main areas of recharge based on the location and size of the mound during the active period of discharge (DOE-RL 1994). The current location of the mound is likely the result of historically higher recharge in the expansion ponds to the east of the main pond, which were constructed because of limited infiltration capacity of the main pond.

The water table beneath B Pond is currently dropping at a rate of approximately 2 m/yr (7 ft/yr), based on water measurements collected in 1997 and 1998. The water table beneath Gable Mountain Pond is dropping at approximately 0.15 m/yr (0.5 ft/yr).

2.2 WASTE SITE DESCRIPTION AND HISTORY

The 200-CW-1 OU consists of 28 waste sites as defined in the Implementation Plan (DOE-RL 1998) and the Tri-Party Agreement and as listed in Table 2-1. Waste sites in this group received mainly cooling water from all major 200 East Area facilities. This OU is one of five in the 200 Areas that received cooling water. The OUs have been divided primarily on the basis of geography (DOE-RL 1997). Twenty-six of the waste sites are RPP sites, and the remaining two are part of a single RCRA TSD unit.

Most of the effluent discharged to waste sites in this group was from the PUREX Plant, B Plant, 204-AR Vault, 241-A-401 Building, 242-A Evaporator, 244-AR Vault, the 284-E Powerhouse, the 283-E Water Treatment Plant, and several smaller facilities. The waste sites also received chemical sewer and steam condensate waste from 221/224-B between 1945 and 1952. Effluent from these source facilities was distributed to waste sites by a network of pipelines, retention basins, diversion structures, and unlined ditches and ponds. The location of the 200-CW-1 OU waste sites, associated source facilities, and structures are shown in Figures 2-2 and 2-5.

Between 1957 and 1984, flows between Gable Mountain Pond and B Pond were split approximately 3:1, favoring the former. Prior to 1957 and after 1984, B Pond received most of the active waste streams. B Pond was expanded in 1980 to increase its percolation capabilities with the addition of the 216-B-3A and B-3B lobes. The 216-B-3C lobe was constructed in 1985. The 216-E-28 Contingency Pond (216-E-25 in the Waste Information Data System [WIDS]) was constructed in 1986 to receive diverted overflow liquids in the event of B Pond failure, but has never been used. Both of the ponds have been backfilled and surface stabilized.

Six ditches transported cooling water and other wastes to the 216-B-3 pond system. The 216-B-2-1, 216-B-2-2, and 216-B-2-3 Ditches connected to the 216-B-3-1, 216-B-3-2, and 216-B-3-3 Ditches. Percolation of wastewater occurred in the ditches before the water reached the ponds. Following a significant unplanned release event from B Plant or PUREX, the ditches were taken out of service and replaced with a new ditch. The contaminated ditches were backfilled and later surface stabilized.

Although the PUREX wastes entered the 216-B-3-3 Ditch/216-B-3 Pond complex through the 216-A-29 Ditch (PUREX chemical sewer), the 216-A-29 Ditch is grouped in the Chemical Sewer Group. Wastewater from PUREX was transported to Gable Mountain Pond via a 106-cm (42-in.) underground pipeline. Nonradioactive waste streams from the 284-E Powerhouse and 283-E Water Treatment Plant were conveyed to the Gable Mountain/B Pond system by an open ditch connected to an underground pipeline.

The 216-N-8 West Lake is in this waste group, although it is a naturally occurring surface water body. Before the Hanford Site was constructed, the pond intermittently formed as a result of seasonal precipitation. During the years of Hanford Site operations, significant discharge of liquid wastes from the 200 Area facilities caused an increase in the elevation of the water table. The current persistence of West Lake and contaminants associated with it is likely the result of these water table changes.

The 216-C-9 Pond is in this OU because of geographic similarities. This pond was originally excavated for the 221-C Canyon Building foundation and was converted to a liquid waste disposal site when Semiworks activities focused on hot testing of separations processes such as PUREX, REDOX, and fission products recovery using existing, smaller facilities. Large quantities of water have been discharged to this site, but the radionuclide inventory is very low.

Twenty-six of the sites in this group are RPP sites, including three former RCRA TSD units that have been successfully clean closed and seven unplanned release sites that are physically associated with one or more waste sites in the cooling water group. Two of the sites in the group are RCRA TSD sites comprising a single RCRA TSD unit. None of the waste sites in this group are currently receiving effluent.

The 216-B-3-3 Ditch and B Pond are considered under the RCRA Part A Permit to be one TSD facility, but will be considered two waste sites in this work plan. The three TSD units that have been clean closed are the 216-B-3A, B, and C Lobes, which were expansion ponds to the main B Pond. The integration of these sites into this work plan will allow for addressing all contaminants, including radiological contaminants.

2.2.1 Process Information

The waste sites in the 200-CW-1 OU received predominantly cooling water, but also minor amounts of effluent containing very low concentrations of radionuclides and/or chemicals. The cooling water remained entirely separate from contaminated process liquids by physical barriers, typically the wall of a heating or cooling pipe coil.

Steam and cooling water were used to make temperature adjustments in process vessels by circulating steam or cooling water through coils inside the vessels. The temperature was increased by regulating the rate of steam entering the coils; the spent steam was condensed with cooling water after exiting the process vessel. The condensed steam and cooling water were released to plant sewers or piping systems that discharged to ditches and ponds. The use of cooling water for steam condensation and process vessel cooling resulted in the generation of very large volumes of effluent; more than 90% of all liquids discharged to the soil column in the 200 Areas were from cooling water. The cooling water was obtained from the 200 Area raw

water supply, which was pumped directly from the Columbia River, filtered, and then sent to facilities for use in plant processes.

The coils that circulated steam and cooling water inside chemical process tanks often developed pinholes and hairline cracks due to the corrosive chemicals and high thermal gradients in these tanks. These minor defects usually did not lead to contamination of the steam and cooling water, because the pressure in the pipe coils was greater than the pressure in the process or condenser vessels. However, there were instances when the pressure in the coils was reduced or suspended and minor leakage through the flaws contaminated the waste stream. In corrosive operating environments, flaws would occasionally be magnified and produce complete failure of the coils. Two unplanned releases (UPR-200-E-32 and UPR-200-E-31) associated with coil failures resulted in significant amounts of radionuclides being released into the cooling water waste streams.

Chemical sewer wastes that were discharged to the 216-A-29 Ditch and then into the B Pond system consisted primarily of makeup tank rinses, with lesser quantities of off-specification batches of chemicals, or overflow chemicals from tanks during aqueous makeup. These chemical solutions and dry chemicals commonly consisted of, but were not limited to, nitric, phosphoric and formic acids, and sodium and aluminum nitrate. Chemical sewers typically discharged to unlined ditches that were intended to receive nonradioactive, dilute chemical waste from the major reprocessing facilities. In almost all respects, the inventory in these waste streams was difficult to assess, because nonradioactive contaminants were not monitored or documented to the degree that radioactive discharges were.

The Gable Mountain Pond/B-Pond and Ditch Cooling Water Group effluent stream was designed to be uncontaminated, but often contained limited quantities of radionuclides and chemicals. These contaminants accumulated in the sediment over time, and vegetation and algae within ponds and ditches tended to collect and concentrate radionuclides. Commonly reported radioactive contaminants include plutonium, americium, cesium, uranium, strontium, and ruthenium. Nonradioactive contaminants, including chemical sewer wastes associated with the $BiPO_4$ process used between 1945 and 1952, were discharged with cooling water in this water group; however, the volume and type of contaminants are difficult to quantify because nonradiological contamination was not routinely monitored. A detailed discussion of contaminants is presented in Section 3.1 and Tables 3-1 through 3-3.

2.2.2 Representative Sites

The concept of using analogous sites to reduce the amount of site characterization and evaluation required to support remedial action decision making is discussed in the Implementation Plan (DOE-RL 1998). The use of this approach relies on first grouping sites with similar location, geology, waste site history, and contaminants, and then choosing one or more representative site for comprehensive field investigations, including sampling. Findings from site investigations at representative sites are extended to apply to other sites in the waste group that were not characterized. Sites for which field data have not been collected are assumed to have similar chemical characteristics to the site(s) that was characterized. Confirmatory investigations of limited scope can be performed at the sites not selected as representative sites, rather than full characterization efforts.

Data from representative sites will be used to evaluate remedial alternatives and choose one to apply for the entire waste group. Confirmation sampling of the analogous sites after remedy selection will be required and is built into the remedial design planning to demonstrate that analogous conditions exist. Although there is a degree of uncertainty in employing the analogous site concept, there is a substantial benefit in the early selection of a remedy that allows early cleanup action to be performed.

Several features common to waste sites in the 200-CW-1 OU make this characterization effort amenable to the analogous site concept. The most significant of these attributes are geography, waste characteristics (i.e., effluent volume, waste stream chemistry), physical setting, and expected distribution of contaminants. Waste sites in this group are located in and near the 200 East Area and are relatively close together. The proximity of sites within the same geochemical setting suggests that conditions affecting contaminant fate and transport should be very similar.

Contaminant flow and transport in the soil column should also be similar for all the waste sites because effluent received by the sites in this group had common chemical characteristics. The waste streams are characterized by high-volume, low concentration, low salt, low organic solutions that were typically maintained within a pH range of 4 to 10. Radioactive contaminants common to this waste stream are plutonium, americium, cesium, uranium, strontium, and ruthenium. Ponds were the main areas of infiltration for waste sites in this group. Based on comparisons of soil pore space and effluent volumes (DOE-RL 1997), very little infiltration occurred below the ditches.

Sites within the OU that best represent typical and worst-case conditions were identified as representative sites (DOE-RL 1997). Those sites with large contaminant inventories relative to the waste group and high volume of effluent received were considered first, as these are considered worst-case situations and represent the sites with the highest contamination and greatest potential impact on the vadose zone and groundwater.

The analogous site approach is applied to RPP sites only; all TSD sites within this OU will be characterized. The RCRA sites are described in Section 2.2.3.

The RPP sites chosen to represent the 200-CW-1 OU are the 216-B-2-2 Ditch and 216-A-25 Pond (Gable Mountain Pond). These waste sites were selected for comprehensive field investigation because they are the typical and worst-case sites in terms of effluent volume and/or contaminant inventory. The 216-B-2-2 Ditch was selected as a representative site because it received an unplanned release of 1,000 Ci of strontium-90 and data are available that can be used to assess the vertical extent of contamination at the site (BHI 1998). Gable Mountain Pond was selected because the largest effluent volume and contaminant inventory were discharged to this disposal unit, and thus it represents a worst-case site.

The following sections describe the representative sites in detail.

2.2.2.1 216-B-2-2 Ditch. The 216-B-2-2 Ditch was an open, unlined earthen ditch approximately 4.6 m (15 ft) wide at ground level, 90 cm (3 ft) wide at the bottom of the ditch, 1.8 to 2.4 m (6 to 8 ft) deep, and 1,070 m (3,500 ft) long. It was excavated to replace the

216-B-2-1 Ditch and was active from November 1963 to May 1970. Figure 2-6 shows a stratigraphic column through the western end of the ditch.

The ditch carried cooling water, steam condensate, and chemical sewer effluent from B Plant; chemical waste and steam condensate from 284-E Powerhouse; cooling water from the 241-CR Vault and 241-BY In-Tank Solidification Units 1 and 2; and cleanup wastewater from the 207-B Retention Basin. The 207-B Retention Basin served mainly as a settling basin to reduce contaminant concentrations in the effluent prior to the release of wastewater to the ditch. Effluent arrived from B Plant to the 207-B Retention Basin via buried pipeline, and was released from the basin to the ditch through another short (approximately 10 m) pipeline.

The 216-B-2-2 Ditch discharged to both B Pond and Gable Mountain Pond. The downstream (east) end of the ditch fed into 60-cm (24-in.) vitrified clay pipe to a junction box, where the effluent could be routed to B Pond or to Gable Mountain Pond. Discharge to B Pond was via a 60-cm (24-in.) vitrified clay pipe that released to the 216-B-3-1 Ditch until 1964, then to the 216-B-3-2 Ditch until September 1970. Discharge to Gable Mountain Pond was through a 60-cm (24-in.) corrugated metal pipe that discharged to the PUREX cooling water pipeline, a 1.1-m (42-in.) corrugated metal pipe.

The ditch was decommissioned and backfilled as a result of unplanned release UPR-200-E-138, during which approximately 1,000 Ci of strontium–90 was released to the ditch on March 22, 1970 (DOE-RL 1993a). The 207-B Retention Basin was bypassed during this event and was not contaminated as a result of this release. On March 23, 1970, earthen dams were constructed across the ditch approximately 300 m (1,000 ft) downstream of the release point. Most of the contamination from the release is estimated to remain in the ditch, but some of the strontium-90 reached B Pond. In 1970, the ditch was backfilled to grade with 2.4 m (8 ft) of clean fill material and was replaced by the 216-B-2-3 Ditch and subsequently by the 216-B-2-3 pipeline. A plastic liner was placed over the first 730 m (2,400 ft) of the ditch and covered with stabilizing fill in 1971 to prevent the uptake of radioactivity by plants. More than 60 cm (24 in.) of soil was placed over the site in 1987 for additional contamination control. The plastic liner was encountered during a recent trenching exercise performed to locate the ditch (BHI 1998).

2.2.2.2 Gable Mountain Pond. The Gable Mountain Pond (216-A-25) was a 29-hectare (71-acre) pond located in a natural depression 2 km (1.2 miles) north of the 200 Area perimeter fence. Figure 2-7 shows the stratigraphy of the vadose zone beneath the pond. It was the largest seepage disposal facility on the Hanford Site and operated from 1957 to 1987. The pond received cooling water from the 202 Building and routinely received low-level effluent from PUREX, 242-A Evaporator, 244-AR Vault, 200 East Area Powerhouse, and 241-A Tank Farms. Effluent reached Gable Mountain Pond through the PUREX cooling water line.

Although the pond has received low levels of contaminated wastewater since its startup, a single unplanned release (UPR-200-E-34) on June 11, 1964, resulted in the discharge of approximately 7,500 Ci of mixed fission products to Gable Mountain Pond. Bentonite clay was spread over the pond bottom as a contamination control to immobilize radionuclides in the upper sediment layers. Details (e.g., quantity, location) pertaining to this contamination control measure are not well documented. Copper sulfate was added to the pond on two occasions subsequent to

unplanned releases, to eliminate the algae and invertebrate life, thus breaking an important link in the food chain of migratory waterfowl.

Gable Mountain Pond was decommissioned from 1984 to 1988 by backfilling with coarse and finer grained sediments. The pond was backfilled with coarse-grained material to a level 0.6 m (2 ft) above the shoreline, beginning at the edges and proceeded towards the center. Approximately 0.3 m (1.0 ft) of fine-grained clean soil was placed over the coarse backfill. Approximately 765,000 m^3 (1,000,000 yd^3) of fill was used to stabilize Gable Mountain Pond. The maximum thickness of the backfill is approximately 2.7 m (9 ft).

2.2.3 RCRA Site – 216-B-3 Main Pond TSD Unit

The 216-B-3 Main Pond TSD unit is one RCRA unit that includes the main B Pond and the 216-B-3-3 Ditch. The original RCRA Part A permit application (Part A), Form 3 (Rev. 0), was submitted to the Washington State Department of Ecology (Ecology) in 1986. At that time the 216-B-3 Pond System (B Pond) was being operated under one Part A, Form 3.

The three expansion lobes (3A, 3B, and 3C) were considered part of this TSD unit until December 1993, when the Part A permit was modified to allow the option of clean closure of the expansion ponds under RCRA while integrating closure activities for the 216-B-3 Pond and 216-B-3-3 Ditch with RCRA corrective action for the 200-BP-11 OU. These three lobes were clean closed in 1994 (DOE-RL 1994); therefore, they are no longer active TSD units and thus will not be considered in this section. The current Part A, Form 3, Revision 6 for the pond and ditch is included in AppendixB. Subsequent to the decision to integrate RCRA closure of the 216-B-3 Pond and 216-B-3-3 Ditch with the 200-BP-11 OU, the strategy changed and OUs were reevaluated. The current path forward for these RCRA TSD sites is integration with the 200-CW-1 OU as defined in the Implementation Plan.

For the purposes of this work plan, the ditch and the pond will be discussed separately.

2.2.3.1 216-B-3-3 Ditch. The 216-B-3-3 Ditch was an open and unlined earthen ditch approximately 6 m (20 ft) wide at ground level, 1.8 m (6 ft) deep, and 1,130 m (3,700 ft) long. The ditch was excavated and put into service in September 1970 to replace the decommissioned 216-B-3-2 Ditch, which was contaminated as a result of UPR-200-E-138. Figure 2-8 shows the vadose zone stratigraphy beneath the ditch.

The ditch received cooling water from B Plant via the 216-B-2-3 Ditch and 216-B-2-3 pipeline, the PUREX cooling water line, and chemical sewer waste from PUREX by way of the 216-A-29 Ditch. One unplanned release (UPR-200-E-51) is associated with this site: 15 kg of cadmium nitrate was released in May 1977. The ditch was decommissioned and backfilled in conjunction with B Pond in 1994. The 216-B-3-3 Ditch, pursuant to RCRA, is an active TSD unit, although it has not received effluent since 1994 nor will effluent be received in the future, and is awaiting final closure. It is included in the RCRA Dangerous Waste Permit Application with B Pond.

2.2.3.2 216-B-3 Main Pond. The 216-B-3 Main Pond (B Pond) was located in a natural topographic depression and varied in size from approximately 6 to 19 hectares (14 to 46 acres). This variation in size was due mainly to the pond's location in a shallow depression and fluctuations in effluent discharge. From the beginning of operation in 1945 until 1964, the pond

was often referred to as B Swamp because of its small size and shallow margins. Throughout its operation, the pond varied between 0.6 m (2 ft) and 6 m (20 ft) deep. At the time the pond was decommissioned and backfilled in 1994, it had an area of approximately 14 hectares (35 acres) (DOE-RL 1993a). The stratigraphy beneath B Pond is shown in Figure 2-9.

The pond received cooling water from the PUREX cooling water line, the 216-B-3-1, 216-B-3-2, and 216-B-3-3 Ditches; and chemical sewer effluent from PUREX via the 216-A-29 Ditch. Most of the effluent contained low concentrations of radionuclides and chemicals, but one known unplanned release is directly associated with this pond, UPR-200-E14. This release occurred in 1958 when a dike on the east side of the pond ruptured and released contaminated water into a ravine east of the pond. The contaminated area was covered with clean soil.

The pond was impacted by three major unplanned releases: approximately 2,500 Ci of mixed fission products from UPR-200-E-34 was released to the 216-B-3-1 Ditch and the pond in 1964, 15 kg of cadmium nitrate from UPR-200-E-51 was released via the 216-A-29 Ditch in 1977, and 1,000 Ci of strontium-90 from UPR-200-E-138 was released through the 216-B-2-2 Ditch in 1970. Bentonite was placed in the pond after UPR-200-E-34 to control the spread of contamination. Contamination control measures were also performed after UPR-200-E-138 occurred by stabilizing the north, south, and west shorelines.

The B Pond, pursuant to RCRA, is an active TSD unit, although it has not received effluent since 1994. It is included on the RCRA Dangerous Waste Permit Application with the 216-3-3 Ditch.

The B Pond was decommissioned in 1994 by backfilling with coarse-grained material covered with finer grained sediment. The maximum measured depth of the pond immediately prior to decommissioning was 3.4 m (11 ft), which is substantially shallower than the 6-m (20-ft) design depth, and suggests that sedimentation and accumulation of biomass reduced the depth during the active period of operation. This accumulation of fine-grained material may also be responsible for reducing the percolation rate beneath the pond (BHI 1996).

B Pond was decommissioned by first allowing the site to de-water, then placing the backfill material along the edge of the site and working it over the bottom in 0.5- to 1.0-m (1.5- to 3-ft) lifts toward the center of the pond. Trees that grew along the edges of the pond were included in the backfill; the larger trees (up to 1 m [3 ft] in diameter) were cut up and placed towards the center of the pond to an elevation of 172.8 m (567 ft). Woody material was not consolidated in any one location. The volume of coarse backfill placed in the pond is approximately 268,000 m^3 (350,000 yd^3). The depth of backfill ranges from 1.2 m (3 ft) along the edge of the pond to 2.1 m (7 ft) in the deepest portions of the pond. Approximately 0.35 m (1.2 ft) of fined-grained clean soil was placed over the coarse backfill. The surface of B Pond currently slopes toward the center of the site on a gentle grade estimated at 0.03%. The pond was not backfilled to the original lake level.

2.3 CONCEPTUAL MODEL

The effluent discharged to the ponds and ditches discussed here was predominantly cooling water with some steam condensate and chemical sewer waste. Limited quantities of radionuclides and chemicals such as nitrate were also present in the effluent in trace amounts; the

pH was typically between 4 and 10. The most significant contamination of the ditches and ponds was caused by four unplanned releases. The following are general observations considered during construction of the conceptual models.

- Most of the contaminants were retained in the sediments at the bottom of the ponds or trenches, or the upper few meters of the soil column (BHI 1998).
- Some additional downward migration may have contributed trace amounts of some contaminants beneath the upper contaminated zone.
- Contaminant concentrations decrease with depth below the waste sites (BHI 1998).
- The contaminants retained in the upper zone of the soil column have high distribution coefficients (K_d). Contaminants with low K_ds (e.g., nitrite, tritium) are not readily adsorbed on soil particles and are carried downward toward groundwater with the percolating effluent.
- Lateral spreading may have occurred in the vadose zone, especially in areas with layers of fine-grained sediment or facilities that received a large amount of effluent.
- Effluent percolated through the vadose zone beneath the ponds and reached groundwater.
- The relatively small surface area of the trenches and the short amount of time they were in use precluded breakthrough of effluent to the groundwater beneath the trenches (DOE-RL 1997).

North of the 200 Areas, in the vicinity of Gable Mountain Pond, the Hanford formation is the predominant facies in the vadose zone. Because the Hanford formation is very permeable, it is unlikely that significant lateral spreading of the percolating effluent occurred. Where the Ringold Formation is present beneath a waste site or where large quantities of bentonite have been added to a pond, lateral migration may be more pronounced. The conceptual model for the 200-CW-1 OU during the active periods of discharge is shown in Figure 2-10. The conceptual model postulates that the highest concentration of contaminants is directly beneath the waste site.

Waste sites in the 200-CW-1 OU no longer receive effluent. Most of the sites in this group have been stabilized and covered with clean soil. With the cessation of artificial recharge, the downward flux of moisture through the vadose zone has declined. The moisture flux was significant beneath the ponds during their operational history, locally raising the water table and contaminating groundwater. When operations ceased at the ponds, the moisture flux began to decrease, as expressed in the locally declining water table. Residual effluent from operations is expected to remain in the vadose zone and continue to drain, decreasing over time as moisture levels decrease and equilibrate with natural recharge from precipitation. The conceptual model for current conditions beneath each of the waste sites is presented in Figures 2-11 through 2-14.

Figure 2-1. Location of the Hanford Site and Waste Sites in the 200-CW-1 Operable Unit.

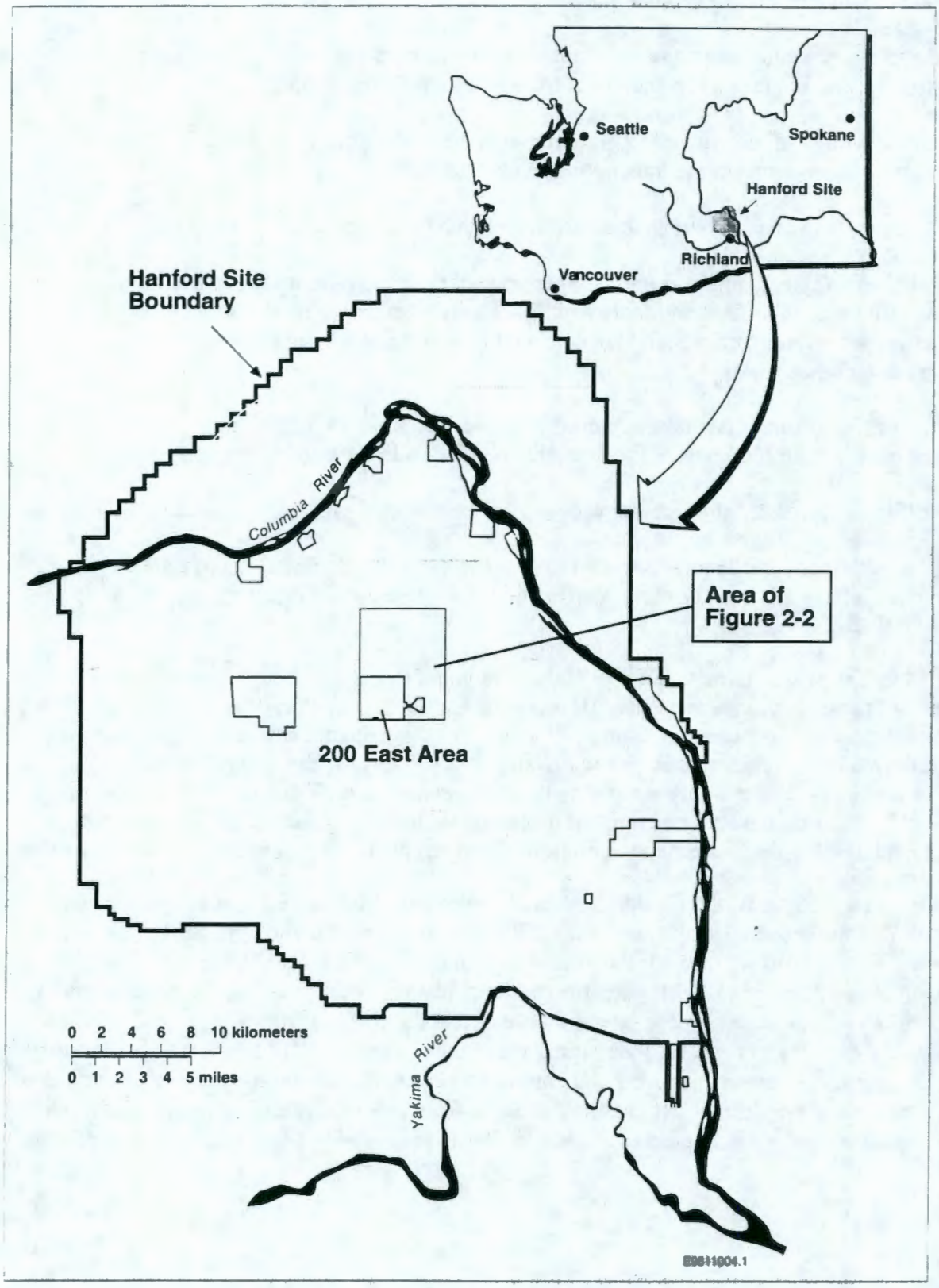
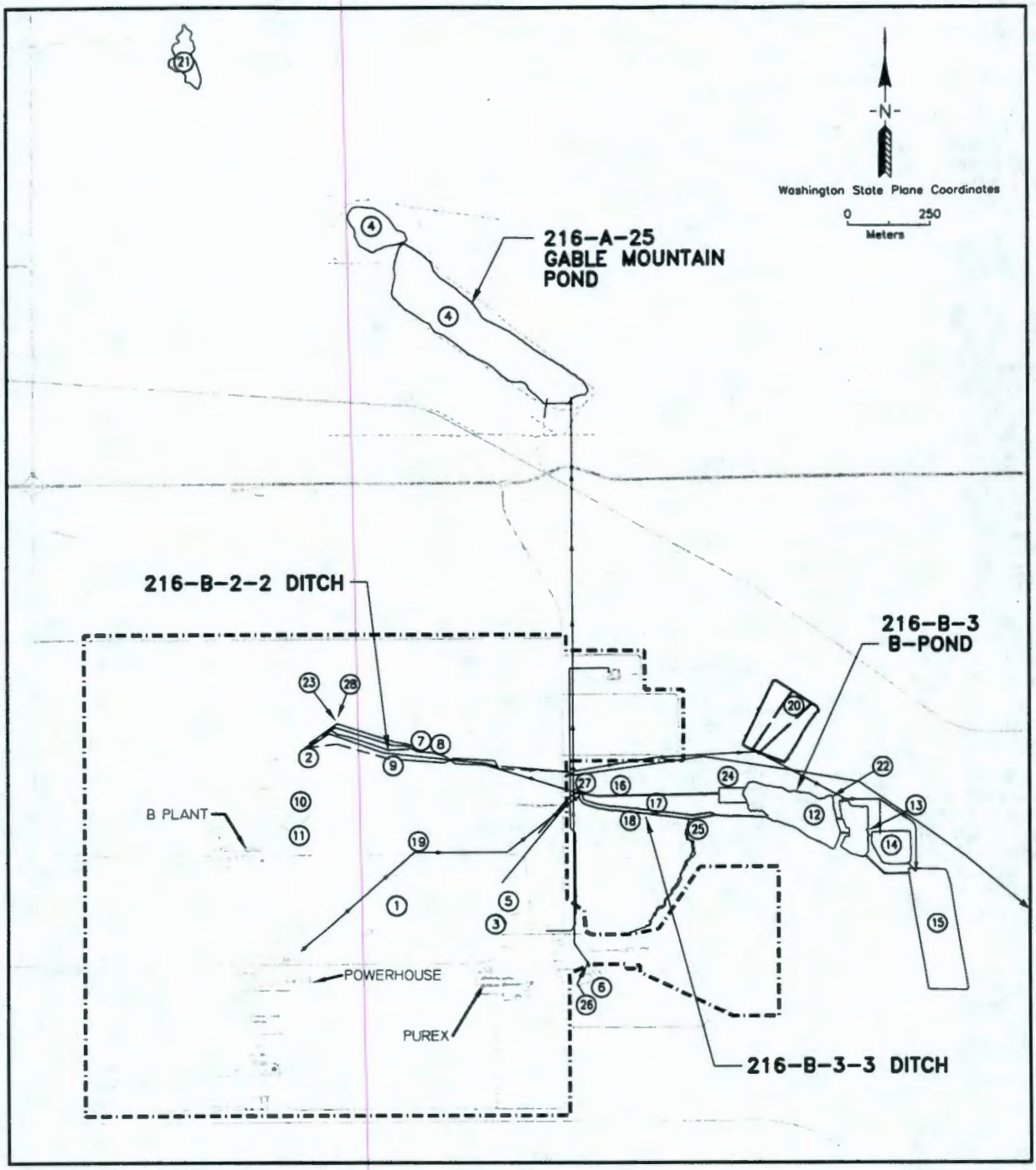


Figure 2-2. Location of Waste Sites in the 200-CW-1 Operable Unit.



LEGEND

200 EAST FENCELINE

1= 200-E PD	8= 216-B-2-2	15= 216-B-3C RAD	22= UPR-200-E-14
2= 207-B	9= 216-B-2-3	16= 216-B-3-1	23= UPR-200-E-32
3= 216-A-9	10= 216-B-59	17= 216-B-3-2	24= UPR-200-E-34
4= 216-A-25	11= 216-B-59B	18= 216-B-3-3	25= UPR-200-E-51
5= 216-A-40	12= 216-B-3	19= 216-C-9	26= UPR-200-E-66
6= 216-A-42	13= 216-B-3A RAD	20= 216-E-28	27= UPR-200-E-94
7= 216-B-2-1	14= 216-B-3B RAD	21= 216-N-8	28= UPR-200-E-138

2E:111098A.DWG

Figure 2-3. Generalized Stratigraphic Column for the 200 East Area.

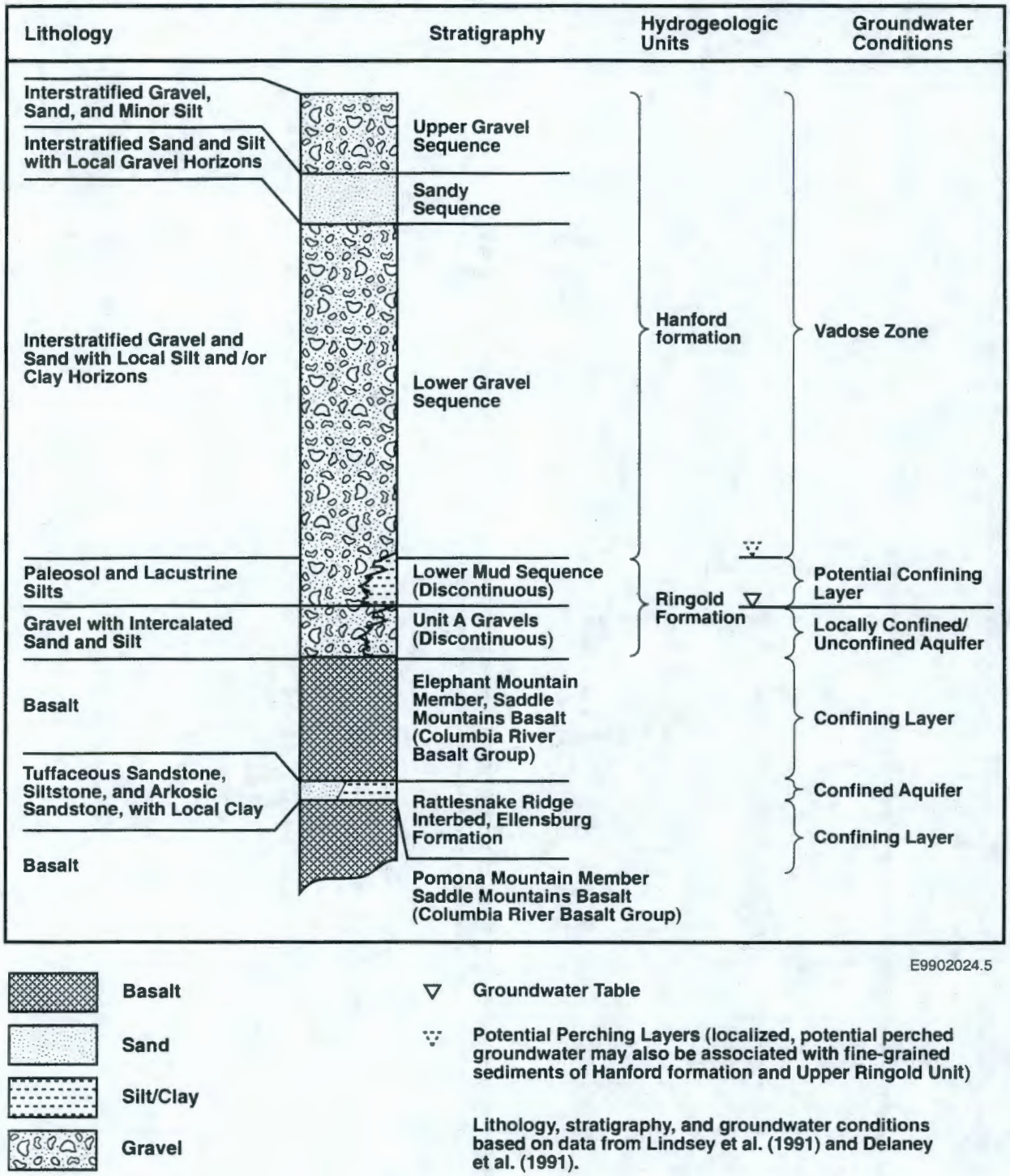
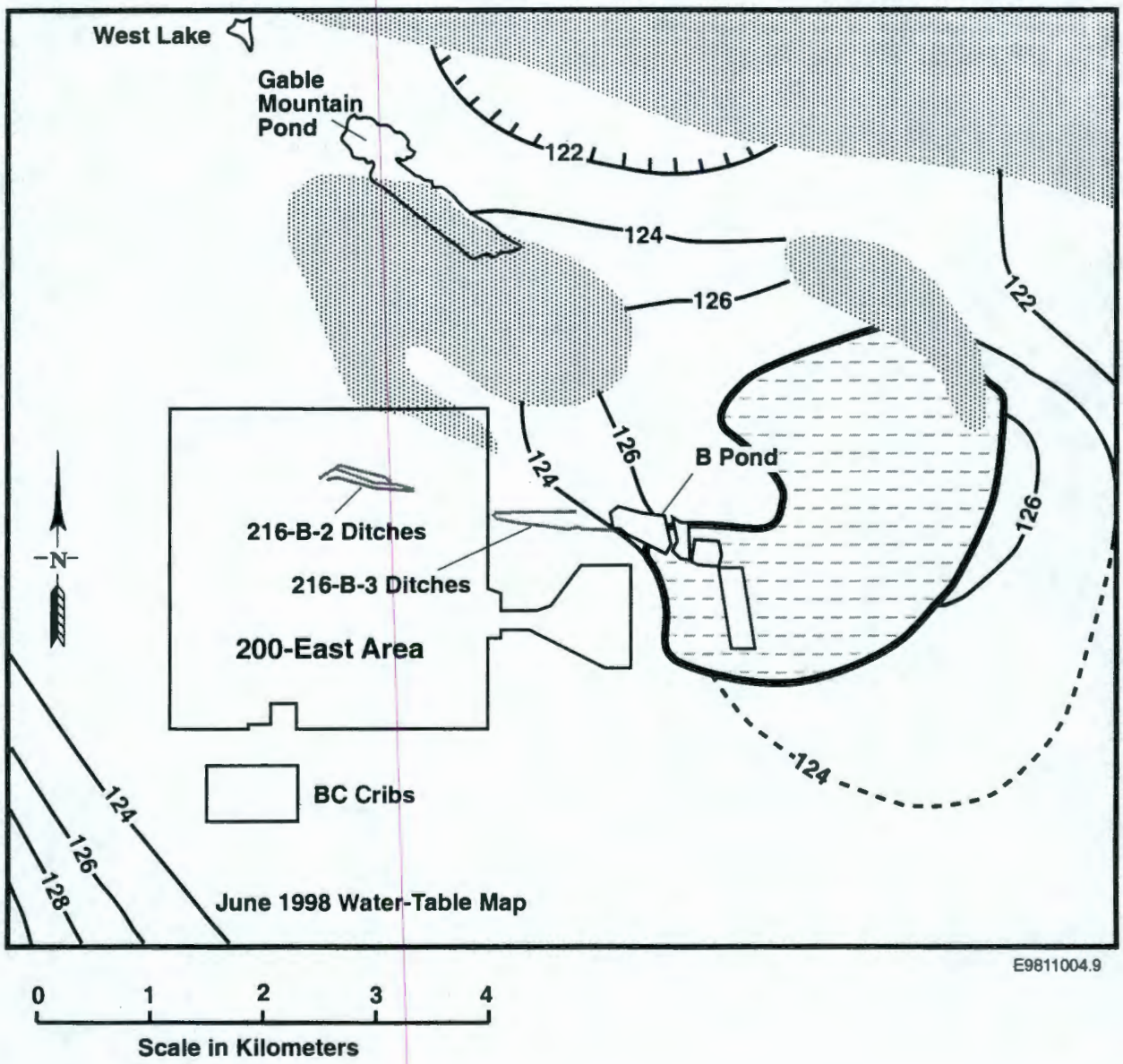


Figure 2-4. Groundwater Table Around the 200 East Area, June 1998.



0 1 2 3 4
Scale in Kilometers

Estimated Basalt Outcrop Above Water Table

100 Water-Table Contour, m; Dashed Where Inferred

Ringold Formation Lower Mud above Water Table

Vertical Datum: North American American Vertical Datum of 1988 (NAVD88)

Figure 2-5. Source Facilities Associated with 200-CW-1 Waste Units.

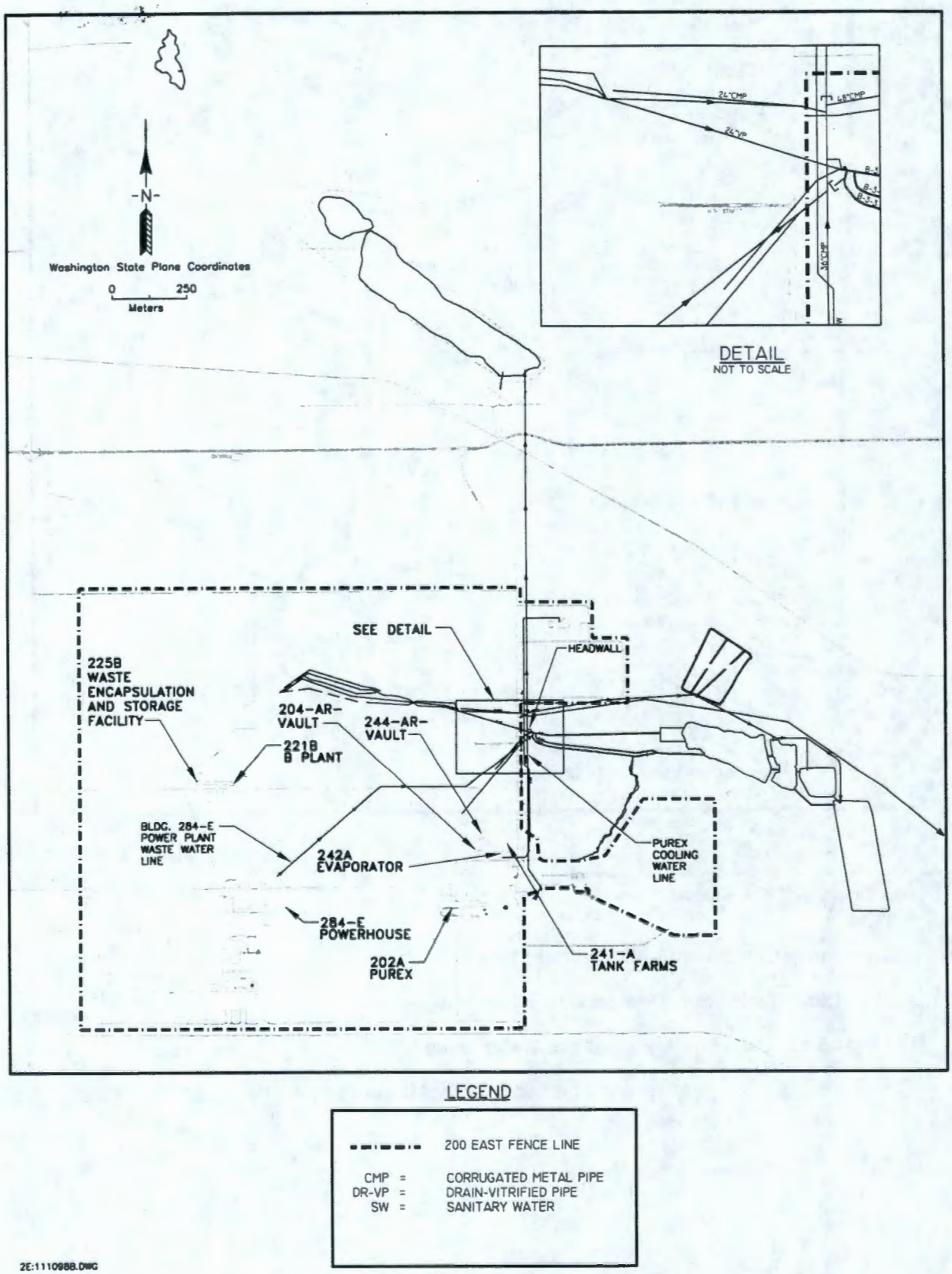


Figure 2-6. Stratigraphy Beneath the 216-B-2-2 Ditch.

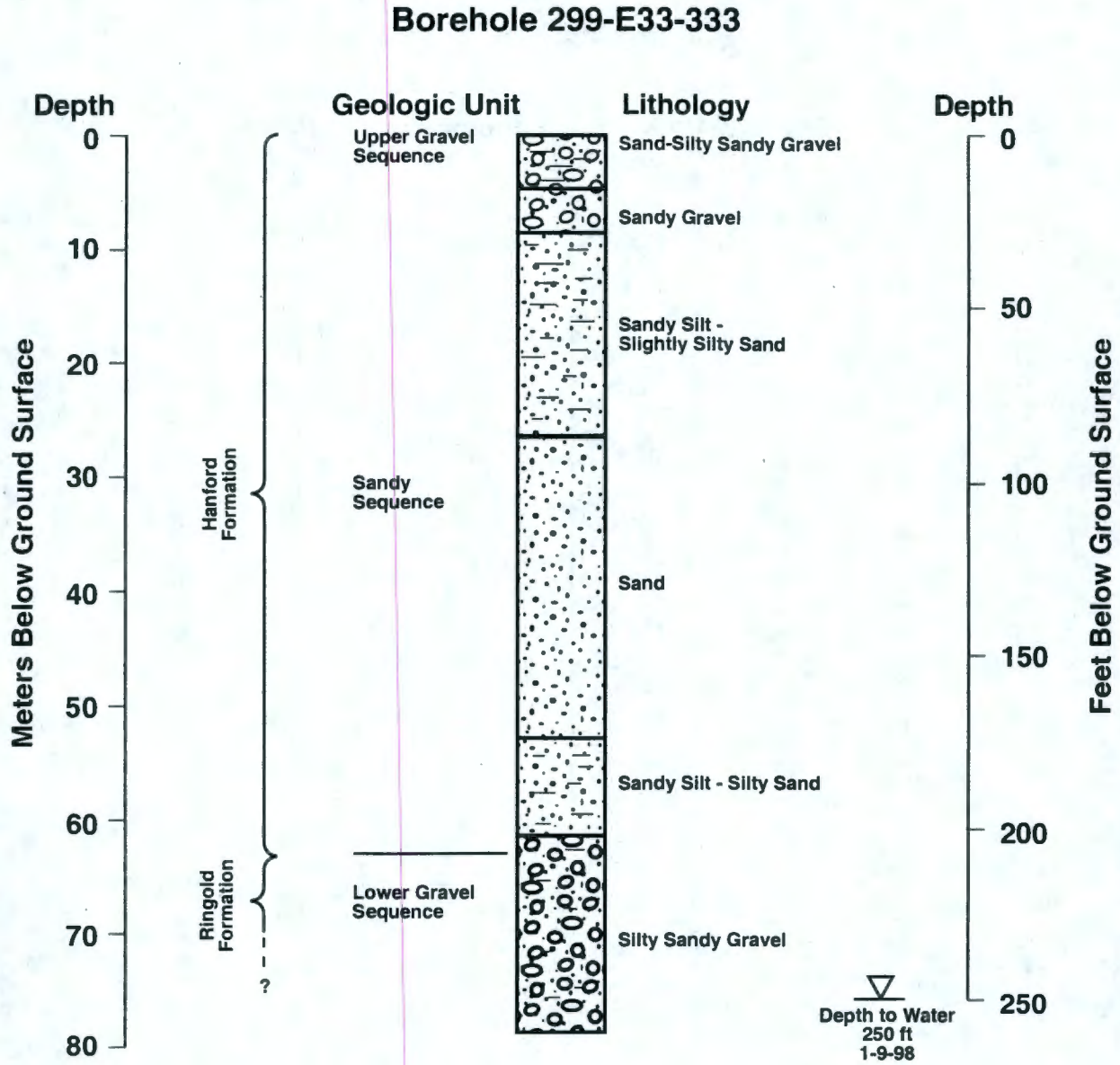
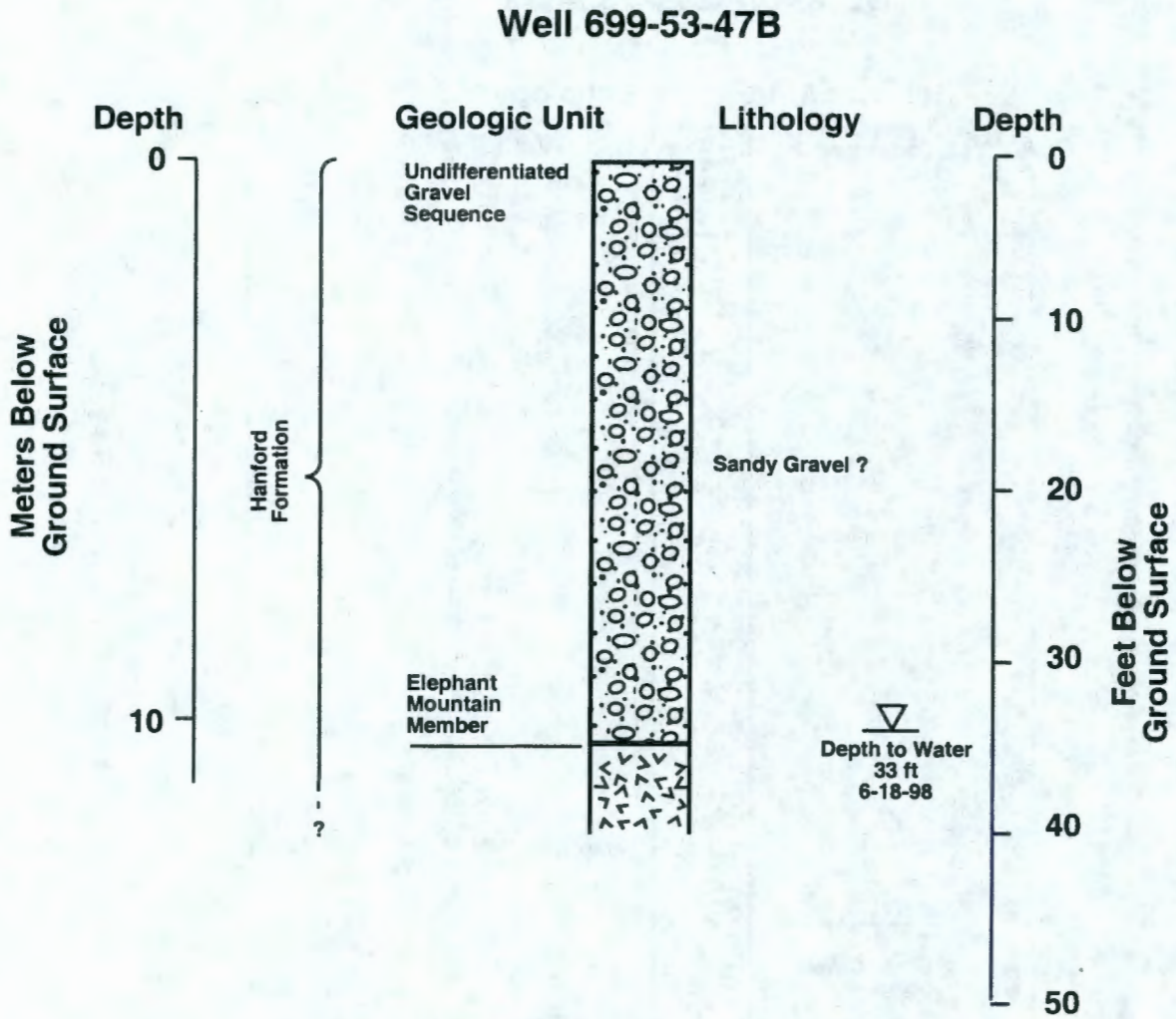


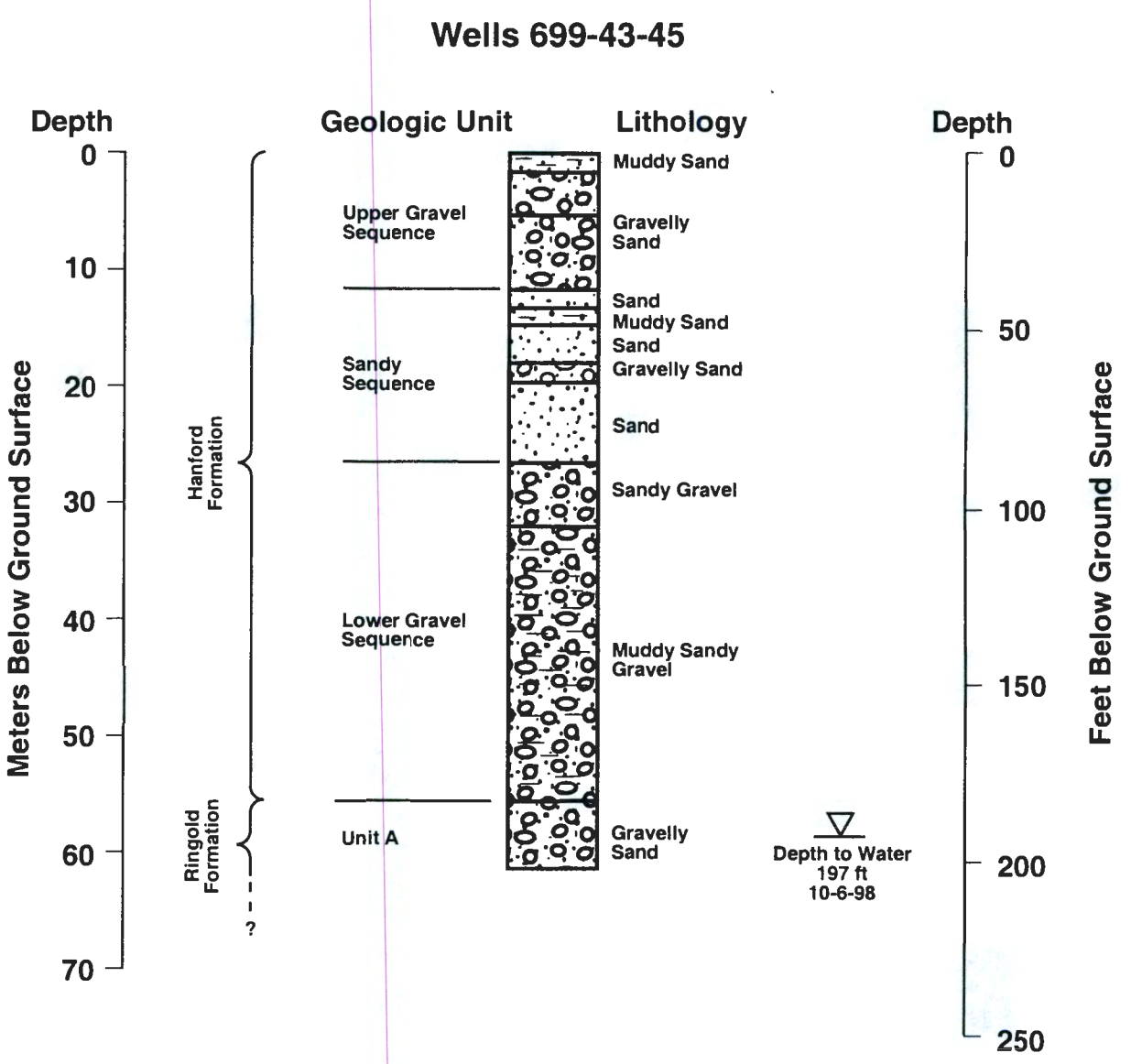
Figure 2-7. Stratigraphy Beneath Gable Mountain Pond.



Source: ERC Geosciences

E9902024.4

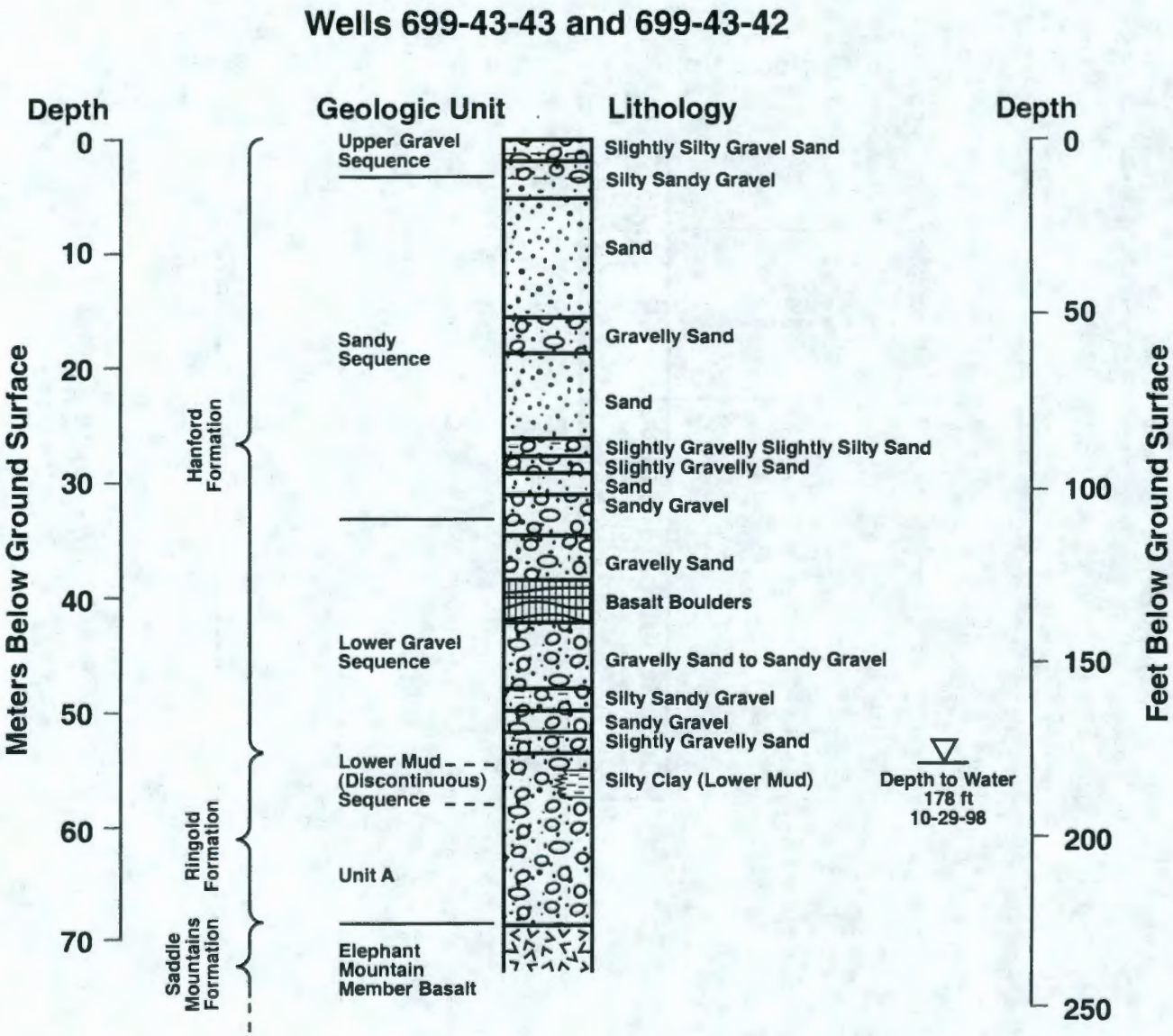
Figure 2-8. Representative Stratigraphy Beneath the 216-B-3-3 Ditch.



Source: ERC Geosciences

E9902024.2

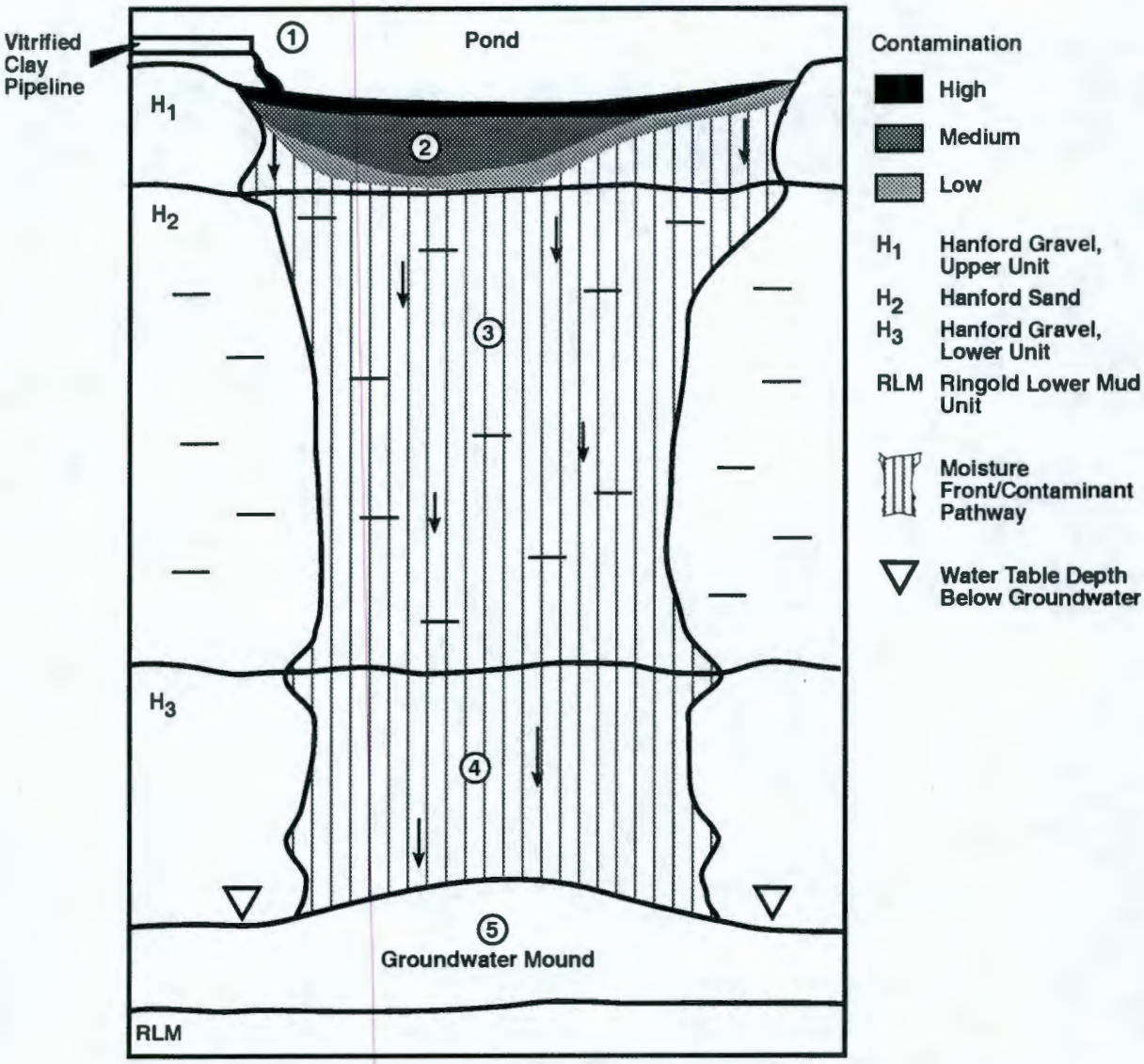
Figure 2-9. Representative Stratigraphy Beneath B Pond.



Source: ERC Geosciences

E9902024.1

Figure 2-10. Conceptual Model of Contaminant Distribution for B Pond During Period of Active Discharge (not to scale).



1. Large volumes of low salt, low organic solutions containing minor quantities of uranium, Pu-239/240, Cs-137, Sr-90, and nitrates were routinely discharged to the pond/sediment column. Occasional high-concentration spills caused major contamination events.

2. Particulates in solution (i.e., Pu-239/240) settle out at the bottom of the pond. Cs-137, Pu-234/240, uranium, and Sr-90 sorb pond bottom sediments. The highest concentrations should be within 2 m of the pond bottom and decrease with depth and distance from the point of discharge. Some uranium complexes with carbonates and moves with the moisture front.

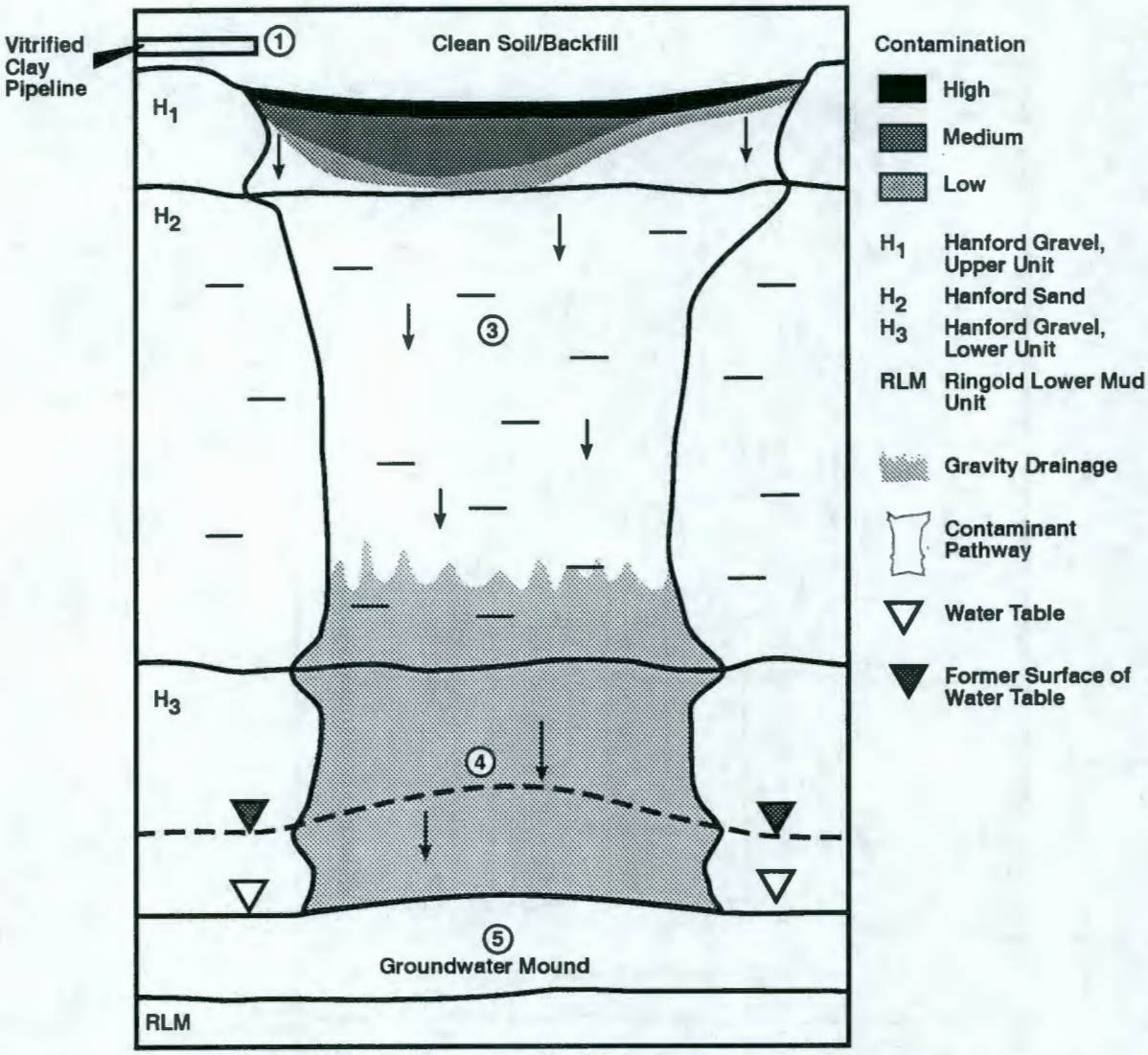
3. The wetting front and mobile contaminants (e.g., uranium) with some Sr-90 move vertical downward through H_1 with minor spreading occurring on top of H_2 and along silt stringers.

4. Mobile contaminants enter groundwater since soil pore volume was exceeded during active discharge.

5. Groundwater mounding occurs beneath large percolation ponds. Sr-90 impacts groundwater at Gable Mountain Pond.

E9903044.4

Figure 2-11. Conceptual Model of Contaminant Distribution at B Pond After Cessation of Discharge (not to scale).



1. 200-CW-1 waste sites no longer receive effluent. Sites have been backfilled/stabilized with clean soil.

2. Particulates in solution (i.e., Pu-239/240) have settled out at the bottom of the pond. Cs-137, Pu-234/240, uranium, and Sr-90 sorbed to pond bottom sediments. The highest concentrations should be within 2 m of the pond bottom and decrease with depth and distance from the point of discharge. Some uranium complexed with carbonates and moved with the moisture front.

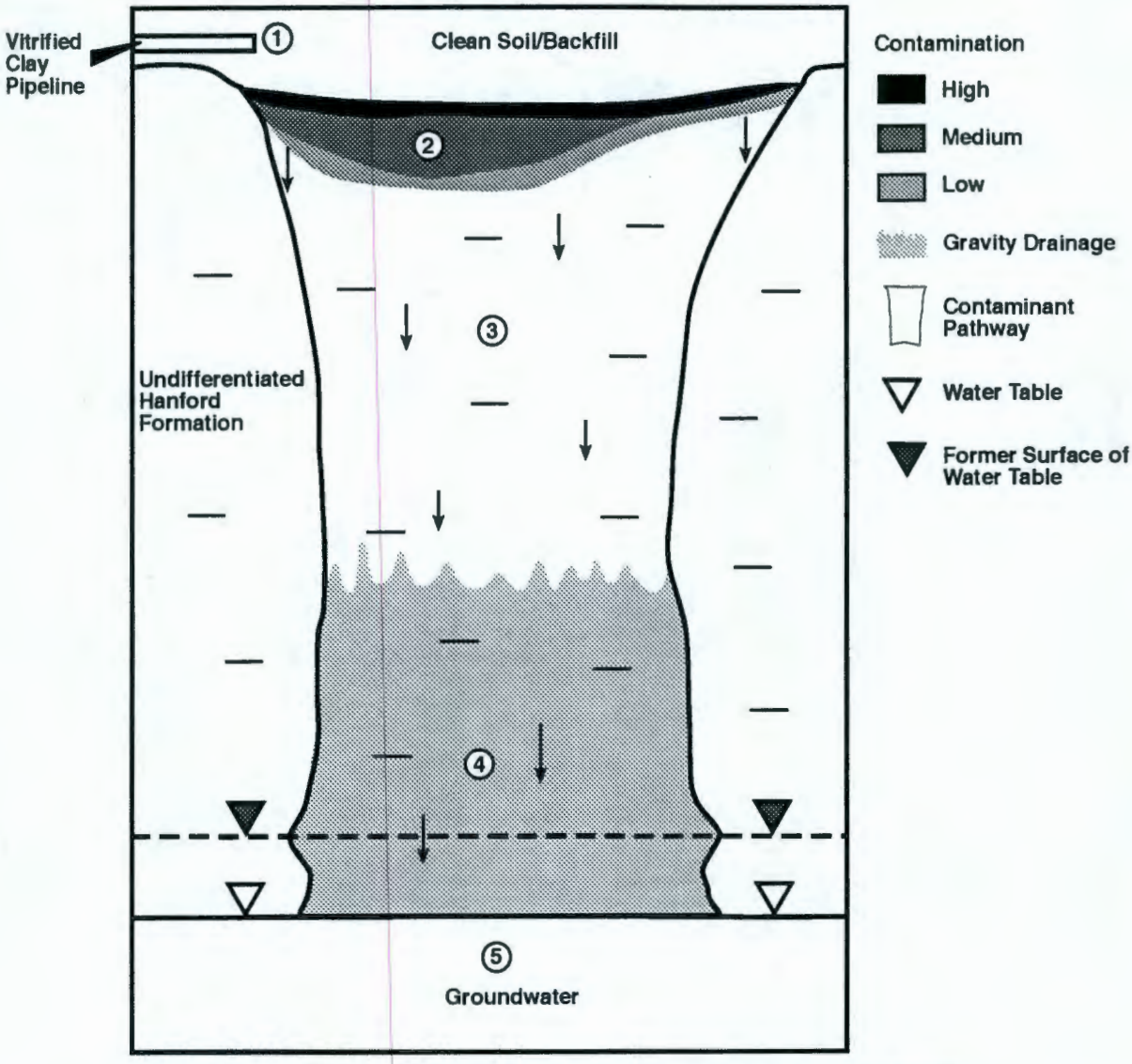
3. Zone of residual contamination. Residual concentrations are less than or equal to background. However, slightly higher concentrations may be detected associated with fine-grained stringers. Trace amount of uranium and Sr-90 may be detected in the zone.

4. High moisture zone. The moisture flux in this zone is decreasing over time as effluent is no longer discharged to the soil column. Contaminants in this zone (tritium, Sr-90, uranium, nitrate, Tc-99) may impact groundwater. After gravity drainage is complete, potential contaminant impacts on groundwater will be reduced. Residual contamination may remain in the vadose zone after gravity drainage.

5. The surface of the water table is dropping because of cessation of discharge in the 200 Area.

E9903044 1

Figure 2-12. Conceptual Model of Contaminant Distribution at Gable Mountain Pond After Cessation of Discharge (not to scale).



1. 200-CW-1 waste sites no longer receive effluent. Sites have been backfilled/stabilized with clean soil.

2. Particulates in solution (i.e., Pu-239/240) have settled out at the bottom of the pond. Cs-137, Pu-234/240, uranium, and Sr-90 sorbed to pond bottom sediments. The highest concentrations should be within 2 m of the pond bottom and decrease with depth and distance from the point of discharge. Some uranium complexed with carbonates and moved with the moisture front.

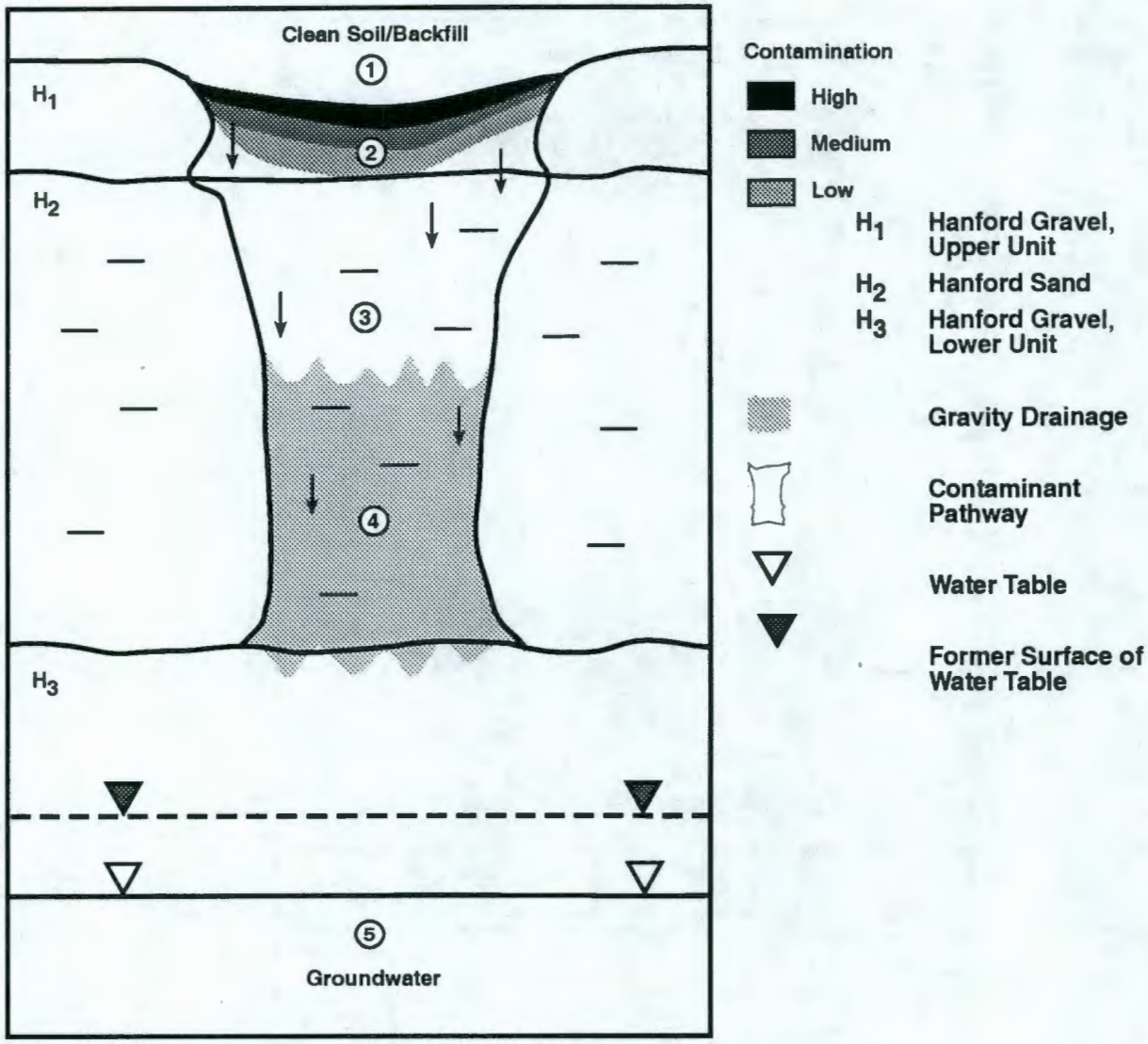
3. Zone of residual contamination. Residual concentrations are less than or equal to background. Trace amount of uranium and Sr-90 may be detected in the zone.

4. High moisture zone. The moisture flux in this zone is decreasing over time as effluent is no longer discharged to the soil column. Contaminants in this zone (tritium, Sr-90, uranium, nitrate, Tc-99) may impact groundwater. After gravity drainage is complete, potential contaminant impacts on groundwater will be reduced. Residual contamination may remain in the vadose zone after gravity drainage.

5. Evidence indicates that Sr-90 from the pond is impacting the aquifer, and concentrations in groundwater have been increasing in recent years.

E9903044.2

Figure 2-13. Conceptual Model of Contaminant Distribution at the 216-B-2-2 Ditch After Cessation of Discharge (not to scale).



1. 200-CW-1 waste sites no longer receive effluent. Sites have been backfilled/ stabilized with clean soil.

2. Particulates in solution (i.e., Pu-239/240) have settled out at the bottom of the pond. Cs-137, Pu-234/240, uranium, and Sr-90 sorbed to pond bottom sediments. The highest concentrations should be within 2 m of the pond bottom and decrease with depth and distance from the point of discharge. Some uranium complexed with carbonates and moved with the moisture front.

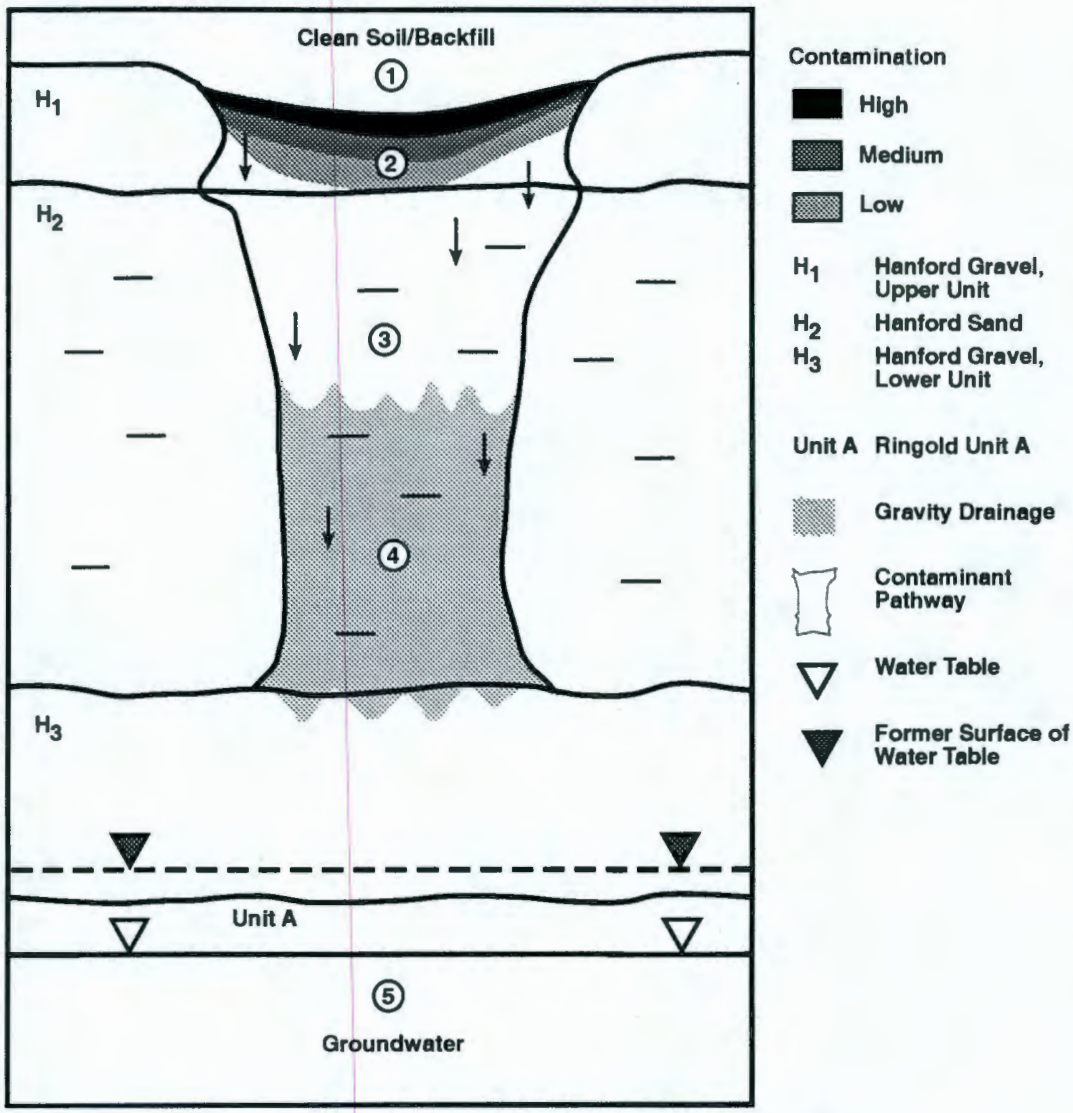
3. Zone of residual contamination. Residual concentrations are less than or equal to background. However, slightly higher concentrations may be detected associated with fine-grained stringers. Trace amount of uranium and Sr-90 may be detected in the zone.

4. High moisture zone. The moisture flux in this zone is decreasing over time as effluent is no longer discharged to the soil column. The moisture front and contaminant (tritium, Sr-90, uranium, nitrate, Tc-99) have not impacted groundwater based on estimates of soil pore volumes. Future impacts to groundwater are a function of natural recharge rates and hydrogeologic conditions. Residual contamination may remain in the vadose zone after gravity drainage.

5. Groundwater does not appear to be impacted by disposal practices at the ditch.

E9903044.3

Figure 2-14. Conceptual Model of Contaminant Distribution at the 216-B-3-3 Ditch After Cessation of Discharge (not to scale).



1. 200-CW-1 waste sites no longer receive effluent. Sites have been backfilled/ stabilized with clean soil.

2. Particulates in solution (i.e., Pu-239/240) have settled out at the bottom of the pond. Cs-137, Pu-234/240, uranium, and Sr-90 sorbed to pond bottom sediments. The highest concentrations should be within 2 m of the pond bottom and decrease with depth and distance from the point of discharge. Some uranium complexed with carbonates and moved with the moisture front.

3. Zone of residual contamination. Residual concentrations are less than or equal to background. However, slightly higher concentrations may be detected associated with fine-grained stringers. Trace amount of uranium and Sr-90 may be detected in the zone.

4. High moisture zone. The moisture flux in this zone is decreasing over time as effluent is no longer discharged to the soil column. The moisture front and contaminant (tritium, Sr-90, uranium, nitrate, Tc-99) have not impacted groundwater based on estimates of soil pore volumes. Future impacts to groundwater are a function of natural recharge rates and hydrogeologic conditions. Residual contamination may remain in the vadose zone after gravity drainage.

5. Groundwater does not appear to be impacted by disposal practices at the ditch.

E9903044.5

Table 2-1. Waste Sites in the 200-CW-1 Operable Unit. (5 Pages)

Site Name	Dates of Operation	Depth	Dimensions	General Description	Unit Category	Source Facility
200-E PD Powerhouse Ditch	Unknown to 1997	2.4 m to 3 m (8 to 10 ft)	762 m (2,500 ft) x 1.2 (4 ft)	Unlined ditch. Contaminated portion of the ditch stabilized in 1996 and replaced by 111.5 m (366 ft) of underground piping. Most of the ditch is currently open.	RPP	284-E Powerhouse
207-B Retention Basin	1945 to 1997	2 m (6.5 ft)	75 m (246 ft) x 37.5 m (123 ft)	Concrete structure. Collected B Plant cooling water.	RPP	B Plant
216-A-9 Crib	1956 to 1969	4 m (12 ft)	128 (420 ft) x 6.1 m (20 ft)	The crib was backfilled with 46 to 61 cm (18 to 24 in.) of uncontaminated soil in 1993. Received acidic waste.	RPP	PUREX, N Reactor liquid waste
216-A-25 Pond (Gable Mountain Pond)	1958 to 1887	1.5 m (5 ft)	71 acres	Large percolation pond. Bentonite added to the pond to tie up radionuclides.	RPP	PUREX, B Plant
216-A-40 Trench	1968 to 1979	4 m (12 ft)	120 m x 6 m (400 ft x 20 ft)	Rubber-lined ditch. Failure of liner contaminated the ditch. Backfilled in 1994. Contaminated support equipment buried in east end of trench.	RPP	244-AR Vault
216-A-42 Retention basin	1978 to 1997	6 m (20 ft)	107 m (342 ft) x 9 m (30 ft)	Concrete structure. Collected PUREX cooling water.	RPP	PUREX
216-B-2-1 Ditch	April 1945 to 1963	1.8 m (6 ft)	4.6 m (15 ft) x 1,067 m (3,500 ft)	Unlined ditch. Decommissioned and backfilled in November 1963 as a result of UPR-200-E-32.	RPP	B Plant, 284-E Powerhouse
216-B-2-2 Ditch	November 1963 to May 1970	1.8 to 2.4 m (6 to 8 ft)	1,067 m (3,500 ft) x 4.6 m (15 ft)	Unlined ditch. Decommissioned and backfilled in 1970 as a result of UPR-200-E-138.	RPP	B Plant, 284-E Powerhouse, 241-CR Vault, 241-BY In-Tank Solidification Units 1 and 2, 207-B Retention Basins

Table 2-1. Waste Sites in the 200-CW-1 Operable Unit. (5 Pages)

Site Name	Dates of Operation	Depth	Dimensions	General Description	Unit Category	Source Facility
216-B-2-3 Ditch	1970 to 1973	1.8 to 2.4 m (6 to 8 ft)	1,220 m (4,000 ft) x 6 m (20 ft)	Unlined ditch. Replaced 216-B-2-2 Ditch in 1970. Decommissioned and backfilled in 1987.	RPP	241-CR Vault, B Plant, 241-BY In-Tank Solidification Units 1 and 2
216-B-3 Main Pond	April 1945 to 1994	0.6 to 6 m (2 to 20 ft)	35 acres	Large percolation pond. Bentonite added to pond in 1964. Decommissioned and backfilled in 1994.	TSD	B Plant, PUREX, 244-AR Vault, 242-A Evaporator, 241-BY In-Tank Solidification Units 1 and 2, 284-E Powerhouse, 241-CR Vault, 207-B Retention Basin, 241-A Ventilation System Complex
216-B-3-1 Ditch	April 1945 to July 1964	1.8 m (6 ft)	975 m (3,200 ft) x 1.8 m (6 ft)	Unlined ditch. Decommissioned and backfilled in 1964.	RPP	B Plant, PUREX, 284-E Powerhouse, 241-BY Tank Farm, 241-CR Vault, 242-A Evaporator
216-B-3-2 Ditch	July 1964 to 1970	1.2 to 2.4 m (4 to 8 ft)	4.6 m (15 ft) x 1,128 m (3,700 ft)	Unlined ditch. Decommissioned and backfilled in 1970.	RPP	B Plant, PUREX, 284-E Powerhouse, 241-BY Tank Farm, 241-CR Vault, 242-A, Evaporator, WESF

Table 2-1. Waste Sites in the 200-CW-1 Operable Unit. (5 Pages)

Site Name	Dates of Operation	Depth	Dimensions	General Description	Unit Category	Source Facility
216-B-3-3 Ditch	July 1970 to 1994	1.8 m (6 ft)	6 m (20 ft) x 1,128 m (3,700 ft)	Unlined ditch. Decommissioned and backfilled in 1994.	TSD	B Plant, PUREX
216-B-3A Expansion Pond	1983 to 1994	Approx. 1 m (2 to 3 ft)	4 hectares (10 acres)	Clean closed under RCRA in 1995.	RPP[a]	Same as 216-B-3 Main Pond
216-B-3B Expansion Pond	1984 to 1986	Approx. 1 m (2 to 3 ft)	4 hectares (10 acres)	Clean closed under RCRA in 1995.	RPP[a]	Same as 216-B-3 Main Pond
216-B-3C Expansion Pond	1985 to 1997	2 to 3 m (6.6 to 10 ft)	17 hectares (141 acres)	Clean closed under RCRA in 1995. Received clean effluent until August 1997.	RPP[a]	Same as 216-B-3 Main Pond
216-B-59 Trench	1967 to 1974	3.6 m (12 ft)	6 m (20 ft) x 122 m (400 ft)	Activated in December 1967 as a trench, upgraded to a retention basin. Received a single release of 477,000 L (126,000 gal) of effluent.	RPP	B Plant
216-B-59B Retention Basin	1974 to 1997	3 m (10 ft)	30 m (100 ft) x 40 m (130 ft)	Designed to receive cooling water from B Plant, this concrete basin was constructed over a section of the 216-B-59 Trench.	RPP	B Plant
216-C-9 Pond	1953 to 1967	7.6 m (25 ft)	244 m (800 ft) x 30 m (100 ft)	Received cooling water from 1953 to 1967. The eastern half of the pond was used as a burial ground for the 201-C Hot Semi-Works Building from 1985 to 1989. The pond was backfilled to grade in 1989.	RPP	201-C Hot-Semi-works Building
216-E-28 Contingency Pond	Never used	1.2 m (4 ft)	30 acres	Built for emergency use in 1986; was never used.	RPP	None
216-N-8 Pond (West Lake)	Natural Pond	NA	77,800 m^2	Received sewage sludge from early Hanford Construction camp.	RPP	Unknown
Unplanned Release UPR-200-E-14	NA	NA	NA	The 216-B-3 Pond dike broke allowing contaminated water to flow into a ravine east of the pond. July 1958.	RPP	216-B-3 Pond

Table 2-1. Waste Sites in the 200-CW-1 Operable Unit. (5 Pages)

Site Name	Dates of Operation	Depth	Dimensions	General Description	Unit Category	Source Facility
Unplanned Release UPR-200-E-32	NA	NA	NA	A coil leak in the 221-B Building contaminated the 4,900,000 L (1,300,000 gal) of primarily low-level cooling water discharged through the 207-B Retention Basin to the 216-B-2-1 Ditch. The primary contaminants were Ce-144 at 30 Ci and Sr-90 at 0.05 Ci. The ditch was closed, backfilled, and stabilized. The retention basin walls were washed and covered with an asphalt-oil emulsion. Contaminated vegetation (Russian thistle with readings of 2,000 ct/min) was removed from the ditch and disposed.	RPP	B Plant
Unplanned Release UPR-200-E-34	NA	NA	NA	As a result of a coil leak at the F-15 PUREX Tank in June 1964, an estimated 10,000 Ci of mixed fission products were released to 216-B-3-1 Ditch, 216-A-25 Pond, and 216-B-3 Pond. The pond algae were killed, and efforts were made to precipitate the fission products. The 216-B-3-1 Ditch was backfilled and replaced by the 216-B-3-2 Ditch.	RPP	PUREX
Unplanned Release UPR-200-E-51	NA	NA	NA	15 kg of cadmium nitrate was released in May 1977 from PUREX Tank TK-324 to the 216-B-3 Pond and the 216-B-3-3 Ditch.	RPP	PUREX
Unplanned Release UPR-200-E-94	NA	NA	NA	Gravel area north of 216-B-3-3 Ditch was contaminated while washing a contaminated vehicle.	RPP	Vehicle Decontamination Area

Table 2-1. Waste Sites in the 200-CW-1 Operable Unit. (5 Pages)

Site Name	Dates of Operation	Depth	Dimensions	General Description	Unit Category	Source Facility
Unplanned Release UPR-200-E-66	NA	NA	NA	11-7-84 contamination from 216-A-42.	RPP	216-A-42 Basin, PUREX
Unplanned Release UPR-200-E-138	NA	NA	NA	An estimated 1,000 Ci Sr-90 was released in March 1970 during an operation with the product storage Tank 801 via a leaking manometer sensing line. The waste was washed to the floor drains, which were directed to 216-B-2-2 Ditch bypassing the 207-B Retention Basin. The 216-B-2-2 Ditch received much of the material resulting in radiation levels of 500 R/h at 8 cm (3 in.) from the pipe gallery. The 216-B-2-2 Ditch was decommissioned and backfilled with surface stabilization. The 216-B-3-2 Ditch was also decontaminated and backfilled as a result of this unplanned release.	RPP	B Plant

RPP = RCRA past-practice unit
TSD = treatment, storage, and/or disposal unit
Waste sites in **bold** are representative sites.
[a]Former RCRA TSD units that have been clean closed under RCRA: listed as RPP sites in Tri-Party Agreement .

3.0 INITIAL EVALUATION OF REPRESENTATIVE SITES AND RCRA TSD UNITS

The purpose of this section is to present results of previous characterization efforts at representative sites and TSD units in the 200-CW-1 OU in order to provide a background for understanding the waste sites in this OU. The contaminant inventory, effluent volume, available soil and groundwater data, and current understanding of the distribution of contamination are also discussed for the representative sites and TSD units.

Certain subsections of this section contain information that will be used for portions of the RCRA TSD closure plan. These are as follows:

- Section 3.1, "Known and Suspected Contamination," provides closure plan facility description
- Section 3.3, "Nature and Extent of Contamination," provides closure plan facility description and groundwater monitoring.

3.1 KNOWN AND SUSPECTED CONTAMINATION

As discussed in Section 2.0, waste sites in this OU received dilute concentrations of a number of radionuclides in cooling water and infrequent influxes of unusually high concentrations of wastes associated with unplanned releases. This and the following sections detail the known and suspected discharges of contamination to the waste sites. Specific information on waste characteristics for the RCRA TSD units, intended to serve as Chapter 4 of the RCRA Closure Plan, is presented in Section 3.3.2.

The estimated inventory of the primary radionuclides and chemicals that were discharged to waste sites in the 200-CW-1 OU was obtained from the WIDS, the aggregate area management study (AAMS) reports for the 200 Areas (e.g., DOE-RL 1993a), and is also summarized in Appendix A of the *Waste Site Grouping for 200 Areas Soil Investigations* (DOE-RL 1997). The estimated inventory for the representative sites and TSD units and total inventory for all 28 waste sites in this OU is presented in Table 3-1. Only the radionuclides uranium, plutonium, americium-241, cesium-137, and strontium-90 are tabulated.

The chemical sewer stream contains a variety of constituents, some of which have been released in reportable quantities. These include hydrazine; sulfuric, nitric, phosphoric, and formic acids; sodium hydroxide; sodium and aluminum nitrate; cadmium; and chromium. The quantity and type of nonradiological contaminants are difficult to quantify as they were not routinely monitored. A complete list of contaminants of potential concern (COPCs) is presented in the *200-CW-1 Gable/B-Pond and Ditches Cooling Water Waste Group Remedial Investigation DQO Summary Report* (BHI 1999, Table 1-5)

3.2 ENVIRONMENTAL MONITORING

Current efforts at the Hanford Site focus on environmental cleanup of the Site. Prior to recent cleanup efforts, monitoring was performed across the Hanford Site to measure and evaluate long-term trends in the environmental accumulation of radioactivity. Risks associated with unacceptable levels of contamination were typically addressed by stabilizing (covering with soil) the area of concern to minimize impact on human health and the environment.

The accumulation of radioactivity at cooling water disposal sites was typically evaluated through sampling and analysis of sediment samples. These samples were typically collected directly from the bottom of the receiving sites; some samples were collected through several meters of water. The accumulation of radioactivity was the principal focus of monitoring; therefore, samples were routinely collected less than 0.3 m (1 ft) below the pond/ditch bottom. Nonradioactive constituents were not commonly analyzed. Samples were collected on an annual basis; however, the number of samples collected was limited and sample locations were generally not well documented. Therefore, very little or no information is typically available to evaluate the lateral and vertical extent of contamination in the vadose zone during active periods of discharge. Groundwater is monitored for some constituents at these sites through the RCRA requirements and the sitewide groundwater monitoring program. The available contaminant information for each site is discussed in the following section.

3.3 NATURE AND EXTENT OF CONTAMINATION

This section uses previously published data to describe the contamination associated with the representative sites and TSD units (Figure 2-2). The section discusses the RPP sites and TSD units separately so that the sections required for a RCRA closure plan are clearly identified.

3.3.1 RCRA Past-Practice Sites

3.3.1.1 216-B-2-2 Ditch. Limited data have been collected to evaluate contaminants associated with the 216-B-2-2 Ditch above the water table, because very little or no routine or operational environmental monitoring was performed during operation of this facility. The current understanding of contaminant fate and transport in the vadose zone at this site is gained from borehole 299-E33-333, completed in January 1998. This borehole was drilled through the 216-B-2-2 Ditch to groundwater, located 76.2 m (250 ft) below ground surface (bgs). The location of this borehole is shown in Figure 3-1. Groundwater is monitored in association with the 216-B-63 Ditch, which is a RCRA TSD unit located immediately to the north of the 216-B-2-2 Ditch (Figure 3-1).

Borehole 299-E33-333 was drilled and sampled to assess the nature and extent of subsurface contamination beneath the ditch and refine the preliminary conceptual model of the site. Characterization activities consisted of excavating to locate the ditch, drilling, soil sampling and analysis, and geophysical logging. This borehole was drilled through the head end of the ditch with the intent to bias the characterization to the area of maximum contamination and provide a vertical profile of contaminant distribution. Samples were collected for chemical, radiological, and physical property analysis. The analyte list included volatile organic compounds, semivolatiles, polychlorinated biphenyls (PCBs), metals, and 25 radiological constituents. All

samples were field surveyed for radioactivity by radiological control technicians. A summary of the results from this borehole is provided below; a more detailed discussion of activities and results is presented in *Borehole Summary Report for the 216-B-2-2 Ditch* (BHI 1998).

Radiological analysis of laboratory samples indicates that the upper 4.6 m (15 ft) of the soil column contains the most contamination; no man-made radionuclides were detected below 4.6 m (15 ft). The primary man-made radionuclides strontium-90, cesium-137, and europium-154 were detected in laboratory samples at maximum concentrations of 4,710 pCi/g, 100 pCi/g, and 1.29 pCi/g, respectively. The maximum concentrations were at the interval between 4 and 4.6 m (13 and 15 ft) bgs (approximately 1.5 m [5 ft] below the historical bottom of the ditch). Radiological screening from the borehole also shows that the highest contamination is in the upper 4.6 m (15 ft) of the soil column. Field radiological surveys for beta-gamma activity ranged from 400 to 150,400 dpm above background, with the highest reading in the interval between 4 and 4.6 m (13 and 15 ft) bgs (approximately 1.5 m [5 ft] below the historical bottom of the ditch). Below 4.6 m (15 ft), beta-gamma activity was a maximum of 600 dpm above background.

This upper zone of contamination was also confirmed using a spectral gamma borehole logging system. The gamma-emitting man-made radionuclides detected during logging were cesium-137 (maximum of 400 pCi/g at 3 m), cobalt-60 (0 to 15 pCi/g near ground surface), and europium-154 (maximum of 2.0 pCi/g at 3 m). Cobalt-60 was found only in the interval from 0 to 0.3 m (0 to 1 ft) bgs; this interval was not sampled for laboratory analysis. Strontium-90, a beta emitter, is not detectable using the spectral logging system. The distribution of man-made radionuclides underlying the 216-B-2-2 Ditch is consistent with the conceptual model developed for the 200-CW-1 OU.

One nontarget volatile organic analyte was detected: total xylenes had a concentration of 8 μg/kg in the interval from 45.7 to 46.5 m (150 to 152.5 ft) bgs. Aroclor-1260 was the only significant semivolatile target analyte detected; it had a maximum concentration of 9.2 mg/kg in the interval from 2.4 to 3 m (8 to 10 ft) bgs.

No groundwater monitoring has been performed to specifically evaluate impacts associated with the 216-B-2-2 Ditch. Monitoring data applicable to the ditch are collected in support of RCRA monitoring at the 216-B-63 Ditch. This ditch is located from a few meters to 60 m (200 ft) north of the 216-B-2-2 Ditch; the two ditches parallel each other over most of their length. Conclusions regarding the 216-B-63 Ditch are applicable to the 216-B-2-2 Ditch because of their close proximity. Eleven wells are in the 216-B-63 Ditch/216-B-2-2 Ditch groundwater monitoring network (Figure 3-1), consisting of six upgradient and five downgradient wells.

Groundwater monitoring at the 216-B-63 Ditch indicates that the groundwater has not been impacted by surface disposal activities at the trench (Barnett and Chou 1998). The constituents being monitored are specific conductance, pH, total organic carbon, total halides, gross beta, and gamma-emitting radionuclides.

In addition to evaluating nearby groundwater wells, another method used to assess the potential impact on groundwater was to compare the total volume of effluent discharged to the ditch to the soil pore volume beneath the facility. For the 216-B-2-2 Ditch, the total effluent volume is less

than the calculated soil pore volume (Appendix A, DOE-RL 1997). This suggests that the wetting front and any contaminants that may have been associated with it have not impacted groundwater. Groundwater flow direction is to the west in the vicinity of this ditch (Figure 2-4), with a gradient of 0.00004 (PNNL 1998).

3.3.1.2 Gable Mountain Pond. Sediment samples from the Gable Mountain Pond were collected at least annually when it was receiving effluent. At least two samples per year were collected from the bottom of the pond near the inlet, and the north or south ends of the pond. The predominant radionuclides detected in the pond were strontium-90, cesium-137, plutonium isotopes, and americium-241. The concentration of these contaminants ranged from 0.6 to 7.0 pCi/g of strontium-90, 4 to 558 pCi/g of cesium-137, 0.4 to 23 pCi/g of plutonium 239/240, and from less than detection limit to 51 pCi/g of americium-241. These and other data collected over the operational life of the pond are presented in the Environmental Protection/Surveillance Annual Reports, which are listed in Table 3-4 of the *200-CW-1 Gable/B-Pond and Ditches Cooling Water Waste Group DQO Summary Report* (BHI 1999).

Cushing and Watson (1974) conducted an investigation in Gable Mountain Pond to determine the potential for the offsite transfer of radioactivity to man. Grab samples were collected from the bottom of the pond to a depth of 0.3 m (1 ft) along five transects that each had four sampling points. These data provide an example of the distribution of radionuclides in a pond setting. The report indicates that cesium-137 is the predominant radionuclide in the pond. The highest concentration of cesium-137 and other radioisotopes was generally detected in sediments on the northwest end and deeper section of the pond along its long axis. Madeen (1970) investigated the vertical distribution of a few contaminants and showed that the relatively immobile radionuclides are contained in the top few centimeters of the pond sediment (Figure 3-2).

An investigation to determine the concentration and distribution of PCBs in pond sediments was conducted in 1984 (PNL 1986). All but one of the samples collected were found to contain the PCB Aroclor 1260; PCB concentrations ranged between 0.002 and 0.148 mg/kg, with the highest concentration next to the mouth of the inlet pipe. The distribution of PCBs was consistent with the hypothesis that higher levels of contamination should be detected near the inlet of the facility.

To evaluate subsurface radiological contamination near the pond, 10 soil samples were collected during the drilling of well 699-53-47B in February 1984 (Fuchs et al. 1984). The location of this well is shown in Figure 3-3. Concentrations of strontium-90 ranged from 0.36 to 1.74 pCi/g in 1984, which would be 0.25 to 1.22 pCi/g when decayed to the present. The highest concentrations were detected at 7.0, 11.6, and 12.6 m (23, 38, and 41.5 ft) bgs. The sample collected at 7.0 m bgs was approximately 0.76 m (2.5 ft) above the water table. The deeper samples were collected from below the water table.

Data from well 699-53-47B indicate that strontium-90 is present in the soil column 9 m (30 ft) northeast of the historical shores of the pond, at concentrations much lower than found in the sediment underlying the pond. Soil contamination in this well is likely the result of localized flooding caused by changing water levels in the pond during periods of high precipitation and discharge. It is less likely that lateral migration within the Hanford formation occurred, because the highly permeable nature of this facies is expected to transmit effluent directly beneath the pond. The distribution of strontium-90 throughout the vadose zone also is consistent with the

presence of strontium-90 in the groundwater. The distribution of strontium-90 in soil samples from well 699-53-47B is shown in Figure 3-4.

It should also be noted that well 699-53-47B was drilled and sampled using the hard-tool drilling method. Hard tooling requires the addition of water to the well to create a drilling mud for lubrication and to clean drill chips from around the well (Fuchs et al. 1984). Because this method has the potential to drive contamination downward, the possibility exists that the samples obtained in this study were not representative of conditions at depth.

Groundwater monitoring at Gable Mountain Pond is performed under the Site-Wide Groundwater Program. Seven groundwater wells are used to monitor the site; however, some of the wells completed above the basalt are becoming more difficult to sample and monitor because of the declining water table. Groundwater monitoring indicates that strontium-90 is the main contaminant of concern (COC); it was detected in three wells near the pond in 1997, and the concentrations are increasing over time. This contamination is likely from unplanned release UPR-200-E-34 in 1964, during which approximately 7,500 Ci of fission products were discharged to the pond. The maximum annual average concentration of strontium-90 detected in 1997 was 1,300 pCi/L in well 699-53-47A. This concentration is substantially above the interim drinking water standard of 8 pCi/L. The strontium groundwater plume and location of groundwater monitoring wells are shown in Figure 3-5. The increase in the level of strontium-90 contamination over time in well 699-53-47B is shown in Figure 3-6. Groundwater is nearly stagnant in this area; there may be a slight flow to the northwest (see Figure 2-4).

3.3.2 216-B-3 TSD Unit

This section presents historical information on the inventory and characteristics of waste released to the 216-B-3 Pond and the 216-B-3-3 Ditch, as well as a summary of soil and groundwater data. This unit is the only TSD unit in this OU that requires closure under *Washington Administrative Code* (WAC) 173-303-610 and the Hanford Facility RCRA Permit (Permit). The 216-B-3A, 216-B-3B, and 216-B-3C Expansion Lobes have been clean closed under RCRA (DOE-RL 1994). The purpose of this section is to present the waste characteristic information that satisfies Section 4.0 of a RCRA closure/postclosure plan. Also included is a discussion of the listed waste hydrazine and potential supporting information for a contained-in determination.

3.3.2.1 Sources of Waste Contributions. Exhaustive information regarding sources of waste contributions to the B Pond system is available in previously published documents. The majority of waste contributions to the B Pond system were from the PUREX Plant and B Plant. Known and suspected contamination to the B Pond system from these facilities is documented in the AAMS reports for B Pond and PUREX (DOE-RL 1993a, 1993b, respectively). Further information is also contained in the *216-B-3 Pond System Closure/Postclosure Plan* (DOE-RL 1990) and the *216-B-3 Expansion Ponds Closure Plan* (DOE-RL 1994).

The largest contributing streams were the B Plant cooling water and steam condensate (nondangerous waste source), PUREX Plant cooling water (nondangerous waste source), the B Plant chemical sewer (potentially dangerous waste source), and the PUREX Plant chemical sewer (dangerous waste source). Additional routine sources of effluent originated from the 242-A Evaporator, 242-B Evaporator, 244-AR Vault, 244-BXR Vault, 244-CR Vault,

241-BY Tank Farm, 241-A Aging Waste Ventilation System Complex, 283-E Water Treatment Facility, and 284-E Powerhouse. None of the effluent released from these additional sources was considered to be dangerous waste. More infrequent waste contributions came from unplanned releases, PUREX Plant steam condensate, and miscellaneous construction activities; all but the unplanned releases were probably nondangerous waste sources.

The PUREX chemical sewer was the major source of dangerous waste to the B Pond system, and is the reason that B Pond is a TSD unit. Four mechanisms existed for the discharge of dangerous waste into the chemical sewer. These mechanisms were as follows.

- **Overflow of condensate from the acid fractionator** – Sporadic overflow of the acid fractionator may have resulted in an acidic waste (D002) discharge to the chemical sewer.

- **Effluent discharges from regeneration of the demineralizers** – Serial discharges of sulfuric acid and sodium hydroxide (both D002) routinely resulted in the discharge of effluent below a pH of 2 and above a pH of 12.5 to the chemical sewer. This practice continued until 1989 when a catch tank was placed in service to hold the regeneration effluents.

- **Disposal of out-of-tolerance chemical makeups** – Various chemicals, including hydrazine (U133) and state-only toxic mixtures (WT01, WT02), were discharged to the chemical sewer when adjustments to chemicals used in the PUREX Plant became out of tolerance to required plant specifications.

- **Accidental spills** – Equipment failures, misvalvings, and overflowing tanks resulted in accidental spills to the chemical sewer. The most significant was unplanned release UPR-200-E-51 that occurred in May 1977 and released 15 kg of cadmium nitrate (D006) to the chemical sewer.

A listing of chemicals released to the PUREX Plant chemical sewer from mid-1983 to 1987 is contained in Table 3-2. Before 1983, detailed release records were not maintained. The quantity identified represents the amount discharged at the point the sewer line entered the 216-A-29 Ditch, but not necessarily the B Pond TSD unit. Chemicals and associated state dangerous waste designation codes identified in Table 3-2 are the same as those identified in the Part A Permit Application for the B Pond system.

Unplanned releases of radiological contamination have impacted the B Pond system (DOE-RL 1993a). Unplanned release UPR-200-E-34 occurred in June 1964 and contaminated the 216-B-3-1 Ditch and B Pond with approximately 2,500 Ci of mixed fission products from PUREX. This release resulted in the placement of bentonite in the pond to adsorb the contamination. Unplanned release UPR-200-E-138 occurred in March 1970 when about 1,000 Ci of strontium-90 was released from B Plant to the 216-B-2-2 Ditch. This release has been shown to have impacted B Pond (DOE-RL 1993a).

3.3.2.2 Maximum Inventory of Waste Managed at the 216-B-3 TSD Unit. Discharges to B Pond ceased in April 1994 when all effluents were rerouted to the 216-B-3C Expansion Pond via a pipeline. Dangerous waste discharges ceased in 1987. Discharges to the B Pond system

were at a maximum during 1988. Total discharge to the facility since 1945 is estimated to have exceeded 1 trillion L. The inventory of radionuclide contamination is presented in Table 3-1.

3.3.2.3 Historical Sampling and Analysis. Surface soil and sediment characterization of B Pond and the 216-B-3-3 Ditch occurred in August and September 1989. Soil and sediment data provide dangerous waste constituent information as well as a limited amount of radionuclide information. The laboratory results from this sampling event are provided in the *Phase 1 Characterization of the 216-B-3 Pond System* (WHC 1991). These data have not been validated, but subsequent sampling at the B Pond system (Phase 2 and Phase 3) shows that the Phase 1 data are a reliable source of information for the determination of known and suspected contamination. A summary of this information is provided below.

Metals. Thirty samples were collected from the main B Pond during the Phase 1 investigation. The metals analyzed for Phase 1 soil sampling were aluminum, antimony, arsenic, barium, beryllium, boron, cadmium, calcium, chromium, cobalt, copper, iron, lead, lithium, magnesium, manganese, mercury, molybdenum, nickel, potassium, selenium, silicon, silver, sodium, strontium, thallium, tin, titanium, vanadium, zinc, and zirconium. Of these metals, only cadmium, lead, and mercury were found in concentrations exceeding the threshold value, defined for metals as the upper concentration for common ranges in soils, the background level in the 216-E-Contingency Pond (an uncontaminated pond sampled during Phase 1), or the contract limit for the specific analyte.

Cadmium was found in concentrations exceeding the threshold value in B Pond and the 216-B-3-3 Ditch. Twenty-one of the thirty samples taken from B Pond were above the threshold value. Three of the fifteen samples taken from the 216-B-3-3 Ditch were above the threshold value. Elevated cadmium levels may be caused by unplanned release UPR-200-E-51.

Lead was found in concentrations exceeding the threshold value only in B Pond. Twenty-one of the thirty samples were above the threshold value.

Mercury was found in concentrations exceeding the threshold value in B Pond and the 216-B-3-3 Ditch. Twenty-two of the thirty samples taken from B Pond and three of the fifteen samples taken from the 216-B-3-3 Ditch were above the threshold value.

Ions. The ions analyzed for the Phase 1 sampling were ammonium, bromide, chloride, cyanide, fluoride, nitrate, nitrite, phosphate, sulfate, and sulfide. Data did not indicate that any of these ions were above the contract required detection limit (CRDL) or at levels of concern at either B Pond or the 216-B-3-3 Ditch.

Organics. Organics analyzed for Phase 1 sampling were chlorinated herbicides, chloropesticides, phosphorous pesticides, PCBs, semivolatile organics, and volatile organics. A complete listing of specific organics analyzed is contained in *Phase 1 Characterization of the 216-B-3 Pond System* (WHC 1991). No compounds were found at concentrations above the CRDL or levels of concern in either B Pond or the 216-B-3-3 Ditch.

An investigation to determine the concentration and distribution of PCBs in pond sediments was conducted in 1984 (PNNL 1986). All of the samples collected contained Aroclor 1260 with concentrations ranging from 0.006 to 0.230 mg/kg. The highest concentrations of Aroclor were

located near the pipe inlet and deepest area in the eastern portion of the pond. There were no conclusions made to the possible origin of PCBs at the B Pond. However, Aroclor 1260 was the main PCB fluid used in the Hanford Site electrical equipment.

Radionuclides. The primary radionuclide analytes for Phase 1 sampling were gross alpha, gross beta, strontium-90, and gamma energy analysis. Five composite samples were analyzed for sodium-22, potassium-40, cobalt-60, zirconium-95/niobium-95, ruthenium-106, cesium-134, and cerium-144/praseadymium-144. The data show that these analytes were present in very low abundance.

3.3.2.4 Contained-In Determination for Hydrazine (U133). Hydrazine product (U133) entered the 216-B-3-3 Ditch and B Pond from the PUREX Plant aqueous makeup unit tanks. As such, all environmental media and debris generated as waste during the characterization and remediation of these TSD units would be identified as listed hydrazine dangerous waste in accordance with WAC 173-303-081(3). This presents a problem from the context of storage, treatment, and disposal of soils and other debris generated from remediation of these units. All substantive dangerous waste management standards will apply to generated soils and debris because they are defined as listed waste. Should environmental media only be regulated due to the hydrazine waste code, this requirement could unduly burden characterization and cleanup activities. Particularly problematic requirements are those associated with land disposal restrictions; U133 wastes must undergo treatment using one of the technologies prescribed in the 40 *Code of Federal Regulations* (CFR) 268 Table, "Treatment Standards for Hazardous Wastes." These technologies encompass mostly thermal or chemical destruction or extraction technologies and would be required prior to disposal of any waste, soils, and/or debris generated at B Pond and the 216-B-3-3 Ditch.

In accordance with the Washington State Department of Ecology's (Ecology's) contained-in policy for environmental media (Letter, Tom Eaton, Ecology, "Contained-in Policy," dated February 19, 1993) and the U.S. Environmental Protection Agency's (EPA's) contained-in requirements for debris (40 CFR 261.3[f]), the listed waste code can be removed from debris and media if levels of the compound for which the waste was listed are below risk-based action levels. Hydrazine rapidly oxidizes to form nontoxic nitrogen and water in the environment. Therefore, hydrazine discharged to the B Pond system in 1991 (the year the 216-A-29 Ditch stopped operating) could not be present in the B Pond system above detection or risk-based action levels. For these reasons, a contained-in determination for U133 hydrazine in soil and debris at the B Pond and 216-B-3-3 Ditch will be requested from Ecology and the EPA under separate documentation..

3.3.3 RCRA Site Groundwater Monitoring for the 216-B-3 TSD Unit

This section presents descriptions and results of interim status groundwater monitoring at B Pond and the 216-B-3-3 Ditch. Interim status groundwater requirements are contained in WAC 173-303-400(3)(a). This section incorporates by reference 40 CFR 265 Subpart F as the groundwater requirements that must be complied with during interim status. The purpose of this section is to present interim status groundwater monitoring information that will be included in a RCRA closure/postclosure plan. This information will be used as Section 5.0 of the closure/postclosure plan that will form the basis for the modification to the Permit. This section

will not include the proposed final status groundwater monitoring program. This information will be provided in the future within the closure/postclosure plan.

The current interim status groundwater monitoring plan as required by WAC 173-303-400 and 40 CFR 265 Subpart F is contained in *Interim Status Groundwater Monitoring Plan for the 216-B-3 Pond* (WHC 1995). Further details regarding the geology, hydrology, and the current groundwater monitoring program for the 216-B-3 Pond and 216-B-3-3 Ditch can be found in this document. In addition, the *216-B-3 Expansion Ponds Closure Plan* (DOE-RL 1994) contains information regarding the same RCRA interim status groundwater monitoring system, and annual reports (e.g., PNNL 1998) present the results from groundwater monitoring.

3.3.3.1 History of RCRA Groundwater Monitoring at the B Pond System. RCRA groundwater monitoring at the B Pond system began in 1988 with an interim status indicator parameter evaluation (detection-level) program. The program was elevated to an assessment-level program in 1990 because of elevated total organic halogens (TOX) and total organic carbon (TOC) levels in two downgradient wells. The results of the groundwater quality assessment, which concluded in 1996, are reported in *Results of RCRA Groundwater Quality Assessment at the 216-B-3 Pond Facility* (Barnett and Teel 1997) and are summarized in Section 3.3.3.5.

3.3.3.2 Aquifer Identification. The uppermost or unconfined aquifer beneath the 216-B-3 Pond is contained primarily within sediments of the Ringold Formation and extends from the water table to the top of the basalt or, in some areas, the lower mud unit of the Ringold Formation. The aquifer is more than 152 m thick in some areas and thins to 0 m along the flanks of bordering bedrock or other impermeable units.

The measured hydraulic properties of the suprabasalt sediments are highly variable. The range of hydraulic conductivities varies over several orders of magnitude, with the sharpest contrast between the Hanford formation and the Ringold Formation. In general, hydraulic conductivities in the Ringold Formation are several orders of magnitude lower than those in the Hanford formation. The westward flow throughout the 200 East Area is along a zone of very high transmissivity and is apparently a result of the water table occurring in the very permeable gravels of the Hanford formation.

3.3.3.3 Well Location and Design. The interim status groundwater monitoring network for the 216-B-3 Pond system and the 216-B-3-3 Ditch includes 25 wells constructed from 1987 through 1992. The location of the monitoring wells is shown in Figure 3-7. Ten of the wells are constructed with screens at the water table. The remaining 15 wells are screened at deeper levels in the aquifer. Construction summaries and details of drilling and design specifications for all wells in the interim status groundwater monitoring system are contained in WHC (1995).

Two upgradient wells were selected to determine the background groundwater chemistry. These are wells 299-E18-1 and 299-E32-4, located in the northwest and southwest portions of the 200 East Area, respectively. These locations were selected to be certain that the wells were not affected by the 216-B-3 Pond groundwater mound. Sixteen downgradient wells were used. Of these, 11 wells were completed in the confined aquifers and 5 wells were completed in the unconfined aquifers. Construction of wells followed RCRA standard well construction

specifications (WHC 1992). WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells," was used to set the basic design requirements.

3.3.3.4 Well Sampling and Analysis. The interim status groundwater monitoring sampling and analysis plan is based on an assessment-level monitoring program (WHC 1995). Sampling under this program occurs quarterly in accordance with 40 CFR 265.92. Constituents that are analyzed for are contamination-indicator parameters (pH, specific conductance, TOX, TOC) and site-specific parameters (semivolatile organic compounds, inductively coupled plasma metals [filtered], gross alpha, gross beta, alkalinity, anions, and turbidity). Analytical procedures follow SW-846 (EPA 1990) or equivalent methods. Water table elevation data have been evaluated at least annually to determine if the monitoring wells are appropriately located. Sampling, preservation, chain-of-custody procedures, and quality assurance and quality control protocols are described in WHC (1995). Sampling results are recorded in quarterly reports and in an annual summary.

Statistical analysis of interim status groundwater monitoring data are summarized in WHC (1995). Background levels for contamination-indicator parameters (established after 1 year of quarterly monitoring) are compared with results from downgradient wells semiannually in accordance with 40 CFR 265.92. Four replicate measurements are obtained from each downgradient well for the contamination-indicator parameters. An averaged replicate t-test method is used to evaluate the data.

The maximum number of wells (25) was monitored from 1993 to late 1995. The number of wells in the network was then reduced to 13 in 1995 to eliminate redundancy and focus resources on additional hydrochemical analyses in the remaining wells. In 1996, one of two upgradient wells (299-E18-1) was dropped from the network, and well 299-E32-4 was shared with the Low-Level Burial Grounds monitoring network.

In January 1998, the Interim Status Groundwater Monitoring Plan network for the 216-B-3 Pond was reduced to nine wells per the Interim Change Notice (ICN) (WHC 1995). This ICN also reduced the frequency of sampling from quarterly to semi-annually and the constituent list to contaminant indicator parameters (detection level) only. The nine wells that make up the network are 299-E32-4 (upgradient), 299-E26-11, 699-40-36, 699-40-40A, 699-41-42, 699-42-37, 699-43-43, 699-43-45, and 699-44-39B. Figure 3-8 shows the current monitoring network.

3.3.3.5 Results of Interim Status Groundwater Monitoring Data. The B Pond system was placed into an assessment-level groundwater monitoring program in 1990 due to elevated TOX and TOC in two wells. From that time until 1996, comprehensive sampling and analysis was performed to determine the cause of these anomalies. The assessment report (Barnett and Teel 1997) concluded that elevated TOX and TOC were isolated occurrences and that no dangerous waste could be correlated to the results. One compound, tris (2-chloroethyl) phosphate (TRIS2CH), was found to have potentially contributed to elevated TOX concentrations. However, due to (1) this compound generally being at low concentrations below or near limits of quantitation, (2) the possibility that TRIS2CH may be a product of well construction, and (3) its low and diminishing concentrations along with TOX and TOC, no further investigation was determined to be justified. There is no record of TRIS2CH being discharged to the B Pond system. The assessment report concluded that interim status groundwater monitoring should

revert to an indicator parameter evaluation program. This decision is currently pending approval by Ecology.

The only contaminants consistently detected in the groundwater that are attributable to B Pond system operations were tritium (maximum 232,000 pCi/L) and nitrate (maximum 22,500 pCi/L). Tritium is not a dangerous waste constituent for the purposes of RCRA groundwater monitoring; however, it is discussed here for completeness regarding the remediation of the 216-B-3 Pond. Only tritium occurred in concentrations above drinking water standards. Tritium and nitrate have generally trended downward in concentration since the beginning of interim status groundwater monitoring in 1988.

Chromium, iron, and manganese have historically exceeded drinking water standards in several wells. These concentrations have been attributed to well construction and oxidizing conditions in the aquifer. Arsenic has been detected at levels far below drinking water standards and is probably not attributable to operations of the B Pond system. Measurements of specific conductance have routinely produced results below Hanford Site background values for groundwater. Radionuclide activities have been very low at the B Pond system with the above-mentioned exception of tritium.

3.4 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This section describes the conceptual model developed to identify potential impacts on human health and the environment from waste sites in this group. Information pertaining to contaminant sources, release mechanisms, transport media, exposure route, and receptors are discussed to develop a conceptual understanding of potential risks and exposure pathways. This information will be used to support an evaluation of potential human health and environmental risk.

The primary sources of contamination at the waste sites in this group were major facilities (e.g., PUREX, B Plant) in the 200 East Area. Facilities in this area routinely discharged low-level contaminated wastewater to unlined ponds and ditches. Releases to the environment from primary sources have resulted in secondary contaminant sources, which are the contaminated soils beneath waste sites/unplanned release sites in this OU. Secondary releases can occur through infiltration, resuspension of contaminated soil, volatilization, biotic uptake, leaching, and external radiation (gamma). The dominant mechanism of contaminant transport is related to infiltration. Residual moisture from effluent discharge has the potential to impact groundwater, as it may be currently migrating through the soil column by gravity drainage in some areas.

Potential receptors (human and ecological) may be exposed to the affected media through several exposure pathways, including inhalation, ingestion, and direct exposure to external gamma radiation. Potential human receptors include current and future site workers and visitors (occasional users). Potential ecological receptors include terrestrial and aquatic plants and animals. The conceptual exposure model for the 200-CW-1 OU is shown in Figure 3-9.

Future impacts to humans are largely dependent on the land use. The type of future land use is not certain at this time, but industrial land use for the 200 Areas is favored by the Tri-Parties.

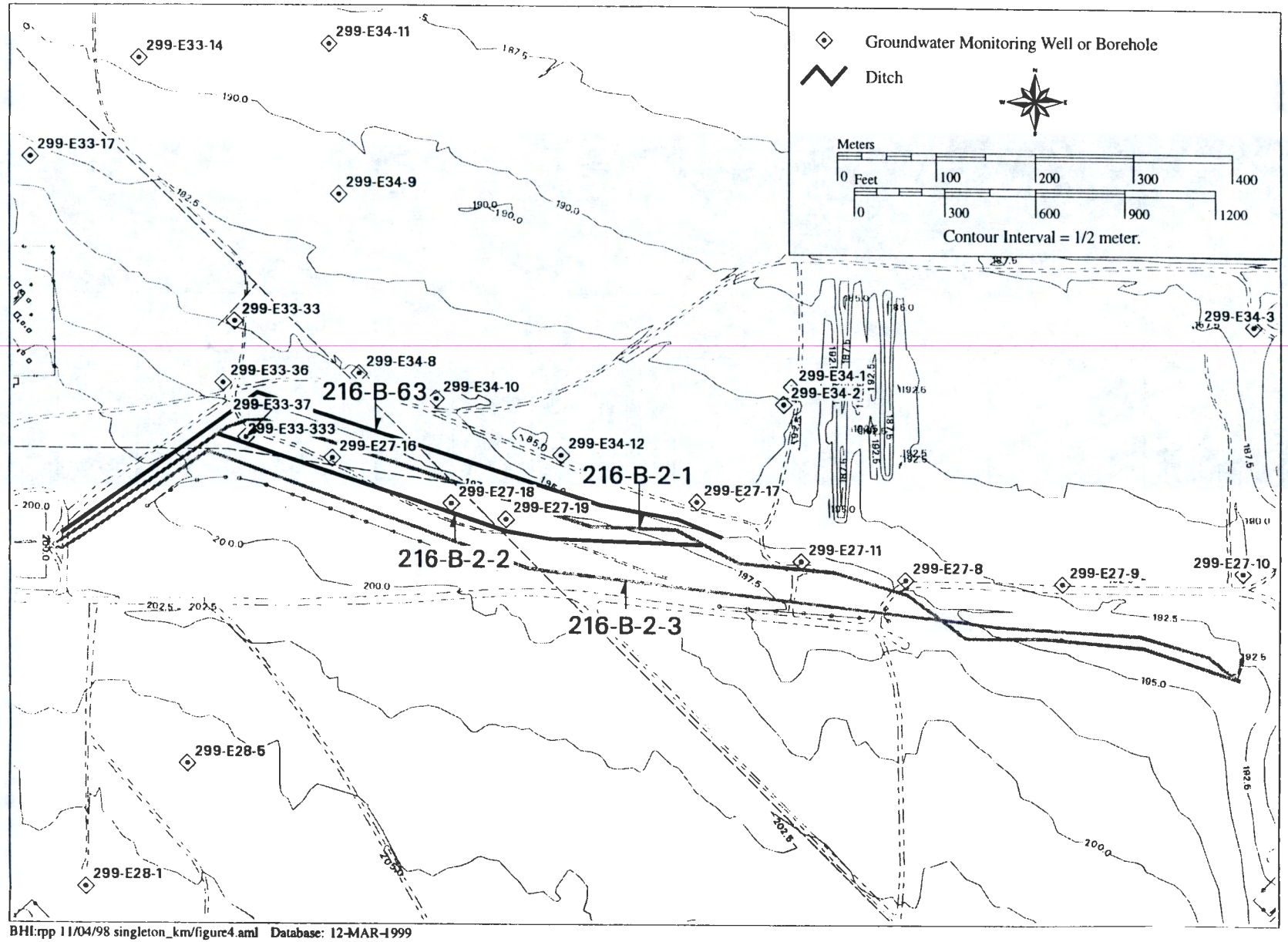
Outside the 200 Area boundary the preferred land use is preservation and conservation (DOE-RL 1998).

3.5 DEVELOPMENT OF CONTAMINANTS OF CONCERN

The development of a list of COPCs and refinement to the list of COCs was one of the main objectives of the data quality objective (DQO) process for characterization of the 200-CW-1 representative sites and TSD units. The DQO process is more fully described in Section 4.1. The preliminary list of COPCs included the complete set of contaminants that were potentially discharged to this cooling water group from facilities discussed in Section 2.2. This master list of COPCs was evaluated against a set of exclusion criteria to enable the development of a final COC list. Chemical characteristics such as toxicity, persistence, and chemical behavior in the environment were considered. The criteria for exclusion of certain constituents, as detailed in the DQO report (BHI 1999), are as follows:

- Short-lived radionuclides (half-lives of less than 3 years)
- Radionuclides that constitute less than 1% of the fission product inventory. Historical sampling also indicates that these radionuclides have not been detected in the environment
- Naturally occurring isotopes that were not created during Hanford Site operations
- Constituents with atomic mass greater than 242 that represent less than 1% of the actinide activities
- Progeny radionuclides that build insignificant activities within 50 years
- Chemicals that have no known carcinogenic or toxic effect
- Constituents that have been diluted, neutralized, and/or decomposed by high volumes of water and/or the presence of acids and bases
- Chemicals that are not persistent in the environment
- Potentially hazardous or toxic substances that are analyzed in the general suite of metals and organic analysis performed.

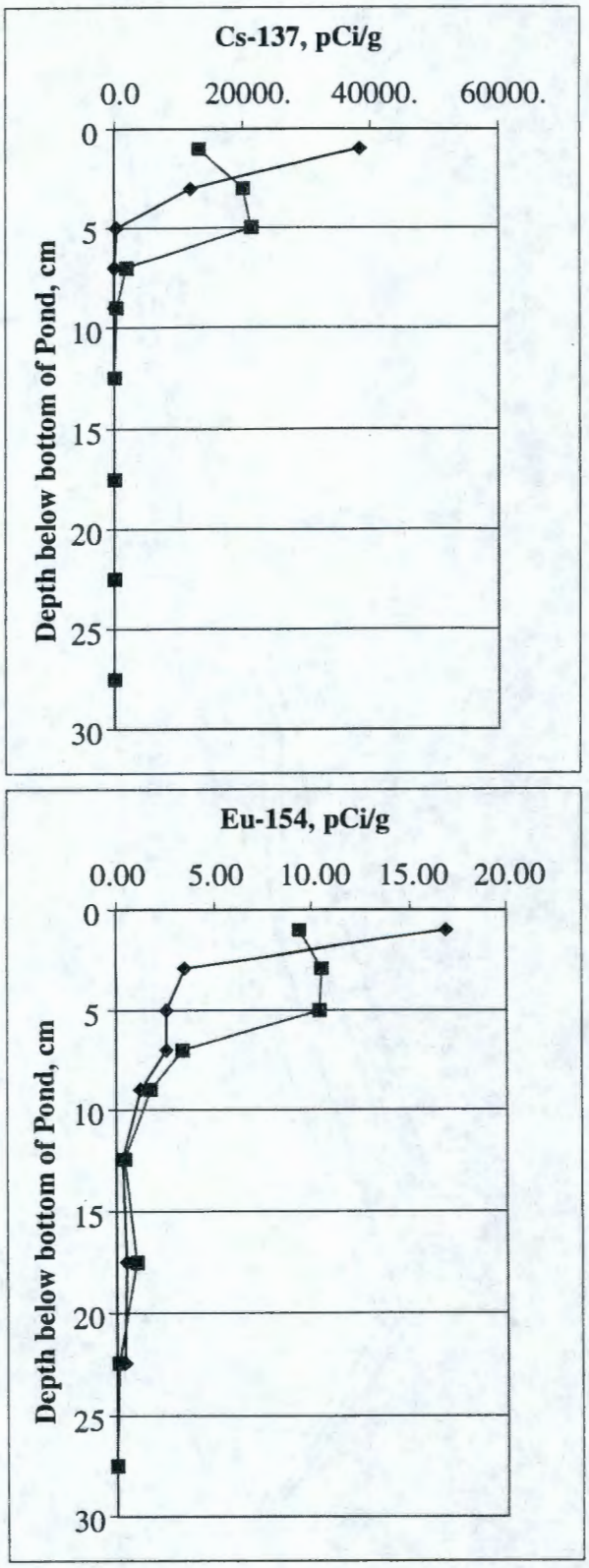
The exclusion process resulted in a final list of COCs for the Gable Mountain Pond/B-Pond and Ditch Cooling Water Group, which is presented in Table 3-3. The preliminary list of COPCs and the excluded analytes and rationale for exclusion are presented in Table 1-6 of the DQO summary report (BHI 1999). Additional information regarding the COCs is presented in the DQO summary report and Section 4.0 of this document.

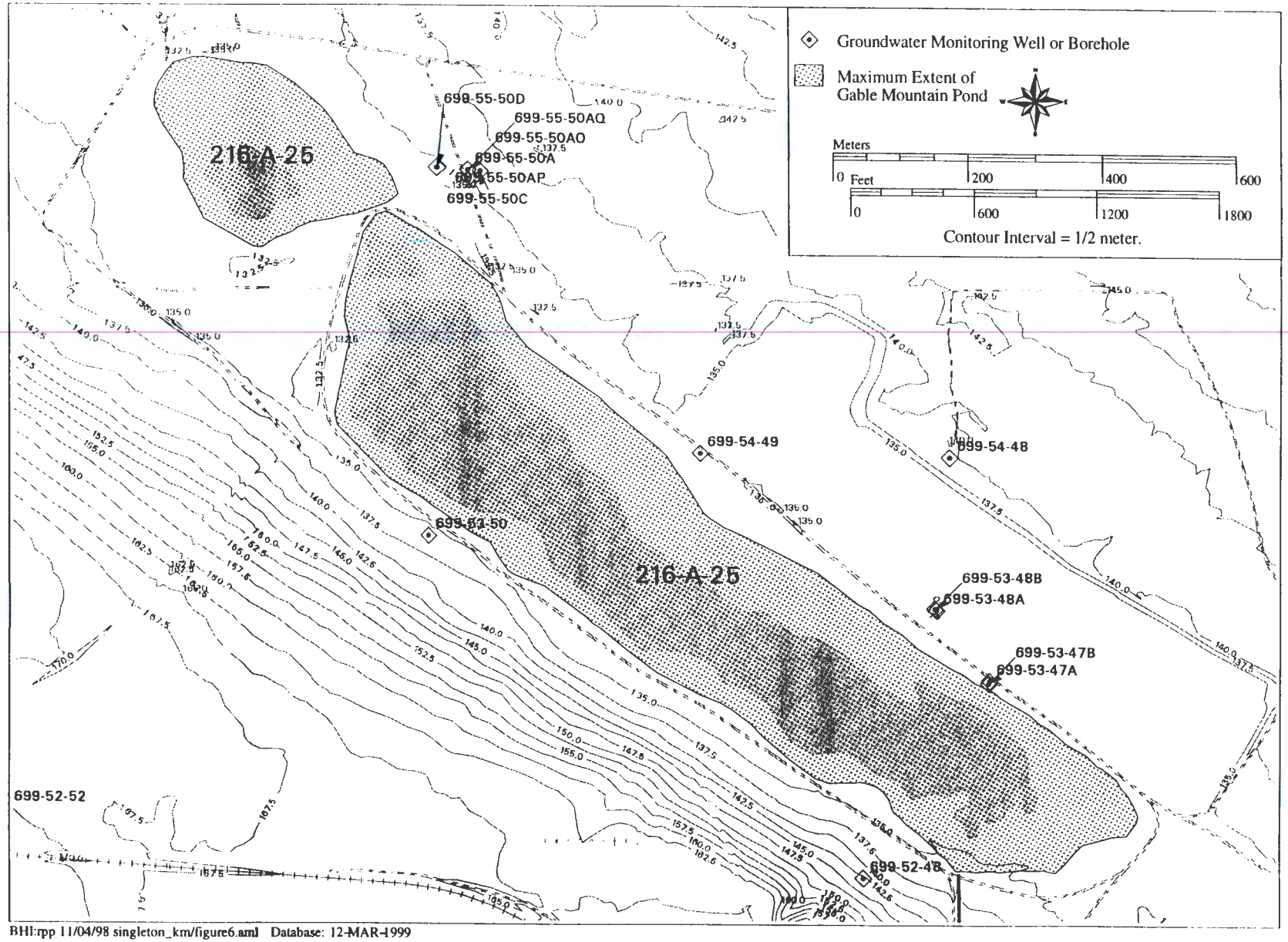


BHI:rpp 11/04/98 singleton_km/figure4.aml Database: 12-MAR-1999

Figure 3-1. The 216-B-2-2 Ditch.

Figure 3-2. Vertical Distribution of Cesium-137 and Europium-154 (decayed to September 1998) for Sediment Samples Collected in Gable Mountain Pond (after Madeen 1970).





BHI:rpp 11/04/98 singleton_km/figure6.aml Database: 12-MAR-1999

Figure 3-3. Gable Mountain Pond.

Figure 3-4. Vertical Distribution of Strontium-90 Near Gable Mountain Pond (decayed to September 1998), from Soil Samples Collected During Construction of Well 699-53-47B (after Fuchs et al. 1984).

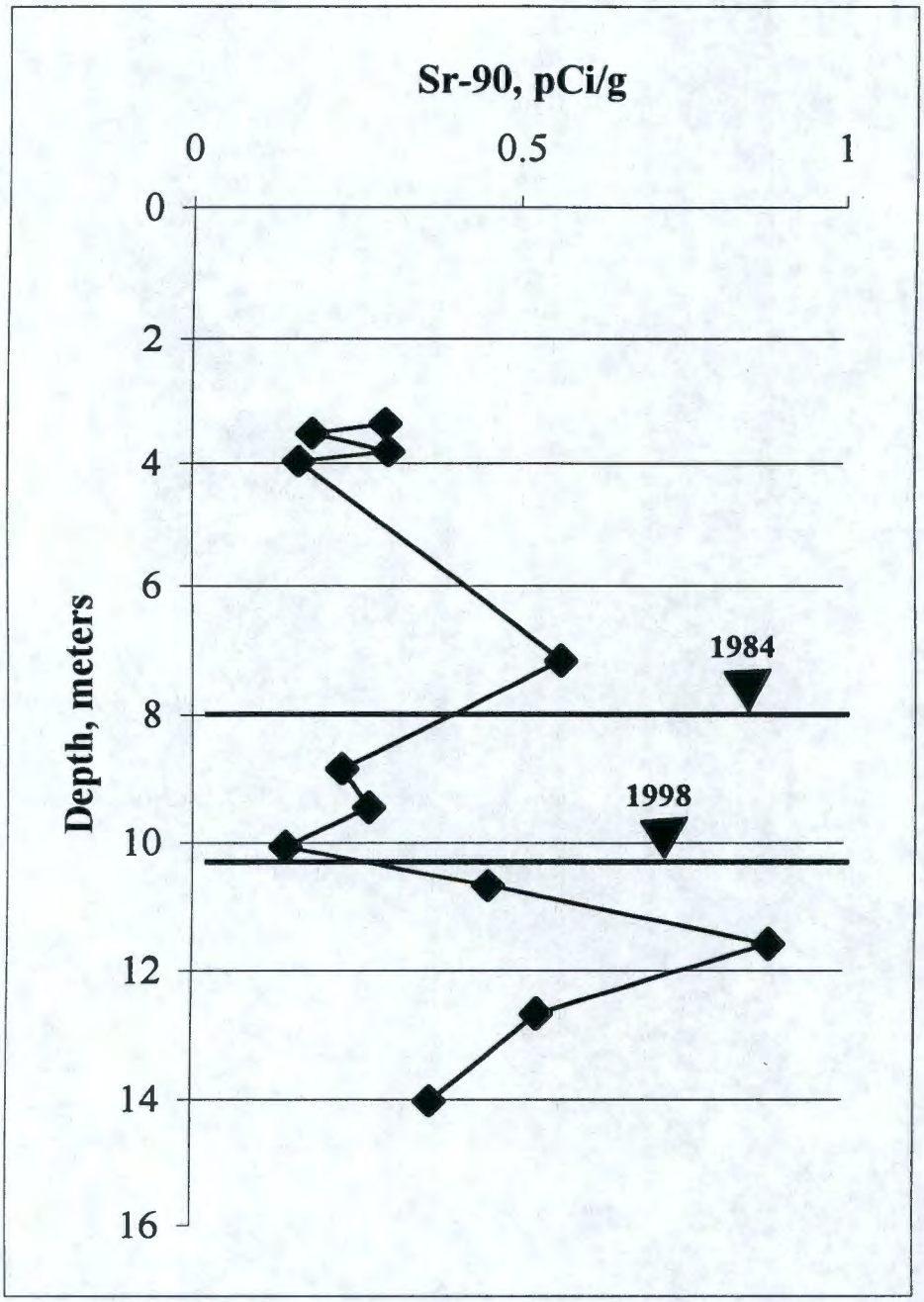


Figure 3-5. Strontium-90 Groundwater Plume at Gable Mountain Pond, 1998. Dots and circles represent locations of groundwater monitoring wells.

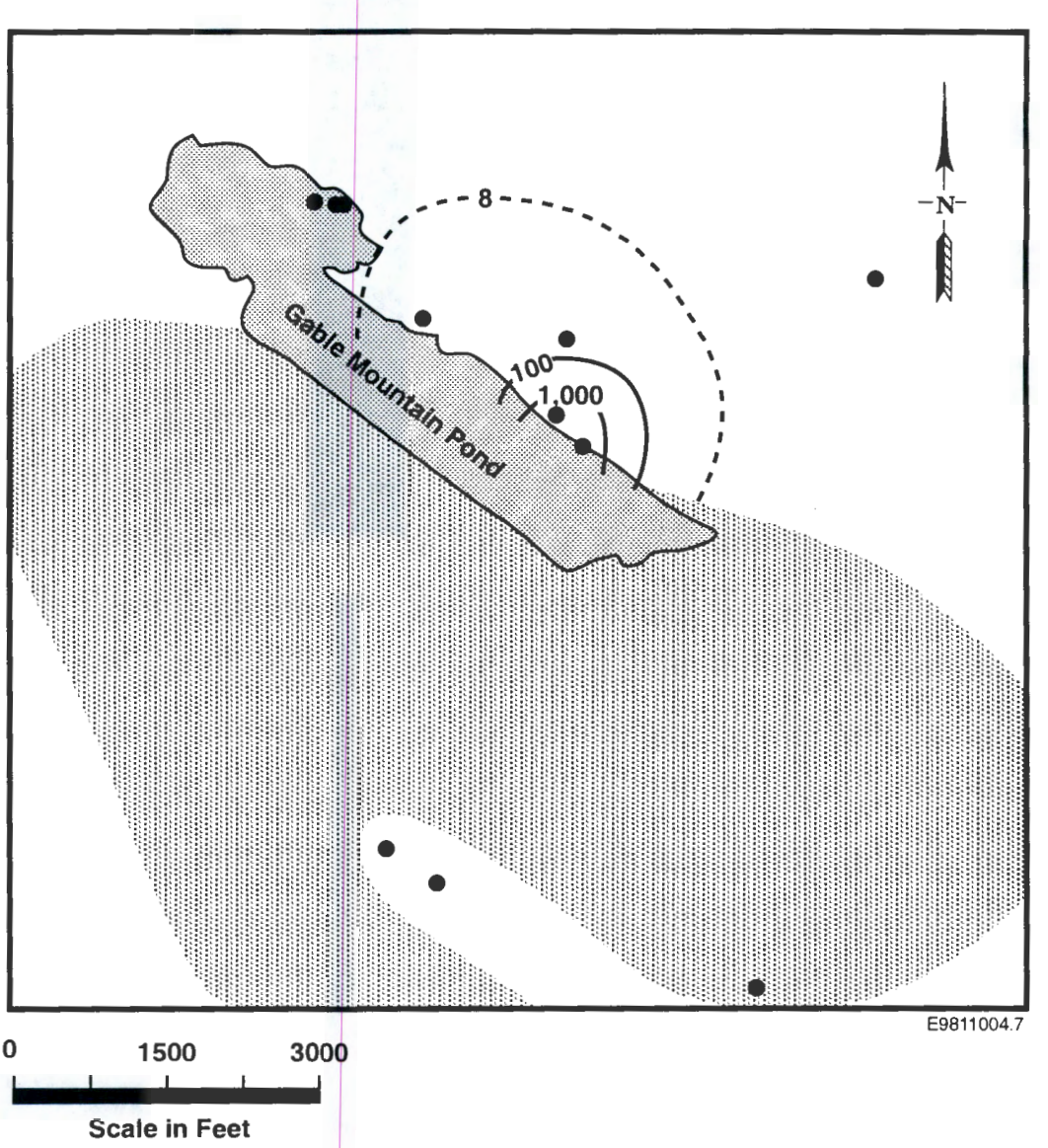


Figure 3-6. Strontium-90 Concentrations in Groundwater from Well 699-53-47B from 1984 to 1998.

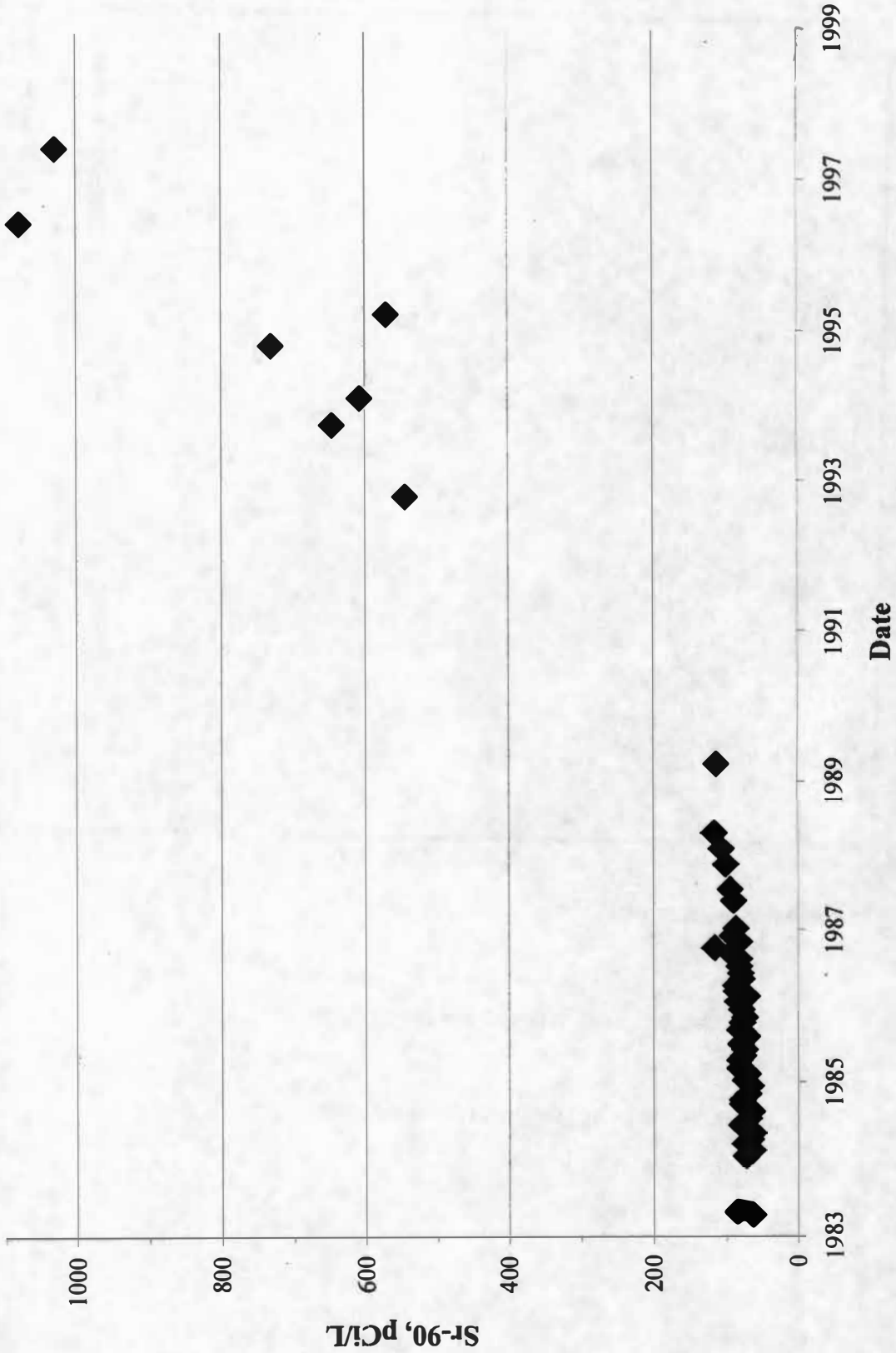


Figure 3-7. B Pond (216-B-3) and Associated Groundwater Monitoring Wells.

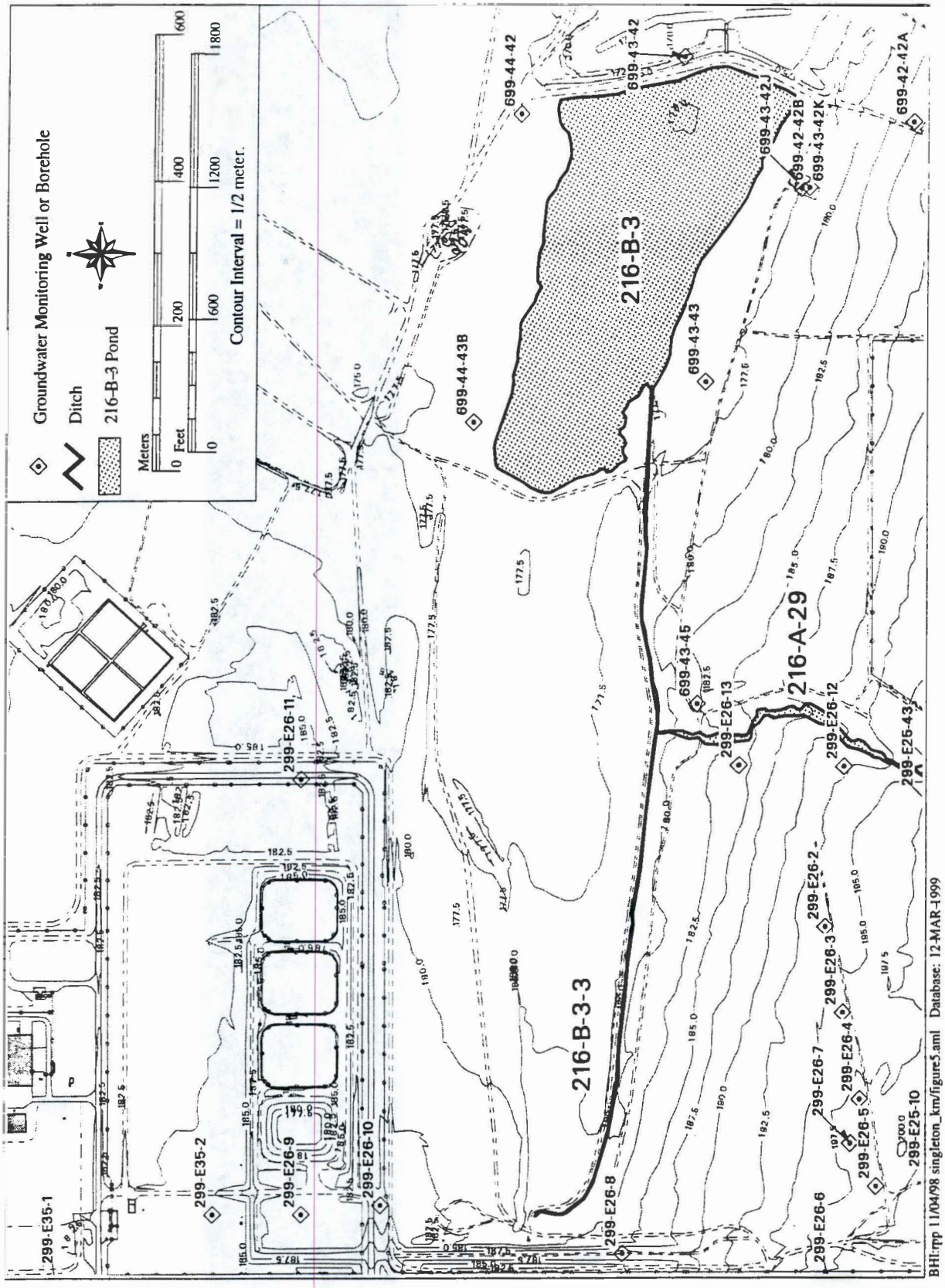


Figure 3-8. Current Groundwater Monitoring Network for the 216-B-3 TSD Unit.

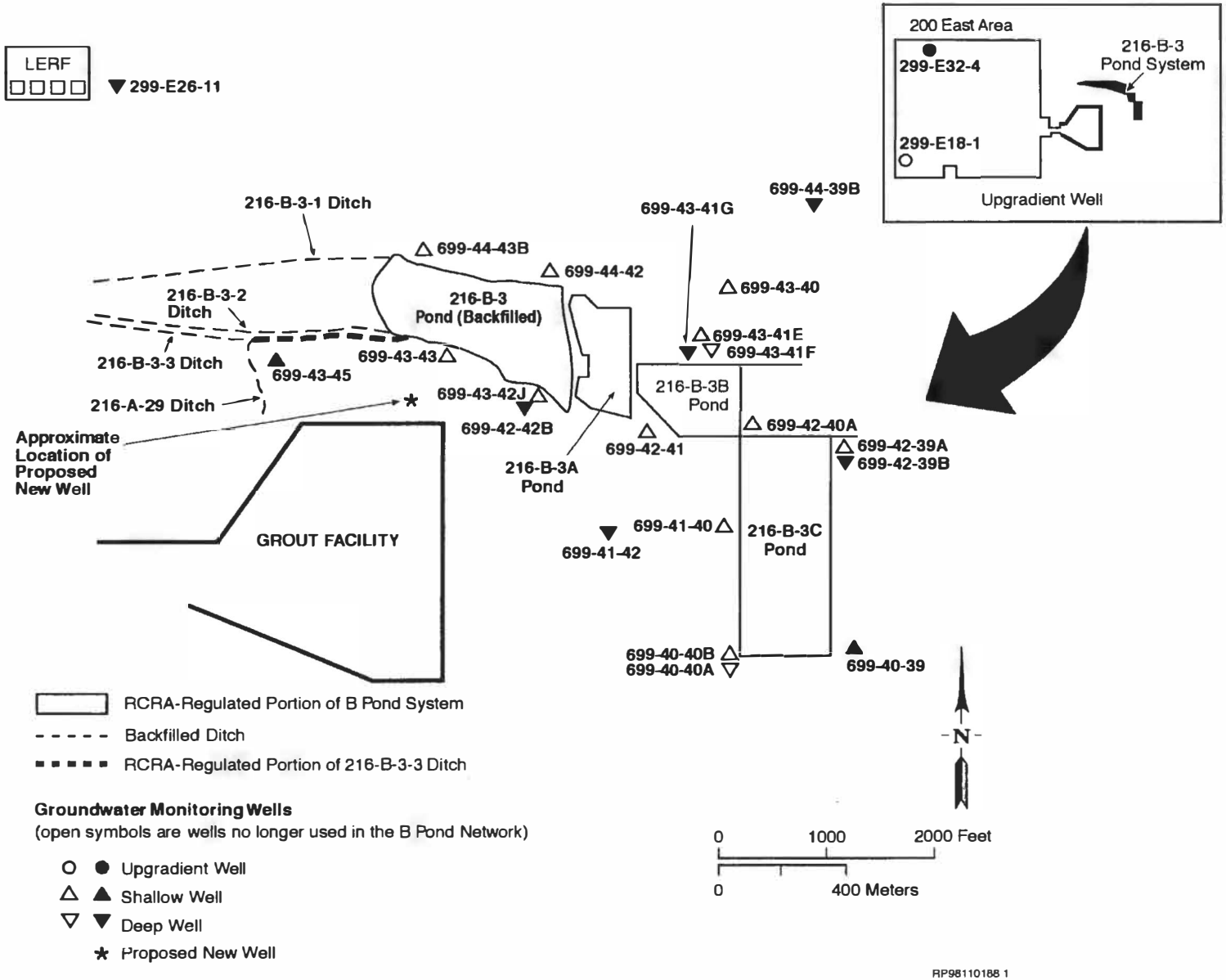


Figure 3-9 Conceptual Exposure Model for the 200-CW-1 Waste Sites.

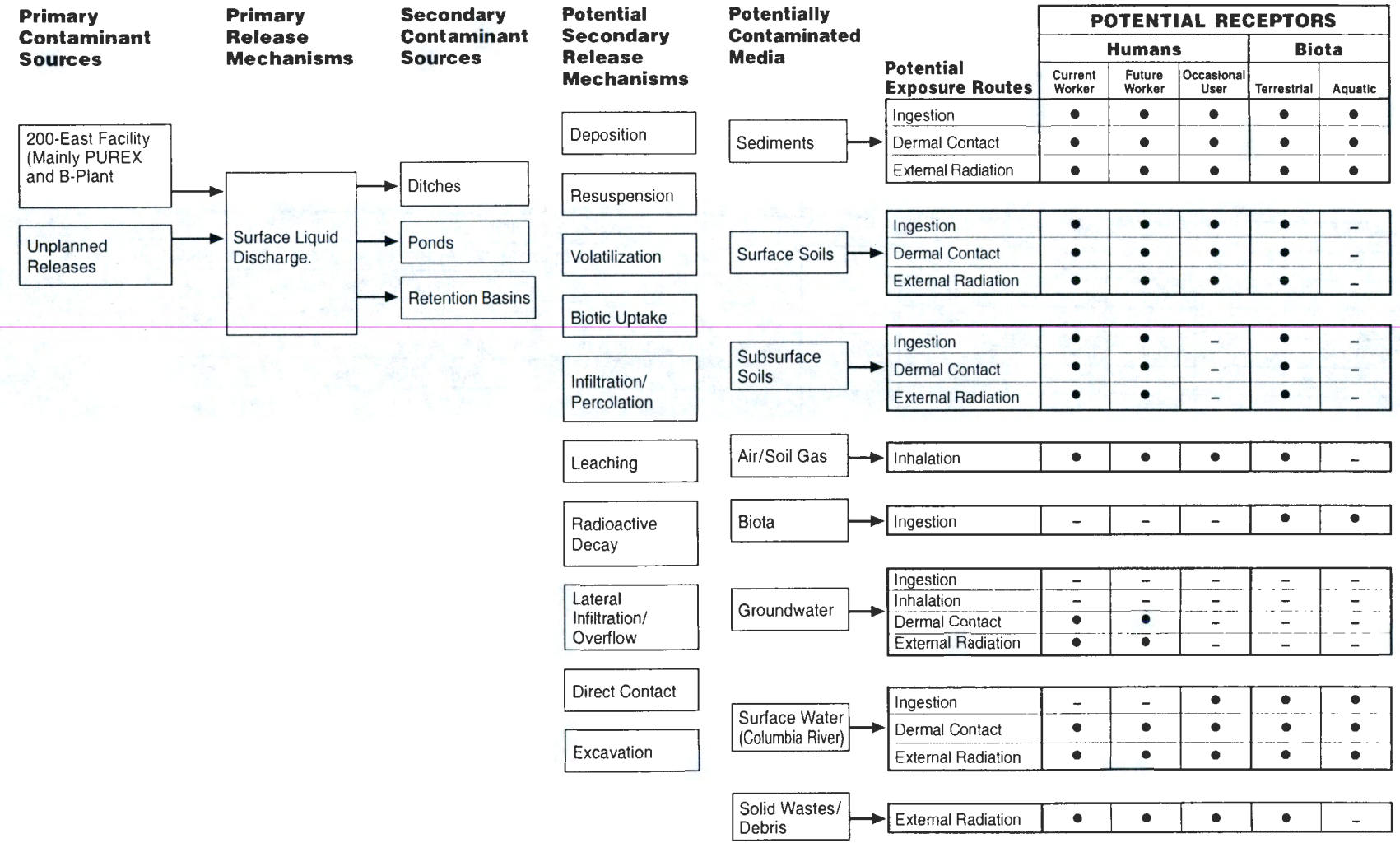


Table 3-1. Inventory of Known and Suspected Contamination for Each Representative Site in the 200-CW-1 Operable Unit, and Effluent Volume Received. Radionuclides decayed to September 1998 (from DOE-RL 1997).

Site	Site Name	Total U (kg)	Total Pu (g)	Am-241 (Ci)	Cs-137 (Ci)	Sr-90 (Ci)	Nitrate (kg)	Effluent Volume (m^3)
200-E PD	200-E Powerhouse Ditch	--	--	--	--	--	--	--
207-B	207-B Retention Basin	--	--	--	--	--	--	--
216-A-9	216-A-9 Crib	0.22	0.5	-	3.8	8.9	300000	981,029
216-A-25	Gable Mountain Pond	878	428	0.000528	167	208	-	307,000,000
216-A-40	216-A-39 Crib, 216-A-39 Trench	--	--	--	--	--	--	946
216-A-42	216-A-42, 207-AA Retention Basin	--	--	--	--	--	--	--
216-B-2-1	216-B-2-1 Ditch	--	250	3.96	76.3	82	--	149,000,000
216-B-2-2	216-B-2-2 Ditch	--	0.042	--	0.256	119	--	49,700
216-B-2-3	216-B-2-3 Ditch	--	--	--	0.256	350	--	--
216-B-3	B Pond	370	250	3.96	76.3	82	-	240,000,000
216-B-3-1	216-B-3-1 Ditch	--	--	--	--	--	--	149,000,000
216-B-3-2	216-B-3-2 Ditch	--	--	--	--	--	--	149,000,000
216-B-3-3	216-B-3-3 Ditch	--	--	--	--	--	--	--
216-B-3A	B Pond Lobe A	--	--	--	--	--	--	--
216-B-3B	B Pond Lobe B	--	--	--	--	--	--	--
216-B-3C	B Pond Lobe C	--	--	--	--	--	--	--
216-B-59	216-B-59 Trench	--	--	--	--	--	--	--
216-B-59B	216-B-59B Retention Basin	--	--	--	--	--	--	477
216-C-9	216-C-7 Swamp, Former 221-C Canyon Excavation	--	0.338	--	0.0098	0.0234	--	1,030,000
216-E-28	216-E-25, 200 East Area Contingency Pond	--	--	--	0.574	1.97	--	--
216-N-8	West Lake, West Pond	---	--	--	--	--	--	--
UPR-200-E-14	UN-200-E-14, 216-B-3 Pond Dike Break	--	--	--	--	--	--	--
UPR-200-E-32	UN-200-E-32, Coil Leak from 221-B	--	--	--	--	--	--	--
UPR-200-E-34	Liquid Release to B-Pond and Gable Pond	--	--	--	--	--	--	--
UPR-200-E-51	Liquid Release from PUREX to B-Pond	--	--	--	--	--	--	--
UPR-200-E-66	216-A-42 Basin Contamination Release	--	--	--	--	--	--	--
UPR-200-E-94	Vehicle Decontamination Area	--	--	--	--	--	--	--
UPR-200-E-138	Liquid release from B Plant	--	--	--	--	--	--	--
	TOTALS:	1248	929	7.92	397	1051	300,000	996,062,152
	Total for representative sites and TSDs:	1248	678	3.96	298	505	0	307,049,700

Table 3-2. Chemical Releases into the PUREX Plant Chemical Sewer Line from Mid-1983 to 1987 (modified from DOE-RL 1990).

Date	Chemical	Pounds	Waste Designation
5/20/83	Aluminum nitrate nonahydrate	17,725	None
10/17/83	Potassium permanganate Sodium carbonate	10,700 1,412	None
2/9/84	Potassium hydroxide	83,000	D002
2/26/84	Sodium hydroxide	3,700	D002, WT02
5/16/84	Cadmium nitrate	25 – 50	D006, WT01
6/6/84	Hydrazine Hydroxylamine nitrate	332 90	U133
8/22/84	Nitric acid	9,000	D002
10/2/84	Hydrazine Hydroxylamine nitrate	280 407	U133, WT02
11/1/84	Sulfuric acid	3,482	None
11/27/84	Nitric acid Ferrous sulfamate Sulfamic acid	349 43 68	None
12/2/84	Potassium hydroxide	150	D002
12/2/84	Potassium hydroxide	62,683	D002, WT02
1/10/85	Hydroxylamine nitrate Hydrazine Nitric acid	100 21 66	U133
1/18/85	Nitric acid	6,236	D002, WT02
2/8/85	Sodium nitrate	160	None
4/4/85	Ferrous sulfamate Nitric acid Sulfamic acid	52 269 132	None
5/14/85	Nitric acid Hydroxylamine nitrate Hydrazine	190 98 .4	U133
5/27/85	Nitric acid	223	None
6/25/85	Nitric acid	24,189	D002, WT02
7/1/85	Ammonium fluoride Ammonium nitrate	5,368 1,016	WT01
8/6/85	Sodium hydroxide	42,440	D002, WT02
10/28/85	Nitric acid	1,181	D002
12/18/85	Cadmium nitrate	35	D006, WT01
12/28/85	Aluminum nitrate nonahydrate	650 – 730	None
2/12/86	Nitric acid Sulfuric acid	42 276	D002
2/13/86	Sulfuric acid	77	D002
2/19/86	Sodium hydroxide	<100	D002, WT02
2/21/86	Sulfuric acid	<100	D002
3/24/86	Sulfuric acid	<100	D002
6/28/86	Sulfuric acid	121	D002
7/7/86	Hydrazine	6	U133
4/25/87	Sodium nitrite	1,275	none

Table 3-3. List of Contaminants of Concern at the 200-CW-1 Operable Unit.

Radioactive Constituents	
Americium-241	Plutonium-239/240
Cesium-137	Strontium-90
Cobalt-60	Technetium-99[a]
Europium-152	Tritium[a]
Europium-154	Thorium-232
Europium-155	Uranium-233/234
Neptunium-237	Uranium-235/236
Nickel-63*	Uranium-238
Plutonium-238	
Chemical Constituents - Metals	
Arsenic	Lead
Barium	Mercury
Beryllium	Nickel
Cadmium	Selenium
Chromium	Silver
Hexavalent Chromium	Vanadium
Copper	Zinc
Chemical Constituents - Other Inorganics	
Ammonia	Phosphate
Chloride	Sulfate
Cyanide	Sulfide
Fluoride	**pH**
Nitrate/Nitrite	
Chemical Constituents - Volatile Organics	
Acetone	Dichloromethane (Methylene Chloride)
1-Butanol (Butyl alcohol)	Ethanol
2-Butanone (MEK)	Halogenated hydrocarbons
Butylated hydroxy toluene	Propanol (Isopropyl alcohol)
Carbon Tetrachloride	Toluene
Chloroform (Trichloromethane)	1,1,1 Trichloroethane
Decane	1,1,2 Trichloroethane
Semi-Volatile Organics	
Diesel fuel[b]	Polychlorinated biphenyls (PCBs)
Kerosene[b]	Shell E-2342 (napthalene and paraffin)[b]
Normal paraffin hydrocarbon[b]	Soltrol-170 ($C_{10}H_{22}$ to C_6 to H_{34}; purified kerosene)[b]
Paraffin hydrocarbons[b]	Tributyl phosphate

*These COPCs are deep-zone sensitive only. No analyses are required for these in the shallow zone soils, as they are soft beta emitters in low abundance that have insignificant dose impact in the shallow zone.

[b]Analyzed as kerosene total petroleum hydrocarbons.

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4.0 WORK PLAN APPROACH AND RATIONALE

4.1 SUMMARY OF DATA QUALITY OBJECTIVE PROCESS

The remedial investigation needs for the 200-CW-1 OU were developed in accordance with the DQO process (EPA 1993; BHI-EE-01, *Environmental Investigations Procedures*, Procedure 1.2). The DQO process is a seven-step planning approach that is used to develop a data collection strategy consistent with data uses and needs. The goals of the process are to provide the data needed to refine the preliminary site conceptual model and support remediation decisions.

The DQO process was implemented by a team of subject matter experts and key decision makers. Subject matter experts provided input on regulatory issues, the physical condition of the sites, and sampling and analysis methods. Key decision makers from the U.S. Department of Energy, EPA, and Ecology participated in the process and approved the characterization approach as outlined in the DQO workbook. The DQO process and involvement of the team of experts and decision makers provides a high degree of confidence that the right type and quality of data are collected to fulfill informational needs of the 200-CW-1 remedial investigation. Results of the DQO process for characterization of the representative sites and TSD units in the 200-CW-1 OU are presented in a summary report (BHI 1999).

4.1.1 Data Uses

Data generated during characterization of the representative sites and TSD units will consist mainly of contaminant data. Contaminant data will be used to define the nature and extent of radiological and chemical contamination; support an evaluation of risks; and assist in the evaluation, selection, and design of a remedial alternative. By defining the type and distribution of contamination, the site-specific conceptual model for contaminant distribution can be verified or rejected. Verification of the current model will direct the application of the analogous unit concept at 200-CW-1 waste sites. A limited amount of data will be collected to characterize the physical properties of soils that will be used to support an assessment of risk (e.g., RESidual RADioactivity Dose Model [RESRAD] modeling). Contaminant and soil property data will be obtained by sampling and analyzing soils at the two representative sites and two TSD units.

4.1.2 Data Needs

A considerable amount of information has been presented in Sections 2.0 and 3.0 regarding 200-CW-1 waste sites. Some of this information will be used to develop a site-specific conceptual model for the waste sites, and additional information is provided by reference. For most waste sites, information is available regarding location, design, major types of waste disposed, and radiological contaminants associated with the bottom of waste sites. However, the data needed to refine the site conceptual model and support remedial decision making are limited. As defined by the DQO process, the focus of the 200-CW-1 RI is to determine the nature and extent of contamination in the vadose zone. Specifically, determinations of the type, concentration (especially highest concentration), and vertical and lateral extent of radiological and chemical contaminants in the vadose zone are the major data needs. Data are also required to determine the physical properties of soils; these data will provide additional inputs to support

an evaluation of risk through the use of models for groundwater transport, exposure to radionuclides, etc.

4.1.3 Data Quality

Data quality was addressed during the DQO session by identifying potential COCs and establishing associated analytical performance criteria. The process of identifying potential COCs is summarized in Section 3.5. Analytical performance criteria were established by evaluating potential ARARs and preliminary remediation goals (PRGs), which are regulatory thresholds/standards or derived risk-based thresholds. These potential ARARs and PRGs represent chemical-, location-, and action-specific requirements that are protective of human health and the environment. Regulatory thresholds/standards or preliminary action levels provide the basis for establishing cleanup levels and dictate analytical performance levels (i.e., laboratory detection limit requirements). Detection limit requirements and standards for precision and accuracy are used to define data quality.

To provide the necessary data quality, detection limits should be lower than preliminary action levels. Additional data quality is gained by establishing specific policies and procedures for the generation of analytical data and field quality assurance/quality control requirements. These requirements are discussed in detail in the sampling and analysis plan (SAP) (Appendix A). Analytical performance requirements are specified in Tables 3-7a and 3-7b of the DQO workbook (BHI 1999). Table 3-7a contains analytical requirements for shallow soils collected up to 4.6 m (0 to 15 ft) bgs, and Table 3-7b provides the analytical requirements for deeper soils. The potential ARARs and PRGs for 200 Area waste sites are discussed in Sections 4.0 and 5.0 of the Implementation Plan (DOE-RL 1998).

4.1.4 Data Quantity

Data quantity refers to the number of samples collected. The number of samples needed to refine the site conceptual model and make remedial decisions is based on a biased sampling approach. Bias in sampling is the intentional location of a sampling point within a waste site based on process knowledge of the waste stream and expected behavior of the contaminant(s) of concern, and is the preferred sampling approach as defined in Section 6.2.2 of the Implementation Plan (DOE-RL 1998) for the RI phase. Using this approach, sampling locations can be selected that increase the chance of encountering the highest contamination in the local soil column.

Sample locations at representative sites and TSD units were selected based on the preliminary conceptual model presented in the DQO summary report and applied to site-specific representative sites and TSD units in Section 2.4 of this work plan. Twenty-nine locations in the four waste sites were selected for sampling. The locations were selected with the goal of intersecting the highest area of contamination and to determine the vertical and lateral extent of contamination within the historical boundary of the waste sites. Three to ten samples will be collected from different depths at each of the sites to evaluate the extent of contamination. Additional samples may be collected as warranted by observations such as changes in lithology and visual indications of contamination. This bias sampling approach was designed to provide the data needed to meet data DQOs for this phase of work.

4.2 CHARACTERIZATION APPROACH

This section provides an overview of characterization activities that are planned to collect the required data identified in the DQO process. These activities are borehole drilling and excavation of test pits (or auger boreholes) to collect and analyze soil samples. The sampling strategy is designed to provide access to potentially contaminated subsurface areas. Sample collection shall be guided by field screening efforts and a sampling scheme that identifies critical sampling depths.

4.2.1 Drilling and Sampling

Two deep boreholes will be drilled and sampled at locations near the inlets to Gable Mountain Pond and B Pond (Figures 4-1 and 4-2). These locations were chosen because the inlet areas are where the highest levels of contamination are generally expected to exist and, therefore, the deep sediments that will be collected should provide a worst case for maximum contamination levels at depth.

The sample collection strategy has been designed to thoroughly characterize the pond sediments and the vadose zone materials beneath them to the top of the groundwater table. Sampling will generally begin at the first sign of radiological contamination, as determined by field measurements. This contamination is expected to begin at the historic bottom of the pond (i.e., pond sediments), but if contamination is detected in backfill materials above the pond bottom, they will also be sampled. Samples shall be collected at 0.76-m (2.5-ft) intervals for the first 3 m (10 ft) from the bottom of the pond, then at 1.5-m (5-ft) intervals to 7.6 m (25 ft), then at 3-m (10-ft) intervals to groundwater. An additional sample will be collected at a total depth of 48.2 m (158 ft) bgs. This will represent the high water mark sample based on information taken from monitoring well 699-43-43 located approximately 61 m (200 ft) due south of the proposed borehole location. For B Pond, samples will also be collected at 15 m (50 ft), 30 m (100 ft), 45.7 m (150 ft), and just above the water table. An additional sample will be collected at a total of 7.8 m (25.5 ft) bgs. This will represent the high water mark sample based on information taken from monitoring well 699-53-47B located approximately 137 m (450 ft) to the west-southwest. Samples that were identified as critical in the DQO process will be collected at 4.6 m (15 ft) and 7.6 m. Additional samples may be collected at the discretion of the geologist/sampler based on field screening and geologic information. A detailed sample schedule for each deep borehole is presented in the SAP (Appendix A).

All drilling will be via a method approved by Bechtel Hanford, Inc. (BHI), and will conform to site-specific technical specifications for environmental drilling services. The drill rig will require a 23-m (75-ft) square pad with a 5-m- (16-ft) wide access road leading to it. Cleaning and decontamination requirements will also be performed using BHI-approved methods.

Likely drilling methods for this project include cable tool, sonic, and diesel hammer. The drilling method must allow the use of a 13-cm- (5-in.) outside-diameter split-spoon sampler. Use of a split-spoon sampler will necessitate composting the sample over at least 0.3 m (1 ft) to obtain enough sample for analysis. The drilling method must not use any system that circulates air or water.

Boreholes will be drilled to the top of the water table. The maximum total depth of the investigation at Gable Mountain Pond and B Pond will be approximately 12 m (40 ft) and 52 m (170 ft) bgs, respectively, based on the depth to water in nearby wells. The presence of water-saturated soils will indicate the end of the borehole and will be determined by the site geologist. Up to three strings of casing may be telescoped to the proposed depth, to minimize transport of contaminants in the vadose zone from the drilling operations. The casing sizes will be of sufficient size to accommodate a split spoon to the bottom of the borehole. Downsizing of the casing will be commensurate with the decrease in contamination levels with depth based on field screening. Actual conditions during drilling may warrant changes; the changes may be implemented after consultation with, and the approval of, the task lead and the site technical representative. The casing at the Gable Mountain Pond borehole will be removed when drilling and sampling are completed. The borehole shall be backfilled with bentonite or an appropriate alternative abandonment procedure in accordance with WAC 173-160, "Minimum Standards for Construction and Maintenance of Wells." The B-Pond boring will be completed as a RCRA groundwater monitoring well for the TSD unit.

4.2.2 Test Pit Excavation/Auger Drilling and Sampling

Twenty-seven test pits and/or shallow auger borings shall be excavated and sampled at the representative sites and TSD units. The locations of these excavations are shown in Figures 4-1 through 4-3. Test pits will likely be used for excavating and sampling; however, a hollow stem auger may be used as an alternative if it is determined to be more cost-effective. The excavations will be used to determine vertical and lateral extent of contamination within the area historically defined as the waste site boundary.

If sampling from a test pit, samples shall be collected at the bottom of the pond (or the first detection of contamination, whichever is encountered first) and at 0.75-m (2.5-ft) intervals to 3 m (10 ft), then at 1.5-m (5-ft) intervals to 7.6 m (25 ft). Additional samples may be collected at the discretion of the geologist/sampler based on field screening information, and critical samples will be collected at 4.6 and 7.6 m bgs. A detailed sample schedule for each test pit/auger borehole is presented in the SAP (Appendix A). The maximum depth of test pit excavation will be 7.6 m (25 ft) bgs.

Test pits will be excavated and sampled with an excavator, which will be large enough to collect samples from the maximum target depth of 7.6 m (25 ft). The samples shall be collected directly from the backhoe bucket and handled in accordance with BHI-EE-01, *Environmental Investigations Procedures*.

Samples collected from hollow stem augers will require the use of a large-diameter split-spoon sampler, which necessitates compositing the sample through at least 0.3 m (1 ft) to get adequate sample size for analysis. In this case, samples will be collected at the intervals described for drilling to 7.6 m (25 ft). As with test pits, critical samples will be collected at 4.6 and 7.6 m (15 and 25 ft); additional samples may be collected at the discretion of the geologist/sampler based on field screening information.

4.2.3 Field Screening

All samples and/or cuttings from the boreholes and test pits will be field screened for evidence of radionuclides by the radiological control technician. Radioactivity screening of the soils will assist in the selection of sample intervals. Field screening instrumentation will be maintained consistent with the manufacturer's specifications and other approved procedures. The site geologist will record all field screening results in the borehole log. Field screening methodology and instrumentation is described in detail in the SAP (Appendix A).

4.2.4 Analysis of Soil

Samples shall be collected for chemical and radionuclide analysis and the determination of soil properties. A fairly broad and comprehensive list of analytes has been selected for this investigation; this list was developed based on an evaluation of all potential contamination that was discharged to the waste sites. Development of this list of COCs is presented in Section 3.5 and Table 3-3. Tables A2-1 and A2-2 of the SAP list detailed descriptions of analytical methods, holding times, and quality assurance and quality control procedures for each contaminant. A limited number of samples will also be analyzed to determine soil physical properties such as moisture content and particle size. All samples will be collected and controlled in accordance with BHI-EE-01, EIP 4.0, "Soil and Sediment Sampling." A detailed sample schedule for all boreholes and test pits is included in the SAP.

4.3 GEOPHYSICAL LOGGING

The two deep boreholes described in Section 4.2.1 will be logged with a spectral gamma-ray logging system to provide continuous vertical logs of gamma-emitting radionuclides, and with a neutron moisture logging system to identify moisture changes.

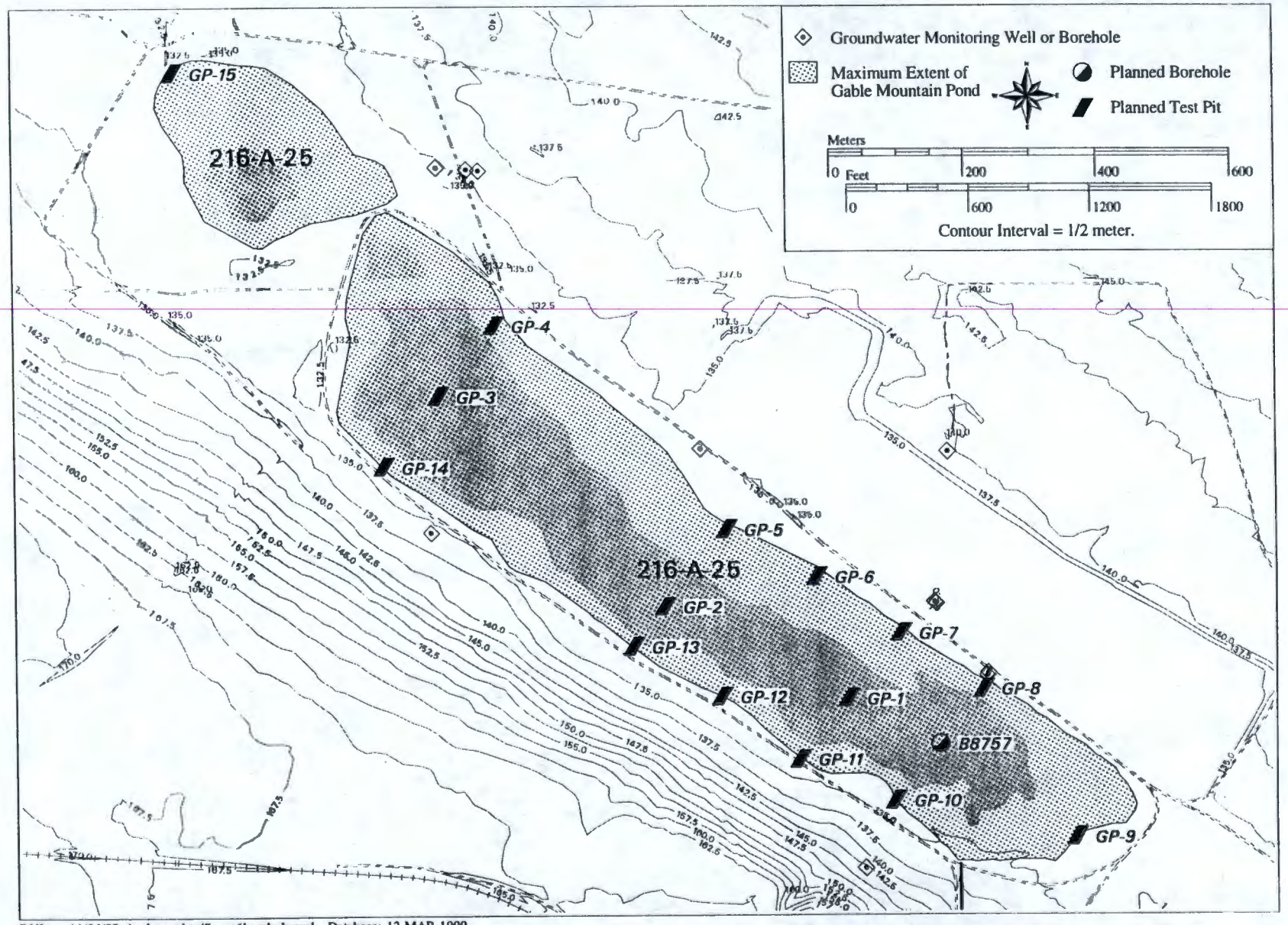
The spectral gamma logging system uses standard laboratory high purity germanium (HPGe) detector instrumentation to identify and quantify gamma-emitting radionuclides in wells as a function of depth. The HPGe detector is calibrated to National Institute of Standards and Technology testing requirements and includes corrections for environmental conditions that deviate from the standard calibration condition. The HPGe detector has been used to locate, identify, and monitor the distribution and movement of contaminants in more than 600 boreholes at the Hanford Site. The precision of this detector is such that movement of mobile constituents in the subsurface can be identified to as little as 0.07 m (0.25 ft) at depths of up to 167.6 m (550 ft). The detector requires constant cooling with liquid nitrogen and was designed to operate completely submerged in water. Venting of the nitrogen gas to the surface is accomplished with a specially designed logging cable.

The geophysical logging system that measures moisture employs a weak radioactive neutron source and neutron detector to provide a direct reading of hydrogen atom distribution in the soil surrounding the borehole. This detector will be used to measure continuous vertical moisture in the vadose zone.

The geophysical logs will be used to supplement the laboratory radionuclide data to determine the vertical distribution of radionuclides in the vadose zone beneath Gable Mountain Pond and B Pond and aid in geological interpretation of subsurface stratigraphy. The deep boreholes will be logged prior to the addition of a new casing string and after the well has reached total depth.

Existing wells in the vicinity of representative sites and TSD units may be logged with the gamma ray logging tool. Logging will only be required in existing wells that have one casing string and lack annular seals. A list of wells to be logged is identified in the SAP.

All geophysical logging will be in accordance with Waste Management Northwest's procedure WMNW-CM-004, Section 17, "Geophysical Logging," and Section 18, "Geophysical Logging Analysis." Applicable detection limits, analytical methods, and accuracy and precision requirements are defined in the documents governing borehole logging. The site geologist will indicate all geophysical surveys on the geologic log, and include the depth interval of initial and repeat runs.



BHI:rpp 11/04/98 singleton_km/figure6borehole.aml Database: 12-MAR-1999

Figure 4-1. Location of Test Pits and Borehole at Gable Mountain Pond.

Figure 4-2. Locations of Test Pits and Borehole at B Pond and the 216-B-3 Ditch.

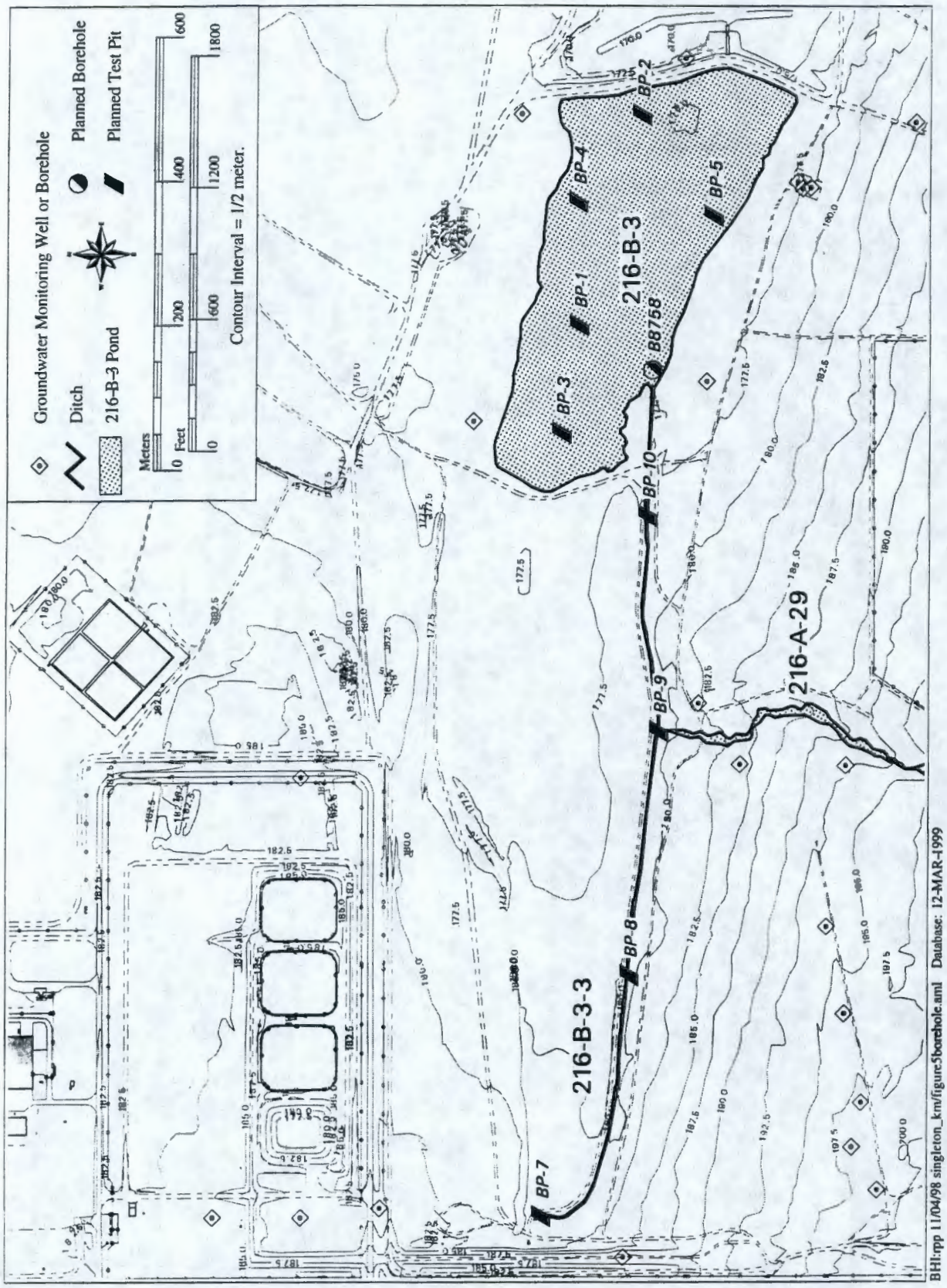
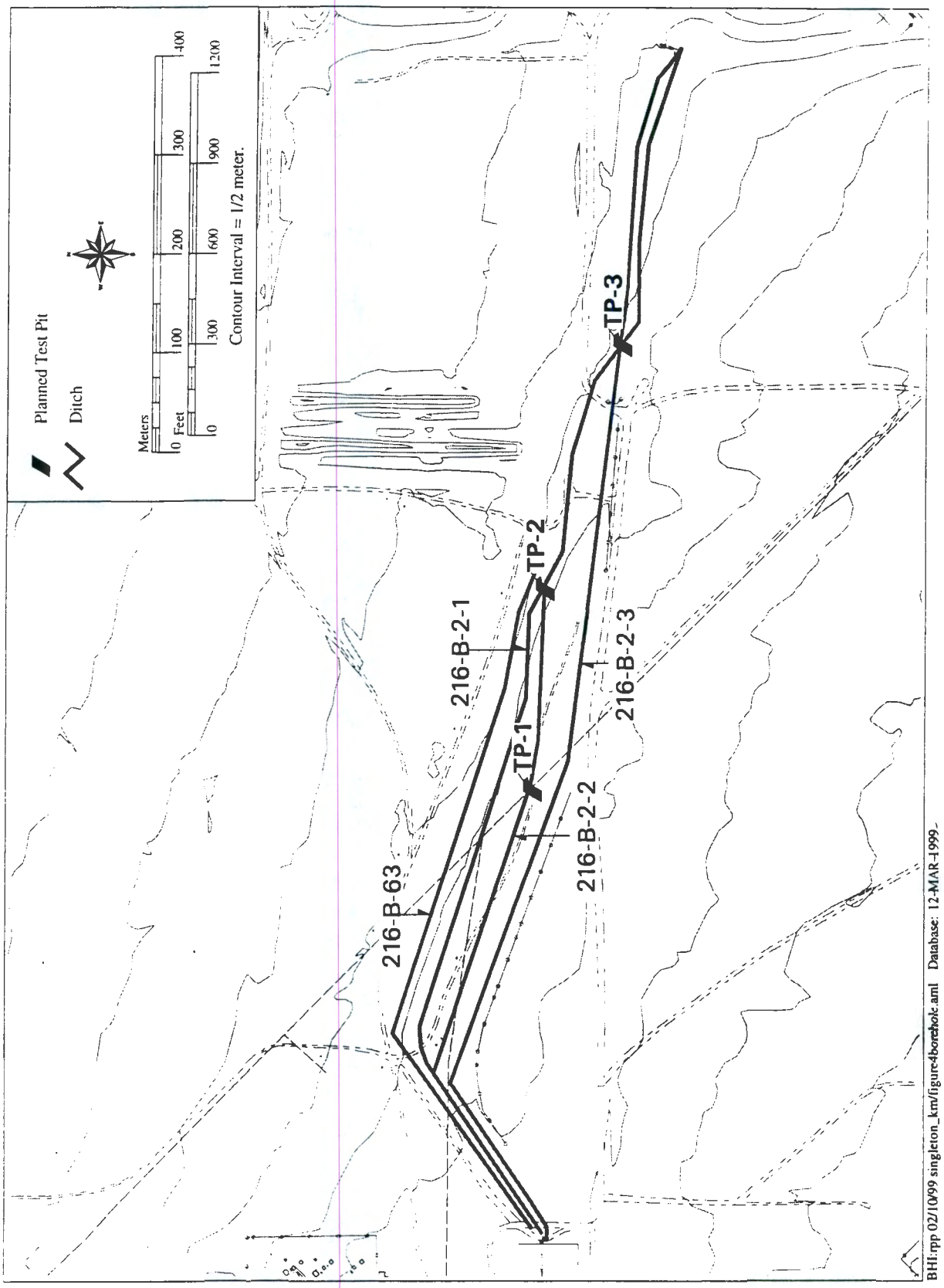


Figure 4-3. Locations of Test Pits at the 216-B-2-2 Ditch.



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5.0 REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROCESS

This chapter describes the RI/FS (assessment) process for the 200-CW-1 OU. The development of and rationale for this process is provided in the Implementation Plan (DOE-RL 1998) and is summarized in Figure 1-1. The process follows the CERCLA format with modifications to concurrently satisfy the requirements specific to RPP waste sites and RCRA TSD units undergoing closure. A summary of the integrated regulatory process is provided in Section 5.1.

Section 5.2 outlines the tasks to be completed during the RI phase, including planning and conducting field sampling activities and preparation of the RI report. These tasks are designed to effectively manage the work, satisfy DQOs identified in Section 4.0, document the results of the RI, and manage waste generated during field activities. The general purpose of the RI is to characterize the nature, extent, concentration, and potential transport of contaminants and provide data to determine the need for and type of remediation. The detailed information that will be collected to carry out these tasks is presented in the SAP (Appendix A) and the waste control plan to be prepared prior to field activities..

Tasks to be completed following the RI include an FS with a RCRA TSD unit closure plan (Section 5.3), a proposed plan and proposed RCRA permit modification for RCRA TSD units (Section 5.4), and a ROD and RCRA Permit Modification for RCRA TSD units (Section 5.4).

Project management occurs throughout the RI/FS process. Project management is used to direct and document project activities so that objectives of the work plan are met and to ensure that the project is kept within budget and schedule. The initial project management activity will be to assign individuals to roles established in Section 7.2 of the Implementation Plan (DOE-RL 1998). Other project management activities include day-to-day supervision of and communication with project staff and support personnel; meetings; control of cost, schedule, and work; records management; progress and final reports; quality assurance; health and safety; and community relations.

Appendix A of the Implementation Plan (DOE-RL 1998) provides the overall quality assurance framework that was used to prepare an OU-specific quality assurance project plan for the 200-CW-1 RI (Appendix A, Section A2.0). Appendix B of the Implementation Plan reviews data management activities that are applicable to the 200-CW-1 OU RI/FS and describes the process for the collection/control of data, records, documents, correspondence, and other information associated with OU activities.

5.1 INTEGRATED REGULATORY PROCESS

RCRA closure and corrective action authorities have clear jurisdiction over waste with chemical constituents (in particular, dangerous waste and dangerous constituents) and "mixed wastes" (mixtures of dangerous waste and radiological contaminants), but not over waste with radiological contaminants only. By applying CERCLA authority concurrently with RCRA closure and corrective action requirements through integration, cleanup will be addressing all regulatory and environmental obligations at this OU as effectively and efficiently as possible.

Also, by applying CERCLA authority jointly with that of RCRA, additional options for disposal of closure, corrective action, and remedial action wastes at the ERDF are possible. By allowing flexibility in final disposal options, the three agencies intend to minimize disposal costs as much as possible while remaining fully protective of human health and the environment.

The integrated process for characterization of the 200-CW-1 OU uses this RI/FS work plan in combination with the Implementation Plan (DOE-RL 1998) to satisfy the requirements for both an RI/FS work plan and a RCRA facility investigation/corrective measures study (RFI/CMS) work plan. General facility background information, potential ARARs, preliminary RAOs, and preliminary remedial technologies developed in the Implementation Plan are incorporated by reference into this work plan. This work plan also provides RCRA TSD closure plan information on facility description, location, and process information (Sections 2.1, 2.2, 3.1, and 3.3), waste characteristics (Sections 3.1 and 3.3), and groundwater monitoring (Section 3.3). Following the completion of the work plan, an RI will be performed that will satisfy the requirements of a RCRA RFI, as well as provide data needed to support the selection of a closure strategy for RCRA TSD units. The RI will be limited to the concurrent investigation of representative waste sites and RCRA TSD units undergoing closure. An RI report summarizing the results of the RI will then be prepared that will satisfy the requirements for an RFI report. The report will also contain the characterization information required in a RCRA TSD closure plan.

After the RI is complete, remedial alternatives/closure strategies will be developed and evaluated against performance standards and evaluation criteria. The integration process for the evaluation of remedial alternatives includes the preparation of an FS/closure plan that will satisfy the requirements for a CMS report and RCRA TSD unit closure plans. Both documents are required to include identification and development of corrective measure/remedial alternatives and an evaluation of those alternatives. The CMS generally also includes a recommended alternative, which is typically the purpose of the proposed plan under CERCLA. The FS will include a section that provides corrective action recommendations for RPP sites. The closure plan will address the RCRA TSD unit in the OU and will be included in the FS as an appendix.

RCRA closure options (landfill, modified, and clean closure as defined in Condition II.K. of the RCRA Hanford Facility Permit) will be determined based upon the alternative selected and the amount of cleanup that can be attained by the alternative. Landfill closure under RCRA will include the construction of an engineered barrier over the unit and equates to a containment alternative under CERCLA. A modified closure option includes alternatives that leave contaminants in place above MTCA Method B cleanup standards in soil, debris, or groundwater. A clean closure option requires that all contaminated material and media be removed and decontaminated to levels below MTCA Method B.

The decision-making process for the 200-CW-1 OU will be based on the use of a proposed plan, ROD, and Hanford Facility RCRA Permit modification. Based on the FS/closure plan, a proposed plan will be prepared that identifies the preferred remedial alternative for waste sites within the OU. The proposed plan will include a draft permit modification with unit-specific permit conditions for RPP waste sites and the RCRA TSD unit within the OU for incorporation into the Hanford Facility RCRA Permit. The CERCLA ROD will document the RCRA TSD closure and RCRA corrective action decisions for these units. The lead regulatory agency

(Ecology) will prepare the CERCLA ROD following completion of the public involvement process for the proposed plan, which, after signature by the Tri-Parties, will authorize the selected remedial action. The remedy selected under CERCLA will be incorporated into the Hanford Facility RCRA Permit as the RCRA closure/corrective action after issuance of the public notice and comment process.

The technical and procedural elements of RCRA and CERCLA are each addressed in full in this process. The CERCLA public involvement, including public notice and opportunity to comment, will be enhanced, as necessary, to concurrently satisfy the public involvement requirements for the RCRA closure and RCRA past-practice processes. The public will be given an opportunity to review and comment on the CMS, closure plans, which are appended to the CMS, and the proposed permit conditions that will be contained in the proposed plan. The proposed plan with a draft permit modification will be issued for a minimum 45-day public review and comment period. Supporting documents, including the FS/closure plan, will also be made available to the public for review at this time. A combined public meeting/public hearing may be held during the comment period to provide information on the proposed action and permit modification and to solicit public comment.

5.2 REMEDIAL INVESTIGATION ACTIVITIES

This section summarizes the planned tasks that will be performed during the RI phase for the 200-CW-1 OU, including the following:

- Planning
- Field investigation
- Management of investigation-derived waste (IDW)
- Laboratory analysis and data verification
- Data evaluation and reporting.

These tasks and subtasks reflect the work breakdown structure that will be used to manage the work and to develop the project schedule provided in Section 6.0.

5.2.1 Planning

The planning subtask includes activities and documentation that need to be completed before field activities can begin. These include the preparation of an activity hazards analysis and site-specific health and safety plan (HASP), radiation work permits, excavation permits and supporting surveys (e.g., cultural, radiological, wildlife, and utilities), work instructions, personnel training, and the procurement of materials and services (e.g., drilling and geophysical logging services). In addition, borehole and test pit locations indentified in Figures 4-1 through 4-3 will be located using a Global Positioning Satellite system.

Appendix B of the Implementation Plan (DOE-RL 1998) provides a general HASP that outlines health and safety requirements for RI activities. Site-specific HASPs will be prepared for test pit excavation and drilling, following requirements of the general HASP. Initial surface radiological surveys will be performed to document any radiological surface contamination and background

levels in and around the sampling locations. This information will be used to document initial site conditions and prepare HASPs and radiation work permits.

5.2.2 Field Investigation

The field investigation task involves data-gathering activities performed in the field that are required to satisfy DQOs. The field characterization approach is summarized in Section 4.2 and detailed in the SAP provided in Appendix A of this work plan. The scope includes soil/sediment sampling and analysis to characterize the vadose zone at the two representative waste sites (216-A-25 Pond and 216-B-2-2 Ditch) and the RCRA TSD unit (216-B-3 Pond and 216-B-3-3 Ditch). Major subtasks associated with the field investigation include the following:

- Test pit excavation and sampling
- Borehole drilling and sampling and associated geophysical logging
- Preparation of field reports.

5.2.2.1 Test Pit Excavation and Sampling. This subtask involves the excavation of test pits for the purpose of collecting soil and sediment samples and characterizing the geology of the upper vadose zone. Samples will be collected from 27 test pits to a maximum depth of 7.6 m (25 ft), using an excavator. Samples will be collected from the bucket of the excavator and packaged for shipment to an offsite laboratory. At the completion of sampling, the test pit will be backfilled and initial site conditions reestablished. Alternatively, hollow stem auger drilling with split-spoon sampling may be used instead of test pits, if this technique is found to be more cost effective. Other activities includes work zone setup, mobilization/demobilization of equipment, equipment decontamination, and field analyses. Planned field analyses include radiological field screening.

All samples and excavated soil will be field screened for radionuclides to provide additional characterization data, assist in the selection of sample intervals (e.g., hot spots), control the work (e.g., separation of contaminated and clean spoil), and ensure the health and safety of workers.

5.2.2.2 Borehole Drilling and Sampling. This subtask involves the drilling of boreholes for the purpose of collecting soil and sediment samples and a geophysical log of the borehole. Two boreholes are planned to collect samples down to the top of the groundwater table near the inlets of the 216-B-3 Pond and 216-A-25 Pond. Samples will be collected with split-spoon samplers and packaged for shipment to an offsite laboratory. At the completion of sampling, the two boreholes will be abandoned and initial site conditions reestablished. Alternatively, the borehole may be completed as a groundwater monitoring well, if needed by the Hanford Site groundwater monitoring program. Other activities include work zone setup, mobilization/demobilization of equipment, equipment decontamination, and field analyses. Planned field analyses include radiological field screening, geologic logging, and geophysical logging of boreholes.

All samples and drill cuttings will be field screened for radionuclides to provide additional characterization data, assist in the selection of sample intervals (e.g., hot spots), assist in establishing radiation control measures, and ensure worker health and safety. In addition, monitoring of volatile organic compounds may be performed at the borehole casing to ensure worker health and safety.

Geophysical logging will be used to gather in situ radiological and physical data from the two boreholes and from several existing wells (specified in Table A3-7 of the SAP). Spectral gamma-ray logging will be performed to assess the distribution of gamma-emitting radionuclides, and neutron logging will be performed for moisture content distribution over the borehole or well interval.

5.2.2.3 Preparation of Field Reports. At the completion of the field investigation, a field report will be prepared to summarize activities performed and information collected in the field, including survey data for test pit and borehole locations, the number and types of samples collected and associated Hanford Environmental Information System numbers, inventory of IDW containers, geological logs, field screening results, and geophysical logging results.

5.2.3 Management of Investigation-Derived Waste

Waste generated during the RI will be managed in accordance with a waste control plan. Appendix E of the Implementation Plan (DOE-RL 1998) provides general waste management processes and requirements for this IDW and forms the basis for activity-specific waste control plans. A waste control plan will be prepared that addresses the handling, storage, and disposal of IDW generated during the RI phase. Furthermore, the plan will identify governing Environmental Restoration Contractor (ERC) procedures and discuss types of waste expected to be generated, the waste designation process, and the final disposal location. The IDW management task begins at the start of the field investigation, when IDW is first generated, through waste designation and disposal. To support waste designation and disposal requirements, the soil samples collected will be analyzed for antimony and thallium, which are considered underlying hazardous constituents.

5.2.4 Laboratory Analysis and Data Validation

Soil and sediment samples collected via test pits and boreholes will be analyzed for a comprehensive suite of radionuclides and chemicals, and for select physical properties based on established DQOs and as defined in the SAP. The list of analytes, methods, and associated target detection limits are provided in Tables A2-1 and A2-2 of the SAP. This task includes the laboratory analysis of samples, the compilation of laboratory results in data packages, and the validation of a representative number of laboratory data packages.

5.2.5 Remedial Investigation Report

This section summarizes data evaluation and interpretation subtasks leading to the production of an RI report. The primary activities include a data quality assessment (DQA); evaluating the nature, extent, and concentration of contaminants based on sampling results; assessing contaminant fate and transport; refining the site conceptual models; and evaluating risks through a qualitative risk assessment (QRA). These activities will be performed as part of the RI report preparation task.

5.2.5.1 Data Quality Assessment. A DQA will be performed on the analytical data to determine if they are the right type, quality, and quantity to support their intended use. The DQA

completes the data life cycle of planning, implementation, and assessment that began with the DQO process. In this task, the data will be examined to see if they meet the analytical quality criteria outlined in the DQO and are adequate to evaluate the decision rules in the DQO.

5.2.5.2 Data Evaluation and Conceptual Model Refinement. This task will include evaluating the information collected during the investigation. The chemical and radiological data obtained from the test pits and boreholes will be compiled, tabulated, and statistically evaluated to gain as much information to satisfy the data needs as possible. Data evaluation tasks may include the following:

- Graphically evaluating the data for vertical distribution of contamination within each test pit and borehole.

- Stratifying the data and computing basic statistical parameters such as mean and standard deviation for individual levels. In the case of the ponds, this will give an indication of lateral and vertical contaminant distribution.

- Constructing contour diagrams and variograms to evaluate spatial correlations within each stratum. This will indicate if contamination is concentrated in a particular area (e.g., near the influent end for the ponds, at the head end of the ditches).

- Performing statistical tests on the data to evaluate the presence or absence of contamination. There are many facets to this step, including determining the distribution of the data and selecting the appropriate statistical tests. The initial screening for contamination should evaluate the data with respect to background, by using simple comparisons of an upper bound of the data to background concentrations (e.g., *Model Toxics Control Act* [MTCA] tests) or more complex comparisons, such as nonparametric hypothesis tests (e.g., Wilcoxon Rank Sum Test). These tests may also compare the data to appropriate cleanup levels.

All of these statistical evaluations will aid in refining the conceptual model for this OU and selecting the remedial alternative.

Data on the soil physical properties will be used to determine the sediment type, which will assist in choosing the proper unsaturated hydraulic conductivity/moisture retention curve. Knowing the soil type and soil moisture will allow the determination of unsaturated hydraulic conductivity, which will be used in modeling flow and transport (see Section 5.1.5.3).

The chemical, physical, and geophysical data will be used for correlating subsurface data, for further refinement of the conceptual model, and as inputs to a QRA.

5.2.5.3 Qualitative Risk Assessment. The application of risk assessment in the characterization and remediation of the 200 Areas will follow a graded approach as described in Section 5.5 of the Implementation Plan. A QRA will be performed as part of the RI report and FS. Once additional data are available for all the sites in an OU, a more quantitative risk assessment may be performed. A quantitative, cumulative risk assessment will be used to evaluate remedial actions and close out the sites in the 200 Areas.

For the 200-CW-1 OU, a QRA will be prepared to evaluate risk to human receptors from potential exposure to contaminants in accessible surface sediments and shallow subsurface soils. The QRA will also evaluate the impact to groundwater that may result from contaminants migrating to the water table through the vadose zone underlying wastes sites in the 200-CW-1 OU.

The computer program RESRAD will be used to model radionuclide dose and impact to groundwater from chemicals and radionuclides. The chemical and physical characterization data obtained in this study will be used in RESRAD along with input parameters appropriate to the land use. As waste sites within the 200-CW-1 OU are both inside and outside the 200 Area boundary, separate QRAs will be done for both commercial/industrial and rural residential land use. The input parameters recommended by the Washington State Department of Health (WDOH 1997) will be used for this effort.

5.3 FEASIBILITY STUDY AND RCRA TSD UNIT CLOSURE PLAN

1. After the RI is complete, remedial alternatives/closure strategies will be developed and evaluated against performance standards and evaluation criteria in the FS and appended RCRA TSD unit closure plans. The FS process consists of several steps: Defining remedial action objectives (RAOs) and RCRA closure and RCRA corrective action performance standards

2. Identifying general response actions (GRAs) to satisfy RAOs.

3. Identifying potential technologies and process options associated with each GRA.

4. Screening process options to select a representative process for each type of technology based on their effectiveness, implementability, and cost.

5. Assembling viable technologies or process options into alternatives representing a range of treatment and containment plus no action.

6. Evaluating alternatives and presenting information needed to support remedy selection and RCRA closure of the unit as a landfill or under modified or clean closure pursuant to RCRA Hanford Facility Permit Condition II.K.

Although some refinement is expected during the FS, Appendix D of the Implementation Plan satisfies the requirements for the screening phase (steps 1 through 6) of the FS process. The preliminary RAOs, PRGs, GRAs, and the screening-level analysis of alternatives is incorporated by reference into this work plan. As a result of the work completed in the Implementation Plan, the FS report will focus on the final phase of the FS consisting of refining and analyzing in detail a limited number of alternatives identified in the screening phase. Remedial action alternatives considered to be applicable to the 200-CW-1 OU include the following:

- No action
- Institutional controls

- Engineered surface barriers with or without vertical barriers
- Excavation and disposal with or without ex situ treatment.

During the detailed analysis each alternative will be evaluated against the following criteria (40 CFR 300.430):

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost
- State acceptance.

One additional modifying criterion, community acceptance, will be applied following the FS at the proposed plan and ROD phase.

National Environmental Policy Act of 1969 (NEPA) values will also be evaluated as part of DOE's responsibility under this authority. NEPA values include impacts to natural, cultural, and historical resources; socioeconomic aspects; and irreversible and irretrievable commitments of resources.

RCRA closure performance standards (WAC 173-303-610[2]) will also be used to evaluate the ability of alternatives to comply with RCRA closure requirements. These standards require the closure of TSD units in a manner that:

- Minimizes the need for further maintenance

- Controls, minimizes, or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of dangerous waste, dangerous waste constituents, leachate, contaminated run-off, or dangerous waste decomposition products to the ground, surface water, groundwater, or the atmosphere

- Returns the land to the appearance and use of surrounding land areas to the degree possible given the nature of the previous dangerous waste activity.

In addition, RCRA corrective action performance standards (WAC 173-303-646[2]) will be used to evaluate alternative compliance with RCRA corrective action requirements. These standards state that corrective action must:

- Protect human health and the environment for all releases of dangerous wastes and dangerous constituents, including releases from all solid waste management units at the facility

- Occur regardless of the time at which waste was managed at the facility or placed in such units and regardless of whether such facilities or unit were intended for the management of solid or dangerous waste

- Be implemented by the owner/operator beyond the facility boundary, where necessary to protect human health and the environment.

The FS will also include supporting information needed to complete the detailed analysis and meet regulatory integration needs, including the following:

- Summarize the RI, including the nature and extent of contamination, the contaminant distribution models, and an assessment of the risks to help establish the need for remediation and to estimate the volume of contaminated media

- Refine the conceptual exposure pathway model to identify pathways that may need to be addressed by remedial action

- Provide a detailed evaluation of ARARs, starting with potential ARARs identified in the Implementation Plan (Section 4.0, DOE-RL 1998)

- Refine potential RAOs and PRGs identified in the Implementation Plan (Section 5.0, DOE-RL 1998), based on the results of the RI, ARAR evaluation, and current land-use considerations

- Refine the list of remedial alternatives identified in the Implementation Plan (Appendix D, DOE-RL 1998), based on the RI

- Provide corrective action recommendations for RPP sites to fulfill the requirements for a CMS report

- Include a closure plan to address RCRA TSD units in the OU as an appendix. The closure plan will incorporate, by reference, specific sections of the work plan or RI report containing specific closure plan information. The closure plan will include closure performance standards, a closure strategy, general closure activities including verification sampling, and a general postclosure plan.

Additional RCRA integration guidance for preparing an FS/closure plan is provided in Section 2.4 of the Implementation Plan (DOE-RL 1998).

5.4 PROPOSED PLAN AND PROPOSED RCRA PERMIT MODIFICATION

The decision-making process for the 200-CW-1 OU will be based on the use of a proposed plan, ROD, and modification to the RCRA Hanford Facility Permit. Following the completion of the FS/closure plan, a proposed plan will be prepared that identifies the preferred remedial alternative for the OU (which will include RCRA closure and corrective action requirements). In

addition to identifying the preferred alternative, the proposed plan will:

- Provide a summary of the completed RI/FS
- Provide criteria by which analogous waste sites within the OU not previously characterized will be evaluated after the ROD to confirm that the contaminant distribution model for the site is consistent with the preferred alternative. Contingencies to move a waste site to a more appropriate waste group will also be developed
- Identify performance standards and ARARs applicable to the OU.

The proposed plan will also include a draft permit modification with unit-specific permit conditions for RPP sites and the RCRA TSD unit for incorporation into the Hanford Facility RCRA Permit. After the public review process is complete, Ecology as the lead regulatory agency will make a decision on the remedial action to be taken that is documented in a ROD. The Hanford Facility RCRA Permit will subsequently be modified by Ecology to incorporate the ROD (and subsequent amendments) by reference, authorizing the RCRA actions.

5.5 POST-ROD ACTIVITIES

After the ROD and modification to the RCRA Hanford Facility Permit have been issued, a remedial design report (RDR) and remedial action work plan (RAWP) will be prepared to detail the scope of the remedial action (which will include RCRA closure and corrective action requirements). As part of this activity, DQOs will be established and SAPs prepared to direct confirmatory and verification sampling and analysis efforts. Prior to the start of remediation, confirmation sampling will be performed to ensure that sufficient characterization data are available to confirm that the selected remedy is appropriate for all waste sites within the OU, to collect data necessary for the remedial design, and to support future risk assessments, if needed. Verification sampling will be performed after the remedial action is complete to determine if ROD requirements have been met and if the remedy was effective. Additional guidance for confirmatory and verification sampling is provided in Section 6.2 of the Implementation Plan (DOE-RL 1998).

The RDR/RAWP will include an integrated schedule of remediation activities for the OU, including the schedule for RCRA TSD unit closure, and satisfy the requirements for a RPP corrective measures implementation work plan and corrective measures design report. Following the completion of the remediation effort, closeout activities will be performed as specified in the ROD, RD/RAWP, and the Permit.

RCRA closure activities and schedules will be defined in the closure plan and will be consistent with those identified in the RDR/RAWP. Enforceable sections of the closure plan will be stated in the modification to the RCRA Hanford Facility Permit. Certification of closure in accordance with WAC 173-303-610(6) will be performed after completion of cleanup actions. The site will be restored as appropriate for future land use. If clean closure is not attained at a TSD unit, postclosure care requirements will be met. These will include final status groundwater

monitoring, maintenance and monitoring of institutional controls and/or surface barriers, and certification of postclosure at the completion of the postclosure period.

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6.0 PROJECT SCHEDULE

The schedule for activities discussed in this work plan is shown in Figure 6-1. This schedule will serve as the baseline for the work planning process and will be used to measure the progress of the implementation of this process. The schedules for preparation, review, and issuance of the RI Report, the FS closure plan, and the proposed plan/proposed Permit modification are also shown in Figure 6-1. The schedule concludes with the preparation of a ROD

The portions of the schedule most germane to this work plan and the attached SAP are fiscal year 1999 and the first half of fiscal year 2000. One Tri-Party Agreement milestone is associated with this project: complete Draft A of the Work Plan by April 30, 1999, for transmittal to the regulators (M-13-20).

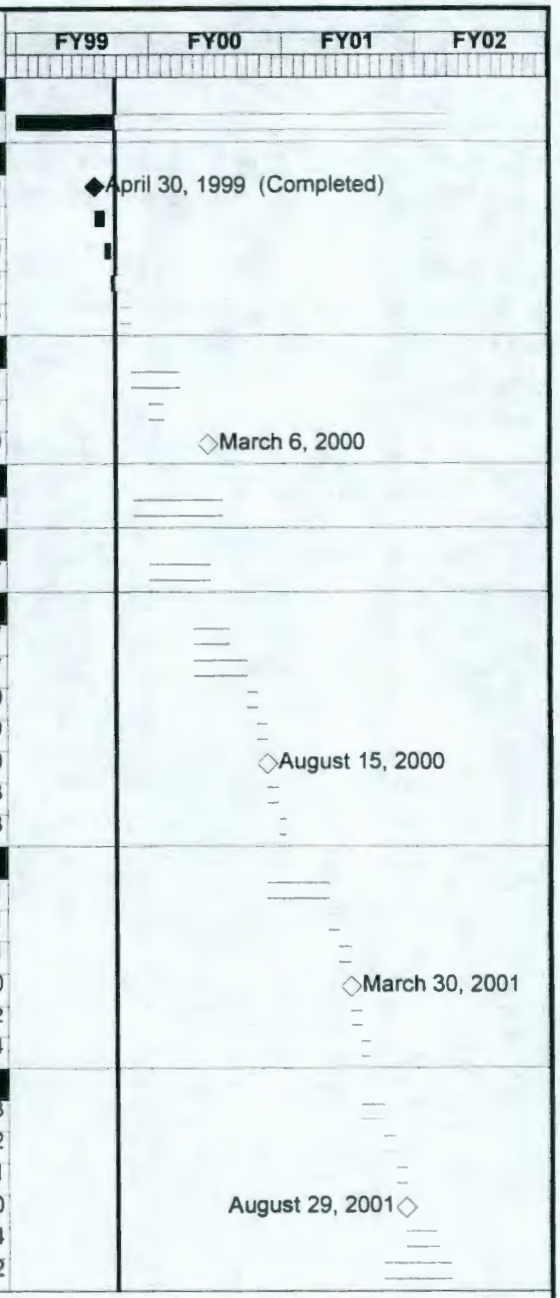
Based on this schedule, the following activities and completion dates will be proposed as Tri-Party Agreement milestones:

- Complete field activities – March 6, 2000
- Submit Draft A RI report for regulator review – August 15, 2000
- Submit Draft A FS/closure plan for regulator review – March 30, 2001
- Submit Draft A proposed plan/draft proposed permit modification for regulator review – August 29, 2001.

A Class II change form will be submitted to Ecology and EPA requesting these items be added as interim milestones to the Tri-Party Agreement.

Figure 6-1. Project Schedule for the 200-CW-1 Operable Unit.

Activity Description	Orig Dur
PROJECT MANAGEMENT	
PROJECT MANAGEMENT	849*
WORK PLAN	
ISSUE DRAFT A OF WP - TPA MILESTONE M-13-20	0
REGULATOR REVIEW OF DRAFT A WP	22
REVISE WORK PLAN & ISSUE REV 0 FOR PUBLIC REVIEW	10
PUBLIC REVIEW OF WORK PLAN	22
FINALIZE WORK PLAN	18
FIELD INVESTIGATION	
TEST PIT EXCAVATION & SAMPLING	94*
BOREHOLE DRILLING & SAMPLING	29*
PROPOSED MILESTONE: COMPLETE FIELD WORK	0
MANAGEMENT OF INVESTIGATION DERIVED WASTE	
MANAGEMENT OF INVESTIGATION-DERIVED WASTE	174*
LAB ANALYSIS & DATA VALIDATION	
LAB ANALYSIS & DATA VALIDATION	120*
REMEDIAL INVESTIGATION REPORT	
DATA QUALITY ASSESSMENT	66*
COMPLETE & ISSUE DRAFT RI REPORT	102*
ERC REVIEW/REVISE/ISSUE DECISIONAL DRAFT RI RPT	20
DOE REVIEW & REVISE DRAFT A RI REPORT	19
PROPOSED MILESTONE: ISSUE DRAFT A RI REPORT	0
REGULATOR REVIEW DRAFT A RI REPORT	23
FINALIZE RI REPORT	13
FEASIBILITY STUDY & RCRA TSD UNIT CLOSURE PLAN	
PREPARE & ISSUE DRAFT FS REPORT/CLOSURE PLAN	121
ERC REVIEW, REVISE/ISSUE DECISIONAL DRAFT FS/CP	21
DOE REVIEW & REVISE DRAFT A FS/CP	21
PROPOSED MILESTONE: ISSUE DRAFT A FS/CP	0
REGULATOR REVIEW DRAFT A FS/CP	22
FINALIZE FS/CP	14
PROPOSED PLAN	
PREPARE & ISSUE DRAFT PP/PPM	43
ERC REVIEW & REVISE DECISIONAL DRAFT OF PP/PPM	22
DOE REVIEW & REVISE DRAFT A PP/PPM	21
PROPOSED MILESTONE: ISSUE DRAFT A PP/PPM	0
REGULATOR REVIEW & ISSUANCE OF REV 0 PP/PPM	64
PREPARE & RECEIVE ROD	132



Project Start 01OCT98
Project Finish 01JAN02
Data Date 28JUN99
Run Date 01JUL99

Milestones
Schedule Bar
Progress Bar

CWWP

Sheet 1 of 1

200-CW-1

GABLE MTN / B POND & DITCH

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7.0 REFERENCES

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APPENDIX A

SAMPLING AND ANALYSIS PLAN

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ACRONYMNS

ASTM	American Society for Testing and Materials
BHI	Bechtel Hanford, Inc.
bgs	below ground surface
CFR	*Code of Federal Regulations*
COC	contaminant of concern
COPC	contaminant of potential concern
DOE	U.S. Department of Energy
dpm	disintegrations per minute
DQO	data quality objective
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERC	Environmental Restoration Contractor
FSP	field sampling plan
HASQARD	*Hanford Analytical Services Quality Assurance Requirements Documents*
HEIS	Hanford Environmental Information System
IDW	investigation-derived waste
ITS	in-tank solidification
OU	operable unit
PUREX	Plutonium/Uranium Extraction (Facility)
QAPjP	quality assurance project plan
QC	quality control
RCF	Radiological Counting Facility
RCRA	*Resource Conservation and Recovery Act of 1976*
RCT	radiological control technician
RESRAD	RESidual RADioactivity Dose Model
SAP	sampling and analysis plan
TSD	treatment, storage, and disposal

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A1.0 INTRODUCTION

This sampling and analysis plan (SAP) directs sampling and analysis activities that will be performed to characterize the vadose zone at four waste sites: the 216-A-25 Pond (Gable Mountain Pond), the 216-B-3 Pond (B Pond), the 216-B-2-2 Ditch, and the 216-B-3-3 Ditch. These waste sites are part of the 200-CW-1 Operable Unit (OU) in the 200 Area Gable Mountain Pond/B-Pond and Ditches Cooling Water Group. The sampling and analysis described in this document will be performed to provide soil/sediment data that may be used to refine the site conceptual model, support an assessment of risk, and evaluate a remedial alternative(s) for waste sites in this OU. Characterization activities described in this plan are based on the implementation of the data quality objectives (DQO) process, as documented in the *200-CW-1 Gable/B Pond and Ditches Cooling Water Waste Group Remedial Investigation DQO Summary Report* (BHI 1998a).

The scope of activities described in this SAP involves the excavation of 27 test pits and/or shallow auger boreholes and the drilling of 2 deep boreholes. Soil samples will be collected and analyzed for radiological and chemical contaminants of concern (COCs) and select physical properties. New and existing boreholes will be geophysically logged to obtain additional information on the distribution of contamination and soil moisture.

A1.1 BACKGROUND

The 28 waste sites associated with the 200-CW-1 OU primarily received steam condensate and cooling water from several facilities in the 200 East Area. This effluent typically contained low concentrations of contaminants, but occasional failure in the process systems resulted in significant amounts of radionuclides being released to the ponds and ditches in the OU. Some contamination has penetrated the vadose zone and reached the aquifer beneath some of the waste sites. Pipelines carrying wastewater to and/or from the waste sites may also have impacted the subsurface through leaks.

The four waste sites that will be investigated in this OU will be characterized to determine the nature and extent of contamination. These sites were chosen for different reasons, as discussed in Section 2.2.2 of the work plan. Knowledge gained from characterizing these sites will be used to refine the conceptual model and facilitate the use of the analogous site approach in reaching remedial action decisions for the OU. The use of the analogous site approach is fundamental to streamlining in the 200 Areas due to the large number of waste sites (DOE-RL 1998).

A1.2 200-CW-1 GROUP/ WASTE SITE LOCATIONS

The 200-CW-1 waste sites are located on the Hanford Site in southeastern Washington State, in the vicinity of the 200 East Area. This cooling water group consists of 28 waste sites that received mostly cooling water from a variety of 200 Area operations. Figure A1-1 shows the specific locations of waste sites in the 200-CW-1 OU.

A1.3 SITE DESCRIPTION AND HISTORY

The following sections provide brief descriptions of the four waste sites that will be investigated. More detail is provided in Section 2.2 of the work plan. Section 3.3 of the work plan contains information on the nature and extent of contamination and previous investigations.

A1.3.1 216-B-2-2 Ditch

The 216-B-2-2 Ditch was an open, unlined earthen ditch approximately 4.6 m (15 ft) wide at ground level, 1.8 to 2.4 m (6 to 8 ft deep), and 1,070 m (3,500 ft long). The ditch carried mainly cooling water, steam condensate, and chemical sewer effluent from B Plant and several other facilities. The 216-B-2-2 Ditch discharged to both B Pond and the Gable Mountain Pond. It was decommissioned and backfilled as a result of unplanned release UPR-200-E-138, during which approximately 1,000 Ci of strontium-90 was released to the ditch on March 22, 1970 (DOE-RL 1993). On March 23, 1970, earthen dams were constructed across the ditch approximately 300 m (1,000 ft) downstream of the release point, trapping most of the contamination in the ditch. In 1970, the ditch was backfilled to grade with 2.4 m (8 ft) of clean fill material. The ditch was restabilized several times between 1970 and 1980 to control the uptake of radioactivity by plants. More than 60 cm (24 in.) of soil was placed over the site to control contamination. A plastic liner was buried in the upper 730 m (2,400 ft) of the ditch in 1973 to prevent the uptake of radioactivity by plants. The plastic liner was exposed during a recent trenching exercise performed to locate the ditch (BHI 1998b).

Recent sampling and analysis of the 216-A-29 Ditch provides relevant information on the potential nature and extent of contamination at the treatment, storage, and disposal (TSD) units. Sampling was performed in July 1998 to evaluate the presence of contamination beneath a proposed roadway and the utilities crossing that was built to support the Tank Waste Remediation Systems privatization effort. Results of the sampling effort were documented in the 216-A-29 Letter Report (BHI 1998c). Analytical results were compared to a previous 1988 sampling effort (FDH 1997b) performed in support of a Resource Conservation and Recovery Act of 1976 (RCRA) closure plan.

The results for both the 1988 and 1998 sampling efforts showed that the average values for all but one of the analytes measured were below background concentrations (computed at the 90th percentile of the background population, per Washington State Department of Ecology (Ecology) guidance [Ecology 1992]) and that all analytes were below *Model Toxics Control Act* (MTCA) cleanup levels. Lead was found above the background value of 10.2 mg/kg in both 1988 and 1998. In the 1998 sampling effort, a maximum value of 98.2 mg/kg was found in a sample collected 3.9 m (13 ft) beneath the surface of the historical ditch at the location of the proposed road and utility corridor. A maximum value of 262 mg/kg was obtained during the 1988 sampling effort which was located in the ditch 150 m (492 ft) upstream from the proposed road/utility corridor location. The maximum lead value is below the U.S. Enviornmental Protection Agency's (EPA's) Integrated Exposure Uptake Biokinetic Model calculated level of 353 mg/kg, which has been established as the MTCA cleanup standard for lead in soil at previous Hanford Site remedial actions.

A1.3.1 216-B-3-3 Ditch

The 216-B-3-3 Ditch was an open and unlined earthen ditch, approximately 6 m (20 ft) wide at ground level, 1.8 m (6 ft) deep, and 1,130 m (3,700 ft) long. The ditch was excavated and put into service in September 1970 to replace the decommissioned 216-B-3-2 Ditch. The ditch received Plutonium/Uranium Extraction (PUREX) Plant chemical sewer waste by way of the 216-A-29 Ditch, as well as cooling water from several facilities and effluent from the 216-B-2-3 Ditch and 216-B-2 pipeline. One unplanned release (UPR-200-E-51) is associated with this site: 15 kg of cadmium nitrate was released from PUREX in May 1977. The ditch was decommissioned and backfilled in conjunction with B Pond in 1994. The 216-B-3-3 Ditch, pursuant to RCRA, is an active treatment, storage, and disposal (TSD) unit, although it is not currently receiving effluent nor will effluent be received in the future. It is included in the RCRA Waste Dangerous Permit Application with B Pond.

A1.3.2 216-B-3 Main Pond

The 216-B-3 main pond (B Pond) was located in a natural topographic depression and varied in size from approximately 6 to 19 hectares (14 to 46 acres). Through its history of operation (1945 to 1994), the pond varied between 0.6 m (2 ft) and 6 m (20 ft) deep. At the time the pond was decommissioned and backfilled in 1994, it covered an area of approximately 14 hectares (35 acres) (DOE-RL 1993).

The pond received effluent from PUREX, B Plant, and several smaller facilities. Most of the effluent was cooling water that contained low concentrations of radionuclides and chemicals. Several unplanned releases, discussed in Section 2.2.3.2 of the work plan, impacted the pond.

The B Pond, pursuant to RCRA, is an active TSD unit, but it is not currently receiving effluent nor will effluent be received in the future. It is included on the RCRA Dangerous Waste Permit Application with the 216-3-3 Ditch.

A1.3.3 Gable Mountain Pond

The 216-A-25 Gable Mountain Pond was a 28-hectare (71-acre) pond located in a natural depression located 1.6 km (1 mi) south of the west end of Gable Mountain. It was the largest seepage disposal facility of several Hanford Site ponds. It was commissioned for service in 1957, and received predominantly cooling water from PUREX and several other facilities. Effluent reached Gable Mountain Pond through the PUREX cooling water line. Section 2.2.2.2 of the work plan describes releases to the pond throughout its operating history.

The pond began operation in 1957 and was stabilized in 1988 by backfilling with clean soil and cobbles to a minimum of 1 m (3 ft) above the original shoreline.

A1.4 CONTAMINANTS OF CONCERN

Step 1 of the DQO process identifies the need to develop a list of contaminants of potential concern (COPCs) for 200-CW-1 waste sites. Development of the COPCs is an essential step

towards refining the site conceptual model. From an initial list of more than 280 contaminants that potentially could have been discharged to 200-CW-1 waste sites, 62 COCs were identified during the DQO process. Development of this list is described in the 200-CW-1 DQO workbook (BHI 1998a) and is summarized in Section 3.5 of the work plan. The COPCs are identified in Table A1-1.

If contaminants not identified as COPCs are detected during laboratory analysis, the data will be evaluated against existing regulatory standards, or risk-based levels if exposure data are available, and existing process knowledge to determine the need for remedial action.

A1.5 DATA QUALITY OBJECTIVES

The EPA's document, *Guidance for the Data Quality Objectives Process* (EPA 1994a), was used to support the development of this SAP. The DQO procedure is a strategic planning approach that provides a systematic procedure for defining the criteria that a data collection design should satisfy. Using the DQO process ensures that the type, quantity, and quality of environmental data used in decision making will be appropriate for the intended application.

This section presents only a summary of the key outputs resulting from the implementation of the seven-step DQO process. For additional details, the reader should refer to the DQO workbook (BHI 1998a).

A1.5.1 Statement of the Problem

The 200-CW-1 OU consists of 28 waste sites and their associated piping systems. The waste sites received mainly noncontact cooling water from 200 East Area facilities. Nineteen of the sites in this group are RCRA past-practice waste sites; two sites are within a RCRA TSD unit. Seven sites are unplanned release sites. Effluent release to these sites is characterized as noncontact waste streams because cooling water theoretically did not come in contact with contaminated process liquids. However, pinhole and hairline cracks in the heating and cooling coils contaminated these waste streams with very low concentrations of radionuclides and/or chemicals. Complete failure of these coils occasionally resulted in significant amounts of radionuclides being released into these effluent streams. Vadose zone soils and the aquifer may have been impacted by effluent released to the 200-CW-1 waste sites.

The primary objectives of the DQO process for the 200-CW-1 OU are to determine the environmental measurements necessary to refine the preliminary site conceptual model, support an evaluation of risk, and evaluate remedial alternatives. Possible remedial alternatives considered in the development of the DQO included the following:

- No-action alternative (no institutional controls)
- Capping
- Excavate and dispose of waste
- Monitored natural attenuation (with institutional controls).

A1.5.2 Decision Rules

Decision rules are developed from the combined results of DQO Steps 2, 3, and 4. These results include the principal study questions, decision statements, remedial action alternatives, data needs, COC action levels, analytical requirements, and the scale of the decision(s). Decision rules are generally structured as "IF…THEN" statements that indicate what action will be taken when a prescribed condition is met. Decision rules incorporate the parameters of interest (e.g., COCs), the scale of the decision (e.g., location), the action level (e.g., COC concentration), and the action(s) that would result. The 200-CW-1 decision statements are summarized in Table A1-2.

A1.5.3 Error Tolerance and Decision Consequences

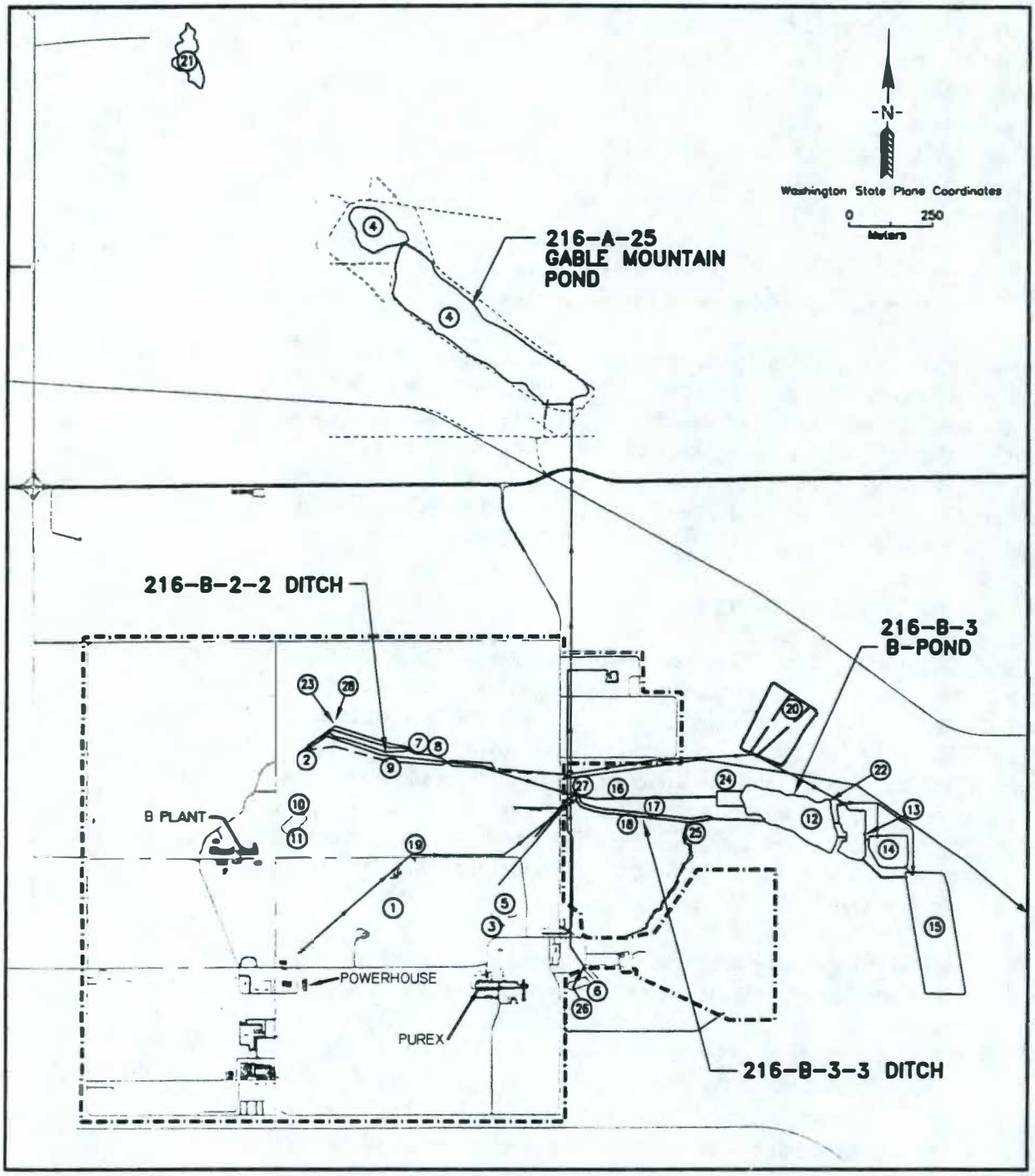
The consequence of selecting an inadequate nonstatistical sampling design is not considered severe. Based on the guidance in Table 4-5a of the DQO workbook (BHI 1998a), the sampling design rigor requirements are not significant because of the combination of low severity and accessibility after remedial investigation sampling. If the sampling design is determined to be inadequate, additional sampling can be performed because the sites will be still accessible. Section 5.2 of the work plan summarizes the sampling activities that are planned after the evaluation of initial characterization efforts that are described in this SAP.

A1.5.4 Sample Design Summary

A nonstatistical sampling design (i.e., professional judgement) was used to select sample locations at the waste sites. This bias sampling approached was selected based on process knowledge, expected behavior of COCs, the observed distribution of contamination, and the preliminary conceptual site model developed for this waste group. Using this approach, sample locations are selected that increase the chance of encountering the worst-case conditions/ maximum concentrations of contaminants. This approach was recently applied at the 216-B-2-2 Ditch during the drilling of well 299-E33-333. The bias sampling approach used at this borehole appears to support the preliminary site conceptual model for 200-CW-1 presented in the waste site groupings report (DOE-RL 1997).

The total number of samples for the waste sites was selected based on the preliminary site conceptual model and the expected distribution of contamination. The model suggests that highest contaminant concentrations should be detected near the bottom of the pond/ditch and decrease with depth. Therefore, a greater frequency of sampling is planned in the zone immediately below the bottom of the ponds/ditches. Sample frequency will decrease with depth based on the expected distribution of contamination. Additional samples will be collected at the discretion of the site geologist based on the field screening data. All material excavated will be screened as described in Section A3.1.1. Field screening will be performed to reduce the potential of overlooking zones of significant contamination. The optimal sample design for this initial phase of characterization is presented in Section A3.0.

Figure A1-1. Location of Waste Sites in the 200-CW-1 Operable Unit.



LEGEND

200 EAST FENCELINE

1= 200-E PD	8= 216-B-2-2	15= 216-B-3C RAD	22= UPR-200-E-14
2= 207-B	9= 216-B-2-3	16= 216-B-3-1	23= UPR-200-E-32
3= 216-A-9	10= 216-B-59	17= 216-B-3-2	24= UPR-200-E-34
4= 216-A-25	11= 216-B-59B	18= 216-B-3-3	25= UPR-200-E-51
5= 216-A-40	12= 216-B-3	19= 216-C-9	26= UPR-200-E-66
6= 216-A-42	13= 216-B-3A RAD	20= 216-E-28	27= UPR-200-E-94
7= 216-B-2-1	14= 216-B-3B RAD	21= 216-N-8	28= UPR-200-E-138

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Table A1-1. Contaminants of Concern for 200-CW-1 Operable Unit (from BHI 1998b).

Radioactive Constituents	
Americium-241	Plutonium-239/240
Cesium-137	Strontium-90
Cobalt-60	Technetium-99[a]
Europium-152	Tritium[a]
Europium-154	Thorium-232
Europium-155	Uranium-233/234[b]
Neptunium-237[c]	Uranium-235/236[b]
Nickel-63[a]	Uranium-238[b]
Plutonium-238	
Chemical Constituents - Metals	
Arsenic	Lead
Barium	Mercury
Beryllium	Nickel
Cadmium	Selenium
Chromium	Silver
Hexavalent chromium	Vanadium
Copper	Zinc
Chemical Constituents - Other Inorganics	
Ammonia	Phosphate
Chloride	Sulfate
Cyanide	Sulfide
Fluoride	pH
Nitrate/nitrite	
Chemical Constituents - Volatile Organics	
Acetone	Dichloromethane (methylene chloride)
1-Butanol (butyl alcohol)	Ethanol
2-Butanone (MEK)	Halogenated hydrocarbons
Butylated hydroxy toluene	Propanol (isopropyl alcohol)
Carbon tetrachloride	Toluene
Chloroform (trichloromethane)	1,1,1 trichloroethane
Decane	1,1,2 trichloroethane
Semi-Volatile Organics	
Diesel fuel[d]	Polychlorinated biphenyls (PCBs)
Kerosene[d]	Shell E-2342 (napthalene and paraffin)[c]
Normal paraffin hydrocarbon[d]	Soltrol-170 ($C_{10}H_{22}C_6$ to H_{34}; purified kerosene)[d]
Paraffin hydrocarbons[d]	Tributyl phosphate

[a] These COCs are deep-zone sensitive only. Analyses are not required for these COCs in the shallow zone soils, as they are soft beta emitters in low abundance that have insignificant dose impact in the shallow zone.

[b] Uranium will be analyzed for total abundance in all samples; any samples with values significantly above background levels will be analyzed for these individual species.

[c] Only analyzed in test pits near the center of the ponds.

[d] Analyzed as kerosene total petroleum hydrocarbons.

Table A1-2. Data Quality Objectives Decision Rules (from BHI 1998b).

DR#	Decision Rule
1	If the RESRAD analysis for the maximum detected concentrations of the radiological COCs in the pond sediment layer results in annual exposures above the human health protection limits for the appropriate scenario, then the remedial alternatives[a] will be evaluated for the pond sediment layer.
2	If the RESRAD analysis for the maximum detected concentrations of the radiological COCs in the soils from 1.8 to 7.6 m (6 to 25 ft) below grade (i.e., below the pond sediment layer) results in annual exposures above the human health protection limits for the appropriate scenario, then the remedial alternatives[a] will be evaluated for the soils from 1.8 to 7.6 m (6 to 25 ft) below grade.
3	If the maximum detected values of the chemical COCs in the pond sediment layer exceed the action levels (for the appropriate scenario), then the remedial alternatives[a] will be evaluated for the pond sediment layer.
4	If the maximum detected values of the chemical COCs in the soils from 1.8 to 7.6 m (6 to 25 ft) below grade (i.e., below the pond sediment layer) exceed the action levels (for the appropriate scenario), then the remedial alternatives[a] will be evaluated for the soils from 1.8 to 7.6 m (6 to 25 ft) below grade.
5	If the contamination distribution in the 0- to 7.6-m (0- to 25-ft) elevation and in the deep vadose zones differ significantly from the preliminary contaminant distribution model, then the preliminary model requires revision prior to use for remedial decision making or remedial action planning.

[a] The use of the term "remedial alternative" is used collectively to refer to one or more of the alternatives described in Section A1.5.1. The selection of an appropriate alternative is beyond the scope of this document.

A2.0 QUALITY ASSURANCE PROJECT PLAN

The quality assurance project plan (QAPjP) establishes the quality requirements for environmental data collection, including sampling, field measurements, and laboratory analysis. The overall QAPjP for Environmental Restoration (ER) waste sites in the 200 Areas is included in Appendix A of the *200 Areas Remedial Investigation/Feasibility Study Implementation Plan - Environmental Restoration Program* (DOE-RL 1998). The QAPjP complies with the requirements of the following:

- U.S. Department of Energy (DOE) Order 5700.6c, *Quality Assurance*
- *Code of Federal Regulations* (CFR), 40 CFR 830.120, "Quality Assurance Requirements"
- *EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations* (EPA 1994b)
- *Hanford Analytical Services Quality Assurance Requirements Documents* (HASQARD) (DOE-RL 1996a).

The plan provides the general framework of technical and administrative requirements that apply to 200-CW-1 and other OUs in the 200 Areas.

To meet the site-specific needs for the 200-CW-1 OU, the QAPjP identifies supplemental requirements developed during the DQO process and described in the group-specific SAP. These requirements are listed below:

- **Analytical Performance.** Requirements for detection limits, precision, and accuracy are presented in Tables A2-1 and A2-2. The analytical methods are also shown in these tables.
- **Field Quality Control.** The frequency and type of quality control (QC) samples to be collected are addressed in Section A2.1.
- **Sample Preservation, Containers, and Holding Time.** The requirements for the specific test/laboratory methods are addressed in Section A2.3 and in Table A2-3.
- **Onsite Measurements Quality Control.** The specific types of QC samples for onsite measurements and the frequency of collection are addressed in Section A2.4.
- **Data Validation and Usability.** Specific validation requirements, including the frequency and level of validation, are addressed in Section A2.5.

The following sections describe the supplemental waste group quality requirements and the procedural controls applicable to this investigation. The 200 Areas QAPjP (Appendix A of the

200 Areas Implementation Plan [DOE-RL 1998]) and this section of the SAP will serve as the QAPjP for the 200-CW-1 remedial investigation.

A2.1 FIELD QUALITY CONTROL

Field QC samples shall be collected to evaluate the potential of cross-contamination and laboratory performance. Field QC for sampling sites in the 200-CW-1 OU will require the collection of collocated duplicates, field splits, equipment rinsate blanks, and trip blank samples. The QC samples are described in this section with the required frequency of collection.

A2.1.1 Collocated Duplicates

Collocated duplicates are independent samples collected as close as possible to the same point in space and time, taken from the same source, stored in separate containers, and analyzed independently. These samples are useful in documenting homogeneity in the soil. It is important that these samples are not homogenized together.

A minimum of 5% of the total collected samples shall be duplicated, or one field duplicate shall be collected for every 20 samples, whichever is greater. At least two collocated duplicates shall be collected from each waste site, and one from each borehole. The duplicates should generally be collected from an area that is expected to have some contamination, so that valid comparisons between the samples can be made (i.e., at least some of the COCs will be above detection limit). When sampling with a split spoon, the duplicate sample will probably be from a separate split spoon either above or below the main sample because of volume constraints. The split-spoon duplicate should be collected somewhere below the interval of continuous coring and above 7.6 m (2.5 ft) below ground surface (bgs) (see Section A3.3.1 and Tables A3-2 and A3-3 for a discussion of borehole sampling, which applies to split-spoon sampling from boreholes or from hollow-stem augers).

A2.1.2 Field Splits

Split samples shall be collected at the same frequency as collocated duplicate samples, with at last two per waste site and one per borehole. Split samples shall be retrieved from the same sample interval using the same equipment and sampling technique; sampling limitations involving split spoons as discussed in Section A2.1.1 apply to field splits as well. Samples shall be split in the field and sent to two independent laboratories. Splits will be used to verify the performance of the primary laboratory.

The first four field splits collected shall be analyzed for all of the COCs listed in Table A2-1. If the data from these indicate that the primary laboratory is performing satisfactorily, the analyte list for the rest of the field splits will be reduced to a subset of the COC list. The reduced-list field splits will be analyzed for the following:

- Gamma-emitting radionuclides
- Strontium-90
- Plutonium isotopes

- Metals
- Anions (except cyanide)
- pH
- Semivolatile organic analyte
- Volatile organic analytes.

These analytes are considered some of the most difficult to analyze and should provide a good indication of laboratory performance.

A2.1.3 Equipment Rinsate Blanks

Equipment blanks shall be collected at the same frequency as collocated duplicate samples, where applicable, and are used to verify the adequacy of sampling equipment decontamination procedures. The field geologist may request that additional equipment blanks be taken. Equipment blanks shall consist of pure deionized water washed through decontaminated sampling equipment and placed in containers identical to those used for actual field samples.

Equipment rinsate blanks shall be analyzed for the following:

- Gross alpha
- Gross beta
- Metals (excluding hexavalent chromium and mercury)
- Anions (except cyanide)
- pH
- Semivolatile organic analyte
- Volatile organic analytes.

These analytes are considered to be the best indicators of inadequate decontamination.

A2.1.4 Trip Blanks

The volatile organic trip blanks will constitute approximately 5% of all samples, which equates to approximately every sixth batch (cooler) of sample containers shipped. The trip blank shall consist of pure deionized water added to one clean sample container in the field, and will be returned unopened to the laboratory, and are prepared as a check for possible contamination originating from container preparation methods, shipment, handling, storage, or site conditions. The trip blank shall be analyzed for volatile organic compounds only.

A2.1.5 Prevention of Cross-Contamination

Special care should be taken to prevent cross-contamination of soil samples. Particular care will be exercised to avoid the following common ways in which cross-contamination or background contamination may compromise the samples:

- Improperly storing or transporting sampling equipment and sample containers

- Contaminating the equipment or sample bottles by setting them on or near potential contamination sources such as uncovered ground
- Handling bottles or equipment with dirty hands
- Improperly decontaminating equipment before sampling or between sampling events.

A2.2 QUALITY OBJECTIVES AND CRITERIA FOR MEASUREMENT DATA

Quality objectives and criteria for measurement data are presented in Tables A2-1 and A2-2 for chemical and radiological analytes of interest. Analysis of soil physical properties will be performed according to American Society for Testing and Materials (ASTM) procedures.

A2.3 SAMPLE PRESERVATION, CONTAINERS AND HOLDING TIMES

Sample preservation, containers, and holding times for chemical and radiological analytes of interest and physical property test are presented in Table A2-3. Final requirements will be identified on the Sampling Authorization Form.

A2.4 ONSITE MEASUREMENTS QUALITY CONTROL

The collection of QC samples for onsite measurements QC is not applicable to field screening techniques described in this plan. Field screening instrumentation will be calibrated and controlled according to the procedures identified in Section A2.6.

A2.5 DATA MANAGEMENT

Data resulting from the implementation of this QAPjP shall be managed and stored by the Environmental Restoration Contractor (ERC) organization responsible for sampling and characterization, in accordance with BHI-EE-01, Section 2.0, "Sample Management." At the direction of the task lead, all analytical data packages shall be subject to final technical review by qualified personnel before their submittal to regulatory agencies or inclusion in reports. Electronic data access, when appropriate, shall be via a database (e.g., Hanford Environmental Information System [HEIS] or a project-specific database). Where electronic data are not available, hard copies shall be provided in accordance with Section 9.6 of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1994).

A2.6 VALIDATION AND VERIFICATION REQUIREMENT

Validation shall be performed on completed data packages by qualified Bechtel Hanford, Inc. (BHI) Sample Management personnel or by a qualified independent contractor. Validation shall consist of verifying required deliverables, requested versus reported analyses, and transcription

errors. Validation shall also include the evaluation and qualification of results based on holding time, method blanks, matrix spikes, laboratory control samples, laboratory duplicates, and chemical and tracer recoveries as appropriate to the methods used. No other validation or calculation checks will be performed. At least 10% of all data shall be validated. Assuming that about 350 samples will be collected during the 200-CW-1 investigations (including full QC sets, but exclusive of discretionary samples; see Table A3-6), at least 18 data packages/sample delivery groups containing 20 sample sets will be generated. Thus, at least two sample delivery groups will be validated. Validation requirements identified in this section are consistent with Level C validation, as defined in data validation procedures (WHC 1993a, 1993b). No validation for physical data will be performed.

A2.7 TECHNICAL PROCEDURES AND SPECIFICATIONS

Sampling and onsite environmental measurements shall be performed according to approved procedures. Sampling and field measurements will be conducted according to BHI-EE-01, *Environmental Investigations Procedures*; BHI-EE-05, *Field Screening Procedures*; and other approved procedures listed below. Individual procedures that may be used during performance of this SAP include the following:

- BHI-EE-01, *Environmental Investigations Procedures*

  Section 1.0, General Information
  - Procedure 1.5, "Field Logbooks"
  - Procedure 1.6, "Survey Requirements and Techniques"

  Section 2.0, Sample Management
  - Procedure 2.0, "Sample Event Coordination"
  - Procedure 2.1, "Sampling Documentation Processing"

  Section 3.0, General Sampling
  - Procedure 3.0, "Chain of Custody"
  - Procedure 3.1, "Sample Packaging and Shipping"
  - Procedure 3.2, "Field Decontamination of Sampling Equipment"

  Section 4.0, Soil, Groundwater, and Biotic Sampling
  - Procedure 4.0, "Soil and Sediment Sampling"
  - Procedure 4.2, "Sample Storage and Shipping Facility"

  Section 5.0, Sampling Techniques
  - Procedure 5.2, "Test Pit Excavation in Contaminated Areas"

  Section 6.0, Drilling
  - Procedure 6.0, "Documentation of Well Drilling, Abandonment, Remediation, and Completion Operations"
  - Procedure 6.1, "Drilling and Sampling in Radiological Contaminated Areas"
  - Procedure 6.2, "Field Cleaning and/or Decontamination of Drilling Equipment"

Section 7.0, Geologic and Hydrologic Data Collection
- Procedure 7.0, "Geologic Logging"
  Procedure 7.2, "Geophysical Survey Work"

- BHI-EE-05, *Field Screening Procedures*
  - Procedure 1.0, "Routine Field Screening"
  - Procedure 2.4. "Operation of the Man-Carried Radiological Detection System (MRDS)"
  - Procedure 2.5, "Operation of Mobile Surface Contaminant Monitor II"
  - Procedure 2.12, "Eberline E-600 Usage for Environmental Surveys"

- BHI-FS-03, *Field Support Waste Management Instructions*
  - Instruction W-006, "Site-Specific Waste Management Instructions"
  - Instruction W-011, "Control of CERCLA and Other Past-Practice Investigation Derived Waste"

- *Environmental Investigation Instruction* (EII), WHC-CM-7-7 (WHC 1988)
  - Instruction 5.5, "Laboratory Cleaning of RCRA/CERCLA Sampling Equipment."

Work shall also be performed in accordance with the following manuals:

- BHI-EE-02, *Environmental Requirements*, Section 11.0, "Solid Waste System Operations"
- BHI-QA-01, *ERC Quality Program*
- BHI-QA-03, *ERC Quality Assurance Program Plans*
  - Plan 5.1, "Field Sampling Quality Assurance Program Plan"
  - Plan 5.2, "Onsite Measurements Quality Assurance Program Plan"
  - Plan 5.3, "Radiological Measurements and Environmental Support Quality Assurance Program Plan"
- BHI-MA-02, *ERC Project Procedures*
- BHI-SH-01, *Hanford ERC Environmental, Safety, and Health Program*
- BHI-SH-05, *Industrial Hygiene Work Instructions*
- BHI-SH-02, *Safety and Health Procedures,* Volumes 1 through 4
- BHI-EE-10, *Waste Management Plan*
- BHI-SH-04, *Radiological Control Work Instructions*
- *Hanford Site Radiation Control Manual* (DOE-RL 1996b)
- Specification for environmental drilling services specific to 200-CW-1.

A2.7.1 Sample Location

Sample locations (e.g., boreholes and test pits) shall be staked and labeled prior to starting the activity. Locations shall be staked by the technical lead or field team leader assigned by the project manager. After the locations have been staked, minor adjustments to the location may be made to mitigate unsafe conditions, avoid structural interferences, or bypass utilities. Major changes in locations will require approval of the project manager. Locations shall be identified

during or after sampling following BHI-EE-01, Procedure 1.6, "Survey Requirements and Techniques."

A2.7.2 Sample Identification

The ERC Sample and Data Tracking database will be used to track the samples through the collection and laboratory analysis process. The HEIS database is the repository for the laboratory analytical results. The HEIS sample numbers will be issued to the sampling organization for this project in accordance with BHI-EE-01, Procedure 2.0, "Sample Event Coordination." Each chemical/radiological and physical properties sample will be identified and labeled with a unique HEIS sample number. The sample location and corresponding HEIS numbers will be documented in the sampler's field logbook.

Each sample container will be labeled with the following information using a waterproof marker on firmly affixed, water-resistant labels:

- HEIS number
- Sample collection date/time
- Name/initials of person collecting the sample
- Analysis required
- Preservation method if applicable.

A2.7.3 Field Sampling Log

All information pertinent to field sampling and analysis will be recorded in bound logbooks in accordance with BHI-EE-01, Procedure 1.5, "Field Logbooks." The sampling team will be responsible for recording all relevant sampling information including, but not limited to, the information listed in Appendix A of Procedure 1.5. Entries made in the logbook will be dated and signed by the individual who made the entry.

A2.7.4 Sample Custody

A chain-of-custody record will be initiated in the field at the time of sampling and will accompany each set of samples (cooler) shipped to any laboratory in accordance with BHI-EE-01, Procedure 3.0, "Chain of Custody." The analyses requested for each sample will be indicated on the accompanying chain-of-custody form. Chain-of-custody procedures will be followed throughout sample collection, transfer, analysis, and disposal to ensure that sample integrity is maintained. Each time responsibility for custody of the sample changes, the new and previous custodians will sign the record and note the date and time. The sampler will make a copy of the signed record prior to sample shipment and transmit it to ERC Sample Management within 24 hours of shipping, as detailed in BHI-EE-01, Procedure 2.1, "Sampling Documentation Processing."

A custody seal (i.e., evidence tape) shall be affixed to the lid of each sample jar. The container seal will be inscribed with the sampler's initials and the date sealed. For any sample jars collected inside the glovebag or glovebox and "bagged out," the evidence tape may be affixed to

the seal of the bag to demonstrate that tampering has not occurred. This will eliminate problems associated with contaminated soils adhering to the custody tape while inside the glovebox.

A2.7.5 Sample Containers and Preservatives

Level I EPA pre-cleaned sample containers will be used for soil samples collected for chemical and radiological analysis. Container sizes may vary depending upon laboratory-specific volumes needed to meet analytical detection limits. If, however, the dose rate on the outside of a sample jar or the curie content exceeds levels acceptable by an offsite laboratory, the sampling lead and task lead can send smaller volumes to the laboratory after consultation with ERC Sample Management to determine acceptable volumes. Preliminary container types and volumes are identified in Table A2-3.

A2.7.6 Sample Shipping

The outside of each sample jar will be surveyed by the radiological control technician (RCT) to verify that the container is free of smearable surface contamination. The RCT shall also measure the radiological activity on the outside of the sample container (through the container) and will mark the container with the highest contact radiological reading in either disintegrations per minute (dpm) or mrem/hr, as applicable. Unless pre-qualified, all samples will have total activity analysis performed by the Radiological Counting Facility (RCF), 222-S Laboratory, or other suitable onsite laboratory, prior to shipment. This information, along with other data that may pre-qualify the samples, will be used to select proper packaging, marking, labeling, and shipping paperwork in accordance with U.S. Department of Transportation regulations (49 CFR) and to verify that the sample can be received by the offsite analytical laboratory in accordance with the laboratory's acceptance criteria. The sampler will send copies of the shipping documentation to ERC Sample Management within 24 hours of shipping, as detailed in BHI-EE-01, Procedure 2.1, "Sampling Documentation Processing."

As a general rule, samples with activities <1 mR/hr will be shipped to an offsite laboratory. Samples with activities between 1 mR/hr and 10 mR/hr may be shipped to an offsite laboratory; samples with activities in this range will be evaluated on a case-by-case basis by ERC Sample Management. Samples with activities >10 mR/hr will be sent to an onsite laboratory.

Table A2-1. Analytical Performance Requirements – Shallow Zone Soils. (3 Pages)

Data Type	Analytical Method	Analyte	Preliminary Action Level	Detection Limit Requirement		Accuracy Required	Precision Required
				MDL	PQL		
Radiological Constituents, in pCi/g							
Rad, α	GeLi/HPGe AmAEA[a]	Americium-241	j	0.1 0.1	1 1	80-120 70-130	±30 ±30
Rad, γ	GeLi/HPGe	Cesium-137	j	0.05	0.1	80-120	±30
Rad, γ	GeLi/HPGe	Cobalt-60	j	0.05	0.1	80-120	±30
Rad, γ	GeLi//HPGe	Europium-152	j	0.1	0.2	80-120	±30
Rad, γ	GeLi/HPGe	Europium-154	j	0.1	0.2	80-120	±30
Rad, γ	GeLi/HPGe	Europium-155	j	0.05	0.1	80-120	±30
Rad, α	NpAEA[a]	Neptunium-237	j	0.1	1	70-130	±30
Rad, α	PuAEA[a]	Plutonium-238	j	0.1	1	70-130	±30
Rad, α	PuAEA [a]	Plutonium-239/240	j	0.1	1	70-130	±30
Rad	RADSr	Radiogenic strontium	j	0.2	1	70-130	±30
Rad, α	ThAEA[a]	Thorium-232	j	0.1	1	70-130	±30
Rad	KPA	Total uranium	N/A	0.2 mg/kg	1.0 mg/kg	70-130	±30
Rad, α	UAEA[a]	Uranium-233/234	j	0.1	1	70-130	±30
Rad, α		Uranium-235/236	j	0.1	1	70-130	±30
Rad, α		Uranium-238	j	0.1	1	70-130	±30
Inorganic Chemical Constituents, in mg/kg							
Data Type	**Analytical Method**	**Analyte**	**Preliminary Action Level**		**Detection Limit Requirements**		**Accuracy Required**	**Precision Required**
			Meth C[b]	**Meth B**	**MDL**	**PQL**		
Chem	EPA 6010	Arsenic	6.5[c]	6.5[c]	2.5/0.2[d]	10/1[d]	70-130	±30
Chem	EPA 6010	Barium	245[e]	132[c,e]	0.1	1	70-130	±30
Chem	EPA 6010	Beryllium	1.51[c]	1.51[c]	0.03	0.2	70-130	±30
Chem	EPA 6010	Cadmium	3.6[e]	1.6[e]	0.3	0.8	70-130	±30
Chem	EPA 6010	Chromium (III)	36[e]	36[e]	0.4	1	70-130	±30
Chem	EPA 7196	Hexavalent chromium	8.0[f]	17.5[f]	0.1	0.7	70-130	±30
Chem	EPA 6010	Copper	130[e]	59.2[e]	0.5	2	70-130	±30
Chem	EPA 6010	Lead	353[e,g]	353[e,g]	3	20	70-130	±30
Chem	EPA 7471	Mercury	0.33[c,e]	0.33[c,e]	0.005	0.05	70-130	±30
Chem	EPA 6010	Nickel	70[e]	32[e]	1	4	70-130	±30
Chem	EPA 6010	Selenium	5[e]	5[e]	5	20	70-130	±30
Chem	EPA 6010	Silver	10[e]	8[e]	0.7	2	70-130	±30
Chem	EPA 6010	Vanadium	24.5[e]	11.2[e]	0.5	3	70-130	±30
Chem	EPA 6010	Zinc	500[e]	480[e]	0.5	2	70-130	±30
Chem	EPA 305.1	Ammonia	59,500[h]	27,200[h]	0.2	0.5	70-130	±30
Chem	EPA 300.0	Chloride	25,000	25,000	0.2	2	70-130	±30
Chem	EPA 9010	Cyanide	2.6	2.6	0.25	1	70-130	±30
Chem	EPA 300.0	Fluoride	210	96	0.2	1	70-130	±30
Chem	IC 300 modified and 353.1[i]	Nitrate	4,400	4,400	0.02	0.2	70-130	±30
Chem	IC 300 modified and 353.1[i]	Nitrite	330	330	0.2	1	70-130	±30

Table A2-1. Analytical Performance Requirements – Shallow Zone Soils. (3 Pages)

Data Type	Analytical Method	Analyte	Preliminary Action Level		Detection Limit Requirements		Accuracy Required	Precision Required
			Meth C[b]	Meth B	MDL	PQL		
Chem	EPA 300.0	Phosphate	N/A[e]	N/A[e]	0.6	6	70-130	±30
Chem	EPA 300.0	Sulfate	25,000	25,000	2	10	70-130	±30
Chem	EPA 9030	Sulfide	N/A	N/A	4	20	70-130	±30
Organic Chemical Constituents, in mg/kg								
Chem	EPA 8260	Acetone	175	80	0.05	0.01	70-130	±30
Chem	EPA 8260	1-Butanol (butyl alcohol)	350	160	0.4	1	70-130	±30
Chem	EPA 8260	2-butanone (MEK)	105	48	0.005	0.01	70-130	±30
Chem	EPA 8260 as TIC	Butylated hydroxy toluene	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Carbon tetrachloride	0.337	0.0337	0.001	0.005	70-130	±30
Chem	EPA 8260	Chloroform (trichloromethane)	7.17	0.717	0.001	0.005	70-130	±30
Chem	EPA 8260 as TIC	Decane	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Dichloromethane (methylene chloride)	0.5	0.5	0.002	0.005	70-130	±30
Chem	EPA 8260 as TIC	Ethanol	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Halogenated hydrocarbons	N/A	N/A	0.002	0.005	70-130	±30
Chem	EPA 8260 as TIC	Propanol (Isopropyl alcohol)	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Toluene	100	100	0.001	0.005	70-130	±30
Chem	EPA 8270	Tributyl phosphate	N/A	N/A	0.4	4	70-130	±30
Chem	EPA 8260	1,1,1-trichloroethane	20	20	0.001	0.005	70-130	±30
Chem	EPA 8260	1,1,2-trichloroethane	0.3	0.0768	0.001	0.005	70-130	±30
Chem	EPA 8082	Polychlorinated biphenyls (PCBs)	66[e]	0.5[e]	0.01	0.1	70-130	±30
Chem	NWTPH-Dx modified for kerosene range	Kerosene, normal paraffin, hydrocarbon, paraffin, hydrocarbons, shell E-2342 (napthalene and paraffin), soltrol-170 ($C_{10}H_{22}$ to $C_{16}H_{34}$) purified kerosene, diesel fuel	N/A	N/A	0.5	5	70-130	±30

Table A2-1. Analytical Performance Requirements – Shallow Zone Soils. (3 Pages)

Data Type	Analytical Method	Analyte	Preliminary Action Level		Detection Limit Requirements		Accuracy Required	Precision Required
			Meth C[b]	Meth B	MDL	PQL		

NOTE: Detection limits in this table are based on optimal conditions. Interferences and different matrices may significantly degrade the values shown.
Dangerous waste generation is not expected at this OU (a contained-in determination is expected for listed waste hydrazine). If generated, the concentrations of any underlying hazardous constituents will be evaluated against applicable regulatory requirements.
α = alpha analysis
γ = gamma analysis
N/A = not applicable
[a] AmAEA, PuAEA, UAEA, NpAEA, ThAEA - chemical separation, electro/microprecipitation deposition, alpha energy analysis via Si barrier detector.
[b] Method C values are based on *Model Toxics Control Act* (MTCA) industrial standards.
[c] Based on Hanford Site background values.
[d] First value shown is via routine inductively coupled plasma (ICP), second value via "trace" ICP or graphite furnace atomic absorption.
[e] The RESRAD model for the 100 Area remedial design/remedial action or 100-N Area corrective measures study predicts that this constituent will not reach groundwater in 1,000 years. It is anticipated that the same will be true in the 200 Areas.
[f] Based on Federal ambient water quality criteria and assumed dilution attenuation factor of 2.
[g] The lead value is based on the IEUBK model from EPA (EPA 1994c).
[h] Ammonia dissolves in the environment and is assumed not to reach groundwater.
[i] Method is from EPA (1984).
[j] There are no preliminary action levels for radionuclides at this time. They will be developed in the remedial investigation/feasibility study process.
GeLi = lithium-drifted germanium detector
HPGe = high-purity germanium
KPA = kinetic phosphorescence analysis

Table A2-2. Analytical Performance Requirements - Deep Zone Soils. (2 Pages)

Data Type	Analytical Method	Analyte	Preliminary Action Level	Detection Limit Requirements		Accuracy Required	Precision Required
				MDL	PQL		
Radionuclides, in pCi/g							
Rad, α	GeLi/HPGe AmAEA[a]	Americium-241	[j]	0.1 0.1	1 1	80-120 70-130	±30 ±30
Rad, γ	GeLi/HPGe	Cesium-137	[j]	0.05	0.1	80-120	±30
Rad, γ	GeLi/HPGe	Cobalt-60	[j]	0.05	0.1	80-120	±30
Rad, γ	GeLi//HPGe	Europium-152	[j]	0.1	0.2	80-120	±30
Rad, γ	GeLi/HPGe	Europium-154	[j]	0.1	0.2	80-120	±30
Rad, γ	GeLi/HPGe	Europium-155	[j]	0.05	0.1	80-120	±30
Rad, α	NpAEA[a]	Neptunium-237	[j]	0.1	1	70-130	±30
Rad	Chem Separation Liq Scintillation	Nickel-63	[j]	5	30	70-130	±30
Rad, α	PuAEA[a]	Plutonium-238	[j]	0.1	1	70-130	±30
Rad, α	PuAEA[a]	Plutonium-239/240	[j]	0.1	1	70-130	±30
Rad	RADSr	Radiogenic strontium	[j]	0.2	1	70-130	±30
Rad	Chem Separation Liq Scintillation	Technetium-99	[j]	5	15	70-130	±30
Rad	Distillation Liq Separation	Tritium	[j]	5	400	70-130	±30
Rad, α	ThAEA[a]	Thorium-232	[j]	0.1	1	70-130	±30
Rad	KPA	Total uranium	[j]	0.2 mg/kg	1 mg/kg	70-130	±30
Rad, α	UAEA[a]	Uranium-233/234	[j]	0.1	1	70-130	±30
Rad		Uranium-235/236	[j]	0.1	1	70-130	±30
Rad		Uranium-238	[j]	0.1	1	70-130	±30
Inorganic Chemicals, in mg/kg							
Data Type	**Analytical Method**	**Analyte**	**Preliminary Action Level**		**Detection Limit Requirements**		**Accuracy Required**	**Precision Required**
			Meth C[b]	**Meth B**	**MDL**	**PQL**		
Chem	EPA 6010	Arsenic	6.5[c]	6.5[c]	2.5/0.2[d]	10/1[d]	70-130	±30
Chem	EPA 6010	Barium	245[e]	132[d,e]	0.1	1	70-130	±30
Chem	EPA 6010	Beryllium	1.51[c]	1.51[c]	0.03	0.2	70-130	±30
Chem	EPA 6010	Cadmium	0.17[e,f]	0.17[e,f]	0.3/0.02[d]	0.8/0.04[d]	70-130	±30
Chem	EPA 6010	Chromium (III)	36[e]	36[e]	0.4	1	70-130	±30
Chem	EPA 7196	Hexavalent chromium	8.0[f]	17.5[f]	0.1	0.7	70-130	±30
Chem	EPA 6010	Copper	130[e]	59.2[e]	0.5	2	70-130	±30
Chem	EPA 6010	Lead	353[e,g]	353[e,g]	3	20	70-130	± 30
Chem	EPA 7471	Mercury	0.33[c,e]	0.33[c,e]	0.005	0.05	70-130	±30
Chem	EPA 6010	Nickel	70[e]	32[e]	1	4	70-130	±30
Chem	EPA 6010	Selenium	5[e]	5[e]	5	20	70-130	±30
Chem	EPA 6010	Silver	10[e]	8[e]	0.7	2	70-130	±30
Chem	EPA 6010	Vanadium	24.5[e]	11.2[e]	0.5	3	70-130	±30
Chem	EPA 6010	Zinc	500[e]	480[e]	0.5	2	70-130	±30
Chem	EPA 305.1	Ammonia	59,500[h]	27,200[h]	0.2	0.5	70-130	±30
Chem	EPA 9010	Cyanide	2.6[f]	2.6[f]	0.25	1	70-130	±30
Chem	EPA 300.0	Fluoride	200	96	0.2	1	70-130	±30
Chem	IC 300 modified and 353.1[I]	Nitrate	4,400	4,400	0.02	0.2	70-130	±30
Chem	IC 300 modified and 353.1[I]	Nitrite	330	330	0.2	1	70-130	±30
Chem	EPA 300.0	Sulfate	25,000	25,000	2	10	70-130	±30
Chem	EPA 300.0	Phosphate	N/A[e]	N/A[e]	0.6	6	70-130	±30
Chem	EPA 300.0	Chloride	25,000	25,000	0.2	2	70-130	±30
Chem	EPA 9030	Sulfide	N/A	N/A	4	20	70-130	±30
Chem	EPA 9045	pH	N/A	N/A	N/A	N/A	70-130	±30

Table A2-2. Analytical Performance Requirements - Deep Zone Soils. (2 Pages)

Data Type	Analytical Method	Analyte	Preliminary Action Level		Detection Limit Requirements		Accuracy Required	Precision Required
					MDL	PQL		
Chem	EPA 8260	Acetone	175	80	0.05	0.01	70-130	±30
Organic Chemicals, in mg/kg								
Data Type	**Analytical Method**	**Analyte**	**Preliminary Action Level**		**Detection Limit Requirements**		**Accuracy Required**	**Precision Required**
			Meth C[b]	**Meth B**	**MDL**	**PQL**		
Chem	EPA 8260	1-Butanol (butyl alcohol)	350	160	0.4	1	70-130	±30
Chem	EPA 8260	2-butanone (MEK)	105	48	0.005	0.01	70-130	±30
Chem	EPA 8260 as TIC	Butylated hydroxy toluene	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Carbon tetrachloride	0.337	0.0337	0.001	0.005	70-130	±30
Chem	EPA 8260	Chloroform (trichloromethane)	7.17	0.717	0.001	0.005	70-130	±30
Chem	EPA 8260 as TIC	Decane	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Dichloromethane (methylene chloride)	0.5	0.5	0.002	0.005	70-130	±30
Chem	EPA 8260 as TIC	Ethanol	N/A	N/A	N/A	N/A	70-130	±30
Chem	EPA 8260	Halogenated hydrocarbons	N/A	N/A	0.002	0.005	70-130	±30
Chem	EPA 8260 as TIC	Propanol (isopropyl alcohol)	N/A	N/A	N/A	N/A	N/A	N/A
Chem	EPA 8260	Toluene	100	100	0.001	0.005	70-130	±30
Chem	EPA 8270	Tributyl phosphate	N/A	N/A	0.4	4	70-130	±30
Chem	EPA 8260	1,1,1-trichloroethane	20	20	0.001	0.005	70-130	±30
Chem	EPA 8260	1,1,2-trichloroethane	0.3	0.0768	0.001	0.005	70-130	±30
Chem	EPA 8080/8082	Polychlorinated biphenyls (PCBs)	66[e]	0.5[e]	0.01	0.1	70-130	±30
Chem	NWTPH-Dx modified for kerosene range	Kerosene, normal paraffin hydrocarbon, paraffin, hydrocarbons, shell E-2342 (napthalene and paraffin), soltrol-170 ($C_{10}H_{22}$ to $C_{16}H_{34}$), purified kerosene, diesel fuel	N/A	N/A	0.5	5	70-130	±30

NOTE: Detection limits in this table are based on optimal conditions. Interferences and different matrices may significantly degrade the values shown.

Dangerous waste generation is not expected at this OU (a contained-in determination is expected for listed waste hydrazine). If generated, the concentrations of any underlying hazardous constituents will be evaluated against applicable regulatory requirements.

α = alpha analysis

γ = gamma analysis

N/A = not applicable

[a] AmAEA, PuAEA, UAEA, NpAEA, ThAEA - chemical separation, electro/microprecipitation deposition, alpha energy analysis via Si barrier detector.

[b] Method C values are based on MTCA industrial standards.

[c] Based on Hanford Site background values.

[d] First value shown is via routine ICP, second value via "trace" ICP or graphite furnace atomic absorption.

[e] The RESRAD model for the 100 Area remedial design/remedial action or 100-N Area corrective measures study predicts that this constituent will not reach groundwater in 1000 years. It is anticipated that the same will be true in the 200 Areas.

[f] Based on Federal ambient water quality criteria and assumed dilution-attenuation factor of 2.

[g] The lead value is based on the IEUBK model from EPA (EPA 1994c).

[h] Ammonia dissolves in the environment and is assumed to not reach groundwater.

[i] Method is from EPA (1984).

[j] There are no preliminary action levels for radionuclides at this time. They will be developed in the remedial investigation/feasibility study

GeLi = lithium-drifted germanium detector

HPGe = high-purity germanium

KPA = kinetic phosphorescence analysis

Table A2-3. Sample Preservation, Container, and Holding Time Guidelines.

Analytes	Analytical Priority	Matrix	Bottle		Volume[a]	Preservation	Packing Requirements	Holding Time
			Number	Type				
Radionuclides								
Americium-241	11	Soil	1	G/P	10 g	None	None	6 months
Gamma spectroscopy	1	Soil	1	G/P	1,500 g	None	None	6 months
Isotopic plutonium	5	Soil	1	G/P	10 g	None	None	6 months
Isotopic thorium	6	Soil	1	G/P	6 g	None	None	6 months
Isotopic uranium	[b]	Soil	1	G/P	10 g	None	None	6 months
Neptunium-237	7[c]	Soil	1	G/P	10 g	None	None	6 months
Nickel-63	7[c]	Soil	1	G/P	6 g	None	None	6 months
Radiogenic strontium	2	Soil	1	G/P	10 g	None	None	6 months
Technetium-99	7[c]	Soil	1	G/P	6 g	None	None	6 months
Total uranium	3	Soil	1	G/P	6 g	None	None	6 months
Tritium – H3	20	Soil	1	G	100 g	None	None	6 months
Chemicals								
Alcohols, glycols, and ketones – 8015M	8	Soil	3	G	40 mL	None	Cool 4°C	14 days
Ammonia – 350.1	16	Soil	1	G/P	300 mL	None	Cool 4°C	28 days
Conductivity – 9050	17	Soil	1	G/P	200 g	None	Cool 4°C	28 days
IC anions – 300.0	7	Soil	1	G/P	250 g	None	None	28 days/48 hours
ICP metals – 6010A (Add-on)	4	Soil	1	G/P	250 g	None	None	6 months
ICP metals – 6010A (TAL)	4	Soil	1	G/P	15 g	None	None	6 months
Chromium hex – 7196	14	Soil	1	G/P	500 mL	None	Cool 4°C	30 days
Mercury – 7471 – (CV)	13	Soil	1	G	125 g	None	None	28 days
Total cyanide – 9010	18	Soil	1	G	40 g	None	Cool 4°C	14 days
PCBs – 8082	15	Soil	1	aG	250 g	None	Cool 4°C	14/40 days
pH (soil) – 9045	19	Soil	1	G/P	250 g	None	None	ASAP
SVOA – 8270A (TCL)	9	Soil	1	aG	250 g	None	Cool 4°C	14/40 days
Sulfides – 9030	12	Soil	1	G	40 g	None	Cool 4°C	7 days
Total petroleum hydrocarbons – Diesel range	10	Soil	1	G	200 g	None	Cool 4°C	14 days
VOA – 8260A (TCL)	21	Soil	1	G	50 g	None	Cool 4°C	14 days
Physical Properties								
Bulk density – D2937	22	Soil	1	liner	1,000 g	None	None	None
Moisture content – ASTM D2216	23	Soil	1	G/P	1,000 g	None	None	None
Particle size distribution – ASTM D422	24	Soil	1	G/P	TBD	None	None	None

[a] Optimal volumes, which may be adjusted downward to accommodate the possibility of retrieval of small amount of sample. Minimum sample size will be defined in the Sampling Authorization Form.

[b] Uranium will be analyzed for total abundance in all samples; any samples with values significantly above background levels will be analyzed for individual species.

[c] These radionuclides are constituents of concern in the deep zone only, and will only be analyzed for in the deeper borehole samples (>15 ft). Their analytical priority will be the same as ICP metals (4).

G = glass
P = plastic
aG = amber glass
TBD = to be determined
ASAP = as soon as possible

A3.0 FIELD SAMPLING PLAN

A3.1 SAMPLING OBJECTIVES

The primary objective of the field sampling plan (FSP) is to clearly identify and describe sampling and analysis activities that will be conducted to resolve decision rules identified in Step 5 of the DQO process (see Section A1.6.2). Decision rule statements indicate that remedial action will be necessary if preliminary action levels and annual exposure protection limits are exceeded or if the current site conceptual model cannot be verified. The field activities described in this section are intended to address and resolve these decision rules. The FSP uses the sampling design proposed in Step 7 of the DQO process and describes pertinent elements of the sampling program. Sample methods, procedures, locations, frequencies, parameters of interest, and bottle requirements are identified in this section.

Two deep boreholes and 27 test pits (or shallow auger borings) will be excavated to characterize the four waste sites in the 200-CW-1 OU. Soil samples will be collected from the vadose zone and analyzed for a suite of chemical and radiological components; a limited number of samples will be collected for analysis of selected physical properties. A spilt-spoon sampler will be the primary sampling device used for the boreholes (or auger borings); test pits shall be excavated and sampled with a backhoe. The locations of planned and existing boreholes and the planned test pits are shown in Figures A3-1 through A3-3.

A3.2 FIELD MEASUREMENTS

A3.2.1 Surface Radiation Survey

A surface radiation survey shall be performed at each waste site. The survey shall be performed to document existing surface contamination and to support preparation of supporting health and safety documentation. Surface radiation surveys shall be conducted by qualified RCTs in accordance with applicable health and safety procedures. A survey report will be prepared for each site. Surveys shall be performed according to BHI-EE-05, Procedure 2.4, "Operation of the Man-Carried Radiological Detection System," and Procedure 2.5, "Operation of the Mobile Surface Contamination Monitoring System," or other applicable approved procedures. A post-sampling survey will also be performed at each sampling site to ensure that sampling activities have not contributed to surface contamination.

A3.2.2 Soil Screening

All samples and cuttings from boreholes and test pits will be field screened for evidence of radioactive contamination by the RCT or other qualified personnel. Surveys of these materials shall be conducted visually and with field instruments. Potential screening instruments are listed in Table A3-1 with their respective detection limits. The RCT shall record all field measurements, noting the depth of the sample and the instrument reading.

Prior to excavation, a local area background reading will be taken with the field screening instruments at a background site to be selected in the field. Field screening will be used to identify the bottom of the pond and adjust sampling points, assist in determining sample shipping requirements, and support worker health and safety monitoring. The site geologists will use professional judgment, screening data, and the information provided in Tables A3-2 through A3-5 to finalize sampling decisions.

The action level for radionuclide screening is twice background, and the action level for volatile organic screening is 5 ppm. Intervals above these action levels will be referred to as "hot spots" and will be assessed for sampling by the field geologist. Samples exceeding 0.5 mrem/hr will be stored at a temporary radioactive material storage area until shipment to the laboratory.

Field screening instruments will be used, maintained, and calibrated in accordance with the manufacturer's specifications and other approved procedures. The field geologist will record field screening results on the borehole log.

A3.3 SOIL SAMPLING AND ANALYSIS

The following sections discuss the details of sampling soil from boreholes and test pits.

A3.3.1 Borehole Sampling and Analysis

Chemical and radiological samples shall be collected from two deep boreholes. Borehole B8757 will be drilled in the southeast portion of Gable Mountain Pond, near the point of historic effluent discharge. Borehole B8758 will be in drilled in the southwestern portion of B Pond where the 216-B-3-3 Trench emptied into the pond. Borehole sample collection shall be guided by the sampling schemes in Tables A3-2 and A3-3. Actual sampling intervals may vary from these schemes depending on the thickness of clean soil cover placed over ponds. The intent of the sampling design is to begin sample collection at the bottom of the pond, which may be located several feet below the ground surface. Additional samples will be collected based upon depth below the bottom of the pond and depth bgs. The bottom of the pond will be identified by retrieving soil samples and examining them using field screening methods and geologic observations.

Four samples will be collected from the bottom of the pond to 3.0 m (10 ft) below the bottom of the pond at 0.75-m (2.5-ft) intervals. The bottom of the pond is expected to be intercepted approximately 1.5 m (5 ft) beneath the surface at both borehole locations. Samples will also be collected from the following intervals below ground surface:

- For the borehole at Gable Mountain Pond, at 4.0 to 4.6 m (13 to 15 ft), 5.5 to 6.1 m (18 to 20 ft), 7.0 to 7.6 m (23 to 25 ft), the high water mark (25.5 ft bgs), and just above the water table, which is expected to be about 9.1 m (30 ft) bgs

- For the borehole at B Pond, at 4.0 to 4.6 m (13 to 15 ft), 5.5 to 6.1 m (18 to 20 ft), 7.0 to 7.6 m (23 to 25 ft), 14.6 to 15.2 m (48 to 50 ft), 29.9 to 30.5 m (98 to 100 ft), 45.1 to

45.7 m (148 to 150 ft), and the high water mark 48 m (158 ft) bgs. The last sample will be collected just above the water table, which is expected to be about 54.0 m (177 ft) bgs.

If any of the samples that have the ground surface as the reference coincide with sampling intervals collected with reference to the bottom of the pond, one sample will be sufficient. Figures A3-4 and A3-5 illustrate general sampling intervals in the boreholes.

The bottom of the pond is a critical sample point because the highest levels of contamination are expected to be encountered at this location, and sampling will be initiated from this soil horizon. Samples from 4.6 m (15 ft) bgs and 7.6 m (25 ft) bgs are also considered critical sampling points to evaluate residential exposure scenarios and remedial alternatives. Sample from depths greater than 7.6 m (25 ft) bgs will be used to verify the site conceptual model and to evaluate remedial action alternatives and groundwater impacts. Drilling and sampling will stop when the water table is encountered.

Sampling will be performed in accordance with BHI-EE-01, Procedure 4.0, "Soil and Sediment Sampling," using a split-spoon sampler. The split-spoon samplers will be equipped with four separate stainless steel or lexan liners. Site personnel will not overdrive the sampling device. With the exception of samples for volatile organic analysis, soil shall be transferred to a pre-cleaned, stainless steel mixing bowl, homogenized, then containerized in accordance with the sampling procedure. Samples collected for volatile organic analysis shall be transferred directly from the liners to an appropriate container without mixing the sample. Chemical and radiological analytes of interest are presented in Tables A2-1 and A2-2. If sample volume requirements cannot be met, samples will be collected according to the priority presented in Table A2-3. Radiological and chemical samples will always take precedence over physical property samples.

Physical property samples shall be collected from deep boreholes to provide site-specific values to support RESidual RADioactivity Dose Model (RESRAD) modeling efforts. Soil properties of interest are moisture content, grain-size distribution, and soil density. Samples for soil density shall generally be collected with a split-spoon sampler equipped with four separate stainless steel or lexan liners. Samples will be analyzed in accordance with ASTM methods, listed in Table A2-3 (ASTM 1993). A minimum of three sample sets will be collected for analysis of physical properties in deep boreholes. One sample set will be collected at Gable Mountain Pond, and two sample sets will be collected at B Pond. The samples will be collected from lithologies that represent the major facies in the vadose zone. Unit 1 of the Hanford formation will be sampled at Gable Mountain Pond, and Units 1 and 2 of the Hanford formation will be sampled at B Pond. The samples shall be collected coincident with chemical and radiological split-spoon sample intervals, where possible. Additional samples may be obtained with the approval of the project manager. Requirements for the collection of physical property samples are also listed in Tables A3-2 and A3-3.

Investigation-derived waste generated during this activity will be handled according to procedures in Section A2.0 and the waste control plan (to be developed).

A3.3.2 Test Pit (Auger) Sampling and Analysis

The collection of samples from test pits shall be guided by the sampling scheme presented in Tables A3-2 through A3-5. Note that sample intervals are based on both depth below the ground surface and depth below the bottom of the pond/ditch. Samples shall be collected for chemical and radiological analysis generally beginning at the bottom of the pond, which will be identified using field screening methods and the professional judgement of the site geologist.

If a backhoe bucket is used as the sampling device, samples will generally be collected at 0.8-m (2.5-ft) intervals from the bottom of the pond to 3 m (10 ft), then at 1.5-m (5-ft) intervals to 7.6 m (25 ft). Samples will be collected directly from the backhoe bucket, which will target the interval 0.3 m (1 ft) below the specified sampling depth. Samples from 4.3 to 4.6 m (14 to 15 ft) bgs and 7.3 to 7.6 m (24 to 25 ft) bgs shall also be collected. It is critical that these two samples and a sample of the sediment at the bottom of the pond or ditch be obtained. Actual sampling frequencies may vary depending on the thickness of clean soil cover placed over ponds/ditch. Figures A3-6A, A3-6B, and A3-C illustrate hypothetical sampling intervalsin the test pits.

If an auger borehole is used to collect samples, the sampling scheme shall be consistent with the borehole collection scheme described in Section A3.3.1 and Tables A3-2 and A3-3, but the last sample will be collected approximately 7.6 m bgs.

Sampling will be performed in accordance with BHI-EE-01, Procedure 4.0, "Soil and Sediment Sampling," using a split-spoon sampler or the backhoe bucket, as applicable. Chemical and radiological analytes of interest are presented in Tables A2-1 and A2-2. Note that some of the test pit (or auger) samples will be analyzed for a subset of the total COC list (see Tables A3-4 and A3-5). If sample volume requirements cannot be met, samples will be collected and analyzed in the sequence shown in Table A2-3. Samples to evaluate the physical properties of soil will be collected from at least one test pit or shallow auger borehole per waste site.

Test pits shall be excavated in a manner that minimizes the generation of visible emissions (dust) from the site boundary. To minimize the generation of dust during backhoe operations, water shall be sprayed on the site before and during the activity. This contamination control measure is necessary to prevent the release of contamination to the air and stabilized areas within the site boundary. If visible emissions cannot be controlled, the activity will be postponed.

Waste generated during this activity will be handled according to procedures listed in Section A2.0 and the waste control plan in Appendix B of the work plan.

A3.3.3 Pre-Shipment Sample Screening

A representative portion of each sample that will be shipped offsite shall be submitted to the RCF, 222-S Laboratory, or other suitable onsite laboratory for total activity analysis. Total activities will be utilized for sample pre-shipment characterization. Samples that slightly exceed the offsite laboratory criterion discussed in Section A3.2.2 may be reduced in volume to allow offsite shipment. Onsite and offsite laboratories will be identified prior to initiating field

activities and will be mutually acceptable to the ERC's Sample and Data Management group and to the task lead.

A3.3.4 Summary of Sampling Activities

A summary of the number and types of samples to be collected at all four waste sites is presented in Table A3-6.

A3.4 GEOPHYSICAL LOGGING

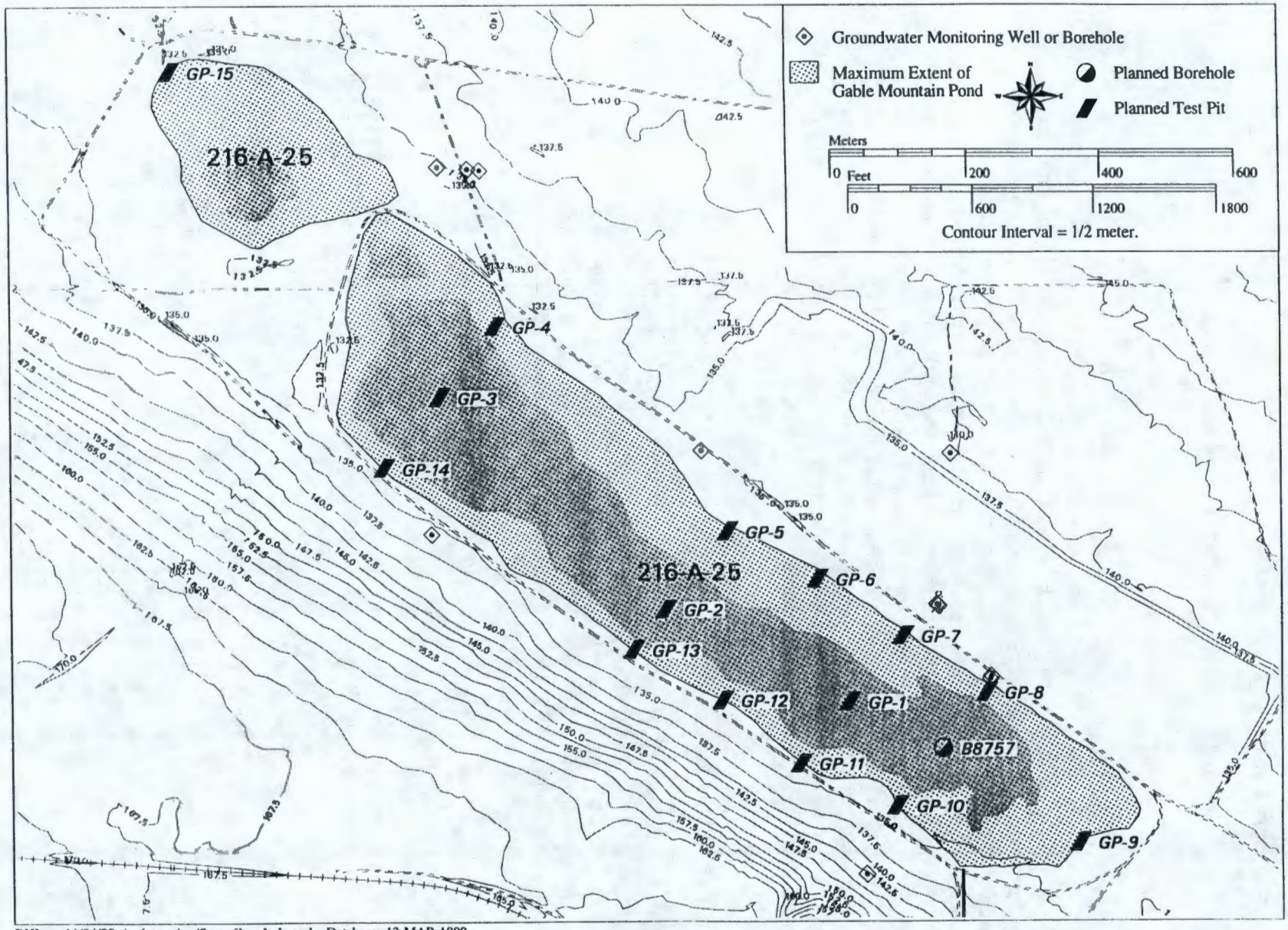
The deep boreholes and selected existing boreholes will be geophysically logged with the high-resolution spectral gamma-ray logging system to determine the vertical distribution and concentration of gamma-emitting radionuclides of concern. Soil moisture will also be determined using a neutron logging tool. These methods are described in Section 4.3 of the work plan. The new boreholes shall be logged prior to telescoping of casing and before abandonment. The starting point for logging will be recorded; this is usually ground surface or top of casing. The site geologist will witness logging runs and verify before and after field calibrations and repeat log intervals. The list of boreholes and wells that will be logged with the radionuclide logging system is presented in Table A3-7. All of these wells are located within 30 m (100 ft) of the boundaries of the sites being investigated.

A3.5 SURVEYING

The location of all planned boreholes and test pits will be surveyed after the sampling and abandonment activities are completed. Surveys shall be performed according to BHI-EE-01, Procedure 1.6, "Survey Requirements and Techniques." Data will be recorded in the North American Vertical Datum of 1988 (NAVD 1988) and the Washington State Plane (South Zone) North American Datum of 1983 (NAD 1983), with the 1991 adjustment for horizontal coordinates. All survey data will be recorded in meters and feet.

A3.6 REVEGETATION

Test pit locations shall be revegetated after the pits have been backfilled if the area supported vegetation before excavation. If applicable, test pit locations shall be seeded with a mixture of grasses.



BHI:rpp 11/04/98 singleton_km/figure6borehole.aml Database: 12-MAR-1999

Figure A3-1. Location of Planned and Existing Test Pits and Borehole at the Gable Mountain Pond.

Figure A3-2. Location of Planned and Existing Boreholes and Test Pits at the 216-B-2-2 Ditch.

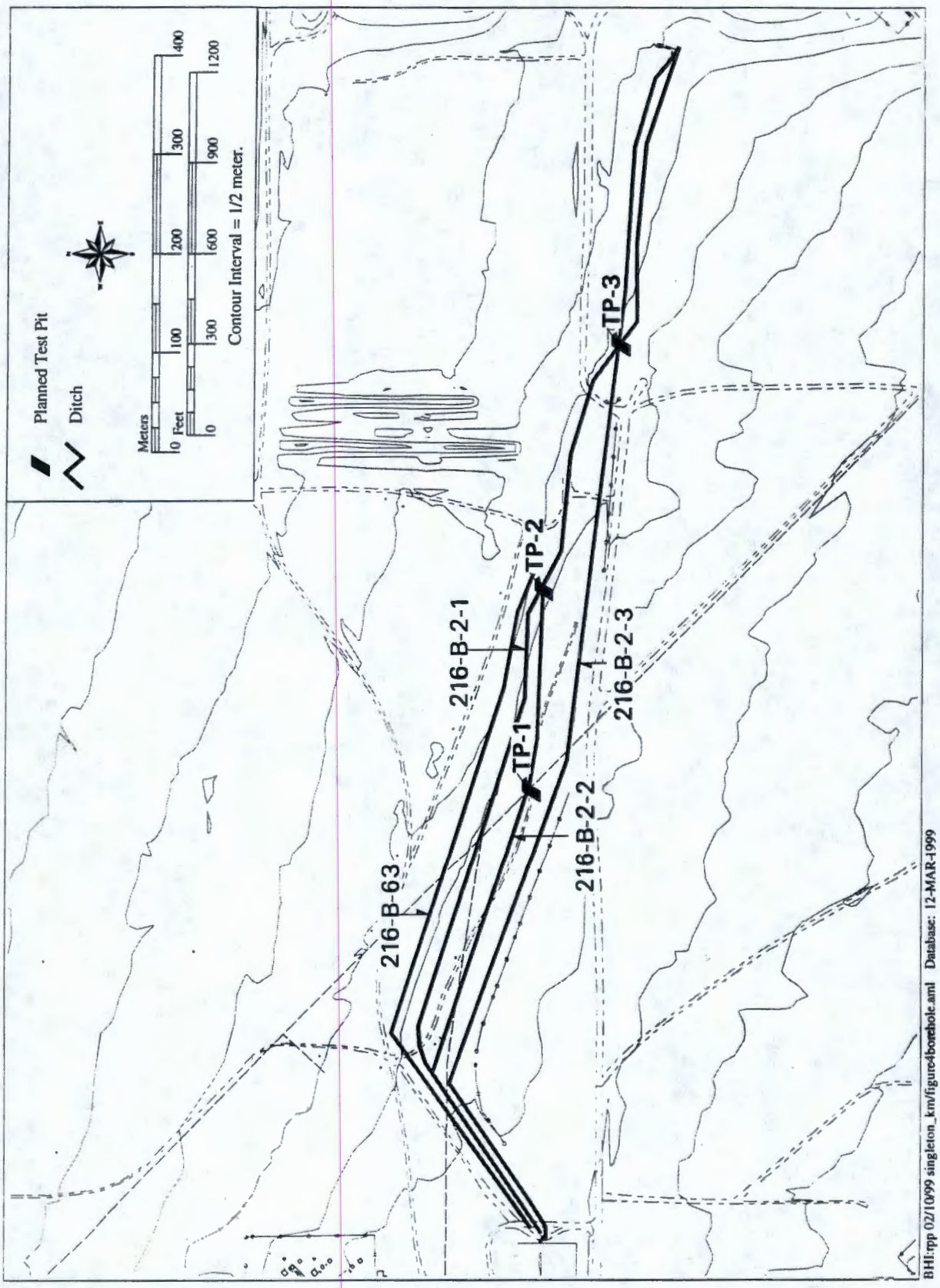


Figure A3-3. Location of Planned and Existing Boreholes and Test Pits at the 216-B-3-3 Ditch and B Pond.

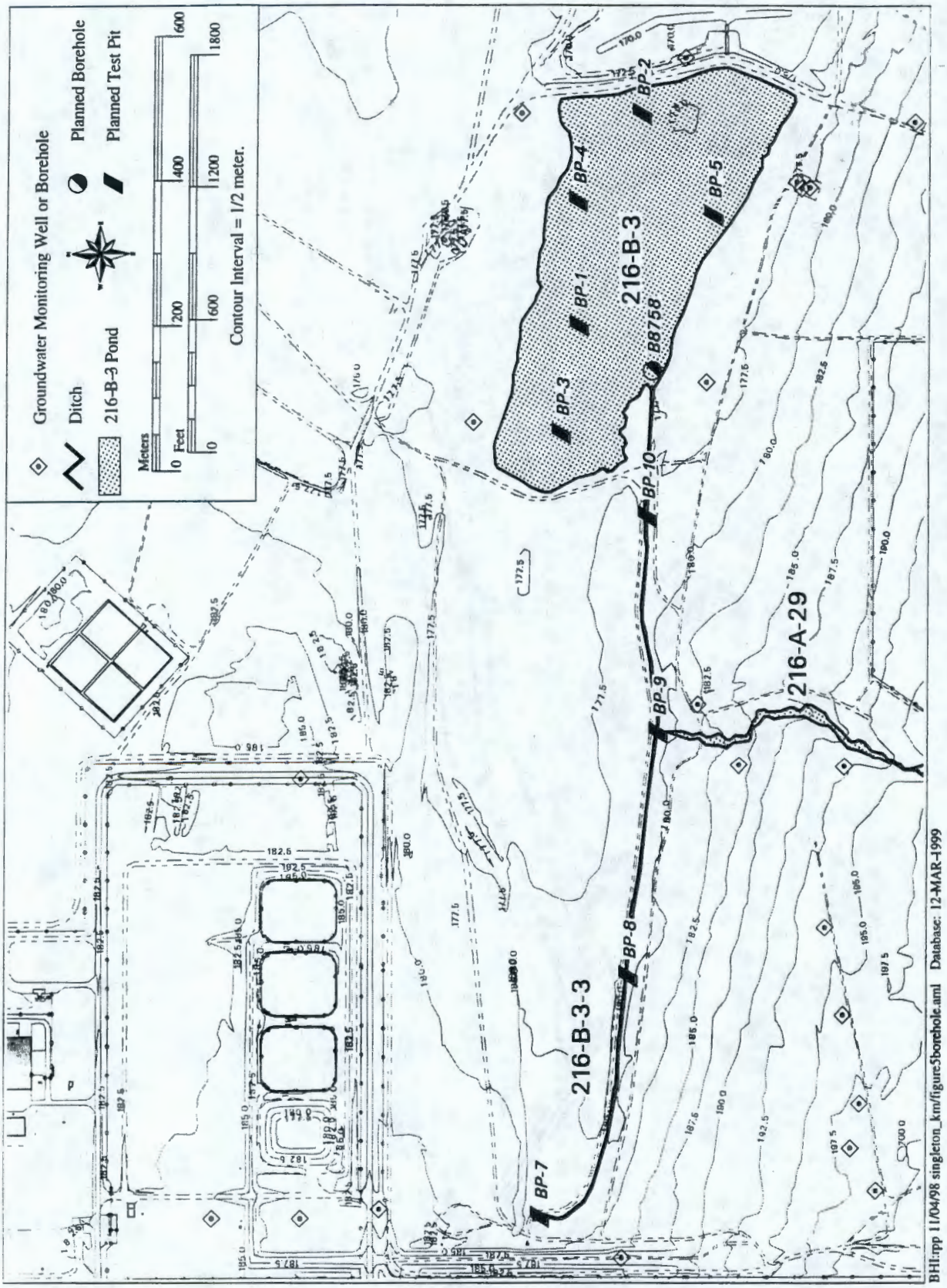


Figure A3-4. Approximate Sampling Intervals in the B Pond Borehole.

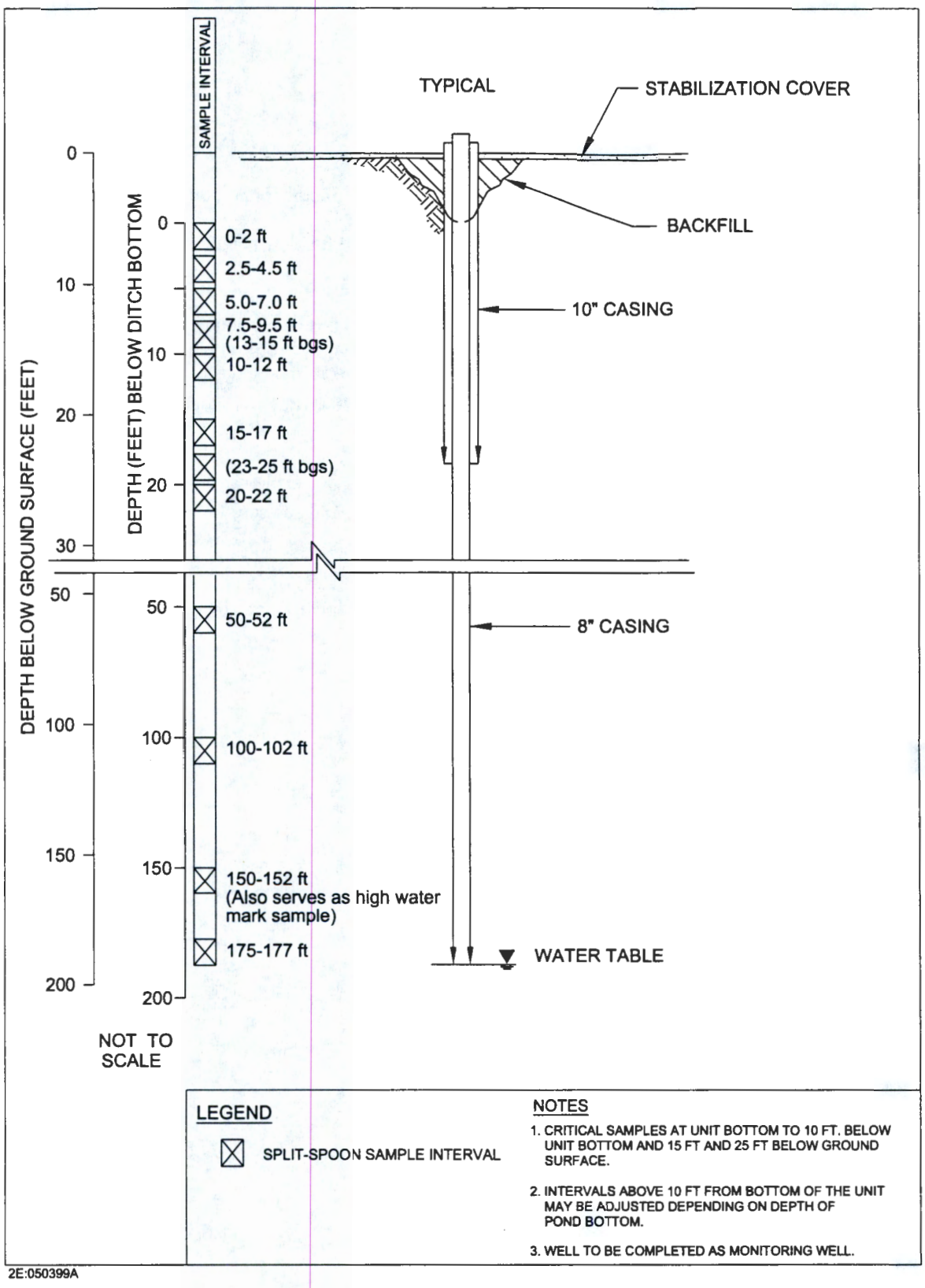


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Figure A3-5. Approximate Sampling Intervals in the Gable Mountain Pond Borehole.

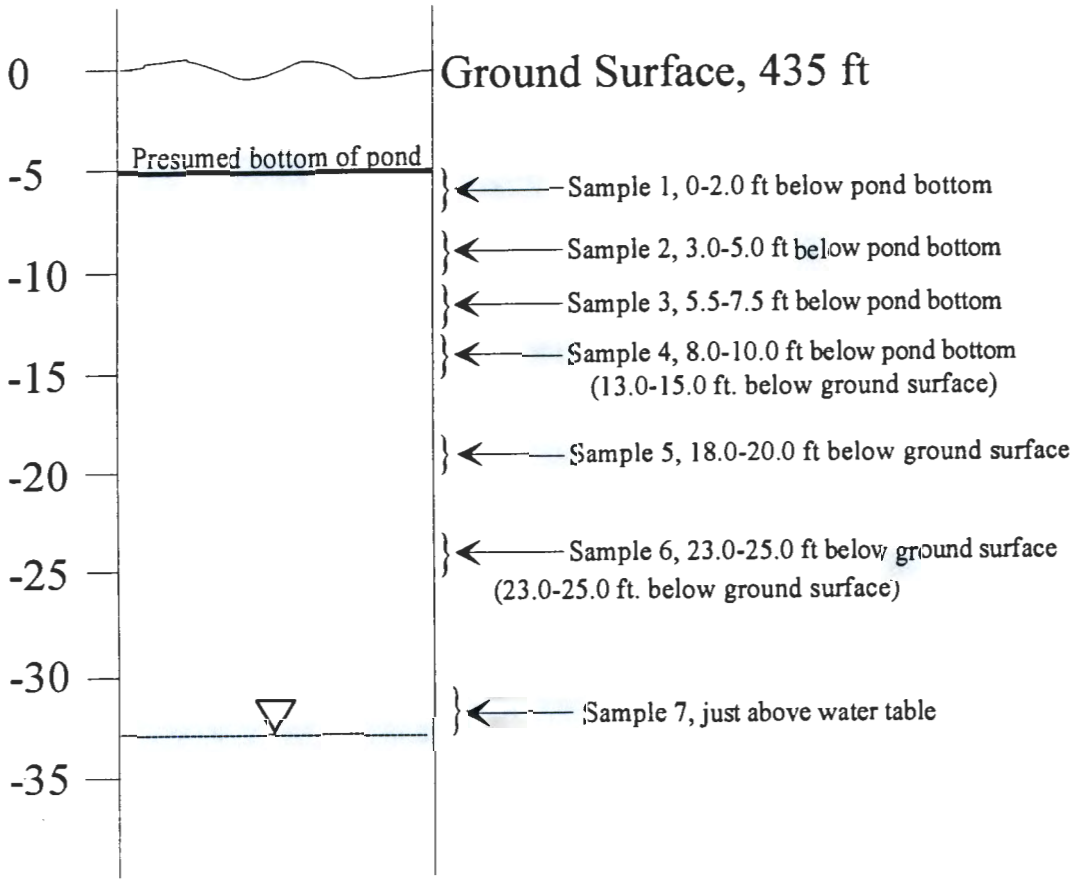

Figure A3-6A. Approximate Sampling Intervals for a Representative Test Pit at B-Pond.

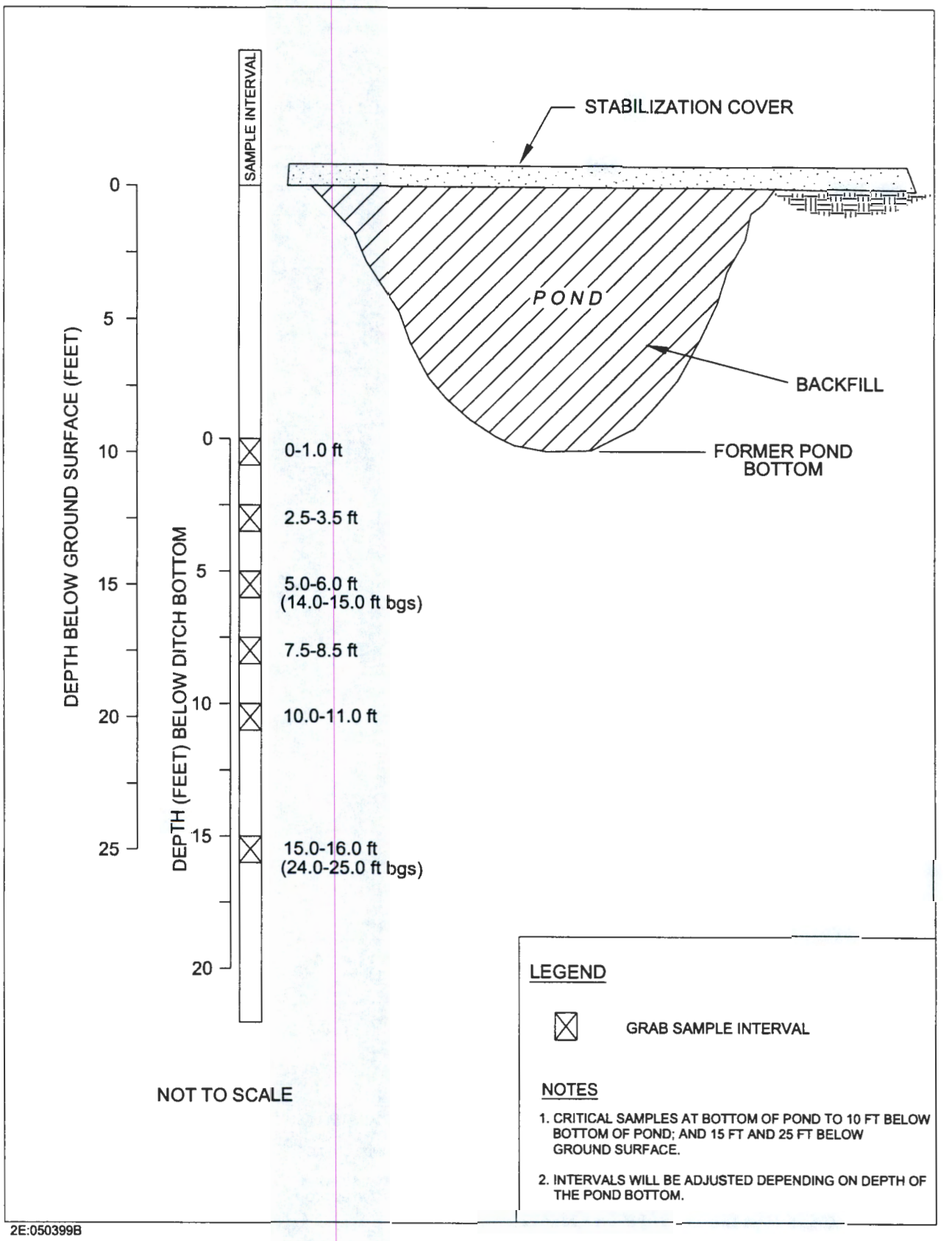

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Figure A3-6B. Approximate Sampling Intervals for a Representative Test Pit at Gable Mountain Pond.

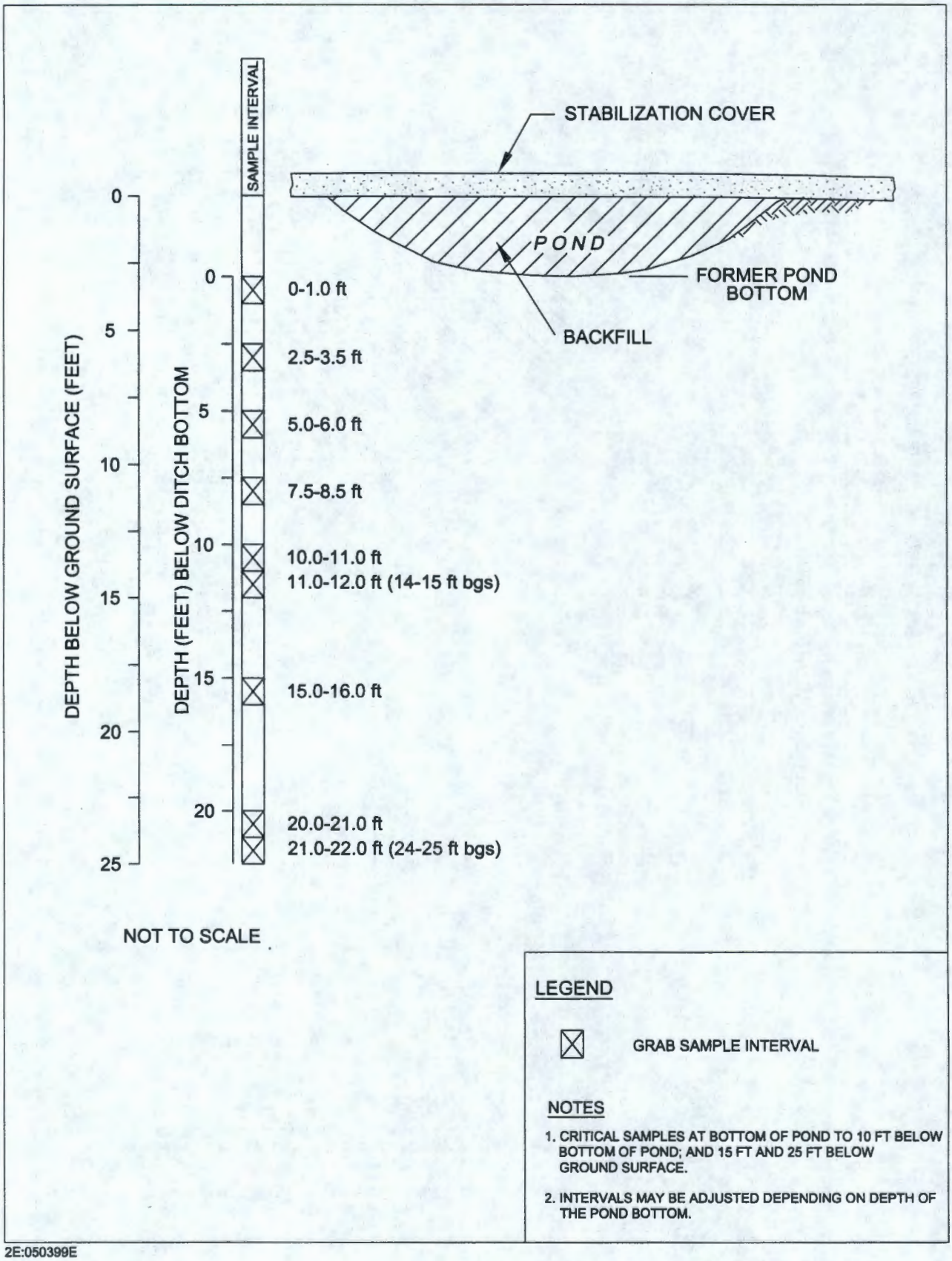

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Figure A3-6C. Approximate Sampling Intervals for a Representative Test Pit at B-2-2 and B-3-3 Ditches.

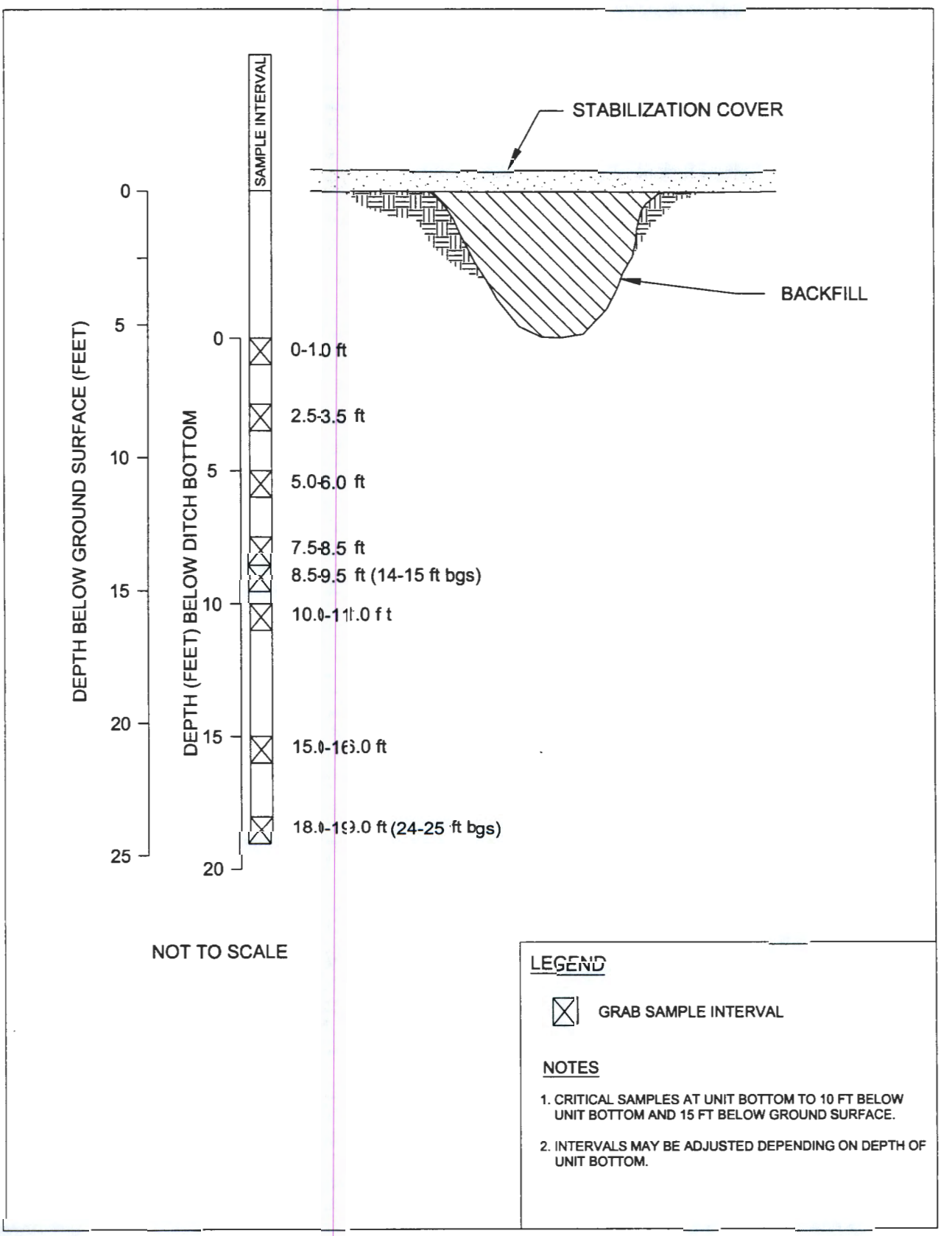

Table A3-1. Field Screening Methods.

Measurement Type	Emission Type	Method/Instrument	Detection Limit
Exposure/Dose Rate	Beta/gamma	RO-20/RO-03 portable ionization chamber	0.5 mR/hr
Contamination Level	Alpha/beta-gamma	E-600 ratemeter with SHP380-A/B scintillation probe	100 dpm α 1,000 dpm β–γ
	Volatile organic compounds	Photoionization detector	2 ppm; may be higher for some compounds

Table A3-2. Gable Mountain Pond Sampling Schedule.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft)		Analyte List[b]		Physical Properties	
			BBP	bgs[a]	<15 ft bgs	>15 ft bgs	Sample Interval, bgs	Parameters
Borehole B8757	B8757	33 ft bgs	0-2, 2.5-4.5, 5.0-7.0, 7.5-9.5 10-12, 15-17 20-22, 25-27 31-33[a]	13-15, 23-25, 25.5-27.5	Table A2-1	Table A2-2	1 sample from Hanford formation, Unit 1	Bulk density, moisture content, particle size distribution
Test Pits	GP-1, GP-6, GP-7, GP-11, GP-12	25 ft bgs	0-1, 2.5-3.5, 5-6, 7.5-8.5, 10-11 15-16, 20-21 24-25	14-15, 24-25	Gamma-emitting radionuclides and metals listed in Table A2-1	Gamma-emitting radionuclides and metals listed in Table A2-2	N/A	N/A
Test Pits	GP-2, GP-3	25 ft bgs	0-1, 2.5-3.5, 5-6, 7.5-8.5, 10-11, 15-16, 20-21, 24-25	14-15, 24-25	Table A2-1	Table A2-2	N/A	N/A
Test Pits	GP-4, GP-5, GP-8, GP-9, GP-10, GP-13, GP-14, GP-15	25 ft bgs	0-1, 2.5-3.5, 5-6 7.5-8.5, 10-11 15-16, 20-21 24-25	14-15, 24-25	Table A2-1, except Np-237	Table A2-2, except Np-237	N/A	N/A

Maximum Number of Samples	162
Approximate Number of Field QC Samples	32[c]
Approximate Total Number of Samples	194

BBP = below bottom of pond
bgs = below ground surface
N/A = not applicable
[a] If sample interval BBP intersects with interval bgs, the BBP sample interval will not be collected.
[b] See Table A2-1 for detection limits and other analytical parameters.
[c] See Table A3-6 for details of QC samples.

Table A3-3. B Pond Sampling Schedule.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft)		Analyte List[b]		Physical Properties	
			BBP	bgs[a]	<15 ft bgs	>15 ft bgs	Sample Interval, bgs	Parameters
Borehole B8758	B8758	177 ft	0-2, 2.5-4.5, 5.0-7.0, 7.5-9.5, 10-12, 15-17, 20-22, 23-25, 50-52, 100-102, 150-152, 175-177[a]	13-15 , 23-25, 157-159	Table A2-1	Table A2-2	1 sample from Hanford formation, Unit 1 1 sample from Hanford formation, Unit 2	Bulk density, moisture content, particle size distribution
Test Pits	BP-1, BP-2,	25 ft bgs	0-1, 2.5-3.5, 5-6, 7.5-8.5, 10-11, 15-16, 20-21, 24-25	14-15, 24-25	Table A2-1	Table A2-2	N/A	N/A
Test Pits	BP-3, BP-4, BP-5	25 ft bgs	0-1, 2.5-3.5, 5-6, 7.5-8.5, 10-11, 15-16, 20-21, 24-25	14-15, 24-25	Table A2-1, except Np-237	Table A2-2	N/A	N/A

Maximum Number of Samples	65
Approximate Number of Field QC Samples	16[c]
Approximate Total Number of Samples	81

BBP = below bottom of pond
bgs = below ground surface
N/A = not applicable
[a] If sample interval BBP intersects with interval bgs, the BBP sample interval will not be collected.
[b] See Table A2-1 for detection limits and other analytical parameters.
[c] See Table A3-6 for details of QC samples.

Table A3-4. 216-B-2-2 Ditch Sampling Schedule.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft)		Analyte List[b]		Physical Properties	
			BBP	bgs[a]	<15 ft bgs	>15 ft bgs	Sample Interval, bgs	Parameters
Borehole	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Test Pits	TP-1, TP-2, TP-3	25 ft bgs	0-1, 2.5-3.5, 5-6, 7.5-8.5, 10-11, 15-16, 20-21, 24-25	14-15, 24-25	Table A2-1, except Np-237	Table A2-2, except Np-237	N/A	N/A

Maximum Number of Samples	30
Approximate Number of Field QC Samples	7[c]
Approximate Total Number of Samples	37

BBP = below bottom of pond
bgs = below ground surface
N/A = not applicable
[a] If sample interval BBP intersects with interval bgs, the BBP sample interval will not be collected.
[b] See Table A2-1 for detection limits and other analytical parameters.
[c] See Table A3-6 for details of QC samples.

Table A3-5. 216-B-3-3 Ditch Sampling Schedule.

Sample Collection Methodology	Sample Location	Maximum Depth of Investigation	Sample Interval Depth (ft)		Analyte List[b]		Physical Properties	
			BBP	bgs[a]	<15 ft bgs	>15 ft bgs	Sample Interval, bgs	Parameters
Borehole	N/A	N/A	N/A	N/A	N/A	N/A	N/A	NA
Test Pits	T-7, T-8, T-9, T-10	25 ft bgs	0-1, 2.5-3.5, 5-6, 7.5-8.5, 10-11, 15-16, 20-21, 24-25	14-15, 24-25	Table A2-1, except Np-237	Table A2-2, except Np-237	N/A	NA

Maximum Number of Samples	40
Approximate Number of Field QC Samples	7[c]
Approximate Total Number of Samples	47

BBP = below bottom of pond
bgs = below ground surface
N/A = not applicable
[a] If sample interval BBP intersects with interval bgs, the BBP sample interval will not be collected.
[b] See Table A2-1 for detection limits and other analytical parameters.
[c] See Table A3-6 for details of QC samples.

Table A3-6. Summary of Projected Sample Collection Requirements.

	Gable Mountain Pond	B Pond	216-B-2-2 Ditch	216-B-3-3 Ditch	Project Total
Chemical Parameters					
Maximum number of characterization samples	162	65	30	40	299
Detail of QC samples					
Collocated duplicates	8	4	2	2	16
Splits	8	4	2	2	16
Equipment blanks	8	4	2	2	16
Trip Blanks	8	4	1	1	14
Approximate number of field QC samples	32	16	7	7	62
Approximate total number of samples	194	81	37	47	359
Physical Properties					
Bulk density, moisture content, particle size distribution	1	2	0	0	3
Approximate total number of samples	1	2	0	0	3

Table A3-7. List of Boreholes for Spectral Gamma Ray Logging.

Borehole Number	Approximate Location	Coordinates (Wash. State Plane, NAD83[91])	
		Northing	Easting
B8758[a]	Near inlet to B Pond	136652.8	576744.4
B8757[a]	Near inlet to Gable Mountain Pond	139384.7	575344.8
699-53-47A	Northeast of Gable Mountain Pond, near east end of site	139485.3	575416.1
699-54-49	Northeast of Gable Mountain Pond near the center of the site	139825.7	574988.0
699-55-50D	Northeast of Gable Mountain Pond, west end of the site	140248.4	574596.5

NOTE: Initial selection of existing wells was based on a review of well construction as-built diagrams. A single casing in contact with the formation is the preferred configuration for logging. A field inspection of the well configuration will be performed for final selection of boreholes.
[a] Planned boreholes.

A4.0 HEALTH AND SAFETY

All field operations will be performed in accordance with BHI health and safety requirements outlined in BHI-SH-01, *Hanford ERC Environmental, Safety, and Health Program*, and in accordance with the requirements of the *Hanford Site Radiological Control Manual* (DOE-RL 1996b). In addition, a work control package will be prepared in accordance with BHI-MA-02, *ERC Project Procedures*, which will further control site operations. This package will include an activity hazard analysis, site-specific health and safety plan, and applicable radiological work permits.

The sampling procedures and associated activities will take into consideration exposure reduction and contamination control techniques that will minimize the radiation exposure to the sampling team as required by BHI-QA-01, *ERC Quality Program*, and BHI-SH-01.

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A5.0 MANAGEMENT OF INVESTIGATION-DERIVED WASTE

Investigation-derived waste (IDW) generated by characterization activities will be managed in accordance with BHI-EE-10, *Waste Management Plan*, and Appendix E of the Implementation Plan. Containment, labeling, and tracking requirements are specified in BHI-FS-03, *Field Support Waste Management Instructions*, Section W-011, "Control of CERCLA and Other Past Practice Investigation Derived Waste," and BHI-EE-01, Procedure 5.2, "Test Pit Excavation in Contaminated Areas." These procedures have been prepared to implement the requirements of the Washington State Department of Ecology, found in *Strategy for Management of Investigation Derived Waste* (Ecology et al. 1995). Management of IDW, minimization practices, and waste types applicable to 200-CW-1 waste control will be described in the waste control plan.

Unused samples and associated laboratory waste for the analysis will be dispositioned in accordance with the laboratory contract, which in most cases will require the laboratory to dispose of this material. The approval of the remedial project manager is required before returning unused samples or waste from offsite laboratories.

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A6.0 REFERENCES

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BHI-QA-01, *ERC Quality Program*, Bechtel Hanford, Inc., Richland, Washington.

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FDH, 1997b, *Soil/Sediment Characterization for the 216-A-29 Ditch*, HNF-SD-TWR-TI-005, Rev. 0, Fluor Daniel Hanford, Richland, Washington.

Resource Conservation and Recovery Act of 1976, 42 U.S.C. 6901, et seq.

WHC, 1988, *Environmental Investigations Instructions*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993a, *Data Validation Procedures for Radiological Analysis*, WHC-SD-EN-SPP-001, Rev. 1, Westinghouse Hanford Company, Richland, Washington.

WHC, 1993b, *Data Validation Procedures for Chemical Analysis*, WHC-SD-EN-SPP-002, Rev. 2, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX B

RCRA PART A PERMIT

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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 6

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/STA 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.	DAY	YR.
0 4		4 5

FOR EXISTING FACILITIES, PROVIDE THE DATE *(mo., day, & yr.)* OPERATION BEGAN OR THE DATE CONSTRUCTION COMMENCED *(use the boxes to the left)*

☐ 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 occurring 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
LITERS PER DAY	V
TONS PER HOUR	D
METRIC TONS PER HOUR	W
GALLONS PER HOUR	E
LITERS PER HOUR	H
ACRE-FEET	A
HECTARE-METER	F
ACRES	B
HECTARES	C

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)*	2. UNIT OF MEASURE *(enter code)*	FOR OFFICIAL USE ONLY	LINE NUMBER	A. PROCESS CODE *(from list above)*	B. PROCESS DESIGN CAPACITY 1. AMOUNT *(specify)*	2. UNIT OF MEASURE *(enter code)*	FOR OFFICIAL USE ONLY
X-1	S 0 2	600	G		6				
X-2	T 0 3	20	E		6				
	T 0 2	840,000	U		7				
2	D 8 4	840,000	G		8				
3					9				
4					10				

Continued from the front.

III. PROCESSES (continued)

SPACE FOR ADDITIONAL PROCESS CODES OR FOR DESCRIBING OTHER PROCESS (code "T04"). FOR EACH PROCESS ENTERED HERE INCLUDE DESIGN CAP/
T02, D84

The 216-B-3 Main Pond (Main Pond) consists of the 216-B-3 Pond and the 216-B-3-3 Ditch. The 216-B-3 Pond, which began service in 1945, currently covers an area of 35 acres (14 hectares) to a depth of 2 to 8 feet (.71 to 2.4 meters). The 216-B-3 Pond receives effluent from the 216-B-3-3 Ditch, which was excavated in 1970 to replace an earlier ditch. The 216-B-3-3 Ditch is approximately 3,700 feet (1,128 meters) long, 30 feet (9.1 meters) wide at ground level, 6 feet (1.8 meters) wide at the bottom, and 4 to 8 feet (1.2 to 2.4 meters) deep. The 216-B-3-3 Ditch received most of its dangerous waste from the 216-A-29 Ditch, which drained the Plutonium Uranium Extraction (PUREX) Plant chemical sewer line. The 216-A-29 Ditch discharged into the 216-B-3-3 Ditch approximately 1,500 feet (460 meters) west of the 216-B-3 Pond. Th 216-A-29 Ditch was shut down and interim stabilized in July 1991.

The Main Pond receives waste water (primarily process and cooling water) from the PUREX Plant, the B Plant Complex, the 242-A Evaporator, and other 200 East Area units. The Main Pond received corrosive waste as a result of the regeneration o the PUREX Plant demineralizer columns (D84). Treatment of the waste occurred by the successive discharge of acidic and caustic waste, which served to neutralize the corrosivity of the waste before and upon reaching the Main Pond. Residual corrosivity was neutralized by the calcareous nature of the Main Pond soil (T02).

The process design capacities given for waste process codes T02 (840,000 gallons (3,180,000 liters) per day) and D84 (840,000 gallons (3,180,000 liters)) represent Main Pond's proportional share (based on percolation capacity) of the proce: design capacity of the entire B Pond System (which includes the 216-B-3 Expansion Ponds, a separate dangerous waste treatm and disposal unit). At the peak of operations, approximately 22,000,000 gallons (83,280,000 liters) per day of liquid wer discharged to the entire 216-B-3 Pond System. Interim stabilization of the 216-B-3 Main Pond began in February 1994. The 216-B-3 Main Pond has been permanently isolated from all liquid effluent sources and will be closed under interim status.

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	METRIC UNIT OF MEASURE	CODE
POUNDS	P	KILOGRAMS	K
TONS	T	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 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 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 charectenstic 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 rigl 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 Was 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 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 wit 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 y 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 corrosiv 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 y 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))
	K 0 5 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

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)*

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	D002	3,500,000	P	T02	D84			Neutralized/Percolation
2	WT02	77,000	↓	↓	↓			Included with Above
3	U133	77,000	P	T02	D84			Neutralization/Percolation
4	WT01	19,000	P	T02	D84			Neutralization/Percolation
5	D006	169,000	↓	↓	↓			Included with Above
6								
7								
8								
9								
10								
11								
12								
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Continued from the front.

DESCRIPTION OF DANGEROUS WASTES (continued)

USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM SECTION D(1) ON PAGE 3.

The Main Pond received dangerous waste from two primary sources: (1) corrosive and toxic dangerous waste resulting from the regeneration of demineralizer columns at the PUREX Plant, and (2) spills of dangerous or mixed waste at the PUREX Plant. Backwash from the regeneration of the demineralizer columns was frequently corrosive (D002) and sometimes contained toxic concentrations of chemicals used in the regeneration process, including nitric acid, sulfuric acid, sodium hydroxide, and potassium hydroxide (WT02). Spills at the PUREX Plant included hydrazine (U133), cadmium nitrate (WT01/D006), and ammonium fluoride/ammonium nitrate (WT01). Since 1984, administrative and engineering barriers have been put in place at the PUREX Plant to prevent dangerous waste from being discharged into the Main Pond.

The quantity of waste listed for D002/WT02 is an estimated annual quantity based on the Main Pond's proportional share (based on percolation capacity) of the amount of corrosive and toxic waste received by the entire 216-B-3 Pond System (which includes the 216-B-3 Expansion Ponds, a separate dangerous waste treatment and disposal unit). The quantities of waste listed for U133 and WT01/D006 represent the Main Pond's proportional share (based on percolation capacity) of the total recorded amount of hydrazine, cadmium, and ammonium fluoride/ammonium nitrate received by the entire 216-B-3 Pond System from the time the PUREX Plant resumed operations in 1983 until the last known chemical discharge occurred in 1987.

The quantities of waste listed for U133 and WT01/D006 include the water in which the chemicals were discharged. Water makes up most of the weight of these discharges.

V. FACILITY DRAWING

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

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 drawings and photos.

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 I 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 & n*

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 th 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 Department of Energy and Operations Office	John D. Wagoner	6/30/94

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 th there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

NAME *(print or type)*	SIGNATURE	DATE SIGNED

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 — 6/30/94

Owner/Operator
John D. Wagoner, Manager
U.S. Department of Energy
Richland Operations Office

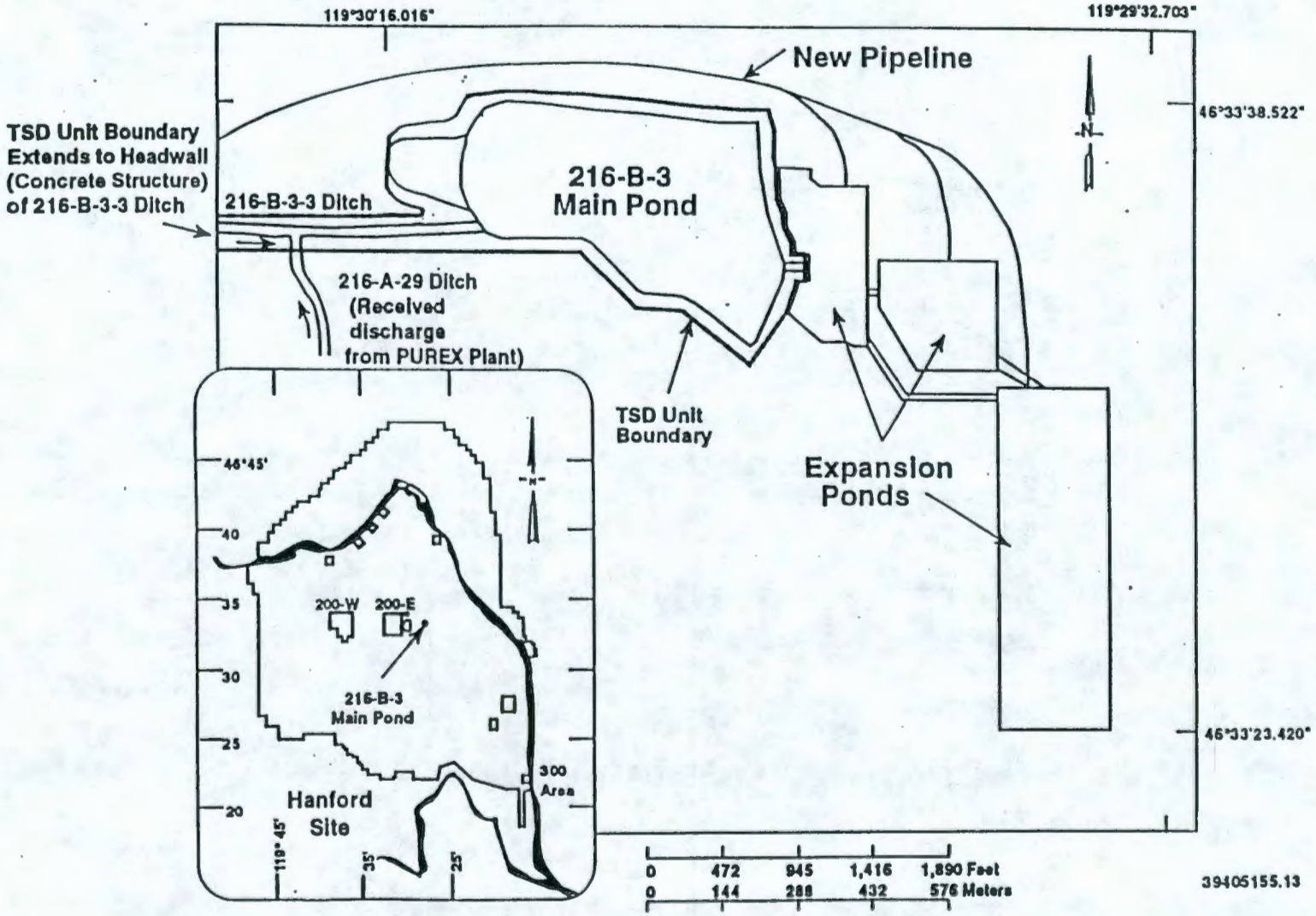
Date

Edward S. Keen — 6/30/94

Co-operator
Edward S. Keen, President
Bechtel Hanford, Inc.

Date

216-B-3 Main Pond



T02, D84

The 216-B-3 Main Pond (Main Pond) was used from _____ to _____. The 216-B-3 Main Pond consists of the 216-B-3 Pond and the 216-B-3-3 Ditch. The 216-B-3 Pond, which began service in 1945, currently covers an area of 14 hectares (35 acres) to a depth of .71 to 2.4 meters (2 to 8 feet). The 216-B-3 Pond receives effluent from the 216-B-3-3 Ditch, which was excavated in 1970 to replace an earlier ditch. The 216-B-3-3 Ditch is approximately 1,128 meters (3,700 feet) long, 9.1 meters (30 feet) wide at ground level, 1.8 meters (6 feet) wide at the bottom, and 1.2 to 2.4 meters (4 to 8 feet) deep. The 216-B-3-3 Ditch received most of its dangerous waste from the 216-A-29 Ditch, which drained the Plutonium Uranium Extraction (PUREX) Plant chemical sewer line. The 216-A-29 Ditch discharged into the 216-B-3-3 Ditch approximately 460 meters (1,500 feet) west of the 216-B-3 Pond. The 216-A-29 Ditch was shut down and interim stabilized in July 1991.

The Main Pond receives waste water (primarily process and cooling water) from the PUREX Plant, the B Plant Complex, the 242-A Evaporator, and other 200 East Area units. The Main Pond received corrosive waste as a result of the regeneration of the PUREX Plant demineralizer columns (D84). Treatment of the waste occurred by the successive discharge of acidic and caustic waste, which served to neutralize the corrosivity of the waste before and upon reaching the Main Pond. Residual corrosivity was neutralized by the calcareous nature of the Main Pond soil (T02).

The process design capacities given for waste process codes T02 3,180,000 liters (840,000 gallons) per day and D84 3,180,000 liters (840,000 gallons) represent Main Pond's proportional share (based on percolation capacity) of the process design capacity of the entire B Pond System (which includes the 216-B-3 Expansion Ponds, a separate dangerous waste treatment and disposal unit). At the peak of operations, approximately 83,280,000 liters (22,000,000 gallons) per day of liquid were discharged to the entire 216-B-3 Pond System. Interim stabilization of the 216-B-3 Main Pond began in February 1994. The 216-B-3 Main Pond has been permanently isolated from all liquid effluent sources and will be closed under interim status.

The Main Pond received dangerous waste from two primary sources: (1) corrosive and toxic dangerous waste resulting from the regeneration of demineralizer columns at the PUREX Plant, and (2) spills of dangerous or mixed waste at the PUREX Plant. Backwash from the regeneration of the demineralizer columns was frequently corrosive (D002) and sometimes contained toxic concentrations of chemicals used in the regeneration process, including nitric acid, sulfuric acid, sodium hydroxide, and potassium hydroxide (WT02). Spills at the PUREX Plant included hydrazine (U133), cadmium nitrate (WT01/D006), and ammonium fluoride/ammonium nitrate (WT01). Since 1984, administrative and engineering barriers have been put in place at the PUREX Plant to prevent dangerous waste from being discharged into the Main Pond.

The quantity of waste listed for D002/WT02 is an estimated annual quantity based on the Main Pond's proportional share (based on percolation capacity) of the amount of corrosive and toxic waste received by the entire 216-B-3 Pond System (which includes the 216-B-3 Expansion Ponds, a separate dangerous waste treatment and disposal unit). The quantities of waste listed for U133 and WT01/D006 represent the Main Pond's proportional share (based on percolation capacity) of the total recorded amount of hydrazine, cadmium, and ammonium fluoride/ammonium nitrate received by the entire 216-B-3 Pond System from the time the PUREX Plant resumed operations in 1983 until the last known chemical discharge occurred in 1987.

The quantities of waste listed for U133 and WT01/D006 include the water in which the chemicals were discharged. Water makes up most of the weight of these discharges.