AR TARGET SHEET

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SECTION 2 OF 2

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4.0 PRELIMINARY CONCEPTUAL SITE MODEL

Section 4.1 presents the chemical and radiological data that are available for each waste management unit. These data, along with physical descriptions of the waste management units (Section 2.0) and descriptions of the surrounding environment (Section 3.0) are evaluated in Section 4.2 and 5.0 in order to qualitatively assess the potential impacts of the contamination to human health and to the environment. The quality and sufficiency of the existing data are assessed in Section 8.0. This information is also used to identify applicable or relevant and appropriate requirements (ARARs) (Section 6.0). Contaminant information is assessed in Section 7.0 to provide a basis for selecting technologies which can be implemented at the waste management units and unplanned release sites.

Contaminants released into the environment at a waste management unit or unplanned release site may migrate from the point of release into other types of media. The potentially affected media in the B Plant Aggregate Area include surface soil, surface waste, vadose zone soil and perched groundwater, air, and biota. The media affected at a specific unit will depend upon the quantities, chemical and physical properties of the material released, and the subsequent site history. Types of data for the B Plant Aggregate Area waste management units are listed in Table 4-1. The potentially affected media at each waste management unit or unplanned release site are listed in Table 4-2 for radionuclide contamination and Table 4-3 for chemical contamination.

4.1 KNOWN AND SUSPECTED CONTAMINATION

There are two major categories of chemical and radiological data available for the B Plant Aggregate Area: unit-specific data that are applicable to individual waste management units and unplanned releases; and area-wide environmental data that are useful in characterizing regional contamination trends.

Some waste management units and unplanned releases have been the subject of chemical and radiological studies in the past; however, most of these studies were limited in scope and did not provide a comprehensive analysis of the character and distribution of the contamination at each unit. The types of site-specific data that are available for some sites include inventory information, surface radiological contamination surveys, external radiation monitoring, soil and sediment sampling, biota sampling, borehole geophysics, and groundwater sampling.

Table 4-1 summarizes the types of unit-specific data available for each of the waste management units. It should be emphasized that the table only summarizes what types of data are available; it does not indicate the sufficiency of the data, either in terms of quality or quantity. These concerns are addressed in Section 8.0. The unit-specific information is presented for each waste management unit in Section 4.1.2.

Although groundwater issues are considered outside the scope of this study, some groundwater data have been included. Groundwater contaminant plumes that are known to have originated from specific waste management units are described because they offer insight into the distribution of contaminants within the vadose zone. A limited amount of groundwater data are presented separately for some of the sites in Section 4.1.2.

In addition to these site-specific data, there are area-wide data that are not directly applicable to any waste management unit within the B Plant Aggregate Area. The most important sources of this general environmental data are quarterly and annual environmental surveillance reports published by Westinghouse Hanford. There are also area-wide geophysical data available that include gravity, magnetic, magnetotelluric, seismic refraction, and seismic reflection surveys (DOE 1988b). However, these studies are not useful for characterizing the extent of chemical and radionuclide contamination and are not presented in Section 4.0. These data are discussed in more detail in Section 8.1.2.

The most recent environmental monitoring of the Hanford Site was conducted by the Pacific Northwest Laboratory (PNL) (Eberhardt et al. 1989) and Westinghouse Hanford. However, most of the data that are applicable to the B Plant Aggregate Area have been published by Westinghouse Hanford. The latest Quarterly Environmental Radiological Survey Summary Reports were reviewed during the current study, as well as the last six annually published environmental surveillance reports (Elder et al. 1986, 1987, 1988, 1989; Schmidt et al. 1990, 1991). The quarterly reports only contain surface radiological contamination survey results. The annual reports describe several different sampling and survey programs including surface soil sampling, external radiation measurements, biota sampling, air sampling, surface water sampling, groundwater sampling, and radiological surveys.

Air, soil, surface water, and biota samples were collected each year at the same locations within the 200 East Area. External radiation measurements were also taken annually at several locations. Until 1990, few of the sample locations were directly associated with any of the identified waste management units and most of this information is only useful in characterizing area-wide trends. In 1990, however, new sampling locations were established that are near areas of known surface contamination. Data from these new sample locations has been included in the B Plant Aggregate Area Management Study (AAMSR). Both the new and old sampling locations are shown on Plates 3, 6, and 7.

Section 4.1 describes available data regarding known and suspected contamination in the B Plant Aggregate Area on a media-specific basis (air, surface soil, surface water, biota, and vadose zone soil). The text summarizes sources of chemical and radiological sampling information. Section 4.1.1 presents data on a media-specific basis. Section 4.1.1.1 presents results of air quality sampling data. Surface soil data are described in Section 4.1.1.2. Results of surface water sampling are presented in Section 4.1.1.3. Results of vegetation and other biota sample analyses are presented in Section 4.1.1.4. Available vadose zone sampling data are presented in Section 4.1.1.5. Section 4.1.1.5 also discusses evidence of

contamination migration within the vadose zone to the unconfined aquifer underlying the site. Additional assessment of the nature and extent of groundwater contamination is presented in the 200 East Groundwater AAMSR.

To supplement available radiological and chemical analytical data, historical waste inventory information for the B Plant Aggregate Area waste management units was also included in the evaluation of known and suspected contaminants. Historical waste inventory data are detailed in Section 2.0 of this report (Tables 2-3 and 2-4). As discussed in Section 2.0, the compilation is based on supporting data from the Waste Inventory Data System (WIDS) (WHC 1991a) and the Hanford Inactive Site Survey (HISS) Database (DOE 1986).

Available data were reviewed to assess whether air, surface soil, vadose zone soil, or groundwater was potentially impacted by waste handling activities at each B Plant Aggregate Area waste management unit. Table 4-2 summarizes available information regarding known or suspected radionuclide contamination at the B Plant Aggregate Area. Table 4-3 summarizes available information regarding known and suspected chemical contamination. In Tables 4-2 and 4-3, waste management units are arranged by physical type (cribs, burial grounds, unplanned releases, etc.). Entries in the tables identify known or suspected releases based on available sampling information or historical waste inventory data.

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4.1.1 Affected Media

4.1.1.1 Air. Eight high volume samplers are stationed within or adjacent to the B Plant Aggregate Area (Plate 3). The air samples are collected by drawing samples through a 47-mm, open-face 3μm filter at about 1 m (3 ft) above the ground with a flowrate of 0.2 m^3/min (2 ft^3/min). Throughout the 200 Areas, air samplers are operated on a continuous basis. Sample filters are exchanged weekly, held one week to allow for decay of short-lived natural radioactivity, and sent for initial laboratory analyses of gross alpha and beta activity. After the initial analysis, the filters are stored until the end of the calendar quarter, at which time they are composited by sample location (or as deemed appropriate according to the annual reports) and sent for laboratory analyses of specific radionuclides. Compositing of the filters by sample location provides a larger sample size, and thus a more accurate measurement of the concentration of airborne radionuclides resulting from operations in the 200 Areas.

The filters are analyzed quarterly for ^{90}Sr, ^{137}Cs, ^{239}Pu, and total U. The results have shown a steady decline in the concentration of these radionuclides from 1985 to 1987, a slight increase in 1988, and then a decline again in 1989 throughout the 200 East Area (Schmidt et al. 1990). The increased radionuclide concentrations in 1988 were on the average greater than 1987 concentrations; however, they were still lower than the first samples taken in 1985. The average values for the radionuclides from air monitoring results from 1985 through 1989 for the B Plant Aggregate Area are provided in Table 4-11. The complete data set from 1985 to 1989 is provided in Table A-2.4.

4.1.1.2 Surface Soil. There are several sources of data available for characterizing surface soil contamination. These include aerial and ground radiological surveys, external radiation measurements and surface soil sampling. These data will be presented in the following sections. In addition, there is a limited amount of site-specific radiological and soil sampling data that will be presented in the appropriate sections of Section 4.1.2.

4.1.1.2.1 Radiological Surveys. Radiological survey results may be influenced by buried or airborne radionuclide contamination but are generally indicative of surface and shallow soil contamination. Depending upon the instrumentation and survey techniques used, results may be reported in ct/min, dis/min, mR/h, or mrem/yr. Typical natural background levels for these measurements are approximately: 50 ct/min, 2,000 dis/min (for an NaI detector), 0.047 mR/h and 84 mrem/yr (Woodruff et al. 1991). An aerial gamma-ray radiation survey was performed over the 200 East Area in July and August 1988 (Reiman and Dahlstrom 1988). The survey lines were flown with a 122 m (400 ft) spacing at an altitude of 61 m (200 ft). The data were normalized to a height of 1 m (3 ft) above the ground surface. Figure 4-1 presents the gross count data (counts per second) on an isoradiation contour map that covers the entire 200 East Area. In this figure, background activity has been subtracted from the data. Background was determined onsite by suppressing specie-specific, naturally occurring activity and confirming with additional background measurements south and east of the Hanford Site.

The entire area has gross gamma counts that are above background. The highest gross count results in the B Plant Aggregate Area were between 700,000 and 2,200,000 ct/s measured over the 241-BX and 241-BY Tank Farm areas (site number 6 on Figure 4-1). This high count area has lobes that extend south and southeastward into the 241-B Tank Farm (site number 7 on Figure 4-1). This is where concentrated high-level waste is stored in 40 underground single-shell tanks and is a known area of significant surface contamination. The second highest area with counts between 220,000 and 700,000 ct/s is located around and immediately southeast of the 221-B Building (site number 9 on Figure 4-1). Waste management units 216-B-4 Reverse Well, 216-B-6 Reverse Well, 216-B-13 French Drain, and Unplanned Releases UN-200-E-44, UN-200E-90, and UN-200-E-103 are clustered in this vicinity. The third highest area with counts between 70,000 and 220,000 ct/s is located at the 225-B Building and west of the 221-B Building (site number 8 in Figure 4-1). Waste management units 216-B-55 Crib, 216-B-64 Retention Basin, and Unplanned Release UN-200-E-64 are located in this area.

These latter two sites are actually a combination of contained, controlled radiation and surface and sub-surface contamination which can not be differentiated. These sites contain: (1) the Waste Encapsulation and Storage Facility (WESF) pool and (2) the high efficiency particulate air (HEPA) filters in the B Plant hot cells. These two sites contain tremendous radiological inventories which undoubtedly influenced the survey and accentuated the reported count values. This fact should be kept in mind when considering Figure 4-1.

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It is impossible to convert these gross gamma counts to a meaningful exposure rate because of the complex distribution of radionuclides on the site. Many of the spectra do not have readily identifiable photo peaks, but rather occur on a smear or continuum. Also, aerial systems integrate radiation levels over an area whose diameter may be ten times the height of the platform above the ground. Because of the large-area integration of the airborne system, localized anomalies will appear to be spread over a larger area with lower activities than actually exist on the ground (Reiman and Dahlstrom 1988). Spectra logs were generated for five sites within the B Plant Aggregate Area and these had only one identifiable photopeak. A photopeak is the specific energy or wavelength that can be associated with the emissions from a specific radionuclide. Cesium-137 was the only radionuclide that could be identified from the spectra information that was collected over each of the five sites during the 1988 survey. As such, the aerial radiation survey data should only be used as a qualitative tool for identifying more highly contaminated areas within the survey boundaries. In addition, the gamma counts noted in the survey probably result from both surface and shallow buried radionuclides, and are thus not entirely indicative of surface contamination.

Elevated radiation zones identified by the aerial survey generally correspond to areas where surface contamination has been noted by surface radiation surveys. Figure 4-2 shows areas of known surface contamination, underground contamination, and migration identified from surface surveys (Huckfeldt 1991b). The primary areas of surface contamination noted in the B Plant Aggregate Area include:

- The 241-BY Tank Farm
- The 241-BX Tank Farm
- The 241-B Tank Farm
- The UPR-200-E-95 Unplanned Release associated with the railroad flatcar storage of contaminated material near the 218-E-2A and 218-E-5 Burial Grounds
- The 207-B Retention Basin
- The 216-B-59B Retention Basin
- The 216-B-5 Reverse Well
- The 241-B-154 Diversion Box
- The miscellaneous area along the railroad spur entering the east end of the 221-B Building
- The 216-B-64 Retention Basin
- The 216-B-55 Crib

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- The 218-E-10 Burial Ground
- The 241-ER-151 Diversion Box
- The 216-B-3 Pond.

Most of these areas fall within the high zones noted in the radiation survey. Areas of active surface contaminant migration include:

- Areas north and east of the 241-B Tank Farm
- West and southwest of the 216-B-64 Retention Basin
- A small patch north of the 241-B-154 Diversion Box
- West of the 241-ER-151 Diversion Box
- The east end of the cross-country transfer line (at the connection to the 241-ER-151 Diversion Box)
- A 10.4 km^2 (4 mi^2) area east, south, and west of the 200-BP-2 Operable Unit (BC Controlled Area).

Table 4-7 summarizes the radiological survey results for each waste management unit and unplanned release. The areas of surface contamination and contaminant migration will be discussed in more detail in the section dealing with the individual waste management units and unplanned releases (Section 4.1.2). Surface radiological surveys are done quarterly, semiannually, or annually at the waste management units. The surface contamination posting may change often because of resurveying and because of cleanups affected under the Radiation Area Remedial Action (RARA) Program. These surveys yield data on gross contaminant levels (ct/min and dis/min) which are useful in identifying the presence of contamination at a waste management unit and in making available comparisons between waste management units.

4.1.1.2.2 External Radiation Dose Rate Measurements. Dose rates from penetrating radiation were measured annually at 24 grid locations directly within or adjacent to the B Plant Aggregate Area between 1985 and 1989. The sample locations are shown on Plates 3, 6, and 7 and the results are listed in Table 4-5 and Table 4-6. The measurements were taken with thermoluminescent dosimeters (TLDs) and are reported in mrem/yr. The TLDs measure dose rates resulting from all types of external radiation sources including cosmic radiation, naturally occurring radioactivity, fallout from nuclear weapons testing, and contributions from other Hanford Site activities. The B Plant Aggregate Area external radiation dose rate measurements have been remarkably consistent ranging from 68 to 140 mrem/yr and averaging 105 mrem/yr over all sites for 1989. There appears to be an increasing trend in dose rates from 1985 to 1988, however, this can be attributed to

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variability in naturally occurring dose rates and statistical uncertainty in conducting dose rate measurements (PNL 1989). Above average sites include the 241-BX Tank Farm at 126 mrem/yr and an area near the 221-B Building at 113 mrem/yr. Generally, the tank farm areas, the 216-B-55 Crib, and the 216-B-3-3 and 216-B-63 Ditches run above average.

In 1990, new sampling locations were established giving B Plant Aggregate Area a reduction to 16 dosimeter sites. The new sites were generally located closer to areas of known contamination with the results being similar to previous data. The results are summarized in Table 4-6.

4.1.1.2.3 Surface Soil Sampling. Between 1978 and 1989 surface soil samples were collected annually from a regular rectangular grid that covers the 200 East Area with 36 sampling points as shown on Plates 3, 6, and 7. Nine of these sampling sites are located in or adjacent to the B Plant Aggregate Area. The sample point locations have never been exactly surveyed, but are located close to the intersections of Hanford Site coordinate lines at 305 m (1,000 ft) spacings. An effort is currently underway to assign precise coordinates to the sample point locations using a new surveying method. In addition, between 1985 and 1989, soils have been sampled along fences enclosing the tank farms in the 200 East Area. There are two soil sample locations associated with the 241-B Tank Farm and one soil sample location associated with the 241-BX Tank Farm. None of the soil sampling locations were at waste management units or unplanned release sites, so these data cannot be applied directly.

The average results of the B Plant Aggregate Area grid soil sampling and fenceline soil sampling results from 1985 through 1989 are provided in Tables 4-8 and 4-9, respectively. The complete set of data collected from 1985 through 1989 are provided in Tables A-2.3 and A-2.1. Counting errors are included with each analytical result and those that are greater than the accompanying counting errors are denoted with shading.

The most commonly detected radionuclides were ^{90}Sr, ^{137}Cs, ^{214}Pb, U total, ^{238}Pu, ^{239}Pu, and ^{152}Eu. However, only ^{137}Cs, ^{90}Sr, ^{214}Pb, U total, and ^{239}Pu were found consistently at concentrations above counting errors (Schmidt et al. 1990)

The highest radionuclide concentrations were generally noted in the vicinity of the 241-B, 241-BX, and 241-BY Tank Farms. Using ^{137}Cs as an indicator of general radionuclide concentration, the highest levels most recently recorded were at grid points 2E3 and 2E9, north and south of the tank farm area. However, the trend at these locations has generally been downward since 1978. The highest ^{90}Sr concentration was found south of the tank farms and the highest ^{239}Pu concentration was found west of the burial grounds.

In 1990, new soil sampling locations were established that are located close to areas of known surface contamination. Currently, no analytical data are available for these new sample locations.

4.1.1.3 Surface Water. Surface water exists in the B Plant Aggregate Area in waste management units 216-N-8 Pond (West Lake), 216-B-3-3 Ditch, and the 216-B-3 Pond and its lobes. The Gable Mountain Pond, 216-A-25, which had been part of the surface water sampling system, has been decommissioned. Water samples of 1 L (0.26 gal) are collected on a weekly basis from active ponds and ditches and analyzed for pH, nitrate, total alpha, total beta, gamma-emitting radionuclides, ^{137}Cs, and ^{90}Sr. In addition to surface water sampling, all water is also sampled at its point of discharge.

Analysis results are presented in Table 4-12, in the form of minimum and maximum measured levels. Surface water sources include 221-B Building and 202-A Building cooling water discharge, the 200 East Powerhouse process water discharge, the chemical sewers from both the 221-B and 202-A Buildings, process waste from the 242-A Evaporator, and groundwater seepage. Maximum levels are well below allowable limits in all cases with the minimum levels usually below the detectable limit. The only result of note is the somewhat high pH for 216-N-8 Pond (West Lake). No waste is actually discharged to this unit but the water level is maintained by groundwater seepage. The pH level is attributed to the high level of phosphates in the soil.

4.1.1.4 Biota. Westinghouse Hanford and PNL have conducted various biota sampling activities inside and outside the Hanford Site beginning in 1971 and continuing through 1988. No upward trends in radionuclide concentrations were detected for any of the wildlife species examined (Eberhardt et al. 1989). A significant downward trend was noted in many sample analytes, particularly ^{137}Cs.

Three factors are believed to have contributed to the decline in concentration of these radionuclides: the cessation of atmospheric testing, the 1971 shutdown of the last Hanford reactor that discharged once-through cooling water to the river, and the reduction of environmental radionuclide contamination associated with some Hanford facilities and operations.

Biota samples have been collected since 1978 from eighteen sites within or adjacent to the B Plant Aggregate Area. Vegetation samples were collected from the same locations as the grid soil samples described in Section 4.1.1.2 (Plates 3, 6, and 7). Average analytical results from 1985 through 1989 are compiled in Table 4-10. The complete data set from this sampling is presented in Appendix A.2.

Vegetation samples have generally had radionuclide concentrations that are slightly elevated above regional background (Schmidt et al. 1990). The most commonly detected radionuclides include ^{40}K, ^{99}Te, ^{103}Ru, and ^{137}Cs. There have been no statistically significant trends in vegetation radionuclide concentration since 1979 (Schmidt et al. 1990).

4.1.1.5 Vadose Zone. The extent of contamination in the vadose zone has been most extensively studied by geophysical well logging. Geophysical well logging has been conducted in the B Plant Aggregate Area since the late 1950's. Gross gamma-ray logs have been used since that time to evaluate radionuclide migration in the vadose zone beneath

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selected waste management units. However, very little gross gamma data have been published. Table 4-4 lists all of the logs that were reviewed as a part of this study. The log interpretation consisted of identifying zones with anomalously high gamma-ray counts that could be indicative of radionuclide contamination. The depth, thickness, and intensity of these zones were then compared with previous logs from these same holes. Any significant changes may be indicative of contaminant migration in the vadose zone. Interpretations were complicated by the fact that logging equipment and procedures have not been consistent. Attempts made to normalize data collected at different times met with limited success, and quantitative interpretations were not possible. The log interpretations are discussed in detail in Appendix A.1. The results of the log interpretations are also summarized with the appropriate waste management units in Section 4.1.2.

Contaminant migration through the vadose zone is dependent upon a number of properties, including chemical form of the waste, characteristics of the soil matrix, physical properties of the vadose zone and the volume of liquid introduced to the soil column. The interaction between waste form and soil characteristics is discussed in Section 4.2.2.1.4.

Waste management units that have received large volumes of liquid are more likely to have caused subsurface contaminant migration. The potential for liquid wastes to migrate through the vadose zone to the groundwater was conservatively estimated by comparing the volume of waste discharged at each waste management unit to the estimated pore volume in the vadose zone soil column below the waste management unit. If the volume of liquid discharged to the ground is larger than the total soil column pore volume, then it is likely that wastewater may have reached the groundwater. These calculations are summarized in Table 4-14. They are based upon several conservative assumptions: (1) the discharged water does not spread out laterally from the point of discharge (i.e., the volume of affected vadose zone is equal to the depth to groundwater times the plan-view area of the base of the waste management unit); (2) there is no significant change in liquid volume being introduced to the soil column due to evapotranspiration; and (3) the average pore volume of the soil column is between 0.10 and 0.30 (the lower and upper pore volume estimates shown in Table 4-14). If the amount of waste received was greater than the porosity (0.1), then the waste management unit was considered to have the potential to migrate to the groundwater. According to these calculations 48 waste management units have the potential for migration of liquid discharges to the unconfined aquifer. This analysis does not take into account long term drainage which may be occurring at all units which received liquid waste.

4.1.2 Site-Specific Data

This section presents the site-specific data that are available for each waste management unit and unplanned release. The units are discussed in the same groups as were presented in Section 2.0. These groupings are useful because like units tend to have similar types of available data.

4.1.2.1 Plants, Buildings, and Storage Areas. No site-specific data were compiled for any of the B Plant Aggregate Area plants and buildings. However, there are four hazardous waste storage areas (HWSA) that are active waste management units. The four are very similar and will be discussed together.

All HWSA's provide temporary storage for hazardous chemicals, typically near the site where they are generated, until arrangements can be made for their removal to a TSD facility. Temporary storage time is strictly limited by RCRA provisions. All B Plant Aggregate Area HWSA's are inspected weekly by plant personnel and the inspections are documented.

Three HWSA's, 2703-E, 2704-E, and 2715-EA, are located in the 200-SS-1 Operable Unit. The first two are simple asphalt pads and the last is a metal shed. The fourth is 226-B, which is a concrete pad located in the 200-BP-6 Operable Unit. Common features include light chain barricades and hazardous material warning signs. Typical materials found in the storage areas are waste acids, alkaline liquids and sodium hydroxide solutions, sodium dichromate containing process solutions, antifreeze, grease, diesel fuel, waste paint and thinning solvents, halogenated hydrocarbons, and flammable solvents.

4.1.2.2 Tanks and Vaults. The data available for the single-shell waste storage tanks generally include inventory information, limited waste sampling, surface radiological surveys, vadose zone borehole geophysics, and internal tank monitoring of chemical and physical parameters. In the past there has been much less emphasis in characterizing the catch tanks, settling tanks, and vaults and little information is available regarding these units. The following section is subdivided between single-shell tanks and other tanks to reflect this difference.

4.1.2.2.1 Single-Shell Tanks. All of the single-shell tanks in the B Plant Aggregate Area are located within the boundaries of the three contiguous tank farms: 241-B Tank Farm, 241-BX Tank Farm, and 241-BY Tank Farm. All the tank farms are characterized as areas of surface contamination and there are areas of active surface migration both north and east of the tank farm's boundaries (Schmidt and Huckfeldt 1991).

The TLDs stationed around the three tank farms have averaged 100 to 140 mrem/yr between 1985 and 1989 (Table 4-5). A single monitoring station located south of the 241-BX Tank Farm in 1990 averaged 138 mrem/yr (Table 4-6). These results are slightly higher than other monitoring stations located in the B Plant Aggregate Area. The high annual dose rate is probably indicative of a combination of surface contamination in the tank farm areas and some emissions from the tanks themselves. Future sampling and analysis plans, which will be developed as a part of the investigation of these areas, will attempt to define and quantify the dose rate contributors. The upper surfaces of tanks 241-B-101 through 241-B-112 and 241-BX-101 through 241-BX-112 are all 2 m (7 ft) below grade, tanks 241-BY-101 through 241-BY-112 are all 2 m (8 ft) below grade, and tanks 241-B-201 through 241-B-204 are all 4 m (11 ft) below grade, so the waste contained within the tanks is largely, but not entirely shielded from the ground surface.

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External radiation dose rate surveys are performed quarterly over the three tank farm areas. The highest dose rates observed for the last half of 1991 occurred in the 241-BY Tank Farm. Dose rates here are generally three to ten times higher than those measured in either the 241-B or 241-BX Tank Farms. The dose rates for the 241-B and 241-BX Tank Farms are similar.

The highest dose rate noted was around the pump pit riser for tank 241-BY-105. The greatest surface contamination noted over the last half of 1991 was the northern portion of the 241-BY Tank Farm. In the 241-B Tank Farm, tanks B-101 and B-102 had the highest external dose rates, while in the 241-BX Tank Farm, tanks BX-109, BX-110, and BX-111 were the areas of highest external dose rate. These data were compiled directly from the Supplemental Scheduled Radiation Survey Reports kept at the Tank Farm Health Physics Department for the 200 East Area (building MO-386).

Several studies have been conducted to estimate the tank contents and the probability of their release to the environment. The primary potential release mechanisms are tank failure and leaking, and the potential buildup and ignition of flammable material in the tanks. Ten of the sixteen tanks in the 241-B Tank Farm, five of the twelve tanks in the 241-BX Tank Farm, and five of the twelve tanks in the 241-BY Tank Farm have failed in the past, so it seems likely that some of the remaining tanks may fail in the future. Tank leaks are identified by monitoring liquid levels in the tanks and by running gamma logs in the monitoring wells surrounding each tank.

Inventory Studies. Chemical inventories for the single-shell tanks have been modeled with the Tracks Radioactive Components (TRAC) computer code developed by Westinghouse Hanford. This program calculated tank inventories for 68 radioactive constituents and 29 chemical constituents. The estimates were based on historical records of the quantities of material initially placed in the tanks from nuclear fuel production and later modified by tank transfers and radioactive decay. The TRAC inventories, though recognized as having serious limitations, represent the best current information on the contents of the tanks. The TRAC predictions for ^{14}C, ^{137}Cs, ^{137}Ba and uranium isotopes show the least agreement with other data sources.

The TRAC inventory data are presented in Table 4-15. These data are for the total tank inventories and do not differentiate between drainable liquid and solids within the tanks. As shown in Table 2-2, some of the unstabilized tanks still contain large volumes of liquid, drainable waste. It is the radionuclides that are partitioned to this liquid phase, which are of primary concern should a tank begin to leak. From a comparison of solid and liquid phase data presented in an earlier TRAC report, it appears that ^{241}Am, ^{14}C, ^{135}Cs, ^{137}Cs, ^{93}Nb, ^{99}Tc, ^{79}Se, and ^{90}Sr are most strongly partitioned to the liquid phase in the tanks and would be the most likely radionuclides, present at high concentrations, to migrate in the event of a leak (Jungfleisch 1984).

Tank Waste Sampling. Chemical sampling and analysis has been performed on some tank contents. The usefulness of these data are limited because: (1) very few radionuclides or organic chemicals were analyzed; (2) much of the sampling and analysis was done in the 1970's and material has been moved into and out of the tanks since that time; and (3) no attempt was made to collect samples that were representative of the tank as a whole. Much of the sampling was done to characterize the chemical composition of liquid that was to be sent through an evaporator.

Selected available chemical data for several tanks are summarized in Table 4-13. The information in the table was compiled from technical letters in the Process Aids volumes in the MO-037 Library. The table includes sample descriptions, radionuclide data for each sample, and bulk density results.

Chemical Explosion Potential. The two most significant explosive materials generated in Hanford single-shell tanks are ferrocyanide and hydrogen. None of the B Plant Aggregate Area tank farm tanks is suspected of having a hydrogen problem; however, several have the potential to generate significant quantities of ferrocyanide (Hanlon 1992). A watch list has been generated that ranks tanks according to their potential for explosion. The factors in this ranking include surface level fluctuation, temperature, total curies of waste, organic content, volume of solids, waste type, pressurization, crust formation, and past flammable gas detections. A total of four tanks from the 241-BX Tank Farm (241-BX-102, 241-BX-106, 241-BX-110, and 241-BX-111) and ten tanks from the 241-BY Tank Farm (241-BY-101, 241-BY-103, 241-BY-104, 241-BY-105, 241-BY-106, 241-BY-107, 241-BY-108, 241-BY-110, 241-BY-111, and 241-BY-112) are on the ferrocyanide gas watch list. There are a total of 24 tanks on this watch list. Four of the B Plant Aggregate Area tanks have the highest estimated quantities of ferrocyanide while five tanks are among the lowest ranked for ferrocyanide.

Tank 241-B-103 is on the watch list for tanks containing concentrations of organic salts greater than 10 wt% total organic compounds (TOCs). These tanks have organic chemicals which are potentially flammable and mixtures of organic materials mixed with nitrate and nitrate salts can deflagrate. This tank is one of eight on the TOC watch list.

Vadose Zone Borehole Geophysical Logging. Most of the single-shell tanks are surrounded by an array of vadose zone boreholes. Gamma logging is performed on these boreholes to identify new tanks leaks and to monitor the migration of existing radioactive contaminant releases to the soil. Table 4-16 summarizes the borehole geophysical data available for each tank. Twelve of the twenty assumed or confirmed leaking tanks in the 241-B, 241-BX, and 241-BY Tank Farms exhibit elevated gamma radiation levels in their associated monitor boreholes.

Single-Shell Tanks Unplanned Releases. There are twelve unplanned releases associated with the single-shell tanks of the 241-B, 241-BX, and 241-BY Tank Farms. Nine of these unplanned releases resulted from tank leaks (UPR-200-E-127 through 135) and three occurred during liquid transfer operations (UPR-200-E-5, UPR-200-E-108, and

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UPR-200-E-116). Most of the available information on these releases is summarized in Table 2-6. Cesium inventory data for each of the tank leaks are summarized in Table 4-17. Radionuclide inventories for burial sites can be found in Table 4-18.

Activity noted by increases in borehole activity (Table 4-16) can usually be related to known, unplanned releases. Unplanned release UPR-200-E-108 occurred due to a leak in a transfer line when pumping from tank 241-B-102 to tank 241-B-101. This leak corresponds to activity in borehole 20-01-06 since radiation is noted to start at the top of the tank liner. Activity noted in boreholes around tanks 241-B-112 and 241-B-201 are likely related to leaks from tanks 241-B-201 (UPR-200-E-129) and 241-B-203 (UPR-200-E-130), which are nearby.

Activity in the vicinity of tanks 241-BX-102 and 241-BX-103 are directly related to three unplanned releases, UPR-200-E-5, -131, and -132. Releases UPR-200-E-131 and -132 are leaks from Tank 241-BX-102. An estimated 51,000 Ci seeped to a depth of 40 m (120 ft) from UPR-200-E-131. Some contamination may have spread to groundwater as a result of borehole drilling. A plugged cascade outlet (UPR-200-E-5) allowed 100,000 to 340,000 L (30,000 to 90,000 gal) of waste to contaminate the soil around 241-BX-102 in 1951.

A leak (UPR-200-E-133) from tank 241-BX-108 was noted in Borehole 20-08-06. This 500 Ci release occurred in March 1974. Borehole activity has since stabilized.

A leak (UPR-200-E-134) from tank 241-BY-103 was confirmed by borehole activity which spread from a 8 m (60 ft) depth down to a 23 m (77 ft) depth in March 1973.

4.1.2.2.2 Catch Tanks, Vaults, and Receiver Tanks. Very little data are available for the catch tanks and vaults. For some units the total volume of waste is known but there is no chemical or radiological information available.

241-B-301B Catch Tank. This is an inactive waste management unit. The volume of the contents of the tank are unknown and it is not monitored. The unit was isolated in 1985 and is weather covered.

241-B-302B Catch Tank. This is an inactive waste management unit. The volume of the contents of the tank are unknown and it is not monitored. The tank was isolated in 1985. Unplanned release UPR-200-E-77 associated with a leaky jumper at diversion box 241-B-154 is related to this catch tank. Approximately 1 Ci of metal waste from the 221-B Building was leaked to the ground (WHC 1991a).

241-BX-302A Catch Tank. This inactive waste management unit is associated with the 241-BX Tank Farm. The volume of its contents are unknown and it is not monitored. The unit was isolated in 1985 and is weather covered.

241-BX-302B Catch Tank. This is an inactive waste management unit. The volume of the contents of the tank are unknown and it is not monitored. The tank was isolated in 1985.

241-BX-302C Catch Tank. This is an inactive waste management unit. The volume of the contents of the tank are unknown and it is not monitored. The tank was isolated in 1985. Unplanned release UPR-200-E-78 which involved 10 Ci of mixed fission product salt waste leaked from diversion box 241-BX-155 and is related to this catch tank (WHC 1991a).

241-B-361 Settling Tank. This settling tank is presently inactive. It received low salt, alkaline radioactive wastes from cell washings of 5-6W cell in 221-B Building and 224-B Building. It is estimated to contain 120,000 L (32,000 gal) of sludge including 2.46 kg (5.42 lb) of plutonium with 1,060 Ci of beta/gama activity (WHC 1991a). The solids are primarily bismuth phosphate. The unit was interim stabilized in 1985. It is noted that this tank is a relatively high radiological hazard in comparison with other 200 Area facilities.

241-ER-311 Catch Tank. This catch tank, an active waste management unit, is associated with the 241-ER 151 Diversion Box. It contains 6,680 L (1,765 gal) of material and was last pumped on June 29, 1991. Unplanned release UPR-200-84 is associated with this unit. In March 1953 a release to ground of about 7,570 L (2,000 gal) of concentrated acid with approximately 10 Ci of fission products occurred. Surface contamination of 90,000 ct/min was measured in October 1975 (WHC 1991a). Another source states that no ground contamination was detected (Stenner et al. 1988).

244-BXR Vault. This is an inactive waste management unit. The volume of its contents are unknown and it is not monitored. The vault is isolated and weather covered.

244-BX Receiver Tank. This is an active waste management unit. The volume of its contents are known and it is monitored by 200 East Area Operations.

270-E Condensate and Neutralization Tank. This is an inactive unit located on the west side of the 216-B-64 Retention Basin. It is estimated to contain 14,000 L (3,800 gal) of sludge with activity of 100 ct/min direct and smearable and less than 0.5 mR/h penetrating (WHC 1991a). It is considered a relatively high radiological hazard relative to other 200 Area surplus facilities. Unplanned release UN-200-E-64 that occurred on October 12, 1984 may be associated with leakage from this unit. Contamination consisted of ^{137}Cs and ^{90}Sr (WHC 1991a). No clean-up action was taken.

4.1.2.3 Cribs and Drains. The types of information available for the cribs and drains include inventory data, radiological survey results,and borehole geophysical data. Soil, vegetation, and air monitoring data are generally unavailable for these waste management units, as there are no sampling locations in these areas. Inventory and radiological

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information have largely been compiled from the WIDS sheets (WHC 1991a) and the HISS database (DOE 1986). Table 4-14 compares the waste volume received by a waste management unit with its calculated specific retention capacity.

4.1.2.3.1 216-B-7A and 7B Cribs. The 216-B-7A and -7B Cribs are posted as an area of surface contamination. The April 1990 radiological survey found 1.2 mR/h contamination in the north end of the area. Similar contamination was detected in March 1989 (WHC 1991a). Current inventory data for the crib are summarized in Tables 2-3 and 2-4. Radionuclides contained in the waste stream at the time of discharge included 1 Ci of ^{60}Co, 100 Ci of ^{137}Cs, 5,600 Ci of ^{90}Sr, 600 Ci of ^{106}Ru, 4,300 g of plutonium, and 180 kg of uranium (Maxfield 1979) (Fecht et al. 1977).

Vadose Wells 299-E33-18, -58, -59, and -75 monitor the soil column around the crib site. A comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14). Groundwater test results indicate that ^{137}Cs, ^{60}Co, ^{3}H, and alpha contamination are detectable in groundwater samples taken from Well 299-E33-18. However, there is no evidence that the contamination originated from the 216-B-7A or -7B Cribs. Further evaluation of groundwater contamination is provided in the 200 East Area Groundwater AAMSR.

4.1.2.3.2 216-B-8TF Crib and Tile Field. The 216-B-8TF Crib and Tile Field is posted as a zone of surface contamination, and is located within a larger zone surface contamination.

The March 1992 radiological survey detected surface contamination of 6,000 dis/min beta. The 1992 survey also found one growing tumbleweed with a reading of 30,000 dis/min (WHC 1991a). Radionuclides contained in the waste stream at the time of discharge included 1 Ci of ^{60}Co, 50 Ci of ^{137}Cs, 15 Ci of ^{90}Sr, 50 Ci of ^{106}Ru, 30 g of plutonium, and 45 kg of uranium (Maxfield 1979).

Inventory data for the crib are summarized in Tables 2-3 and 2-4. Vadose Wells 299-E33-16, -66, -67, -68, -69, -70, -71, -72, and -89 monitor the soil beneath the crib. Scintillation probe profiles indicate groundwater contamination has not occurred beneath this site (Fecht et al. 1977). However, a comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.3 216-B-9TF Crib and Tile Field. This unit is posted with surface contamination (around the cave-in potential area) and underground radioactive material placards. The April 1990 survey found several areas with up to 60,000 dis/min, similar to levels found in 1989. No surface contamination was detected in March 1992 (WHC 1991a). Radionuclides contained in the waste stream at the time of discharge included 0.1 Ci of ^{60}Co, 10 Ci of ^{137}Cs, 15 Ci of ^{90}Sr, 100 Ci of ^{106}Ru, 170 g of plutonium, and 45 kg of uranium (Maxfield 1979).

Inventory data for the crib are summarized in Tables 2-3 and 2-4. Vadose Wells 299-E28-53, -54, -55, -61 and 299-E28-1, -5, -6, -56, -57, -58, and -60 are used to monitor radionuclide concentration in the soil beneath the crib and the tile field respectively. Scintillation probe profiles suggest the contaminants are suspended near the surface in the sediment column and have not contaminated groundwater (Fecht et al. 1977). However, a comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

In April 1949, a well that was drilled at an 85 degree angle to bottom out directly under the crib was found filled with sediment to within 7.3 m (24 ft) of the surface; a sediment sample from this well had 1,830 μCi of fission products and alpha contamination of 14,800,000 dis/min/kg of sediment (Brown and Ruppert 1950). The well casing was found to be corroded from the acid introduced to the crib, indicating that liquids were introduced at approximately 46 m (150 ft) below ground surface.

4.1.2.3.4 216-B-10A Crib. The 216-B-10A Crib is posted as an area of underground radioactive materials. Radionuclides contained in the waste stream at the time of discharge included 0.1 Ci of ^{60}Co, 1 Ci of ^{137}Cs, 5 Ci of ^{90}Sr, 10 Ci of ^{106}Ru, 9.8 g of plutonium, and 9.1 kg of uranium (Maxfield 1979). No contamination was detected in the March 1992 survey, and there has been no change since the March 1988 survey (WHC 1991a).

Inventory data for the crib are summarized in Tables 2-3 and 2-4. Vadose Well 299-E28-17 monitors the soil column beneath the 216-B-10A and 216-B-10B Cribs. The well is located 18.3 m (60 ft) southeast of the 216-B-10A Crib and radiation levels are at or below background levels (Fecht et al. 1977). However, a comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.5 216-B-10B Crib. The 216-B-10B Crib is posted as an area of underground radioactive materials. No contamination was detected in the March 1992 survey (WHC 1991a).

Inventory data for the crib are summarized in Tables 2-3 and 2-4. Vadose Well 299-E28-17 monitors the soil column beneath the 216-B-10A and 241-B-10B Cribs. The well is located 18.3 m (60 ft) southeast of the 216-B-10A Crib and radiation levels are at or below background levels (Fecht et al. 1977).

4.1.2.3.6 216-B-12 Crib. This crib consists of three wooden boxes in a cascade series. It has recently been posted underground radioactive material. No contamination was detected in the March 1992 survey. This unit was abandoned when a flow restriction was observed. There had been a gradual subsidence, with a final result of about a 1.5 m (5 ft) depression (WHC 1991a). Inventory data for the crib are summarized in Tables 2-3 and 2-4.

The crib is monitored by Wells E28-9, E28-16, E28-65 and E28-66. A comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.7 216-B-14 Crib. Cribs 216-B-14 through -19 are located in the BC Controlled Area, south of the 200 East Area. During January 1956 to December 1957 they received 120,000,000 L (32,000,000 gal) of high-salt scavenged waste from 221-U Building. This BC disposal site received the greatest amount of radioactivity disposed of at any one site on the Hanford Project (920,000 gross beta curies) (Maxfield 1979).

Three wells were drilled at the BC Site in 1966 to determine the distribution of radionuclides below the selected areas. The results of core analyses from these wells indicated that the bulk of the long-lived radionuclides were retained high in the soil column, from 45.7 to 76.2 m (150 to 250 ft) above the water table as it existed at that time (Maxfield 1979).

Radionuclides contained in the 216-B-14 Crib waste stream at the time of discharge included 5 Ci of ^{60}Co, 250 Ci of ^{137}Cs, 400 Ci of ^{90}Sr, 59,000 Ci of ^{106}Ru, 25 g of plutonium, and 220 kg of uranium (Maxfield 1979). However, no contamination was detected in the November 1991 radiological survey. Inventory data for the crib are summarized in Tables 2-3 and 2-4.

Vadose Wells 299-E13-1, -2, -3, -4, -5, -20, and -21 are used to monitor the soil column beneath the crib site. Scintillation probe profiles indicate that the radioactive contaminant plume may extend to the groundwater below the 216-B-14 and 216-B-16 Cribs (Fecht et al. 1977). A comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.8 216-B-15 Crib. The 216-B-15 Crib is located in the BC Controlled Area, south of the 200 East Area. It is identified as an underground radioactive materials zone by concrete marker posts.

Radionuclides contained in the 216-B-15 Crib waste stream at the time of discharge included 5 Ci of ^{60}Co, 200 Ci of ^{137}Cs, 200 Ci of ^{90}Sr, 22,000 Ci of ^{106}Ru, 5 g of plutonium, and 100 kg of uranium (Maxfield 1979). However, no surface contamination was detected in the November 1991 radiological survey. Inventory data for the crib are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.9 216-B-16 Crib. The 216-B-16 Crib is located in the BC Controlled Area, south of the 200 East Area. It is identified as an underground radioactive materials zone by concrete marker posts.

Radionuclides contained in the 216-B-16 Crib waste stream at the time of discharge included 5 Ci of ^{60}Co, 650 Ci of ^{137}Cs, 700 Ci of ^{90}Sr, 13,000 Ci of ^{106}Ru, 10 g of Pu, and 320 kg of uranium (Maxfield 1979). However, no contamination was detected in the November 1991 radiological survey. Inventory data for the crib are summarized in Tables 2-3 and 2-4.

Vadose Wells 299-E13-1, -2, -3, -4, -5, -20, and -21 are used to monitor the soil column beneath the crib site. Scintillation probe profiles indicate that the radioactive contaminant plume may extend to the groundwater below the 216-B-14 and 216-B-16 Cribs (Fecht et al. 1977).

4.1.2.3.10 216-B-17 Crib. The 216-B-17 Crib is located in the BC Controlled Area, south of the 200 East Area. It is identified as an underground radioactive materials zone by concrete marker posts.

Radionuclides contained in the 216-B-17 Crib waste stream at the time of discharge included 1 Ci of ^{60}Co, 220 Ci of ^{137}Cs, 160 Ci of ^{90}Sr, 250 Ci of ^{106}Ru, 10 g of plutonium, and 350 kg of uranium (Maxfield 1979). However, no contamination was detected in the November 1991 radiological survey. Inventory data for the crib are summarized in Tables 2-3 and 2-4.

4.1.2.3.11 216-B-18 Crib. The 216-B-18 Crib is located in the BC Controlled Area, south of the 200 East Area. It is identified as an underground radioactive materials zone by concrete marker posts.

Radionuclides contained in the 216-B-18 Crib waste stream at the time of discharge included 5 Ci of ^{60}Co, 250 Ci of ^{137}Cs, 190 Ci of ^{90}Sr, 19,000 Ci of ^{106}Ru, 10 g of plutonium, and 240 kg of uranium (Maxfield 1979). However, no surface contamination was detected in the November 1991 radiological survey. Inventory data for the crib are summarized in Tables 2-3 and 2-4.

The soil overlying the 216-B-18 Crib was discovered to have a concavity of approximately 0.3 m (1 ft), during a field inspection in February 1974. There was no exposure of the crib to the air. The concavity was filled-in with gravel (Maxfield 1979).

A comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

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4.1.2.3.12 216-B-19 Crib. The 216-B-19 Crib is located in the BC Controlled Area, south of the 200 East Area. It is identified as an underground radioactive materials zone by concrete marker posts.

Radionuclides contained in the 216-B-19 Crib waste stream at the time of discharge included 5 Ci of ^{60}Co, 270 Ci of ^{137}Cs, 200 Ci of ^{90}Sr, 5,100 Ci of ^{106}Ru, 10 g of plutonium, and 180 kg of uranium (Maxfield 1979). However, no surface contamination was detected in the November 1991 radiological survey. Inventory data for the crib are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.13 216-B-43 Crib. The 216-B-43 through -50 Cribs (collectively known as the 241-BY Cribs) are inactive waste management units located adjacent to the northern boundary of the 241-BY Tank Farm. These cribs consist of four vertical concrete pipes, set below grade in a square pattern, and fed by a central pipe that branches into a chevron pattern to feed each culvert. The culverts are set on a gravel bed (Stenner et al. 1988). The vertical pipes are 1.2 m (4 ft) in diameter and 1.2 m (4 m) long, the are placed 2 m (7 ft) below grade, set on a 1.5 m (5 ft) thick bed of gravel. The pipes are arranged in a square with the centers spaced 4.6 m (15 ft) apart in a 4.6 x 4.6 x 9 m (15 x 15 x 30 ft) deep excavation (DOE/RL 1991a).

Extensive remedial investigation/feasibility study (RI/FS) work has begun in the 200-B-1 Operable Unit. This unit includes cribs 216-B-43 through 50, 216-B-57, and 216-B-61. The RI/FS work plan was published in March 1990 (DOE/RL 1990a) and the Phase I RI activities began in 1991 and are currently ongoing. Initial work covers source sampling and analysis (Task 2), vadose zone sampling and analysis (Task 4), and groundwater sampling and analysis (Task 7). Preliminary remedial technologies for soil and groundwater have been identified and are being evaluated. This work is mentioned here; however, it is preliminary and no data from the RI/FS is included in this AAMSR.

Inventory data for the crib are summarized in Tables 2-3 and 2-4. Vadose Boreholes 299-E33-1, -2, -3, -4, -5, -6, -7, -13, -22, -23, -24, -25, and -26 monitor the soil column and unconfined aquifer beneath the BY Crib area. Scintillation probe profiles indicate that radionuclides are present in vadose zone soils into the water table, with elevated radioactivity at distinct intervals. This could indicate lateral migration of radionuclides by perching of crib effluents on less permeable strata during crib operation or from leaks in the 241-BY Tank Farm (DOE 1990). Groundwater samples from the area around the 241-BY Cribs contain cyanide, ^{90}Sr, ^{99}Te, ^{60}Co, nitrate, and beta. Nitrate and cyanide plumes are distinctly associated with the 241-BY Crib area, suggesting that the cribs may be a source. In 1956, a monitoring well near the BY cribs detected ^{60}Co in exceedance of the Hanford Atomic Products Operation (HAPO) concentration limits (4×10^{-5} μCi/ml) by over 300 times.

The 216-B-43 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The April 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min. Vadose Borehole 299-E33-1 monitors the soil column beneath the crib. The waste volume discharged to the 216-B-43 Crib did not exceed its calculated specific retention capacity (see Section 2.3.3 and Table 4-14).

In 1991 the area around the 216-B-43 to -50 and 216-B-57 Cribs was interim stabilized. This was done to eliminate surface contamination and migration deficiencies and to maintain environmental compliance until the final remediation strategy is implemented. Stabilization activities included removing debris, resurveying, conspicuously marking all above-grade structures, covering contaminated areas with cobble, rock, and clean soil, and reposting the area as underground radioactive material.

4.1.2.3.14 216-B-44 Crib. The 216-B-44 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min.

Vadose Borehole 299-E33-2 monitors the soil column beneath the site. The waste volume discharged to this unit exceeded its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

4.1.2.3.15 216-B-45 Crib. The 216-B-45 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min. Similar results were found during the March 1988 survey.

Vadose Borehole 299-E33-3 monitors the soil column beneath the crib. The waste volume discharged to this unit exceeded its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

4.1.2.3.16 216-B-46 Crib. The 216-B-46 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min.

Vadose Borehole 299-E33-4 monitors the soil column beneath the site. The waste volume discharged to the 216-B-46 Crib exceeded its calculated specific retention capacity (see Section 2.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

4.1.2.3.17 216-B-47 Crib. The 216-B-47 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min.

Vadose Borehole 299-E33-5 monitors the soil column beneath the crib. The waste volume discharged to this unit exceed its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

4.1.2.3.18 216-B-48 Crib. The 216-B-48 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min.

Vadose Borehole 299-E33-6 monitors the soil column beneath the site. The waste volume discharged to the 216-B-48 Crib exceeded its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

4.1.2.3.19 216-B-49 Crib. The 216-B-48 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min.

Vadose Borehole 299-E33-6 monitors the soil column beneath the crib. The waste volume discharged to this unit exceeded its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

4.1.2.3.20 216-B-50 Crib. The 216-B-50 Crib is enclosed within a surface radiation zone and a radioactive underground materials zone. The March 1990 survey found spots of beta contamination from 6,000 to 20,000 dis/min.

Vadose Borehole 299-E33-7 monitors the soil column beneath the site. The waste volume discharged to the 216-B-50 Crib vastly exceed its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

The 216-B-50 Crib did not receive waste until January 1965 because of elevated ^{60}Co and ^{137}Cs levels in groundwater. In 1956, a monitoring well near the 216-BY Cribs had ^{60}Co levels exceeding the HAPO concentration limits of 0.00004 μCi by over 300 times. The decision to use the 216-B-50 Crib for In-Tank Solidification (ITS) system condensate was made following 8 to 9 years of observations when it was shown that the groundwater activity levels were definitely decreasing.

4.1.2.3.21 216-B-55 Crib. The active 216-B-55 Crib is a 230 m (750 ft) long waste disposal site located approximately 200 m (600 ft) west of 221-B Building. It is 3 m (10 ft) wide and 4 m (12 ft) deep. It is composed of a perforated 30 cm (12 in.) pipe that runs the length of the unit three ft above the bottom. The excavation is filled with gravel, and has side slopes of 1.5:1 (DOE/RL 1991a).

The crib became operational in September 1967 (Maxfield 1979) and was designed to receive low level liquid wastes (steam condensate) from the 221-B Building. Radioisotopes present within the waste stream include ^{241}Am, ^{137}Cs, ^{139}Pu, ^{106}Ru, ^{90}Sr, and ^{3}H (Brown et al. 1990; Aldrich 1984). The March 1992 radiological survey found spots of surface contamination up to 2,000 dis/min beta activity.

Well E28-12 monitors the 216-B-55 Crib. Only background radioactivity is detected in the well September 1989 survey. No change in activity has been detected since the previous survey (Fecht et al. 1977). However, a comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.22 216-B-56 Crib. The 216-B-56 Crib, located approximately 150 m (500 ft) north of 7th street near the center of the 200-BP-5 Operable Unit, was designed to receive organic wastes from 221-B Building; however, the pipeline to the unit was not installed because disposal practices were changed and discharge of organic wastes to the ground was prohibited (Maxfield 1979).

Vadose Borehole 299-E28-14 monitors the soil column beneath the site. Scintillation probe profiles indicate only background activity levels (Fecht et al. 1977).

The WIDS indicates that the site had to be filled with gravel after cross-contamination occurred from surrounding sites. No surface contamination was detected in the March 1992 radiological survey.

4.1.2.3.23 216-B-57 Crib. The 216-B-57 Crib is enclosed within a surface contamination zone. The bottom of the excavation is 3 m (10 ft) below grade, and the dispersal pipe is approximately 2 m (7 ft) below grade. Radiological surveillance of the crib is done annually. At the April 1990 survey extensive contamination was found up to 350,000 dis/min on the site and around the outside perimeter. At the March 1992 survey, no contamination was detected. Current inventory data are summarized in Tables 2-3 and 2-4.

Vadose Borehole 299-E33-24 monitors the soil column beneath the trench site. Scintillation probe profiles indicate the radioactive contaminant plume is suspended in the sediment column from 7.6 to 19.8 m (25 to 65 ft) below the ground surface (Maxfield 1979). The waste volume discharged to the 216-B-57 Crib greatly exceeded its calculated specific retention capacity (see Section 2.3.3) and has been evaluated in Table 4-14 as having the potential to migrate to the unconfined aquifer.

In 1991 contaminated soil from the open area between the 216-B-43 through -50 Cribs, 12th Street, and Baltimore Avenue was excavated and placed on top of the 216-B-43 through -50 Cribs and the 216-B-57 Crib. The areas were then capped with clean soil and re-posted with underground radioactive material warning signs (prior to remedial activities, crib and trench areas were posted with surface contamination signs). Recent drilling activities at the cribs required that the sites be re-posted with surface contamination warning signs.

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4.1.2.3.24 216-B-60 Crib. The 216-B-60 Crib has been covered by the northeast corner of the 225-B Encapsulation Facility (Maxfield 1979). Consequently, it cannot be surveyed, and there are no postings for it. The inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.3.25 216-B-61 Crib. The 216-B-61 Crib is enclosed in a light weight chain barricade. The 216-B-61 Crib was designed to receive waste storage tank condensate from the ITS system No. 1 unit in the 241-BY Tank Farm. Although this crib was built, it was never used (WHC 1991a).

Monitoring Boreholes 299-E33-25 and -26 monitor the soil column beneath the crib. Although no waste was reportedly disposed to the crib, monitoring well data indicate low-level contaminants are present. The source of these contaminants is unknown (WHC 1991a).

4.1.2.3.26 216-B-62 Crib. This crib is enclosed within a surface contamination zone. The pipe that feeds the crib is approximately 3 m (10 ft) below grade. No contamination was detected in the March 1992 radiological survey.

Wells 299-E28-18, -E28-20, and -E28-21 monitor the 216-B-62 Crib. Radionuclides exceeding background activity were detected between 11 and 29 m (36 and 95 ft) below the 0. ground surface in Well 299-E28-18. The WIDS database reports that the total alpha decay (directly related to ^{234}U and ^{238}U concentration) in Wells 299-E28-18 and -E28-21 is continually decreasing, although in Well 299-E28-18 concentrations of ^{234}U and ^{238}U exceeded the concentration limits prior to August 1986.

Current groundwater activity in these wells averages about 15 pCi/L which is below the Administrative Control Value of 60 pCi/L. The Administration Control Value for various radionuclides is described in the annual environmental surveillance reports of the Westinghouse Hanford Company (Schmidt et al. 1991). The concentrations of uranium in the groundwater have remained below this limit since 1989 (Schmidt et al. 1992). It is suspected that the uranium is most likely originating from under the inactive 216-B-12 Crib located several hundred feet to the south. However, a comparison of the estimated pore volume beneath the crib with the quantity of effluent disposed to the crib suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.3.27 Chemical Tile Field North of 2703-E HWSA. This tile field is an active waste site located about 245 m (800 ft) north of 4th Street and 60 m (200 ft) west of Baltimore Avenue. The volume and type of waste that the tile field received is not known.

4.1.2.3.28 216-B-13 French Drain. The bottom of this french drain is approximately 4.5 m (18 ft) below grade. It is enclosed by a light chain barricade and marked as a surface radiation, underground radioactive materials zone with cave-in potential. The french drain has a plywood cover and is filled with crushed limestone. Radionuclide content is estimated

to be less than 1 Ci total beta (Maxfield 1979). No contamination was detected in the March 1992 radiological survey. The french drain has a plywood cover and is filled with crushed limestone.

4.1.2.3.29 216-B-51 French Drain. The french drain is posted as a surface contamination zone. The bottom of the drain is approximately 4.2 m (14 ft) below grade. Radionuclide content is estimated to be less than 10 Ci total beta (Maxfield 1979). Beta contamination up to 4,000 dis/min was detected in the March 1992 radiological survey.

Monitoring Wells 299-E33-11 and 299-E33-14 monitor the groundwater beneath the site. Based on scintillation probe profiles and estimated waste inventory, groundwater contamination is not believed to have occurred at this site. A WIDS radionuclide inventory for this site was not available. It is assumed that the same radionuclides and chemicals disposed of at the BC site were also disposed of at this waste site (Fecht et al. 1977).

4.1.2.4 Reverse Wells. Reverse wells, sometimes referred to as injection wells, are a well with perforated or open lower end. They were used for the disposal of low-level process waste. There are five reverse wells in the B Plant Aggregate Area.

4.1.2.4.1 216-B-4 Reverse Well. The 216-B-4 Reverse Well, operational from April 1945 to December 1949, received approximately 10,000 L (2,600 gal) of low salt, neutral to basic, transuranic fission waste. The WIDS hazardous chemical inventory lists only 1,000 kg (2,200 lb) of nitric acid contained in the waste stream. Radionuclide inventory for the reverse well was not available; however, Maxfield (1979) estimates less than 1 Ci total beta activity.

The 216-B-4 Reverse Well is classified as a zone of underground radioactive material and is marked by a concrete post, however, it is not contained within a barrier. Radiological surveillance is done annually. At the March 1992 survey no contamination was detected. There has been no change since the October 1988 survey.

A comparison of the estimated pore volume beneath the well with the quantity of effluent disposed to the well suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.4.2 216-B-5 Reverse Well. The 216-B-5 Reverse Well, operational from April 1945 to October 1947, is part of a system that includes the 241-B-361 Settling Tank. The system received approximately 30,600,000 L (808,000 gal) of low salt, neutral to basic waste that overflowed into the reverse well from the settling tank. The waste contained approximately 4,300 g of plutonium and 3,800 Ci of beta/gamma activity (Maxfield 1979). Other constituents of the waste stream at the time of discharge included 76 Ci of ^{90}Sr, 81 Ci of ^{137}Cs, and 160 Ci of ^{106}Ru. Analyses performed to determine the amount of uranium present in the waste indicated that less than 8% of the alpha activity could be attributed to uranium (Brown and Ruppert 1950).

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A study by Brown and Ruppert (1950), designed to determine potential hazards from wastes discharged to ground, was developed in 1946 and implemented in 1947 and 1948 following an alleged discovery of alpha contamination in the groundwater in well 299-E33-18. Two major objectives of the study were to determine the spatial distribution of radionuclide contamination in the ground water and to predict the direction the contamination would migrate if it moved at all. (Smith 1980)

Eleven wells (299-E23-1, 299-E27-1, 299-E28-1, -2, -3, -4, -5,-6, -7, and two more to the east of these which were not needed to delineate the radionuclide distribution) were drilled as part of the effort to determine the distribution of radionuclides in the groundwater around the reverse well. Sediment and groundwater samples were collected at the time of drilling and were analyzed for alpha and total beta-gamma contamination. (Smith 1980)

The sediment samples collected from the wells were analyzed for ^{239}Pu, ^{240}Pu, ^{137}Cs, and ^{90}Sr. The sediment sampling results are listed in Table 4-19. The results showed that radionuclides exceeding 10 nCi/g were limited to within 6 m (20 ft) of the reverse well, and levels of ^{239}Pu, and ^{240}Pu exceeding 100 nCi/g were limited to within 1 m (3 ft). The ^{137}Cs distribution showed that it moved laterally away from the reverse well in a silt layer in the unsaturated sediments at the basalt surface. A widespread layer of contamination located just above the basalt surface was revealed by gamma scintillation logging. (Smith 1980)

The 216-B-5 physically extends into the groundwater and therefore has discharged into the groundwater. It is also identified in Table 4-14 as having effluent with the potential to migrate to the groundwater. In 1976, water samples from three (299-E28-1, -5, and -7) of the eleven wells drilled for the studies of groundwater contamination near the reverse well showed radiation levels (Smith 1980, Table 3) four orders of magnitude less than drinking water standards, therefore, the sorbed radionuclide plumes are causing no contamination problems in the groundwater (Smith 1980). Further information on groundwater studies around the 216-B-5 reverse well are provided in the 200 East Groundwater AAMSR.

The 216-B-5 Reverse Well is classified as an area of surface and underground contamination. It is marked by a concrete post, and surrounded by a light chain barrier. Radiological surveillance is done annually. At the April 1990 survey general contamination of 1,500 to 3,000 dis/min was found in the northeast corner of the zone. Two areas outside the zone perimeter were reported to have contamination of 15,000 dis/min and 4,000 dis/min (WHC 1991a). This is an increase from the 1989 survey. The March 1992 survey detected spotty beta contamination up to 6,000 dis/min.

4.1.2.4.3 216-B-6 Reverse Well. The 216-B-6 Reverse Well, operational from April 1945 to December 1949, received approximately 6,000,000 L (1,600,000 gal) of mixed waste. The waste stream included both nitric and sulfuric acids, as well as transuranic fission products. However, the site contains less than 10 Ci total beta (WHC 1991a).

The 216-B-6 Reverse Well is classified as a zone of underground radioactive material and is marked by a concrete post; however, it is not contained within a barrier. Radiological surveillance is done annually. At the March 1992 survey no contamination was detected. There has been no change since the October 1988 survey.

A comparison of the estimated pore volume beneath the well with the quantity of effluent disposed to the well suggest that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.4.4 216-B-11A and 216-B-11B Reverse Wells. The 216-B-11A and 216-B-11B Reverse Wells are two units placed approximately 18 m (60 ft) apart. They were operational from December 1951 to December 1954 and received approximately 29,600,000 L (7,820,000 gal) of low salt, neutral to basic process condensate from the 242-B Evaporator (Maxfield 1979).

A study done by Fecht et al. in 1977 reports that radioactive contaminants were detected 22.9 m (75 ft) below the ground surface in vadose monitoring Borehole 299-E33-20, and 27.4 m (89.9 ft) below the surface in Borehole 299-E33-19 (Fecht et al. 1977). A comparison of the estimated pore volume beneath the well with the quantity of effluent disposed to the well suggest that the effluent has potential to reach groundwater (Table 4-14).

The 216-B-11A and 216-B-11B Reverse Well area is classified as a zone of surface contamination. It has been covered by gravel and clean soil and is surrounded by a light chain barrier. Radiological surveillance is done annually. At the April 1990 survey general contamination of 3,000 to 5,000 dis/min was found. An area along the east side measured up to 2 mR/h. The March 1992 survey detected spotty areas of up to 6,000 dis/min beta activity.

4.1.2.5 Ponds, Ditches, and Trenches. The 216-B-3 Pond system consists of a main pond and three connected lobes, as well as several ditches leading to the ponds. The three expansion ponds are the 216-B-3A, 216-B-3B, and 216-B-3C Ponds (lobes). Overflow effluent leaving the 216-B-3 Pond enters the 216-B-3A lobe which in turn enters into the 216-B-3C lobe. The 216-B-3B lobe has been dry since 1986. The ditches associated with the pond system include the 216-B-3-1, 216-B-3-2, and 216-B-3-3 Ditches, as well as the 216-A-29 Ditch. The 216-A-29 Ditch, which was backfilled in 1991, will not be discussed in this report as it is a part of the PUREX Plant Aggregate Area. Several additional ponds, ditches and trenches are also discussed in this section.

The 200/600 Area Operational Environmental Monitoring Program currently collects water (surface), aquatic vegetation, and sediment samples from the following active ponds and ditches in the B Plant Aggregate Area: the 216-B-63 Ditch (Trench), 216-B-3-3 Ditch, 216-B-3 Pond, 216-B-3A Pond, 216-B-3C Pond, and 216-N-8 Pond (West Lake). Water samples of 1 L (0.26 gal) are collected on a weekly basis. The pH is determined each week, then the samples are composited and analyzed monthly for total alpha, total beta, gamma-emitting radionuclides, and ^{90}Sr. Additionally, a 1-L (0.26 gal) sample is taken quarterly

from each site for nitrate analysis. Samples of aquatic vegetation are collected from ponds and ditches yearly to determine root uptake of radionuclides from potentially contaminated sediments. Along with vegetation samples, sediment samples are collected to measure the accumulation of radionuclides. The vegetation and sediments are analyzed for gamma-emitting radionuclides, ^{90}Sr, ^{239}Pu, and uranium. The 1990 results from these analyses are provided in Appendix G of Schmidt et al. 1992. (Schmidt et. al. 1992) The surface water sample analyses from 1985 to 1989 for these units are provided in Table 4-12.

4.1.2.5.1 216-B-3 Pond. The 216-B-3 Pond is the main pond portion of the active 216-B-3 overflow pond and ditch system. It is currently classified as an area of surface contamination and is surrounded by a light chain barrier.

There has been only one known unplanned release directly associated with the 216-B-3 Pond. Unplanned release UN-200-E-14 occurred in 1958 when a dike broke along the east side of the 216-B-3 Pond, allowing water to flow out of the pond. After the break was repaired, the area was covered with clean soil. Most of the available information on this release is summarized in Table 2-6.

Four other unplanned releases, UPR-200-E-32, UPR-200-E-34, UPR-200-E-51, and UPR-200-E-138, are also associated with the 216-B-3 Pond through its integral relationship with its tributary ditches. However, these four releases are more directly associated with the individual ditches in which they occurred and are discussed with the recipient ditches.

Currently, the 216-B-3 Pond is part of four connected ponds that receive cooling water and other associated streams. Surface water, vegetation, and sediment samples are obtained from 216-B-3 Pond, analyzed and reported as discussed in Section 4.1.2.5. The 1990 survey results for the 216-B-3 Pond (216-B-3 Pond East and South) showed that radionuclide concentrations in the surface water were below detection limits; vegetation samples showed 3.76 E-8 g/g (max.) of uranium and 1.8 pCi/g (max.) of ^{90}Sr; and, sediment samples showed 5.1 E-01 pCi/g (max.) of Pu, 8.9 E-07 g/g (max.) of uranium, 12.5 pCi/g (max.) of ^{137}Cs, and 1.6 pCi/g of ^{90}Sr. Additional surface water and sediment sampling results are provided in Tables 4-12 and 4-21, respectively.

According to a study done by Mitchell in 1988, all constituents monitored in the groundwater were below the EPA Interim Primary Drinking Water Standards with the exception of ^{3}H, which was as high as 54,000 pCi/L in Borehole 699-45-42. However, ^{3}H levels have been decreasing since 1971. Currently, the 216-B-3 Pond is in Groundwater Assessment due to high values of TOC and TOX detected in several RCRA wells north of the 216-B-3B lobe in June 1990. From June 1990 to July 1991, no sampling took place because of difficulties with a contract laboratory. Groundwater sampling of the 216-B-3 Pond was reinstated in July 1991. The groundwater contamination associated with this unit is further addressed in the 200 East Groundwater AAMSR.

A comparison of the estimated pore volume beneath the pond with the quantity of effluent disposed to the pond suggests that the pond contains effluent with the potential to reach groundwater (Table 4-14).

Unplanned release UN-200-E-14 occurred in 1958 when the dike along the east edge of 216-B-3 Pond broke allowing water to escape. The quantity of water and amount of radioactivity released were undetermined. The area was released from radiation zone status in December 1970. However, the unplanned release is included in the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement).

4.1.2.5.2 216-B-3A Pond. The 216-B-3A Pond (lobe) is an active mixed waste management unit that was constructed in 1983 to receive overflow from the 216-B-3 Pond. The increased discharge to the 216-B-3 Pond resulted from the restart of PUREX operations.

Currently, surface water, vegetation, and sediment samples are obtained, analyzed and reported as discussed in Section 4.1.2.5. The 1990 survey results for the 216-B-3A Pond (216-B-3 Pond Overflow) showed that radionuclide concentrations in the surface water were below detection limits; vegetation samples showed 2.08 E-8 g/g of uranium and 0.90 pCi/g of ^{90}Sr; and, sediment samples showed 5.5 E-01 pCi/g of Pu, 5.3 E-07 g/g of uranium, 12.1 pCi/g ^{137}Cs, and 1.2 pCi/g of ^{90}Sr. Additional surface water and sediment sampling results are provided in Tables 4-12 and 4-21, respectively.

4.1.2.5.3 216-B-3B Pond. The 216-B-3B Pond (lobe) is listed as an active waste management unit in the WIDS data sheets. However, it has been dry and unused since 1986. Although the pond is currently dry, the pipelines to the unit are still in place and it could be used in the event of high water flow, so it remains in active status. The pond was dredged in 1986 due to decreasing percolation. At that time up to 2.2 m (7 ft) of material was removed to a level equal to the channels in the bottom of the pond. The removed material was placed along the north shore of the 216-B-3 Pond. Sediment sample data is provided in Table 4-21.

There is a light chain barricade around the entire pond and it has "Danger" warning signs. Within the barricade, there is a second light chain barricade surrounding the inlet ditch. It is posted with surface radiation contamination warning signs.

4.1.2.5.4 216-B-3C Pond. The 216-B-3C Pond (lobe) has been active since its construction in 1985. It was built to handle overflow from the 216-B-3B pond as a result of increased discharge to the 216-B-3 Pond system arising from the decommissioning of the Gable Mountain Pond (216-A-25 Pond). This lobe is the largest of the three lobes and currently disposes of essentially all of the 216-B-3 Pond system's flow.

Currently, surface water, vegetation, and sediment samples are obtained, analyzed and reported as discussed in Section 4.1.2.5. According to the 1990 survey, the 216-B-3C Pond (216-B-3 3rd Overflow) had a maximum total alpha concentration of 53 pCi/L in the surface water, which is higher than the Derived Concentration Guide limit of 30 pCi/L. Vegetation

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samples showed radiation levels at 1.31 E-08 g/g of uranium and 8.1 pCi/g of ^{90}Sr. Sediment samples showed 33 pCi/g of plutonium, 3.5 E-06 g/g of uranium, 110 pCi/g of ^{137}Cs, 2.5 pCi/g ^{90}Sr, and 63 pCi/g of $^{144}CePr$ (Schmidt et al. 1992). Additional surface water and sediment sampling results are provided in Tables 4-12 and 4-21, respectively.

4.1.2.5.5 216-A-25 Pond. The 216-A-25 Pond, also known as Gable Mountain Pond, was active from 1957 to 1987. Over that time, it is estimated that the pond received approximately 307,000,000,000 L (81,100,000,000 gal) of low-level mixed waste (WHC 1991a).

In 1964, a reported 10,000 Ci of radionuclides were released when a cooling coil ruptured in the PUREX Plant (UPR-200-E-34). Approximately three-fourths of the release went to the 216-A-25 Pond and one-fourth to the 216-B-3 Pond. The following radionuclides have been detected in the Gable Mountain Pond soil samples: ^{241}Am, ^{3}H, ^{106}Ru, ^{137}Cs, ^{147}Pm, ^{90}Sr, and plutonium (WHC 1991a).

In 1984, increases in the ^{90}Sr concentration in Borehole 699-53-47A prompted an investigation and additional monitoring wells were installed. The investigation concluded that the ^{90}Sr plume was localized and moving so slowly as to have no significant impact at the Hanford Site boundary (Serkowski and Jordan 1989).

Cleanup of the Gable Mountain Pond started in July 1984 and was completed in December 1988. The unit was backfilled with clean pit run soil and cobbles to a minimum of 0.6 m (2 ft) above the original shoreline. Bentonite clay was also placed on the bottom of the pond as an attempt to tie-up the radionuclides in the upper sediment layers.

Concentrations of ^{90}Sr in the groundwater have remained relatively stable over the last few years with values ranging from below detection (5 pCi/L) in some locations to approximately 360 pCi/L in other areas (Serkowski and Jordan 1989). Although this is higher than the groundwater Administrative Control Value of 74 pCi/L, it is still much lower than the groundwater Derived Concentration Guide (DCG) value of 1,000 pCi/L (Schmidt et al. 1992). A comparison of the estimated pore volume beneath the pond with the quantity of effluent disposed to the pond suggests that the effluent has potential to reach groundwater (Table 4-14). Groundwater contamination associated with this area is further addressed in the 200 East Groundwater AAMSR.

Radiological surveillance of the pond is done semiannually. At the October 1990 survey no contamination was detected and there has been no change since the May 1989 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.6 216-N-8 Pond. The 216-N-8 Pond, also known as West Pond or West Lake, has never received direct discharges of contaminated effluent. However, West Lake is known to be contaminated, probably from groundwater recharge, but the exact source of contamination is not known.

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Currently, samples of the surface water, vegetation, and sediment samples are obtained, analyzed and reported as discussed in Section 4.1.2.5. The 1990 survey results for the West Lake showed that radionuclide concentrations in the surface water were below administrative control values; vegetation samples showed 8.58 E-08 g/g of uranium and 0.71 pCi/g of ^{90}Sr; and, sediment samples showed 0.98 pCi/g of Pu, 4.0 E-06 g/g of uranium, 1.4 pCi/g ^{137}Cs, and 1.0 pCi/g of ^{90}Sr (Schmidt et al. 1992). Additional surface water sampling results are provided in Table 4-12.

The 216-N-8 Pond is particularly high in alkaline and phosphate levels, and has a relatively high pH. These properties were likely caused by the disposal of sanitary sewage sludge from the early Hanford construction camp.

4.1.2.5.7 2101-M Pond. The 2101-M Pond, which became operational in 1953, receives small amounts of steam condensate and evaporative cooler overflow drainwater from the 2101-M heating and air conditioning system. The pond has also received barium chloride laboratory waste solutions at an estimated volume of less than 1,893 L/yr (500 gal/yr). During the active life of the Basalt Waste Isolation Project (BWIP) Laboratory, solutions of dissolved barium in groundwater samples were discharged to the pond. Other laboratory chemicals may have been discharged to the pond from 1981 to July 1985. Administrative controls were established in July 1985 to prohibit disposal of dangerous wastes.

Detailed records documenting the wastes generated and the amounts of these wastes that may have been discharged to the pond were not maintained. Some wastes that may have been released to the pond from BWIP Laboratory include barium, sodium hydroxide, and dilute acid.

The soil characterization and groundwater data from the pond strongly suggest that the constituents in the soil and the groundwater beneath the pond are present in concentrations that do not pose a substantial present or potential threat to human health or the environment. The pond is encompassed by a light-weight chain barricade with "RCRA Waste Site Do Not Disturb" and "Dry Rot" warning signs.

4.1.2.5.8 216-E-28 Pond. The 216-E-25 Pond is listed as an inactive waste management unit in the WIDS data sheets. It was constructed in 1986 and 1987 as an emergency facility for temporary use in the event of an abrupt shutdown of the 216-B-3 Pond. To date, the contingency pond has not been used, and there are no inventory data included in the WIDS (WHC 1991a).

4.1.2.5.9 216-B-2-1 Ditch. The 216-B-2-1 Ditch is classified as an area of surface and subsurface contamination. There is no barrier surrounding the contaminated zone.

One unplanned release, UPR-200-E-32, is associated with this ditch. It resulted in an estimated release of 30 Ci of ^{144}Ce, and 0.05 Ci of ^{90}Sr. Most of the available information on this release is summarized in Table 2-6. Because of the release, in 1964, the first 305 m (1,000 ft) of the 216-B-2-1 ditch was closed and backfilled with 1.8 m (6 ft) of clean soil.

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As a result of breakthrough by contaminated vegetation, an additional 46 m (18 in.) of sand covered with 10 cm (4 in.) of gravel was placed on the site in 1973 (Maxfield 1979). In 1986, due to the recurrence of contaminated vegetation, the 216-B-2-1, -2, and -3 Ditches were restabilized with 61 cm (24 in.) of best available soil.

This ditch is surveyed semiannually. The April 1991 radiological survey found an one plant to contain beta contamination up to 20,000 dis/min. Current radionuclide inventory data is provided in Table 2-3. Soil sample analyses are not available.

A comparison of the estimated pore volume beneath the ditch with the quantity of effluent disposed to the ditch suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.10 216-B-2-2 Ditch. The 216-B-2-2 Ditch is classified as an area of subsurface contamination. There is no barrier surrounding the contaminated zone. This ditch was closed after UPR-200-E-138 and then backfilled to grade with 2.4 m (8 ft) of clean fill material.

The release, UPR-200-E-138, occurred in 1970 originating from the 8-1 Tank located in the 221-B Building. Most of the available information on this release is summarized in Table 2-6. Approximately 1,000 Ci of ^{90}Sr was released. However, most of the contamination was contained in the ditches. The radionuclides reaching 216-B-3 Pond included approximately 13 Ci of ^{137}Cs, 50 Ci of ^{90}Sr, and 54 Ci of ^{144}Ce. Bulldozers pushed soil over the north, south, and west shorelines of the 216-B-3 Pond reducing radioactivity from a maximum of 650 mR/h to 10 mR/h at the ditch inlet. Other measurements around the pond ranged from 1,000 ct/min to 25,000 ct/min (Maxfield 1979).

Russian thistles and willow trees which grew on the backfilled area showed internal beta-gamma contamination up to a maximum of 3,000 ct/min prior to the covering of the first 731 m (2,400 ft) with sand and plastic root liners in 1973. Since that time no contaminated vegetation has been found while Russian thistles growing on the uncovered section of the ditch have shown readings up to 1,500 ct/min beta-gamma contamination (Maxfield 1979). However, due to the recurrence of contaminated vegetation in the area in 1986, the 216-B-2-1, -2, and -3 Ditches were restabilized with 61 cm (24 in.) of best available soil.

The radionuclides reported to be released to the ditch include ^{137}Cs, ^{90}Sr, and ^{239}Pu, and ^{240}Pu. Radionuclide data obtained from the WIDS data sheets indicated that 0.042 g of plutonium as well as 0.314 Ci of ^{137}Cs, and 147 Ci of ^{90}Sr remain beneath the clean backfill material.

This ditch is surveyed semiannually. At the April 1991 survey, vegetation was found with beta contamination up to 20,000 dis/min. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the ditch with the quantity of effluent disposed to the ditch suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.11 216-B-2-3 Ditch. The 216-B-2-3 Ditch is classified as an area of subsurface contamination. There is no barrier surrounding the contaminated zone. The ditch has been backfilled to grade with 2.4 m (8 ft) of clean soil, and replaced with a pipeline.

The 216-B-2-3 Ditch is surveyed semiannually. At the April 1991 survey, vegetation was found with beta contamination up to 20,000 dis/min. This was an increase from the previous year. The site is considered one of low-level radioactivity with readings that are generally less than 200 ct/min by a GM probe (Maxfield 1979). In 1986, the 216-B-2-1, -2, and -3 Ditches were restabilized with 61 cm (24 in.) of best available soil due to the recurrence of contaminated vegetation in the area. No radionuclide data were presented for this site in the WIDS sheets for decays through December 1989.

4.1.2.5.12 216-B-3-1 Ditch. The 216-B-3-1 Ditch, operational from April 1945 to July 1964, is classified as an area of subsurface contamination. It is surrounded by a light chain barrier and posted with underground radioactive material warning signs. It was backfilled to grade with 1.8 m (6 ft) of clean soil in 1964, after approximately 2,500 Ci of fission products were released to the ditch from UPR-200-E-34. (Most of the available information on UPR-200-E-34 is summarized in Table 2-6.) In 1971, it was covered with a 10 mil thick plastic root barrier, 45 cm of sand, and 10 cm of gravel.

Prior to the 1971 stabilization, Russian thistle was growing profusely over areas of the covered ditch. Radiation measurements of up to 40 mrads/h were observed on surfaces of the thistle (Maxfield 1979). During a routine surveillance in 1984, contamination was found as follows: spotty contamination of soil up to 50,000 ct/min, vegetation up to 100,000 ct/min, coyote feces up to 2,000 ct/min, and animal burrows up to 12,000 ct/min (WHC 1991a).

The 216-B-3-1 Ditch is surveyed semiannually. During the March 1992 survey, no contamination was detected. This is a decrease from the October 1990 survey.

Radionuclide data for the 216-B-3-1 Ditch is not available in the WIDS; however, it is stated by Maxfield (1979) that 3 Ci of mixed waste were discharged to the ditch during its operational lifetime.

A comparison of the estimated pore volume beneath the ditch with the quantity of effluent disposed to the ditch suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.13 216-B-3-2 Ditch. The 216-B-3-2 Ditch, operational from July 1964 to September 1970, is classified as an area of subsurface contamination and is surrounded by a light chain barrier. The ditch was backfilled to grade with between 1.2 and 2.4 m

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(4 and 8 ft) of clean backfill material in 1970, immediately following the release of an estimated 1,000 Ci of Sr-90 (UPR-200-E-138). This unplanned release led to readings at the head of the ditch of 450 mR/h, and general activity along the ditch averaging 10,000 ct/min. After the bottom was covered with 0.3 m (1 ft) of soil, readings were reduced to 20 mR/h at the head of the ditch, and 200 ct/min of general activity along the ditch (Maxfield 1979).

Since being completely backfilled, the 216-B-3-2 Ditch has been surveyed semiannually. No contamination was detected in the March 1992 survey. This is a decrease from previous years.

A comparison of the estimated pore volume beneath the ditch with the quantity of effluent disposed to the ditch suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.14 216-B-3-3 Ditch. The 216-B-3-3 Ditch is an active waste management unit that currently feeds the 216-B-3 Pond and is classified as an area of surface contamination. It is surrounded by a light chain barrier.

Currently, surface water, vegetation, and sediment samples are obtained, analyzed and reported as discussed in Section 4.1.2.5. According to the 1990 survey, the 216-B-3-3 Ditch had a maximum total beta concentration of 299 pCi/L in the surface water, which is lower than the Derived Concentration Guide limit of 1,000 pCi/L. Vegetation samples showed radiation concentrations at 5.96 E-08 g/g of uranium and 0.75 pCi/g of ^{90}Sr, and sediment samples showed radiation concentrations at 25.0 pCi/g of Pu, 1.2 E-06 g/g of uranium, 298 pCi/g of ^{137}Cs, and 3.7 pCi/g of ^{90}Sr. Additional surface water and sediment sampling results are provided in Tables 4-12 and 4-21, respectively.

This ditch is associated with the unplanned release UPR-200-E-51. Most of the available information on this release is summarized in Table 2-6.

4.1.2.5.15 216-B-20 Trench. From 1952 to 1958, liquid wastes containing uranium and fission products resulting from the bismuth phosphate separations process were removed from underground storage tanks for uranium recovery. After the uranium was recovered, the cesium and strontium content of the effluent stream was reduced by precipitate scavenging. The resultant supernatant liquor was released to the ground in the BC Cribs and Trenches (216-B-20 through -34, 216-B-53A, -53B, -54, and 58 Trenches). The whole BC Trenches area is encompassed by concrete market posts, some of which are connected with chains.

The 216-B-20 Trench was the first BC trench to receive this supernatant. It is classified as an area of underground radioactive contamination and was backfilled to grade with excavated material, which was stored adjacent to it. In 1969 the unit was covered with 15 cm (6 in.) of gravel.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.16 216-B-21 Trench. The 216-B-21 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. In 1969 the unit was covered with 15 cm (6 in.) of gravel.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data is summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.17 216-B-22 Trench. The 216-B-22 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. In 1969 the unit was covered with 15 cm (6 in.) of gravel.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.18 216-B-23 Trench. The 216-B-23 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

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4.1.2.5.19 216-B-24 Trench. The 216-B-24 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous year. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.20 216-B-25 Trench. The 216-B-25 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.21 216-B-26 Trench. The 216-B-26 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. In 1969 layers of sand and gravel were put over the trench to bring it up to 3 m (10 ft) above the bottom, and to avoid radionuclide uptake by plants.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.22 216-B-27 Trench The 216-B-27 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. In 1969 layers of sand and gravel were put over the trench to bring it up to 3 m (10 ft) above the bottom to avoid radionuclide uptake by plants. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.23 216-B-28 Trench. The 216-B-28 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. In 1958 a burrow into this trench was found. It is believed that animals used the burrow to get at salt crystals formed from the waste. The burrow was filled with gravel and covered with asphalt. The asphalt has since broken up (WHC 1991a).

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

Unplanned release UN-200-E-83 is thought to have originated from the 216-B-28 Trench. Most of the available information on this release is summarized in Table 2-6.

Monthly and quarterly surveillance reports indicate the contamination is fixed beneath the vegetation. There is no significant evidence of resuspension of the radioactive particulate matter.

4.1.2.5.24 216-B-29 Trench. The 216-B-29 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.25 216-B-30 Trench. The 216-B-30 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

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Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.26 216-B-31 Trench. The 216-B-31 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.27 216-B-32 Trench. The 216-B-32 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.28 216-B-33 Trench. The 216-B-33 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. To avoid the possibility of plant uptake of radionuclides, the unit was covered with sand and gravel in 1969.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.29 216-B-34 Trench. The 216-B-34 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. In 1969 layers of sand and gravel were put over the trench to bring it up to 3 m (10 ft) above the bottom and to avoid radionuclide uptake by plants.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.30 216-B-35 Trench. The 216-B-35 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine and an herbicide was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

Trenches 216-B-35 through -42 are located about 60 m (200 ft) due west of the 241-BX Single-Shell Tank Farm. The soil column beneath the trenches is monitored by Wells 299-E33-8, -10, -21, -28, -29, -32, -286, -287, -288, -289, and -290. Scintillation probe profiles indicate the radioactive contaminant plume is suspended in the soil above groundwater (Fecht et al. 1977).

4.1.2.5.31 216-B-36 Trench. The 216-B-36 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

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4.1.2.5.32 216-B-37 Trench. The 216-B-37 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.33 216-B-38 Trench. The 216-B-38 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m(2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.34 216-B-39 Trench. The 216-B-39 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.35 216-B-40 Trench. The 216-B-40 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the 1989 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

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4.1.2.5.36 216-B-41 Trench. The 216-B-41 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.37 216-B-42 Trench. The 216-B-42 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and approximately 1 m (2 ft) of topsoil treated with 2,4-d amine was added and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done annually. At the April 1992 survey no contamination was detected and there has been no change in activity since the March 1988 survey. Current inventory data are summarized in Tables 2-3 and 2-4.

4.1.2.5.38 216-B-52 Trench. The 216-B-52 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade with excavated material, which was stored adjacent to it. The area has been stabilized with gravel and weed growth has been controlled by a sterilent.

Radiological surveillance of the trench is done infrequently. At the September 1984 survey no contamination was detected. Current inventory data are summarized in Tables 2-3 and 2-4.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.39 216-B-53A Trench. The 216-B-53A Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and the area was stabilized by adding 1 m (2 ft) of topsoil and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

Vadose Borehole 299-E13-61 monitors the soil column beneath the trenches. Considering a depth to groundwater at about 103 m (338 ft) below ground surface, a low PNL Hazardous Ranking System Migration Score, and relatively small quantities of waste discharged to the facilities suggest the waste in the sediment column has not reached

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groundwater (Fecht et al. 1977). However, a comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.5.40 216-B-53B Trench. The 216-B-53B Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and the area was stabilized by adding 1 m (2 ft) of topsoil and seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

Vadose Borehole 299-E13-61 monitors the soil column beneath the trenches. Considering a depth to groundwater at about 103 m (338 ft) below ground surface, a low PNL Hazardous Ranking System Migration Score, and relatively small quantities of waste discharged to the facilities suggest the waste in the sediment column has not reached groundwater (Fecht et al. 1977).

4.1.2.5.41 216-B-54 Trench. The 216-B-54 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and the area was stabilized by adding 1 m (2 ft) of topsoil which was seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

Vadose Borehole 299-W13-61 monitors the soil column beneath the trenches. Considering a depth to groundwater at about 103 m (338 ft) below ground surface, a low PNL Hazardous Ranking System Migration Score, and relatively small quantities of waste discharged to the facilities suggest the waste in the sediment has not reached groundwater (Fecht et al. 1977).

4.1.2.5.42 216-B-58 Trench. The 216-B-58 Trench is classified as an area of underground radioactive contamination. It was backfilled to grade and the area was stabilized by adding 1 m (2 ft) of topsoil which was seeded with thickspike, crested, and Siberian wheatgrass.

Radiological surveillance of the trench is done semiannually. At the November 1991 survey spots of up to 80,000 dis/min beta activity were detected. This is an increase from the previous survey. Current inventory data are summarized in Tables 2-3 and 2-4.

Vadose Borehole 299-E13-61 monitors the soil column beneath the trenches. Considering a depth to groundwater at about 103 m (338 ft) below ground surface, a low

PNL Hazardous Ranking System Migration Score, and relatively small quantities of waste discharged to the facilities suggest the waste in the sediment column has not reached groundwater (Fecht et al. 1977).

4.1.2.5.43 216-B-59 Trench. The 216-B-59 Trench was designed to receive B Plant cooling water with radionuclide concentrations above those allowed for ponds. The site was activated in 1967 and only received one delivery of approximately 477,000 L (126,000 gal) of waste. The trench was then upgraded to a retention basin (216-B-59B Retention Basin).

The 216-B-59B Retention Basin is currently an active waste management unit. It is surrounded by a 2 m (6 ft) high chain-link fence. Yellow contamination flags are adjacent to the western boundary. The retention basin is discussed further in Section 4.1.2.8.1.

4.1.2.5.44 216-B-63 Trench/Ditch. The 216-B-63 Trench was constructed in 1970 to receive chemical sewer wastes from the 221-B Building. The trench has not received dangerous waste since September 1985, and routine discharges to the trench were discontinued in February 1992. This unit is the process of being redesignated as a ditch in the Tri-Party Agreement.

Currently, surface water, vegetation, and sediment samples are obtained, analyzed and reported as discussed in Section 4.1.2.5. The 1990 survey results for the 216-B-63 Trench showed that radionuclide concentrations in the surface water were below detection limits; vegetation samples were not taken; and sediment samples showed 13 pCi/g of Pu, 6.6 E-06 g/g of uranium, 81 pCi/g ^{137}Cs, and 42.2 pCi/g of ^{90}Sr. Additional surface water sampling results are provided in Table 4-12.

A comparison of the estimated pore volume beneath the trench with the quantity of effluent disposed to the trench suggests that the effluent has potential to reach groundwater (Table 4-14).

4.1.2.6 Septic Tanks. None of the septic tanks in the B Plant Aggregate Area are reported to have received hazardous waste; consequently there are no radiological data provided for them in the WIDS data sheets. The volume of sanitary wastewater and sewage received by each septic tank per day is reported in Table 4-20.

4.1.2.7 Transfer Facilities, Diversion Boxes, and Pipelines. Transfer facilities connect major processing facilities with each other and with various waste disposal and storage facilities. For the B Plant Aggregate Area they include process lines and diversion boxes. The process lines are not waste management units according to the Tri-Party Agreement and they will be addressed in detail under a separate decommissioning and decontamination program. However, process lines with associated unplanned releases will be discussed in this section. Only limited radiological data are available for diversion boxes in the B Plant Aggregate Area. Most of the data is summarized from the WIDS sheets (WHC 1991a).

4.1.2.7.1 241-B-151 Diversion Box. The 241-B-151 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1945 to June 1984. Two known unplanned releases, UPR-200-E-4 and UPR-200-E-73, resulting in radionuclide contamination are associated with this site. Most of the available information on these releases are summarized in Table 2-6.

Leak detection and air monitoring are performed continuously within the tank farm in which this diversion box is located. It has been isolated and weather covered. Currently, the site is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this site.

4.1.2.7.2 241-B-152 Diversion Box. The 241-B-152 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1945 to June 1984. Two known unplanned releases, UPR-200-E-74 and UPR-200-E-38, resulting in radionuclide contamination are associated with this site. Most of the available information on these releases are summarized in Table 2-6.

Leak detection and air monitoring are performed continuously within the 241-B Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the site is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this site.

4.1.2.7.3 241-B-153 Diversion Box. The 241-B-153 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1945 to June 1984. Two known unplanned releases, UPR-200-E-6 and UPR-200-E-75, resulting in radionuclide contamination are associated with this unit. Most of the available information on this release is summarized in Table 2-6.

Leak detection and air monitoring are performed continuously within the 241-B Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the site is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this site.

4.1.2.7.4 241-B-154 Diversion Box. The 241-B-154 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1945 to June 1984. Contamination is estimated to be high in alpha, beta, and gamma (WHC 1991a). Two unplanned releases, UPR-200-E-77 and UN-200-E-45, are associated with this unit. Most of the available information on these releases are summarized in Table 2-6.

Leak detection and air monitoring are performed continuously within the 241-B Tank Farm, in which this diversion box is located. It has been isolated and weather covered. A radiological survey in October 1975 measured surface contamination up to 80,000 ct/min. It has been covered with 0.3 m (1 ft) of clean soil; however, recontamination has occurred.

Currently, it is classified as an area of surface contamination and is surrounded by a light chain barrier. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.5 241-B-252 Diversion Box. The 241-B-252 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1945 to June 1984.

Leak detection and air monitoring are performed continuously within the tank farm in which this diversion box is located. It has been isolated and weather covered. Currently, the site is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.6 242-B-151 Diversion Box. The 242-B-151 Diversion Box received liquid mixed waste from 1945 to June 1984. Currently, the site is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.7 241-BR-152 Diversion Box. The 241-BR-152 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1948 to June 1984.

Leak detection and air monitoring are performed continuously within the 241-BX Tank Farm, in which this diversion box is located. It has been isolated and weather covered. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.8 241-BX-153 Diversion Box. The 241-BX-153 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1948 to June 1983.

Leak detection and air monitoring are performed continuously within the tank farm in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.9 241-BX-154 Diversion Box. The 241-BX-154 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1948 to July 1985.

Leak detection and air monitoring are performed continuously within the tank farm in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a light chain barrier. WIDS radionuclide inventories are not available for this unit.

4.1.2.7.10 241-BX-155 Diversion Box. The 241-BX-155 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid

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mixed waste from 1948 to June 1984. One unplanned release, UPR-200-E-78, is associated with this site. Most of the available information on this release is summarized in Table 2-6.

Leak detection and air monitoring are performed continuously within the tank farm in which this diversion box is located. It has been isolated and weather covered. Currently, an area of approximately 60 m^2 around the unit is designated a zone of surface contamination. It is surrounded by tape and a chain fence, and posted with surface contamination signs. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.11 241-BXR-151 Diversion Box. The 241-BXR-151 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1948 to June 1984.

Leak detection and air monitoring are performed continuously within the 241-BX Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the site is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.12 241-BXR-152 Diversion Box. The 241-BXR-152 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1948 to June 1984.

Leak detection and air monitoring are performed continuously within the 241-BX Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.13 241-BXR-153 Diversion Box. The 241-BXR-153 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1948 to June 1984.

Leak detection and air monitoring are performed continuously within the 241-BX Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.14 241-BYR-152 Diversion Box. The 241-BYR-152 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1950 to June 1984.

Leak detection and air monitoring are performed continuously within the tank farm in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.15 241-BYR-153 Diversion Box. The 241-BYR-153 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1950 to June 1984.

Leak detection and air monitoring are performed continuously within the 241-BY Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.16 241-BYR-154 Diversion Box. The 241-BYR-154 Diversion Box, used for the transfer of waste solutions from processing and decontamination operations, received liquid mixed waste from 1950 to June 1984.

Leak detection and air monitoring are performed continuously within the 241-BY Tank Farm, in which this diversion box is located. It has been isolated and weather covered. Currently, the unit is classified as an area of surface contamination and is surrounded by a chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.17 241-ER-151 Diversion Box. The 241-ER-151 Diversion Box is currently used for cross-site process and decontamination waste. In March 1953, at least 6,435 L (1,700 gal) of contaminated acid were lost to the ground when its associated catch tank (241-ER-311 Catch Tank) developed a leak (UPR-200-E-84). A radiological survey in October 1975 measured surface contamination of up to 90,000 ct/min at the site of the unplanned release (WHC 1991a).

This diversion box is not associated with any particular tank farm, however, leak detection and air monitoring are performed continuously. Currently, the unit is classified as an area of surface contamination and is surrounded by a 2 m (6 ft) chain link fence. The WIDS radionuclide inventories are not available for this unit.

4.1.2.7.18 241-ER-152 Diversion Box. The 241-ER-152 Diversion Box is currently used to transport radioactive waste solutions from processing and decontamination operations.

Leak detection and air monitoring are performed continuously at this site. Currently, it is classified as an area of surface contamination and is surrounded by a light chain barrier. WIDS radionuclide inventories are not available for this unit.

4.1.2.8 Basins. The 216-B-59B, 207-B, and 216-B-64 Retention Basins are the only basins in the B Plant Aggregate Area. Most of the data available for the basins and their associated unplanned releases are summarized from the WIDS sheets (WHC 1991a). Another basin facility, the Liquid Effluent Retention Facility (LERF), is currently under construction in the B Plant Aggregate Area.

4.1.2.8.1 216-B-59B Retention Basin. The 216-B-59B Retention Basin, originally the 216-B-59 Trench, has been an active waste site since December 1967. The original trench

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was designed to receive 221-B Building cooling water with radionuclide concentrations greater than those allowed for the ponds. The site only received one delivery of approximately 477,000 L (126,000 gal) of waste before being upgraded to a retention basin by adding a hypalon liner and changing the identification number to 216-B-59B.

The 216-B-59B Retention Basin, which held diverted cooling water to be reprocessed, was further upgraded by replacing the hypalon liner with a concrete liner and cover. Minor pumping and piping modifications were also made. No inventory data for this unit is presented in the WIDS sheets.

There is a 2 m (6 ft) high chain-link fence surrounding the basin and yellow contamination flags are adjacent to the western boundary. It is classified as an area of surface contamination. The identification number of the retention basin is scheduled to be changed back to 216-B-59.

4.1.2.8.2 207-B Retention Basin. The 207-B Retention Basin, active since its construction in April 1945, is classified as an area of surface contamination. It currently receives B Plant cooling water and chemical sewer waste from process equipment jackets in the 221-B Building. During the years of operation, the concrete walls of the retention basin were also contaminated by radioactive constituents in the streams passing through the unit. In 1953, the residual contamination in the walls was covered with a coat of tar sealant to prevent the spread of radionuclides.

One unplanned release associated with the 217-B-2-7 Ditch (UPR-200-E-32) resulted in small amounts of radionuclide contamination in the basin (see Section 2.3.5.10). Batch sampling and analysis of liquid effluents is performed and composited monthly. Radiological surveillance is done annually. At the July 1990 survey some specks of 200 to 600 ct/min were detected on the north side of the basin. The perimeters on the previous survey were less than detectable. No inventory data for this unit is presented in the WIDS sheets.

4.1.2.8.3 216-B-64 Retention Basin. The 216-B-64 Retention Basin was built in 1974 to receive steam condensate from the 221-B Building that exceeded release limits. The unit was used only once for an initial test, however, it is now classified as a zone of surface contamination due to unplanned release UN-200-E-64. Most of the available information on this release is summarized in Table 2-6.

The 216-B-64 Retention basin is surrounded by a cyclone fence. Radiological surveillance is done annually. At the April 1990 survey an area of contamination was found along the west perimeter with readings of 60,000 dis/min. The March 1992 survey showed an increase to 1,000,000 dis/min beta activity. No inventory data for this unit is presented in the WIDS sheets.

4.1.2.8.4 Liquid Effluent Retention Facility. The LERF, currently undergoing construction immediately north of the 216-B-3 Pond, will be used for the temporary storage of effluent prior to its treatment and disposal. Effluents discharged to the LERF basins will

be sampled, analyzed, and verified as complying with WAC 173-216 discharge acceptance criteria before being released to the 200 Areas treated effluent disposal basin.

4.1.2.9 Burial Sites. There are a total of twelve waste burial waste management units in the B Plant Aggregate Area. Five of these sites contain either non-hazardous, non-radioactive waste or have no detectable surface contamination. The seven remaining sites contain buried material contaminated with radioisotopes. All the sites are listed in Table 4-18 along with the reported radionuclide inventory values for the seven contaminated sites.

The waste buried in most of these sites generally consists of failed equipment and industrial wastes packaged in boxes. Wastes were transported to the burial grounds by railcar. Unless noted otherwise, the burial grounds are located in the 200-BP-10 Operable Unit, which includes the 218-E-2, -2A, -4, -5, -5A, -9, and -10 Burial Grounds.

4.1.2.9.1 200 East Powerhouse Ash Pit. This active site contains 81,000 yd^3 of ash from the 200 East Powerhouse (operable unit 200-SS-1). The pit commenced operation in 1943. The ash has been analyzed using the EP Toxicity Test and no hazardous material was found. An estimated 9,500 yd^3 of ash is added to the pit annually.

4.1.2.9.2 218-E-2 Burial Ground. This inactive site consists of nine waste trenches ranging in length from 27 to 140 m (90 to 465 ft) with a bottom width of 3 m (11 ft). The site started-up in 1945 and ceased operation in 1953. It contains failed equipment and industrial waste. Also known as the 200 East Industrial Waste Site No. 002, it is indistinguishable from the 218-E-9 Burial Ground. The site received 0.0031 m^3 of mixed MFP/TRU wastes. It has been backfilled. Radionuclide inventory values for this site are reported in Table 4-18. Maxfield (1979) reports that 300,000 g of uranium and 800 g of plutonium are buried in the 218-E-2 Burial Ground. Current inventory data are included in Tables 2-3 and 2-4.

4.1.2.9.3 218-E-2A Burial Ground. This site is also known as the Regulated Equipment Storage Site No. 02A and was active from 1945 until 1955. It consists of one trench. No surface contamination has been detected at the 281-E-2A Burial Ground.

However, unplanned release UPR-200-E-95 is associated with both the 218-E-2A and 218-E-5 Burial Grounds. The railroad spur between these two sites was used as an above ground storage area. Wastes were stored in boxes on railroad flatcars. The unplanned release is not the result of a single occurrence but is believed to be the accumulation of many small releases over time.

4.1.2.9.4 218-E-3 Burial Ground. This burial ground received waste for only a short time in 1954. It is located in the extreme southwest corner of operable unit 200-SS-1. Site material has been exhumed and analyzed and the site released from radiation zone status.

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4.1.2.9.5 218-E-4 Burial Ground. This site is also known as 200 East Minor Construction No. 4 and is thought to consist of two trenches. It received repair and construction wastes from the modification of the 221-B Building during 1955 and 1956. Contaminated tumbleweeds have been a problem at this site. Radionuclide inventory values are reported in Table 4-18. Maxfield (1979) lists 1,000 g of uranium and 10 g of plutonium are buried in the 218-E-4 Burial Ground.

Unplanned release UPR-200-E-112 occurred near this burial ground on February 12, 1979. Contaminated liquid spilled out of an ion exchange column loaded in a burial box on a railroad flatcar in the B Plant Aggregate Area railroad tunnel. The contamination was carried out and along the tracks by one wheel of the railcar contaminating the right-of-way.

4.1.2.9.6 218-E-5 Burial Ground. From 1954 to 1956 this burial site received industrial dry wastes and small boxes. The north end of the site contains railroad boxcars contaminated with uranyl nitrate hexahydrate. In 1979 the two trenches were covered with fill. Radionuclide inventory values for this site are reported in Table 4-18. Contaminated tumbleweeds have been a past problem at this site. Unplanned release UPR-200-E-95, reported above with 218-E-2A Burial Ground, is associated with this burial ground. Maxfield (1979) reports that 120,000 g of uranium and 620 g of plutonium are buried in the 218-E-5 Burial Ground.

4.1.2.9.7 218-E-5A Burial Ground. Solid, mixed TRU waste is buried at this location. From 1956 to 1959 the site received four large boxes of failed equipment and industrial wastes and waste from L cell (202A Burial Package). The D-2 column from the PUREX K cell is also buried at the site. Potentially contaminated tumbleweeds are present. Radionuclide inventory values for this site are reported in Table 4-18. Maxfield (1979) reports that 120,000 g of uranium and 1,400 g of plutonium are buried in the 218-E-5 Burial Ground.

4.1.2.9.8 218-E-6 Burial Ground. This burial ground is a shallow 1.2 m (4 ft) deep trench in which a wooden shack and other wooden items were burned and covered over in the fall of 1955. The site has been exhumed and released from radiation zone status. It is located in operable unit 200-BP-6, south and across 7th Street from the railroad tunnel end of the 221-B Separations Building.

4.1.2.9.9 218-E-7 Burial Ground. The site consists of two wooden vaults and a concrete culvert pipe encasement and received mixed MFP/TRU wastes from 1947 to 1952. Wastes consisted of laboratory and sample wastes from the 222-B Building with an estimated volume of 170 m^3 (6,000 ft^3). Maxfield (1979) reports that 1,000 g of uranium and 1 g of plutonium are buried in the 218-E-9 Burial Ground. It is adjacent to the 218-E-6 Burial Ground in operable unit 200-BP-6 and was also known as the 200 East 222-B Vaults. Heavy vegetation covers the site. Radionuclide inventory values for this site are reported in Table 4-18. Current inventory data are summarized in Table 2-3 and 2-4.

4.1.2.9.10 218-E-9 Burial Ground. This is a site of significant surface contamination as noted in Table 4-18. It is also known as the 200 East Regulated Equipment Storage Site No. 009. It was an above ground storage site covering 62,000 m^2. Fission product equipment that became contaminated in the uranium recovery program at the tank farm is buried at this location. There is a contaminated tumbleweed problem at the site.

Unplanned release UPR-200-E-61 is not associated with any individual burial ground but is attributed to the accumulated contamination that occurred at the railcar unloading ramp as a result of unloading and burial operations. It was declared on October 31, 1981, as a site of general beta and gamma contamination. The railroad right-of-way through the burial grounds was decontaminated. Most of the available information on this release is summarized in Table 2-6.

4.1.2.9.11 200-E8 Borrow Pit Demolition Site. The 200-E8 Borrow Pit, a RCRA facility, received hazardous waste in 1984. No chemical or radiological data are available for this unit.

4.1.2.9.12 218-E-10 Burial Ground. This site consists of 10 existing trenches and 9 planned trenches for the disposal of solid, mixed industrial wastes. It has the highest radionuclide inventory of any B Plant waste management unit as shown in Table 4-18. The unit started in February, 1960, and is currently active.

The unit is surveyed semi-annually and is posted as underground radioactive material. Routine airborne radionuclide monitoring is performed. No surface contamination has been reported, however, a potential weed/tumbleweed problem has been noted. The unit is in compliance with the Environmental Compliance Manual.

4.1.2.9.13 200-East Area Construction Pit. The 200-East Area Construction Pit received nonhazardous solid waste from 1945 through 1955. There have been no known chemicals dumped into this unit. No chemical or radiological data are available.

4.1.2.10 Unplanned Releases. Unplanned releases that are associated with other B Plant Aggregate Area waste management units were briefly mentioned with the applicable waste management unit discussions above. A full review of all of the unplanned releases is contained in Table 2-6.

4.2 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This preliminary assessment is intended to provide a qualitative evaluation of potential human health and environmental hazards associated with the known and suspected contaminants at the B Plant Aggregate Area. The assessment includes a discussion of release mechanisms, potential transport pathways, develops a conceptual model of human and environmental exposure based on these pathways, and presents the physical, radiological, and toxicological characteristics of the known or suspected contaminants.

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In developing the conceptual model, potential exposures to groundwater have not been addressed in detail. Since migration to groundwater is the primary route for potential future exposures to many of the chemicals disposed of at the site, this pathway (i.e., travel time, receptors) will be addressed in the 200 East Groundwater AAMSR.

It is important to note that these evaluations do not attempt to quantify potential human health or environmental risks associated with exposure to B Plant Aggregate Area waste management unit contaminants. Such a risk assessment cannot be performed until additional waste unit characterization data are acquired. Risk assessment activities will be performed in accordance with the *Hanford Baseline Risk Assessment Methodology* document (DOE/RL 1992b) being prepared in response to the M-29 milestone, which incorporates the requirements established in the *Risk Assessment Guidance for Superfund* (EPA 1989a) and the EPA Region 10 *Supplemental Risk Assessment Guidance for Superfund* (EPA 1991a).

The ability of this qualitative assessment to address potential environmental and ecological risks is severely constrained by the relative lack of data regarding potentially exposed biotic populations and exposure pathways. As was discussed in Section 3.6, past studies of biota have, for the most part, been conducted on a site wide basis and do not provide data that is useful in evaluating the potential impacts of the B Plant Aggregate Area. To the extent that B Plant Aggregate Area biota sampling has been conducted (Section 4.1.1.4), it has been limited to vegetation sampling. The role of biota in transporting contaminants through the environment is discussed in the sections that follow, and biota are included as receptors in the conceptual model. However, the assessment of potential ecological risks associated with biota exposure to B Plant Aggregate Area contaminants is currently constrained by the lack of data. This data gap is addressed in Section 5.0, and is discussed further in Section 8.2.3.

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4.2.1 Release Mechanisms

The B Plant Aggregate Area waste management units can be divided into two general categories based on the nature of the waste released: (1) units where waste was discharged directly to the environment and (2) units where waste was disposed of inside a containment structure and bypassed an engineered barrier to reach the environment (e.g., through the vadose zone to the aquifer).

In the first group are those waste management units where release of wastes to the soil column was an integral part of the waste disposal strategy. Included in this group are tile fields, septic system drain fields, French drains, cribs and ditches without liners, reverse wells, and some disposal trenches. Also in this group are unplanned releases that involved waste material released to the soil. For this group of waste management units, if discharges to the unit contained contaminants of concern, it can be assumed that soils underlying the waste management unit are contaminated. The first task in developing a conceptual model for these units is to determine whether contaminants of concern are retained in soil near the waste management unit, or are likely to migrate to the underlying aquifer and then to

receptor points such as drinking water wells or surface water bodies. Factors affecting migration of chemicals away from the point of release will be discussed in the following section.

In the second group are waste management units that were intended to act as a barrier to environmental releases. Included in this group are burial grounds containing drums or other containers, cribs and ditches with membrane liners, vaults, tanks, waste transfer facilities, and unplanned releases that occurred within containment structures. Waste management units that received only dry waste could also be included in this category, since the potential for wastes to migrate to soils outside of the unit is low due to the negligible natural recharge rate at the Hanford Site. For these waste management units, the first consideration to be addressed in developing a conceptual model is the integrity of the containment structure.

The ability of this report to evaluate the efficacy of engineered barriers is limited by the lack of vadose zone soil sampling data and air sampling data for many waste management units. Available sampling information for the waste management units and unplanned releases has been summarized in Section 4.1.

The efficacy and integrity of concrete liners (Retention Basins) and concrete and steel tanks (vaults) are well known and documented (see Anderson 1990 and Hanlon 1992) due to the long-term use of similar units in B Plant. For those units that received only dry wastes, such as gloves, pumps, contaminated dirt, and process equipment, the potential for release is expected to be low. However, small amounts of liquid wastes (tritium, lab wastes) are known to have been disposed of in these waste management units, and early disposal records (prior to about 1968) are incomplete. Thus, releases from these structures to the surrounding soil are possible.

In addition to evaluating releases to the subsurface, the conceptual model must address the potential for releases to air and, for radionuclides, the potential for direct irradiation. All units have some type of barrier to releases to the surface; however, barriers can fail over time or may not be designed to prevent migration by certain transport pathways (e.g., volatilization).

Some of the cribs and trenches in the B Plant Aggregate Area have experienced cave-ins or subsidence in recent years due to decomposition of the wooden framework (e.g., 216-B-18 Crib). Such collapse can lead to high levels of direct radiation at the surface and the potential for spread of contaminated materials by wind erosion. Westinghouse Hanford has an ongoing program (RARA) to detect and remediate cave-ins by covering the cribs and trenches with additional soil, and any exposures from these incidents are generally short-term.

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4.2.2 Transport Pathways

Transport pathways expected within the B Plant Aggregate Area are summarized in this section, including:

- Drainage and leaching from soil to groundwater
- Volatilization from wastes and shallow soils
- Wind erosion of contaminated surface soils
- Deposition of fugitive dust on soils, plants, and surface water
- Uptake from soils by vegetation
- Uptake from soils by animals via direct contact with soils or ingestion of vegetation
- Direct radiation.

In addition, transport within the saturated zone and subsequent release to groundwater wells or to surface water (i.e., the Columbia River) is of potential concern, but will not be addressed in this document, since this topic will be the focus of the 200 East Groundwater AAMS.

Following transport, exposure may occur through the following pathways:

- Inhalation of volatilized contaminants or suspended particulates
- Ingestion of contaminants in soils, vegetation, or animals
- Direct dermal contact with contaminants in soils
- Direct exposure to radiation.

4.2.2.1 Transport from Soils to Groundwater. Soil is the initial receiving medium for waste discharges in the B Plant Aggregate Area, whether the release is directly to soil or through failure of a containment system. Several factors determine whether chemicals that are introduced into the vadose zone will reach the unconfined aquifer, which lies at a depth of approximately 60 m (200 ft) below ground surface. These factors are discussed in the following sections.

4.2.2.1.1 Depth of Release. As a general rule, for a given volume, waste management units that released wastes at a greater depth below the surface have a higher potential to contaminate groundwater than waste management units where the release was

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shallow. The 216-B-5 Reverse Well is a primary example of a deep release at the B Plant Aggregate Area. This unit discharged wastes to the vadose zone approximately 91 m (300 ft) below the surface.

4.2.2.1.2 Liquid Volume or Recharge Rate. For waste constituents to migrate to the underlying water table, some source of recharge must be present. In the B Plant Aggregate Area, the primary source of moisture for mobilizing contaminants are waste management units that discharge liquid waste to the soil column. As discussed in Section 3.5.2, estimates of natural precipitation recharge range from 0 to 10 cm/yr, primarily depending on surface soil type, vegetation, and topography. Gravelly surface soils with no or minor shallow rooted vegetation appear to facilitate precipitation recharge. One modelling study (Smoot et al. 1989) indicated that some radionuclide (^{137}Cs and ^{106}Ru) transport could occur with as little as 5 cm/yr of natural recharge. However, other researchers (Routson and Johnson 1990) have concluded that no net precipitation recharge occurs in the 200 Areas, particularly at waste management units that are capped with fine-grained soils or impermeable covers.

With respect to artificial recharge, some waste management units (e.g., the 216-B-12 Crib) were identified in which the known volume of liquid waste discharged substantially exceeded the total estimated soil pore volume present below the footprint of the facility. In this case, the moisture content of soil below the waste management units likely approached saturation during the periods of use of these facilities. Because vadose zone hydraulic conductivities are maximized at water contents near saturation, the volume of liquid wastewater historically discharged to the waste management units probably enhanced fluid migration in the vadose zone beneath these units.

Long term gravity drainage is also a potential mechanism of contaminant migration. It is unknown how long after shutdown the soil under such a unit will continue to drain and to transport contamination down to the groundwater.

Contaminants that are not initially transported to the water table by drainage may be mobilized at a later date if a large volume of liquid is added to the unit. In addition, liquids discharged to one unit could mobilize wastes discharged to an adjacent unit if lateral migration takes place within the vadose zone. There are no known cases of this occurring in the B Plant Aggregate Area, however the potential exists. A known example of this process occurred at the U Plant Aggregate Area 216-U-16 Crib, where lateral migration of acidic waste above a caliche layer mobilized radionuclides in the 216-U-1 and 216-U-2 Cribs (Baker et al. 1988).

4.2.2.1.3 Soil Moisture Transport Properties. The moisture flux in the vadose zone is dependent on hydraulic conductivity as well as gradients of moisture content or matrix suction. Higher unsaturated hydraulic conductivities are associated with higher moisture contents. However, higher unsaturated hydraulic conductivities may be associated with fine-grained soils compared to coarse-grained soils at low moisture contents. Because of the stratified nature of the Hanford Site vadose zone soils and the moisture content dependence of unsaturated hydraulic conductivity, vertical anisotropy is expected, i.e., vadose zone soils

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are likely to be more permeable in the horizontal direction than in the vertical. This vertical anisotropy may reduce the potential for contaminant migration to the unconfined aquifer.

4.2.2.1.4 Retardation. The rate at which contaminants will migrate out of a complex waste mixture and be transported through unsaturated soils depends on a number of characteristics of the chemical, the waste, and the soil matrix. In general, chemicals that have low solubilities in the leaching fluid or are strongly adsorbed to soils will be retarded in their migration velocity compared to the movement of soil pore water. Studies have been conducted of soil parameters affecting waste migration at the Hanford Site to attempt to identify the factors that control migration of radionuclides and other chemicals. Recent studies of soil sorption are summarized in Serne and Wood (1990). Some of the processes that have been shown to control the rate of transport are:

- **Adsorption to Soils.** Most contaminants are chemically attracted to some degree to the solid components of the soil matrix. For organic compounds, the adsorption is generally to the organic fraction of the soil, although in extremely low-organic soils, adsorption to inorganic components may be of greater importance. Soil components contributing to adsorption of inorganic compounds include clays, organic matter, and iron and aluminum oxyhydroxides. In general, Hanford surface soils are characterized as sandy or gravelly with very low organic content (<0.1%) and low clay content (<12%) (Tallman et al. 1981). Thus, site-specific adsorption factors are likely to be lower, and rate of transport higher, than the average for soils nationwide.

- **Filtration.** Filtration of suspended particulates by fine-grained sediments has been suggested as a mechanism for concentration of radionuclides in certain sedimentary layers. This finding suggests that migration of suspended particulates may be an important mechanism of transport for poorly soluble contaminants.

- **Solubility.** The rate of release of some chemicals is controlled by the rate of dissolution of the chemical from a solid form. The concentration of these chemicals in the pore water will be extremely low, even if they are poorly sorbed. An example cited by Serne and Wood (1990) is the solubility of plutonium oxide, which appears to be the limiting factor controlling the release of plutonium from waste materials at neutral and basic pH.

- **Ionic Strength of Waste.** For some inorganics, the dominant mechanism leading to desorption from the soil matrix is ion exchange. Leachate having high ionic strength (high salt content) can bias the sorption equilibrium toward desorption, leading to higher concentrations of the contaminant in the soil pore water.

- **Waste pH.** The pH of a leachant has a strong effect on inorganic contaminant transport. Acidic leachates tend to increase migration both by increasing the solubility of precipitates and by changing the distribution of charged species in

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solution. The exact impact of acidic or basic wastes will depend on whether the chemical is normally in cationic, anionic, or neutral form, and the form that it takes at the new pH. Cationic species tend to be more strongly adsorbed to soils than neutral or anionic species. The extent to which addition of acidic leachate will cause a contaminant to migrate will also depend on the buffering or neutralizing capacity of the soil, which is correlated with the calcium carbonate ($CaCO_3$) content of the soil. The soils in the Hanford formation beneath the B Plant Aggregate Area generally have carbonate contents in the range of 0.1 to 5%. Higher carbonate contents (20 to 30%) are observed within the Plio-Pleistocene caliche layer.

Once the leaching solution has been neutralized, the dissolved constituents may re-precipitate or become reabsorbed to the soil. Observations of pH impacts on waste transport at the Hanford Site include:

- The remobilization of uranium beneath the 216-U-1 and 216-U-2 Cribs in the U Plant Aggregate Area is believed to have occurred in part because of this introduction of low pH solutions.

- Leaching of americium from the Z Plant Aggregate Area 216-Z-9 Crib sediments was found to be solubility controlled and correlated to solution pH.

4.2.2.1.5 Complexation by Organics. Certain organic materials disposed of at the B Plant Aggregate Area are known to form complexes with inorganic ions, which can enhance their solubility and mobility. Tributyl phosphate is one of the primary organic complexing agent disposed of at the B Plant Aggregate Area. Cyanide is another example of a complexing agent disposed of at the B Plant Aggregate Area. This chemical complexes with ^{60}Co, making it more mobile.

4.2.2.1.6 Contaminant Loss Mechanisms. Processes that can lead to loss of chemicals from soils, and thus decrease the amount of chemical available for leaching to groundwater, include:

- **Radioactive Decay.** Radioactivity decays over time, generally decreasing the quantities and concentrations of radioactive isotopes.

- **Biotransformation.** Microorganisms in the soil may degrade organic contaminants such as kerosene and inorganic chemicals such as nitrate.

- **Chemical Transformation.** Hydrolysis, oxidation, reduction, radiolytic degradation and other chemical reactions are possible degradation mechanisms for contaminants.

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- **Vegetative Uptake.** Vegetation may remove chemicals from the soil, bring them to the surface, and introduce them to the food web.

- **Volatilization.** Organic chemicals and volatile radionuclides can be transported in the vapor phase through open pores in soil either to adjacent soil or to the atmosphere. These volatilized compounds could include acetone, radon (a decay product of uranium), and tritium (HTO in tritiated water). Some elements (mainly fission products such as iodine, ruthenium, cerium, and antimony) are referred to as "semivolatiles" because they have a lesser tendency to volatilize.

4.2.2.2 Transport from Soils and Surface Water to Air. Transport of contaminants from waste management units to the atmosphere can occur by means of vapor transport or by fugitive dust emissions.

Vapor transport may occur from waste management units where volatile organics (e.g., CCl_4) or volatile radionuclides (^{14}C, $^{14}CO_2$, ^{129}I, or ^{3}H) have been released. Transport mechanisms include evaporation/volatilization diffusion down a concentration gradient and gas-driven flow. Situations where the latter process may occur include production of methane gas from degradation of organic compounds in soil, or production of hydrogen and oxygen gases by radiolytic hydrolysis of water.

In order for fugitive dust emissions to occur, contaminants must be exposed at the surface of the waste management unit. A number of mechanisms could lead to exposure of contaminants in soil-covered waste management units. These mechanisms include uptake by vegetation, transport by animals, disruption of the waste management unit (e.g., cave-ins at cribs), and wind erosion. Wind erosion can strip off surface soil and uncover waste materials. This mechanism has been identified as an ongoing problem in some of the waste management unit areas. The processes by which biota may expose contaminated soils are discussed in Section 4.2.2.4.

The contribution of the B Plant Aggregate Area to the overall fugitive dust emissions at the Hanford Site is expected to be relatively minor, based on results of air monitoring downwind of the B Plant Aggregate Area waste management units.

4.2.2.3 Transport from Soils to Surface Water. The only surface water available in the B Plant Aggregate Area is at the 2101-M Pond, 216-B-3 Pond, 216-N-8 Pond, and the 216-B-3-3 Ditch. The 216-B-3 Pond consists of four individual ponds, of which, only three currently contain surface water. These are the 216-B-3 main lobe and the 216-B-3A and 216-B-3C Lobes.

Transport of contaminants to surface water bodies outside of the B Plant Aggregate Area via groundwater discharge and deposition of fugitive dust on water bodies are the primary pathways of potential concern for surface water effects. Groundwater discharge wili be addressed in the 200 East Groundwater AAMSR. Fugitive dust emissions are discussed in the ensuing sections.

4.2.2.4 Transport from Soils and Surface Water to Biota. Biota, plants and animals, have the potential for taking up (bio-uptake), concentrating (bioaccumulating), transporting, and depositing contamination beyond its original extent. Transfer from one species to another in the food chain is also possible because of predation. The possibility of these processes contributing significantly to the transport of contamination from the B Plant Aggregate Area waste management units or to result in damage to the affected ecosystems is unclear. The currently available data, as described in Sections 3.6 and 4.1, are too general and do not adequately evaluate biotic transport or ecological risk. This data gap is discussed further in Section 5.0 and 8.0. The future acquisition of additional data will be guided by the requirements for human health and ecological risk assessments in the Hanford Baseline Risk Assessment Methodology (DOE/RL 1992b) being prepared in response to the M-29 milestone.

4.2.2.4.1 Uptake by Vegetation. Release of radioactivity to the surface by growth of vegetation is an ongoing problem at B Plant Aggregate Area waste management units. Roots of sagebrush and other native species can take up radionuclides from soils below the surface and transport these chemicals to the foliage. Wind dispersal of portions of the contaminated vegetation, or entire plants (tumbleweeds) can lead to transport of contaminants outside of the unit. Westinghouse Hanford has an ongoing vegetation control (herbicide application, reseeding with shallow-rooted vegetation, and mechanical removal) and radiological survey program to prevent radioactivity from being transported by this mechanism. However, the program does not ensure complete removal of vegetation, and incidents of detection of contaminated vegetation are reported occasionally in the radiological surveys.

4.2.2.4.2 Transport by Animals. Disturbance of waste management unit barriers by animals occasionally leads to release of contaminants to the surface. Subsurface soils can be transported to the surface by burrowing animals, thus exposing contaminants for release to the air. Additionally, animals that become contaminated by direct contact with subsurface waste or through ingestion of subsurface contaminants (e.g., chemical salts) and contaminated vegetation, water, or other animals can spread contamination in their feces on the surface and outside of the waste management unit. An example of transport through this mechanism is the UN-200-E-83 Unplanned Release in the B Plant Aggregate Area, in which native wildlife burrowed into one of the operable trenches (216-B-23 Trench) and transmitted the contaminants to soils and vegetation to an area west and southeast of the BC Crib and trench area through feces and urine. Burrowing rodents and harvester ants can also transport near-surface contaminants to the surface.

4.2.3 Conceptual Model

Figure 4-3 presents a graphical summary of the physical characteristics and mechanisms at the site which could potentially affect the generation, transport, and impact of contamination in the B Plant Aggregate Area on humans and biota (conceptual model).

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The sources of contamination include stack emissions and drainage, process wastes (condensates, cooling water, sewage) from B Plant, U Plant, and PUREX Plant; condensate from the B Plant tank farms; laboratory wastes; drainage from diversion boxes; sanitary wastes; process feed materials; stack drainage and emissions; bismuth phosphate metal wastes; high level liquid wastes; low level waste; and contaminated equipment or waste material that was spilled during transit or disposed of in the burial grounds.

Contaminants from these sources have been disposed of at the waste management units that are under investigation. These include the 216-B-3 Pond, ditches, retention basins, diversion boxes, trenches, cribs, french drains, reverse wells, catch tanks, septic tanks and drain fields, burial grounds, single-shell tanks, vaults, the WESF storage pool, and the various unplanned releases that have occurred on the site. These releases and disposal activities are described in Sections 2 and 4.1. Some of the unplanned releases are associated with specific waste sites, and are shown on Figure 4-3 as dashed lines with "U" designations.

From these waste management units, various release mechanisms may have transported contamination to the potentially affected media. Volatilization could release chemicals from surface waters into the atmosphere. Some of the more volatile constituents could be released from the vadose zone to the atmosphere through the soil gas system. Materials in the ditches flowing toward B Pond may have infiltrated/percolated into the vadose zone, or sorbed to the sediments in the ditch. Biota may have taken up contaminants from the surface water and near-surface contaminated soils (via deep roots or burrowing animals).

Many waste management units discharge their waste effluents directly to the near surface (vadose zone) soils. The trenches are potential release points via leaching or drainage of the liquid portion of the disposed materials. The cribs provide seepage discharge and similarly the French drains, reverse wells, and septic system drain fields directly inject their effluents into the subsurface sediments. The unplanned releases have mainly impacted surface soils although some contamination may have also taken place on building surfaces. Fugitive dust from sediment and surface soils has also been released or resuspended due to wind effects or surface disturbances, and from surface soils that have been buried or removed to off-site disposal.

The primary mechanism of vertical contaminant migration is the downward movement of water from the surface through the vadose zone to the unconfined aquifer. The contaminants generally move as a dissolved phase in the water and their rate of migration is controlled both by groundwater movement rates and by adsorption and desorption reactions involving the surrounding sediments. Some contaminants are strongly sorbed on sediments and their downward movement through the stratigraphic column is greatly retarded. Significant lateral migration of contaminants is restricted to perched water zones and to the unconfined aquifer, where water is moving laterally. Again adsorption and desorption reactions may greatly retard lateral contaminant migration. Contaminants that were introduced to the soil column outside of the aggregate area may migrate into the area along with perched or aquifer water.

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Figure 4-4 is a schematic diagram illustrating these processes and describing probable contaminant distributions in the vadose zone. For liquid waste management units, the point of release shown on this figure may be in the subsurface, such as at cribs, drains, and reverse wells, or it may be exposed to the surface, such as at ponds, ditches, trenches, or at most unplanned releases. Small-scale contaminant releases are much less likely to impact the lower vadose zone or groundwater than large scale releases. Liquid disposal units in the B Plant Aggregate Area are dominated by ditches and ponds. Table 4-14 identifies those units that had liquid discharges large enough to conceivably reach the unconfined aquifer.

Contaminant distributions near the burial ground type units in the B Plant Aggregate Area are likely significantly different from those associated with the liquid waste management units. Because burial grounds received only dry waste, the burial grounds are unlikely to release contaminants to the vadose zone. As a result, only surface contaminant releases have been identified at burial grounds. In this case, wind and near surface biological activity are the dominant processes for transporting and redistributing contaminants.

Contaminant distribution at most unplanned releases is expected to be at or just below the surface. These sites generally received little, if any, liquid, therefore, migration into the lower vadose zone is not expected. The primary process for transporting and redistributing contaminants in this case is wind and near surface biological activity.

Figure 4-4 is based on the stratigraphy underlying the 200 East Area, the chemical characteristics of the primary suspected contaminants in the area, and known vadose zone contaminant distributions identified from previous studies. The subsurface geology of the aggregate area is presented in Sections 3.4 and 3.5, and the chemical characteristics of various contaminants are detailed in Section 4.2.4.

In the past, drilling and sampling programs have been conducted at the 216-Z-1A Tile Field (Price et al. 1979), the 216-Z-9 Trench (Smith 1973), the 216-Z-12 Crib (Kasper 1981), the 200-BP-1 Operable Unit cribs (the BY Cribs) (Buckmaster and Kaczor 1992), the 216-U-10 Pond (Last and Duncan 1980), and the 216-Z-19 Ditch (Last and Duncan 1980). These studies, in conjunction with geophysical well logging data, have been used to estimate the expected contaminant distributions beneath comparable waste management units in the B Plant Aggregate Area.

Some of the general conclusions that may be drawn from these previous studies are:

(1) Maximum radionuclide contaminant concentrations should be expected directly beneath the main discharge points of the units with the exception of highly mobile contaminants such as tritium.

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(2) Radionuclide contamination is not expected to spread laterally more than 15 to 30 m (50 to 100 ft) beyond the point of discharge and should be at much lower concentrations than those noted beneath the center of the discharge point; a possible exception being areas of perched water.

(3) Radionuclide contamination decreases rapidly with depth. The highest concentrations should occur within 2 or 3 m (6 to 10 ft) of the bottom of the discharge point and concentrations should be near background levels at 20 m (65 ft) depth.

(4) The maximum lateral radionuclide contaminant movement tends to occur along relatively impermeable horizons.

(5) Radionuclide contaminants should be concentrated in fine-grained horizons compared to surrounding coarse-grained horizons and when found in coarse-grained horizons they are associated with the fine-grained particles.

(6) Most chemical contaminants of concern have distributions that tend to mimic radionuclide contaminant distributions in the vadose zone.

There are four exposure routes by which humans (offsite and onsite) and other biota (plants and animals) can be exposed to these possible contaminants:

- Inhalation of airborne volatiles or fugitive dusts with adsorbed contamination
- Ingestion of surface water, fugitive dust, surface soils, biota (either directly or through the food chain), or groundwater
- Direct dermal contact with the waste materials (such as those exhumed by burrowing animals), contaminated surface soils, buildings, or plants
- Direct radiation from waste materials, surface soils, building surfaces, or fugitive dusts.

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4.2.4 Characteristics of Contaminants

Table 4-22 is a list of radioactive and nonradioactive chemical substances that represent candidate contaminants of potential concern for this study based on their known presence in wastes, usage, disposal in waste management units, historical association, or detection in environmental media at the B Plant Aggregate Area. Table 4-23 summarizes the types of known or suspected contamination thought to exist at the individual waste management units and unplanned releases. Known contaminants have been proven to exist from sampling and inventory data (Tables 2-3 and 2-4). Suspected contaminants are those which could occur at a site based upon historical practices or chemical associations. Given the large number of

chemicals known or suspected to be present, it is appropriate to focus this assessment on those contaminants that have been detected through sampling efforts and which pose the greatest risk to human health or the environment.

The EPA Region 10 guidance on risk-based contaminant screening (EPA 1991a), as summarized in the *Hanford Baseline Risk Assessment Methodology* (DOE/RL 1992b), was consulted for the purpose of establishing the B Plant Aggregate Area contaminants of potential concern. That risk-based contaminant screening mostly involves comparing maximum contaminant concentrations to risk-based benchmark concentrations. However, for the B Plant Aggregate Area, contaminant concentrations in environmental media are not available, and direct risk-based screening could not be performed. To ensure that the intent of the EPA Region 10 approach could be achieved, an alternative, and more conservative, approach was developed. This requires B Plant Aggregate Area contaminants with potential risks to be included in the list of contaminants of potential concern. The alternative approach retains any contaminant that is known or suspected that is known or suspected of being a carcinogen or toxic, regardless of quantity or concentration.

Table 4-24 lists the contaminants of concern for the B Plant Aggregate Area. This list was developed from Table 4-22 and includes only those contaminants which meet the following criteria:

- Radionuclides that have a half-life of greater than one year. Radionuclides with half-lives less than one year will not persist in the environment at concentrations sufficient to contribute to overall risks.

- Radionuclides with a half-life of less than one year and are part of long-lived decay chains that result in the buildup of the short-lived radionuclide activity to a level of 1% or greater of the parent radionuclide's activity within the time period of interest. Although daughter radionuclides are adequately identified during normal parent radionuclide investigations, they are also identified as contaminants of concern through this criterion. This provides an additional level of assurance that all primary contaminants will be addressed.

- Contaminants that are known or suspected carcinogens or have a U.S. Environmental Protection Agency (EPA) noncarcinogenic toxicity factor. In addition, chemicals with known toxic effects but no toxicity factors are included. Several of the chemicals have known toxic effects but no toxicity criteria are presently available. In some instances the criteria have been withdrawn by EPA pending review of the toxicological data and will be reissued at a future date. Chemicals with known toxicity for which toxicity factors are presently not available include lead, selenium, kerosene and tributyl phosphate.

The following characteristics will be discussed for the contaminants listed in Table 4-24:

- Detection of contaminants in environmental media
- Historical association with plant activities
- Mobility
- Persistence
- Toxicity
- Bioaccumulation.

4.2.4.1 Detection of Contaminants in Environmental Media. The nature and extent of surface and subsurface soils, surface water, groundwater, air, and biota contamination have not yet been adequately characterized for the B Plant Aggregate Area. All recent environmental monitoring data were reviewed and summarized for each media in Section 4.1.

The most extensive monitoring data available has been for groundwater. Because groundwater will be evaluated in the 200 East Groundwater AAMSR, it will not be discussed further here. Surface soil and biota samples have been collected from locations on a regular rectangular grid. These sampling locations do not correspond to any of the waste management units, but are intended to characterize the B Plant Aggregate Area as a whole. Air and external radiation samples have been collected at several locations within or adjacent to the B Plant Aggregate Area. These sampling stations are also not located directly on any of the waste management units and therefore the sampling results cannot be attributed to any particular unit. The only routine sampling data that correspond directly to waste management units are the external radiation surveys, which are performed on a regular basis. There is little soil or vegetation sampling data available for any of the units.

4.2.4.2 Historical Association with B Plant Activities. Radionuclides that are known components of B Plant waste streams are listed in Table 2-9. This list includes chemicals in the process wastes as well as chemicals that were detected at elevated levels in wastewater. Since these waste streams are known to have been disposed of directly to the soil column in some waste management units, it is probable that the chemicals on this list have affected environmental media.

Based on the WIDS data (WHC 1991a), radionuclides that are known to have been disposed of to B Plant waste management units in the greatest quantities are as follows:

- ^{239}Pu
- ^{240}Pu

- ^{137}Cs
- ^{90}Sr
- ^{3}H
- ^{238}U.

Note that a complete radionuclide analysis of the B Plant waste streams is not available. Thus, it is possible that additional radionuclides were disposed of to B Plant Aggregate Area waste management units that are not included in the waste inventories.

Nonradioactive chemicals reportedly released into B Plant Aggregate Area waste management units in large quantities include nitric acid, nitrates, sodium, phosphate, sulfate, tributyl phosphate, ammonium nitrate, and ferrocyanide.

4.2.4.3 Mobility. Since most wastes at the B Plant Aggregate Area were released directly to subsurface soils via injection, infiltration, or burial, the mobility of the wastes in the subsurface will determine the potential for future exposures. The mobility of the contaminants listed in Table 4-24 varies widely and depends on site-specific factors as well as the intrinsic properties of the contaminant. Much of the site-specific information needed to characterize mobility is not available and will need to be obtained during future field investigations. However, it is possible to make general statements about the relative mobility of the candidate contaminants of concern.

4.2.4.3.1 Transport to the Subsurface. The mobility of radionuclides and other inorganic elements in groundwater depends on the chemical form and charge of the element or molecule, which in turn depends on site-related factors such as the pH, oxidation-reduction state, and ionic composition of the groundwater. Cationic species (e.g., Cd^{2+}, Pu^{4+}) generally are retarded in their migration relative to groundwater to a greater extent than anionic species such as nitrate (NO_3^-). The presence in groundwater of complexing or chelating agents can increase the mobility of metals by forming neutral or negatively charged compounds.

The chemical properties of radionuclides are essentially identical to the nonradioactive form of the element; thus, discussions of the chemical properties affecting the transport of contaminants can apply to both radionuclides and nonradioactive chemicals.

A soil-water distribution coefficient (K_d) can be used to predict mobility of inorganic chemicals in the subsurface. Table 4-25 presents a summary of soil-water distribution coefficients (K_d) that have been developed for many of the inorganic chemicals of concern at the B Plant Aggregate Area. As discussed above, the pH and ionic strength of the leaching medium has an impact on the absorption of inorganics to soil; thus, the listed K_ds are valid only for a limited range of pH and waste composition. In addition, soil sorption of inorganics is highly dependent on the mineral composition of the soil, the ionic composition

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of the soil pore water, and other site-specific factors. Thus, a high degree of uncertainty is involved with use of K_ds that have not been verified by experimentation with site soils.

Serne and Wood (1990) recommended K_d values for use with Hanford waste assessments for a limited number of important radionuclides (Am, Cs, Co, I, Pu, Ru, Sr, and tritium) based on soil column or batch desorption studies, and have proposed conservative average values for a more extensive list of elements based on a review of the literature. An assumed K_d of <1 is recommended for Am, Cs, Pu, and Sr under acidic conditions.

Strenge and Peterson (1989) developed default K_d values for a large number of elements for use in the Multimedia Environmental Pollution Assessment System (MEPAS) (Droppo et al. 1989), a computerized waste management unit evaluation system. The K_d values were based on findings in the scientific literature, and include non-site-specific as well as Hanford Site values. Values are provided for nine sets of environmental conditions: three ranges of waste pH and three ranges of soil adsorbent material (sum of percent clay, organic material, and metal hydrous oxides). The values presented in Table 4-25 are for conditions of neutral waste pH and less than 10% adsorbent material, which is likely to be most representative of Hanford Site soils.

The mobility of inorganic species in soil can be divided roughly into three classes, using site-specific values (Serne and Wood 1990) where available and generic values otherwise: highly mobile ($K_d<5$), moderately mobile ($5<K_d<100$), and low mobility ($K_d>100$). Table 4-26 lists the class ranking for each of the inorganic contaminants of concern. The ranking presented in this table is intended to provide a qualitative indication of general mobility characteristics. Actual mobility of specific contaminants will be influenced by their valence state and ligands. Specific mobilities will be determined in future site investigations and will address these potential influences.

The tendency of organic compounds to adsorb to the organic fraction of soils is indicated by the soil organic matter partition coefficient, K_{oc}. Partition coefficients for the organic chemicals of concern at the B Plant Aggregate Area are listed in Table 4-25. Chemicals with low K_{oc} values are weakly absorbed by soils and will tend to migrate in the subsurface, although their rate of travel will be retarded somewhat relative to the pore water or groundwater flow. Soils at the Hanford Site have very little organic carbon content and thus sorption to the inorganic fraction of soils may dominate over sorption to soil organic matter.

4.2.4.3.2 Transport to Air. Transport of contaminants from waste management units to the atmosphere can occur by means of vapor transport or by fugitive dust emissions. Chemicals subject to transport via airborne dust dispersion are those that are non-volatile and persistent on the soil surface, including most radionuclides and inorganics, and some organics such as creosote and coal tar.

Chemicals subject to volatilization are mostly organic compounds; however, some of the radionuclides detected at the site are subject to evaporation and could be lost from shallow soils to the ambient air. The most important species in this category are ^{14}C, ^{3}H, and ^{129}I.

The tendency of an organic compound to volatilize can be predicted from its Henry's Law Constant, K_h, a measured or calculated parameter with units of atmospheres per cubic meter per mole of chemical. Henry's Law Constants of the organic candidate contaminants of concern are presented in Table 4-27. Compounds with a K_h greater than about 10^{-3} will be lost rapidly to the atmosphere from surface water and shallow soils. Organic contaminants of concern that fall into this class include:

- Carbon tetrachloride
- Chloroform
- Methylene chloride
- PCBs
- Toluene
- Tributyl phosphate
- 1,1,1-Trichloroethane.

4.2.4.4 Persistence. Once released to environmental media, the concentration of a contaminant may decrease because of biological or chemical transformation, radioactive decay, or the intermediate transfer processes discussed above that remove the chemical from the medium (e.g., volatilization to air). Radiological, chemical, and biological decay processes affecting the persistence of the B Plant Aggregate Area contaminants of concern are discussed below.

The persistence of radionuclides depends primarily on their half-lives. A comparison of the half-lives and specific activities for most radionuclide contaminants of concern for B Plant is presented in Table 4-28. The specific activity is the decay rate per unit mass, and is inversely proportional to the half-life of the radionuclide. Half-lives for the radionuclides listed in Table 4-28 range from seconds to over one billion years. Also listed are the radiation emissions of primary concern for the radionuclide. Note that radionuclides can emit multiple types of radiation and often undergo several decay steps in quick succession (e.g., beta decay followed by release of one or more gamma rays associated with daughter radionuclides). The daughter products of these decays are often themselves radioactive.

Decay will occur during transport (e.g., through the vadose zone to the aquifer, through the aquifer) and may lead to significant reductions in levels ultimately reaching

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offsite areas (e.g., Columbia River). For direct exposures (e.g., to surface soils or air), the half-life of the radionuclide is of less importance, unless the half-life is so short that the radionuclide undergoes substantial decay between the time of disposal and release to the environment.

Nonradioactive inorganic chemicals detected at the site are generally persistent in the environment, although they may decline in concentration due to transport processes or change their chemical form due to chemical or biological reactions. Nitrate undergoes chemical and biological transformations that may lead to its loss to the atmosphere (as N_2) or incorporation into living organisms, depending on the oxidation-reduction environment and microbiological communities present in the medium.

Biotransformation rates for organics vary widely and are highly dependent on site-specific factors such as soil moisture, oxidation-reduction conditions, and the presence of nutrients and of organisms capable of degrading the compound. Ketones, such as acetone are easily degraded by microorganisms in soil and thus would tend not to persist. Chlorinated solvents (e.g., methylene chloride) may undergo slow biotransformation in the subsurface under anoxic conditions. Volatile aromatics, such as toluene, are generally intermediate in their biodegradability.

4.2.4.5 Toxicity. Contaminants may be of potential concern for impacts to human health if they are known or suspected to have carcinogenic properties, or if they have adverse noncarcinogenic human health effects. The toxicity characteristics of the chemicals detected at the aggregate area are summarized below.

4.2.4.5.1 Radionuclides. All radionuclides are classified by EPA as known human carcinogens based on their property of emitting ionizing radiation and on the evidence provided by epidemiological studies of radiation-induced cancers in humans. Non-carcinogenic health effects associated with radiation exposure include genetic and teratogenic effects; however, these effects generally occur at higher exposure levels than those required to induce cancer. Thus, the carcinogenic effect of radionuclides is the primary identified health concern for these chemicals (EPA 1989a).

Risks associated with radionuclides differ for various routes of exposure depending on the type of ionizing radiation emitted. Nuclides that emit alpha or beta particles are hazardous primarily if the materials are inhaled or ingested, since these particles expend their energy within a short distance after penetrating body tissues. Gamma-emitting radioisotopes, which deposit energy over much larger distances, are of concern as both external and internal hazards. A fourth mode of radioactive decay, neutron emission, is generally not of major health concern, since this mode of decay is much less frequent than other decay processes. In addition to the mode of radioactive decay, the degree of hazard from a particular radionuclide depends on the rate at which particles or gamma radiation are released from the material.

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To illustrate their relative significance, excess cancer risks for exposure to the primary radionuclide contaminants of concern by inhaling air, drinking water, ingesting soil, and by external irradiation are shown in Table 4-29. These values represent the increase in probability of cancer to an individual exposed for a lifetime to a radionuclide at a level of 1 pCi/m^3 in air, 1 pCi/L in drinking water, 1 pCi/g in ingested soil, or to external radiation from soil having a radionuclide content of 1 pCi/g (EPA 1991a). These values are computed as the slope factor (risk per unit intake or exposure) multiplied by the inhalation or ingestion rate and the number of days in a 70-year lifetime (EPA 1991b).

For those radionuclides without EPA slope factors, the *Hanford Baseline Risk Assessment Methodology* (DOE/RL 1992b) will be consulted. This document proposes to consult the EPA Office of Radiation Programs to request the development of a slope factor or to use the dose conversion factors developed by the International Commission on Radiological Protection to calculate a risk value. Any Hanford site risk assessments will be performed in accordance with the *Hanford Baseline Risk Assessment Methodology* document (DOE/RL 1992b) which includes the guidance established in the *Risk Assessment Guidance for Superfund* (EPA 1989a) and the EPA Region 10 *Supplemental Risk Assessment Guidance for Superfund* (EPA 1991a).

The unit risk factors for different radionuclides incorporate factors to account for distribution of each radionuclide within various body organs, the type of radiation emitted, and the length of time that the nuclide is retained in the organ of interest.

Based on the factors listed in Table 4-29, the highest risk for exposure to 1 pCi/m^3 in air is from plutonium, americium and uranium isotopes, which are alpha emitters. Among the radionuclide contaminants of concern for the B Plant Aggregate Area, the highest risks from ingestion of soil at 1 pCi/g are for ^{227}Ac, ^{241}Am, ^{243}Am, ^{238}Pu, ^{244}Cm, ^{134}Cs, ^{129}I, ^{237}Np, ^{231}Pa, ^{210}Pb, ^{210}Po, ^{223}Ra, ^{225}Ra, ^{226}Ra, ^{228}Ra, ^{229}Th, and the uranium isotopes. The primary gamma-emitters are ^{214}Bi, ^{60}Co, ^{134}Cs, ^{137}Cs (because of its metastable decay product, ^{137m}Ba), ^{152}Eu, ^{154}Eu, and ^{214}Pb. It is important to note that this table only presents unit risk factors for the listed radionuclides and does not include potential contributions from daughter products.

The standard EPA risk assessment methodology assumes that the probability of a carcinogenic effect increases linearly with dose at low dose levels, i.e., there is no threshold for carcinogenic response. The EPA methodology also assumes that the combined effect of exposure to multiple carcinogens is additive without regard to target organ or cancer mechanism. However, the additive risk resulting for radionuclides and carcinogenic chemicals should be computed separately (EPA 1989a).

4.2.4.5.2 Hazardous Chemicals. Carcinogenic and non-carcinogenic health effects associated with chemicals anticipated at the aggregate area are summarized in Table 4-40. The basis for these potential health effects is described in the respective reference documents and may be associated with either human or animal data. Health effects were developed according to the hierarchy established in the Risk Assessment Guidance for Superfund

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(EPA 1989a). References were consulted in the following order: IRIS (Integrated Risk Information System) (EPA 1991b), HEAST (Health Effects Assessment Summary Tables) (EPA 1991c), and other toxicity articles and documents.

Several of the chemicals have known toxic effects but no toxicity criterion is presently available. In some instances the criteria have been withdrawn by EPA pending review of the toxicological data and will be reissued at a future date. Chemicals with known toxicity for which toxicity factors are presently not available include lead and tributyl phosphate.

4.2.4.6 Bioaccumulation potential. Contaminants may be of concern for exposure if they have a tendency to accumulate in plant or animal tissues at levels higher than those in the surrounding medium (bioaccumulation) or if their levels increase at higher trophic levels in the food chain (biomagnification). Contaminants may be bioaccumulated because of element-specific uptake mechanisms (e.g., incorporation of strontium into bone) or by passive partitioning into body tissues (e.g., concentration of organic chemicals in fatty tissues).

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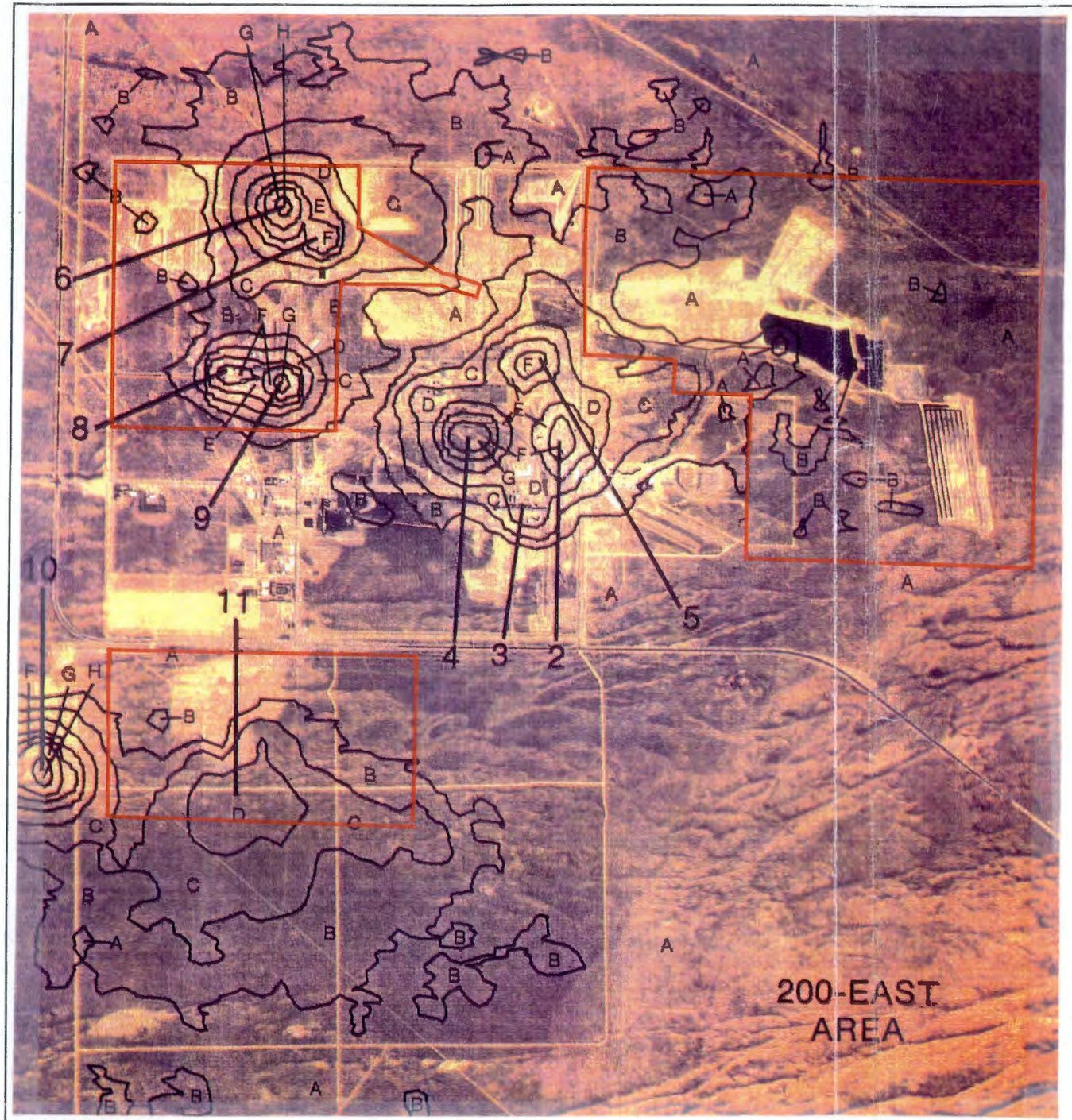
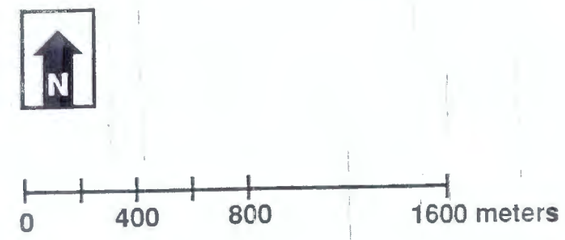


Figure 4-1. Gamma Isoradiation Contour Map of the 200 East Area. (Reiman and Dahlstrom 1988)



Zone A = <700 ct/s
Zone B = 700 to 2,200 ct/s
Zone C = 2,200 to 7,000 ct/s
Zone D = 7,000 to 22,000 ct/s
Zone E = 22,000 to 70,000 ct/s
Zone F = 70,000 to 220,000 ct/s
Zone G = 220,000 to 700,000 ct/s
Zone H = 700,000 to 2,200,000 ct/s
6 = 241-BX and 241-BY Tank Farms
7 = 241-B Tank Farm
8 = 225-B Building
9 = 221-B Building
11 = 200-BP-2 Operable
Other numbers refer to sites outside the B Plant Aggregate Area.
B Plant Aggregate Area is outlined in red.
The results are displayed as relative levels of man-made radionuclde activity.

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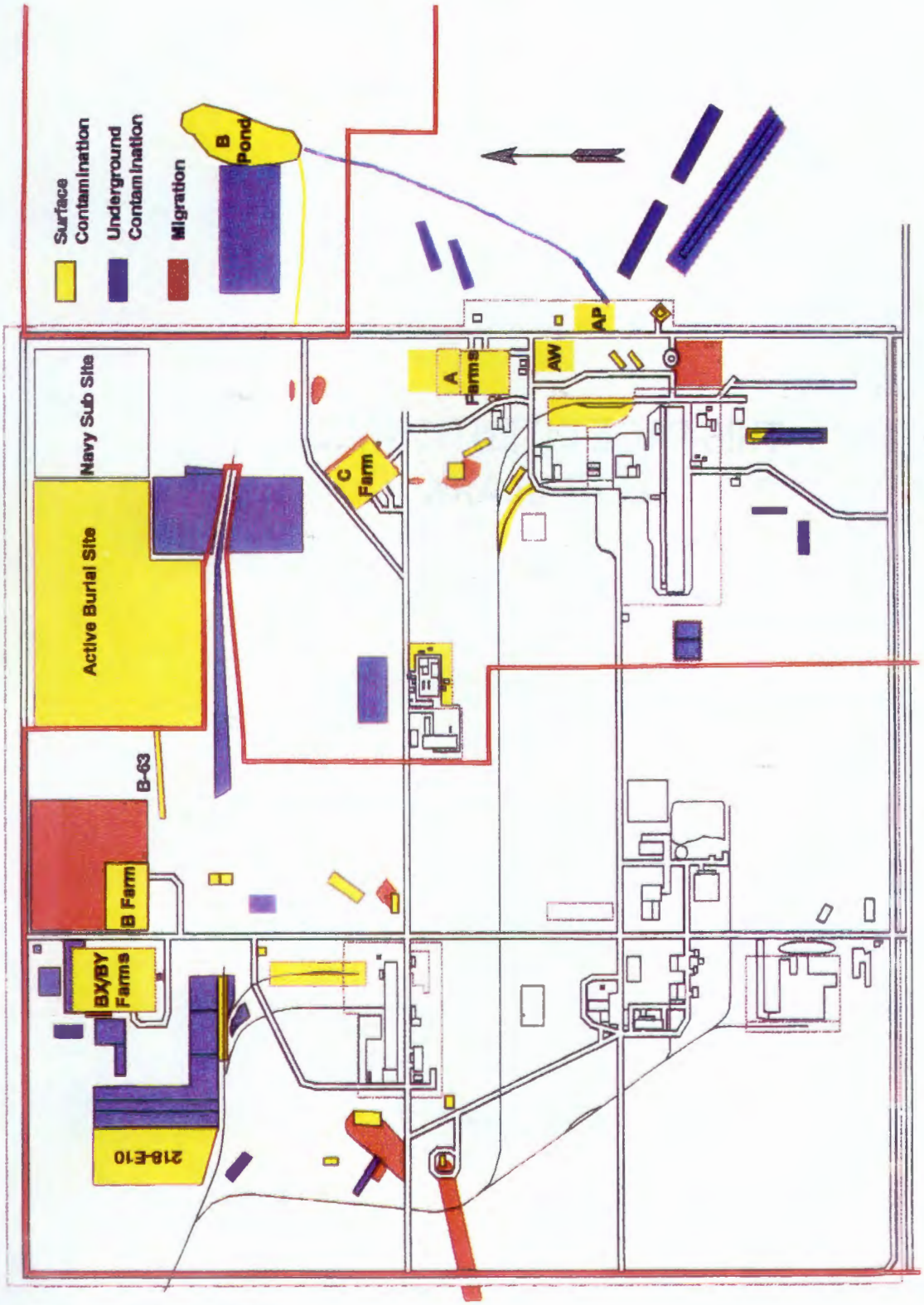
Figure 4-2. Surface, Underground, and Migrating Contamination Map of the 200 East Area. (Huckfeldt 1991b)



B Plant Aggregate Area is outlined in red.

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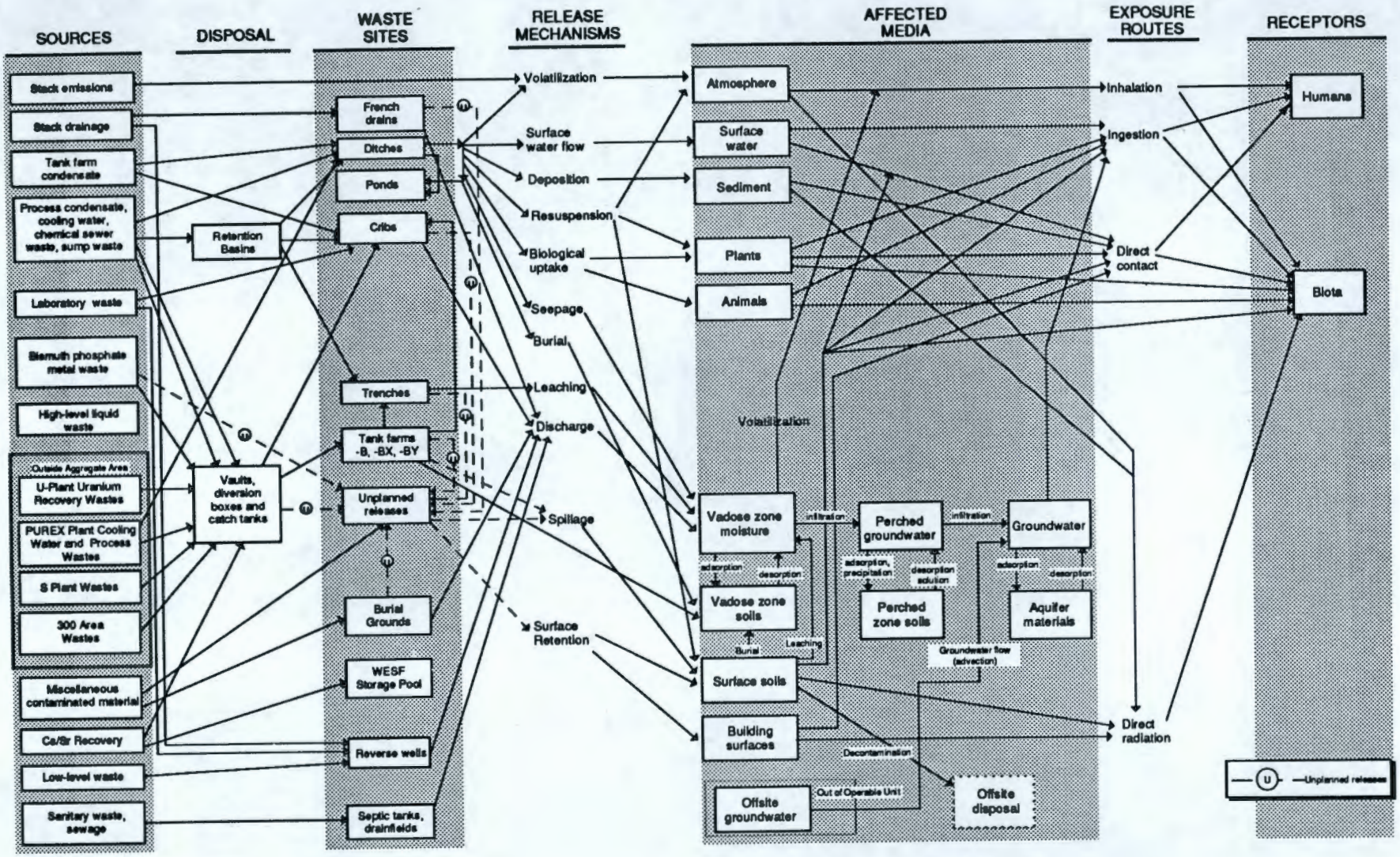
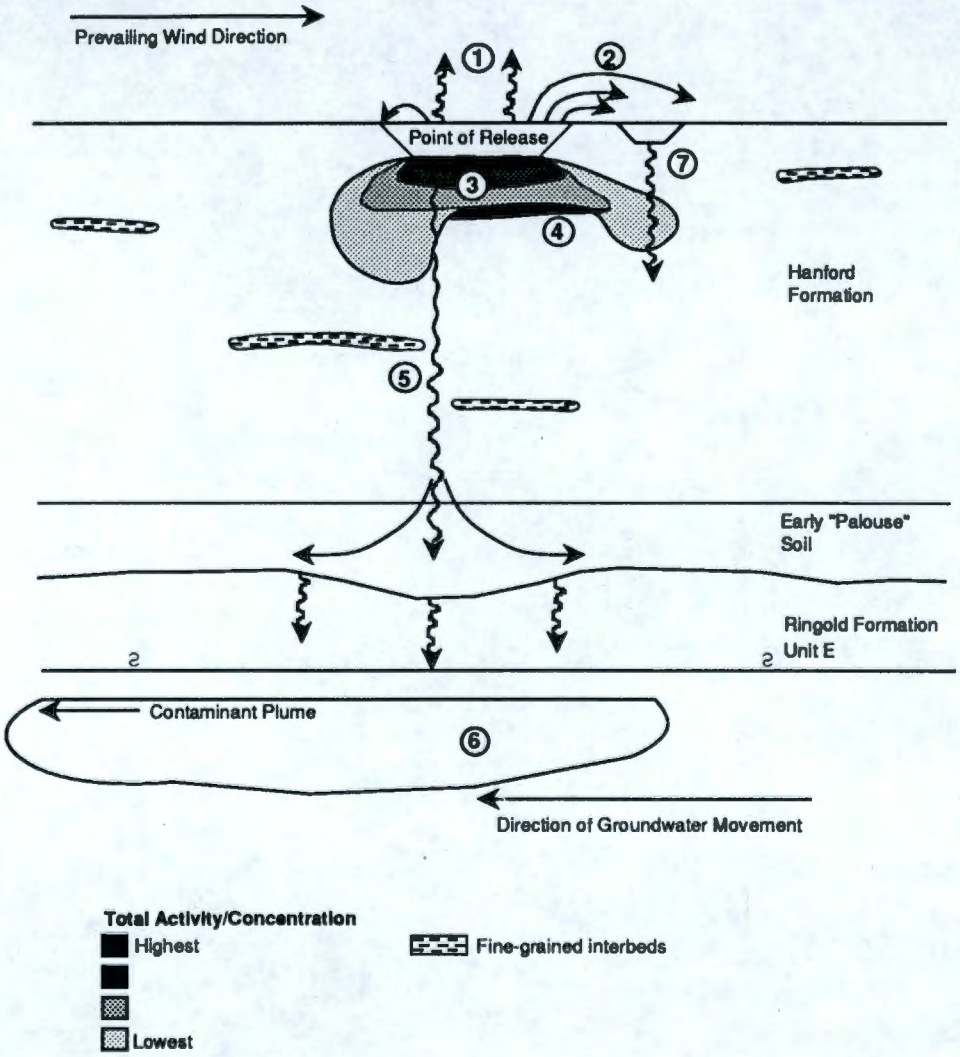


Figure 4-3. Conceptual Model of the B Plant Aggregate Area.



① Some contaminants may volatilize and enter the atmosphere after release.

② Wind may move contaminants laterally at the surface. For a surface release, this may occur immediately. For subsurface releases, contaminants must first be moved to the surface by biological activity.

③ The majority of contaminants are held in the vadose zone soils immediately beneath the point of release. The highest total activities will be immediately beneath the point of release and less mobile contaminants such as TRUs should be restricted to this area.

④ Thin discontinuous aquitards may cause small perched water zones. Some lateral migration of contaminants may occur above such a zone, particularly if it occurs close to the point of release.

⑤ The majority of liquid travels downward through the vadose zone carrying some more mobile contaminants such as fission products. Contaminants may be locally concentrated in fine-grained horizons, though at much lower concentrations than occur immediately beneath the point of release.

⑥ Some of the most mobile contaminants (tritium, cyanide, iodine, nitrates, nitrites, fluoride) reach the groundwater and may form contaminant plumes.

⑦ Waste water from adjacent active waste management units may remobilize contaminants in the underlying vadose zone.

Figure 4-4. Physical Conceptual Model of Contamination Distribution.

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
Plants, Buildings, and Storage Areas									
2703-E Hazardous Waste Staging Area	C	–	–	–	–	–	–	–	–
2704-E Hazardous Waste Staging Area	C	–	–	–	–	–	–	–	–
2715-EA Hazardous Waste Staging Area	C	–	–	–	–	–	–	–	–
226-B Hazardous Waste Staging Facility	C	–	–	–	–	–	–	–	–
Tanks and Vaults									
241-B-101 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-102 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-103 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-104 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-105 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-106 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-107 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-108 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-109 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-110 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-111 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-112 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-201 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-202 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-203 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-204 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
241-BY-101 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-102 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-103 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-104 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-105 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-106 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-107 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-108 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-109 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-110 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-111 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BY-112 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-101 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-102 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-103 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-104 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-105 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-106 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-107 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-108 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-109 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-110 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
241-BX-111 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-BX-112 Single-Shell Tank	C, R	–	–	–	–	–	–	–	–
241-B-301B Catch Tank	–	–	–	–	–	–	–	–	–
241-B-302B Catch Tank	–	–	–	–	–	–	–	–	–
241-BX-302A Catch Tank	–	–	–	–	–	–	–	–	–
241-BX-302B Catch Tank	–	–	–	–	–	–	–	–	–
241-BX-302C Catch Tank	–	–	–	–	–	–	–	–	–
241-ER-311 Catch Tank	–	–	–	–	–	–	–	–	–
241-B-361 Settling Tank	–	–	–	–	–	–	–	–	–
244-BXR Vault	–	–	–	–	–	–	–	–	–
244-BX Receiving Tank	–	–	–	–	–	–	–	–	–
270-E Cond. Neut. Tank	–	–	–	–	–	–	–	–	–
Cribs and Drains									
216-B-7A Crib	C,R	–	–	–	–	–	–	R	–
216-B-7B Crib	C,R	–	–	–	–	–	–	R	–
216-B-8TF Crib/Tile Field	C,R	–	–	–	–	–	–	R	–
216-B-9TF Crib/Tile Field	C,R	–	–	–	–	–	–	R	–
216-B-10A Crib	C,R	–	–	–	–	–	–	R	–
216-B-10B Crib	C,R	–	–	–	–	–	–	R	–
216-B-12 Crib	C,R	–	–	–	–	–	R	R	–
216-B-14 Crib	C,R	–	–	–	–	–	–	R	–
216-B-15 Crib	C,R	–	–	–	–	–	–	R	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
216-B-16 Crib	C,R	–	–	–	–	–	–	R	–
216-B-17 Crib	C,R	–	–	–	–	–	–	R	–
216-B-18 Crib	C,R	–	–	–	–	–	–	R	–
216-B-19 Crib	C,R	–	–	–	–	–	–	R	–
216-B-43 Crib	C,R	–	–	–	–	–	–	R	–
216-B-44 Crib	C,R	–	–	–	–	–	–	R	–
216-B-45 Crib	C,R	–	–	–	–	–	–	R	–
216-B-46 Crib	C,R	–	–	–	–	–	–	R	–
216-B-47 Crib	C,R	–	–	–	–	–	–	R	–
216-B-48 Crib	C,R	–	–	–	–	–	–	R	–
216-B-49 Crib	C,R	–	–	–	–	–	–	R	–
216-B-50 Crib	C,R	–	–	–	–	–	–	R	–
216-B-55 Crib	C,R	–	–	R	–	–	R	R	–
216-B-56 Crib	–	–	–	–	–	–	–	R	–
216-B-57 Crib	C,R	–	–	–	–	–	–	R	–
216-B-60 Crib	–	–	–	–	–	–	–	–	–
216-B-61 Crib	–	–	–	–	–	–	–	–	–
216-B-62 Crib	R	–	–	R	–	–	R	R	–
CTF North of 2703-E	–	–	–	–	–	–	–	–	–
216-B-13 French Drain	–	–	–	–	–	–	–	R	–
216-B-51 French Drain	–	–	–	–	–	–	–	R	–
Reverse Wells									

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
216-B-4 Reverse Wells	C	–	–	–	–	–	–	R	–
216-B-5 Reverse Wells	C	–	–	R	R	–	–	R	–
216-B-6 Reverse Wells	C	–	–	–	–	–	–	R	–
216-B-11A Reverse Well	C,R	–	–	–	–	–	–	R	–
216-B-11B Reverse Well	C,R	–	–	–	–	–	–	R	–
Ponds, Ditches, and Trenches									
216-B-3 Pond	R	–	R	R	R	–	–	R	–
216-B-3A Pond	–	–	–	–	R	–	–	–	–
216-B-3B Pond	–	–	–	–	–	–	–	–	–
216-B-3C Pond	–	–	R	R	R	–	–	–	–
216-A-25 Pond	R	–	–	–	–	–	R	R	–
216-E-28 Contingency Pond	–	–	–	–	–	–	–	–	–
216-N-8 Pond	–	–	R	R	R	–	R	R	–
2101-M Pond	–	–	–	–	C,R	C,R	–	–	–
216-B-2-1 Ditch	–	–	–	–	–	–	–	R	–
216-B-2-2 Ditch	–	–	–	–	–	–	–	R	–
216-B-2-3 Ditch	–	–	–	R	–	–	–	R	–
216-B-3-1 Ditch	–	–	–	–	–	–	–	R	–
216-B-3-2 Ditch	–	–	–	–	–	–	–	R	–
216-B-3-3 Ditch	–	–	R	–	R	–	R	R	–
216-B-20 Trench	C,R	–	–	–	–	–	–	R	–
216-B-21 Trench	C,R	–	–	–	–	–	–	R	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
216-B-22 Trench	C,R	–	–	–	–	–	–	R	–
216-B-23 Trench	C,R	–	–	–	–	–	–	R	–
216-B-24 Trench	C,R	–	–	–	–	–	–	R	–
216-B-25 Trench	C,R	–	–	–	–	–	–	R	–
216-B-26 Trench	C,R	–	–	–	–	–	–	R	–
216-B-27 Trench	C,R	–	–	–	–	–	–	R	–
216-B-28 Trench	C,R	–	–	–	–	–	–	R	–
216-B-29 Trench	C,R	–	–	–	–	–	–	R	–
216-B-30 Trench	C,R	–	–	–	–	–	–	R	–
216-B-31 Trench	C,R	–	–	–	–	–	–	R	–
216-B-32 Trench	C,R	–	–	–	–	–	–	R	–
216-B-33 Trench	C,R	–	–	–	–	–	–	R	–
216-B-34 Trench	C,R	–	–	–	–	–	–	R	–
216-B-35 Trench	C,R	–	–	–	–	–	–	R	–
216-B-36 Trench	C,R	–	–	–	–	–	–	R	–
216-B-37 Trench	C,R	–	–	–	–	–	–	R	–
216-B-38 Trench	C,R	–	–	–	–	–	–	R	–
216-B-39 Trench	C,R	–	–	–	–	–	–	R	–
216-B-40 Trench	C,R	–	–	–	–	–	–	R	–
216-B-41 Trench	C,R	–	–	–	–	–	–	R	–
216-B-42 Trench	C,R	–	–	–	–	–	–	R	–
216-B-52 Trench	C,R	–	–	–	–	–	–	R	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
216-B-53A Trench	C,R	–	–	–	–	–	–	R	–
216-B-53B Trench	C,R	–	–	–	–	–	–	R	–
216-B-54 Trench	C,R	–	–	–	–	–	–	R	–
216-B-58 Trench	C,R	–	–	–	–	–	–	–	–
216-B-63 Trench	–	–	R	R	R	–	R	–	–
Septic Tanks and Associated Drain Fields									
2607-E1 Septic Tank	–	–	–	–	–	–	–	–	–
2607-E2 Septic Tank	–	–	–	–	–	–	–	–	–
2607-E3 Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
2607-E4 Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
2607-E7B Septic Tank	–	–	–	–	–	–	–	–	–
2607-E8 Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
2607-E9 Septic Tank	–	–	–	–	–	–	–	–	–
2607-E11 Septic Tank	–	–	–	–	–	–	–	–	–
2607-EB Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
2607-EH Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
2607-EK Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
2607-EM Septic Tank	–	–	–	–	–	–	–	–	–
2607-EN Septic Tank	–	–	–	–	–	–	–	–	–
2607-EO Septic Tank	–	–	–	–	–	–	–	–	–
2607-EP Septic Tank	–	–	–	–	–	–	–	–	–
2607-EQ Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–

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Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
2607-ER Septic Tank	–	–	–	–	–	–	–	–	–
2607-GF Septic Tank/Drain Field	–	–	–	–	–	–	–	–	–
Transfer Facilities, Diversion Boxes, and Pipelines									
241-B-151 Diversion Box	–	–	–	–	–	–	–	–	–
241-B-152 Diversion Box	–	–	–	–	–	–	–	–	–
241-B-153 Diversion Box	–	–	–	–	–	–	–	–	–
241-B-154 Diversion Box	–	–	–	–	–	–	–	–	–
241-B-252 Diversion Box	–	–	–	–	–	–	–	–	–
241-BR-152 Diversion Box	–	–	–	–	–	–	–	–	–
241-BX-153 Diversion Box	–	–	–	–	–	–	–	–	–
241-BX-154 Diversion Box	–	–	–	–	–	–	–	–	–
241-BX-155 Diversion Box	–	–	–	–	–	–	–	–	–
241-BXR-151 Diversion Box	–	–	–	–	–	–	–	–	–
241-BXR-152 Diversion Box	–	–	–	–	–	–	–	–	–
241-BXR-153 Diversion Box	–	–	–	–	–	–	–	–	–
241-BYR-152 Diversion Box	–	–	–	–	–	–	–	–	–
241-BYR-153 Diversion Box	–	–	–	–	–	–	–	–	–
241-BYR-154 Diversion Box	–	–	–	–	–	–	–	–	–
241-ER-151 Diversion Box	–	–	–	–	–	–	–	–	–
241-ER-152 Diversion Box	–	–	–	–	–	–	–	–	–
242-B-151 Diversion Box	–	–	–	–	–	–	–	–	–
Basins									

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
207-B Retention Basin	–	–	–	–	–	–	–	R	–
216-B-59B Retention Basin	R	–	–	–	–	–	–	R	–
216-B-64 Retention Basin	–	–	–	–	–	–	–	R	–
Burial Sites									
218-E-2 Burial Ground	R	–	–	–	–	–	–	R	–
218-E-2A Burial Ground	–	–	–	–	–	–	–	R	–
218-E-3 Burial Ground	–	–	–	–	–	–	–	–	–
218-E-4 Burial Ground	R	–	–	–	–	–	–	R	–
218-E-5 Burial Ground	R	–	–	–	–	–	–	R	–
218-E-5A Burial Ground	R	–	–	–	–	–	–	R	–
218-E-6 Burial Ground	–	–	–	–	–	–	–	–	–
218-E-7 Burial Ground	R	–	–	–	–	–	–	R	–
218-E-9 Burial Ground	–	–	–	–	–	–	–	R	–
218-E-10 Burial Ground	–	–	–	–	–	–	–	–	–
200 Area Construction Pit	–	–	–	–	–	–	–	–	–
200-E Powerhouse Ash Pit	–	–	–	–	–	–	–	–	–
Unplanned Release									
UN-200-E-1	–	–	–	–	–	–	–	–	–
UN-200-E-2	–	–	–	–	–	–	–	–	–
UN-200-E-3	–	–	–	–	–	–	–	–	–
UN-200-E-7	–	–	–	–	–	–	–	–	–
UN-200-E-9	–	–	–	–	–	–	–	–	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
UN-200-E-14	–	–	–	–	–	–	–	–	–
UN-200-E-41	R	–	–	–	–	–	–	–	–
UN-200-E-43	–	–	–	–	–	–	–	–	–
UN-200-E-44	–	–	–	–	–	–	–	–	–
UN-200-E-45	–	–	–	–	–	–	–	–	–
UN-200-E-52	–	–	–	–	–	–	–	–	–
UN-200-E-54	–	–	–	–	–	–	–	–	–
UN-200-E-55	–	–	–	–	–	–	–	–	–
UN-200-E-61	–	–	–	–	–	–	–	–	–
UN-200-E-63	–	–	–	–	–	–	–	–	–
UN-200-E-64	R	–	–	–	–	–	–	–	–
UN-200-E-69	–	–	–	–	–	–	–	–	–
UN-200-E-76	R	–	–	–	–	–	–	–	–
UN-200-E-79	–	–	–	–	–	–	–	–	–
UN-200-E-80	–	–	–	–	–	–	–	–	–
UN-200-E-83	R[a/]	–	–	–	–	–	–	–	–
UN-200-E-85	C,R	–	–	–	–	–	–	–	–
UN-200-E-87	R	–	–	–	–	–	–	R	–
UN-200-E-89	–	–	–	–	–	–	–	R	–
UN-200-E-90	–	–	–	–	–	–	–	–	–
UN-200-E-92	–	–	–	–	–	–	–	–	–
UN-200-E-95	–	–	–	–	–	–	–	R	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
UN-200-E-101	–	–	–	–	–	–	–	R	–
UN-200-E-103	–	–	–	–	–	–	–	–	–
UN-200-E-105	–	–	–	–	–	–	–	–	–
UN-200-E-109	C	–	–	–	–	–	–	–	–
UN-200-E-110	–	–	–	–	–	–	–	–	–
UN-200-E-112	–	–	–	–	–	–	–	–	–
UN-200-E-140	C	–	–	–	–	–	–	–	–
UPR-200-E-4	–	–	–	–	–	–	–	–	–
UPR-200-E-5	R	–	–	–	–	–	–	–	–
UPR-200-E-6	–	–	–	–	–	–	–	–	–
UPR-200-E-32	R	–	–	–	–	–	–	R	–
UPR-200-E-34	–	–	–	–	–	–	–	–	–
UPR-200-E-38	–	–	–	–	–	–	–	–	–
UPR-200-E-51	C	–	–	–	–	–	–	–	–
UPR-200-E-73	–	–	–	–	–	–	–	–	–
UPR-200-E-74	–	–	–	–	–	–	–	–	–
UPR-200-E-75	–	–	–	–	–	–	–	–	–
UPR-200-E-77	–	–	–	–	–	–	–	R	–
UPR-200-E-78	–	–	–	–	–	–	–	R	–
UPR-200-E-84	–	–	–	–	–	–	–	R	–
UPR-200-E-108	–	–	–	–	–	–	–	–	–
UPR-200-E-116	C,R	–	–	–	–	–	–	–	–

Table 4-1. Types of Data for the B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Inventory	Air Sampling Data	Biota Sampling Data	Water Sample Data	Surface Soil/ Sediment Data	Subsurface Vapor/ Soil Sampling Data	Radiation Monitoring Data	Surface Radiological Survey	Borehole Geophysics
UPR-200-E-127	R	–	–	–	–	–	–	–	–
UPR-200-E-128	R	–	–	–	–	–	–	–	–
UPR-200-E-129	R	–	–	–	–	–	–	–	–
UPR-200-E-130	C	–	–	–	–	–	–	–	–
UPR-200-E-131	R	–	–	–	–	–	–	–	–
UPR-200-E-132	–	–	–	–	–	–	–	–	–
UPR-200-E-133	R	–	–	–	–	–	–	–	–
UPR-200-E-134	–	–	–	–	–	–	–	–	–
UPR-200-E-135	–	–	–	–	–	–	–	–	–
UPR-200-E-138	–	–	–	–	–	–	–	–	–

[a] DOE/RL 1991a
Other information from WIDS and HISS databases.
C = Chemical-Related Data
R = Radionuclide-Related Data

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Plants, Buildings, and Storage Areas						
2703-E Hazardous Waste Staging Area	--	--	--	--	--	For the temporary storage of liquid hazardous materials
2704-E Hazardous Waste Staging Area	--	--	--	--	--	For the temporary storage of hazardous materials
2715-EA Hazardous Waste Staging Area	--	--	--	--	--	For the temporary storage of hazardous materials
226-B Hazardous Waste Staging Facility	s	s	--	--	--	For the temporary storage of hazardous materials
224-B Concentration Facility	s	s	--	--	--	Contains radioactive equipment/concrete
Tanks and Vaults						
241-B-101 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-102 Single-Shell Tank	--	--	--	--	--	Associated with UPR-200-E-108
241-B-103 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-104 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-105 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-106 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-107 Single-Shell Tank	--	s	--	--	s	No reported release (See UPR-200-E-127)
241-B-108 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-109 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-110 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-128
241-B-111 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-112 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-201 Single-Shell Tank	--	s	--	--	s	No reported release (See UPR-200-E-129)
241-B-202 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-203 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-130

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-B-204 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-101 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-102 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-103 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-134
241-BY-104 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-105 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-106 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-107 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-108 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-135
241-BY-109 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-110 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-111 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-112 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-101 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-102 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-131, UPR-200-E-132, and UPR-200-E-5
241-BX-103 Single-Shell Tank	--	k	--	--	s	No reported release
241-BX-104 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-105 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-106 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-107 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-108 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-109 Single-Shell Tank	--	--	--	--	--	No reported release

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-BX-110 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-111 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-112 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-301B Catch Tank	--	--	--	--	--	No reported release
241-B-302B Catch Tank	--	--	--	--	--	No reported release
241-BX-302A Catch Tank	--	--	--	--	--	No reported release
241-BX-302B Catch Tank	--	--	--	--	--	No reported release
241-BX-302C Catch Tank	--	--	--	--	--	No reported release
241-ER-311 Catch Tank	--	k	--	--	--	Associated with UPR-200-E-84
241-B-361 Settling Tank	--	--	--	--	--	No reported release
270-E Condensate Neutralization Tank	--	s	--	--	--	High priority for decommissioning
244-BXR Vault	--	--	--	--	--	No reported release
244-BX Receiving Tank	--	--	--	--	--	No reported release
Cribs and Drains						
216-B-7A Crib	--	k	--	--	s	--
216-B-7B Crib	--	k	--	--	s	--
216-B-10A Crib	--	--	--	--	s	--
216-B-10B Crib	--	--	--	--	s	--
216-B-12 Crib	s	s	--	s	s	--
216-B-14 Crib	--	s	--	--	s	--
216-B-15 Crib	--	s	--	--	s	--
216-B-16 Crib	--	s	--	--	s	--
216-B-17 Crib	--	s	--	--	s	--

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-18 Crib	--	s	--	--	s	Cave-in occurred in 1974; filled in with gravel
216-B-19 Crib	--	s	--	--	s	--
216-B-43 Crib	--	k,r?	--	s	s	--
216-B-44 Crib	--	k,r?	--	s	s	--
216-B-45 Crib	--	k,r?	--	s	s	--
216-B-46 Crib	--	k,r?	--	s	s	--
216-B-47 Crib	--	k,r?	--	s	s	--
216-B-48 Crib	--	k,r?	--	s	s	--
216-B-49 Crib	--	k,r?	--	s	s	--
216-B-50 Crib	--	k,r?	--	s	s	--
216-B-55 Crib	--	--	--	R	s	--
216-B-56 Crib	--	--	--	--	s	Unit never used; pipeline not installed
216-B-57 Crib	--	k	--	--	s	--
216-B-60 Crib	--	--	--	--	--	--
216-B-61 Crib	--	--	--	--	--	Unit never used
216-B-62 Crib	--	--	--	--	s	--
216-B-8TF Crib/Tile Field	--	k	--	k	s	--
216-B-9TF Crib/Tile Field	--	k	--	s	s	--
216-B-13 French Drain	--	--	--	--	s	--
216-B-51 French Drain	--	--	--	--	s	--
Chemical Tile Field North of 2703-E	--	--	--	--	--	--
Reverse Wells						
216-B-4 Reverse Well	--	--	--	--	s	--

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-5 Reverse Well	--	k	--	--	k	--
216-B-6 Reverse Well	--	--	--	--	s	--
216-B-11A Reverse Well	s	k	s	s	s	--
216-B-11B Reverse Well	s	k	s	s	s	--
Ponds, Ditches, and Trenches						
216-B-3 Pond	--	s	s	s	s	Associated with UPR-200-E-32, UPR-200-E-34, and UPR-200-E-138
216-B-3A Pond	--	--	--	--	--	--
216-B-3B Pond	--	--	--	--	--	--
216-B-3C Pond	--	--	--	--	--	--
216-A-25 Pond	--	s,r?	s	s	s	Associated with UPR-200-E-34
216-E-28 Contingency Pond	--	--	--	--	--	--
216-N-8 Pond	--	--	--	--	--	--
2101-M Pond	--	--	--	--	--	--
216-B-2-1 Ditch	s	k,r?	--	s,r?	k	Associated with UPR-200-E-34
216-B-2-2 Ditch	--	k	s	s	k	Associated with UPR-200-E-138
216-B-2-3 Ditch	--	s,r?	--	--	s	--
216-B-3-1 Ditch	--	k	--	k	s	Associated with UPR-200-E-34
216-B-3-2 Ditch	--	s	s	k	s	Associated with UPR-200-E-138
216-B-3-3 Ditch	--	k	s	s	--	Associated with UPR-200-E-51
216-B-20 Trench	--	--	--	--	s	--
216-B-21 Trench	--	--	--	--	s	--
216-B-22 Trench	--	--	--	--	s	--

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-23 Trench	--	--	--	--	s	--
216-B-24 Trench	--	--	--	--	s	--
216-B-25 Trench	--	--	--	--	s	--
216-B-26 Trench	--	--	--	--	s	--
216-B-27 Trench	--	--	--	--	s	--
216-B-28 Trench	--	--	--	--	s	--
216-B-29 Trench	--	--	--	--	s	--
216-B-30 Trench	--	--	--	--	s	--
216-B-31 Trench	--	--	--	--	s	--
216-B-32 Trench	--	--	--	--	s	--
216-B-33 Trench	--	--	--	--	s	--
216-B-34 Trench	--	--	--	--	s	--
216-B-35 Trench	--	--	--	--	s	--
216-B-36 Trench	--	--	--	--	s	--
216-B-37 Trench	--	--	--	--	s	--
216-B-38 Trench	--	--	--	--	s	--
216-B-39 Trench	--	--	--	--	s	--
216-B-40 Trench	--	--	--	--	s	--
216-B-41 Trench	--	--	--	--	s	--
216-B-42 Trench	--	--	--	--	s	--
216-B-52 Trench	--	--	--	s	s	--
216-B-53A Trench	--	--	--	s	s	--
216-B-53B Trench	--	--	--	--	s	--

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-54 Trench	--	--	--	--	s	--
216-B-58 Trench	--	--	--	--	s	--
216-B-63 Trench	--	k	--	s	s	--
Septic Drains and Associated Drain Fields						
2607-E1 Septic Tank	--	--	--	--	--	No reported contaminants
2607-E2 Septic Tank	--	--	--	--	--	No reported contaminants
2607-E3 Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-E4 Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-E7B Septic Tank	--	--	--	--	--	No reported contaminants
2607-E8 Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-E9 Septic Tank	--	--	--	--	--	No reported contaminants
2607-E11 Septic Tank	--	--	--	--	--	No reported contaminants
2607-EB Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EH Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EK Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EM Septic Tank	--	--	--	--	--	No reported contaminants
2607-EN Septic Tank	--	--	--	--	--	No reported contaminants
2607-EO Septic Tank	--	--	--	--	--	No reported contaminants
2607-EP Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EQ Septic Tank	--	--	--	--	--	No reported contaminants
2607-ER Septic Tank	--	--	--	--	--	No reported contaminants
2607-GF Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
Transfer Facilities, Diversion Boxes, and Pipelines						

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-B-151 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-4 and UPR-200-E-73
241-B-152 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-74 and UPR-200-E-38
241-B-153 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-6 and UPR-200-E-75
241-B-154 Diversion Box	s	s	--	--	s	Associated with UPR-200-E-77 and UPR-200-E-45
241-B-252 Diversion Box	--	--	--	--	--	No reported release
241-BR-152 Diversion Box	--	--	--	--	--	No reported release
241-BX-153 Diversion Box	--	--	--	--	--	No reported release
241-BX-154 Diversion Box	--	--	--	--	--	No reported release
241-BX-155 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-78
241-BXR-151 Diversion Box	--	--	--	--	--	No reported release
241-BXR-152 Diversion Box	--	--	--	--	--	No reported release
241-BXR-153 Diversion Box	--	--	--	--	--	No reported release
241-BYR-152 Diversion Box	--	--	--	--	--	No reported release
241-BYR-153 Diversion Box	--	--	--	--	--	No reported release
241-BYR-154 Diversion Box	--	--	--	--	--	No reported release
241-ER-151 Diversion Box	--	--	--	--	--	No reported release
241-ER-152 Diversion Box	--	--	--	--	--	No reported release
242-B-151 Diversion Box	--	--	--	--	--	No reported release
Basins						
207-B Retention Basin	--	k	--	--	--	Associated with UPR-200-E-32
216-B-59B Retention Basin	--	s	--	--	--	--
216-B-64 Retention Basin	--	k	--	--	--	Unit never used

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Burial Sites						
218-E-2 Burial Ground	--	s,r?	--	k	s	--
218-E-2A Burial Ground	--	s,r?	--	--	s	--
218-E-3 Burial Ground	--	--	--	--	--	Exhumed and released from radiation zone status
218-E-4 Burial Ground	--	s,r?	--	k	s	--
218-E-5 Burial Ground	--	s	--	k	s	--
218-E-5A Burial Ground	--	s,r?	--	k	s	--
218-E-6 Burial Ground	--	--	--	--	--	Exhumed and released from radiation zone status
218-E-7 Burial Ground	--	--	--	--	--	--
218-E-9 Burial Ground	--	s,r?	--	k	s	--
218-E-10 Burial Ground	--	--	--	s	s	--
200 Area Construction Pit	--	--	--	--	--	--
200-E Powerhouse Ash Pit	--	--	--	--	--	--
Unplanned Releases						
UN-200-E-1	--	s	--	--	s,r?	--
UN-200-E-2	--	s	--	--	k	--
UN-200-E-3	--	s	--	--	k	--
UN-200-E-7	--	--	--	--	k	--
UN-200-E-9	--	--	--	--	--	--
UN-200-E-14	--	k,r	--	--	--	--
UN-200-E-41	--	--	--	--	--	Waste line leakage contaminated the stairwell at the 271-B Building
UN-200-E-43	--	k	--	--	s	--

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-44	--	s,r	--	--	--	--
UN-200-E-45	--	k,r?	--	--	k,r?	--
UN-200-E-52	--	k,r?	--	--	k,r?	--
UN-200-E-54	--	k,r?	--	--	--	--
UN-200-E-55	s	k,r?	--	--	--	--
UN-200-E-61	--	k,r	--	--	--	--
UN-200-E-63	--	k	--	k,r	--	--
UN-200-E-64	--	k	--	--	--	--
UN-200-E-69	--	k	--	--	--	--
UN-200-E-76	--	k,r?	--	--	k,r?	--
UN-200-E-79	--	k,r?	--	--	s	--
UN-200-E-80	--	k,r?	--	--	k,r?	--
UN-200-E-83	--	k	--	s	--	--
UN-200-E-85	--	s	--	--	s	--
UN-200-E-87	s	k	--	s	--	--
UN-200-E-89	--	--	--	--	--	--
UN-200-E-90	s	s	--	--	s	--
UN-200-E-92	--	s,r	--	--	--	--
UN-200-E-95	--	k	--	--	--	--
UN-200-E-101	--	s	--	s	--	--
UN-200-E-103	--	s,r?	--	--	s,r?	--
UN-200-E-105	--	k,r?	--	--	s	Contaminated area covered with concrete
UN-200-E-109	--	k,r?	--	--	s	Stabilized with asphalt

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-110	--	k	--	--	--	--
UN-200-E-112	--	k,r	--	--	--	--
UN-200-E-140	--	k,r	--	--	s,r	--
UPR-200-E-4	--	k,r?	--	--	k,r?	--
UPR-200-E-5	--	k	--	--	k	--
UPR-200-E-6	--	k	--	--	s	--
UPR-200-E-32	--	k,r?	--	k,r?	s	--
UPR-200-E-34	--	k	s	--	s	--
UPR-200-E-38	--	k	--	--	s	--
UPR-200-E-51	--	--	--	--	--	51 kg of cadmium nitrate was released
UPR-200-E-73	--	s,r?	--	--	s	--
UPR-200-E-74	--	k,r?	--	--	--	--
UPR-200-E-75	--	s,r?	--	--	s	--
UPR-200-E-77	--	s,r?	--	--	s	--
UPR-200-E-78	--	k,r	--	--	--	--
UPR-200-E-84	--	k	--	--	--	--
UPR-200-E-108	--	k,r	--	--	--	--
UPR-200-E-116	--	k,r?	--	--	--	--
UPR-200-E-127	--	s	--	--	s	--
UPR-200-E-128	--	k,r?	--	--	k	Salt well installed; interstitial liquid removed
UPR-200-E-129	--	s	--	--	s	--
UPR-200-E-130	--	s	--	--	--	--
UPR-200-E-131	--	k	--	--	s	--

Table 4-2. Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UPR-200-E-132	--	k,r?	--	--	s	--
UPR-200-E-133	--	k,r?	--	--	s	--
UPR-200-E-134	--	s,r?	--	--	s	Salt well installed; interstitial liquid removed
UPR-200-E-135	--	s,r	--	--	s	Salt well installed
UPR-200-E-138	--	k,r?	--	--	s	--

Notes:

s Suspected contamination, primarily based on WIDS (WHC 1991a) and other waste inventory data.
k Known contamination based on chemical analytical data, WIDS (WHC 1991a), or other sources.
r Complete remediation reported.
r? Remediation attempted, effectiveness not documented.
A dashed line (--) indicates where no data are available.

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Plants, Buildings, and Storage Areas						
2703-E Hazardous Waste Staging Area	s	s	--	--	--	For the temporary storage of liquid hazardous materials
2704-E Hazardous Waste Staging Area	--	s	--	--	--	For the temporary storage of hazardous materials
2715-EA Hazardous Waste Staging Area	s	s	--	--	--	For the temporary storage of waste paint and thinning solvents
226-B Hazardous Waste Staging Facility	--	--	--	--	--	For the temporary storage of hazardous materials
224-B Concentration Facility	--	--	--	--	--	Contains radioactive equipment/concrete
Tanks and Vaults						
241-B-101 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-102 Single-Shell Tank	--	--	--	--	--	Associated with UPR-200-E-108
241-B-103 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-104 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-105 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-106 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-107 Single-Shell Tank	--	s	--	--	s	No reported release (See UPR-200-E-127)
241-B-108 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-109 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-110 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-128
241-B-111 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-112 Single-Shell Tank	--	s	--	--	s	No reported release
241-B-201 Single-Shell Tank	--	s	--	--	s	No reported release (See UPR-200-E-129)
241-B-202 Single-Shell Tank	--	--	--	--	--	No reported release

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-B-203 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-130
241-B-204 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-101 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-102 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-103 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-134
241-BY-104 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-105 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-106 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-107 Single-Shell Tank	--	s	--	--	s	No reported release
241-BY-108 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-135
241-BY-109 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-110 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-111 Single-Shell Tank	--	--	--	--	--	No reported release
241-BY-112 Single-Shell Tank	--	--	--	--	--	Associated with UPR-200-E-116
241-BX-101 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-102 Single-Shell Tank	--	s	--	--	s	Associated with UPR-200-E-131, UPR-200-E-132, and UPR-200-E-5
241-BX-103 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-104 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-105 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-106 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-107 Single-Shell Tank	--	s	--	--	s	No reported release

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-BX-108 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-109 Single-Shell Tank	--	--	--	--	--	No reported release
241-BX-110 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-111 Single-Shell Tank	--	s	--	--	s	No reported release
241-BX-112 Single-Shell Tank	--	--	--	--	--	No reported release
241-B-301B Catch Tank	--	--	--	--	--	No reported release
241-B-302B Catch Tank	--	--	--	--	--	No reported release
241-BX-302A Catch Tank	--	--	--	--	--	No reported release
241-BX-302B Catch Tank	--	--	--	--	--	No reported release
241-BX-302C Catch Tank	--	--	--	--	--	No reported release
241-ER-311 Catch Tank	--	k	--	--	s	Associated with UPR-200-E-84
241-B-361 Settling Tank	--	s	--	--	--	No reported release
270-E Condensate Neutralization Tank	--	s	--	--	--	High priority for decommissioning
244-BXR Vault	--	--	--	--	--	No reported release
244-BX Receiving Tank	--	--	--	--	--	No reported release
Cribs and Drains						
216-B-7A Crib	--	s	--	--	s	--
216-B-7B Crib	--	s	--	--	s	--
216-B-10A Crib	--	--	--	--	s	--
216-B-10B Crib	--	--	--	--	--	--
216-B-12 Crib	--	s	--	--	s	--
216-B-14 Crib	--	s	--	--	s	--

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-15 Crib	--	s	--	--	s	--
216-B-16 Crib	--	s	--	--	s	--
216-B-17 Crib	--	s	--	--	s	--
216-B-18 Crib	--	s	--	--	s	Cave-in occurred in 1974; filled in with gravel
216-B-19 Crib	--	s	--	--	s	--
216-B-43 Crib	--	s	--	--	s	--
216-B-44 Crib	--	s	--	--	s	--
216-B-45 Crib	--	s	--	--	s	--
216-B-46 Crib	--	s	--	--	s	--
216-B-47 Crib	--	s	--	--	s	--
216-B-48 Crib	--	s	--	--	s	--
216-B-49 Crib	--	s	--	--	s	--
216-B-50 Crib	--	s	--	--	s	--
216-B-55 Crib	--	s	--	--	s	--
216-B-56 Crib	--	--	--	--	--	Unit never used; pipeline not installed
216-B-57 Crib	--	s	--	--	s	--
216-B-60 Crib	--	--	--	--	--	--
216-B-61 Crib	--	--	--	--	--	Unit never used
216-B-62 Crib	--	--	--	--	--	--
216-B-8TF Crib/Tile Field	--	s	--	s	s	--
216-B-9TF Crib/Tile Field	--	--	--	--	--	--
216-B-13 French Drain	--	--	--	--	--	--

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-51 French Drain	--	--	--	--	--	--
Chemical Tile Field North of 2703-E	--	--	--	--	--	--
Reverse Wells						
216-B-4 Reverse Well	--	--	--	--	--	--
216-B-5 Reverse Well	--	s	--	--	s	--
216-B-6 Reverse Well	--	--	--	--	s	--
216-B-11A Reverse Well	--	s	--	--	s	--
216-B-11B Reverse Well	--	s	--	--	s	--
Ponds, Ditches, and Trenches						
216-B-3 Pond	--	s	s	s	s	Associated with UPR-200-E-32, UPR-200-E-34, and UPR-200-E-138
216-B-3A Pond	--	--	--	--	--	--
216-B-3B Pond	--	--	--	--	--	--
216-B-3C Pond	--	--	--	--	--	--
216-A-25 Pond	--	--	--	--	--	Associated with UPR-200-E-34
216-E-28 Contingency Pond	--	--	--	--	--	--
216-N-8 Pond	--	k	s	s	k	--
2101-M Pond	--	s	s	--	--	--
216-B-2-1 Ditch	--	s	s	s	s	Associated with UPR-200-E-32
216-B-2-2 Ditch	--	s	s	s	s	Associated with UPR-200-E-138
216-B-2-3 Ditch	--	--	--	--	--	--
216-B-3-1 Ditch	--	s	--	s	s	Associated with UPR-200-E-34

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-3-2 Ditch	--	s	--	s	s	Associated with UPR-200-E-138
216-B-3-3 Ditch	--	s	s	s	s	Associated with UPR-200-E-51
216-B-20 Trench	--	s	--	--	s	--
216-B-21 Trench	--	s	--	--	s	--
216-B-22 Trench	--	s	--	--	s	--
216-B-23 Trench	--	s	--	--	s	--
216-B-24 Trench	--	s	--	--	s	--
216-B-25 Trench	--	s	--	--	s	--
216-B-26 Trench	--	s	--	--	s	--
216-B-27 Trench	--	s	--	--	s	--
216-B-28 Trench	--	s	--	--	s	--
216-B-29 Trench	--	s	--	--	s	--
216-B-30 Trench	--	s	--	--	s	--
216-B-31 Trench	--	s	--	--	s	--
216-B-32 Trench	--	s	--	--	s	--
216-B-33 Trench	--	s	--	--	s	--
216-B-34 Trench	--	s	--	--	s	--
216-B-35 Trench	--	s	--	--	s	--
216-B-36 Trench	--	s	--	--	s	--
216-B-37 Trench	--	s	--	--	s	--
216-B-38 Trench	--	s	--	--	s	--
216-B-39 Trench	--	s	--	--	s	--

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-B-40 Trench	--	s	--	--	s	--
216-B-41 Trench	--	s	--	--	s	--
216-B-42 Trench	--	--	--	--	s	--
216-B-52 Trench	--	--	--	--	s	--
216-B-53A Trench	--	--	--	--	--	--
216-B-53B Trench	--	--	--	--	--	--
216-B-54 Trench	--	--	--	--	--	--
216-B-58 Trench	--	--	--	--	--	--
216-B-59 Trench	--	--	--	--	--	--
216-B-63 Trench	--	s	s	s	s	--
Septic Drains and Associated Drain Fields						
2607-E1 Septic Tank	--	--	--	--	--	No reported contaminants
2607-E2 Septic Tank	--	--	--	--	--	No reported contaminants
2607-E3 Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-E4 Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-E7B Septic Tank	--	--	--	--	--	No reported contaminants
2607-E8 Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-E9 Septic Tank	--	--	--	--	--	No reported contaminants
2607-E11 Septic Tank	--	--	--	--	--	No reported contaminants
2607-EB Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EH Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EK Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
2607-EM Septic Tank	--	--	--	--	--	No reported contaminants
2607-EN Septic Tank	--	--	--	--	--	No reported contaminants
2607-EO Septic Tank	--	--	--	--	--	No reported contaminants
2607-EP Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-EQ Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
2607-ER Septic Tank	--	--	--	--	--	No reported contaminants
2607-GF Septic Tank/Drain Field	--	--	--	--	--	No reported contaminants
Transfer Facilities, Diversion Boxes, and Pipelines						
241-B-151 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-4 and UPR-200-E-73
241-B-152 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-74 and UPR-200-E-38
241-B-153 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-6 and UPR-200-E-75
241-B-154 Diversion Box	--	s	--	--	s	Associated with UPR-200-E-77 and UPR-200-E-45
241-B-252 Diversion Box	--	--	--	--	--	No reported release
241-BR-152 Diversion Box	--	--	--	--	--	No reported release
241-BX-153 Diversion Box	--	--	--	--	--	No reported release
241-BX-154 Diversion Box	--	--	--	--	--	No reported release
241-BX-155 Diversion Box	--	--	--	--	--	Associated with UPR-200-E-78
241-BXR-151 Diversion Box	--	--	--	--	--	No reported release
241-BXR-152 Diversion Box	--	--	--	--	--	No reported release
241-BXR-153 Diversion Box	--	--	--	--	--	No reported release
241-BYR-152 Diversion Box	--	--	--	--	--	No reported release
241-BYR-153 Diversion Box	--	--	--	--	--	No reported release

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-BYR-154 Diversion Box	--	--	--	--	--	No reported release
241-ER-151 Diversion Box	--	--	--	--	--	No reported release
241-ER-152 Diversion Box	--	--	--	--	--	No reported release
242-B-151 Diversion Box	--	--	--	--	--	No reported release
Basins						
207-B Retention Basin	--	--	--	--	--	Associated with UPR-200-E-32
216-B-59B Retention Basin	--	--	--	--	--	
216-B-64 Retention Basin	--	--	--	--	--	Unit never used
Burial Sites						
218-E-2 Burial Ground	--	--	--	s	--	--
218-E-2A Burial Ground	--	--	--	--	--	--
218-E-3 Burial Ground	--	--	--	--	--	Exhumed and released from radiation zone status
218-E-4 Burial Ground	--	--	--	s	--	--
218-E-5 Burial Ground	--	s	--	--	s	--
218-E-5A Burial Ground	--	--	--	s	--	--
218-E-6 Burial Ground	--	--	--	--	--	Exhumed and released from radiation zone status
218-E-7 Burial Ground	--	--	--	--	--	--
218-E-9 Burial Ground	--	s	--	s	--	--
218-E-10 Burial Ground	--	s	--	s	s	--
200 Area Construction Pit	--	--	--	--	--	--
200-E Powerhouse Ash Pit	--	--	--	--	--	--
Unplanned Releases						

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-1	--	s	--	--	s	--
UN-200-E-2	--	s	--	--	--	--
UN-200-E-3	--	s	--	--	s	--
UN-200-E-7	--	--	--	--	s	--
UN-200-E-9	--	k,r	--	--	--	--
UN-200-E-14	--	k,r	--	s	--	--
UN-200-E-41	--	--	--	--	--	Waste line leakage contaminated the stairwell at the 271-B Building
UN-200-E-43	--	s	--	--	s	--
UN-200-E-44	--	s	--	s	--	--
UN-200-E-45	--	s,r?	--	--	s,r?	--
UN-200-E-52	--	s	--	--	--	--
UN-200-E-54	--	k,r?	--	--	s	--
UN-200-E-55	--	--	--	--	--	--
UN-200-E-61	--	--	--	--	--	--
UN-200-E-63	--	--	--	--	--	--
UN-200-E-64	--	--	--	--	--	--
UN-200-E-69	--	--	--	--	--	--
UN-200-E-76	--	s,r?	--	--	s	--
UN-200-E-79	--	s,r?	--	--	s	--
UN-200-E-80	--	k,r?	--	--	k,r?	--
UN-200-E-83	--	--	--	--	--	--

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-85	--	s	--	--	s	--
UN-200-E-87	--	--	--	--	--	--
UN-200-E-89	--	--	--	--	--	--
UN-200-E-90	--	--	--	--	--	--
UN-200-E-92	--	--	--	--	--	--
UN-200-E-95	--	--	--	--	--	--
UN-200-E-101	--	--	--	--	--	--
UN-200-E-103	--	s,r?	--	--	s,r?	--
UN-200-E-105	--	k,r?	--	--	s	Contaminated area covered with concrete
UN-200-E-109	--	k,r?	--	--	s	Stabilized with asphalt
UN-200-E-110	--	k	--	--	--	--
UN-200-E-112	--	--	--	--	--	--
UN-200-E-140	--	k,r	--	--	s,r	--
UPR-200-E-4	--	--	--	--	--	--
UPR-200-E-5	--	s	--	--	s	--
UPR-200-E-6	--	s	--	--	s	--
UPR-200-E-32	--	s,r?	--	s,r?	s	--
UPR-200-E-34	--	--	--	--	--	--
UPR-200-E-38	--	--	--	--	--	--
UPR-200-E-51	--	k	--	s	s	51 kg of cadmium nitrate released
UPR-200-E-73	--	s,r?	--	--	s	--
UPR-200-E-74	--	s,r?	--	--	s	--

Table 4-3. Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UPR-200-E-75	--	s,r?	--	--	s	--
UPR-200-E-77	--	s,r?	--	--	s	--
UPR-200-E-78	--	k,r	--	--	--	--
UPR-200-E-84	--	s	--	--	--	--
UPR-200-E-108	--	s,r	--	--	--	--
UPR-200-E-116	--	k,r?	--	--	--	--
UPR-200-E-127	--	s	--	--	s	--
UPR-200-E-128	--	s,r?	--	--	s	Salt well installed; interstitial liquid removed
UPR-200-E-129	--	s	--	--	s	--
UPR-200-E-130	--	s	--	--	--	--
UPR-200-E-131	--	s	--	--	s	--
UPR-200-E-132	--	s,r?	--	--	s	--
UPR-200-E-133	--	s,r?	--	--	s	--
UPR-200-E-134	--	s,r?	--	--	s	Salt well installed; interstitial liquid removed
UPR-200-E-135	--	s,r?	--	--	s	Salt well installed
UPR-200-E-138	--	s,r?	s	s,r?	s,r?	--

Notes:

s Suspected contamination, primarily based on WIDS (WHC 1991a) and other waste inventory data.

k Known contamination based on chemical analytical data, WIDS (WHC 1991a), or other sources.

r Complete remediation reported.

r? Remediation attempted, effectiveness not documented.

A dashed line (--) indicates where no data are available.

Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-B-43 Crib	E33-1	--	2/28/79[a] 4/19/68 5/23/63
216-B-44 Crib	E-33-2	--	7/16/87[a] 5/4/76[a] 4/27/70 5/23/63 5/11/59
216-B-45 Crib	E33-3	--	2/28/79[a] 8/4/76[a] 4/27/70 5/23/63
	E33-22	--	7/16/87[a] 5/4/76[a] 8/27/65
216-B-46 Crib	E34-4	--	7/16/87[a] 5/20/76 4/27/70 5/23/63 1/28/59
	E33-23	--	7/16/87[a] 5/4/76 4/27/70 9/20/65
216-B-47 Crib	E33-5	--	5/4/76 4/27/70 5/23/69 5/4/59
216-B-48 Crib	E33-6	--	7/16/87[a] 5/4/76[a] 4/29/70 5/23/63 5/11/59
216-B-49 Crib	--	--	--
216-B-50 Crib	E33-7	--	2/20/76 7/16/87 4/19/62 1/28/59
	E33-13	--	7/16/87[a] 5/4/76[a]
	E33-38	--	2/20/90[a] 1/9/91[a]

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Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-B-57 Crib	E33-24	--	5/4/76 4/27/70 4/19/62
216-B-61 Crib	E33-25	--	2/20/76[a] 4/24/70
	E33-26	--	5/4/70
216-B-20 Trench	E13-7	--	7/8/87 4/30/76 4/24/68 5/10/63 5/26/59
216-B-21 Trench	E16-8	--	7/9/87[a] 2/10/76 4/24/68 5/10/63 5/4/59
216-B-22 Trench	E13-9	--	7/8/87[a] 4/30/76 4/24/66 5/10/63 5/26/59
216-B-23 Trench	--	--	--
216-B-24 Trench	E13-11	--	3/22/84[a] 4/30/76 5/26/59
216-B-25 Trench	--	--	--
216-B-26 Trench	E13-12	--	7/9/87[a] 4/30/76 5/26/59
216-B-27 Trench	--	--	--
216-B-28 Trench	E13-19	--	7/10/87[a] 4/24/68 5/10/63 5/26/59
216-B-29 Trench	E13-14	--	4/3/84[a] 5/3/76 4/23/68 5/13/63 5/27/59
216-B-30 Trench	--	--	--

9 3 1 2 8 9 6 1 1 2 7

Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-B-31 Trench	E13-15	--	7/9/87[a] 5/3/76 4/23/68 5/13/63 5/27/59
	E13-16	--	7/9/87[a] 3/21/84[a] 4/30/76 4/25/68 5/13/63 5/26/59
216-B-32 Trench	--	--	--
216-B-33 Trench	--	--	--
216-B-34 Trench	E13-10	--	7/9/87[a] 4/30/76 4/24/68 5/13/63 5/26/59
	E13-17	--	7/9/87[a] 5/3/76 5/27/59
	E13-18	--	7/9/87[a] 5/3/76 5/13/63 5/27/59
	E13-54	--	7/13/87[a]
	E13-55	--	7/9/87[a]
	E13-56	--	7/9/87[a]
	E13-57	--	7/9/87[a]
	E13-58	--	7/9/87[a]
	E13-59	--	7/8/87[a]
	E13-60	--	7/8/87[a]
	E13-61	--	7/13/87[a]
216-B-52 Trench	--	--	--
216-B-53A Trench	--	--	--
216-B-53B Trench	--	--	--
216-B-54 Trench	--	--	--
216-B-58 Trench	--	--	--

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Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-B-14 Crib	E13-1	--	7/13/87[a]
216-B-15 Crib	E13-2	--	7/13/87[a]
216-B-16 Crib	E13-3	--	7/10/87[a]
	E13-21	--	7/10/87[a]
216-B-17 Crib	E13-4	--	7/13/87[a]
216-B-18 Crib	E13-5	--	4/18/85[a]
216-B-19 Crib	E13-6	--	7/10/87[a]
	E13-20	--	7/10/87[a]
216-B-9TF Crib and Tile Field	E28-53	--	5/4/76[a] 5/24/63
	E28-54	--	8/25/87[a] 5/4/76[a] 5/24/63[a]
	E28-55	--	5/4/76[a] 5/24/63
	E28-56	--	5/4/76[a]
	E28-57	--	5/4/76[a]
	E28-58	--	5/4/76[a] 5/24/63
	E28-59	--	5/4/76[a]
	E28-60	--	5/4/76[a]
	E28-61	--	5/4/76[a] 5/24/63
	E28-2	--	7/6/79[a] 1/28/76[a]
	E28-5	--	5/4/76[a]
241-BX-155 Diversion Box	--	--	--
241-BX-302C Catch Tank	--	--	--
216-B-5 Reverse Well	E28-3	--	1/28/87[a] 7/6/79[a]
	E28-1	--	5/4/76[a]
	E28-7	--	7/15/89[a]
	E28-4	--	7/15/87[a] 9/22/87[a]
	E28-74	--	8/12/87[a]

9 3 1 2 8 9 6 1 1 2 9

Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
241-B-361 Settling Tank	--	--	--
216-B-56 Crib	E28-14	--	2/5/87[a] 7/6/79[a] 5/4/76
	E28-4	--	1/2/87[a] 7/6/79[a]
216-B-59/59B Trench	--	--	--
241-B-154 Diversion Box	--	--	--
241-B-302B Catch Tank	--	--	--
216-B-12 Crib	E28-9	--	8/25/87[a] 5/5/76[a]
	E28-16	--	5/5/76
	E28-64	--	5/5/76 9/2/67
	E28-65	--	5/5/76[a] 9/2/68
	E28-66	--	5/5/76[a] 9/27/68
	E28-76	--	8/25/87[a]
216-B-55 Crib	E28-12	--	9/27/91[a] 3/20/84[a] 10/8/80[a] 2/19/76[a] 4/28/70 4/18/68
	E28-13	--	9/29/82[a]
	E28-18	--	9/29/82[a]
	E28-19	--	3/20/84[a]
216-B-60 Crib	--	--	--
216-B-64 Retention Basin	--	--	--
218-E-6 Burial Ground	--	--	--
216-B-2-1 Ditch	--	--	--
216-B-2-3 Ditch	--	--	--
216-B-62 Ditch	E28-18	--	4/9/87[a] 10/8/80[a] 2/19/76

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Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
	E28-20	--	9/17/91[a/] 3/23/90[a/] 3/20/84[a/] 10/8/80[a/] 5/4/76
216-B-63 Trench	--	--	--
	E28-21	--	9/27/82[a/] 10/8/80[a/] 5/3/76
	E28-75	--	9/17/91[a/] 3/23/90[a/] 9/21/84[a/] 3/21/84[a/]
	E33-286	--	7/15/87[a/]
	E33-287	--	7/15/87[a/]
	E33-288	--	7/15/87[a/]
	E33-289	--	7/15/87[a/]
	E33-290	--	7/15/87[a/]
218-E-2 Burial Ground	--	--	--
218-E-2A Burial Ground	--	--	--
218-E-4 Burial Ground	--	--	--
218-E-5 Burial Ground	--	--	--
218-E-5A Burial Ground	--	--	--
218-E-8 Burial Ground	--	--	--
216-B-35 Trench		--	--
216-B-36 Trench	E33-10	--	12/3/76[a/]
	E33-21	--	5/4/76[a/] 4/27/70 5/17/63 5/4/59
216-B-37 Trench	--	--	--
216-B-38 Trench	--	--	--
216-B-39 Trench	--	--	--
216-B-40 Trench	--	--	--
216-B-41 Trench	E33-8	--	2/20/76[a/] 5/4/59
216-B-42 Trench	--	--	--

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Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-B-7A,B Cribs	E33-18	--	5/5/76[a/] 5/5/59
	E33-58	--	5/5/76[a/] 5/23/63
	E33-59	--	5/5/76[a/] 5/23/63
	E33-75	--	5/5/76[a/] 5/22/63
218-B-8TF Crib and Tile Field	E33-15	--	5/5/76[a/] 5/5/59
	E33-16	--	2/20/76[a/] 4/28/68 5/22/63 5/5/59
	E28-57	--	5/4/76 5/24/63
	E33-66	--	5/5/76[a/] 5/22/63
	E33-67	--	5/5/76[a/] 5/22/63
	E33-68	--	5/5/76[a/] 5/22/63
	E33-69	--	5/5/76[a/] 5/22/63
	E33-70	--	5/5/76[a/] 5/22/63
	E33-71	--	5/5/76[a/] 5/22/63
	E33-72	--	5/5/76
	E33-73	--	5/5/76[a/] 5/22/63
	E33-74	--	5/5/76[a/] 5/22/63
	E33-76	--	5/5/76[a/]
	E33-89	--	5/5/76[a/] 5/22/63
	E33-12	--	5/4/76
	E33-89	--	1/21/91[a/]

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Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-B-11A,B Reverse Wells	E33-20	--	2/20/76[a]
	E33-19	--	5/5/76[a] 5/5/59
216-B-51 French Drain	E33-11	--	5/5/76[a] 4/24/70 5/20/63 5/5/59
	E33-14	--	5/5/78[a] 4/24/70 5/20/63
216-B-4 Reverse Well	--	--	--
216-B-6 Reverse Well	--	--	--
216-B-10A,B Cribs	E28-17	--	5/5/76
216-B-13 French Drain	--	--	--
216-B-3 Pond	6-43-43	--	9/1/88[a]
	6-43-45	--	6/6/89[a]
	6-44-42	--	9/19/88[a]
	6-44-43B	--	5/18/89[a]
	6-45-42	--	8/18/80[a]
216-B-3A Pond	6-42-41	--	7/30/91[a]
	6-42-42A	--	7/2/80[a]
	6-42-42B	--	9/14/88[a]
	6-43-40	--	8/27/91[a]
	6-43-42	--	5/27/80[a]
	6-43-42J	--	8/10/88[a]
	6-42-42K	--	11/18/88[a]
216-B-3B Pond	6-42-39A	--	8/2/91[a]
	6-42-40C	--	7/14/82[a]
	6-43-41E	--	4/18/89[a]
	6-43-41F	--	4/28/89[a] 4/18/89[a]
216-B-3C Pond	6-39-39	--	5/6/80[a]
	6-40-39	--	6/29/89[a] 4/25/89[a]

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Table 4-4. Summary of Gamma-Ray Logs.

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
	64-40-40A	--	9/17/91[a] 8/30/91[a]
	6-40-40B	--	9/19/91[a] 8/12/91[a] 7/31/91[a] 7/24/91[a]
	6-40-43	--	10/24/91[a]
	6-41-40	--	6/8/89[a] 5/23/89[a]
216-B-3-1 Ditch	--	--	--
216-B-3-2 Ditch	--	--	--
216-B-3-3 Ditch	--	--	--
216-E-28 Pond	--	--	--
218-E-3 Burial Ground	--	--	--

[a]Digitized Logs
A dashed line (--) indicates where no data are available.

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Table 4-5. Results of External Radiation Monitoring, 1985 through 1989: TLDs (mrem/yr).

Location	1985	1986	1987	1988	1989	Average Total
2E1: 200 East Area NW						
Max	83	102	88	112	--	96
Min	62	69	49	85	--	66
Total	72	82	74	96	--	81
2E2: 241-BY Tank Farm NW						
Max	90	109	115	135	--	112
Min	69	78	86	103	--	84
Total	80	92	99	113	--	96
2E3: 241-B, -BY Tank Farm N						
Max	137	154	158	180	--	157
Min	104	11	118	139	--	93
Total	124	123	141	155	--	138
2E7: E-10 W						
Max	78	95	99	129	--	100
Min	66	70	77	92	--	76
Total	73	80	92	107	--	88
2E8: E-10E						
Max	83	100	96	120	124	105
Min	69	76	84	91	80	80
Total	76	86	90	105	104	92

Table 4-5. Results of External Radiation Monitoring, 1985 through 1989: TLDs (mrem/yr).

Location	1985	1986	1987	1988	1989	Average Total
2E9: 241-BX Tank Farm S						
Max	136	142	137	162	140	143
Min	105	98	119	121	92	107
Total	115	117	127	139	126	125
2E13: 200 East Area W						
Max	77	95	95	104	--	93
Min	68	65	75	84	--	73
Total	71	76	83	97	--	82
2E14: B Plant W						
Max	87	100	100	109	112	102
Min	63	71	83	87	104	82
Total	76	83	90	101	106	91
2E15: B Plant NE						
Max	105	136	107	121	120	118
Min	73	84	93	99	108	91
Total	92	105	100	112	113	86
2E19: 200 East Area W						
Max	84	98	93	108	--	96
Min	63	72	82	87	--	76
Total	75	81	88	97	--	85

Table 4-5. Results of External Radiation Monitoring, 1985 through 1989: TLDs (mrem/yr).

Location	1985	1986	1987	1988	1989	Average Total
2E20: B Plant SSW						
Max	69	95	93	106	104	93
Min	67	68	72	60	80	69
Total	68	79	83	88	96	83
2E21: B Plant SSE						
Max	83	97	94	110	116	100
Min	64	70	75	66	68	69
Total	74	80	87	91	98	86
2E25: 200 East Area W						
Max	76	98	91	109	--	94
Min	59	67	69	65	--	65
Total	68	79	78	90	--	79
2E26: 2101-M W						
Max	82	99	98	116	--	99
Min	63	73	79	66	--	70
Total	72	81	88	95	--	84
2E27: 2101-M E						
Max	70	91	89	109	--	90
Min	60	67	72	65	--	66
Total	66	75	80	87	--	77

Table 4-5. Results of External Radiation Monitoring, 1985 through 1989: TLDs (mrem/yr).

Location	1985	1986	1987	1988	1989	Average Total
2E31: U.S. Ecology N						
Max	76	88	92	107	--	91
Min	62	67	70	61	--	65
Total	70	75	82	86	--	78
2E32: B-C Cribs NW						
Max	79	98	95	111	--	96
Min	61	66	70	61	--	65
Total	69	79	84	93	--	81
2E33: 200 East Area S						
Max	79	89	90	107	108	95
Min	61	68	74	61	72	67
Total	69	75	81	90	93	82

Source: Schmidt et al. 1990; Elder et al. 1986, 1987, 1988, 1989.

Table 4-6. Results of External Radiation Monitoring for 1990: TLDs (mrem/yr).

Location	Maximum	Minimum	Average
225: 216-B-3-3 Ditch	152	92	119
226: Gable Mt. Pond East	112	88	98
227: Gable Mt. Pond North	104	80	88
228: West Lake	128	92	106
229: 218-E-10 East[a]	132	104	121
230: 241-BX Tank Farm South[b]	192	108	138
232: 216-B-12 East	120	100	108
233: 221-B West[c]	128	104	116
234: 221-B Northeast[d]	140	96	114
235: 221-B Southwest	112	96	102
236: 221-B SSW[e]	112	100	107
237: 216-B-55-1	128	92	115
238: 216-B-55-2	116	92	103
239: 216-B-62-1	112	92	98
240: 216-B-62-2	112	96	98
241: 216-B-63	128	96	106

Source: Schmidt et al. 1991
Note: The TLD location numbering system changed for 1990.
[a]This site was formerly 2E8.
[b]This site was formerly 2E9.
[c]This site was formerly 2E14.
[d]This site was formerly 2E15.
[e]This site was formerly 2E20.

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Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
Plants, Buildings, and Storage Areas					
2703-E Hazardous Waste Staging Area	NA	NA	NA	NA	NA
2704-E Hazardous Waste Staging Area	NA	NA	NA	NA	NA
2715-EA Hazardous Waste Staging Area	NA	NA	NA	NA	NA
226-B Hazardous Waste Staging Facility	NA	NA	NA	NA	NA
Tanks and Vaults					
241-B-301B Catch Tank	NA	NA	NA	NA	NA
241-B-302B Catch Tank	NA	NA	NA	NA	NA
241-BX-302A Catch Tank	NA	NA	NA	NA	NA
241-BX-302B Catch Tank	NA	NA	NA	NA	NA
241-BX-302C Catch Tank	NA	NA	NA	NA	NA
241-ER-311 Catch Tank	NA	NA	NA	NA	NA
241-B-361 Settling Tank	NA	NA	NA	NA	NA
244-BXR Vault	NA	NA	NA	NA	NA
244-BX Receiving Tank	NA	NA	NA	NA	NA
270-E Cond. Neut. Tank	NA	NA	NA	NA	NA
Cribs and Drains					
216-B-7A Crib	NA	15,000	NA	Mar-92	Beta
216-B-7B Crib	NA	12,000	NA	Mar-92	Beta
216-B-8TF Crib	NA	6,000	NA	Mar-92	Beta
216-B-9TF Crib	NC	NC	NC	Mar-92	NC
216-B-10A Crib	NC	NC	NC	Mar-92	NC
216-B-10B Crib	NC	NC	NC	Mar-92	NC
216-B-12 Crib	NC	NC	NC	Mar-92	NC
216-B-14 Crib	NC	NC	NC	Nov-91	NC
216-B-15 Crib	NC	NC	NC	Nov-91	NC
215-B-16 Crib	NC	NC	NC	Nov-91	NC
216-B-17 Crib	NC	NC	NC	Nov-91	NC
216-B-18 Crib	NC	NC	NC	Nov-91	NC

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Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
216-B-19 Crib	NA	NC	NC	Nov-91	NC
216-B-43 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-44 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-45 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-46 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-47 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-48 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-49 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-50 Crib	NA	6,000-20,000[b]	NA	Mar-90	Beta
216-B-55 Crib	NA	2,000[b]	NA	Mar-92	Beta
216-B-56 Crib	NC	NC	NC	Mar-92	NC
216-B-57 Crib	NC	NC	NC	Mar-92	NC
216-B-60 Crib	NA	NA	NA	NA	NA
216-B-61 Crib	NA	NA	NA	Dec-90	NA
216-B-62 Crib	NC	NC	NC	Mar-92	NC
216-B-13 French Drain	NC	NC	NC	Mar-92	NC
216-B-51 French Drain	NA	4,000	NA	Mar-92	Beta
Reverse Wells					
216-B-4 Reverse Well	NC	NC	NC	Mar-92	NC
216-B-5 Reverse Well	NA	6,000[b]	NA	Mar-92	Beta
216-B-6 Reverse Well	NC	NC	NC	Mar-92	NC
216-B-11A Reverse Well	NA	6,000[b]	NA	Mar-92	Beta
216-B-11B Reverse Well	NA	6,000[b]	NA	Mar-92	Beta
Ponds, Ditches, and Trenches					
216-B-3 Pond	NA	4,000	NA	Aug-91	Beta
216-B-3A Pond	NA	NA	NA	NA	NA
216-B-3B Pond	NA	NA	NA	NA	NA
216-B-3C Pond	NA	NA	NA	NA	NA
216-A-25 Pond	NC	NC	NC	Oct-90	NC
216-E-28 Contingency Pond	NA	NA	NA	NA	NA
216-N-8 Pond	NC	NC	NC	Feb-90	NC
2101-M Pond	NA	NA	NA	NA	NA

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Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
216-B-2-1 Ditch	NA	20,000[a]	NA	Apr-91	Beta
216-B-2-2 Ditch	NA	20,000[a]	NA	Apr-91	Beta
216-B-2-3 Ditch	NA	20,000[a]	NA	Apr-91	Beta
216-B-3-1 Ditch	NC	NC	NC	Mar-92	NC
216-B-3-2 Ditch	NC	NC	NC	Mar-92	NC
216-B-3-3 Ditch	NC	NC	NC	Feb-92	NC
216-B-20 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-21 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-22 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-23 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-24 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-25 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-26 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-27 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-28 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-29 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-30 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-31 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-32 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-33 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-34 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-35 Trench	NC	NC	NC	Apr-92	NC
216-B-36 Trench	NC	NC	NC	Apr-92	NC
216-B-37 Trench	NC	NC	NC	Apr-92	NC
216-B-38 Trench	NC	NC	NC	Apr-92	NC
216-B-39 Trench	NC	NC	NC	Apr-92	NC
216-B-40 Trench	NC	NC	NC	Apr-92	NC
216-B-41 Trench	NC	NC	NC	Apr-92	NC
216-B-42 Trench	NC	NC	NC	Apr-92	NC
216-B-52 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-53A Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-53B Trench	NA	80,000[b]	NA	Nov-91	Beta

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Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
216-B-54 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-58 Trench	NA	80,000[b]	NA	Nov-91	Beta
216-B-63 Trench	NC	NC	NC	Aug-90	Beta
Septic Tanks and Associated Drain Fields					
2607-E1 Septic Tank	NA	NA	NA	NA	NA
2607-E2 Septic Tank	NA	NA	NA	NA	NA
2607-E3 Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-E4 Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-E7B Septic Tank	NA	NA	NA	NA	NA
2607-E8 Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-E9 Septic Tank	NA	NA	NA	NA	NA
2607-E11 Septic Tank	NA	NA	NA	NA	NA
2607-EB Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-EH Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-EK Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-EM Septic Tank	NA	NA	NA	NA	NA
2607-EN Septic Tank	NA	NA	NA	NA	NA
2607-EO Septic Tank	NA	NA	NA	NA	NA
2607-EP Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-EQ Septic Tank/Drain Field	NA	NA	NA	NA	NA
2607-ER Septic Tank	NA	NA	NA	NA	NA
2607-GF Septic Tank/Drain Field	NA	NA	NA	NA	NA
Transfer Facilities, Diversion Boxes, and Pipelines					
241-B-151 Diversion Box	NA	NA	NA	NA	NA
241-B-152 Diversion Box	NA	NA	NA	NA	NA
241-B-153 Diversion Box	NA	NA	NA	NA	NA

9 3 1 2 8 9 6 1 1 4 3

Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
241-B-154 Diversion Box	NA	NA	NA	NA	NA
241-B-252 Diversion Box	NA	NA	NA	NA	NA
241-BR-152 Diversion Box	NA	NA	NA	NA	NA
241-BX-153 Diversion Box	NA	NA	NA	NA	NA
241-BX-154 Diversion Box	NA	NA	NA	NA	NA
241-BX-155 Diversion Box	NA	NA	NA	NA	NA
241-BXR-151 Diversion Box	NA	NA	NA	NA	NA
241-BXR-152 Diversion Box	NA	NA	NA	NA	NA
241-BXR-153 Diversion Box	NA	NA	NA	NA	NA
241-BYR-152 Diversion Box	NA	NA	NA	NA	NA
241-BYR-153 Diversion Box	NA	NA	NA	NA	NA
241-BYR-154 Diversion Box	NA	NA	NA	NA	NA
241-ER-151 Diversion Box	NA	NA	NA	NA	NA
241-ER-152 Diversion Box	NA	NA	NA	NA	NA
242-B-151 Diversion Box	NA	NA	NA	NA	NA
Basins					
207-B Retention Basin	200-600	NA	NA	Jul-90	NA
216-B-59 Retention Basin	NC	NC	NC	Oct-89	NC
216-B-64 Retention Basin	NA	1,000,000	NA	Mar-92	Beta

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Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
Burial Sites					
218-E-2 Burial Ground	10,000[a/]	NA	NA	Nov-90	NA
218-E-2A Burial Ground	NC	NA	NA	Oct-90	NA
218-E-3 Burial Ground	NA	NA	NA	NA	NA
218-E-4 Burial Ground	4,000[a/]	NA	NA	Oct-90	NA
218-E-5 Burial Ground	10,000[a/]	NA	NA	Nov-90	NA
218-E-5A Burial Ground	10,000[a/]	NA	NA	Nov-90	NA
218-E-6 Burial Ground	NA	NA	NA	NA	NA
218-E-7 Burial Ground	NA	NA	NA	NA	NA
218-E-9 Burial Ground	10,000[a/]	NA	NA	Nov-90	NA
218-E-10 Burial Ground	NA	NA	NA	NA	NA
200 Area Construction Pit	NA	NA	NA	NA	NA
200-E Powerhouse Ash Pit	NA	NA	NA	NA	NA
Unplanned Releases					
UN-200-E-1	NA	NA	NA	NA	NA
UN-200-E-2	NA	NA	NA	NA	NA
UN-200-E-3	NA	NA	NA	NA	NA
UN-200-E-7	NA	NA	NA	NA	NA
UN-200-E-9	NA	NA	NA	NA	NA
UN-200-E-14	NA	NA	NA	NA	NA
UN-200-E-41	NA	NA	NA	NA	NA
UN-200-E-43	NA	NA	NA	NA	NA
UN-200-E-44	NA	NA	NA	NA	NA
UN-200-E-45	NA	NA	NA	NA	NA
UN-200-E-52	NA	NA	NA	NA	NA
UN-200-E-54	NA	NA	NA	NA	NA
UN-200-E-55	NA	NA	NA	NA	NA
UN-200-E-61	NA	NA	NA	NA	NA
UN-200-E-63	100,000	6,000	NA	Jun-81	gamma (dis/min)
UN-200-E-64	NA	NA	NA	NA	NA
UN-200-E-69	NA	NA	NA	NA	NA

9 3 1 2 8 9 6 1 1 4 5

Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
UN-200-E-76	NA	NA	NA	NA	NA
UN-200-E-79	NA	NA	NA	NA	NA
UN-200-E-80	NA	NA	NA	NA	NA
UN-200-E-83	NA	NA	NA	NA	NA
UN-200-E-85	200[a]	NA	NA	1975	NA
UN-200-E-87	NC	NC	NC	Sep-89	NA
UN-200-E-89	1,000-2,000[b] 200-400[b] 100,000[b]	NA	NA	1978 Sep-90	NA
UN-200-E-90	NA	NA	NA	NA	NA
UN-200-E-92	NA	NA	NA	NA	NA
UN-200-E-95	200-400	4,000[b]	NA	Sep-90	NA
UN-200-E-101	NC	NC	NC	Sep-90	NA
UN-200-E-103	NA	NA	NA	NA	NA
UN-200-E-105	NA	NA	NA	NA	NA
UN-200-E-109	NA	NA	NA	NA	NA
UN-200-E-110	NA	NA	NA	NA	NA
UN-200-E-112	NA	NA	NA	NA	NA
UN-200-E-140	NA	NA	NA	NA	NA
UPR-200-E-4	NA	NA	NA	NA	NA
UPR-200-E-5	NA	NA	NA	NA	NA
UPR-200-E-6	NA	NA	NA	NA	NA
UPR-200-E-32	20,000[b] 2,000[a] 4,000[b]	NA	NA	Sep-89	NA
UPR-200-E-34	NA	NA	NA	NA	NA
UPR-200-E-38	NA	NA	NA	NA	NA
UPR-200-E-51	NA	NA	NA	NA	NA
UPR-200-E-73	NA	NA	NA	NA	NA
UPR-200-E-74	30,000	NA	NA	1975	NA
UPR-200-E-75	NA	NA	NA	NA	NA
UPR-200-E-77	200-600	NA	2[b]	Sep-90	NA
UPR-200-E-78	150	5[b]	NA	Sep-90	NA

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Table 4-7. Results of External Radiation Surveys.

Waste Management Unit	Radiation Surveys			Radiation Survey Date	Radiation Type
	ct/min	dis/min	mrem/h		
UPR-200-E-84	90,000 3,000	NA	NA	Oct-75 Sep-90	NA
UPR-200-E-108	NA	NA	NA	NA	NA
UPR-200-E-116	NA	NA	NA	NA	NA
UPR-200-E-127	NA	NA	NA	NA	NA
UPR-200-E-128	NA	NA	NA	NA	NA
UPR-200-E-129	NA	NA	NA	NA	NA
UPR-200-E-130	NA	NA	NA	NA	NA
UPR-200-E-131	NA	NA	NA	NA	NA
UPR-200-E-132	NA	NA	NA	NA	NA
UPR-200-E-133	NA	NA	NA	NA	NA
UPR-200-E-134	NA	NA	NA	NA	NA
UPR-200-E-135	NA	NA	NA	NA	NA
UPR-200-E-138	NA	NA	NA	NA	NA

[a]Tumbleweeds/vegetation
[b]Localized spot
[c] Elevated background levels
NA = Not available
NC = No contamination detected

9 3 1 2 8 9 6 1 1 4 7

Table 4-8. Summary of Grid Soil Sampling Results (pCi/g). Page 1 of 3

Radionuclide	Site								
	2 E1[a]	2 E2[a]	2 E3[a]	2 E7[a]	2 E8[a]	2 E9[a]	2 E13[a]	2 E14[a]	2 E15[a]
Ce-141	-9.40E-03	--	-2.59E-02	--	3.07E-02	-8.10E-02	3.44E-02	1.37E-02	--
Ce-144	-2.80E-02	-2.10E-04	1.91E-02	4.40E-02	-6.10E-03	-1.86E-02	4.66E-02	-4.43E-03	-7.70E-03
Co-58	-2.95E-03	1.74E-02	2.85E-03	8.00E-03	8.23E-03	5.52E-03	3.23E-03	6.00E-04	-1.30E-02
Co-60	-5.85E-03	1.80E-02	5.80E-03	-1.40E-03	1.15E-02	5.60E-03	7.34E-03	1.20E-02	-1.50E-03
Cs-134	-2.65E-02	4.00E-02	-1.50E-03	-1.00E-02	-1.40E-03	-1.73E-02	3.42E-02	1.56E-02	1.78E-02
Cs-137	2.45E+00	2.39E+00	2.22E+01	1.80E+00	7.40E+00	1.74E+01	7.72E-01	6.10E+00	1.35E+00
Eu-152	9.65E-02	1.30E-01	1.02E-01	8.10E-02	1.08E-01	1.48E-01	1.02E-01	6.57E-02	1.13E-01
Eu-154	-3.10E-02	6.20E-02	2.78E-02	2.40E-02	2.22E-02	-1.29E-02	4.02E-02	-3.55E-02	5.70E-02
Eu-155	9.30E-02	8.35E-02	1.07E-01	6.60E-02	5.59E-02	1.74E-04	7.85E-02	6.96E-02	4.10E-02
I-129	--	--	-1.68E+00	--	-2.18E-01	8.29E-02	9.19E-02	1.88E-01	--
K-40	--	--	1.52E+01	--	1.38E+01	1.32E+01	1.36E+01	1.48E+01	--
Mn-54	1.33E-02	2.30E-02	1.30E-02	-5.90E-03	2.39E-02	-4.39E-02	2.32E-03	1.72E-02	6.40E-03
Nb-95	--	--	-4.12E-02	--	-1.56E-01	-5.88E-02	2.31E-02	1.03E-01	--
Pb-212	--	--	8.84E-01	--	8.95E-01	6.87E-01	6.37E-01	1.85E-01	--
Pb-214	7.00E-01	7.90E-01	7.24E-01	7.20E-01	7.15E-01	6.42E-01	5.38E-01	6.71E-01	6.60E-01
Pu-238	2.04E-03	7.42E-04	9.00E-04	4.60E-04	1.23E-03	1.00E-03	3.94E-03	3.78E-04	5.90E-04
Pu-239	1.23E-01	1.23E-02	3.05E-02	3.80E-01	5.49E-02	2.00E-02	3.71E-02	1.52E-02	3.98E-02
Ru-106	-8.00E-02	--	7.14E-02	-4.70E-02	-4.21E-02	1.29E-01	2.83E-02	-1.40E-02	-4.00E-02
Sr-90	3.40E-01	1.73E-01	9.10E-01	3.30E-01	5.55E-01	2.28E+00	1.99E-01	6.92E-01	1.05E+00
Tc-99	--	--	4.80E-01	--	4.78E-01	3.28E-01	9.95E-01	2.17E-01	--
U (total)	1.55E-01	2.12E-01	2.08E-01	2.90E-01	2.97E-01	2.38E-01	3.05E-01	2.40E-01	3.24E-01
Zn-65	-3.40E-02	-1.20E-01	-8.03E-02	-4.60E-02	-5.15E-02	-8.75E-02	4.54E-02	2.18E-03	-3.90E-02
Zr-95	9.00E-03	-7.30E-03	5.36E-03	-5.50E-03	2.92E-02	1.42E-03	2.16E-02	2.05E-02	5.90E-03
Radionuclide	Site								
	2 E1[a]	2 E2[a]	2 E3[a]	2 E7[a]	2 E8[a]	2 E9[a]	2 E13[a]	2 E14[a]	2 E15[a]
Ce-141	-9.40E-03	--	-2.59E-02	--	3.07E-02	-8.10E-02	3.44E-02	1.37E-02	--
Ce-144	-2.80E-02	-2.10E-04	1.91E-02	4.40E-02	-6.10E-03	-1.86E-02	4.66E-02	-4.43E-03	-7.70E-03
Co-58	-2.95E-03	1.74E-02	2.85E-03	8.00E-03	8.23E-03	5.52E-03	3.23E-03	6.00E-04	-1.30E-02
Co-60	-5.85E-03	1.80E-02	5.80E-03	-1.40E-03	1.15E-02	5.60E-03	7.34E-03	1.20E-02	-1.50E-03
Cs-134	-2.65E-02	4.00E-02	-1.50E-03	-1.00E-02	-1.40E-03	-1.73E-02	3.42E-02	1.56E-02	1.78E-02
Cs-137	2.45E+00	2.39E+00	2.22E+01	1.80E+00	7.40E+00	1.74E+01	7.72E-01	6.10E+00	1.35E+00
Eu-152	9.65E-02	1.30E-01	1.02E-01	8.10E-02	1.08E-01	1.48E-01	1.02E-01	6.57E-02	1.13E-01
Eu-154	-3.10E-02	6.20E-02	2.78E-02	2.40E-02	2.22E-02	-1.29E-02	4.02E-02	-3.55E-02	5.70E-02
Eu-155	9.30E-02	8.35E-02	1.07E-01	6.60E-02	5.59E-02	1.74E-04	7.85E-02	6.96E-02	4.10E-02
I-129	--	--	-1.68E+00	--	-2.18E-01	8.29E-02	9.19E-02	1.88E-01	--
K-40	--	--	1.52E+01	--	1.38E+01	1.32E+01	1.36E+01	1.48E+01	--

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Table 4-8. Summary of Grid Soil Sampling Results (pCi/g). Page 2 of 3

Mn-54	1.33E-02	2.30E-02	1.30E-02	-5.90E-03	2.39E-02	-4.39E-02	2.32E-03	1.72E-02	6.40E-03
Nb-95	–	–	-4.12E-02	–	-1.56E-01	-5.88E-02	2.31E-02	1.03E-01	–
Pb-212	–	–	8.84E-01	–	8.95E-01	6.87E-01	6.37E-01	1.85E-01	–
Pb-214	7.00E-01	7.90E-01	7.24E-01	7.20E-01	7.15E-01	6.42E-01	5.38E-01	6.71E-01	6.60E-01
Pu-238	2.04E-03	7.42E-04	9.00E-04	4.60E-04	1.23E-03	1.00E-03	3.94E-03	3.78E-04	5.90E-04
Pu-239	1.23E-01	1.23E-02	3.05E-02	3.80E-01	5.49E-02	2.00E-02	3.71E-02	1.52E-02	3.98E-02
Ru-106	-8.00E-02	–	7.14E-02	-4.70E-02	-4.21E-02	1.29E-01	2.83E-02	-1.40E-02	-4.00E-02
Sr-90	3.40E-01	1.73E-01	9.10E-01	3.30E-01	5.55E-01	2.28E+00	1.99E-01	6.92E-01	1.05E+00
Tc-99	–	–	4.80E-01	–	4.78E-01	3.28E-01	9.95E-01	2.17E-01	–
U (total)	1.55E-01	2.12E-01	2.08E-01	2.90E-01	2.97E-01	2.38E-01	3.05E-01	2.40E-01	3.24E-01
Zn-65	-3.40E-02	-1.20E-01	-8.03E-02	-4.60E-02	-5.15E-02	-8.75E-02	4.54E-02	2.18E-03	-3.90E-02
Zr-95	9.00E-03	-7.30E-03	5.36E-03	-5.50E-03	2.92E-02	1.42E-03	2.16E-02	2.05E-02	5.90E-03
Radionuclide	Site								
	2 E19[a]	2 E20[a]	2 E21[a]	2 E25[a]	2 E26[a]	2 E27[a]	2 E31[a]	2 E32[a]	2 E33[a]
Ce-141	-1.8E-02	5.20E-02	-4.70E-02	–	-1.10E-02	–	–	2.50E-02	–
Ce-144	8.15E-02	-3.51E-02	3.85E-02	-3.10E-02	1.22E-02	4.70E-02	-6.30E-02	-2.85E-02	-5.00E-03
Co-58	-1.85E-02	1.91E-02	3.35E-03	1.60E-02	-3.20E-03	1.70E-02	1.80E-03	-1.30E-02	1.70E-02
Co-60	3.10E-03	6.83E-03	4.03E-03	5.80E-03	-8.90E-03	3.20E-03	2.55E-02	-1.12E-02	-4.50E-03
Cs-134	8.00E-03	8.80E-03	2.05E-02	-8.10E-03	2.63E-902	1.55E-02	3.17E-02	3.25E-02	-1.50E-03
Cs-137	9.00E-01	2.52E+00	8.70E-01	4.60E-01	7.40E-01	2.57E-01	4.58E-01	8.38E-01	5.85E-02
Eu-152	5.80E-02	1.10E-01	8.20E-02	7.50E-02	1.35E-02	7.95E-02	1.17E-01	7.64E-02	5.70E-02
Eu-154	-8.85E-03	7.14E-02	3.70E-02	1.10E-02	4.35E-02	8.00E-02	4.65E-02	3.67E-03	-1.70E-02
Eu-155	5.65E-02	8.28E-02	5.05E-02	5.00E-02	5.20E-02	3.60E-02	3.50E-02	8.20E-02	4.50E-02
I-129	–	-5.94E-01	-9.10E-02	–	–	–	–	–	–
K-40	–	1.51E+01	–	–	–	–	–	–	–
Mn-54	-1.00E-03	1.33E-02	1.61E-02	1.70E-02	1.15E-02	2.40E-02	2.00E-02	1.29E-02	1.09E-02
Nb-95	–	-3.70E-04	–	–	–	–	–	–	–
Pb-212	–	7.79E-01	–	–	–	–	–	–	–
Pb-214	3.60E-01	6.47E-01	6.60E-01	5.60E-01	6.50E-01	5.60E-01	5.70E-01	6.10E-01	5.10E-01
Pu-238	7.40E-04	4.71E-04	4.00E-04	4.90E-04	5.00E-04	–	5.15E-04	5.20E-05	1.70E-04
Pu-239	2.70E-02	3.20E-02	3.70E-02	1.30E-02	1.55E-02	3.70E-03	9.67E-03	1.37E-02	9.00E-04
Ru-106	9.00E-03	1.10E-02	1.73E-02	–	7.10E-02	1.80E-03	2.22E-01	-1.00E-02	-5.10E-02
Sr-90	1.90E-01	6.16E-01	2.71E-01	4.20E-02	4.45E-01	3.92E-01	2.82E-01	6.00E-01	1.82E-01
Tc-99	–	1.26E-01	4.60E-01	–	–	–	–	–	–
U (total)	2.80E-01	3.29E-01	2.86E-01	3.00E-01	2.85E-01	3.65E-01	3.18E-01	2.89E-01	2.40E-01
Zn-65	-3.79E-02	-9.60E-02	-1.10E-02	-5.20E-02	-2.03E-01	-1.40E-01	-3.80E-02	-4.00E-02	-4.50E-02
Zr-95	2.60E-02	3.04E-02	2.30E-02	1.50E-02	-2.59E-03	1.30E-03	2.70E-02	5.33E-04	4.05E-02

Table 4-8. Summary of Grid Soil Sampling Results (pCi/g). Page 3 of 3

Radionuclide	Site								
	2 E19[a]	2 E20[a]	2 E21[a]	2 E25[a]	2 E26[a]	2 E27[a]	2 E31[a]	2 E32[a]	2 E33[a]
Ce-141	-1.8E-02	5.20E-02	-4.70E-02	–	-1.10E-02	–	–	2.50E-02	–
Ce-144	8.15E-02	-3.51E-02	3.85E-02	-3.10E-02	1.22E-02	4.70E-02	-6.30E-02	-2.85E-02	-5.00E-03
Co-58	-1.85E-02	1.91E-02	3.35E-03	1.60E-02	-3.20E-03	1.70E-02	1.80E-03	-1.30E-02	1.70E-02
Co-60	3.10E-03	6.83E-03	4.03E-03	5.80E-03	-8.90E-03	3.20E-03	2.55E-02	-1.12E-02	-4.50E-03
Cs-134	8.00E-03	8.80E-03	2.05E-02	-8.10E-03	2.63E-902	1.55E-02	3.17E-02	3.25E-02	-1.50E-03
Cs-137	9.00E-01	2.52E+00	8.70E-01	4.60E-01	7.40E-01	2.57E-01	4.58E-01	8.38E-01	5.85E-02
Eu-152	5.80E-02	1.10E-01	8.20E-02	7.50E-02	1.35E-02	7.95E-02	1.17E-01	7.64E-02	5.70E-02
Eu-154	-8.85E-03	7.14E-02	3.70E-02	1.10E-02	4.35E-02	8.00E-02	4.65E-02	3.67E-03	-1.70E-02
Eu-155	5.65E-02	8.28E-02	5.05E-02	5.00E-02	5.20E-02	3.60E-02	3.50E-02	8.20E-02	4.50E-02
I-129	–	-5.94E-01	-9.10E-02	–	–	–	–	–	–
K-40	–	1.51E+01	–	–	–	–	–	–	–
Mn-54	-1.00E-03	1.33E-02	1.61E-02	1.70E-02	1.15E-02	2.40E-02	2.00E-02	1.29E-02	1.09E-02
Nb-95	–	-3.70E-04	–	–	–	–	–	–	–
Pb-212	–	7.79E-01	–	–	–	–	–	–	–
Pb-214	3.60E-01	6.47E-01	6.60E-01	5.60E-01	6.50E-01	5.60E-01	5.70E-01	6.10E-01	5.10E-01
Pu-238	7.40E-04	4.71E-04	4.00E-04	4.90E-04	5.00E-04	–	5.15E-04	5.20E-05	1.70E-04
Pu-239	2.70E-02	3.20E-02	3.70E-02	1.30E-02	1.55E-02	3.70E-03	9.67E-03	1.37E-02	9.00E-04
Ru-106	9.00E-03	1.10E-02	1.73E-02	–	7.10E-02	1.80E-03	2.22E-01	-1.00E-02	-5.10E-02
Sr-90	1.90E-01	6.16E-01	2.71E-01	4.20E-02	4.45E-01	3.92E-01	2.82E-01	6.00E-01	1.82E-01
Tc-99	–	1.26E-01	4.60E-01	–	–	–	–	–	–
U (total)	2.80E-01	3.29E-01	2.86E-01	3.00E-01	2.85E-01	3.65E-01	3.18E-01	2.89E-01	2.40E-01
Zn-65	-3.79E-02	-9.60E-02	-1.10E-02	-5.20E-02	-2.03E-01	-1.40E-01	-3.80E-02	-4.00E-02	-4.50E-02
Zr-95	2.60E-02	3.04E-02	2.30E-02	1.50E-02	-2.59E-03	1.30E-03	2.70E-02	5.33E-04	4.05E-02

[a]All values are averages for each year with a detection since 1985. A dashed line (–) indicates where no data are available. Table A-2.3 provides a complete set of data from 1985 through 1989.

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Table 4-9. Summary of Fenceline Soil Sampling Results.

Radionuclide	Site			
	2E-N[a]	B-TF-NE[a]	B-TF-SE[a]	BX-TF-W[a]
Ce-141	-1.76E-02	-3.83E-02	-7.33E-03	1.97E-03
Ce-144	-8.70E-02	4.65E-02	-4.26E-02	-6.00E-03
Co-58	2.30E-03	3.31E-03	7.20E-03	-2.07E-02
Co-60	1.03E-02	1.64E-02	9.37E-03	-9.30E-03
Cs-134	2.28E-02	-1.08E-02	-6.33E-03	4.17E-03
Cs-137	9.42E+00	1.57E+02	1.64E+01	4.70E+00
Eu-152	9.75E-02	4.23E-02	1.48E-02	8.55E-02
Eu-154	-5.60E-03	-4.71E-02	4.92E-02	-2.89E-02
Eu-155	5.90E-02	9.40E-02	4.53E-02	1.44E-02
K-40	1.58E+01	1.39E+01	1.43E+01	1.33E+01
Mn-54	1.98E-02	5.79E-03	7.21E-03	7.57E-03
Nb-95	1.34E-02	-3.71E-02	-4.84E-02	-6.80E-02
Pb-212	8.38E-01	4.31E-01	6.78E-01	5.89E-01
Pb-214	6.92E-01	5.57E-01	5.84E-01	5.62E-01
Pu-238	-3.20E-05	2.60E-04	3.75E-04	2.35E-04
Pu-239	4.30E-03	7.40E-03	9.50E-03	4.95E-03
Ru-106	-1.33E-03	-1.12E-01	-5.60E-02	-2.10E-02
Sr-90	1.55E+00	7.56E+00	6.96E+00	2.69E-01
U (total)	8.70E-02	3.20E-01	1.22E-01	3.32E-01
Zn-65	-5.23E-02	-4.57E-02	-1.37E-02	2.99E-02
Zr-95	1.55E-03	2.41E-02	1.50E-02	-3.37E-03

[a]All values are averages for each year with a detection since 1985. Table A-2.1 provides a complete set of data from 1985 through 1989.

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Table 4-10. Summary of Vegetation Sampling Results (pCi/g). Page 1 of 2

Radionuclide	Site								
	2 E1[a]	2 E2[a]	2 E3[a]	2 E7[a]	2 E8[a]	2 E9[a]	2 E13[a]	2 E14[a]	2 E15[a]
Be-7	--	--	--	--	--	--	--	--	--
Ce-141	-7.70E-03	-7.70E-03	-1.79E-02	-5.20E-02	-1.54E-02	6.10E-03	-5.20E-03	-1.43E-02	3.50E-02
Co-58	--	--	--	--	--	--	--	--	--
Co-60	-1.90E-03	1.85E-02	2.25E-02	-3.10E-03	1.36E-02	1.56E-02	3.74E-03	1.18E-02	-1.40E-03
Cs-134	4.30E-02	7.98E-02	--	--	1.45E-01	--	1.19E-01	3.91E-02	--
Cs-137	8.98E-02	3.02E-01	4.63E-01	8.60E-02	1.32E-01	2.26E-01	2.48E+01	5.12E-01	1.76E-01
Eu-152	5.40E-02	6.48E-02	-2.39E-02	-2.30E-02	8.48E-02	6.41E-02	6.24E-02	3.07E-02	5.70E-02
Eu-154	3.11E-02	4.10E-02	1.03E-02	-7.10E-02	1.34E-02	1.66E-02	-9.74E-03	1.25E-02	-8.90E-03
Eu-155	1.88E-02	6.20E-03	5.71E-02	-2.20E-03	5.16E-02	3.25E-02	-9.30E-03	1.40E-03	3.57E-02
I-129	--	--	-2.29E-01	--	6.43E-02	1.62E-01	1.29E-01	3.17E-02	--
K-40	--	--	1.10E+01	--	1.09E+01	1.09E+01	1.27E+01	1.27E+01	--
Nb-95	8.43E-03	6.00E-02	-2.24E-02	6.24E-04	1.70E-02	-3.66E-03	1.71E-02	3.53E-03	1.50E-02
Pb-212	--	--	-4.25E-01	--	5.21E-02	5.21E-02	6.24E-02	6.24E-02	--
Pb-214	--	--	5.33E-02	--	3.91E-02	3.91E-02	7.09E-02	7.09E-02	--
Pu-238	--	--	1.22E-04	--	9.34E-05	3.92E-05	2.20E-03	2.20E-03	--
Pu-239	4.00E-04	--	7.26E-04	--	1.80E-03	1.75E-03	5.79E-03	5.79E-03	--
Ru-103	--	--	--	--	1.94E-01	--	1.75E-01	--	1.04E-01
Ru-106	--	--	--	--	--	--	--	--	--
Sr-90	2.15E-01	--	2.48E-01	--	4.31E-02	4.16E-01	1.21E-01	7.15E-02	--
Tc-99	--	--	6.07E-01	--	8.03E-02	3.60E-01	4.26E-01	3.68E-01	--
Zr-95	6.00E-03	3.50E-02	6.79E-03	-3.70E-02	-1.36E-02	7.50E-04	1.01E-02	1.19E-02	-7.10E-02

Radionuclide	Site								
	2 E19[a]	2 E20[a]	2 E21[a]	2 E25[a]	2 E26[a]	2 E27[a]	2 E31[a]	2 E32[a]	2 E33[a]
Be-7	--	--	--	--	--	--	--	--	--
Ce-141	-2.10E-02	-1.52E-02	2.60E-02	-3.20E-03	3.00E-02	-8.40E-02	3.50E-02	-8.60E-03	-5.20E-02
Co-58	--	--	--	--	--	--	-5.60E-03	--	--
Co-60	1.37E-02	-8.68E-03	1.49E-02	-1.70E-02	-1.80E-03	1.10E-02	2.32E-01	-8.40E-03	4.60E-03
Cs-134	--	6.10E-01	--	--	--	5.60E-02	1.92E-01	3.13E-01	--
Cs-137	4.34E-02	3.07E-01	1.31E-01	1.56E-01	9.60E-02	1.39E-01	9.25E-02	2.54E-01	9.96E-02
Eu-152	2.00E-03	1.85E-02	3.40E-02	3.40E-02	6.30E-02	3.10E-02	4.90E-02	-6.50E-02	3.30E-02
Eu-154	4.80E-02	1.32E-02	-1.60E-02	2.40E-02	1.30E-02	-6.30E-03	3.30E-03	6.70E-03	-1.80E-02
Eu-155	6.06E-02	4.70E-03	-6.50E-03	5.86E-02	3.70E-02	2.60E-02	--	1.80E-02	5.20E-02
I-129	--	3.21E-01	--	--	--	--	--	--	--
K-40	--	1.04E+01	--	--	--	--	-5.10E-02	--	--
Nb-95	-2.90E-03	1.05E-01	2.80E-03	-2.30E-02	2.90E-02	-1.30E-02	--	-2.20E-02	-2.60E-02
Pb-212	--	1.10E-01	--	--	--	--	--	--	--
Pb-214	--	6.68E-02	--	--	--	--	--	--	--

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Table 4-10. Summary of Vegetation Sampling Results (pCi/g). Page 2 of 2

Radionuclide	Site								
	2 E19[a]	2 E20[a]	2 E21[a]	2 E25[a]	2 E26[a]	2 E27[a]	2 E31[a]	2 E32[a]	2 E33[a]
Pu-238	--	1.47E-04	--	--	--	--	--	--	--
Pu-239	--	3.17E-03	--	--	--	--	1.70E-03	--	--
Ru-103	--	2.46E-01	3.95E-02	--	--	8.95E-02	2.06E-01	1.90E-01	--
Ru-106	--	--	--	--	--	--	--	--	--
Sr-90	1.70E-01	2.16E-01	--	--	4.90E-02	--	4.54E-01	--	1.80E-01
Tc-99	--	9.33E-01	--	--	--	--	--	--	--
Zr-95	1.48E-02	-1.00E-03	1.50E-02	3.32E-02	1.10E-02	4.90E-02	6.35E-02	-2.70E-03	-2.90E-02

[a]All values are averages for each year with a detection since 1985. A dashed line (--) indicates where no data are available. Table A-2.2 provides a complete set of data from 1985 through 1989.

Table 4-11. Summary of Air Monitoring Results (pCi/m^3).

Radionuclide	Site						
	N116[a]	N157[a]	N159[a]	N957[a]	N967[a]	N968[a]	N973[a]
Sr-90	5.89E-04	2.95E-04	9.80E-04	1.26E-03	6.46E-04	5.05E-04	8.95E-04
Cs-137	9.94E-04	2.21E-02	1.65E-02	1.19E-03	4.14E-03	1.15E-03	4.85E-03
Pu-239	4.54E-05	3.49E-05	1.03E-04	2.48E-05	2.36E-05	3.82E-05	2.93E-04
U (Total)	2.52E-04	1.59E-04	1.43E-04	2.07E-04	1.21E-04	2.05E-04	1.39E-04

[a]All values are averages for each year with a detection since 1985. Table A-2.4 provides a complete set of data from 1985 through 1989.

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Table 4-12. Summary of Surface Water Sampling[a] (pCi/L).

Radionuclide	1985		1986		1987		1988		1989	
	Result	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error
Location RM18: 216-B-63 Ditch										
Total beta	Max. 1,700 Min. 27 Avg. 233	922	376 <24		<98 <DL		<DL <DL		66 <DL	
Total alpha	Max. 12 Min. 1 Avg. 4	6	<11 <DL		<4 <DL		29 <DL		7 <DL	
Cs-137	Max. 630 Min. 42 Avg. 105	323	200 <DL		170 <DL		149 <DL		107 <DL	
Sr-90	Max. 1,260 Min. 14 Avg. 140	679	166 <DL		<28 <DL		<DL <DL		28 <DL	
Location RM21: 216-B-3-3 Ditch										
Total beta	Max. 420 Min. 7 Avg. 65	234	756 <22		155 <DL		191 <DL		225 <DL	
Total alpha	Max. 12 Min. 1 Avg. 3	6	22 <DL		52 <DL		<DL <DL		38 <DL	
Cs-137	Max. 56 Min. 43 Avg. 47	8	<7 <DL		<55 <DL		<DL <DL		64 <DL	
Sr-90	Max. 50 Min. 18 Avg. 31	20	53 <DL		<40 <DL		<DL 14		26 <DL	

Table 4-12. Summary of Surface Water Sampling[a] (pCi/L).

Radionuclide	1985		1986		1987		1988		1989	
	Result	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error
Location RM22: 216-B-3 Pond North										
Total beta	Max. 139 Min. 17 Avg. 45	66	<130 <17		<44 <DL		115 <DL		115 <DL	
Total alpha	Max. 30 Min. 2 Avg. 9	21	7 <DL		10 <DL		<DL <DL		27 <DL	
Cs-137	Max. 80 Min. 40 Avg. 50	20	<56 <DL		<60 <DL		<DL <DL		90 <DL	
Sr-90	Max. 50 Min. 16 Avg. 28	25	510 <DL		<42 <DL		<DL <DL		<DL <DL	
Location RM23: 216-B-3 Pond South										
Total beta	Max. 95 Min. 16 Avg. 42	46	110 <16		<110 <DL		112 <DL		232 <DL	
Total alpha	Max. 9 Min. 1 Avg. 4	5	<8 <DL		<30 <DL		5 <DL		<DL <DL	
Cs-137	Max. 74 Min. 40 Avg. 48	19	<80 <DL		143 <DL		125 <DL		64 <DL	
Sr-90	Max. 256 Min. 10 Avg. 41	130	1.09 <DL		<43 <DL		<DL <DL		29 <DL	

Table 4-12. Summary of Surface Water Sampling[a] (pCi/L).

Radionuclide	1985		1986		1987		1988		1989	
	Result	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error
Location RM24: 216-A-25 Pond Inlet										
Total beta	Max. 380 Min. 10 Avg. 50	200	267 <16		59 <DL		NC		NC	
Total alpha	Max. 5 Min. 1 Avg. 3	2	<4 <DL		<13 <DL		NC		NC	
Cs-137	Max. 120 Min. 43 Avg. 56	43	141 <DL		<80 38		NC		NC	
Sr-90	Max. 58 Min. 11 Avg. 40	132	<72 <DL		<110 <DL		NC		NC	
Location RM25: 216-A-25 Pond Outfall										
Total beta	Max. 66 Min. 13 Avg. 38	35	<330 37		260 45		NC		NC	
Total alpha	Max. 22 Min. 1 Avg. 4	11	<10 <DL		<11 <DL		NC		NC	
Cs-137	Max. 80 Min. 42 Avg. 48	19	<90 <DL		140 <DL		NC		NC	
Sr-90	Max. 50 Min. 15 Avg. 28	19	85 <1.8		45 <DL		NC		NC	

Table 4-12. Summary of Surface Water Sampling[a] (pCi/L).

Radionuclide	1985		1986		1987		1988		1989	
	Result	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error
Location RM26: 216-B-3 Pond Overflow										
Total beta	Max. 67 Min. 12 Avg. 31	33	74 <13		30 <DL		102 <DL		82 <DL	
Total alpha	Max. 11 Min. 1 Avg. 4	5	3 <DL		10 <DL		<DL <DL		20 <DL	
Cs-137	Max. 116 Min. 38 Avg. 54	43	<64 <DL		<87 <DL		<DL <DL		64 <DL	
Sr-90	Max. 269 Min. 16 Avg. 45	138	<45 <DL		<30 <DL		<DL <DL		27 <DL	
Location RM29: 216-B-3 Pond 3rd Over Flow										
Total beta	Max. 44 Min. 21 Avg. 29	20	142 <14		<59 <DL		100 <DL		114 <DL	
Total alpha	Max. 3 Min. 2 Avg. 2	1	41 <DL		<14 <DL		5 <DL		24 <DL	
Cs-137	Max. 61 Min. 43 Avg. 49	17	<63 <DL		<57 <DL		87 <DL		63 <DL	
Sr-90	Max. 84 Min. 27 Avg. 43	55	114 <DL		<40 <DL		27 <DL		78 <DL	

Table 4-12. Summary of Surface Water Sampling[a] (pCi/L).

Radionuclide	1985		1986		1987		1988		1989	
	Result	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error	Result[b]	Error
Location RM53: West Lake										
Total beta	Max. 54,000 Min. 190 Avg. 13,700	53	<520 <130		578 320		642 18		494 <DL	
Total alpha	Max. 6,200 Min. 40 Avg. 1,590	6,140	<190 <DL		132 39		114 3		100 <DL	
Cs-137	Max. 53 Min. 40 Avg. 41	7	<DL <DL		<44 <DL		<DL 00		60 <DL	
Sr-90	Max. 20 Min. 10 Avg. 13	8	<30 <DL		<20 <DL		<DL <DL		<DL <DL	

[a]Source: Elder et al. 1985, 1986, 1987, 1988, and 1989

[b]DL = Detection Limit: Beta = 100 pCi/L; Alpha = 40 pCi/L; ^{137}Cs = 200 pCi/L; and, ^{90}Sr = 100 pCi/L (Schmidt et. al. 1992) Shading indicates positive detection (result greater than error).

NC = No samples collected in 1988 and 1989.

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Table 4-13. Summary of Single-Shell Tank Waste Sampling Data.

Tank	Description	Date	Pu (g/g)	^{137}Cs (μCi/g)	$^{89,90}Sr$ (μCi/g)	^{154}Eu (μCi/g)	Bulk Density (g/cm^3)
B-101	Sludge	3-15-73	--	9.9×10^2	1.92×10^4	0.56×10^2	2.38
B-101	Liquid	3-15-73	--	1.77×10^2	14.5	0.88	--
B-101	Sludge	2-24-76	1.21×10^{-5}	4.21×10^2	1.57×10^3	--	1.59
B-104	Salt crystals	5-22-73	--	0.3	--	--	--
B-105	Solids	6-9-76	--	0.64	5.9	--	1.10
B-107	Sludge	4-8-76	2.73×10^{-6}	3.2	12.9	0.4	1.64
B-201	Solid	--	5.00×10^{-5}	0.109	2.70	--	1.37
B-202	Solid	--	5.50×10^{-6}	0.15	1.01×10^3	--	1.25
B-203	Solid	--	9.01×10^{-6}	0.009	6.54	--	1.09
B-203	Solid	12-30-82	1.17×10^{-6}	0.03	13.12	--	--
B-204	Solid	--	9.74×10^{-6}	0.012	4.00	--	1.14
BX-101	Sludge	3-8-76	0.86×10^{-6}	7.14×10^2	1.07×10^3	--	1.68
BX-107	Solid	7-25-79	1.75×10^{-6}	11.14	14.20	--	1.46
BX-110	Solid	2-14-79	2.13×10^{-6}	47.3	7.8	--	1.44
BY-104	Sludge	3-16-76	0.70×10^{-6}	2.73×10^2	1.08×10^2	--	1.61
BY-104	Liquid	3-16-76	--	36.6	0.14	--	1.45
BY-106	Liquid	4-13-72	--	2.38×10^2		--	1.415
BY-112	Top solids	4-4-72	--	1.51×10^2	34.2	--	1.48
BY-112	Bottom solids	4-4-72	--	20.6	40.3	--	1.44
BY-112	Liquid	4-4-72	--	4.83×10^2	0.27	--	1.42

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Table 4-14. Evaluation of Potential Groundwater Contamination.

Waste Management Unit[a]	Range of Soil Column Pore Volumes (m^3)[b]	Liquid Effluent Volume Received (m^3)	Potential Migration to Unconfined Aquifer
Cribs and Drains			
216-B-7A/7B Crib	186 to 558	43,600	Yes
216-B-8TF Crib	17,580 to 52,730	27,200	Yes[c]
216-B-9TF Crib	8,660 to 25,990	36,000	Yes
216-B-10A Crib	155 to 465	9,990	Yes
216-B-10B Crib	155 to 465	28	No
216-B-12 Crib	6,100 to 18,300	520,000	Yes
216-B-13 French Drain	39 to 118	21	No
216-B-14 Crib	5,890 to 17,670	8,710	Yes[c]
216-B-15 Crib	5,890 to 17,670	6,320	Yes[c]
216-B-16 Crib	5,890 to 17,670	5,600	No
216-B-17 Crib	5,890 to 17,670	3,410	No
216-B-18 Crib	5,890 to 17,670	8,520	Yes[c]
216-B-19 Crib	5,890 to 17,670	6,400	Yes[c]
216-B-43 Crib	3,400 to 10,200	2,120	No
216-B-44 Crib	3,295 to 9,885	5,600	Yes[c]
216-B-45 Crib	3,295 to 9,885	4,920	Yes[c]
216-B-46 Crib	3,243 to 9,730	6,700	Yes[c]
216-B-47 Crib	3,452 to 10,355	3,710	Yes[c]
216-B-48 Crib	3,347 to 10,042	4,090	Yes[c]
216-B-49 Crib	3,295 to 9,885	6,700	Yes[c]
216-B-50 Crib	3,295 to 9,885	54,800	Yes
216-B-51 French Drain	45 to 135	1	No
216-B-55 Crib	6,073 to 18,220	1,230,000	Yes
216-B-57 Crib	1,925 to 5,775	84,400	Yes
216-B-60 Crib	146 to 438	18.9	No
216-B-62 Crib	3,860 to 11,580	282,000	Yes

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Table 4-14. Evaluation of Potential Groundwater Contamination.

Waste Management Unit[a]	Range of Soil Column Pore Volumes (m^3)[b]	Liquid Effluent Volume Received (m^3)	Potential Migration to Unconfined Aquifer
Reverse Wells			
216-B-4 Reverse Well	0.8 to 2.3	10	Yes
216-B-5 Reverse Well[d]		30,600	Yes[d]
216-B-6 Reverse Well	0.5 to 1.4	6,000	Yes
216-B-11A and 216-B-11B Reverse Wells	56.4 to 169.2	29,600	Yes
Ponds, Ditches, and Trenches			
216-A-25 Pond	229,870 to 689,620	307,000,000	Yes
216-B-3 Pond	760,840 to 2,282,510	240,000,000	Yes
216-B-2-1 Ditch	37,120 to 111,360	149,000,000	Yes
216-B-2-2 Ditch	24,600 to 73,800	49,700	Yes[c]
216-B-3-1 Ditch	8,037 to 24,111	149,000,000	Yes
216-B-3-2 Ditch	23,230 to 69,700	149,000,000	Yes
216-B-20 Trench	4,560 to 13,670	4,680	Yes[c]
216-B-21 Trench	4,650 to 13,950	4,670	Yes[c]
216-B-22 Trench	4,600 to 13,800	4,740	Yes[c]
216-B-23 Trench	4,465 to 13,390	4,520	Yes[c]
216-B-24 Trench	4,560 to 13,670	4,700	Yes[c]
216-B-25 Trench	4,420 to 13,260	3,760	No
216-B-26 Trench	4,465 to 13,390	5,880	Yes[c]
216-B-27 Trench	4,465 to 13,390	4,420	No
216-B-28 Trench	4,510 to 13,530	5,050	Yes[c]
216-B-29 Trench	4,510 to 13,530	4,840	Yes[c]
216-B-30 Trench	4,510 to 13,530	4,780	Yes[c]
216-B-31 Trench	4,510 to 13,530	4,740	Yes[c]
216-B-32 Trench	4,510 to 13,530	4,770	Yes[c]
216-B-33 Trench	4,510 to 13,530	4,740	Yes[c]
216-B-34 Trench	4,510 to 13,530	4,870	Yes[c]

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Table 4-14. Evaluation of Potential Groundwater Contamination.

Waste Management Unit[a]	Range of Soil Column Pore Volumes (m^3)[b]	Liquid Effluent Volume Received (m^3)	Potential Migration to Unconfined Aquifer
216-B-35 Trench	1,730 to 5,190	1,060	No
216-B-36 Trench	1,730 to 5,190	1,940	Yes[c]
216-B-37 Trench	1,710 to 5,130	4,320	Yes[c]
216-B-38 Trench	1,685 to 5,055	1,430	No
216-B-39 Trench	1,685 to 5,055	1,540	No
216-B-40 Trench	1,640 to 4,920	1,640	Yes[c]
216-B-41 Trench	1,640 to 4,920	1,440	No
216-B-42 Trench	1,755 to 5,265	1,500	No
216-B-52 Trench	5,240 to 15,710	8,530	Yes[c]
216-B-53A Trench	543 to 1,630	549	Yes[c]
216-B-53B Trench	1,370 to 4,120	15.1	No
216-B-54 Trench	1,823 to 5,470	999	No
216-B-58 Trench	1,880 to 5,640	413	No
216-B-63 Trench	3,650 to 10,940	7,200,000	Yes

[a]Waste Management Units 2101-M Pond, 216-N-8 Pond, 216-B-3A Pond, 216-B-3B Pond, 216-B-3C Pond, 216-B-2-3 Ditch, and 216-B-3-3 Ditch are omitted here due to a lack of available inventory data. Waste Management Units 216-B-56 Crib, 216-B-61 Crib, and 216-E-28 Pond were never used and are also omitted.

[b]Pore volume calculation: = (waste unit plan area) x (nominal depth to groundwater) x (porosity). The lower pore volume value reflects 0.10 porosity; the higher pore volume value reflects 0.30 porosity. The pore volume calculation does not account for the ability of the soil to retain the liquid discharged.

[c]The effluent volume received by these units exceeds the lower pore volume estimate but is below the high estimate. Given the high permeability of the soil column in general, it is likely that some of the discharged waste volume reached groundwater.

[d]The 216-B-5 Reverse Well physically extended 6 m below the water table.

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Table 4-15. TRAC Inventory Data.

Total (1/1/90)	B-101 Curies	B-102 Curies	B-103 Curies	B-104 Curies	B-105 Curies	B-106 Curies	B-107 Curies	B-108 Curies
1. Ac225	2E-08	1E-08	2E-08	3E-09	2E-08	2E-09	2E-08	2E-08
2. Ac227	3E-05	9E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
3. Am241	1E+02	1E+01	7E+01	4E+00	4E-01	2E-01	1E+00	5E+00
4. Am242	9E-31	4E-04	3E-02	3E-05	3E-05	4E-04	4E-05	1E-02
5. Am242m	9E-31	4E-04	3E-02	3E-05	3E-05	3E-04	4E-05	1E-02
6. Am243	3E-31	3E-04	1E-02	4E-05	5E-06	2E-04	1E-05	7E-03
7. At217	2E-08	1E-08	1E-08	3E-09	2E-08	2E-09	2E-08	2E-08
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	1E-25	2E+03	1E+04	4E+03	4E+04	2E+03	4E+04	3E+04
10. Bi210	3E-10	4E-11	5E-11	2E-11	1E-11	9E-12	6E-11	2E-10
11. Bi211	3E-05	9E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
12. Bi213	2E-08	1E-08	2E-08	3E-09	2E-08	2E-09	2E-08	2E-08
13. Bi214	2E-09	2E-10	3E-10	7E-11	3E-11	4E-11	2E-10	1E-09
14. C14	5E+00	1E+00	3E+00	4E-01	1E+01	5E-01	1E+01	1E+01
15. Cm242	7E-31	4E-04	3E-02	3E-05	2E-05	3E-04	3E-05	9E-03
16. Cm244	2E-30	2E-03	2E-02	4E-06	2E-04	1E-03	4E-03	1E-01
17. Cm245	1E-34	1E-07	1E-06	8E-11	4E-09	8E-08	1E-07	6E-06
18. Cs135	3E-31	3E-02	7E-02	9E-02	6E-01	2E-02	2E-01	1E-01
19. Cs137	1E-25	3E+03	1E+04	5E+03	4E+04	2E+03	5E+04	3E+04
20. Fr221	2E-08	1E-08	2E-08	3E-09	2E-08	2E-09	2E-08	2E-08
21. Fr223	5E-07	1E-07	3E-07	1E-07	1E-06	1E-07	5E-07	2E-06
22. I129	3E-31	1E-03	8E-03	3E-03	2E-02	1E-03	2E-02	4E-02
23. Nb93m	3E+01	7E-01	2E+00	4E-01	1E-01	7E-03	5E-01	3E-01

Table 4-15. TRAC Inventory Data.

24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	3E+02	1E+02	7E+02	1E+01	3E+02	1E+01	7E+01	3E+00
26. Np237	5E-04	3E-03	2E-02	6E-03	5E-02	2E-03	6E-02	8E-02
27. Np239	3E-31	2E-04	1E-02	4E-05	5E-06	2E-04	1E-05	7E-03
28. Pa231	1E-04	2E-05	5E-05	2E-05	1E-04	2E-05	8E-05	3E-04
29. Pa233	5E-04	3E-03	2E-02	6E-03	5E-02	2E-03	6E-02	8E-02
30. Pa234m	7E+00	7E-01	2E+00	3E-01	2E-01	3E-01	2E+00	8E+00
31. Pb209	2E-08	1E-08	2E-08	3E-09	2E-08	2E-09	2E-08	2E-08
32. Pb210	3E-10	3E-11	5E-11	2E-11	9E-12	9E-12	6E-11	2E-10
33. Pb211	3E-05	9E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
34. Pb214	2E-09	2E-10	3E-10	7E-11	3E-11	4E-11	2E-10	1E-09
35. Pd107	4E-31	2E-03	1E-02	3E-03	2E-02	1E-03	3E-02	7E-02
36. Po210	3E-10	3E-11	5E-11	2E-11	9E-12	8E-12	6E-11	2E-10
37. Po213	2E-08	1E-08	1E-08	3E-09	2E-08	2E-09	2E-08	2E-08
38. Po214	3E-09	3E-10	3E-10	9E-11	4E-11	4E-11	3E-10	1E-09
39. Po215	3E-05	9E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
40. Po218	2E-09	2E-10	3E-10	7E-11	3E-11	4E-11	2E-10	1E-09
41. Pu238	3E+01	4E+00	5E+00	2E-01	2E-02	4E-03	9E-02	2E-02
42. Pu239	5E+02	5E+01	2E+02	1E+02	1E+01	1E+00	4E+01	4E+00
43. Pu240	2E+02	1E+01	5E+01	1E+01	1E+00	1E-01	3E+00	3E-01
44. Pu241	3E+03	3E+02	6E+02	2E+01	2E+00	2E-01	5E+00	5E-01
45. Ra223	3E-05	8E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
46. Ra225	2E-08	1E-08	2E-08	3E-09	2E-08	2E-09	2E-08	2E-08
47. Ra226	2E-09	2E-10	3E-10	7E-11	3E-11	4E-11	2E-10	1E-09
48. Ru106	4E+00	1E-01	2E-02	3E-08	5E-09	5E-08	1E-07	1E-05

Table 4-15. TRAC Inventory Data.

49. Sb126	8E+00	2E-01	7E-01	6E-02	6E-03	7E-04	6E-02	6E-03
50. Sb126m	8E+00	2E-01	7E-01	6E-02	6E-03	7E-04	6E-02	6E-03
51. Se79	5E-30	3E-02	1E-01	5E-02	4E-01	2E-02	4E-01	7E-01
52. Sm151	7E+03	2E+02	7E+02	1E+02	1E+01	1E+00	2E+02	2E+01
53. Sn126	7E+00	2E-01	7E-01	6E-02	6E-03	7E-04	6E-02	6E-03
54. Sr90	5E-26	3E+02	9E+03	8E+03	1E+03	1E+02	2E+04	5E+04
55. Tc99	2E-28	9E-01	5E+00	2E+00	1E+01	7E-01	1E+01	3E+01
56. Th227	3E-05	8E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
57. Th229	2E-08	1E-08	2E-08	3E-09	2E-08	2E-09	2E-08	2E-08
58. Th230	6E-07	6E-08	7E-08	1E-08	5E-09	6E-09	4E-08	2E-07
59. Th231	3E-01	4E-02	8E-02	1E-02	8E-03	1E-02	8E-02	4E-01
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	7E+00	7E-01	2E+00	3E-01	2E-01	3E-01	2E+00	8E+00
62. Tl207	3E-05	9E-06	2E-05	1E-05	1E-04	8E-06	4E-05	1E-04
63. U233	7E-06	6E-06	8E-06	1E-06	1E-05	6E-07	1E-05	1E-05
64. U234	5E-03	5E-04	6E-04	7E-05	3E-05	3E-05	2E-04	1E-03
65. U235	3E-01	4E-02	8E-02	1E-02	8E-03	1E-02	9E-02	4E-01
66. U238	7E+00	8E-01	2E+00	3E-01	2E-01	3E-01	2E+00	8E+00
67. Y90	6E-26	3E+02	1E+04	8E+03	1E+03	1E+02	2E+04	5E+04
68. Zr93	4E+01	1E+00	3E+00	4E-01	4E-02	5E-03	4E-01	4E-02
TOT CURIES	1.13E+04	6.29E+03	4.14E+04	2.52E+04	8.25E+04	4.24E+03	1.31E+05	1.60E+05
TOTAL TRU	635.0	65.6	275.2	104.6	20.5	1.8	54.2	19.2
Total (1/1/90)	B-101 Moles	B-102 Moles	B-103 Moles	B-104 Moles	B-105 Moles	B-105 Moles	B-107 Moles	B-108 Moles
69. Ag	2E-35	1E-07	6E-07	2E-07	2E-06	9E-08	2E-06	3E-06

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Table 4-15. TRAC Inventory Data.

70. Al	1E+03	2E+04	1E+05	7E+04	6E+03	1E+04	3E+05	3E+05
71. Ba	1E+02	9E+00	6E+00	9E-01	7E+00	5E-01	8E+00	6E+00
72. Bi	4E-13	3E-13	4E-13	6E+06	6E+05	7E+04	7E+04	7E+03
73. $C_2H_3O_3$	0E+00	0E+00	4E+02	0E+00	0E+00	0E+00	0E+00	0E+00
74. $C_6H_5O_7$	2E-05	2E+04	3E+04	0E+00	0E+00	1E+04	0E+00	2E+04
75. CO_3	3E+05	1E+05	1E+05	2E+05	1E+06	5E+04	1E+05	7E+04
76. C_2O_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	4E+02	2E+01	2E+00	0E+00	0E+00	5E-04	0E+00	2E-04
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
79. Ce	9E-31	1E+00	3E+00	7E+01	5E+00	6E-01	3E+01	7E+00
80. Cl	5E-35	2E-05	3E-05	8E-05	5E-04	2E-05	2E-05	2E-05
81. Cr	7E+03	3E+02	4E+01	2E+04	2E+03	2E+02	1E+04	1E+03
82. EDTA	0E+00	0E+00	6E+02	0E+00	0E+00	0E+00	0E+00	0E+00
83. F	9E-28	4E+02	2E+03	4E+05	8E+05	7E+04	7E+05	2E+06
84. Fe	8E+04	9E+04	1E+04	3E+05	3E+04	5E+03	2E+05	2E+04
85. $Fe(CN)_6$	9E+01	1E+01	2E+02	0E+00	0E+00	6E-05	3E+01	8E+01
86. HEDTA	0E+00	0E+00	1E+03	0E+00	0E+00	0E+00	0E+00	1E+00
87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	1E-12	1E-03	6E+02	0E+00	0E+00	1E-03	0E+00	7E+02
89. La	0E+00	0E+00	7E-14	0E+00	0E+00	0E+00	0E+00	0E+00
90. Mn	6E-08	5E+01	2E+02	0E+00	0E+00	4E+01	0E+00	7E+01
91. NO_2	2E-25	6E+03	4E+04	5E+04	4E+03	3E+03	4E+05	3E+05
92. NO_3	3E-04	2E+05	5E+05	8E+05	3E+06	7E+05	4E+06	4E+06
93. Na	4E+05	4E+05	7E+05	3E+06	1E+07	6E+06	5E+06	1E+07
94. Ni	2E+03	1E+03	1E+03	0E+00	0E+00	2E+02	5E-03	4E-02

Table 4-15. TRAC Inventory Data.

95. OH	3E+05	3E+05	2E+05	9E+05	1E+05	2E+04	6E+05	6E+04
96. PO_4	3E-26	9E+03	7E+03	7E+06	2E+06	2E+06	5E+05	1E+06
97. Pb	2E+04	2E+04	1E+04	4E-10	5E-09	2E-03	1E-09	4E-04
98. SeO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO_3	6E-08	3E+02	2E+03	1E+04	8E+02	2E+02	1E+04	7E+03
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO_4	2E+04	4E+04	4E+04	7E+04	4E+05	1E+04	3E+04	2E+04
102. Sr	2E-30	5E-04	6E-01	0E+00	0E+00	4E-04	0E+00	6E+00
103. WO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	4E+00	5E-01	2E+00	7E+03	7E+02	8E+01	2E+04	2E+03
105. Volume	1E+02	5E+01	9E+01	4E+02	3E+02	1E+02	2E+02	1E+02
Total (1/1/90)	B-109 Curies	B-110 Curies	B-111 Curies	B-112 Curies	B-201 Curies	B-202 Curies	B-203 Curies	B-204 Curies
1. Ac225	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13
2. Ac227	3E-05	2E-04	8E-04	1E-04	0E+00	2E-05	3E-12	3E-11
3. Am241	2E+00	1E+03	4E+00	4E+01	0E+00	4E+01	1E-01	1E+00
4. Am242	4E-03	3E+00	2E-04	9E-02	0E+00	0E+00	0E+00	0E+00
5. Am242m	4E-03	4E+00	2E-04	9E-02	0E+00	0E+00	0E+00	0E+00
6. Am243	2E-03	2E+00	5E-05	5E-02	0E+00	0E+00	0E+00	0E+00
7. At217	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	1E+04	6E+04	5E+05	2E+05	0E+00	0E+00	0E+00	0E+00
10. Bi210	6E-11	5E-10	3E-11	5E-11	0E+00	5E-11	1E-13	1E-12
11. Bi211	3E-05	2E-04	8E-04	1E-04	0E+00	2E-05	3E-12	3E-11
12. Bi213	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	6E-14	6E-13

Table 4-15. TRAC Inventory Data.

13. Bi214	3E-10	2E-09	1E-10	2E-10	0E+00	3E-10	5E-13	5E-12
14. C14	7E+00	1E+02	2E+03	8E+01	0E+00	0E+00	0E+00	0E+00
15. Cm242	3E-03	3E+00	2E-04	7E-02	0E+00	0E+00	0E+00	0E+00
16. Cm244	3E-02	1E+01	1E+00	7E-01	0E+00	0E+00	0E+00	0E+00
17. Cm245	2E-06	1E-03	3E-05	5E-05	0E+00	0E+00	0E+00	0E+00
18. Cs135	6E-02	2E-01	2E+00	1E+00	0E+00	0E+00	0E+00	0E+00
19. Cs137	1E+04	6E+04	6E+05	2E+05	0E+00	0E+00	0E+00	0E+00
20. Fr221	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13
21. Fr223	5E-07	2E-06	1E-05	1E-06	0E+00	3E-07	4E-14	4E-13
22. I129	1E-02	5E-01	5E+00	3E-01	0E+00	0E+00	0E+00	0E+00
23. Nb93m	9E-02	4E+01	4E+01	2E+00	0E+00	0E+00	0E+00	0E+00
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	8E+00	2E+03	2E+03	2E+02	0E+00	0E+00	0E+00	0E+00
26. Np237	3E-02	3E-02	1E+01	6E-01	0E+00	2E-04	9E-07	9E-06
27. Np239	2E-03	2E+00	5E-05	5E-02	0E+00	0E+00	0E+00	0E+00
28. Pa231	8E-05	4E-04	1E-03	1E-04	0E+00	7E-05	1E-11	1E-10
29. Pa233	3E-02	3E-02	1E+01	6E-01	0E+00	2E-04	9E-07	9E-06
30. Pa234m	2E+00	7E+00	4E-01	6E-01	0E+00	3E+00	0E+00	0E+00
31. Pb209	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13
32. Pb210	6E-11	5E-10	3E-11	5E-11	0E+00	5E-11	1E-13	1E-12
33. Pb211	3E-05	2E-04	8E-04	1E-04	0E+00	2E-05	3E-12	3E-11
34. Pb214	3E-10	2E-09	1E-10	2E-10	0E+00	3E-10	5E-13	5E-12
35. Pd107	2E-02	9E-01	8E+00	5E-01	0E+00	0E+00	0E+00	0E+00
36. Po210	6E-11	5E-10	3E-11	5E-11	0E+00	5E-11	1E-13	1E-12
37. Po213	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13

Table 4-15. TRAC Inventory Data.

38. Po214	3E-10	2E-09	1E-10	2E-10	0E+00	3E-10	7E-13	7E-12
39. Po215	3E-05	2E-04	8E-04	1E-04	0E+00	2E-05	3E-12	3E-11
40. Po218	3E-10	2E-09	1E-10	2E-10	0E+00	3E-10	5E-13	5E-12
41. Pu238	1E-02	1E+01	2E-01	1E+00	0E+00	4E+00	5E-03	5E-02
42. Pu239	5E-01	2E+02	3E+01	4E+00	0E+00	2E+02	7E-01	7E+00
43. Pu240	4E-02	5E+01	6E+00	6E-01	0E+00	5E+01	1E-01	1E+00
44. Pu241	5E-02	7E+02	3E+01	3E+00	0E+00	5E+02	8E-01	8E+00
45. Ra223	3E-05	2E-04	8E-04	1E-04	0E+00	2E-05	3E-12	3E-11
46. Ra225	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13
47. Ra226	3E-10	2E-09	1E-10	2E-10	0E+00	3E-10	5E-13	5E-12
48. Ru106	4E-06	1E+00	1E-04	1E-04	0E+00	0E+00	0E+00	0E+00
49. Sb126	8E-04	1E+01	1E-02	2E-03	0E+00	0E+00	0E+00	0E+00
50. Sb126m	8E-04	1E+01	1E-02	2E-03	0E+00	0E+00	0E+00	0E+00
51. Se79	3E-01	8E+00	9E+01	6E+00	0E+00	0E+00	0E+00	0E+00
52. Sm151	2E+00	1E+04	2E+01	2E+00	0E+00	0E+00	0E+00	0E+00
53. Sn126	8E-04	1E+01	1E-02	1E-03	0E+00	0E+00	0E+00	0E+00
54. Sr90	5E+03	6E+04	1E-04	1E+05	0E+00	0E+00	0E+00	0E+00
55. Tc99	9E+00	3E+02	3E+03	2E+02	0E+00	0E+00	0E+00	0E+00
56. Th227	3E-05	2E-04	7E-04	9E-05	0E+00	2E-05	3E-12	3E-11
57. Th229	2E-08	5E-09	1E-06	4E-08	0E+00	7E-11	5E-14	5E-13
58. Th230	4E-08	3E-07	1E-08	2E-08	0E+00	7E-08	1E-10	1E-09
59. Th231	9E-02	3E-01	2E-02	2E-02	0E+00	1E-01	2E-08	2E-07
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	2E+00	7E+00	4E-01	6E-01	0E+00	3E+00	0E+00	0E+00
62. Tl207	3E-05	2E-04	8E-04	1E-04	0E+00	2E-05	3E-12	3E-11

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Table 4-15. TRAC Inventory Data.

63. U233	1E-05	4E-06	1E-03	4E-05	0E+00	3E-08	6E-11	6E-10
64. U234	2E-04	3E-03	7E-05	2E-04	0E+00	5E-04	6E-07	6E-06
65. U235	9E-02	3E-01	2E-02	3E-02	0E+00	1E-01	2E-08	2E-07
66. U238	2E+00	7E+00	4E-01	6E-01	0E+00	3E+00	0E+00	0E+00
67. Y90	5E+03	6E+04	1E-04	1E+05	0E+00	0E+00	0E+00	0E+00
68. Zr93	5E-03	6E+01	9E-02	9E-03	0E+00	0E+00	0E+00	0E+00
TOT CURIES	3.06E+04	2.63E+05	1.11E+06	6.03E+05	0.00E+00	8.03E+02	1.71E+00	1.71E+01
TOTAL TRU	9.6	1374.5	2144.2	126.5	0.0	244.0	0.8	8.1
Total (1/1/90)	B-109 Moles	B-110 Moles	B-111 Moles	B-112 Moles	B-201 Moles	B-202 Moles	B-203 Moles	B-204 Moles
69. Ag	1E-06	3E-05	5E-04	2E-05	0E+00	0E+00	0E+00	0E+00
70. Al	1E+05	3E+05	2E+05	2E+06	0E+00	2E+03	0E+00	0E+00
71. Ba	6E+00	1E+02	3E+01	6E+01	0E+00	8E-01	0E+00	0E+00
72. Bi	8E+02	1E+07	4E+06	4E+05	0E+00	7E+01	7E+02	7E+03
73. $C_2H_3O_3$	2E-01	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
74. $C_6H_5O_7$	7E+03	5E+05	0E+00	2E+05	0E+00	3E+03	0E+00	0E+00
75. CO_3	1E+05	0E+00	2E+06	5E+05	0E+00	0E+00	0E+00	0E+00
76. C_2O_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	1E-01	4E+02	5E-16	1E+02	0E+00	3E+00	0E+00	0E+00
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
79. C_3	4E+00	0E+00	1E-01	5E+01	0E+00	0E+00	0E+00	0E+00
80. Cl	7E-06	0E+00	6E-06	1E-04	0E+00	0E+00	0E+00	0E+00
81. Cr	1E+02	3E+04	8E+03	8E+02	0E+00	9E+01	4E+02	4E+03
82. EDTA	3E-01	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
83. F	1E+06	9E-38	1E+02	7E+04	0E+00	5E+04	5E+04	5E+04

Table 4-15. TRAC Inventory Data.

84. Fe	3E+03	6E+05	1E+05	4E+04	0E+00	7E+02	0E+00	0E+00
85. $Fe(CN)_6$	3E+01	0E+00	8E+01	9E+02	0E+00	0E+00	0E+00	0E+00
86. HEDTA	1E+00	0E+00	3E+02	9E+00	0E+00	0E+00	0E+00	0E+00
87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	2E+03	0E+00	3E+04	5E+03	0E+00	4E+04	4E+04	4E+04
89. La	2E-13	0E+00	0E+00	0E+00	0E+00	3E+01	3E+02	3E+03
90. Mn	2E+01	1E+03	1E+02	5E+02	0E+00	8E+01	6E+02	6E+03
91. NO_2	1E+05	0E+00	8E+05	2E+06	0E+00	0E+00	0E+00	0E+00
92. NO_3	5E+05	5E+06	2E+07	7E+06	0E+00	3E+05	2E+05	2E+05
93. Na	8E+06	5E+06	3E+07	5E+06	1E+01	3E+05	3E+05	3E+05
94. Ni	1E-02	7E+03	1E-02	7E+02	0E+00	5E+01	0E+00	0E+00
95. OH	3E+04	1E+06	8E+05	2E+05	1E+01	8E+04	1E+05	1E+05
96. PO_4	2E+06	1E+07	4E+06	4E+05	0E+00	5E+03	5E+03	5E+03
97. Pb	1E-04	5E+00	2E-08	3E-03	0E+00	3E-02	6E-17	6E-16
98. SeO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO_3	3E+03	2E-38	1E+04	5E+04	0E+00	0E+00	0E+00	0E+00
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO_4	8E+03	5E-08	8E+05	1E+05	0E+00	6E+02	7E+02	7E+02
102. Sr	2E+00	2E+00	0E+00	4E+01	0E+00	3E-01	0E+00	0E+00
103. WO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	3E+02	9E+00	1E-02	6E+00	0E+00	0E+00	0E+00	0E+00
105. Volume	1E+02	6E+02	5E+02	8E+01	3E+01	3E+01	5E+01	5E+01
Total (1/1/90)	BX-101 Curies	BX-102 Curies	BX-103 Curies	BX-104 Curies	BX-105 Curies	BX-106 Curies	BX-107 Curies	BX-108 Curies
1. Ac225	2E-08	8E-08	3E-08	9E-07	1E-07	3E-07	7E-09	6E-09

Table 4-15. TRAC Inventory Data.

2. Ac227	3E-05	2E-04	3E-07	8E-04	4E-04	8E-04	3E-05	2E-06
3. Am241	1E+02	7E+02	2E-03	2E+01	4E+03	3E+03	3E+00	3E-01
4. Am242	3E-05	1E+00	2E-06	8E-03	7E+00	4E+00	4E-05	4E-06
5. Am242m	3E-05	1E+00	2E-06	8E-03	7E+00	5E+00	4E-05	4E-06
6. Am243	1E-04	6E-01	9E-07	3E-03	3E+00	2E+00	9E-05	9E-06
7. At217	2E-08	8E-08	3E-08	9E-07	1E-07	3E-07	7E-09	6E-09
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	8E-15	3E+05	9E-13	6E+05	1E+05	6E+06	1E+04	4E+02
10. Bi210	1E-10	6E-11	4E-12	5E-11	2E-10	3E-10	5E-11	8E-12
11. Bi211	3E-05	2E-04	3E-07	8E-04	4E-04	8E-04	3E-05	2E-06
12. Bi213	2E-08	8E-08	3E-08	1E-06	1E-07	3E-07	7E-09	6E-09
13. Bi214	5E-10	1E-10	7E-12	2E-10	6E-10	7E-10	2E-10	3E-11
14. C14	2E+01	6E+02	9E+01	1E+03	8E+02	2E+03	2E-01	8E-02
15. Cm242	3E-05	1E+00	2E-06	6E-03	6E+00	4E+00	3E-05	3E-06
16. Cm244	3E-19	3E+00	7E-20	2E+00	1E+01	1E+01	2E-05	5E-05
17. Cm245	2E-23	2E-04	2E-24	4E-05	9E-04	7E-04	3E-10	1E-09
18. Cs135	4E-20	1E+00	9E-18	2E+00	4E-01	2E+01	3E-01	2E-03
19. Cs137	9E-15	3E+05	9E-13	6E+05	2E+05	6E+06	1E+04	5E+02
20. Fr221	2E-08	8E-08	3E-08	1E-06	1E-07	3E-07	7E-09	6E-09
21. Fr223	4E-07	3E-06	4E-09	1E-05	6E-06	1E-05	5E-07	3E-08
22. I129	1E-19	1E+00	1E-18	5E+00	2E+00	4E+00	8E-03	2E-04
23. Nb93M	7E-01	8E+00	5E-08	5E+01	5E+01	5E+01	2E+00	2E-01
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	4E+02	6E+03	3E+02	1E+03	3E+04	3E+03	5E+01	8E-02
26. Np237	6E-04	9E-01	1E-08	1E+01	1E+00	4E+00	2E-02	5E-04

Table 4-15. TRAC Inventory Data.

27. Np239	1E-04	6E-01	8E-07	3E-03	3E+00	2E+00	9E-05	9E-06
28. Pa231	9E-05	4E-04	9E-07	1E-03	8E-04	1E-03	6E-05	5E-06
29. Pa233	6E-04	9E-01	1E-08	1E+01	1E+00	4E+00	2E-02	5E-04
30. Pa234m	3E+00	4E-02	4E-02	8E-01	5E-02	4E-02	8E-01	1E-01
31. Pb209	2E-08	8E-08	3E-08	9E-07	1E-07	3E-07	7E-09	6E-09
32. Pb210	9E-11	6E-11	4E-12	5E-11	2E-10	2E-10	5E-11	8E-12
33. Pb211	3E-05	2E-04	3E-07	8E-04	4E-04	8E-04	3E-05	2E-06
34. Pb214	5E-10	1E-10	7E-12	2E-10	6E-10	7E-10	2E-10	3E-11
35. Pd107	2E-19	2E+00	8E-19	9E+00	4E+00	6E+00	7E-03	3E-04
36. Po210	9E-11	6E-11	4E-12	5E-11	2E-10	3E-10	5E-11	8E-12
37. Po213	2E-08	8E-08	3E-08	9E-07	1E-07	3E-07	7E-09	6E-09
38. Po214	6E-10	2E-10	8E-12	3E-10	7E-10	9E-10	2E-10	3E-11
39. Po215	3E-05	2E-04	3E-07	8E-04	4E-04	8E-04	3E-05	2E-06
40. Po218	5E-10	1E-10	7E-12	2E-10	6E-10	7E-10	2E-10	3E-11
41. Pu238	1E+01	1E+00	2E-01	2E+00	9E-01	6E-01	1E-01	1E-02
42. Pu239	5E+02	3E+01	2E-04	6E+01	3E-03	2E-03	5E+01	5E+00
43. Pu240	1E+02	9E+00	3E-04	2E+01	3E-02	3E-02	4E+00	4E-01
44. Pu241	3E+03	2E+02	2E-03	2E+02	2E-03	4E-03	1E+01	1E+00
45. Ra223	3E-05	2E-04	3E-07	8E-04	4E-04	8E-04	3E-05	2E-06
46. Ra225	2E-08	8E-08	3E-08	1E-06	1E-07	3E-07	7E-09	6E-09
47. Ra226	5E-10	1E-10	7E-12	2E-10	6E-10	7E-10	2E-10	3E-11
48. Ru106	2E-04	6E-04	1E-03	2E-03	5E-03	1E-02	7E-08	7E-09
49. Sb126	1E-01	5E-09	3E-08	2E-01	9E-08	6E+00	3E-01	3E-02
50. Sb126m	1E-01	5E-09	3E-08	2E-01	9E-08	6E+00	3E-01	3E-02
51. Se79	2E-18	2E+01	1E-17	9E+01	4E+01	7E+01	1E-01	3E-03

Table 4-15. TRAC Inventory Data.

52. Sm151	3E+02	9E-04	4E-03	2E+02	2E-03	7E+03	9E+02	9E+01
53. Sn126	1E-01	5E-09	3E-08	2E-01	9E-08	6E+00	3E-01	3E-02
54. Sr90	1E-15	1E+05	2E+05	2E+04	4E+06	1E+06	4E+04	5E+03
55. Tc99	6E-17	6E+02	4E-16	3E+03	2E+03	2E+03	5E+00	1E-01
56. Th227	3E-05	2E-04	2E-07	7E-04	4E-04	8E-04	3E-05	2E-06
57. Th229	2E-08	8E-08	3E-08	1E-06	1E-07	3E-07	7E-09	6E-09
58. Th230	1E-07	7E-09	2E-09	4E-08	3E-09	1E-08	2E-08	4E-09
59. Th231	1E-01	2E-03	2E-03	3E-02	2E-03	2E-03	3E-02	6E-03
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	3E+00	4E-02	4E-02	8E-01	5E-02	4E-02	8E-01	1E-01
62. Tl207	3E-05	2E-04	3E-07	8E-04	4E-04	8E-04	3E-05	2E-06
63. U233	1E-05	8E-05	1E-05	9E-04	1E-04	3E-04	4E-06	2E-06
64. U234	1E-03	7E-05	2E-05	3E-04	4E-05	3E-05	1E-04	2E-05
65. U235	1E-01	2E-03	2E-03	3E-02	2E-03	2E-03	3E-02	6E-03
66. U238	3E+00	4E-02	4E-02	8E-01	5E-02	4E-02	8E-01	1E-01
67. Y90	1E-15	1E+15	2E+05	2E+04	4E+06	2E+06	4E+04	5E+03
68. Zr93	9E-01	1E-08	6E-08	9E-01	1E-08	9E-10	2E+00	2E-01
TOT CURIES	4.44E+03	8.48E+05	4.00E+05	1.25E+06	8.50E+06	1.52E+07	1.01E+05	1.10E+04
TOTAL TRU	630.0	1345.4	90.2	1092.0	4827.9	4721.6	53.3	5.4
Total (1/1/90)	BX-101 Moles	BX-102 Moles	BX-103 Moles	BX-104 Moles	BX-105 Moles	BX-106 Moles	BX-107 Moles	BX-108 Moles
69. Ag	1E-23	8E-05	5E-23	5E-04	2E-04	5E-04	6E-07	2E-08
70. Al	1E+06	7E+06	4E+06	5E+05	2E+06	1E+07	1E+05	3E+05
71. Ba	3E+00	1E+01	5E+00	3E+01	1E+01	2E+02	3E+00	2E+00
72. Bi	5E-13	4E-12	6E-13	1E-11	2E-04	5E-12	7E+04	7E+03

73. $C_2H_3O_3$	0E+00	0E+00	0E+00	0E+00	0E+00	4E+03	0E+00	0E+00
74. $C_6H_5O_7$	6E-13	5E+05	3E-14	0E+00	1E+06	1E+06	0E+00	0E+00
75. CO_3	1E+05	8E+05	1E+06	3E+06	4E+05	3E+06	7E+05	4E+03
76. C_2O_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	4E+03	4E+02	5E+01	0E+00	1E+01	9E-01	0E+00	1E-07
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
79. Ce	7E-20	3E+01	3E-17	2E-03	2E+01	6E+02	1E+02	3E-01
80. Cl	2E-24	1E-04	3E-29	1E-07	2E-05	5E-04	2E-04	4E-07
81. Cr	3E-01	2E-02	3E-06	2E-05	2E-05	5E+00	1E+04	1E+03
82. EDTA	0E+00	0E+00	0E+00	0E+00	0E+00	6E+03	0E+00	0E+00
83. F	4E-15	7E+04	9E+05	1E+00	6E+04	5E+05	1E+05	2E+04
84. Fe	1E+05	1E+05	1E+03	0E+00	2E+05	2E+05	2E+05	2E+04
85. $Fe(CN)_6$	2E+01	3E+03	6E+02	9E+00	6E+00	1E+03	0E+00	5E-02
86. HEDTA	9E-18	6E+01	5E-23	3E+02	7E+01	1E+04	0E+00	0E+00
87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	6E-16	1E+04	3E-21	3E+04	8E+04	4E+05	0E+00	0E+00
89. La	0E+00	0E+00	0E+00	0E+00	0E+00	3E-24	0E+00	0E+00
90. Mn	2E-15	2E+03	3E+02	2E+02	4E+03	7E+03	0E+00	0E+00
91. NO_2	2E-14	2E+06	3E-11	9E+05	2E+05	7E+06	8E+04	8E+03
92. NO_3	9E-04	2E+07	5E+07	5E+07	4E+07	1E+08	1E+06	2E+04
93. Na	2E+05	2E+07	6E+07	6E+07	5E+07	1E+08	4E+06	4E+04
94. Ni	1E+04	2E+04	1E+03	2E+01	4E+04	8E+03	0E+00	6E-13
95. OH	4E+06	1E+07	1E+07	3E+06	4E+06	7E+06	6E+05	1E+06
96. PO_4	2E-15	2E+04	4E+04	7E+03	2E+05	1E+06	4E+05	8E+03
97. Pb	9E+03	1E+04	1E+03	2E-08	8E-02	2E+04	1E-09	6E-11

Table 4-15. TRAC Inventory Data.

98. SeO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO_3	2E-14	2E+06	1E+05	2E+04	5E+04	4E+05	2E+04	2E+02
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO_4	2E+03	2E+05	2E+05	1E+06	3E+05	2E+06	2E+05	4E+02
102. Sr	9E-21	3E+02	4E+02	1E+02	1E+03	2E+02	0E+00	0E+00
103. WO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	3E+00	9E+00	2E+01	4E+00	1E+02	6E+01	2E+04	2E+03
105. Volume	5E+01	6E+01	8E+02	5E+02	5E+02	1E+03	4E+02	2E+01
Total (1/1/90)	BY-101 Curies	BY-102 Curies	BY-103 Curies	BY-104 Curies	BY-105 Curies	BY-106 Curies	BY-107 Curies	BY-108 Curies
1. Ac225	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
2. Ac227	2E-04	5E-05	4E-05	8E-04	3E-04	2E-04	1E-04	9E-05
3. Am241	8E+01	2E+01	2E+02	2E+02	2E+02	1E+02	6E+01	9E+01
4. Am242	2E-01	5E-02	3E-02	3E-01	2E-01	2E-01	8E-02	1E-01
5. Am242m	2E-01	5E-02	3E-02	3E-01	2E-01	2E-01	8E-02	1E-01
6. Am243	1E-01	3E-02	1E-02	2E-01	1E-01	1E-01	6E-02	9E-02
7. At217	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
8. Ba135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba137m	5E+05	1E+05	2E+04	5E+05	4E+05	5E+05	2E+05	2E+05
10. Bi210	9E-11	4E-11	2E-10	2E-09	1E-09	3E-10	3E-10	2E-10
11. Bi211	2E-04	5E-05	4E-05	8E-04	3E-04	2E-04	1E-04	9E-05
12. Bi213	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
13. Bi214	1E-10	1E-10	9E-10	9E-09	4E-09	1E-09	1E-09	1E-09
14. C14	2E+02	5E+01	1E+01	2E+02	1E+02	2E+02	6E+01	6E+01
15. Cm242	1E-01	4E-02	2E-02	3E-01	2E-01	1E-01	6E-02	1E-01

Table 4-15. TRAC Inventory Data.

16. Cm244	2E+00	4E-01	8E-02	2E+00	1E+00	2E+00	6E-01	9E-01
17. Cm245	9E-05	3E-05	5E-06	1E-04	8E-05	1E-04	4E-05	6E-05
18. Cs135	2E+00	6E-01	1E-01	2E+00	2E+00	2E+00	7E-01	1E+00
19. Cs137	5E+05	1E+05	2E+04	5E+05	4E+05	5E+05	2E+05	2E+05
20. Fr221	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
21. Fr223	3E-06	7E-07	6E-07	1E-05	5E-06	3E-06	2E-06	1E-06
22. I129	6E-01	2E-01	3E-02	7E-01	5E-01	6E-01	2E-01	3E-01
23. Nb93m	5E+00	1E+00	2E+00	4E+01	2E+01	1E+01	8E+00	8E+00
24. Ni59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni63	5E+02	7E+02	3E+03	2E+03	2E+03	3E+02	7E+02	1E+03
26. Np237	1E+00	4E-01	6E-02	1E+00	1E+00	1E+00	5E-01	7E-01
27. Np239	1E-01	3E-02	1E-02	2E-01	1E-01	1E-01	5E-02	9E-02
28. Pa231	3E-04	9E-05	1E-04	1E-03	7E-04	3E-04	3E-04	1E-04
29. Pa233	1E+00	4E-01	6E-02	1E+00	1E+00	1E+00	5E-01	7E-01
30. Pa234m	5E-02	4E-01	5E+00	5E+01	2E+01	2E-01	5E+00	9E-01
31. Pb209	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
32. Pb210	9E-11	4E-11	2E-10	2E-09	1E-09	3E-10	3E-10	2E-10
33. Pb211	2E-04	5E-05	4E-05	8E-04	3E-04	2E-04	1E-04	9E-05
34. Pb214	1E-10	1E-10	9E-10	9E-09	4E-09	1E-09	1E-09	1E-09
35. Pd107	1E+00	3E-01	5E-02	1E+00	9E-01	1E+00	4E-01	5E-01
36. Po210	9E-11	4E-11	2E-10	2E-09	1E-09	3E-10	3E-10	2E-10
37. Po213	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
38. Po214	2E-10	1E-10	1E-09	1E-08	5E-09	1E-09	2E-09	1E-09
39. Po215	2E-04	5E-05	4E-05	8E-04	3E-04	2E-04	1E-04	9E-05
40. Po218	1E-10	1E-10	9E-10	9E-09	4E-09	1E-09	1E-09	1E-09

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Table 4-15. TRAC Inventory Data.

41. Pu238	1E-01	2E-01	2E+01	4E+01	1E+01	1E+01	7E+00	1E+01
42. Pu239	4E-02	4E-03	9E+02	2E+02	9E+01	3E+01	3E+01	3E+01
43. Pu240	1E-02	2E-03	2E+02	3E+01	2E+01	6E+00	6E+00	6E+00
44. Pu241	2E-02	2E-03	3E+03	1E+02	8E+01	4E+01	3E+01	4E+01
45. Ra223	2E-04	5E-05	4E-05	8E-04	3E-04	2E-04	1E-04	9E-05
46. Ra225	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
47. Ra226	1E-10	1E-10	9E-10	9E-09	4E-09	1E-09	1E-09	1E-09
48. Ru106	2E-04	8E-05	2E-02	3E-04	3E-04	2E-04	9E-05	1E-04
49. Sb126	2E-03	2E-04	6E-01	6E+00	5E+00	1E+00	1E+00	2E+00
50. Sb126m	2E-03	2E-04	6E-01	6E+00	5E+00	1E+00	1E+00	2E+00
51. Se79	1E+01	3E+00	6E-01	1E+01	1E+01	1E+01	4E+00	5E+00
52. Sm151	4E+00	4E-01	6E+02	9E+03	6E+03	2E+03	2E+03	2E+03
53. Sn126	2E-03	2E-04	5E-01	6E+00	4E+00	1E+00	1E+00	1E+00
54. Sr90	4E+05	1E+05	7E+05	3E+05	2E+05	4E+05	2E+05	5E+04
55. Tc99	4E+02	1E+02	2E+01	4E+02	3E+02	4E+02	2E+02	2E+02
56. Th227	2E-04	5E-05	4E-05	7E-04	3E-04	2E-04	1E-04	9E-05
57. Th229	1E-07	5E-08	8E-08	1E-07	1E-07	1E-07	7E-08	7E-08
58. Th230	2E-09	2E-08	2E-07	2E-06	6E-07	2E-07	2E-07	2E-07
59. Th231	2E-03	2E-02	2E-01	2E+00	8E-01	1E-02	2E-01	4E-02
60. Th233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th234	5E-02	4E-01	5E+00	5E+01	2E+01	2E-01	5E+00	9E-01
62. Tl207	2E-04	5E-05	4E-05	8E-04	3E-04	2E-04	1E-04	9E-05
63. U233	1E-04	4E-05	4E-05	1E-04	1E-04	1E-04	6E-05	7E-05
64. U234	2E-05	1E-04	2E-03	1E-02	3E-03	1E-03	1E-03	1E-03
65. U235	2E-03	2E-02	2E-01	2E+00	8E-01	1E-02	2E-01	4E-02

66. U238	5E-02	4E-01	5E+00	5E+01	2E+01	2E-01	5E+00	9E-01
67. Y90	4E+05	1E+05	7E+05	3E+05	2E+05	4E+05	2E+05	5E+04
68. Zr93	1E-02	1E-03	3E+00	4E+01	3E+01	9E+00	7E+00	9E+00
TOT CURIES	1.72E+06	4.81E+05	1.47E+06	1.61E+06	1.23E+06	1.76E+06	7.03E+05	5.03E+05
TOTAL TRU	281.9	70.8	1137.2	626.2	359.8	361.8	157.9	191.7
Total (1/1/90)	BY-101 Moles	BY-102 Moles	BY-103 Moles	BY-104 Moles	BY-105 Moles	BY-106 Moles	BY-107 Moles	BY-108 Moles
69. Ag	5E-05	1E-05	2E-06	5E-05	4E-05	5E-05	2E-05	3E-05
70. Al	4E+06	2E+06	4E+06	4E+06	5E+06	5E+06	2E+06	2E+06
71. Ba	4E+01	1E+01	2E+01	4E+01	3E+01	3E+01	1E+01	2E+01
72. Bi	2E-12	2E-12	4E-04	5E+04	3E+04	1E-06	1E+04	1E+03
73. $C_2H_3O_3$	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
74. $C_6H_5O_7$	3E+05	1E+05	2E+04	4E+05	3E+05	3E+05	1E+05	2E+05
75. CO_3	1E+06	3E+05	1E+05	3E+06	2E+06	1E+06	6E+05	7E+05
76. C_2O_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	5E-03	2E-02	4E-01	7E+04	1E+05	2E+04	7E+03	1E+04
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
79. Ce	9E+01	3E+01	5E+00	1E+02	7E+01	1E+02	3E+01	5E+01
80. Cl	3E-04	8E-05	1E-05	3E-04	2E-04	3E-04	1E-04	2E-04
81. Cr	6E-13	2E-12	5E-05	6E+03	5E+03	1E-07	2E+03	2E+02
82. EDTA	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
83. F	1E+05	1E+06	4E+06	1E+05	1E+05	1E+05	5E+04	9E+04
84. Fe	6E+04	2E+04	3E+03	2E+05	1E+05	6E+04	5E+04	4E+04
85. $Fe(CN)_6$	1E+03	4E+02	2E+03	1E+05	7E+04	3E+04	3E+04	3E+04
86. HEDTA	2E+01	5E+00	9E-01	2E+01	1E+01	2E+01	7E+00	1E+01

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Table 4-15. TRAC Inventory Data.

87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	1E+04	3E+03	5E+02	1E+04	8E+03	1E+04	4E+03	7E+03
89. La	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
90. Mn	1E+03	3E+02	6E+01	1E+03	9E+02	1E+03	4E+02	7E+02
91. NO_2	4E+06	1E+06	2E+05	4E+06	3E+06	4E+06	2E+06	2E+06
92. NO_3	2E+07	3E+07	8E+07	2E+07	1E+07	2E+07	6E+06	9E+06
93. Na	2E+07	3E+07	9E+07	1E+07	1E+07	1E+07	4E+06	8E+06
94. Ni	3E+00	1E+02	3E+03	2E+05	1E+05	6E+04	6E+04	6E+04
95. OH	1E+06	5E+06	1E+07	5E+05	7E+06	4E+06	2E+06	4E+05
96. PO_4	5E+05	2E+04	1E+06	7E+04	1E+05	6E+04	3E+04	4E+04
97. Pb	2E-02	1E+00	2E+03	7E-03	7E-03	7E-03	3E-03	5E-03
98. SeO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO_3	1E+05	3E+04	6E+03	1E+05	1E+05	1E+05	4E+04	6E+04
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO_4	3E+05	8E+04	8E+04	3E+05	2E+05	3E+05	1E+05	1E+05
102. Sr	9E+01	5E+03	6E+04	9E+01	3E+03	3E+04	2E+04	1E+03
103. WO_4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	2E+01	8E+00	4E+01	2E+04	1E+04	2E+01	4E+03	4E+02
105. Volume	4E+02	4E+02	1E+03	7E+02	6E+02	6E+02	3E+02	3E+02

Table 4-16. Summary of Tank Farm Vadose Zone Borehole Geophysical Logging Data.

Tank	Number of Associated Boreholes	Geophysical Evidence of Leaking?	Comments
241-B Tank Farm			
241-B-101	7	Yes	Radioactive increase noted at 12 to 15 m (40 to 50 ft) level in two boreholes, 20-01-01 and 20-01-07, installed during June 174. Borehole 20-01-06 indicated considerable soil contamination from an old leak or spill, since the radiation starts at the top of the tank liner. Borehole readings have remained stable.
241-B-102	6	No	Radiation levels in the vadose zone boreholes have remained stable.
241-B-103	5	Yes	Unexplained activity at the base of Boreholes 20-03-03 and 20-03-06 in 1978. Boreholes have been stable.
241-B-104	2	No	Radiation levels in the vadose zone boreholes have remained stable.
241-B-105	1	Yes	High level of activity in Boreholes 20-05-06 and 20-06-06; radiation levels have remained stable.
241-B-106	4	No	Radiation levels in the vadose zone boreholes have remained stable.
241-B-107	4	No	Dry wells have remained stable.
241-B-108	5	No	Radiation levels in the vadose zone boreholes have remained stable.
241-B-109	3	No	Radiation levels in the vadose zone boreholes have remained stable.
241-B-110	9	No	Because of substantial contamination, Borehole 20-10-12 has limited use as a leak detector. Borehole radiation levels have remained stable.
241-B-111	1	Yes	Activity in Boreholes 20-11-09 and 20-12-06. Have remained stable during the review period.
241-B-112	5	Yes	Unexplained activity in two boreholes, 20-12-03 and 20-12-06. Boreholes and liquid levels have remained stable during the review period.
241-B-201	0	Yes	Categorized "Questionable Integrity" in 1971 because of increasing activity in Borehole 20-00-01.
241-B-202	0	No	Categorized "Not Intended for Reuse" in April 1976.

Table 4-16. Summary of Tank Farm Vadose Zone Borehole Geophysical Logging Data.

Tank	Number of Associated Boreholes	Geophysical Evidence of Leaking?	Comments
241-B-203	0	No	Categorized "Confirmed Leaker" in 1983 and was categorized "Not Intended for Reuse" in April 1976.
241-B-204	0	No	Categorized "Inactive, Sound" and "Not Intended for Reuse" in April 1976.
241-BX Tank Farm			
241-BX-101	3	Yes	Increases in readings from Borehole 21-01-02 in 1972 resulted in the immediate removal of supernatant. Borehole activity has remained steady.
241-BX-102	10	Yes	"Confirmed Leaker" in 1971 as a result of activity detected in Borehole 21-27-11.
241-BX-103	5	No	Contaminated soil in the vicinity of Boreholes 21-03-03, 21-03-05, and 21-03-12 is believed to have been caused by tank overflow and spillage a number of years ago; 100,000 to 300,000 L (30,000 to 90,000 gal) of waste were spilled on the ground between tanks 241-BX-102 and 241-BX-103 in 1951.
241-BX-104	6	No	None
241-BX-105	6	No	None
241-BX-106	5	No	None
241-BX-107	2	No	Test drilling and augering done in 1974 indicated that the high level of activity in Borehole 21-07-06 was associated with a transfer line leak.
241-BX-108	7	Yes	Activity in Borehole 20-08-06 began to increase in March 1974 (estimated liquid loss was 9,500 L (2,500 gal) with 500 Ci of Cs-137); residual supernatant was removed. All borehole activity has since stabilized.
241-BX-109	4	No	None
241-BX-110	9	Yes	Radiation levels in vadose zone have remained stable.
241-BX-111	6	No	Radiation levels in vadose zone have remained stable.

Table 4-16. Summary of Tank Farm Vadose Zone Borehole Geophysical Logging Data.

Tank	Number of Associated Boreholes	Geophysical Evidence of Leaking?	Comments
241-BX-112	6	No	Radiation levels in vadose zone have remained stable.
241-BY Tank Farm			
241-BY-101	5	No	Radiation levels in vadose zone have remained stable.
241-BY-102	5	No	None
241-BY-103	10	Yes	Increased activity in Borehole 22-03-09 was the basis for removing this unit from service in May 1973. The radiation peak, although of low activity, increased and spread from a range of 18 to 19 m (59 to 62 ft) to a range of 17 to 23 m (56 to 77 ft) by mid-March 1973. Continued monitoring has indicated no further significant increases.
241-BY-104	5	No	None
241-BY-105	3	No	Categorized "Questionable Integrity." Borehole activity has remained stable.
241-BY-106	6	Yes	Borehole 22-06-05 showed radionuclides slowly migrating to a lower depth, from 9.4 m (31 ft) in 1972 to 19.2 m (63 ft) in 1983; but now appears stable. Categorized "Questionable Integrity" in 1977.
241-BY-107	6	No	Nearby activity in Borehole 22-07-02 in 1979 was attributed to non-tank sources; migration due to snow melt.
241-BY-108	7	No	Boreholes have remained stable.
241-BY-109	6	No	None
241-BY-110	4	No	None
241-BY-111	5	No	None
241-BY-112	7	No	None

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Table 4-17. Cesium Inventories for Tank Leak Unplanned Releases.

Release Number	Tank	Amount Leaked	^{137}Cs (kCi)
UPR-200-E-127	B-107	8,000 gal	2.00
UPR-200-E-128	B-110	8,300 gal	4.30
UPR-200-E-129	B-201	1,200 gal	0.42
UPR-200-E-130	B-203	300 gal	--
UPR-200-E-131	BX-102	70,000 gal	51.00
UPR-200-E-132	BX-102	2,500 gal	--
UPR-200-E-133	BX-108	2,500 gal	0.50
UPR-200-E-134	BY-103	5,000 gal	--
UPR-200-E-135	BY-108	5,000 gal	--

A dashed line (--) indicates where no data are available.

9 3 1 2 8 9 6 1 1 8 5

Table 4-18. Radionuclide Inventories for Burial Sites.

Site ID	Waste Type	^{137}Cs (Ci)	^{106}Ru (Ci)	^{90}Sr (Ci)	Comments
218-E-2	solid, mixed MFP/TRU	213	2.4×10^{9}	188	--
218-E-2A	solid, mixed waste	--	--	--	no contamination detected
218-E-3	solid, mixed waste	--	--	--	released from radiation zone status
218-E-4	solid, mixed waste	9.4×10^{-2}	1.5×10^{-11}	8.3×10^{-2}	construction waste from 221-B Building
218-E-5	solid, mixed waste	70.7	9.9×10^{9}	62.7	north end contains railroad boxcars contaminated with UNH
218-E-5A	solid, mixed TRU	165	1.4×10^{7}	147	contains L Cell, D-2 Column from PUREX
218-E-6	non-hazardous, non-radioactive	--	--	--	released from radiation zone status
218-E-7	solid, mixed MFP/TRU	4.96	2.5×10^{11}	4.36	heavy vegetation over site
218-E-9	solid, mixed waste	--	--	--	fission product equipment contaminated by 221-U Building uranium recovery program
218-E-10	solid, mixed waste	9.31×10^{5}	7.71×10^{1}	7.68×10^{-5}	active
200-A Construction Pit	non-hazardous, non-radioactive	--	--	--	--
200-E Powerhouse Ash Pit	non-hazardous, non-radioactive	--	--	--	--

A dashed line (--) indicates where no data are available.

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Table 4-19. Summary of Sediment Monitoring for the 216-B-5 Reverse Well.

Well	Date	Depth (m)	Sr-90	Cs-137	Pu-238	Pu-239, 240	Am-241
Sediment Samples (nCi/g)							
Derived Concentration Guidelines (nCi/g)			600,000	20,000,000	75,000	75,000	--
E299-328-7[a]	1980	88.4	--	7.91E-04	--	--	--
E299-E28-7[a]	1980	93	3.59E-02	7.57E-05	--	5.33E-02	<3.6E-04
E299-E28-7[a]	1980	97.5	2.03E-03	6.51E-02	--	4.42E-03	<4.6E-04
E299-E28-23[a]	1980	88.1	2.19E+01	3.08E+01	--	7.50E+01	2.19E+00
E299-E28-23[a]	1980	92.1	--	1.65E+01	--	--	--
E299-E28-23[a]	1980	97.5	--	1.57E+00	--	--	--
E299-E28-24[a]	1980	88.1	3.17E-01	--	--	6.82E-03	<6.4E-04
E299-E28-24[a]	1980	91.4	4.54E-02	4.08E-01	--	2.42E-01	3.94E-03
E299-E28-24[a]	1980	96.8	3.71E-02	6.26E-02	--	4.04E-02	<6.7E-04
E299-E28-25[a]	1980	88.1	--	1.49E-04	--	--	--
E299-E28-25[a]	1980	91.4	8.01E-02	2.56E-03	--	2.15E-02	<4.2E-04
E299-E28-25[a]	1980	97.8	<1.6E-03	4.92E-04	--	2.65E-03	<4.0E-04

[a]Source: Smith 1980.
A dashed line (--) indicates where no data are available.

Table 4-20. Summary of Sanitary Wastewater and Sewage Received Daily by B Plant Aggregate Area Septic Tanks.

Septic Tank	Waste Volume Received (m3)
2607-EB	0.02
2607-EH	1.36
2607-EK	39.2
2607-EM	6.14
2607-EN	2.06
2607-EO	2.12
2607-EP	0.8
2607-EQ	13.5
2607-ER	NA
2607-E1	11.7
2607-E2	2.38
2607-E3	14.4
2607-E4	0.24
2607-E7B	NA
2607-E8	6.24
2607-E9	0.02
2607-E11	3.16
2607-GF	NA

Source: WHC, 1991a
NA = No data available.

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Table 4-21. Summary of Sediment Sampling for the 216-B-3 Pond System.

Analyte	Threshold Value[1/]	CDL	216-B-3-3 Ditch	216-B-3 Pond	216-B-3A Pond	216-B-3B Pond	216-B-3C Pond
Inorganics	(µg/g)	(µg/L)	(µg/g)	(µg/g)	(µg/g)	(µg/g)	(µg/g)
Aluminum	11,238	–	11,747	13,036	–	–	–
Ammonium	6.26	–	–	10.54	7.69	–	–
Arsenic	4.91	500	<CDL	<CDL	<CDL	<CDL	<CDL
Barium	–	1,000	<CDL	<CDL	<CDL	<CDL	<CDL
Boron	–	–	<CDL	<CDL	<CDL	<CDL	<CDL
Bromide	–	–	<CDL	<CDL	<CDL	<CDL	<CDL
Cadmium	8.23	–	9.4	11.64	8.7	–	–
Calcium	4,755	–	7,320	4,906	11,146	8,275	5,312
Chloride	1.47	–	–	3.1	2.29	–	7.9
Chromium	12.86	500	18.6	21.05	–	–	–
Cobalt	9.7	–	9.9	10.3	–	–	–
Copper	15.96	–	19.5	21.78	19.35	16.1	18.5
Cyanide	–	–	<CDL	<CDL	<CDL	<CDL	<CDL
Fluoride	<CDL	1	1.29	<CDL	<CDL	<CDL	<CDL
Iron	29,437	–	37,479	32,925	–	–	–
Lead	15.16	500	<CDL	142.88	<CDL	<CDL	<CDL
Lithium	10.2	–	10.8	12.78	–	–	–
Magnesium	6,408	–	6,635	6,649	6,546	–	–
Manganese	391	–	464	–	641.5	–	–
Mercury	<CDL	0.2 µg/g	0.3	4.23	–	–	–
Molybdenum	–	–	<CDL	<CDL	<CDL	<CDL	<CDL
Nickel	12.3	–	19.2	14.6	–	–	–
Nitrite	2.44	–	<CDL	<CDL	<CDL	<CDL	<CDL
Phosphate	4.56	–	<4.56	<4.56	<4.56	<4.56	<4.56
Potassium	1,758	–	–	1,991.25	–	–	–
Selenium	–	–	<CDL	<CDL	<CDL	<CDL	<CDL
Silver	1	500	–	2.55	–	–	1.2
Sodium	280.2	–	–	299.33	465	–	283
Strontium	30.1	–	34.8	34.7	34.85	–	–
Sulfate	5.55	–	7.03	49.06	8.12	–	9.31

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Table 4-21. Summary of Sediment Sampling for the 216-B-3 Pond System.

Analyte	Threshold Value[1/]	CDL	216-B-3-3 Ditch	216-B-3 Pond	216-B-3A Pond	216-B-3B Pond	216-B-3C Pond
Sulfide	–	10 μg/g	<CDL	<CDL	25.7	<CDL	10.9
Thallium	–	–	<CDL	<CDL	<CDL	<CDL	<CDL
Titanium	2,552	–	2,560	2,803.67	–	2,599	–
Vanadium	63.80	–	69.40	70.44	–	69.60	–
Zinc	41.30	–	62.86	64.17	47.79	41.40	57.23
Zirconium	23.10	–	25.80	29.29	27.62	27.18	25.80
Volatile Organics	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)
Acetone	218	–	–	333	–	–	–
Carbon Disulfide	<CDL	10	–	34	–	–	–
1,3 Dichlorobenzene	26	–	–	–	–	–	–
Methylene Chloride	<CDL	5	14	35	–	–	6
Methyl Ethyl Ketone	<CDL	10	11	35	–	–	12
Semivolatiles	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)
Bis(2-ethylhexyl) phthalate	–	–	ND	ND	ND	ND	ND
Other Organics	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)	(μg/kg)
Herbicides	–	–	ND	ND	ND	ND	ND
Pesticides	–	–	ND	ND	ND	ND	ND
Polychlorinated Biphenyls	–	–	ND	ND	ND	ND	ND
Radionuclides	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)	(pCi/g)
Gross Alpha	–	–	5.5	9.1	4.2	3.7	9.2
Gross Beta	–	–	68.6	103.3	32.2	18.2	290.1
Ce-144	–	–	1.8	0.38	2.03	ND	0.38
CePr-144	–	0.18	ND	0.68	ND	ND	0.68
Co-57	–	–	0.33	ND	ND	ND	ND
Co-60	–	0.02	ND	ND	ND	ND	ND
Cs-134	–	0.02	0.23	nd	0.08	ND	ND
Cs-137	–	0.02	108.2	72.74	5.6	0.01	6.1
K-40	–	0.35	12.2	16	12.6	10.6	11.4
Na-22	–	0.02	0.21	ND	ND	ND	ND
Nb-95	–	–	ND	0.06	0.1	ND	ND
Pb-212	–	–	0.47	0.82	0.7	0.39	0.82

Table 4-21. Summary of Sediment Sampling for the 216-B-3 Pond System.

Analyte	Threshold Value[1/]	CDL	216-B-3-3 Ditch	216-B-3 Pond	216-B-3A Pond	216-B-3B Pond	216-B-3C Pond
Pb-214	--	--	0.54	0.71	0.47	0.37	0.71
Ru-106	--	0.17	ND	ND	ND	ND	ND
Sr-90	--	0.005	2.1	1.407	0.275	0.04	0.336
Zr-95	--	--	ND	0.04	ND	ND	ND
ZrNb-95	--	0.03	0.47	ND	ND	ND	0.31

Source: WHC 1991c.
All values are averages for regular samples exceeding background tolerance limits.
ND = Non-detectable.
CDL = Contract Detection Limit.
A dashed line (--) indicates where not data are available.
[1/]Threshold values are the calculated upper tolerance limits statistically derived from average background values.

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Table 4-22. Candidate Contaminants of Potential Concern for the B Plant Aggregate Area.

RADIONUCLIDES

TRANSURANICS

Americium-241
Americium-242
Americium-242m
Americium-243
Curium-242[a/]
Curium-244
Curium-245
Neptunium-237
Neptunium-238[a/]
Neptunium-239[a/]
Plutonium-238
Plutonium-239/240
Plutonium-241
Plutonium-242

URANIUM

Uranium-233
Uranium-234
Uranium-235
Uranium-236
Uranium-238

FISSION PRODUCTS

Actinium-225
Actinium-227
Actinium-228[a/]
Antimony-126[a/]
Antimony-126m[a/]
Astitine-217
Barium-135m[a/]
Barium-137m
Barium-140[a/]
Bismuth-210
Bismuth-211
Bismuth-212[a/]
Bismuth-213
Bismuth-214
Carbon-14
Cerium-141[a/]
Cerium-144[a/]
Cesium-134
Cesium-135
Cesium-137
Cobalt-57[a/]
Cobalt-58[a/]
Cobalt-60
Europium-152
Europium-154
Europium-155
Francium-221
Francium-223[a/]
Gadolinium-152
Iodine-129
Iron-59[a/]
Lanthanum-140[a/]
Lead-209
Lead-210
Lead-211
Lead-212[a/]
Lead-214
Manganese-54[a/]
Nickel-59
Nickel-63
Niobium-93m
Niobium-95[a/]
Niobium-95m[a/]
Palladium-107
Polonium-210
Polonium-211[a/]
Polonium-212[a/]
Polonium-213
Polonium-214
Polonium-215
Polonium-216[a/]
Polonium-218
Potassium-40
Praeseodymium-144[a/]
Praeseodymium-144m[a/]
Promethium-147
Protactinium-231
Protactinium-233[a/]
Protactinium-234[a/]
Protactinium-234m
Radium
Radium-223
Radium-224[a/]
Radium-225
Radium-226
Radium-228
Radon-219
Radon-220[a/]
Radon-222
Rhodium-103[a/]
Rhodium-103m[a/]
Rhodium-106[a/]
Ruthenium-103
Ruthenium-106
Samarium-147
Samarium-151
Selenium-79
Silver-110[a/]
Silver-110m[a/]
Sodium-22
Strontium-85[a/]
Strontium-89[a/]
Strontium-90
Technetium-99
Tellurium-129
Thallium-207
Thallium-208[a/]
Thallium-209
Thorium-227
Thorium-228
Thorium-229
Thorium-230
Thorium-231
Thorium-232
Thorium-233[a/]
Thorium-234
Tin-126[a/]
Tritium
Yttrium-90
Yttrium-91[a/]
Zinc-65[a/]
Zirconium-93
Zirconium-95[a/]

INORGANIC CHEMICALS

Acetic acid
Alkaline liquids
Aluminum
Aluminum nitrate (mono basic)
Aluminum nitrate nonahydrate
Ammonia (anhydrous)
Ammonium carbonate
Ammonium fluoride
Ammonium hydroxide
Ammonium ion
Ammonium nitrate
Ammonium oxalate

9 3 1 2 8 9 6 1 1 9 2

Table 4-22. Candidate Contaminants of Potential Concern for the B Plant Aggregate Area.

INORGANIC CHEMICALS (CONT.)

Ammonium silicofluoride
Ammonium sulfate
Ammonium oxalate
Ammonium silicofluoride
Ammonium sulfate
Ammonium sulfite
Antifreeze
Arsenic
Barium
Barium nitrate
Beryllium
Bismuth
Bismuth nitrate
Bismuth phosphate
Boric acid
Boron
Cadmium
Cadmium nitrate
Calcium
Calcium carbonate
Calcium chloride
Carbon dioxide
Carbonate
Ceric fluoride
Ceric iodate
Ceric nitrate
Ceric sulfate
Cerium
Cesium carbonate
Cesium chloride
Chloride
Chromium
Chromium nitrate
Chromous sulfate
Copper
Cyanide
DOW Anti-Foam B
Duolite ARC-359 (IX Resin)
(sulfonated phenolic)
Ferric cyanide
Ferric nitrate
Ferrous sulfamate
Ferrous sulfate
Fluoride
Hydrobromic acid
Hydrochloric acid
Hydrofluoric acid
Hydrogen
Hydrogen Fuloride
Hydrogen peroxide
Hydroiodic acid
Hydroxide
Hydroxyacetic acid
Hydroxylamine hydorchloride
Hyflo-Super-Cel
(contains silica)
Iron
Lanthanum fluoride
Lanthanum hydroxide
Lanthanum nitrate
Lanthanum-neodynium nitrate
Lead
Lead nitrate
Lithium
Magnesium
Magnesium carbonate
Magnesium nitrate
Manganese
Mercuric nitrate
Mercury
Misc. Toxic Process Chemicals
Nickel
Nickel nitrate
Niobium
Nitrate
Nitric acid
Nitrite
Normal paraffin hydrocarbon
Oxalic acid
Periodic acid
Phosphate
Phosphoric acid
Phosphorous pentoxide
Phosphotungetic acid
Plutonium fluoride
Plutonium nitrate
Plutonium peroxide
Potassium
Potassium carbonate
Potassium ferrocyanide
Potassium fluoride
Potassium hydroxide
Potassium oxalate
Potassium permanganate
Pu-Lanthanum fluoride
Pu-Lanthanum oxide
Rubidium
Silica
Silicon
Silver
Silver nitrate
Sodium
Sodium aluminate
Sodium bismuthate
Sodium bisulfate
Sodium bromate
Sodium carbonate
Sodium citrate
Sodium dichromate
Sodium ferrocyanide
Sodium fluoride
Sodium gluconate
Sodium hydroxide
Sodium nitrate
Sodium nitrite
Sodium persulfate
Sodium phosphate
Sodium sulfate
Sodium thiosulfate
Strontium carbonate
Strontium fluoride
Strontium sulfate
Sugar
Sulfamic acid
Sulfate
Sulfuric acid
Tartaric acid
Thorium
Tin
Titanium
Uranium
Uranium oxide
Uranyl nitrate hexahydrate
Various acids
Yttrium
Zeolon
Zinc
Zirconium
Zirconyl nitrate

ORGANIC CHEMICALS

1-Butanol
1-Butanone

Table 4-22. Candidate Contaminants of Potential Concern for the B Plant Aggregate Area.

2-Butanone
Acetone
Bismuth phosphate
Butanoic acid
Butyl alchohol
Butylated hydroxy toluene
Carbon tetrachloride
Cesium phosphtungetic salts
Chloroform
Chloroplatinic acid
Citric acid
Decane
Di2-ethyl hexyl phosphoric acid
Dibutyl butyl phosphonate
Dibutyl phosphate
Dichloromethane
Diesel fuel
Dowex 21 K/Amberlite XE-270 (IX Resin)
Ethanol
Ethyl ether
Flammable solvents
Formaldehyde (solution)
Grease
Halogenated hydrocarbons
Hydrazine
Hydroxy acetic acid-Trisodium hydroxy ethylene-Diamine triacetic acid
Hydroxylamine nitrate
Ionac A-580/Pemutit SK (IX Resin)
Isopropyl alcohol
Kerosene
Methyl ethyl ketone
Methylene chloride
Misc. toxic process chemicals
Molybdate-citrate reagent
Monobutyl phosphate
Normal parrafin hydrocarbon
Paraffin hydrocarbons
PCBs
Propanol
Shell E-2342 (Napthalene and paraffin)
Sodium acetate
Soltrol-170 ($ClOH_{22}$ to Cl_6H_{34}; purified kerosene)
Tartaric acid
Tetrasodium ethylene diamine tetra-acetate (EDTA)
Thenoyltrifluoroacetone
Toluene
Tri-n-dodecylamine
Tributyl phosphate
Trichloroethane
Trichloromethane
Trisodium hydroxyethyl ethylene-diamine triacetate (HEDTA)
Waste Paint and Thinners
Zeolite AW-500 (IX Resin)

[a]The radionuclide has a half-life of <1 year and if it is a daughter product, the parent has a half-life of <1 year, or the buildup of the short-lived daughter would result in an activity of <1% of the parent radionuclide's initial activity.

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Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
Plants, Buildings, and Storage Areas							
2703-E Hazardous Waste Staging Area	–	–	–	S	K	S	S
2704-E Hazardous Waste Staging Area	–	–	–	S	K	K	K
2715-EA Hazardous Waste Staging Area	–	–	–	S	S	K	K
226-B Hazardous Waste Staging Facility	–	–	–	S	K	K	K
224-B Concentration Facility	K	K	S	K	S	S	K
Tanks and Vaults							
241-B-101 Single-Shell Tank	K	K	K	K	K	K	K
241-B-102 Single-Shell Tank	K	K	K	K	K	K	K
241-B-103 Single-Shell Tank	K	K	K	K	K	K	K
241-B-104 Single-Shell Tank	K	K	K	K	K	K	K
241-B-105 Single-Shell Tank	K	K	K	K	K	K	K
241-B-106 Single-Shell Tank	K	K	K	K	K	K	K
241-B-107 Single-Shell Tank	K	K	K	K	K	K	K
241-B-108 Single-Shell Tank	K	K	K	K	K	K	K
241-B-109 Single-Shell Tank	K	K	K	K	K	K	K
241-B-110 Single-Shell Tank	K	K	K	K	K	K	K
241-B-111 Single-Shell Tank	K	K	K	K	K	K	K
241-B-112 Single-Shell Tank	K	K	K	K	K	K	K
241-B-201 Single-Shell Tank	K	K	K	K	K	K	K
241-B-202 Single-Shell Tank	K	K	K	K	K	K	K
241-B-203 Single-Shell Tank	K	K	K	K	K	K	K
241-B-204 Single-Shell Tank	K	K	K	K	K	K	K

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Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
241-BX-101 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-102 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-103 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-104 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-105 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-106 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-107 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-108 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-109 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-110 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-111 Single-Shell Tank	K	K	K	K	K	K	K
241-BX-112 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-101 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-102 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-103 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-104 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-105 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-106 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-107 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-108 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-109 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-110 Single-Shell Tank	K	K	K	K	K	K	K
241-BY-111 Single-Shell Tank	K	K	K	K	K	K	K

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
241-BY-112 Single-Shell Tank	K	K	K	K	K	K	K
241-B-301B Catch Tank	S	S	S	S	S	S	S
241-B-302B Catch Tank	S	S	S	S	S	S	S
241-BX-302A Catch Tank	S	S	S	S	S	S	S
241-BX-302B Catch Tank	S	S	S	S	S	S	S
241-BX-302C Catch Tank	S	S	S	S	S	S	S
241-ER-311 Catch Tank	S	S	S	S	S	S	S
241-B-361 Settling Tank	K	K	S	S	S	S	S
270-E Condensate Neutralization Tank	–	K	–	–	–	–	–
244-BXR Vault	K	K	K	K	K	K	K
244-BXR Receiving Tank	K	K	K	K	K	K	K
Cribs and Drains							
216-B-7A Crib	K	K	K	S	K	S	S
216-B-7B Crib	K	K	K	S	K	S	S
216-B-10A Crib	K	K	K	S	K	S	S
216-B-10B Crib	K	K	K	S	S	S	S
216-B-12 Crib	K	K	K	S	K	S	S
216-B-14 Crib	K	K	K	S	K	S	S
216-B-15 Crib	K	K	K	S	K	S	S
216-B-16 Crib	K	K	K	S	K	S	S
216-B-17 Crib	K	K	K	S	K	S	S
216-B-18 Crib	K	K	K	S	K	S	S
216-B-19 Crib	K	K	K	S	K	S	S

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Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
216-B-43 Crib	K	K	K	S	K	S	S
216-B-44 Crib	K	K	K	S	K	S	S
216-B-45 Crib	K	K	K	S	K	S	S
216-B-46 Crib	K	K	K	S	K	S	S
216-B-47 Crib	K	K	K	S	K	S	S
216-B-48 Crib	K	K	K	S	K	S	S
216-B-49 Crib	K	K	K	S	K	S	S
216-B-50 Crib	K	K	K	S	K	S	S
216-B-55 Crib	K	K	K	S	K	S	S
216-B-56 Crib	–	S	–	–	–	–	–
216-B-57 Crib	K	K	K	S	K	S	S
216-B-60 Crib	K	K	K	S	S	S	S
216-B-61 Crib	–	–	–	–	–	–	–
216-B-62 Crib	K	K	K	S	S	S	S
216-B-8TF Crib/Tile Field	K	K	K	S	K	S	S
216-B-9TF Crib/Tile Field	K	K	K	S	K	S	S
216-B-13 French Drain	K	K	S	–	S	–	–
216-B-51 French Drain	–	S	–	–	K	–	–
Chemical Tile Field North of 2703-E	–	K	–	–	–	–	–
Reverse Wells							
216-B-4 Reverse Well	K	K	S	S	S	S	S
216-B-5 Reverse Well	K	K	S	S	K	S	S
216-B-6 Reverse Well	K	K	S	S	K	S	S

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
216-B-11A Reverse Well	K	K	K	S	S	S	S
216-B-11B Reverse Well	K	K	K	S	S	S	S
Ponds, Ditches, and Trenches							
216-B-3 Pond	K	K	K	S	S	S	S
216-B-3A Pond	–	–	–	–	–	–	–
216-B-3B Pond	–	–	–	–	–	–	–
216-B-3C Pond	–	–	–	–	–	–	–
216-A-25 Pond	K	K	K	S	S	S	S
216-E-28 Contingency Pond	–	–	–	–	–	–	–
216-N-8 Pond	S	K	S	S	S	S	K
2101-M Pond	–	–	–	–	K	K	K
216-B-2-1 Ditch	K	K	K	S	S	S	S
216-B-2-2 Ditch	K	K	K	S	S	S	S
216-B-2-3 Ditch	S	K	S	S	S	S	S
216-B-3-1 Ditch	S	K	S	S	S	S	S
216-B-3-2 Ditch	S	K	S	S	S	S	S
216-B-3-3 Ditch	–	K	–	S	S	S	S
216-B-20 Trench	K	K	K	S	K	S	S
216-B-21 Trench	K	K	K	S	K	S	S
216-B-22 Trench	K	K	K	S	K	S	S
216-B-23 Trench	K	K	K	S	K	S	S
216-B-24 Trench	K	K	K	S	K	S	S
216-B-25 Trench	K	K	K	S	K	S	S

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
216-B-26 Trench	K	K	K	S	K	S	S
216-B-27 Trench	K	K	K	S	K	S	S
216-B-28 Trench	K	K	K	S	K	S	S
216-B-29 Trench	K	K	K	S	K	S	S
216-B-30 Trench	K	K	K	S	K	S	S
216-B-31 Trench	K	K	K	S	K	S	S
216-B-32 Trench	K	K	K	S	K	S	S
216-B-33 Trench	K	K	K	S	K	S	S
216-B-34 Trench	K	K	K	S	K	S	S
216-B-35 Trench	K	K	K	S	K	S	S
216-B-36 Trench	K	K	K	S	K	S	S
216-B-37 Trench	K	K	K	S	K	S	S
216-B-38 Trench	K	K	K	S	K	S	S
216-B-39 Trench	K	K	K	S	K	S	S
216-B-40 Trench	K	K	K	S	K	S	S
216-B-41 Trench	K	K	K	S	K	S	S
216-B-42 Trench	K	K	K	S	K	S	S
216-B-52 Trench	K	K	K	S	K	S	S
216-B-53A Trench	K	K	K	–	–	–	–
216-B-53B Trench	K	K	K	–	–	–	–
216-B-54 Trench	K	K	K	–	–	–	–
216-B-58 Trench	K	K	K	–	–	–	–
216-B-63 Trench	K	K	K	S	S	S	S

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
Septic Tanks and Associated Drain Fields							
2607-E1 Septic Tank	–	–	–	S	S	S	–
2607-E2 Septic Tank	–	–	–	S	S	S	–
2607-E3 Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-E4 Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-E7B Septic Tank	–	–	–	S	S	S	–
2607-E8 Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-E9 Septic Tank	–	–	–	S	S	S	–
2607-E11 Septic Tank	–	–	–	S	S	S	–
2607-EB Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-EH Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-EK Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-EM Septic Tank	–	–	–	S	S	S	–
2607-EN Septic Tank	–	–	–	S	S	S	–
2607-EO Septic Tank	–	–	–	S	S	S	–
2607-EP Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-EQ Septic Tank/Drain Field	–	–	–	S	S	S	–
2607-ER Septic Tank	–	–	–	S	S	S	–
2607-GF Septic Tank/Drain Field	–	–	–	S	S	S	–
Transfer Facilities, Diversion Boxes, and Pipelines							
241-B-151 Diversion Box	S	S	S	S	S	S	S
241-B-152 Diversion Box	S	S	S	S	S	S	S
241-B-153 Diversion Box	S	S	S	S	S	S	S

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
241-B-154 Diversion Box	S	S	S	S	S	S	S
241-B-252 Diversion Box	S	S	S	S	S	S	S
241-BR-152 Diversion Box	S	S	S	S	S	S	S
241-BX-153 Diversion Box	S	S	S	S	S	S	S
241-BX-154 Diversion Box	S	S	S	S	S	S	S
241-BX-155 Diversion Box	S	S	S	S	S	S	S
241-BXR-151 Diversion Box	S	S	S	S	S	S	S
241-BXR-152 Diversion Box	S	S	S	S	S	S	S
241-BXR-153 Diversion Box	S	S	S	S	S	S	S
241-BYR-152 Diversion Box	S	S	S	S	S	S	S
241-BYR-153 Diversion Box	S	S	S	S	S	S	S
241-BYR-154 Diversion Box	S	S	S	S	S	S	S
241-ER-151 Diversion Box	S	S	S	S	S	S	S
241-ER-152 Diversion Box	S	S	S	S	S	S	S
242-B-151 Diversion Box	S	S	S	S	S	S	S
Basins							
207-B Retention Basin	S	K	S	S	S	S	S
216-B-59B Retention Basin	–	S	–	–	–	–	–
216-B-64 Retention Basin	S	K	S	S	S	S	S

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
Burial Sites							
218-E-2 Burial Ground	K	K	K	–	–	–	–
216-E-2A Burial Ground	–	–	–	–	–	–	–
218-E-3 Burial Ground	–	–	–	–	–	–	–
218-E-4 Burial Ground	K	K	K	–	–	–	–
218-E-5 Burial Ground	K	K	K	–	–	–	–
218-E-5A Burial Ground	K	K	K	–	–	–	–
216-E-6 Burial Ground	–	S	–	–	S	–	–
218-E-7 Burial Ground	K	K	S	–	–	–	–
218-E-9 Burial Ground	–	K	K	–	–	–	–
218-E-10 Burial Ground	K	K	K	S	S	S	S
200 Area Construction Pit	–	–	–	–	–	–	–
200-E Powerhouse Ash Pit	–	–	–	–	–	–	–
Unplanned Releases							
UN-200-E-1	S	K	S	S	S	S	S
UN-200-E-2	–	S	–	–	–	–	–
UN-200-E-3	S	K	S	–	–	–	–
UN-200-E-7	S	K	S	S	S	S	S
UN-200-E-9	S	S	S	S	S	S	K
UN-200-E-14	–	–	–	–	–	–	–
UN-200-E-41	S	K	S	S	S	–	S
UN-200-E-43	–	K	–	–	–	–	–
UN-200-E-44	S	K	S	S	S	–	S

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
UN-200-E-45	S	S	S	S	S	S	S
UN-200-E-52	–	K	–	–	–	–	–
UN-200-E-54	–	K	–	–	–	–	–
UN-200-E-55	–	K	–	–	–	–	–
UN-200-E-61	–	K	–	–	–	–	–
UN-200-E-63	–	K	–	–	–	–	–
UN-200-E-64	–	K	–	–	–	–	–
UN-200-E-69	–	K	–	–	–	–	–
UN-200-E-76	–	K	–	S	–	–	–
UN-200-E-79	–	K	–	–	–	–	–
UN-200-E-80	–	K	–	K	–	–	–
UN-200-E-83	–	K	–	–	–	–	–
UN-200-E-85	–	K	–	–	K	–	–
UN-200-E-87	K	K	S	–	–	–	–
UN-200-E-89	S	K	S	S	–	–	–
UN-200-E-90	–	S	–	–	–	–	–
UN-200-E-92	–	K	–	–	–	–	–
UN-200-E-95	–	K	–	–	–	–	–
UN-200-E-101	–	K	–	–	–	–	–
UN-200-E-103	S	K	S	S	S	–	S
UN-200-E-105	S	K	S	S	S	–	S
UN-200-E-109	–	–	–	–	–	–	–
UN-200-E-110	–	–	–	–	–	–	–

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
UN-200-E-112	–	K	–	–	–	–	–
UN-200-E-140	–	–	–	–	–	K	–
UPR-200-E-4	–	K	–	–	–	–	–
UPR-200-E-5	–	–	–	–	–	–	–
UPR-200-E-6	–	K	–	–	–	–	–
UPR-200-E-32	–	K	–	–	S	S	S
UPR-200-E-34	K	K	S	–	–	–	–
UPR-200-E-38	S	K	S	S	S	S	S
UPR-200-E-51	–	–	–	K	–	–	–
UPR-200-E-73	S	K	S	S	S	S	S
UPR-200-E-74	S	K	S	S	S	S	S
UPR-200-E-75	S	K	S	S	S	S	S
UPR-200-E-77	S	S	S	K	S	S	S
UPR-200-E-78	S	K	S	S	S	S	S
UPR-200-E-84	–	K	–	–	–	–	–
UPR-200-E-108	S	K	S	K	–	–	–
UPR-200-E-116	–	K	–	–	–	–	–
UPR-200-E-127	S	K	S	–	–	–	–
UPR-200-E-128	S	K	S	–	–	–	–
UPR-200-E-129	S	K	S	–	–	–	–
UPR-200-E-130	–	S	–	K	K	–	–
UPR-200-E-131	S	K	S	–	–	–	–
UPR-200-E-132	S	K	S	–	–	–	–

Table 4-23. Summary of Known and Suspected Contamination at B Plant Aggregate Area Waste Management Units and Unplanned Releases.

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-volatiles
UPR-200-E-133	S	K	S	–	–	–	–
UPR-200-E-134	S	K	S	–	–	–	–
UPR-200-E-135	–	S	–	–	–	–	K
UPR-200-E-138	–	K	–	–	–	–	–

K = Known contamination (based on specific media sampling data and liquid disposal inventories).

S = Suspected contamination (specific sampling media data of liquid disposal inventory data lacking, but historical process information indicates that contamination of media could occur).

A dashed line (–) indicates where no data are available.

Table 4-24. Contaminants of Potential Concern for the B Plant Aggregate Area.

RADIONUCLIDES

Gross alpha
Gross beta

TRANSURANICS

Americium-241
Americium-242
Americium-242m
Americium-243
Curium-244
Curium-245
Neptunium-237
Plutonium-238
Plutonium-239/240
Plutonium-241
Plutonium-242

URANIUM

Uranium-233
Uranium-234
Uranium-235
Uranium-236
Uranium-238

FISSION PRODUCTS

Actinium-225
Actinium-227
Astitine-217
Barium-137m
Bismuth-210
Bismuth-211
Bismuth-213
Bismuth-214
Carbon-14
Cesium-134
Cesium-135
Cesium-137
Cobalt-60
Europium-152
Europium-154
Europium-155
Francium-221
Gadolinium-152
Iodine-129
Lead-209
Lead-210
Lead-211
Lead-214
Nickel-59
Nickel-63
Niobium-93m
Palladium-107
Polonium-210
Polonium-213
Polonium-214
Polonium-215
Polonium-218
Potassium-40
Promethium-143
Protactinium-231
Protactinium-234m
Radium-223
Radium-225
Radium-226
Radium-228
Radon-219
Radon-222
Ruthenium-106
Samarium-147
Samarium-151
Selenium-79
Sodium-22
Strontium-90
Technetium-99
Thallium-207
Thorium-227
Thorium-229
Thorium-230
Thorium-231
Thorium-232
Thorium-234
Tritium
Yttrium-90
Zirconium-93

HEAVY METALS

Arsenic
Barium
Beryllium
Cadmium
Chromium
Copper

HEAVY METALS

Iron
Lead
Manganese
Mercury
Nickel
Silver
Tin
Uranium
Zinc

OTHER INORGANICS

Ammonia
Boron
Cyanide
Fluoride
Nitrate/Nitrite
Sulfuric Acid

VOLATILE ORGANICS

1-Butanol
Acetone
Carbon tetrachloride
Chloroform
Ethyl ether
Methylene chloride
Methyl ethyl ketone
Toluene
1,1,1-Trichloroethane

SEMIVOLATILE ORGANICS

Hydrazine
Kerosene
PCBs
Tributyl phosphate

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Table 4-25. Soil-Water Distribution Coefficient K_d for Radionuclides[a] and Inorganics of Concern at B Plant Aggregate Area Waste Management Units.

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[b] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[c] (Strenge and Peterson 1989) in mL/g	Mobility Class
Actinium	–	–	228	low
Americium	100 - 1000 (<1 @ pH 1-3)	100	82	low
Ammonia	–	–	–	unknown
Astitine	–	–	–	unknown
Arsenic	–	0	5.86	moderate
Barium	–	50	530	moderate
Beryllium	–	–	1,400	low
Bismuth	–	20	–	moderate
Boron	–	–	0.19	high
Cadmium	–	15	14.9	moderate
Carbon (^{14}C)	–	0 m<5	0	high
Cesium	200 - 1,000 1 - 200 (acidic waste)	50	51	low
Chromium	–	0	16.8	moderate
Cobalt	500 - 2000	10	1.9	low
Copper	–	15	41.9	moderate
Curium	100 - >2,000	100	82	low
Cyanide	–	0	–	high
Europium	–	–	228	low
Fluoride	–	0 m <1	0	high
Francium	–	–	–	unknown
Gadolinium	–	–	–	unknown
Iodine	<1	0	0	high
Iron	–	20	15	moderate
Lead	–	30	234	moderate
Manganese	–	20	16.5	moderate
Mercury	–	–	322	low

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Table 4-25. Soil-Water Distribution Coefficient K_d for Radionuclides[a] and Inorganics of Concern at B Plant Aggregate Area Waste Management Units.

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[b] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[c] (Strenge and Peterson 1989) in mL/g	Mobility Class
Neptunium	<1-5	3	3	high
Nickel	–	15	12.2	moderate
Niobium	–	–	50	moderate
Nitrate/Nitrite	–	0 m <1	0	high
Palladium	–	–	4	high
Plutonium	100 - 1,000 < 1 at pH 1 - 3	100	10	low
Polonium	–	–	5.9	moderate
Potassium	–	–	0.2	high
Protactinium	–	–	0	high
Promethium	–	–	–	unknown
Radium	–	20	24.3	moderate
Radon	–	–	–	unknown
Ruthenium	20 - 700 (<2 at >1 M nitrate)	–	274	moderate
Samarium	–	–	228	low
Selenium	–	0	5.91	high
Silver	–	20	0.4	moderate
Sodium	–	3	0	high
Strontium	5 - 100 3 - 5 (acidic conditions) 200 - 500 (w/phosphate or oxalate)	10	24.3	moderate
Sulfuric Acid	–	–	0	high
Technetium	0 - 1	0	3	high
Thallium	–	–	0	high
Thorium	–	50	100	moderate
Tin	–	–	10	moderate
Titanium	–	–	–	unknown
Tritium	0	0	0	high

9 3 1 2 8 9 6 1 2 0 9

Table 4-25. Soil-Water Distribution Coefficient K_d for Radionuclides[a] and Inorganics of Concern at B Plant Aggregate Area Waste Management Units.

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[b] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[c] (Strenge and Peterson 1989) in mL/g	Mobility Class
Uranium	–	0	0	high
Yttrium	–	–	228	low
Zinc	–	15	12.7	moderate
Zirconium	–	30	50	moderate

[a]Radionuclides with half-lives of greater than 3 months.

[b]Average K_Ds for low salt and organic solutions with neutral pH.

[c]Default values for pH 6 to 9 and soil content of [clay + organic matter + metal oxyhydroxides] < 10% (Strenge and Peterson 1989).

A dashed line (–) indicates where no data are available.

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Table 4-26. Mobility of Inorganic Species in Soil.

Highly mobile ($K_d < 5$)	
Boron Carbon (as $^{14}CO_2$) Cyanide Fluoride Iodine Neptunium Nitrate/Nitrite Falladium Palladium Potassium	Protactinium Selenium Sodium Sulfuric acid Technetium Thallium Tritium Uranium
Moderately mobile ($5 < K_d < 100$)	
Arsenic Barium Bismuth Cadmium Chromium Copper Iron Lead Manganese	Nickel Niobium Polonium Radium Ruthenium Silver Strontium Thorium Tin Zinc Zirconium
Low mobility ($K_d > 100$)	
Actinium Americium Beryllium Cesium Cobalt Curium Europium Mercury Plutonium Samarium Yttirum	

9 3 1 2 8 9 6 1 2 1 1

Table 4-27. Physical/Chemical Properties of Organic Contaminants of Concern for B Plant Aggregate Area Waste Management Units.

Compound	Molecular Weight in g/mole	Water Solubility in mg/L	Vapor Pressure in mm Hg	Henry's Law Constant in atm-m^3/mo	Soil/Organic Matter Partition Coef. K_{oc} in mL/g
Acetone	58.0	miscible	270	2.1×10^{-5}	2.2
1-Butanol	74.1	79,000	24	4.8×10^{-6}	4.7
Carbon tetrachloride	154.0	758	90	2.4×10^{-2}	110
Chloroform (trichloromethane)	119	8,200	150	2.9×10^{-3}	31
Ehtyl ether	74.1	65,000	440	9.0×10^{-4}	4.8
Hydrazine	32.1	300,000	14	2.0×10^{-6}	0.005
Kerosene[a/]	142.2	32	0.045	2.9×10^{-4}	4,500
Methylene chloride	84.9	20,000	360	2×10^{-3}	8.8
Methy ethyl ketone	72.1	270,000	78	2.7×10^{-5}	4.5
PCBs	328.0	0.031	7.7×10^{-5}	1.1×10^{-3}	5.3×10^{5}
Toluene	92.2	540	28	6.4×10^{-3}	30
Tributyl phosphate	266.3	280	15	1.9×10^{-2}	6,000
1,1,1 Trichloroethane	133.41	1.5E+3	1.2E+2	1.4E-2	1.5E+2

Source: Strenge and Peterson (1989).

[a/]Kerosene properties are represented by 2-methyl naphthalene.

Table 4-28. Radiological Properties of Potential Radionuclides of Concern in B Plant Aggregate Area Waste Management Units. Page 1 of 3

Radionuclide	Half-Life	Specific Activity[a/] in Ci/g	Principal Radiation of Concern[b/]
^{225}Ac	10 d	5.8×10^{4}	α
^{227}Ac	21.8 yr	7.2×10^{1}	β, α
^{241}Am	432 yr	3.4×10^{0}	α
^{242}Am	16 hr	8.1×10^{5}	β
^{242m}Am	152 yr	9.7×10^{0}	α
^{243}Am	7,380 yr	2.0×10^{-1}	α
^{217}At	0.03 sec	1.7×10^{12}	α
^{137m}Ba	2.6 min	5.3×10^{8}	γ
^{210}Bi	5.01 d	1.2×10^{5}	β
^{211}Bi	2.13 min	4.2×10^{8}	α, β
^{213}Bi	45.6 min	1.9×10^{7}	β, α
^{214}Bi	19.9 min	4.4×10^{7}	β, γ
^{14}C	5,730 yr	4.5×10^{0}	β
^{244}Cm	18.1 yr	8.1×10^{1}	α
^{245}Cm	8,500 yr	1.7×10^{-1}	α, γ
^{60}Co	5.3 yr	1.1×10^{3}	γ
^{134}Cs	2.06 yr	1.3×10^{3}	γ
^{135}Cs	3×10^{6} yr	8.8×10^{-4}	β
^{137}Cs	30 yr	8.7×10^{1}	γ
^{152}Eu	13.3 yr	7.7×10^{2}	$\beta, \gamma^{c/}$
^{154}Eu	8.8 yr	2.7×10^{2}	$\beta, \gamma^{c/}$
^{155}Eu	4.96 yr	4.6×10^{2}	β, γ
^{221}Fr	4.8 min	1.8×10^{8}	α, γ
^{152}Gd	1.1×10^{14} yr	8.1×10^{-11}	α
^{3}H	12.3 yr	9.7×10^{3}	β
^{129}I	1.6×10^{7} yr	1.7×10^{-4}	β
^{40}K	1.3×10^{9} yr	6.7×10^{-6}	$\beta, \gamma^{c/}$
^{59}Ni	8×10^{4} yr	7.6×10^{-2}	γ
^{63}Ni	92 yr	6.2×10^{2}	β
^{22}Na	2.6 yr	6.3×10^{3}	β, γ
^{93m}Nb	14.6 yr	2.8×10^{2}	$\gamma^{c/}$
^{237}Np	2.14×10^{6} yr	7.0×10^{-4}	α, γ

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Table 4-28. Radiological Properties of Potential Radionuclides of Concern in B Plant Aggregate Area Waste Management Units. Page 2 of 3

Radionuclide	Half-Life	Specific Activity[a/] in Ci/g	Principal Radiation of Concern[b/]
^{239}Np	2.35 d	2.3×10^{5}	β
^{231}Pa	32,800 yr	4.7×10^{-2}	α
^{234m}Pa	1.2 min	6.7×10^{8}	β, γ
^{209}Pb	3.25 hr	4.5×10^{6}	β
^{210}Pb	22.3 yr	7.6×10^{1}	β
^{211}Pb	36.1 min	2.5×10^{7}	β
^{214}Pb	26.8 min	3.3×10^{7}	β, γ[c/]
^{107}Pd	6.5×10^{6} yr	5.1×10^{-4}	β
^{210}Po	138 d	4.5×10^{3}	α,γ
^{213}Po	4.2×10^{-6} sec	1.3×10^{16}	α
^{214}Po	6×10^{-5} sec	8.8×10^{14}	α
^{215}Po	7.8×10^{-4} sec	2.9×10^{13}	α
^{218}Po	3.05 min	2.8×10^{8}	α
^{143}Pr	14 d	6.5×10^{4}	β
^{238}Pu	87.7 yr	1.7×10^{1}	α
^{239}Pu	24,400 yr	6.2×10^{-2}	α
^{240}Pu	6,560 yr	2.3×10^{-1}	α
^{241}Pu	14.4 yr	1.0×10^{2}	β
^{242}Pu	3.8×10^{5}yr	3.9×10^{-3}	α
^{223}Ra	11.4 d	5.1×10^{4}	α
^{225}Ra	14.8 d	3.9×10^{4}	β
^{226}Ra	1,600 yr	9.9×10^{-1}	α
^{228}Ra	5.8 yr	2.7×10^{2}	β
^{219}Rn	4.0 sec	1.2×10^{10}	α
^{222}Rn	3.8 d	1.5×10^{5}	α,γ
^{106}Ru	1.0 yr	3.4×10^{3}	β, γ[c/]
^{79}Se	<65,000 yr	7.0×10^{-2}	β
^{147}Sm	6.9×10^{9} yr	3.5×10^{-7}	α
^{151}Sm	90 yr	2.6×10^{1}	β
^{90}Sr	28.5 yr	1.4×10^{2}	β
^{99}Tc	213,000 yr	1.7×10^{-2}	β
^{227}Th	18.7 d	3.1×10^{4}	α

Table 4-28. Radiological Properties of Potential Radionuclides of Concern in B Plant Aggregate Area Waste Management Units. Page 3 of 3

Radionuclide	Half-Life	Specific Activity[a/] in Ci/g	Principal Radiation of Concern[b/]
^{229}Th	7,340 yr	2.1×10^{-1}	α
^{230}Th	77,000 yr	2.1×10^{-2}	α
^{231}Th	25.5 hr	5.3×10^{5}	β
^{232}Th	1.4×10^{10} yr	1.1×10^{-7}	α
^{234}Th	24.1 d	2.3×10^{4}	β
^{207}Tl	4.8 min	1.9×10^{8}	β, γ
^{233}U	159,000 yr	9.7×10^{-3}	α
^{234}U	244,500 yr	6.2×10^{-3}	α
^{235}U	7.0×10^{8} yr	2.2×10^{-6}	α, γ
^{236}U	3.4×10^{6} yr	4.5×10^{-4}	α
^{238}U	4.5×10^{9} yr	3.4×10^{-7}	α
^{90}Y	6.41 hr	5.4×10^{5}	β
^{93}Zr	1.5×10^{6} yr	2.6×10^{-3}	β

a/ Calculated from half-life and atomic weight.
b/ α - alpha decay; β - negative beta decay; γ - release of gamma rays.
c/ Daughter radiation.

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Table 4-29. Comparison of Radionuclide Relative Risks or Radionuclides of Concern at the B Plant Aggregate Area. Page 1 of 3

Radionuclide	Air Unit Risk[a] in $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[b] in $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[c] in $(pCi/g)^{-1}$	External Exposure Unit Risk[d] in $(pCi/g)^{-1}$
^{225}Ac	1.2×10^{-3}	8.7×10^{-7}	4.6×10^{-8}	9.4×10^{-6}
^{227}Ac	4.2×10^{-2}	1.8×10^{-5}	9.5×10^{-7}	1.3×10^{-7}
^{241}Am	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-7}	1.6×10^{-5}
^{242}Am	NA	NA	NA	NA
^{242m}Am	NA	NA	NA	NA
^{243}Am	2.1×10^{-2}	1.5×10^{-5}	8.1×10^{-7}	3.6×10^{-5}
^{217}At	2.9×10^{-11}	2.3×10^{-13}	1.2×10^{-14}	1.4×10^{-7}
^{137m}Ba	3.0×10^{-10}	1.2×10^{-10}	6.5×10^{-12}	3.4×10^{-4}
^{210}Bi	4.1×10^{-5}	9.7×10^{-8}	5.1×10^{-9}	0
^{211}Bi	9.7×10^{-8}	6.1×10^{-10}	3.2×10^{-11}	2.8×10^{-5}
^{213}Bi	1.6×10^{-7}	1.2×10^{-8}	6.2×10^{-10}	8.1×10^{-5}
^{214}Bi	1.1×10^{-6}	7.2×10^{-9}	3.8×10^{-10}	8.0×10^{-4}
^{14}C	3.2×10^{-9}	4.7×10^{-8}	2.5×10^{-9}	0
^{244}Cm	1.4×10^{-2}	1.0×10^{-5}	5.4×10^{-7}	5.9×10^{-7}
^{245}Cm	NA	NA	NA	NA
^{60}Co	8.1×10^{-5}	7.8×10^{-7}	4.1×10^{-8}	1.3×10^{-3}
^{134}Cs	1.4×10^{-5}	2.1×10^{-6}	1.1×10^{-7}	8.9×10^{-4}
^{135}Cs	1.4×10^{-6}	2.1×10^{-7}	1.1×10^{-8}	0
^{137}Cs	9.6×10^{-6}	1.4×10^{-6}	7.6×10^{-8}	0
^{152}Eu	6.1×10^{-3}	1.1×10^{-7}	5.7×10^{-9}	6.3×10^{-4}
^{154}Eu	7.2×10^{-5}	1.5×10^{-7}	8.1×10^{-9}	6.8×10^{-4}
^{155}Eu	NA	NA	NA	--
^{152}Gd	NA	NA	NA	NA
^{3}H	4.0×10^{-8}	2.8×10^{-9}	1.5×10^{-10}	0
^{129}I	6.1×10^{-5}	9.6×10^{-6}	5.1×10^{-7}	1.5×10^{-5}
^{40}K	4.0×10^{-6}	5.7×10^{-7}	3.0×10^{-8}	7.8×10^{-5}
^{22}NA	NA	NA	NA	NA
^{93m}Nb	NA	NA	NA	NA

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Table 4-29. Comparison of Radionuclide Relative Risks or Radionuclides of Concern at the B Plant Aggregate Area. Page 2 of 3

Radionuclide	Air Unit Risk[a] in $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[b] in $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[c] in $(pCi/g)^{-1}$	External Exposure Unit Risk[d] in $(pCi/g)^{-1}$
^{59}Ni	3.5×10^{-7}	4.4×10^{-9}	2.3×10^{-10}	3.4×10^{-7}
^{63}Ni	8.7×10^{-7}	1.2×10^{-8}	6.2×10^{-10}	0
^{237}Np	1.8×10^{-2}	1.4×10^{-5}	7.3×10^{-7}	1.8×10^{-5}
^{231}Pa	2.0×10^{-2}	9.7×10^{-6}	5.1×10^{-7}	2.0×10^{-5}
^{234m}Pa	8.2×10^{-10}	3.0×10^{-10}	1.6×10^{-11}	6.4×10^{-6}
^{209}Pb	3.6×10^{-8}	4.3×10^{-9}	2.3×10^{-10}	0
^{210}Pb	8.7×10^{-4}	3.4×10^{-5}	1.8×10^{-6}	1.8×10^{-6}
^{211}Pb	1.5×10^{-6}	9.2×10^{-9}	4.9×10^{-10}	2.9×10^{-5}
^{214}Pb	1.5×10^{-6}	9.2×10^{-9}	4.9×10^{-10}	1.5×10^{-4}
^{107}Pd	NA	NA	NA	NA
^{143}Pm	NA	NA	NA	NA
^{210}Po	1.4×10^{-6}	1.3×10^{-5}	7.0×10^{-7}	4.8×10^{-9}
^{213}Po	4.1×10^{-15}	1.6×10^{-17}	8.6×10^{-19}	1.7×10^{-8}
^{214}Po	1.4×10^{-13}	5.1×10^{-16}	2.7×10^{-17}	4.7×10^{-8}
^{215}Po	2.9×10^{-12}	1.4×10^{-14}	7.6×10^{-16}	8.7×10^{-8}
^{218}Po	3.0×10^{-7}	1.4×10^{-9}	7.6×10^{-11}	0
^{238}Pu	2.1×10^{-2}	1.4×10^{-5}	7.6×10^{-7}	5.9×10^{-7}
^{239}Pu	2.6×10^{-2}	1.6×10^{-5}	8.4×10^{-8}	2.6×10^{-7}
^{240}Pu	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-8}	5.9×10^{-7}
^{241}Pu	1.5×10^{-4}	2.5×10^{-7}	1.3×10^{-8}	0
^{242}Pu	$2.1 \text{ X } 10^{-2}$	$1.5 \text{ X } 10^{-5}$	$8.1 \text{ X } 10^{-8}$	$4.8 \text{ X } 10^{-7}$
^{223}Ra	1.6×10^{-3}	4.1×10^{-6}	2.2×10^{-7}	8.4×10^{-5}
^{225}Ra	8.2×10^{-4}	3.4×10^{-6}	1.8×10^{-7}	8.0×10^{-6}
^{226}Ra	1.5×10^{-3}	6.1×10^{-6}	3.2×10^{-7}	4.1×10^{-6}
^{228}Ra	3.4×10^{-4}	5.1×10^{-6}	2.7×10^{-7}	5.6×10^{-13}
^{219}Rn	2.4 x 10-8	–	–	3.5 x 10-5
^{222}Rn	3.7 x 10-7	–	–	2.2 x 10-7
^{106}Ru	2.3×10^{-4}	4.9×10^{-7}	2.6×10^{-8}	0

Table 4-29. Comparison of Radionuclide Relative Risks or Radionuclides of Concern at the B Plant Aggregate Area. Page 3 of 3

Radionuclide	Air Unit Risk[a] in $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[b] in $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[c] in $(pCi/g)^{-1}$	External Exposure Unit Risk[d] in $(pCi/g)^{-1}$
^{79}Se	NA	NA	NA	NA
^{147}Sm	NA	NA	NA	NA
^{151}Sm	NA	NA	NA	NA
^{90}Sr	2.8×10^{-5}	1.7×10^{-6}	8.9×10^{-8}	0
^{99}Tc	4.2×10^{-6}	6.6×10^{-8}	3.5×10^{-9}	3.4×10^{-10}
^{227}Th	2.5×10^{-3}	2.5×10^{-7}	1.3×10^{-8}	6.6×10^{-6}
^{229}Th	3.9×10^{-2}	2.0×10^{-6}	1.1×10^{-7}	5.8×10^{-5}
^{230}Th	1.6×10^{-2}	1.2×10^{-6}	6.5×10^{-8}	5.9×10^{-7}
^{231}Th	2.5×10^{-7}	2.0×10^{-8}	1.1×10^{-9}	1.1×10^{-5}
^{232}Th	1.6×10^{-2}	1.1×10^{-6}	5.9×10^{-8}	4.5×10^{-7}
^{234}Th	1.6×10^{-3}	2.0×10^{-7}	1.1×10^{-8}	5.6×10^{-6}
^{207}Tl	2.3×10^{-9}	6.6×10^{-10}	3.5×10^{-11}	1.2×10^{-6}
^{233}U	1.4×10^{-2}	7.2×10^{-6}	3.8×10^{-7}	3.2×10^{-7}
^{234}U	1.4×10^{-2}	7.2×10^{-6}	3.8×10^{-7}	5.6×10^{-7}
^{235}U	1.3×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	9.7×10^{-5}
^{236}U	NA	NA	NA	NA
^{238}U	1.2×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	4.5×10^{-7}
^{93}Zr	NA	NA	NA	NA
^{90}Y	2.8×10^{-6}	1.6×10^{-7}	8.6×10^{-9}	0

[a]Excess cancer risk associated with lifetime exposure to 1 pCi/m^3 (10^{-12} curies) per day in air (EPA 1991).

[b]Excess cancer risk associated with lifetime exposure to 1 pCi (10^{-12} curies) per day in drinking water (EPA 1991).

[c]Excess cancer risk associated with lifetime exposure to 1 pCi/g (10^{-12} curies/g) per day in soil (EPA 1991).

[d]Excess cancer risk associated with lifetime exposure to surface soils containing 1 pCi/g of gamma-emitting radionuclides (EPA 1991).

NA = No information available.

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Table 4-30. Potential Chronic Health Effects of Chemicals Detected or Disposed of at the B Plant Aggregate Area. Page 1 of 2

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route
INORGANIC CHEMICALS		
Arsenic	Respiratory Tract [A];	--
Ammonia	NA	degrades odor; taste of water
Barium	--	fetotoxicity; increased blood pressure
Beryllium	Lung [B2]; Tumors [B2]	NA; none observed
Boron	--	NA; testicular lesions
Cadmium	respiratory tract [B1]; NA	cancer; renal damage
Chromium	lung [A] - Cr(VI) only; NA	nasal mucosa atrophy; hepatotoxicity
Copper	--	NA; gastrointestinal irritation
Cyanide	--	NA; weight loss, thyroid effects, myelin degeneration
Fluoride	--	NA; dental flurosis at high levels
Iron	--	--
Lead	[B2][c]; [B2]	central nervous system (CNS) effects[c]; CNS effects
Manganese	--	respiratory tract; no effect
Mercury	--	neurotoxicity; kidney effects
Nickel	respiratory tract [A]; NA	cancer; reduced weight gain
Nitrate/Nitrite	--	NA; methemoglobinemia in infants[d]
Silver	--	
Sulfuric acid	--	respiratory tract; NA
Tin	--	NA; liver and kidney lesions
Uranium (soluble salts)	--	NA; body weight loss, nephrotoxicity

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Table 4-30. Potential Chronic Health Effects of Chemicals Detected or Disposed of at the B Plant Aggregate Area. Page 2 of 2

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route
Zinc	--	NA; anemia
ORGANIC CHEMICALS	--	--
Acetone	--	NA; kidney and liver effects
1-Butanol	--	NA; effects on erythrocyte
Carbon tetrachloride	liver [B2]	NA; liver lesions
Chloroform	liver; kidney [B2]	NA; liver lesions
Ethyl ether	--	NA; liver effects
Hydrazine	nasal cavity [B2]; liver [B2]	--
Methylene chloride	lung, liver [B2]; liver [B2]	NA; liver toxicity
Methyl ethyl ketone	--	CNS; fetotoxicity
PCBs	NA[B2]; liver [B2]	--
Toluene	--	CNS effects, eye irritation; change in liver and kidney weights
Tributyl phosphate	--	respiratory irritant; kidney damage[b]

[a]Weight of Evidence Groups for carcinogens: A - Human carcinogen (sufficient evidence of carcinogenicity in humans); B - Probable human carcinogen (B1 - Limited evidence of carcinogenicity in humans; B2 - Sufficient evidence of carcinogenicity in animals with inadequate or lack of data in humans); C - Possible human carcinogen (limited evidence of carcinogenicity in animals and inadequate or lack of human data); D - Not classifiable as to human carcinogenicity (inadequate or no evidence).

[b]Verified toxicity information was not available from EPA 1991. Toxicity information was obtained from EPA Registry of Toxic Effects of Chemical Systems (RTECS). A blank space means that no information was available from the above sources.

[c]Lead is considered by EPA to have both neurotoxic and carcinogenic effects; however, no toxicity criteria are available for lead at the present time.

[d]Toxic effect is considered to occur from exposure to nitrite; nitrate can be converted to nitrite in the body by intestinal bacteria.

NA = Information not available.

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5.0 HEALTH AND ENVIRONMENTAL CONCERNS

This preliminary qualitative evaluation of potential human health concerns is intended to provide input to the B Plant Aggregate Area waste management unit recommendation process (Section 9.0). This process requires consideration of immediate and long-term impacts to human health and the environment. As discussed in Section 4.2, existing B Plant Aggregate Area and waste management unit data are not adequate to support an evaluation of potential impacts on the environment. Although ecological impacts are an integral part of the complete assessment of aggregate and waste unit potential risks, they cannot be evaluated further at this time. Ecological risk assessment is included in the listing of data needs presented in Section 8.0 with the associated data needs identified as a data gap to be addressed in future investigations. The approach that has been taken to identify potential concerns related to individual waste management units and unplanned releases is as follows:

- Contaminants of potential concern are identified for each exposure pathway that is likely to occur within the B Plant Aggregate Area. Selection of contaminants was discussed in Section 4.2. Contaminants of potential concern were selected from the list of candidate contaminants of potential concern presented in Table 4-22. This table includes contaminants that are likely to be present in the environment based on occurrence in the liquid process wastes that were discharged to soils, and also contaminants that have been detected in environmental samples within the aggregate area but have not been identified as components of B Plant waste streams.

- Exposure pathways potentially applicable to individual waste management units are identified based on the presence of the above contaminants of potential concern in wastes in the waste management units, consideration of known or suspected releases from those waste management units, and the physical and institutional controls affecting site access and use over the period of interest. The relationships between waste management units and exposure pathways are summarized in the conceptual model (Section 4.2).

- Estimates of relative hazard derived for the B Plant waste management units are identified using the *Comprehensive Environmental Response, Compensation, and Liability Act* (CERCLA) Hazard Ranking System (HRS), modified Hazard Ranking System (mHRS), surface radiation survey data, and by the Westinghouse Hanford Environmental Protection Group scoring. Other indicators of relative hazard, such as rate of release of contaminants, irreversible results of continuing residence of contaminants, etc., were not used because they generally require unit-specific data that are not available for most units.

The human health concerns and various hazard ranking scores listed above are used to establish whether or not a waste management unit is considered a "high" priority. In the data evaluation process presented in Section 9.0, "high" priority sites are evaluated for the

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potential implementation of an interim remedial measure (IRM). "Low" priority sites are evaluated to determine what type of additional investigation is necessary to establish a final remedy. Further detail is presented in Section 9.0.

The data used for this evaluation are presented in the earlier sections of this report. The types of data that have been assessed include waste management unit histories and physical descriptions (Section 2.0), descriptions of the physical environment of the study area (Section 3.0) and a summary of the available chemical and radiological data for each waste management unit (Section 4.0).

The quality and sufficiency of these data are assessed in Section 8.0. This information is also used to identify potentially applicable or relevant and appropriate requirements (ARARs)(Section 6.0).

5.1 CONCEPTUAL FRAMEWORK FOR RISK-BASED SCREENING

The range of potential human health and environmental exposure pathways at the B Plant Aggregate Area was summarized in Section 4.2. In Section 4.2 the role of biota in transporting contaminants through the environment is also discussed, and biota are included as a receptors in the conceptual model. However, the assessment of potential ecological risks associated with biota exposure to B Plant Aggregate Area contaminants is currently constrained by the lack of data. This gap in the B Plant Aggregate Area data is discussed in Section 8.2.3. As a result, the risk-based screening of waste management unit priorities discussed in this section is by necessity limited to potential human health risks.

The U.S. Environmental Protection Agency (EPA 1989a) considers a human exposure pathway to consist of four elements: (1) a source and mechanism for contaminant release, (2) a retention or transport medium (or media), (3) a point of potential human contact, and (4) an exposure route (e.g., ingestion) at the contact point. The probability of the existence of a particular pathway is dependent upon the physical and institutional controls affecting waste management unit access and use. In the absence of unit access controls and other land use restrictions, the identified potential exposure pathways could all occur. For example, it could be hypothesized that an individual could establish a residence within the boundaries of the B Plant Aggregate Area, disrupt the soil surface and contact buried contamination, and drill a well and withdraw contaminated groundwater for drinking water and crop irrigation. However, within the 5- to 10-yr period of interest associated with identification and prioritization of remedial actions within the B Plant Aggregate Area, unrestricted access and uncontrolled disruption of buried contaminants have a negligible probability of occurrence. The 5- to 10-yr period of interest has been arbitrarily chosen as the timeframe within which most of the critical decisions will be made regarding remediation strategies.

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The conceptual model presented in Section 4.2 was evaluated to identify an appropriate framework for screening waste management units and establishing their remediation priorities based on potential health hazards. Based on the 5- to 10-yr period of interest for waste unit prioritization, and the presence of site access controls during that period, a screening framework was developed encompassing the range of release mechanisms, affected media, and exposure routes associated with an onsite occupational receptor. While work activities are assumed to include occasional contact with surface soils, it is assumed that no contact with buried contaminants will take place without proper protective measures.

Workers may be exposed via the following routes at the B Plant Aggregate Area:

- Ingestion of surface soils
- Inhalation of volatilized contaminants and resuspended particles
- Direct dermal contact with surface soils
- Direct exposure to radiation from surface soils and airborne resuspended particles.

Since evaluation of migration in the saturated zone is not within the scope of a source area aggregate area management study (AAMS), ingestion or contact with groundwater was not evaluated as an exposure pathways. However, since migration of waste constituents within the saturated zone will be addressed in the 200 East Groundwater AAMSR, contaminants likely to migrate to the water table and waste management units that have a high potential to impact groundwater will be identified.

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5.2 POTENTIAL EXPOSURE SCENARIOS AND HUMAN HEALTH CONCERNS

The routes by which a Hanford Site worker could potentially be exposed to contamination at the waste management units include ingestion, inhalation, direct contact with surface soils, and direct exposure to radiation. To evaluate the potential for exposure at individual waste management units, it is necessary to have data available for surface soils, air, and radiation levels. Although samples have been collected from each of these media, only the surface radiation survey data (contamination levels and dose rate) are specific to individual waste management units. Therefore, only pathways associated with the surface radiological contamination and external dose rates can be evaluated with confidence at this time. Potential exposures by other pathways were evaluated based on available knowledge regarding contaminants disposed of to the waste management unit and the integrity of engineered barriers to releases.

5.2.1 External Exposure

External dose rate surveys, which are performed on a waste management unit basis, were used as the measure of a unit's potential for impacting human health through direct external radiation exposure. The contaminants of potential concern for this pathway are the radionuclides that emit moderate to high energy penetrating gamma radiation. The measured dose rates at B Plant Aggregate Area waste management units are presented in Table 5-1 from the available survey data.

For 54 of the 139 B Plant Aggregate Area waste management units listed in Table 5-1, no current radiation survey data are available. For the 85 units that do have radiation survey data of some type, 34 were reported as having no contamination detected.

Westinghouse Hanford manual WHC-CM-4-10, Section 7 (WHC 1988c) was used as the basis for setting one of the criteria that are used to identify waste management units that can be considered high priority sites. The manual indicates that posting ("Radiation Area") and access controls are to be implemented at a level of 2 mrem/h for the purpose of personnel protection. With the same objective in mind, the level of 2 mrem/h is recommended as one of the criteria for distinguishing high priority from lower priority waste management units. The 216-B-8TF Crib, 216-B-11A, and 216-B-11B Reverse Wells were the only units that met or exceeded the 2 mrem/h.

High levels of radiation were reportedly associated with some of the unplanned releases that are listed in Table 5-1. However, many of these releases occurred in the early years of the Hanford Site and more recent survey data are not available. Some of the releases were reportedly remediated by removing contaminated soil for disposal in burial grounds, paving or covering the area with soil, or flushing the soil with water. The effectiveness of the various remediation measures is not known, and confirmatory survey measurements are not available. Thus, with the exception of unplanned releases located within engineered waste management units, which are routinely surveyed, information on the current radiological status of remediated unplanned releases is deficient and is identified as a data gap in Section 8.0.

5.2.2 Ingestion of Soil or Inhalation of Fugitive Dust

Radionuclides and nonradioactive chemicals of concern for the soil ingestion and fugitive dust inhalation pathways are those that are nonvolatile, persistent in surface soils, and have appreciable carcinogenic or toxic affects by ingestion or inhalation. However, little information is available to evaluate the levels of specific radionuclides or nonradioactive contaminants in surface soils. Available gross activity survey data for the B Plant Aggregate Area waste management units are provided in Table 5-1.

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The Westinghouse Hanford Environmental Protection group policies state that the presence of any smearable alpha constitutes a potential threat to human health and qualifies a waste management unit for a high remediation priority (Huckfeldt 1991b). Waste management units that exhibit elevated (relative to background) alpha readings in radiological surveys can be presumed to have surface contamination, since alpha radiation cannot penetrate solids.

Westinghouse Hanford manual WHC-CM-4-10 (WHC 1988b) is also used to set criteria for identifying waste management units that can be considered high remediation priority sites. The manual indicates that posting ("Surface Contamination Area") and access controls are to be implemented at a level of 100 ct/min (1,000 dis/min) above background beta/gamma, and/or 20 dis/min alpha, for the purpose of personnel protection. These levels are based on the criteria that radiation exposure be maintained "as low as reasonably achievable" (ALARA). With the same objective in mind, the levels of 100 ct/min above background beta/gamma and 20 dis/min alpha are recommended as two of the criteria for identification of high priority waste management units. For those survey readings that are in units of dis/min, a conversion will be made to ct/min assuming a detector efficiency of 10%.

It should be noted that these radiation readings may indicate transient conditions (e.g., presence of contaminated vegetation) and that routine stabilization of surface contamination is carried out under the auspices of the Westinghouse Hanford Radiation Area Remedial Action (RARA) program.

Units subject to collapse of containment structures pose a potential threat of exposure by release of contaminants to the surface. Twelve (12) of the cribs are wooden structures that could fail catastrophically, which could force contaminants from the buried crib to the surface. Additionally, there are 12 trenches that have wooden covers, which also have the potential for collapse. The 216-B-18 Crib experienced a cave-in in 1974 and has since been backfilled with gravel. The 216-B-10A, 216-B-10B, and 216-B-12 Cribs have all subsided several feet. Units with a potential for collapse are identified and evaluated by the Westinghouse Hanford RARA Program, and preventative actions are taken when determined to be appropriate as discussed in Section 9.0.

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5.2.3 Inhalation of Volatiles

As summarized in Section 4.1, the distribution of volatile organics in soils is not well-defined in the B Plant Aggregate Area. Although several semivolatile compounds, such as tributyl phosphate and paraffin hydrocarbons, have been disposed of in the cribs, no information is available on whether these compounds are still present in the near surface soil column for transport to the soil surface.

The primary volatile radionuclide of concern is tritium. Exposure to tritium (as tritiated water vapor) and the potential for tritium release via radiolytic production of hydrogen from aqueous radioactive wastes is of concern. The mode of disposal of this material can not be determined from available information.

5.2.4 Migration to Groundwater

Risks that could potentially occur due to migration of contaminants in groundwater to existing or potential receptors will be addressed in the 200 East Groundwater AAMS and thus, will not be discussed in the B Plant AAMS. However, the potential for individual units to impact groundwater has been discussed in Section 4.1.

5.3 ADDITIONAL SCREENING CRITERIA

In addition to determining human health concerns for a worker at each of the waste management units, previously developed site ranking criteria were investigated for the purpose of setting priorities for waste management units and unplanned releases. These criteria are the CERCLA HRS scores assigned during preliminary assessment/site inspection (PA/SI) activities performed for the Hanford Site (DOE/RL 1988), and the rankings assigned by the Westinghouse Hanford Environmental Protection Group to prioritize sites needing remedial actions for radiological control (Huckfeldt 1991b).

Both of these ranking systems take into account some measure of hazard and environmental mobility, and are thus appropriate to consider for waste management unit prioritization. The HRS ranking system evaluates sites based on their relative risk, taking into account the population at risk, the hazardous waste constituent toxicity and concentration at the facility, the potential for contamination of the environment, the potential risk of fire and explosion, and the potential for exposure associated with humans or animals that come into contact with the waste management unit inventory. The HRS is thus appropriate to consider for screening waste management units.

The PA/SI screening was performed using the EPA's HRS and the mHRS. The HRS (40 CFR 300) is a site ranking methodology which was designed to determine whether sites should be placed on the CERCLA National Priority List (NPL) based on chemical contamination history. The EPA has established the criteria for placement on the NPL to be a score of 28.5 or greater. The HRS criteria used in the PA/SI have been revised (December 14, 1990). The HRS scores are only used as available indicators of relative risk; therefore, the revision will not impact the evaluation process. The mHRS is a ranking system developed by the Pacific Northwest Laboratory (PNL) for the U.S. Department of Energy (DOE) that uses the basic methodology of the old (pre-December 1990) HRS; however, it more accurately predicts the impacts from radionuclides. The mHRS takes into account concentration, half-life, and other chemical-specific parameters that are not considered by the old HRS. The mHRS has not been accepted by EPA as a ranking system.

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Many of the B Plant Aggregate Area waste management units were ranked in the PA/SI using both the HRS and mHRS. For those waste management units that were not ranked in the PA/SI, unit type and discharge history were evaluated in comparison with ranked units for the purpose of setting priorities. If a waste management unit that has been ranked exhibits characteristics similar to the unranked waste management unit (e.g., construction, waste type, and volume), the value for the ranked unit was applied to the unit without an HRS or mHRS score. If no ranked waste management units exhibit similar characteristics, then a qualitative high or low ranking was determined through evaluation of unit configuration and contamination history.

Table 5-1 lists the HRS and mHRS rankings, as well as scores that were assigned for unranked waste management units, based on their similarity to ranked units in terms of type, construction, and quantity of waste disposed. If no similar waste management units were available for comparison, the units were not ranked but were assigned a qualitative indicator of migration potential based on engineering judgement considering factors such as type of unit, waste characteristics, and volume of liquid received. Table 5-1 also lists the units scored by the Westinghouse Environmental Protection Group (Huckfeldt 1991b). A score of 7 or greater results in the assignment of a "high" priority to the unit. A value of 7 was chosen to represent the approximate midpoint of the scoring range.

For the HRS ranking, 19 units of the 139 B Plant Aggregate Area waste management units listed in Table 5-1 were given a score of 28.5 or greater. For the mHRS ranking, 14 units were given a score of 28.5 or greater (all of which also had HRS scores greater than 28.5). Seven (7) units received a qualitative "high" score and 45 units received a qualitative "low" score. Each of the units that received a qualitative "high" HRS and mHRS score were given such a rating based on their discharge history of large quantities of hazardous materials, which could potentially have been transported to the groundwater. The units that received "low" scores were given such a ranking because there is no or little known history of liquid hazardous material disposal that could affect groundwater beneath the B Plant Aggregate Area.

Three of the 139 units were assigned Westinghouse Environmental Protection Group scores of 7 or greater, indicating the need for remedial action.

5.4 SUMMARY OF SCREENING RESULTS

The screening process was used to sort sites as either high priority or low priority. Table 5-1 lists the B Plant Aggregate Area waste management units that exceeded one or more of the screening criteria identified in the preceding Sections. In total, 61 units were identified as high priority. Because this screening is preliminary, and just one of the factors considered in evaluating remedial action requirements, each of the screening criteria were given equal weight in the prioritization process. This resulted in a bias for prioritization.

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Radiation survey results (dose rate and/or contamination) were available for 85 of the 139 waste management units. Thirty-four (34) were reported as having no detectable results. Of the remaining 51 units, all 51 had radiation survey results that exceeded one or more of the criteria (2 mrem/h, 100 dis/min beta/gamma, and 20 dis/min alpha).

For the HRS scores, 19 waste management units were given scores of 28.5 or greater. For the mHRS, 14 units received a score of 28.5 or greater. Seven (7) units received qualitative "high" scores. Some of the sites were designated as high priority for 2 or more of the criteria, hence 61 total sites are designated high priority.

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Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	dis/min	mrem/h	Environmental Protection Score[c]	Priority
Tanks and Vaults								
241-B-361B	Settling Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
Crib and Drains								
216-B-7A	Crib	65.43	65.43	NA	15,000	NA	NA	High
216-B-7B	Crib	65.43	65.43	NA	12,000	NA	NA	High
216-B-8TF	Crib	1.42	1.42	NA	6,000 (tumbleweed)	NA	NA	High
216-B-9TF	Crib	1.03	1.14	NC	NC	NC	10	High
216-B-10A	Crib	47.81	47.81	NC	NC	NC	NA	High
216-B-10B	Crib	1.03	0.55	NC	NC	NC	NA	Low
216-B-12	Crib	62.92	28.41	NC	NC	NC	NA	High
216-B-14	Crib	2.27	2.36	NC	NC	NC	NA	Low
216-B-15	Crib	1.36	1.42	NC	NC	NC	NA	Low
216-B-16	Crib	62.92	52.20	NC	NC	NC	NA	High
216-B-17	Crib	1.36	1.42	NC	NC	NC	NA	Low
216-B-18	Crib	1.36	1.42	NC	NC	NC	NA	Low
216-B-19	Crib	1.81	1.89	NC	NC	NC	NA	Low
216-B-43	Crib	57.88	48.67	NA	20,000	NA	NA	High
216-B-44	Crib	60.40	50.42	NA	20,000	NA	NA	High
216-B-45	Crib	62.92	52.20	NA	20,000	NA	NA	High
216-B-46	Crib	62.92	52.20	NA	20,000	NA	NA	High
216-B-47	Crib	1.31	1.42	NA	20,000	NA	NA	High

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Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	Radiation Surveys[b] dis/min	Radiation Surveys[b] mrem/h	Environmental Protection Score[c]	Priority
216-B-48	Crib	62.92	52.20	NA	20,000	NA	NA	High
216-B-49	Crib	62.92	52.20	NA	20,000	NA	NA	High
216-B-50	Crib	50.33	43.70	NA	20,000	NA	NA	High
216-B-55	Crib	Low[d]	Low[d]	NA	2,000	NA	NA	High
216-B-56	Crib	Low[d]	Low[d]	NC	NC	NC	NA	Low
216-B-57	Crib	50.33	27.68	NC	NC	NC	NA	High
216-B-60	Crib	0.98	1.14	NA	NA	NA	NA	Low
216-B-61	Crib	Low[d]	Low[d]	NA	NA	NA	NA	Low
216-B-62	Crib	Low[d]	Low[d]	NC	NC	NC	NA	Low
TFN 2703E	Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
216-B-13	French Drain	0.71	0.71	NC	NC	NC	NA	Low
216-B-51	French Drain	0.71	0.71	NA	4,000	NA	NA	High
Reverse Wells								
216-B-4	Reverse Well	47.81	25.74	NC	NC	NC	NA	High
216-B-5	Reverse Well	60.40	61.54	NA	6,000	NA	NA	High
216-B-6	Reverse Well	50.33	50.33	NC	NC	NC	NA	High
216-B-11A	Reverse Well	47.81	26.32	NA	6,000	2	9	High
216-B-11B	Reverse Well	47.81	26.32	NA	6,000	2	9	High
Ponds, Ditches, and Trenches								
216-B-3	Pond	High[d]	High[d]	NA	4,000	NA	NA	High
216-B-3A	Pond	High[d]	High[d]	NA	NA	NA	NA	High
216-B-3B	Pond	Low[d]	Low[d]	NA	NA	NA	NA	Low

Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	Radiation Surveys[b] dis/min	Radiation Surveys[b] mrem/h	Environmental Protection Score[c]	Priority
216-B-3C	Pond	High[d]	High[d]	NA	NA	NA	NA	High
216-A-25	Pond	High[d]	High[d]	NC	NC	NC	NA	High
216-E-28	Pond	Low[d]	Low[d]	NA	NA	NA	NA	Low
216-N-8	Pond	Low[d]	Low[d]	NC	NC	NC	NA	Low
216-B-2-1	Ditch	0.00	0.00	NC	20,000	NA	NA	High
216-B-2-2	Ditch	45.30	30.67	NA	20,000	NA	NA	High
216-B-2-3	Ditch	High[e]	High[e]	NA	20,000	NA	NA	High
216-B-3-1	Ditch	0.00	0.00	NC	NC	NC	NA	Low
216-B-3-2	Ditch	0.00	0.00	NC	NC	NC	NA	Low
216-B-3-3	Ditch	Low[f]	Low[f]	NC	NC	NC	NA	Low
216-B-20	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-21	Trench	1.31	1.42	NA	80,000	NA	NA	High
216-B-22	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-23	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-24	Trench	1.31	1.42	NA	80,000	NA	NA	High
216-B-25	Trench	1.31	1.42	NA	80,000	NA	NA	High
216-B-26	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-27	Trench	1.31	1.42	NA	80,000	NA	NA	High
216-B-28	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-29	Trench	1.31	1.42	NA	80,000	NA	NA	High
216-B-30	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-31	Trench	1.36	1.42	NA	80,000	NA	NA	High

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Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	Radiation Surveys[b] dis/min	Radiation Surveys[b] mrem/h	Environmental Protection Score[c]	Priority
216-B-32	Trench	1.36	1.42	NA	80,000	NA	NA	High
216-B-33	Trench	1.42	1.42	NA	80,000	NA	NA	High
216-B-34	Trench	1.42	1.09	NA	80,000	NA	NA	High
216-B-35	Trench	1.31	1.42	NC	NC	NC	NA	Low
216-B-36	Trench	1.25	1.42	NC	NC	NC	NA	Low
216-B-37	Trench	1.42	1.42	NC	NC	NC	NA	Low
216-B-38	Trench	1.25	1.42	NC	NC	NC	NA	Low
216-B-39	Trench	1.25	1.42	NC	NC	NC	NA	Low
216-B-40	Trench	1.25	1.42	NC	NC	NC	NA	Low
216-B-41	Trench	1.25	1.42	NC	NC	NC	NA	Low
216-B-42	Trench	1.25	1.42	NC	NC	NC	NA	Low
216-B-52	Trench	1.42	1.42	NA	80,000	NA	NA	High
216-B-53A	Trench	0.98	0.60	NA	80,000	NA	NA	High
216-B-53B	Trench	1.03	1.14	NA	80,000	NA	NA	High
216-B-54	Trench	1.03	0.82	NA	80,000	NA	NA	High
216-B-58	Trench	1.03	1.14	NA	80,000	NA	NA	High
216-B-63	Trench	Low[d]	Low[d]	NC	NC	NC	NA	Low
Septic Tanks and Associated Drain Fields								
2607-EB	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-EH	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low

Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	dis/min	mrem/h	Environmental Protection Score[c]	Priority
2607-EK	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-EM	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-EN	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-EO	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-EP	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-EQ	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-ER	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-GF	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E1	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E2	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E3	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E4	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E7B	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E8	Septic Tank/ Drain Field	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E9	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low
2607-E11	Septic Tank	Low[d]	Low[d]	NA	NA	NA	NA	Low

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Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	Radiation Surveys[b] dis/min	Radiation Surveys[b] mrem/h	Environmental Protection Score[c]	Priority
Basins								
207-B	Retention Basin	High[d]	High[d]	600	NA	NA	NA	High
216-B-59B	Retention Basin	Low	Low	NC	NC	NC	NA	Low
216-B-64	Retention Basin	High[d]	High[d]	NA	1,000,000	NA	NA	High
Burial Sites								
218-E-2	Burial Ground	0.70	0.90	10,000 (tumbleweeds)	NA	NA	NA	High
218-E-2A	Burial Ground	0.00	0.00	NC	NC	NC	NA	Low
218-E-3	Burial Ground	0.00	0.00	NA	NA	NA	NA	Low
218-E-4	Burial Ground	0.70	0.40	4,000 (tumbleweeds)	NA	NA	NA	High
218-E-5	Burial Ground	0.70	0.80	10,000 (tumbleweeds)	NA	NA	NA	High
218-E-5A	Burial Ground	0.70	0.90	10,000 (tumbleweeds)	NA	NA	NA	High
218-E-6	Burial Ground	0.00	0.00	NA	NA	NA	NA	Low
218-E-7	Burial Ground	0.70	0.80	NA	NA	NA	NA	Low
218-E-9	Burial Ground	0.00	0.00	10,000 (tumbleweeds)	NA	NA	NA	High
200 Area Construction Pit	Construction Pit	0.00	0.00	NA	NA	NA	NA	Low

Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	Radiation Surveys[b] dis/min	Radiation Surveys[b] mrem/h	Environmental Protection Score[c]	Priority
Unplanned Releases								
UN-200-E-7		1.50	0.00	NA	NA	NA	NA	Low
UN-200-E-9		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-14		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-41		0.00	0.00	NA	NA	NA	NA	Low
UN-200-E-43		1.00	0.00	NA	NA	NA	NA	Low
UN-200-E-44		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-52		1.00	0.00	NA	NA	NA	NA	Low
UN-200-E-54		1.00	0.00	NA	NA	NA	NA	Low
UN-200-E-55		0.80	0.00	NA	NA	NA	NA	Low
UN-200-E-61		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-63		Low[d]	Low[d]	100,000	6,000	NA	NA	High
UN-200-E-64		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-69		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-79		1.20	0.00	NA	NA	NA	NA	Low
UN-200-E-80		1.20	0.00	NA	NA	NA	NA	Low
UN-200-E-83		0.70	0.00	NA	NA	NA	NA	Low
UN-200-E-87		1.00	0.00	NC	NC	NC	NA	Low
UN-200-E-90		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-92		Low[d]	Low[d]	NA	NA	NA	NA	Low
UN-200-E-95		0.70	0.00	NA	4,000	NA	NA	High
UN-200-E-101		Low[d]	Low[d]	NC	NC	NC	NA	Low

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Table 5-1. Hazard Ranking Scores for B Plant Aggregate Area.

Site Name	Site Type	HRS[a] Rating	mHRS[a] Rating	Radiation Surveys[b] ct/min	Radiation Surveys[b] dis/min	Radiation Surveys[b] mrem/h	Environmental Protection Score[c]	Priority
UN-200-E-103		Low[d]	Low[d]	NA	NA	NA	--	Low
UN-200-E-112		0.80	0.00	NA	NA	NA	--	Low
UN-200-E-140		Low[d]	Low[d]	NA	NA	NA	--	Low
UPR-200-E-4		1.10	0.00	NA	NA	NA	--	Low
UPR-200-E-32		1.10	0.00	20,000	--	--	--	High
UPR-200-E-34		Low[d]	Low[d]	NA	NA	NA	--	Low
UPR-200-E-51		Low[d]	Low[d]	NA	NA	NA	--	Low
UPR-200-E-84		1.00	0.00	3,000	--	--	--	High
UPR-200-E-138		Low[d]	Low[d]	NA	NA	NA	--	Low

NA = No Data Available.
NC = No Contamination Detected.
[a] Ranking Perfomed by the EBASCO Consulting Firm. "High" priority = Ranking of ≥ 28.5.
[b] Radiation survey data listed in Table 4-7. "High" priority = Beta/gamma above background ≥ 100ct/min, or alpha ≥ 20 dis/min, or personnel exposure rate ≥ 2 mrem/h. (WHC 1988c)
[c] Environmental Protection Score from Huckfeldt 1991b. "High" priority = Score ≥ 7.
[d] This unit was ranked by unit configuration and contamination history since no other ranked unit has similar characteristics.
[e] This unit was ranked by comparison to the 216-B-2-2 Ditch.
[f] This unit was ranked by comparison to the 216-B-3-2 Ditch.

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6.0 POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

6.1 INTRODUCTION

The Superfund Amendments and Reauthorization Act (SARA) of 1986 amended the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) to require that all applicable or relevant and appropriate requirements (ARARs) be employed during implementation of a hazardous waste site cleanup. "Applicable" requirements are defined by the U.S. Environmental Protection Agency (EPA) in "CERCLA Compliance with Other Laws Manual" (OSWER Directive 9234.1-01, August 8, 1988) as:

> cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

A separate set of "relevant and appropriate" requirements that must be evaluated include:

> cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

"To-be-Considered Materials" (TBCs) are nonpromulgated advisories or guidance issued by federal or state governments that are not legally binding and do not have the status of potential ARARs. However, in many circumstances, TBCs will be considered along with potential ARARs and may be used in determining the necessary level of cleanup for protection of health or the environment.

The following sections identify potential ARARs to be used in developing and assessing various remedial action alternatives at the B Plant Aggregate Area. Specific requirements pertaining to hazardous and radiological waste management, remediation of contaminated soils, surface water protection, and air quality will be discussed.

The potential ARARs focus on federal or state statutes, regulations, criteria, and guidelines. The specific types of potential ARARs evaluated include the following:

- Contaminant-specific
- Location-specific
- Action-specific.

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Potential contaminant-specific ARARs are usually health or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical contaminant values that are generally recognized by the regulatory agencies as allowable to protect human health and the environment. In the case of the B Plant Aggregate Area, potential contaminant-specific ARARs address chemical constituents and/or radionuclides. The potential contaminant-specific ARARs that were evaluated for the B Plant Aggregate Area are discussed in Section 6.2.

Potential location-specific ARARs are restrictions placed on the concentration of hazardous substances, or the conduct of activities, solely because they occur in specific locations. The potential location-specific ARARs that were evaluated for the B Plant Aggregate Area are discussed in Section 6.3.

Potential action-specific ARARs apply to particular remediation methods and technologies, and are evaluated during the detailed screening and evaluation of remediation alternatives. The potential action-specific ARARs that were evaluated for the B Plant Aggregate Area are discussed in Section 6.4.

The TBC requirements are other federal and state criteria, advisories, and regulatory guidance that are not promulgated regulations, but are to be considered in evaluating alternatives. Potential TBCs include U.S. Department of Energy (DOE) Orders that carry out authority granted under the Atomic Energy Act. All DOE Orders are potentially applicable to operations at the B Plant Aggregate Area. Specific TBC requirements are discussed in Section 6.5.

Potential contaminant- and location-specific ARARs will be refined during the aggregate area management study (AAMS) process. Potential action-specific ARARs are briefly discussed in this section, and will be further evaluated upon final selection of remedial alternatives. The points at which these ARARs must be achieved and the timing of the ARARs evaluations are discussed in Sections 6.6 and 6.7, respectively.

6.2 CONTAMINANT-SPECIFIC REQUIREMENTS

A contaminant-specific requirement sets concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants. Based on available information, some of the currently known or suspected contaminants that may be present in the B Plant Aggregate Area are outlined in Table 4-32. The currently identified potential federal and state contaminant-specific ARARs are summarized below.

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6.2.1 Federal Requirements

Federal contaminant-specific requirements are specified in several statutes, codified in the U.S. Code (USC), and promulgated in the Code of Federal Regulations (CFR), as follows:

- **Clean Water Act (33 USC 1251).** Federal Water Quality Criteria (FWQC) (40 CFR 131) are developed under the authority of the Clean Water Act (CWA) (33 USC 1251) to serve as guidelines to the states for determining receiving water quality standards. Different FWQC are derived for protection of human health and protection of aquatic life. The human health FWQC are further subdivided according to how people are expected to use the water (e.g., drinking the water versus consuming fish caught from the water). The SARA 121(d)(2) states that remedial actions shall attain FWQC where they are relevant and appropriate, taking into account the designated or potential use of the water, the media affected, the purpose of the criteria, and current information. Many more substances have FWQC than maximum contaminant levels (MCLs) issued under the Safe Drinking Water Act (SDWA, see discussion below); consequently, EPA and other state agencies rely on these criteria more than MCLs, even though these criteria can only be considered relevant and appropriate and not applicable.

  The FWQC would not be considered at the B Plant Aggregate Area, as no natural surface water bodies exist. The only existing man-made surface water bodies at B Plant Aggregate Area are waste management units: the 207-A and the 216-A-42 retention basins.

- **Safe Drinking Water Act (42 USC 300(f)).** Under the authority of the Safe Drinking Water Act (42 USC 300(f)), MCLs (40 CFR 141) apply when the water may be used for drinking. Currently, EPA and the State of Washington apply MCLs as the standards for groundwater contaminants at CERCLA sites that could be used as drinking water sources. Groundwater contamination and application of MCLs as ARARs are addressed under a separate AAMS specific to groundwater.

- **Resource Conservation and Recovery Act (42 USC 6901, 40 CFR 260 to 271).** The Resource Conservation and Recovery Act (RCRA) addresses the generation and transportation of hazardous waste, and waste management activities at facilities that treat, store, or dispose of hazardous wastes. Subtitle C (Hazardous Waste Management) mandates the creation of a cradle-to-grave management and permitting system for hazardous wastes. The RCRA defines hazardous wastes (40 CFR 261) as "solid wastes" (even though the waste is often liquid in physical form) that may cause or significantly contribute to an increase in mortality or serious illness, or that poses a substantial hazard to human health or the environment when improperly managed. In Washington State, RCRA is implemented by EPA and the authorized state agency, the Washington State Department of Ecology (Ecology).

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The CERCLA Sections 121(d) and 121(e) respectively require that CERCLA activities, including remedial actions, comply with substantive requirements and not administrative requirements such as permitting. Therefore, hazardous waste activities conducted onsite at the B Plant Aggregate Area will comply with the substantive requirements of RCRA, and not permitting requirements of RCRA, which are deemed to be potential ARARs.

Two key potential contaminant-specific potential ARARs have been adopted under the federal hazardous waste regulations: the Toxicity Characteristic Leaching Procedure (TCLP) designation limits promulgated under 40 CFR Part 261; and the hazardous waste land disposal restrictions (LDRs) for constituent concentrations promulgated under 40 CFR Part 268.

The TCLP designation limits define when a waste is hazardous, and are used to determine when more stringent management standards apply than would be applied to typical solid wastes. Thus, the TCLP potential contaminant-specific potential ARARs can be used to determine when RCRA waste management standards may be required. The TCLP limits are presented in Table 6-1.

The LDRs are numerical limits derived by EPA by reviewing available technologies for treating hazardous wastes. Until a prohibited waste can meet the numerical limits, it can be prohibited from land disposal. Two sets of limits have been promulgated: limits for constituent concentrations in waste extract, which uses the TCLP test to obtain a leached sample of the waste; and limits for constituent concentrations in waste, which addresses the total contaminant concentration in the waste. Applicability to CERCLA actions is based on determinations of waste "placement/disposal" during a remediation action. According to OWSER Directive 9347.3-OSFS, EPA concludes that Congress did not intend in situ consolidation, remediations, or improvement of structural stability to constitute placement or disposal. The land disposal numerical limits can be used to determine if generated cleanup wastes can be redisposed of onsite without further treatment, or must be subject to certain treatment practices prior to land disposal. The LDR limits are presented in Table 6-1 (see Section 6.4.1 for further discussion on the applying limits.

- **Clean Air Act (42 USC 7401).** The Clean Air Act (42 USC 7401) establishes National Primary and Secondary Ambient Air Quality Standards (NAAQS) (40 CFR Part 50), National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61), and New Source Performance Standards (NSPS) (40 CFR Part 60).

  In general, new and modified stationary sources of air emissions must undergo a preconstruction review to determine whether the construction or modification of any source, such as a CERCLA remedial program, will interfere with attainment or maintenance of NAAQS or fail to meet other new source review requirements

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including NESHAPs and NSPS. However, the process applies only to "major" sources of air emissions (defined as emissions of 250 tons per year). The B Plant Aggregate Area would not constitute a major source.

Section 112 of the Clean Air Act directs EPA to establish standards at the level that provides an ample margin of safety to protect the public health from hazardous air pollutants. The NESHAP standards for radionuclides are directly applicable to DOE facilities under Subpart H of Section 112 that establishes a 10 mrem/year facility-wide standard for exposure to an offsite receptor. Further, if the maximum individual dose during remediation exceeds 1% of the NESHAPs standard (0.1 mrem/yr), a report meeting the substantive requirements of an application for approval of construction must be prepared.

6.2.2 State of Washington Requirements

Potential state contaminant-specific requirements are specified in several statutes, codified in the Revised Code of Washington (RCW) and promulgated in the Washington Administrative Code (WAC).

- **Model Toxics Control Act (RCW 70.105D, Chapter 173-340 WAC).** The Model Toxics Control Act (MTCA) (RCW 70.105D) authorized Ecology to adopt cleanup standards for remedial actions at hazardous waste sites. These regulations are considered potential ARARs for soil, groundwater, and surface water cleanup actions. The processes for identifying, investigating, and cleaning up hazardous waste sites are defined and cleanup levels are set for groundwater, soil, surface water, and air in Chapter 173-340 WAC.

  Under the MTCA regulations, cleanup standards may be established by one of three methods.

  - Method A may be used if a routine cleanup action, as defined in WAC 173-340-200, is being conducted at the site or relatively few hazardous substances are involved for which cleanup standards have been specified by Tables 1, 2, or 3 of WAC 173-340-720 through -745.

  - Under Method B, a risk level of 10^{-6} is established and a risk calculation based on contaminants present is determined.

  - Method C cleanup standards represent concentrations that are protective of human health and the environment for specified site uses. Method C cleanup standards may be established where it can be demonstrated that such standards comply with applicable state and federal laws, that all practical methods of treatment are used, that institutional controls are implemented, and that one of the following conditions exist: (1) Method A

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or B standards are below background concentrations; (2) Method A or Method B results in a significantly greater threat to human health or the environment; (3) Method A or Method B standards are below technically possible concentrations, or (4) the site is defined as an industrial site for purposes of soil remediation.

Table 1 of Method A addresses groundwater, so it is not considered to be an ARAR for the B Plant Aggregate Area (groundwater will be addressed in the 200 East Groundwater Aggregate Area Management Study Report). Table 2 of Method A is intended for non-industrial site soil cleanups, and Table 3 is intended for industrial site soil cleanups. Method A industrial soil cleanup standards for preliminary contaminants of concern are provided as potential ARARs in Table 6-1.

In addition to Method A, Method B and Method C cleanup standards may also be considered potential ARARS for the B Plant Aggregate Area. Method B and Method C cleanup standards can be calculated on a case-by-case basis in concert with Ecology. Method B and Method C should be used where Method A standards do not exist or cannot be met, or where routine cleanup actions cannot be implemented at a specific waste management unit.

- **State Hazardous Waste Management Act and Dangerous Waste Regulations (Chapter 173-303 WAC).** The State of Washington is a RCRA-authorized state for hazardous waste management, and has developed state-specific hazardous waste regulations under the authority of the State Hazardous Waste Management Act. Generally, state hazardous waste regulations (WAC 173-303) parallel the federal regulations. The state definition of a hazardous waste incorporates the EPA designation of hazardous waste that is based on the compound being specifically listed as hazardous, or on the waste exhibiting the properties of reactivity, ignitability, corrosivity, or toxicity as determined by the TCLP.

  In addition, Washington State identifies other waste as hazardous. Three unique criteria are established: toxic dangerous waste; persistent dangerous waste; and carcinogenic dangerous waste. These additional designation criteria may be imposed by Ecology as potential ARARs, for purposes of determining acceptable cleanup standards and appropriate waste management standards.

- **Ambient Air Quality Standards and Emission Limits for Radionuclides (Chapter 173-480 WAC).** These Ecology ambient air quality standards specify maximum accumulated dose limits to members of the public. Other Air Quality Standards potentially applicable include carbon monoxide, ozone, nitrogen dioxide (WAC 173-475), and volatile organic compounds (VOCs) (WAC 173-490). Although these standards may be potential ARARs, these standards are less restrictive than DOE public dose limits per DOE Order 5400.5, Radiation Protection of the Public and the Environment.

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- **Monitoring and Enforcement of Air Quality and Emission Standards for Radionuclides (Chapters 246-247 WAC).** These standards by the Washington State Department of Health (Health) adopt the Ecology standards for maximum accumulated dose limits to members of the public. These standards apply to DOE facilities as provided in WAC 246-247-010 (2).

- **Controls for New Sources of Toxic Air Pollutants (Chapter 173-460 WAC).** In accordance with regulations recently promulgated by Ecology in Chapter 173-460 WAC, any new emission source will be subject to Toxic Air Pollutant emission standards. The regulations establish acceptable source impact levels (ASILs) for hundreds of organic and inorganic compounds. Ecology's ASILs may constitute potential ARARs for cleanup activities that have a potential to affect air. The ASILs for preliminary contaminants of concern are provided in Table 6-1.

- **Water Quality Standards.** Washington State has promulgated various numerical standards related to surface water and groundwater contaminants. These are included principally in the following regulations:

  - **Public Water Supplies (Chapter 248-54 WAC).** This regulation establishes drinking water standards for public water supplies. The standards essentially parallel the federal drinking water standards (40 CFR Parts 141 and 143).

  - **Water Quality Standards for Groundwaters of the State of Washington (RCW 90.48, Chapter 173-200 WAC).** This regulation establishes contaminant standards for protecting existing and future beneficial uses of groundwater through the reduction or elimination of the discharge of contaminants to the state's groundwater.

  - **Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201 WAC and Proposed Amendments to Chapters 173-203 and 173-201 WAC).** Ecology has adopted numerical ambient water quality criteria for six conventional pollutant parameters (defined at WAC 173-201-025): (1) fecal coliform bacteria; (2) dissolved oxygen; (3) total dissolved gas; (4) temperature; (5) pH; and (6) turbidity. In addition, toxic, radioactive, or deleterious material concentrations shall be below those of public health significance or which may cause acute or chronic toxic conditions to the aquatic environment or which may adversely affect any water use. Numerical criteria currently exist for a limited number of toxic substances (WAC 173-201-047). Ecology has initiated rulemaking to modify and incorporate additional numerical criteria for toxic chemicals, and to reclassify certain waters of the state to Class A or better.

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Under the state Water Quality Standards, the criteria and classifications do not apply inside an authorized dilution zone surrounding a wastewater discharge. In defining dilution zones, Ecology generally follows guidelines contained in "Criteria for Sewage Works Design." Although water quality standards can be exceeded inside the dilution zone, state regulations will not permit discharges that cause mortalities of fish or shellfish within the zone or that diminish aesthetic values.

These water quality standards do not constitute ARARs for purposes of establishing cleanup standards for the B Plant Aggregate Area.

Groundwater will be addressed in the 200 East Groundwater AAMSR in which pertinent groundwater-related potential ARARs will be covered. No surface water bodies exist within the B Plant Aggregate Area, so there will be no need to achieve ambient water quality standards during remediation activities.

The numerical water quality standards cited above may become potential ARARs if selected remedial actions could result in discharges to groundwater or surface water (e.g., if treated wastewaters are discharged to the soil column or the Columbia River). Determining appropriate standards for such discharges will depend on the type of remediation performed and will have to be established on a case-by-case basis as remedial actions are defined.

- **National Pollutant Discharge Elimination System and Water Quality Standards (RCW 90.48, WAC 173-220 and 40 CFR 122).** National Pollutant Discharge Elimination System (NPDES) regulations govern point source discharges into navigable waters. Limits on the concentrations of contaminants and volumetric flowrates that may be discharged are determined on a case-by-case basis and permitted under this program. No point source discharges have been identified. The EPA implements this program in Washington State for federal facilities; however, assumption of the NPDES program by the state is likely within five years.

6.3 LOCATION-SPECIFIC REQUIREMENTS

Potential location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in specific locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats.

Table 6-2 lists various location-specific standards and indicates which of these may be potential ARARs. Potential ARARs have been identified as follows:

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- **Floodplains.** Requirements for protecting floodplains are not ARARs for activities conducted within the B Plant Aggregate Area as the aggregate area is not located in flood plain boundaries (see Section 3.1). However, remedial actions selected for cleanup may require projects in or near floodplains (e.g., construction of a treatment facility outfall at the Columbia River). In such cases, location-specific floodplain requirements may be potential ARARs.

- **Wetlands, Shorelines, and Rivers and Streams.** Requirements related to wetlands, shorelines, and rivers and streams are not ARARs for activities conducted within the B Plant Aggregate Area. However, remedial actions selected for cleanup may require projects on a shoreline or wetland, or discharges to wetlands (e.g., construction of a treatment facility outfall at the Columbia River). In such cases, location-specific shoreline and wetlands requirements may be potential ARARs.

- **Threatened and Endangered Species Habitats.** As discussed in Section 3.6, various threatened and endangered species inhabit portions of the Hanford Site and may occur in the B Plant Aggregate Area (American peregrine falcon, bald eagle, white pelican, and sandhill crane). Therefore, critical habitat protection for these species would constitute a potential ARAR.

- **Wild and Scenic Rivers.** The Columbia River Hanford Reach is currently undergoing study pursuant to the federal Wild and Scenic Rivers Act. Pending results of this study, actions that may impact the Hanford Reach may be restricted. This requirement would not be an ARAR for remedial activities within the B Plant Aggregate Area. However, Wild and Scenic Rivers Act requirements may be potential ARARs for actions taken as a result of B Plant Aggregate Area cleanup efforts that could affect the Hanford Reach.

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6.4 ACTION-SPECIFIC REQUIREMENTS

Potential action-specific ARARs are requirements that are triggered by specific remedial actions at the site. These remedial actions will not be fully defined until a remedial approach has been selected. However, the universe of potential action-specific ARARs defined by a preliminary screening of potential remedial action alternatives will help focus the selection process. Potential action-specific ARARs are outlined below. (Note that potential contaminant- and potential location-specific ARARs discussed above will also include provisions for potential action-specific ARARs to be applied once the remedial action is selected.)

6.4.1 Federal Requirements

- **Comprehensive Environmental Response, Compensation, and Liability Act (42 USC 9601).** The CERCLA and regulations adopted pursuant to CERCLA contained in the National Contingency Plan (40 CFR Part 300) include selection criteria for remedial actions. Under the criteria, excavation and offsite land disposal options are least favored when onsite treatment options are available. Emphasis is placed on alternatives that permanently treat or immobilize contamination. Selected alternatives must be protective of human health and the environment, which implies that federal and state ARARs be met. However, a remedy may be selected that does not meet all ARARs if the requirement is technically impractical, if its implementation would produce a greater risk to human health or the environment, if an equivalent level of protection can otherwise be provided, if state standards are inconsistently applied, or if the remedy is only part of a complete remedial action which attains ARARs.

  The CERCLA gives state cleanup standards essentially equal importance as federal standards in guiding cleanup measures in cases where state standards are more stringent. State standards pertain only if they are generally applicable, were passed through formal means, were adopted on the basis of hydrologic, geologic, or other pertinent considerations, and do not preclude the option of land disposal by a state-wide ban. Most importantly, CERCLA provides that cleanup of a site must ensure that public health and the environment are protected. Selected remedies should meet all ARARs, but issues such as cost-effectiveness must be weighed in the selection process.

- **Resource Conservation and Recovery Act (42 USC 6901, 40 CFR 260 to 271).** The RCRA (42 USC 6901), and regulations adopted pursuant to RCRA, describe numerous action-specific requirements that may be potential ARARs for cleanup activities. The primary regulations are promulgated under 40 CFR Parts 262 (standards for generators), 264, and 265 (standards for owners and operators of hazardous waste treatment, storage, or disposal facilities), and include such action-specific requirements as follows:

  - Packaging, labeling, placarding, and manifesting of offsite waste shipments

  - Inspecting waste management areas to ensure proper performance and safe conditions

  - Preparation of plans and procedures to train personnel and respond to emergencies

  - Management standards for containers, tanks, incinerators, and treatment units

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- Design and performance standards for land disposal facilities

- Groundwater monitoring system design and performance.

Many of these requirements will depend on the particular remediation activity undertaken, and will have to be identified as remediation proceeds.

One key area of potential action-specific RCRA ARARs is the 40 CFR Part 268 LDRs. In addition to the contaminant-specific constituent concentration limits established in the LDRs (as previously discussed in Section 6.2), EPA has identified best demonstrated available treatment technologies (BDATs) for various waste streams. The EPA could require the use of BDATs prior to allowing land disposal of wastes generated during remediation. The EPA's imposition of the LDRs and BDAT requirements will depend on various factors.

Applicability to CERCLA actions is based on determinations of waste "placement/disposal" during a remediation action. According to OSWER Directive 9347.3-05FS, EPA concludes that Congress did not intend in situ consolidation, remediation, or improvement of structural stability to constitute placement or disposal. Placement or disposal would be considered to occur if:

- Wastes from different units are consolidated into one unit (other than a land disposal unit within an area of contamination)

- Waste is removed and treated outside a unit and redeposited into the same or another unit (other than a land disposal unit within an area of contamination)

- Waste is picked up from a unit and treated within the area of contamination in an incinerator, surface impoundment, or tank and then redeposited into the unit (except for in situ treatment).

Consequently, the requirement to use BDAT would not apply under the LDR standards unless placement or disposal had occurred. However, remediation actions involving excavation and treatment could trigger the requirements to use BDAT for wastes subject to the LDR standards. In addition, the agencies could consider BDAT technologies to be relevant and appropriate when developing and evaluating potential remediation technologies.

Two additional components of the LDR program should be considered with regard to an excavate and treat remedial action. First, a national capacity variance was issued by EPA for contaminated soil and debris for a two-year period ending May 8, 1992 (54 FR 26640). Second, a series of variances and exemptions may be applied under an excavate and treat scenario. These include the following:

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- A no-migration petition
- A case-by-case extension to an effective date
- A treatability variance
- Mixed waste provisions of a Federal Facilities Compliance Act.

The applicability and relevance of each of these options will vary based on the specific details of a B Plant Aggregate Area excavate and treat option. An analysis of these variances can be developed once engineering data on the option becomes available.

The effect of the LDR program on mixed waste management is significant. Currently, limited technologies are available for effective treatment of these waste streams and no commercially available treatment facilities exist except for liquid scintillation counting fluids used for laboratory analysis and testing. The EPA recognized that inadequate capacity exists and issued a national capacity variance until May 8, 1992, to allow for the development of such treatment capacity.

Lack of treatment and disposal capacity also presents implications for storage of these materials. Under 40 CFR 268.50, mixed wastes subject to LDR may be stored for up to one year. Beyond one year, the owner/operator has the burden of proving such storage is for accumulating sufficient quantities for treatment. On August 29, 1991, EPA issued a mixed waste storage enforcement policy providing some relief from this provision for generators of small volumes of mixed wastes. However, the policy was limited to facilities generating less than 28 m^3 (1,000 ft^3) of land disposal-prohibited waste per year. Congress is considering amendments to RCRA postponing the storage prohibition for another five years; however, final action on these amendments has not occurred.

- **Clean Water Act (33 USC 1251).** Regulations adopted pursuant to the CWA (33 USC 1251) under the NPDES mandate use of best available treatment technologies (BAT) prior to discharging contaminants to surface waters. The NPDES requirements would not be ARARs for actions conducted only within the B Plant Aggregate Area. However, NPDES requirements could constitute potential ARARs for cleanup actions which would result in discharge of treated wastewaters to the Columbia River, and associated treatment systems could be required to utilize BAT.

- **Department of Transportation Standards (49 CFR 171 to 177).** The Department of Transportation standards contained in 49 CFR 171 to 177 specify the requirements for packaging, labeling, and placarding for offsite transport of hazardous materials. These standards ensure that hazardous substances and wastes are safely transported using adequate means of transport and proper documentation.

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6.4.2 State of Washington Requirements

- **Hazardous Waste Management (WAC 173-303).** As discussed in Section 6.2.2, there are various requirements addressing the management of hazardous wastes that may be potential action-specific ARARs. Pertinent Washington regulations appear in Chapter 173-303 WAC (under the authority of RCW 70.105) and generally parallel federal management standards. Determination of potential ARARs will be on a case-by-case basis as cleanup actions proceed.

- **Solid Waste Management (WAC 173-304).** Washington State regulations describe management standards for solid waste in Chapter 173-304 WAC (under the authority of RCW 70.95). Some of these management standards may be potential ARARs for disposal of cleanup wastes within the B Plant Aggregate Area. Solid waste standards include such requirements as follows:

  - Inspecting waste management areas to ensure proper performance and safe conditions

  - Management standards for incinerators and treatment units

  - Design and performance standards for landfills

  - Groundwater monitoring system design and performance.

  Many of these requirements will depend on the particular remediation activity undertaken, and will have to be identified as remediation proceeds.

- **Water Quality Management.** Chapter 90.48 RCW, the Washington State Water Pollution Control Act (WPCA), requires use of all known, available, and reasonable treatment technologies (AKART) for treating contaminants prior to discharge to waters of the state. Implementing regulations appear principally at Chapters 173-216, 173-220, and 173-240 WAC.

  The WPCA requirements for groundwater could be potential ARARs for actions conducted within the B Plant Aggregate Area if such actions would result in discharge of liquid contaminants to the soil column. In this event, Ecology would require use of AKART to treat the liquid discharges prior to soil disposal.

  The WPCA requirements for surface water would not be ARARs for actions conducted only within the B Plant Aggregate Area. However, these requirements could potentially constitute ARARs for cleanup actions that would result in discharge of treated wastewaters to the Columbia River and associated treatment systems could be required to demonstrate they meet AKART.

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- **Air Quality Management (RCW 70.94).** Under the authority of the Washington Clean Air Act (RCW 70.94) the Toxic Air Pollution regulations for new air emission sources, promulgated in Chapter 173-460 WAC, require use of best available control technology for air toxics (T-BACT). The Toxic Air Pollution regulations may be potential ARARs for cleanup actions at the B Plant Aggregate Area that could result in emissions of toxic contaminants to the air. Ecology may require the use of T-BACT to treat such air emissions.

- **Water Well Construction (RCW 18.104).** This regulation establishes authority for Ecology to require the licensing of water well contractors and operators, and for the regulation of water well construction.

- **Nuclear Energy and Radiation (RCW 70.98).** Chapter 70.98 RCW establishes a program to establish procedures for assumption and performance of certain regulatory responsibilities with respect to byproduct, source, and special nuclear materials.

- **Pollution Disclosure Act (RCW 90.52).** Chapter 90.52 RCW describes the authority of the state to regulate reports for any commercial or industrial discharge, other than sanitary sewage, into waters of the state.

- **Water Resources Act (RCW 90.54).** Chapter 90.54 RCW gives the state authority to implement water related resources programs.

- **Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 WAC).** Well construction regulations establish minimum standards for water well construction and require the preparation of construction reports.

- **Rules and Regulations Governing the Licensing of Well Contractors and Operators (Chapter 173-162 WAC).** Chapter 173-162 WAC establishes requirements for licensing well drillers.

- **State Waste Discharge Permit Program (Chapter 173-216 WAC).** Chapter 173-216 WAC establishes a permit system for discharges of wastewater to groundwater and surface water via municipal sewage system.

- **Underground Injection Control Program (Chapter 173-218 WAC).** Chapter 173-218 WAC pertains to the injection of wastes into aquifers that are used for drinking water.

- **Incinerators (Chapter 173-303-170 WAC).** If incinerators are used for a remedial technology this regulation would be applicable.

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6.5 OTHER CRITERIA AND GUIDANCE TO BE CONSIDERED

In addition to the potential ARARs presented, other federal and state criteria, advisories, guidance, and similar materials are TBC in determining the appropriate degree of remediation for the B Plant Aggregate Area. A myriad of resources may be potentially evaluated. The following represents an initial assessment of pertinent TBC provisions.

6.5.1 Health Advisories

The EPA Office of Drinking Water publishes advisories identifying contaminants for which health advisories have been issued.

6.5.2 International Commission of Radiation Protection/National Council on Radiation Protection

The International Commission of Radiation Protection and the National Council on Radiation Protection have a guidance standard of 100 mrem/yr whole body dose of gamma radiation. These organizations also issue recommendations on other areas of interest regarding radiation protection.

6.5.3 Environmental Protection Agency Proposed Corrective Actions for Solid Waste Management Units

In the July 27, 1990, federal register (55 FR 30798), EPA published proposed regulations for performing corrective actions (cleanup activities) at solid waste management units associated with RCRA facilities. The proposed 40 CFR Part 264 Subpart S include requirements that would be TBCs for determining an appropriate level of cleanup at the B Plant Aggregate Area. In particular, EPA included an appendix, "Appendix A - Examples of Concentrations Meeting Criteria for Action Levels," which presented recommended contaminant concentrations warranting corrective action. These contaminant-specific TBCs are included in Table 6-1 for the preliminary contaminants of concern.

6.5.4 Department of Energy Standards for Radiation Protection

A number of DOE Orders exist which could be TBCs. The DOE Orders that establish potential contaminant-specific or action-specific standards for the remediation of radioactive wastes and materials are discussed below.

- **DOE Order 5400.5 - DOE Standards for Radiation Protection of the Public and Environment.** The DOE Order 5400.5 establishes the requirements for DOE facilities to protect the environment and human health from radiation

including soil and air contamination. The purpose of the Order is to establish standards and requirements for operations of the DOE and DOE contractors with respect to protection of members of the public and the environment against undue risk from radiation.

The Order mandates that the exposure to members of the public from a radiation source as a consequence of routine activities shall not exceed 100 mrem/yr from all exposure sources due to routine DOE activities. In accordance with the Clean Air Act, exposures resulting from airborne emissions shall not exceed 10 mrem/yr to the maximally exposed individual at the facility boundary. The DOE Order 5400.5 provides Derived Concentration Guide (DCG) values for releases of radionuclides into the air or water. The DCG values are calculated so that, under conditions of continuous exposure, an individual would receive an effective dose equivalent of 100 mrem/yr. Because dispersion in air or water is not accounted for in the DCG, actual exposures of maximally exposed individuals in unrestricted areas are considerably below the 100 mrem/yr level.

The DOE Order 5400.5 also provides for establishment of soil cleanup levels through a site-specific pathway analysis such as the allowable residual contamination level method. The calculation of allowable residual contamination level values for radionuclides is dependent on the physical characteristics of the site, the radiation dose limit determined to be acceptable, and the scenarios of human exposure judged to be possible and to result in the upper-bound exposure.

- **DOE Order 5820.2A - Radioactive Waste Management.** The DOE Order 5820.2A applies to all DOE contractors and subcontractors performing work that involves management of waste containing radioactivity. This Order requires that wastes be managed in a manner that assures protection of the health and safety of the public, operating personnel, and the environment. The DOE Order 5820.2A establishes requirements for management of high-level, transuranic, and low-level wastes as well as wastes containing naturally occurring or accelerator produced radioactive material, and for decommissioning of facilities. The requirements applicable to the B Plant Aggregate Area remediation activities include those related to transuranic waste and low-level radioactive waste. These are summarized below.

  - **Management of Transuranic Waste.** Transuranic (TRU) waste resulting from the B Plant Aggregate Area remedial action must be managed to protect the public and worker health and safety, and the environment, and performed in compliance with applicable radiation protection standards and environmental regulations. Practical and cost-effective methods must be used to reduce the volume and toxicity of TRU waste.

    The TRU waste must be certified in compliance with the Waste Isolation Pilot Plant (WIPP) Acceptance Criteria, placed in interim storage, if

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required, and sent to the WIPP. Any TRU waste that the DOE has determined, with the concurrence of the EPA Administrator, does not need the degree of isolation provided by a geologic repository or TRU waste that cannot be certified or otherwise approved for acceptance at the WIPP must be disposed of by alternative methods. Alternative disposal methods must be approved by DOE Headquarters and comply with NEPA requirements and EPA/state regulations.

- **Management of Low-Level Radioactive Waste.** The requirements for management of low-level radioactive waste presented in DOE Order 5820.2A are relevant to the remedial alternative of removal and disposal of B Plant Aggregate Area wastes. Performance objectives for this option shall ensure that external exposure to the radioactive material released into surface water, groundwater, soil, plants, and animals does not result in an effective dose greater than 25 mrem/yr to the public. Releases to the environment shall be at levels as low as reasonably achievable. An inadvertent intruder after the institutional control period of 100 years is not to exceed 100 mrem/yr for continuous exposure or 500 mrem for a single acute exposure. A performance assessment is to be prepared to demonstrate compliance with the above performance objectives.

Other requirements under DOE Order 5820.2A which may affect remediation of the B Plant Aggregate Area include waste volume minimization, waste characterization, waste acceptance criteria, waste treatment, and shipment. The low-level radioactive waste may be stored by appropriate methods prior to disposal to achieve the performance objectives discussed above. Disposal site selection, closure/post-closure, and monitoring requirements are also discussed in this Order.

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6.6 POINT OF APPLICABILITY

A significant factor in the evaluation of remedial alternatives for the B Plant Aggregate Area will be the determination of the point at which compliance with identified ARARs must be achieved (i.e., the point of a specific ARAR's applicability). These points of applicability are the boundaries at which the effectiveness of a particular remedial alternative will be assessed.

For most individual radioactive species transported by either water or air, Ecology and Health standards generally require compliance at the boundaries of the Hanford Site (e.g., Clean Air Act, Section 6.2.1). The assumed point of compliance for radioactive species is the point where a member of the public would have unrestricted access to live and conduct business, and, consequently, to be maximally exposed. Although Health is responsible for monitoring and enforcing the air standards promulgated by Ecology, and generally recognizes

the site boundary as the point of applicability, Ecology has recently indicated that compliance may be required at the point of emission.

The point at which compliance with identified ARARs must be achieved will be a significant factor in evaluating appropriate remedial alternatives in the B Plant Aggregate Area. Applicability of ARARs at the point of discharge, at the boundary of the disposal unit, at the boundary of the AAMS, at the boundary of the Hanford Site, and/or at the point of maximum exposure will need to be determined.

6.7 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS EVALUATION

Evaluation of ARARs is an iterative process that will be conducted at multiple points throughout the remedial process:

- When the public health evaluation is conducted to assess risks at the B Plant Aggregate Area, the contaminant-specific ARARs and advisories and location-specific ARARs will be identified more comprehensively and used to help determine the cleanup goals.

- During detailed analysis of alternatives, all the ARARs and advisories for each alternative will be examined to determine what is needed to comply with other laws and to be protective of public health and the environment.

Following completion of the investigation, the remedial alternative selected must be able to attain all ARARs unless one of the six statutory waivers provided in Section 121 (d)(4)(A) through (f) of CERCLA is invoked. Finally, during remedial design, the technical specifications of construction must ensure attainment of ARARs. The six reasons ARARs can be waived are as follows:

- The remedial action is an interim measure, where the final remedy will attain ARARs upon completion.

- Compliance will result in greater risk to human health and the environment than will other options.

- Compliance is technically impractical.

- An alternative remedial action will attain the equivalent performance of the ARAR.

- For state ARARs, the state has not consistently applied (or demonstrated the intention to consistently apply) the requirements in similar circumstances.

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- For CERCLA-financed actions under Section 104, compliance with the ARAR will not provide a balance between the need for protecting public health, welfare, and the environment at the facility, and the need for fund money to respond to other sites (this waiver is not applicable at the Hanford Site).

Once investigations have been completed and final remedies have been selected, the ARARs that must be met will be formally identified in the Record of Decision (ROD). Compliance with those ARARs specified in the ROD will be achieved through the remedial action. The ARARs may need to be reevaluated if unanticipated circumstances are encountered during remediation which prevent the ability to satisfy the identified ARARs.

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Table 6-1. Potential Contaminant-Specific ARARs and TBCs for Preliminary Inorganic and Organic Contaminants of Concern. Page 1 of 2

	RCRA TCLP Designation Limits	RCRA Land Ban Limits		MTCA Method A Cleanup Levels Industrial Soil	Toxic Air Pollutants (ASIL)	RCRA Corrective Action Levels (Proposed)[a]	
	in mg/L	CCWE in mg/L	CCW in mg/kg	in mg/kg	in $\mu g/m^3$	Air in $\mu g/m^3$	Soil in mg/kg
INORGANIC CHEMICALS							
Ammonia (Anhydrous)	–	–	–	–	59.9[b]	–	–
Arsenic	5.0	5.0	–	200.0	0.00023[c]	.00007	80.0
Barium	100.0	100.0	–	–	1.7[b]	–	–
Berylium	–	–	–	–	0.00042[c]	0.004	0.02
Boron	–	–	–	–	–	–	–
Cadmium	1.0	1.0	–	10.0	0.00056[c]	0.0006	40.0
Chromium	5.0	5.0 (Total)	–	500.0	0.000083[c]	0.00009	400.0
Copper	–	–	–	–	3.3[b]	–	–
Cyanide	–	–	590 (Total)	–	16.7	–	–
Fluoride	–	–	–	–	8.3[b]	–	–
Iron	–	–	–	–	–	–	–
Lead	5.0	5.0	–	1,000.0	–	–	–
Manganese	–	–	–	–	16.7	–	–
Mercury	0.2	0.20 (low-level)	–	1.0	0.3[b]	–	20.0
Nickel	–	134	–	–	3.3[b]	–	2000.0
Nitric Acid	–	–	–	–	16.7[b]	–	–
Nitrite	–	–	–	–	–	–	–
Silver	5.0	5.0	–	–	0.3	–	200.0
Sulfuric Acid	–	–	–	–	3.3[b]	–	–
Tin	–	–	–	–	6.7	–	–
Uranium	–	–	–	–	0.7	–	–
Zinc	–	–	–	–	–	–	–
ORGANIC CHEMICALS							
Acetone	–	–	5.9	–	5927.4[b]	–	8000.00
1-Butanol	–	–	–	–	–	–	–
Carbon Tetrachloride	0.5	.96	–	–	0.067	0.03	5.0
Chloroform	6.0	—	5.6	–	0.0430[c]	0.04	100.0

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Table 6-1. Potential Contaminant-Specific ARARs and TBCs for Preliminary Inorganic and Organic Contaminants of Concern. Page 2 of 2

	RCRA TCLP Designation Limits	RCRA Land Ban Limits		MTCA Method A Cleanup Levels Industrial Soil	Toxic Air Pollutants (ASIL)	RCRA Corrective Action Levels (Proposed)[a]	
	in mg/L	CCWE in mg/L	CCW in mg/kg	in mg/kg	in $\mu g/m^3$	Air in $\mu g/m^3$	Soil in mg/kg
Ethyl ether	–	–	–	–	–	–	–
Hydrazine	–	–	–	–	–	0.0002	0.2
Kerosene	–	–	–	–	–	–	–
Methyl Ethyl Ketone	200.0	–	36	–	1964.7[c]	300.0	4000.0
Methylene Chloride	–	.33	.96	0.5	–	0.3	90.
MIBK ("Hexone")	–	.33	.33	–	682.7	–	–
PCBs	–	–	–	10.0	–	–	–
Toluene	–	.33	.28	40	1248.8	7000.0	2000.0
Tributyl Phosphate	–	–	–	–	8.3[b]	–	–
1,1,1-Tri-chloroethane	–	.014	5.6	20.0	149.9	1000.0	7000.0

ASIL = Acceptable Source Impact Level
CCWE = Constituent Concentration in Waste Extract
CCW = Constituent Concentration in Waste
MTCA = Washington State Model Toxics Control Act
RCRA = Federal Resource Conservation and Recovery Act
TCLP = Toxic Characteristic Leaching Procedure
WAC = Washington Administrative Code

mg/L = milligrams per liter
mg/kg = milligrams per kilogram
$\mu g/m^3$ = micrograms per cubic meter

[a] RCRA Corrective Action Levels are only proposed at this time (40 CFR Part 264 Subpart S), so are not ARARs yet; they are "To Be Considered."
[b] 24-hour average
[c] Annual average

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Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation	ARAR
GEOLOGICAL:				
Within 61 m (200 ft) of a fault displaced in Holocene time.	New treatment, storage or disposal of hazardous waste prohibited.	Hazardous waste management near Holocene fault.	40 CFR 264.18; WAC 173-303-420	Not ARAR. No Holocene fault.
Holocene faults and subsidence areas.	New solid waste disposal facilities prohibited over faults with displacement in Holocene time, and in subsidence areas.	New solid waste management activities near Holocene fault.	WAC 173-304-130	Not ARAR. No Holocene fault.
Unstable slopes.	New solid waste disposal areas prohibited from hills with unstable slopes.	New solid waste disposal on an unstable slope.	WAC 173-304-130	Not ARAR. No unstable slope.
100-year floodplains.	Solid and hazardous waste disposal facilities must be designed, built, operated, and maintained to prevent washout.	Solid or hazardous waste disposal in a 100-year floodplain.	40 CFR 264.18; WAC 173-303-420; WAC 173-304-460	Potential ARAR.
	Avoid adverse effects, minimize potential harm, restore/preserve natural and beneficial values in floodplains.	Actions occurring in a floodplain.	40 CFR Part 6 Subpart A; 16 USC 661 et seq; 40 CFR 6.302	Potential ARAR.
Salt dome and salt bed formations, underground mines, and caves.	Placement of non-containerized or bulk liquid hazardous wastes is prohibited.	Hazardous waste placement in salt dome, salt bed, mine, or cave.	40 CFR 264.18	Not ARAR. None of these units.
SURFACE WATER:				
Wetlands.	New hazardous waste disposal facilities prohibited in wetlands (including within 61 m (200 ft) of shoreline).	Hazardous waste disposal within 61 m (200 ft) of surface water.	WAC 173-303-420	Potential ARAR.
	New solid waste disposal facilities prohibited within 61 m (200 ft) of surface water (stream, lake, pond, river, salt water body).	Solid waste disposal within 61 m (200 ft) of surface water.	WAC 173-304-130	Potential ARAR.
	New solid waste disposal facilities prohibited in wetlands (swamps, marshes, bogs, estuaries, and similar areas).	Solid waste disposal in a wetland (swamp, marsh, bog, estuary, etc.).	WAC 173-304-130	Not ARAR. No wetlands present.

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Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation	ARAR
SURFACE WATER: (cont)				
Wetlands. (cont)	Discharge of dredged or fill materials into wetlands prohibited without a permit.	Discharges to wetlands and navigable waters.	40 CFR Part 230; 33 CFR Parts 303, and 320 to 330	Potential ARAR.
	Minimize potential harm, avoid adverse effects, preserve and enhance wetlands.	Construction or management of property in wetlands.	40 CFR Part 6 Appendix A	Not ARAR. No wetlands present.
Shorelines.	Actions prohibited within 61 m (200 ft) of shorelines of statewide significance unless permitted.	Actions near shorelines.	Chapter 90.58 RCW; Chapter 173-14 WAC.	Potential ARAR.
Rivers and streams.	Avoid diversion, channeling or other actions that modify streams or rivers, or adversely affect fish or wildlife habitats and water resources.	Actions modifying a stream or river and affecting fish or wildlife.	40 CFR 6.302	Potential ARAR.
GROUNDWATER:				
Sole source aquifer.	New solid and hazardous waste land disposal facilities prohibited over a sole source aquifer.	Disposal over a sole source aquifer.	WAC 173-303-402; WAC 173-304-130	Not ARAR. No sole source aquifer.
Uppermost aquifer.	Bottom of lowest liner of new solid waste disposal facility must be at least 3 m (10 ft) above seasonal high water in uppermost aquifer 1.5 m (5 ft) if hydraulic gradient controls installed).	New solid waste disposal.	WAC 173-304-130	Not ARAR. Groundwater is deeper than 3 m (10 ft).
Aquifer Protection Areas.	Activities restricted within designated Aquifer Protection Areas.	Activities within an Aquifer Protection Area.	Chapter 36.36 RCW.	Not ARAR. Not an Aquifer Protection Area.
Groundwater Management Areas.	Activities restricted within Ground Water Management Areas.	Activities within a Groundwater Management Area.	Chapter 90.44 RCW; Chapter 173-100 WAC	Not ARAR. Not a Groundwater Management Area.

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation	ARAR
DRINKING WATER SUPPLY:				
Drinking water supply well.	New solid waste disposal areas prohibited within 305 m (1,000 ft) upgradient, or 90 days travel time, of drinking water supply well.	New solid waste disposal within 305 m (1,000 ft) of drinking water supply well.	WAC 173-304-130	Not ARAR. No drinking water supply wells.
Watershed.	New solid waste disposal areas prohibited within a watershed used by a public water supply system for municipal drinking water.	New solid waste disposal in a public watershed.	WAC 173-304-130	Not ARAR. Not a public watershed.
AIR:				
Non-attainment areas.	Restrictions on air emissions in areas designated as non-attainment areas under state and federal air quality programs.	Activities in a designated non-attainment area.	Chapter 70.94 RCW; Chapters 173-400 and 173-403 WAC.	Not ARAR. Not a non-attainment area.
SENSITIVE ENVIRONMENTS:				
Endangered/threatened species habitats.	New solid waste disposal prohibited from areas designated by US Fish and Wildlife Service as critical habitats for endangered/ threatened species.	New solid waste disposal in critical habitats.	WAC 173-304-130	Not ARAR. Not a critical habitat.
	Actions within critical habitats must conserve endangered/threatened species.	Activities where endangered or threatened species exist.	50 CFR Parts 200 and 402.	Potential ARAR.
Parks.	No new solid waste disposal areas within 305 m (1,000 ft) of state or national park.	New solid waste disposal near state/national park.	WAC 173-304-130	Not ARAR. No state/national park.
	Restrictions on activities in areas that are designated state parks, or recreation/ conservation areas.	Activities in state parks or recreation/conservation areas.	Chapter 43.51 RCW; Chapter 352.32 WAC	**Not ARAR. None of these state areas.**
Wilderness areas.	Actions within designated wilderness areas must ensure area is preserved and not impaired.	Activities within designated wilderness areas.	16 USC 1131 et seq; 50 CFR 35.1 et seq	Not ARAR. Not a wilderness area.

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Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation	ARAR
Wildlife refuge.	Restrictions on actions in areas that are part of the National Wildlife Refuge System.	Activities within designated wildlife refuges.	16 USC 668dd et seq; 50 CFR Part 27	Not ARAR. Not a wildlife refuge.
Natural areas preserves.	Activities restricted in areas designated as having special habitat value (Natural Heritage Resources).	Activities within identified Natural Area Preserves.	Chapter 79.70 RCW; Chapter 332-650 WAC	Not ARAR. Not a Natural Area Preserve.
Wild, scenic, or recreational rivers.	Avoid actions that would have adverse effects on designated wild, scenic, or recreational rivers.	Activities near wild, scenic, and recreational rivers.	16 USC 1271 et seq; 40 CFR 6.302; Chapter 79.72 RCW	Potential ARAR.
Columbia River Gorge	Restrictions on activities that could affect resources in the Columbia River Gorge.	Activities within the Columbia River Gorge.	Chapter 43.97 RCW	Not ARAR. Not in Columbia River Gorge.
UNIQUE LANDS AND PROPERTIES:				
Natural resource conservation areas.	Restrictions on activities within designated Conservation Areas.	Activities within designated Conservation Areas.	Chapter 79.71 RCW	Not ARAR. Not a Conservation Area.
Forest lands.	Activities restricted within state forest lands to minimize fire hazards and other adverse impacts.	Activities within state forest lands.	Chapter 76.04 RCW; Chapter 332-24 WAC	Not ARAR. Not a forest land.
	Restrictions on activities in state and federal forest lands.	Activities within state and federal forest lands.	16 USC 1601; Chapter 76.09 RCW	Not ARAR. Not a forest land.
Public lands.	Activities on public lands are restricted, regulated, or proscribed.	Activities on state-owned lands	Chapter 79.01 RCW	Not ARAR. Not a state land.
Scenic vistas.	Restrictions on activities that can occur in designated scenic areas.	Activities in designated scenic vista areas.	Chapter 47.42 RCW	Not ARAR. Not a scenic area.

Table 6-2. Potential Location-Specific ARARs.

Location	Requirement	Prerequisite	Citation	ARAR
UNIQUE LANDS AND PROPERTIES: (cont)				
Historic areas.	Actions must be taken to preserve and recover significant artifacts, preserve historic and archaeologic properties and resources, and minimize harm to national landmarks.	Activities that could affect historic or archaeologic sites or artifacts.	16 UST 469, 470 et seq; 36 CFR Parts 65 and 800; Chapters 27.34, 27.53, and 27.58 RCW.	Not ARAR. No historic or archaeologic sites.
LAND USE:				
Neighboring properties.	No new solid waste disposal areas within 30.5 m (100 ft) of the facility's property line.	New solid waste disposal within 100 feet of facility property line.	WAC 173-304-130	Not ARAR. Not near facility boundary.
	No new solid waste disposal areas within 76 m (250 ft) of property line of residential zone properties.	New solid waste disposal within 250 feet of property line of residential property.	WAC 173-304-130	Not ARAR. No residential property near.
Proximity to airports.	Disposal of garbage that could attract birds prohibited within 3,048 m (10,000 ft) (turbojet aircraft)/1,524 m (5,000 ft) (piston-type aircraft) of airport runways.	Garbage disposal near airport.	WAC 173-304-130	Not ARAR. No airports near.

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7.0 PRELIMINARY REMEDIAL ACTION TECHNOLOGIES

Previous sections identified contaminants of concern at the B Plant Aggregate Area, potential routes of exposure, and potentially applicable or relevant and appropriate requirements (ARARs). Section 7.0 identifies preliminary remedial action objectives (RAOs) and develops preliminary remedial action alternatives consistent with reducing the potential hazards of this contamination and satisfying potential ARARs. The overall objective of this section is to identify viable and innovative remedial action alternatives for media of concern at the B Plant Aggregate Area.

The process of identifying viable remedial action alternatives consists of several steps. In Section 7.1, RAOs are first identified. Next, in Section 7.2, general response actions are determined along with specific treatment, resource recovery, and containment technologies within the general response categories. Specific process options belonging to each technology type are identified, and these process options are subsequently screened based on their effectiveness, implementability, and cost (Section 7.3). The combining of process options into alternatives occurs in Section 7.4. Here the alternatives are described and diagrammed. Criteria are then identified in Section 7.5 for preliminary screening of alternatives that may be applicable to the waste management units and unplanned release sites identified in the B Plant Aggregate Area. Figure 7-1 is a matrix summarizing the development of the remedial action alternatives starting with media-specific RAOs.

Because of uncertainty regarding the nature and extent of contamination at the B Plant Aggregate Area waste management units, recommendations for remedial alternatives are general and cover a broad range of actions. Remedial action alternatives will be considered and more fully developed in future focused feasibility studies (FFS). The *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) is used to focus the range of remedial action alternatives that will be evaluated in focused studies. In general, the *Hanford Site Past-Practice Strategy* remedial investigation (RI)/Feasibility Study (FS) and the Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI)/Corrective Measures Studies (CMS) are defined as the combination of interim remedial measures (IRMs), limited field investigations (LFIs) for final remedy selection where interim actions are not clearly justified, and focused or aggregate area feasibility/treatability studies for further evaluation of treatment alternatives. After completion of an IRM, data will be evaluated including concurrent characterization and monitoring data to determine if a final remedy can be selected.

A secondary purpose of the evaluation of preliminary remedial action alternatives is the identification of additional information needed to complete the evaluation. This information may include field data needs and treatability tests of selected technologies. Additional data will be developed for most waste management units or waste groups during future data gathering activities (e.g., LFIs, characterization supporting IRMs, or treatability studies). These data may be used to refine and supplement the RAOs and proposed alternatives

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identified in this initial study. Data needs are defined in Section 8.0. Alternatives involving technologies that are not well-demonstrated under the conditions of interest are identified in Sections 7.3 and 7.5. These technologies may require bench-scale and pilot-scale treatability studies. The intent is to conduct treatability studies for promising technologies early in the RI/FS process. Conclusions regarding the feasibility of some individual technologies may change after new data become available.

The bias-for-action philosophy of addressing contamination at the Hanford Site requires an expedited process for implementing remedial actions. Implementation of general response actions may be accomplished using an observational approach in which the implementation is redirected as information is obtained. This observational approach is an iterative process of data acquisition and refinement of the conceptual model. Data needs are determined by the model, and data collected to fulfill these needs are used as additional input to the model. Use of the observational approach while conducting response actions in the 200 Areas will allow integrating these actions with longer range objectives of final remediation of similar areas and the entire 200 Areas. Site characterization and remediation data will be collected concurrently with the use of LFIs, IRMs, and treatability testing. The knowledge gained through these different activities will be applied to similar areas. The overall goal of this approach is convergence on an appropriate response action as early as possible while continuing to obtain valuable characterization information during remediation phases.

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7.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES

The RAOs are remediation goals for protection of human health and the environment that specify the contaminants and media of concern, exposure pathways, and allowable contaminant levels. The RAOs discussed in this section are considered to be preliminary and may change or be refined as new data are acquired and evaluated.

The fundamental objective of the corrective action process at the B Plant Aggregate Area is to protect environmental resources and/or human receptors from the potential threats that may exist because of known or suspected contamination. Specific interim and final RAOs will depend in part on current and reasonable potential future land use in the B Plant Aggregate Area and the 200 East Area. The RAOs also take into account the preference under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) for permanent isolation and permanent or significant reduction of volume, toxicity, or mobility of hazardous substances.

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To focus remedial actions with a bias for action through implementing IRMs, preliminary RAOs are identified for the 200 East Area and B Plant Aggregate Area. The overall objective for the 200 East Area is as follows:

> Reduce the risk of harmful effects to the environment and human users of the area by isolating and permanently reducing the toxicity, mobility, or volume of contaminants from the source areas to meet ARARs or risk-based levels that will allow industrial use of the area (this is a potential final RAO, and an interim action objective based on current use of the 200 Areas).

The RAOs are further developed in Table 7-1 for media of concern and applicable exposure pathways (see Sections 4.1 and 4.2) for the B Plant Aggregate Area. The media of concern for the B Plant Aggregate Area include the following:

- Radionuclide-contaminated and chemically contaminated soils that could result in direct exposure or inhalation of vapors or particles
- Contaminated soils that are or could contribute to groundwater contamination
- Vadose zone vapors that could cause ambient air impacts or contribute to the lateral and vertical migration of contaminants in the soil and to the groundwater
- Biota that could mobilize radionuclides or chemical contaminants directly or could degrade the integrity of other controls, such as caps thereby mobilizing contaminants.

Waste materials currently stored in single-shell tanks that contribute or may contribute contaminants to environmental media will not be addressed by this aggregate area management study (AAMS) program but rather by the Single-Shell Tank Closure Program. In addition, groundwater as an exposure medium is not addressed in this source Aggregate Area Management Study Report (AAMSR), but is discussed in the 200-East Groundwater AAMSR.

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7.2 PRELIMINARY GENERAL RESPONSE ACTIONS

General response actions represent broad classes of remedial measures that may be appropriate to achieve both interim and final RAOs at the B Plant Aggregate Area, and are presented in Table 7-2. The following are the general response actions for the B Plant Aggregate Area followed by a brief description:

- No action (applicable to specific facilities)
- Institutional controls
- Waste removal and treatment or disposal

- Waste containment
- In-situ waste treatment
- Combinations of the above actions.

These general response actions are intended to cover the range of options from no action to complete remediation. Included are options that satisfy the CERCLA preference for isolation and permanent or significant reduction in volume, mobility, and toxicity of hazardous substances. No action is included for evaluations as required by the National Environmental Policy Act (NEPA) and National Contingency Plan (NCP) [40 CFR 300.68(f)(l)(v)] to provide a baseline for comparison with other response actions. The no action alternative may be appropriate for some facilities and sources of contamination if risk assessments determine acceptable natural resource or human health risks posed by those sources or facilities and no exceedances of contaminant-specific ARARs occur.

Institutional controls involve the use of physical barriers or access restrictions to reduce or eliminate public exposure to contamination. Many access and land use restrictions are currently in place at the Hanford Site and will remain in place during implementation of IRMs. Because the 200 Areas are already committed to waste management for the long term, institutional controls will also be important for final remedial measures alternatives.

Waste removal and treatment or disposal involves excavation of contamination sources for eventual treatment and/or disposal either on a small- or large-scale basis. One approach being considered for large-scale waste removal is macro-engineering, which is based on high volume excavation using conventional surface mining technologies. Waste removal on a macro-engineering scale would be used over large areas such as groups of waste management units, operable units, or operational areas as a final remedial action. Waste removal on a small scale would be conducted for individual waste management units on a selective basis. Small-scale waste removal could be conducted as either an interim or final remedial action.

The alternatives for disposal of the excavated waste would depend on the volume of soil and the nature of the contaminants:

- Soil that contained low levels of radionuclides but no hazardous chemical waste could be disposed of into existing disposal sites at Hanford, or it could be shipped to licensed offsite disposal sites.

- Soil that contained chemical contaminants but no radionuclides could be disposed of at existing offsite RCRA-approved landfills, or disposed of onsite in a Hanford RCRA-approved landfill.

- Soil that was designated as "mixed waste" with both low-level radionuclides and hazardous chemical contaminants would have to be disposed of at Hanford.

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- There are currently no facilities at the Hanford Site or offsite for permanent geologic disposal of transuranic (TRU) waste. If such soil was excavated, it would have to be temporarily stored at Hanford until a geologic repository disposal site was licensed and constructed or another disposal option is identified.

One potential problem with offsite radioactive waste disposal is the lack of an alternate disposal location that will decrease the potential human exposure over the long time required for many of the contaminants. Waste removal actions may not be needed, or only be required on a small scale, to protect human health or the environment for industrial uses of the 200 Areas.

Waste treatment involves the use of biological, thermal, physical, or chemical technologies. Typical treatment options include biological land farming, thermal processing, soil washing, and fixation/solidification/stabilization. As described in Section 7.3, some of the technologies that have been used as industrial sites may not be feasible at the Hanford Site. Some treatment technologies must be pilot tested before they could be implemented. Waste treatment could be conducted either as an interim or final action and may be appropriate in meeting RAOs for all potential future land uses.

Waste containment includes the use of capping technologies (i.e., capping and grouting) to minimize the driving force for downward or lateral migration of contaminants. Vertical barriers can also be used to minimize lateral migration and to prevent biota from penetrating into contaminated areas. Containment also provides a radiation exposure barrier and a barrier to direct exposure. In addition, these barriers provide long-term stability with relatively low maintenance requirements. Containment actions may be appropriate for either interim or final remedial actions.

In-situ waste treatment includes thermal, chemical, physical, and biological technology types, of which there are several specific process options including in-situ vitrification, in-situ grouting or stabilization, soil flushing, and in-situ biotreatment. The distinguishing feature of in-situ treatment technologies is the ability to attain RAOs without removing the wastes. The final waste form generally remains in place. This feature is advantageous when exposure during excavation would be significant or when excavation is technically impractical. In-situ treatment can be difficult because the process conditions may not be easily controlled.

In the next section, specific process options within these technology groups are evaluated.

7.3 TECHNOLOGY SCREENING

In this section, potentially applicable technology types and process options are identified. These process options are then screened using effectiveness, implementability,

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and relative cost as criteria to eliminate those process options that would not be feasible at the site. The remaining applicable processes are then grouped into remedial alternatives in Section 7.4.

The effectiveness criteria focuses on: (1) the potential effectiveness of process options in handling the areas or volumes of media and meeting the RAOs; (2) the potential impacts to human health and the environment during the construction and implementation phase; and (3) how proven and reliable the process is with respect to the contaminants and conditions at the site. This criteria also concentrates on the ability of a process option to treat a contaminant type (organics, inorganics, metals, radionuclides, etc.) rather than a specific contaminant (nitrate, cyanide, chromium, plutonium, etc.).

The implementability criteria places greater emphasis on the institutional aspects of implementability, such as the ability to obtain necessary permits for offsite actions, the availability of treatment, storage, and disposal services, and the availability of necessary equipment and skilled workers to implement the technology. It also focuses on the process option's developmental status, whether it is an experimental or established technology.

The relative cost criterion is an estimate of the overall cost of a process, including capital and operating costs. At this stage in the process, the cost analysis is made on the basis of engineering judgement, and each process is evaluated as to whether the costs are high, medium, or low relative to other process options.

A process option is rated effective if it can handle the amount of area or media required, if it does not impact human health or the environment during the construction and implementation phases, and if it is a proven or reliable process with respect to the contaminants and conditions at the site. Also, a process option is considered more effective if it treats a wide range of contaminants rather than a specific contaminant. An example of a very effective process option would be vitrification because it treats inorganics, metals, and radionuclides. On the other hand, chemical reduction may only treat chromium (VI), making it a less useful option.

An easily implemented process option is one that is an established technology, uses readily available equipment and skilled workers, uses treatment, storage, and disposal services that are readily available, and has few regulatory constraints. Preference is given to technologies that are easily implemented.

Preference is given to lower cost options, but cost is not an exclusionary criterion. A process option is not eliminated based on cost alone.

Results of the screening process are shown in Table 7-3. Brief descriptions are given of the process options, followed by comments regarding the evaluation criteria. The last column of the table indicates whether the process option is rejected or carried forward for possible alternative formation. The table first lists technologies that address soil RAOs.

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Next, technologies pertaining to biota RAOs are presented. All the biota-specific technologies happen to be technologies that were listed for soil RAOs. Air RAOs are dealt with as soil remediation issues because the air contamination is a result of the contaminants in the soil: addressing and remediating the air pathways would be unnecessary and ineffective as long as there is soil contamination. If the soil is remediated, the source of the air contamination would be removed.

The conclusions column of Table 7-3 indicates that no action, monitoring, 3 institutional process options, and 16 other process options are retained for further development of alternatives. These options are carried forward into the development of preliminary alternatives.

7.4 PRELIMINARY REMEDIAL ACTION ALTERNATIVES

This section develops and describes several remedial alternatives considered applicable to disposal sites that contain hazardous chemicals, radionuclides, and volatile and semivolatile organic compounds (VOCs). These alternatives are not intended as recommended actions for any individual waste management units, but are intended only to provide potential options applicable to most units where multiple contaminants are present. Selection of actual remedial alternatives that should be applied to the individual units would be partly based on future expedited or interim actions and LFIs, as recommended in Section 9.0 of this report. Selection of proper alternatives would be conducted within the framework of the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) and the strategy outlined in Section 9.4. The selection process would also be based on a preference for isolation and permanent treatment.

The remedial alternatives are developed in Section 7.4.1. Then, in Section 7.4.2 through Section 7.4.7, the remedial action alternatives are described. Detailed evaluations and costs are not provided because site-specific conditions must be further investigated before meaningful evaluations could be conducted.

7.4.1 Development of Remedial Alternatives

Potentially feasible remedial technologies were described and evaluated in Section 7.3. Some of those technologies have been proven to be effective and constructible at industrial waste management units, while other technologies are in the developmental stages. The EPA guidance (EPA 1988b) on FSs for uncontrolled waste management units recommends that a

limited number of candidate technologies be grouped into "Remedial Alternatives." For this study, technologies were combined to develop remedial alternatives and provide at least one alternative for each of the following general strategies:

- No action
- Institutional controls
- Removal, above-ground treatment, and disposal
- Containment
- In-situ treatment.

The alternatives are intended to treat all or a major component of the B Plant Aggregate Area contaminated waste management units or unplanned releases. Consistent with the development of RAOs and technologies, alternatives were developed based on treating classes of compounds (radionuclides, heavy metals, inorganics, and organics) rather than specific contaminants. At a minimum, the alternative must be a complete package. For example, disposal of radionuclide-contaminated soil must be combined with excavation and backfilling of the excavated unit.

One important factor in the development of the preliminary remedial action alternatives is the fact that radionuclides, heavy metals, and some inorganic compounds cannot be destroyed. Rather, these compounds must be physically immobilized, contained, isolated, or chemically converted to less mobile forms to satisfy RAOs. Organic compounds can be destroyed, but may represent a smaller portion of the overall contamination at the B Plant Aggregate Area. Both no action and institutional control options are required to be considered as part of the CERCLA RI/FS guidance. The purpose of including both of these alternatives is to provide decision makers with information on the entire range of available remedial actions.

For the containment alternative, an engineered multimedia cover, with or without vertical barriers (depending on the specifics of the remediation) was selected. Two alternatives were selected to represent the excavation and treatment strategy. One of these deals with disposal of TRU contaminated soils. Finally, three in-situ alternatives were identified. One deals with vapor extraction for VOCs, one with stabilization of soils and the other with vitrification of soils.

It is recognized that this does not represent an exhaustive list of all applicable alternatives. However, these do provide a reasonable range of remedial actions that are likely to be evaluated in future FSs. The remedial action alternatives are summarized as follows:

- No action

- Institutional controls

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- Engineered multimedia cover with or without vertical barriers (containment); Feasible vertical barriers include slurry walls and grout curtains

- In-situ grouting or stabilization of soil (in-situ treatment)

- Excavation, above-ground treatment, and disposal of soil (removal, treatment and disposal); feasible technologies for organic compounds include thermal processing and stabilization; feasible technologies for radionuclides include soil washing, vitrification, and stabilization

- In-situ vitrification of soil (in-situ treatment)

- Excavation, treatment, and geologic disposal of soil with TRU radionuclides (removal, treatment, and disposal)

- In-situ soil vapor extraction of VOCs (in-situ treatment).

These alternatives, with the exception of no action and institutional controls, were developed because they satisfy a number of RAOs simultaneously and use technologies that are appropriate for a wide range of contaminant types. For example, constructing an engineered multimedia cover may effectively contain radionuclides, heavy metals, inorganic compounds, and organic compounds simultaneously. It satisfies the RAO of protecting human health and the environment from direct exposures from contaminated soil, bio-mobilization, and airborne contaminants. In-situ soil vapor extraction is more specific than the other alternatives, but it addresses a contaminant class (VOCs) that is not readily treated using the other options, such as in-situ stabilization. It is possible that some waste management units may require a combination of the identified alternatives to completely address all contaminants.

The use of contaminant-specific remedial technologies was avoided because there appear to be few, if any, waste management units where a single contaminant has been identified. It is possible to construct alternatives that include several contaminant-specific technologies, but the number of combinations of technologies would result in an unmanageable number of alternatives. Moreover, the possible presence of unidentified contaminants may render specific alternatives unusable. Alternatives may be refined as more contamination data are acquired. For now, the alternatives will be directed at remediating the major classes of compounds (radionuclides, heavy metals, inorganics, and organics).

In all alternatives except the no-action alternative, it is assumed that monitoring and institutional controls are required, although they may be temporary. These features are not explicitly mentioned, and details are purposely omitted until a more detailed evaluation may be performed in subsequent studies. Also, treatability studies may accompany many of the alternative during implementation.

In the next sections, the preliminary remedial action alternatives are described in more detail, with the exception of the no-action and institutional control options.

7.4.2 Alternative 1--Engineered Multimedia Cover with or without Vertical Barriers

Alternative 1 consists of an engineered multimedia cover. Vertical barriers such as grout curtains or slurry walls may be used in conjunction with the cover. Figure 7-2 shows a schematic diagram of an engineered multimedia cover with the vertical barriers. If the affected area includes either a naturally occurring or engineered depression, then imported backfill would be placed to control runoff and run-on water. The engineered cover itself may consist of fine-grained soil, gravel, sand, asphalt, top soil, and/or geo-synthetic liners. A liquid collection layer could also be included. The specific design of the cover and vertical barriers would be the subject of a focused feasibility study (FFS) which may be supported by treatability studies and performance testing. The barrier would be designed to minimize infiltration of surface water and to minimize biological intrusion (e.g., deep-rooting plants and burrowing animals). The covered area may be fenced, and warning signs may be posted.

Alternative 1 would provide a permanent cover over the affected area. The cover would accomplish the following: minimize the migration of precipitation into the affected soil; reduce the migration of windblown dust that originated from contaminated surface soils; reduce the potential for direct exposure to contamination and reduce the volatilization of VOCs and tritium to the atmosphere. If vertical barriers are included, they would limit the amount of lateral migration of contaminants.

This alternative would not reduce the volume or toxicity of the contaminants, and periodic inspections, maintenance, and monitoring would be required for an indefinite period.

7.4.3 Alternative 2--In-situ Grouting or Stabilization of Soil

Radioactive and hazardous soil would be grouted in this alternative using in-situ injection methods to significantly reduce the leachability of hazardous contaminants, radionuclides and/or VOCs from the affected soil. This technology has not been proven to be effective for VOCs, so it is not recommended as the sole remedial action for VOC affected areas. Grouting may also be used to fill voids, such as in cribs, thereby reducing subsidence. Another variation of this alternative would be to stabilize the soil using in-situ mixing of soil with stabilizing compounds such as pozzolanics or fly ash.

There are two common methods of in-situ grout injection that have been used at industrial sites. In the first method (shown on Figure 7-3), grout injection wells are installed at prescribed lateral spacing (based on pilot tests) and screened through the affected vertical

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zones. Specially formulated grout is then injected at high pressure, to provide overlapping zones of influence, and allowed to cure. This first method can theoretically be used to stabilize soil deep below the ground surface. In the second method, a patented large diameter auger/mixer is used to mechanically agitate and blend grout mixtures that are injected into the soil through ports in the auger. This method has commonly been used to grout large areas of soil down to a depth of about 4.6 m (15 ft).

Alternative 2 would provide a combination of immobilization and containment of heavy metal, radionuclide, and inorganic, and semivolatile organic contamination. Thus, this alternative would reduce migration of precipitation into the affected soil; reduce the migration of windblown dust that originated from contaminated surface soils; reduce the potential for direct exposure to contaminated soils; and reduce the volatilization of VOCs.

In-situ grouting has been demonstrated to be effective for stabilization of metals and semivolatile organic compounds at several CERCLA sites. However, this is considered to be a developing technology and has not yet been fully proven. Therefore, it is expected that treatability tests would be required. Because this alternative would not remove the contaminants from the soil, it is likely that institutional controls might also be required.

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7.4.4 Alternative 3--Excavation, Soil Treatment, and Disposal

Under Alternative 3, radioactive and hazardous soil would be excavated using conventional techniques, with special precautions to minimize fugitive dust generation. Depending on the configuration of the area to be excavated, shoring might be required to comply with safety requirements and to reduce the quantity of excavated soil. The excavated soil would be treated above ground. Several treatment options could be selected from the physical, chemical, and thermal treatment process options screened in Section 7.3. For example, thermal desorption with off-gas treatment could be used if organic compounds are present; soil washing could be used to remove contaminated silts and sands or specific compounds; and stabilization could be used to immobilize radionuclides and heavy metals. The specific treatment method would depend on site-specific conditions. Treatability tests wold be performed to determine the specific soil treatment protocols methodology. The treated soil would be backfilled into the original excavation or landfilled. Soil treatment by-products may require additional processing or treatment. Figure 7-4 shows a schematic diagram of this alternative.

Alternative 3 would be effective in treating a full range of contamination, depending on the type of treatment processes selected. Attainment of soil RAOs would depend on the depth to which the soil was excavated. If near surface soil was treated, airborne contamination, direct exposure to contaminated soil, and bio-mobilization of contamination would be minimized. Because of practical limits on deep excavation, deep contamination may not be removed and would be subject to migration into groundwater. Alternative 3 could be used in conjunction with Alternative 1 (multimedia cap) to reduce this possibility.

A combination of laboratory treatability tests and pilot-scale field tests might be required to develop the optimum methods for above-ground treatment of the excavated soil. The specification of the required treatability test would depend on the nature of the contaminants at each of the remediation sites.

7.4.5 Alternative 4--In-Situ Vitrification of Soil

In this alternative, the contaminated soil in a subject site would be immobilized by in-situ vitrification. Treatability tests would be performed initially to determine the unit-specific operating conditions. Figure 7-5 shows a schematic diagram of the alternative. Import fill would initially be placed over the affected area to reduce exposures to the remediation workers from surface contamination. High power electrodes would be used to vitrify the contaminated soil under the site to a depth below where contamination is present. A large fume hood would be constructed over the site before the start of the vitrification process to collect and treat emissions. After completion of the vitrification, the site would be built back to original grade with imported backfill. Fences and warning signs may be placed around the vitrified monolith to minimize disturbance and potential exposure.

In-situ vitrification would be effective in treating radionuclides, heavy metals, and inorganic contamination and may also destroy organic contaminants. This would reduce the potential for exposures by leaching to groundwater, windblown dust and direct dermal contact. However, this alternative would not reduce the mass or toxicity of the radionuclides present onsite. Also, in-situ vitrification may be limited to depths of less than about 30 m (100 ft), which may not be adequate to immobilize deep contamination.

If organic compounds are present in the affected area, they could migrate laterally and vertically during the vitrification process, as a result of the soil heating process. Therefore, this technology must include provisions for collecting and treating organic vapors. This could be done using a combination of soil venting wells and an above-ground capture hood.

It should be noted that the in-situ vitrification is a relatively new technology which is experiencing some "growing pains," and has not yet been used for a large-scale cleanup at an industrial site. Tests to date have not exceeded depths of 6 m (20 ft). Therefore, using this technology at the Hanford Site will likely require extensive pilot testing.

7.4.6 Alternative 5--Excavation, Above-Ground Treatment, and Geologic Disposal of Soil with Transuranic Radionuclides

Some of the waste management units in the B Plant Aggregate Area may contain isolated zones where the concentrations of TRU radionuclides exceed 100nCi/g. For Alternative 5, the soil from those isolated zones would be excavated, stabilized or treated,

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and shipped to an offsite geologic disposal site. Such a disposal facility has not yet been licensed, so interim storage of the stabilized soil may be required until the facility is constructed.

Figure 7-6 shows a schematic diagram of Alternative 5. Depending on the configuration of the affected area, shoring may be required during excavation to comply with worker safety regulations and to minimize the amount of excavated soil. Special excavation procedures would have to be used to minimize fugitive dust. The excavated soil would be sorted according to its TRU concentration. Soil with TRU radionuclides exceeding 100 nCi/g would be either vitrified or stabilized using an above-ground treatment plant, then stored until a geologic disposal facility was available.

Some of the excavated soil could contain TRU radionuclides at concentrations less than 100 nCi/g and could be treated using a combination of the technologies described in Section 7.3. After the non-TRU soil was treated to achieve appropriate cleanup standards, it could be backfilled into the original excavation. Alternatively, the non-TRU soil could be disposed of at an appropriate landfill. Imported fill material would be used to restore the unit to its original grade. If the residual unexcavated soil or the treated soil used for backfill contained contaminants at concentrations exceeding the RAOs, then a combination of an engineered cover and vertical barriers (Alternative 1) might have to be installed at the unit to prevent direct exposure or groundwater impacts.

This alternative would utilize many excavation and treatment technologies that have been only partly demonstrated at industrial sites. Extensive treatability testing would be required for the TRU-containing soil to develop optimum methods for treating or stabilizing the TRU radionuclides. Additional treatability studies might be required to support the above-ground treatment of the non-TRU soil.

For Alternative 5, soil containing TRU radionuclides at concentrations exceeding 100 nCi/g would be excavated, treated, and disposed. Thus, potential exposure to and migration of TRU-wastes would be minimized. Potential exposure to other contaminants would be determined by other remedial alternatives implemented. At sites containing TRU and non-TRU wastes, the use of Alternative 5 alone may not satisfy all RAOs.

7.4.7 Alternative 6--In-situ Soil Vapor Extraction for Volatile Organic Compounds

Figure 7-7 shows a schematic diagram of a representative soil vapor extraction system. Soil vapor is vented from wells that are screened in permeable soil zones that contain high organic vapor concentrations. The vented air would be treated to remove water vapor, the organic vapor of concern, particulate radionuclides that might be entrained in the air stream, and volatile radionuclides. Figure 7-7 shows one common combination of offgas treatment technologies; other technologies can also be used depending on the nature of the vapors that

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are extracted. Water vapor must be removed (usually by condensation) to protect the vacuum pumps. If the condensed water contains organic contamination or radionuclides, then it would have to be treated and/or disposed of in an appropriate manner. Particulate radionuclides that were entrained in the air stream can be effectively removed using banks of conventional High Efficiency Particulate Air (HEPA) filters. The organic vapors would have to be treated to satisfy Best Available Control Technology (BACT) in accordance with air toxics regulations. If the disposal site is considered a RCRA facility, then the offgas treatment system must also satisfy RCRA emission control standards. Destruction efficiencies exceeding 98% have often been achieved using soil vapor extraction systems at industrial sites. The required destruction efficiency will be determined based on applicable ARARs.

A pilot-scale test would probably have to be performed to determine the required venting well spacing and the required vacuum pump design. Analysis of the vented gas during the pilot test would be done to assess what types of offgas emission controls would be required.

Some of the waste management units at the B Plant Aggregate Area contain VOCs along with other non-volatile contaminants. Alternative 6 utilizes proven technologies to remove the volatilized vapors from the vadose zone soil. In-situ soil vapor extraction is a proven technology for removal of VOC from the vadose zone soils although some pilot-scale testing may be needed at specific units. Soil vapor extraction would reduce downward migration of the VOC vapors through the vadose zone, and thereby minimize potential cross-media migration into the groundwater. Soil vapor extraction would reduce upward migration of VOC through the soil column into the atmosphere, and thereby minimize inhalation exposures to the contaminants. In some cases, the radionuclides were discharged to the waste management units with VOCs (e.g., MIBK). Removal of the VOC by implementing soil vapor extraction could reduce the mobility of the radionuclides, and thereby reduce the potential for downward migration of the radionuclides. Finally, soil vapor extraction would enhance partitioning of the VOC off of the soil and into the vented air stream, resulting in the permanent removal and destruction of the VOC. Alternative 6 may be used in conjunction with other alternatives if contaminants other than VOCs are present. However, because of the limited number of B Plant Aggregate Area units that contain VOCs, the use of soil vapor extraction will not be extensive.

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7.5 PRELIMINARY REMEDIAL ACTION ALTERNATIVES APPLICABLE TO WASTE MANAGEMENT UNITS AND UNPLANNED RELEASE SITES

The purpose of this section is to discuss which preliminary remedial action alternatives could be used to remediate each B Plant Aggregate Area waste management unit or unplanned release site. The criteria used for deciding this are as follows:

- Installing an engineered multimedia cover with or without vertical barriers (Alternative 1) could be used on any site where contaminants may be leached or mobilized by surface water infiltration or if surface/near-surface contamination exists.

- In-situ grouting or stabilization (Alternative 2) could be used on any waste management unit or unplanned release site that contain heavy metals, radionuclides, and/or other inorganic compounds. In-situ grouting could also be effective in filling voids for subsidence control.

- Excavation and soil treatment (Alternative 3) could be used at most waste management units or unplanned release sites that contain radionuclides, heavy metals, other inorganics compounds, semi-volatile organic compounds, and VOCs.

- In-situ vitrification (Alternative 4) could be used at most waste management units or unplanned release sites, although vapor extraction may be needed when VOCs are present. Waste management units or unplanned release sites where in-situ vitrification may not be effective include reverse wells and other sites where the contamination is present in a very narrow geometry. In-situ vitrification is also not considered for surface spills.

- Excavation, treatment, and geologic disposal of TRU-containing soils (Alternative 5) could only be used on those waste management units and unplanned release sites that contain TRU radionuclides. Since a geologic repository is likely to accept only TRU radioactive soils, the non-TRU radioactive soils will not be remediated using this alternative.

- In-situ soil vapor extraction (Alternative 6) could be used on any waste management unit or unplanned release site that contains volatile organic compounds. Such sites are not common in the B Plant Aggregate Area. Nonetheless, the 216-B-63 Ditch to which the B Plant chemical sewer is directed with high probabilities of VOC contamination is one waste management unit at which soil vapor extraction would be an effective remedy.

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Using these criteria, Table 7-4 was created showing possible preliminary remedial action alternatives that could be used to remediate each of the waste management units and unplanned release sites. Each waste management unit or unplanned release may require just one alternative or a combination of many alternatives. Furthermore, similar units may be remediated simultaneously. Also, more specific waste treatment alternatives could be identified and evaluated as more information is obtained. Note that a single alternative may not be sufficient to remediate all contamination at a single waste management unit or unplanned release site. For example, soil vapor extraction could precede in-situ vitrification to remove organic contaminants. Also, different combinations of technologies are possible besides those presented in these preliminary alternatives. Table 7-4 excludes units that are covered by other programs. For example, single-shell tanks are excluded because they are addressed by the Single-Shell Tank Closure Program.

Each waste management unit or unplanned release site may require just one alternative or a combination of many alternatives. Furthermore, similar sites may be remediated simultaneously. Also, more specific waste treatment alternatives could be identified and evaluated as more information is obtained.

Technology development studies will be needed for the in-situ vitrification process; and treatability studies will be needed for the in-situ grouting or stabilization process and for soil treatment processes to make sure that they will effectively remediate the contaminants. Specifically, organic waste mobility may be a problem for in-situ vitrification; grouting agents and the resulting reduction of contaminant leachability will need to be determined before in-situ grouting can be performed; and appropriate treatment protocols and systems will need to be identified before soil washing can be used. Capping, soil vapor extraction, and disposal options are all proven processes but may require site-specific performance assessment (treatability) studies.

The focused feasibility studies (FFS) will be required to evaluate alternative designs for all of the alternatives evaluated, as they relate to the specific waste management unit being remediated. A site-by-site economic evaluation is also required before making a decision. This evaluation will require site-specific information obtained in LFIs and FFSs.

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Table 7-2. Preliminary Remedial Action Technologies.

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
Soil	No Action	No Action	No Action	NA
	Institutional Controls	Land Use Restrictions	Deed Restrictions	NA
		Access Controls	Signs/Fences	NA
			Entry Control	NA
		Monitoring	Monitoring	NA
	Containment	Capping	Multimedia	I,M,R,O
		Vertical Barriers	Slurry Walls	I,M,R,O
			Grout Curtains	I,M,R,O
			Cryogenic Walls	I,M,R,O
		Dust & Vapor Suppression	Membranes/Sealants/ Wind Breaks/Wetting Agents	I,M,R,O
	Excavation	Excavation	Standard Construction Equipment	I,M,R,O
	Treatment	Thermal Treatment	Vitrification	I,M,R,O
			Incineration	O
			Thermal Desorption	O
			Calcination	I,M,R,O
		Chemical Treatment	Chemical Reduction	M
			Hydrolysis	I,O
		Physical Treatment	Soil Washing	I,M,R,O
			Solvent Extraction	O
			Physical Separation	I,M,R,O

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Table 7-2. Preliminary Remedial Action Technologies.

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
			Fixation/Solidification/ Stabilization	I,M,R,O
			Containerization	I,M,R,O
		Biological Treatment	Aerobic	O
			Anaerobic	O
	Disposal	Landfill Disposal	Landfill Disposal	I,M,R,O
		Geologic Repository	Geologic Repository	R (I,M,O if mixed with R)
	In Situ Treatment	Thermal Treatment	Vitrification	I,M,R,O
			Thermal Desorption	O
		Chemical Treatment	Reduction	M,O
		Physical Treatment	Soil Flushing	I,M,R,O
			Vapor Extraction	O
			Grouting	I,M,R
			Fixation/Solidification/ Stabilization	I,M,R,O
		Biological Treatment	Aerobic	O
			Anaerobic	O
Biota	No Action	No Action	No Action	NA
	Institutional Controls	Land Use Restrictions	Deed Restrictions	NA
		Access Controls	Signs/Fences	NA
			Entry Control	NA
		Monitoring	Monitoring	NA

Table 7-2. Preliminary Remedial Action Technologies.

Media	General Response Action	Technology Type	Process Option	Contaminants Treated
	Excavation	Excavation	Standard Construction Equipment	I,M,R,O
	Disposal	Landfill Disposal	Landfill Disposal	I,M,R,O
	Containment	Capping	Multimedia	I,M,R,O

I = Other inorganics contaminants applicability.
M = Heavy metals contaminants applicability.
R = Radionuclide contaminants applicability.
O = Organic contaminants applicability.
NA = Not applicable.

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Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
SOIL TECHNOLOGIES:						
No Action	No Action	Do nothing to cleanup the contamination or reduce the exposure pathways.	Not effective in reducing the contamination or exposure pathways.	Easily implemented, but might not be acceptable to regulatory agencies, local governments, and the public.	Low	Retained as a "baseline" case.
Land Use Restrictions	Deed Restrictions	Identify contaminated areas and prohibit certain land uses such as farming.	Depends on continued implementation. Does not reduce contamination.	Administrative decision is easily implemented.	Low	Retained to be used in conjunction with other process options.
Access Controls	Signs/Fences	Install a fence and signs around areas of soil contamination.	Effective if the fence and signs are maintained.	Easily implemented. Restrictions on future land use.	Low	Retained to be used in conjunction with other process options.
	Entry Control	Install a guard/monitoring system to prevent people from becoming exposed.	Very effective in keeping people out of the contaminated areas.	Equipment and personnel easily implemented and readily available.	Low	Retained to be used in conjunction with other process options.
Monitoring	Monitoring	Analyze soil and soil gas samples for contaminants and scan with radiation detectors.	Does not reduce the contamination, but is very effective in tracking the contaminant levels.	Easily implemented. Standard technology.	Low	Retained to be used in conjunction with other process options.
Capping	Multimedia	Fine soils over synthetic membrane or other layers and covered with soil; applied over contaminated areas.	Effective on all types of contaminants, not likely to crack. Likely to hold up over time.	Easily implemented. Restrictions on future land use will be necessary.	Medium	Retained because of potential effectiveness and implementability.

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Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
Vertical Barriers	Slurry Walls	Trench around areas of contamination is filled with a soil (or cement) bentonite slurry.	Effective in blocking lateral movement of all types of soil contamination. May not be effective for deep contamination.	Commonly used practice and easily implemented with standard earth moving equipment. May not be possible for deep contamination.	Medium	Retained for shallow contamination.
	Grout Curtains	Pressure injection of grout in a regular pattern of drilled holes.	Effective in blocking lateral movement of all types of soil contamination.	Commonly used practice and easily implementable, but depends on soil type. May be difficult to ensure continuous wall.	Medium	Retained because of potential effectiveness and implementability.
	Cryogenic Walls	Circulate refrigerant in pipes surrounding the contaminated site to create a frozen curtain with the pore water.	Effective in blocking lateral movement of all types of soil contamination.	Specialized engineering design required. Requires ongoing freezing.	Medium	Rejected because it is difficult to implement.
Dust and Vapor Suppression	Membranes/ Sealants/Wind Breaks/Wetting Agents	Using membranes, sealants, wind breaks, or wetting agents on top of the contaminated soil to keep the contaminants from becoming airborne.	Effective in blocking the airborne pathways of all the soil contaminants, but may require regular upkeep.	Commonly used practice and very easy to implement, but land restrictions will be necessary.	Low	Rejected because of limited duration of integrity and protection.
Excavation	Standard Excavating Equipment	Moving soil around the site and loading soil onto process system equipment.	Effective in moving and transporting soil to vehicles for transportation, and for grading the surface.	Equipment and workers are readily available.	Low	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
Thermal Treatment	Above-ground Vitrification	Convert soil to glassy materials by application of electric current.	Effective in destroying organics and immobilizing the inorganics and radionuclides. Off-gas treatment for volatiles may be required.	Commercial units are available. Laboratory testing required to determine additives, operating conditions, and off gas treatment. Must pre-treat soil to reduce size of large materials.	High	Retained because of potential ability to immobilize radionuclides and destroy organics.
	Incineration	Destroy organics by combustion in a fluidized bed, kiln, etc.	Effectively destroys the organic soil contaminants. Some heavy metals will volatilize. Radionuclides will not be treated.	Technology is well developed. Mobile units are currently available for relatively small soil quantities. Off-site treatment is available. Air emissions and wastewater generation should be addressed.	High	Rejected because of potential air emissions and wastewater generation.
	Thermal Desorption	Organic volatilization at 150 to 400°C (300 to 800°F) by heating contaminated soil followed by off gas treatment.	Effectively destroys the organic soil contaminants. Heavy metals less likely to volatilize than in high temperature treatments. Radionuclides will not be treated.	Successfully demonstrated on a pilot-scale level. Full-scale remediation yet to be demonstrated. Pilot testing essential.	Medium	Retained because of potential effectiveness and implementability.

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Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Calcination	High temperature decomposition of solids into separate solid and gaseous components without air contact.	Effective in the decomposition of inorganics such as hydroxides, carbonates, nitrates, sulfates, and sulfites. Removes organic components but does not combust them because of the absence of air. Radionuclides will not be treated.	Commercially available. Most often used for concentration and volume reduction of liquid or aqueous waste. Off-gas treatment is required.	High	Rejected because of limited effectiveness on non-liquid or aqueous wastes.
Chemical Treatment	Chemical Reduction	Treat soils with a reducing agent to convert contaminants to a more stable or less toxic form.	May be effective in treating heavy metal soil contaminants. Radioactivity will not be reduced.	Virtually untested on treating soils. Competing reactions may reduce efficiency.	Medium	Rejected because of limited applicability and implementation problems.
	Hydrolysis	Acid- or base-catalyst reaction in water to break down contaminants to less toxic components.	Very effective on compounds generally classified as reactive. Limited effectiveness on stable compounds. Radioactivity will not be reduced.	Common industrial process. Use for treatment of soils not well demonstrated.	Medium	Rejected because of limited effectiveness and unproven on soils.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
Physical Treatment	Soil Washing	Leaching of waste constituents from contaminated soil using a washing solution.	Effectiveness is contaminant specific. Generally more effective on contaminants that partition to the fine soil fraction. Radioactivity will not be reduced.	Treatability tests are necessary. Well developed technology and commercially available.	Medium	Retained because of potential effectiveness and implementability.
	Solvent Extraction	Contacting a solvent with contaminated soils to preferentially dissolve the contaminants into the solvent.	The selected solvent is often just as hazardous as the contaminants presented in the waste. May lead to further contamination. Radioactivity will not be reduced.	Laboratory testing necessary to determine appropriate solvent and operating conditions. Not fully demonstrated for hazardous waste applications.	Medium	Rejected because the solvent may lead to further contamination.
	Physical Separation	Separating soil into size fractions.	Effective as a concentration process for all contaminants that partition to a specific soil size fraction.	Most often used as a pretreatment to be combined with another technology. Equipment is readily available.	Low	Retained because of potential effectiveness and implementability.
	Fixation/ Solidification/ Stabilization	Form low permeability solid matrix by mixing soil with cement, asphalt, or polymeric materials.	Effective in reducing inorganic and radionuclide soil contaminant mobility. Effectiveness for organic stabilization is highly dependent on the binding agent.	Stabilization has been implemented for site remediations. Treatability studies are needed. Volume of waste is increased.	Medium	Retained because of potential effectiveness and implementability.

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Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Containerization	Enclosing a volume of waste within an inert jacket or container.	Effective for difficult to stabilize, extremely hazardous, or reactive waste. Reduces the mobility of radionculides.	May be implemented for low concentration waste. Disposal or safe storage of containers required. Regulatory constraints may prevent disposal of containers of certain waste types.	Low	Retained because of potential effectiveness and implementability.
Biological Treatment	Aerobic	Microbial degradation in an oxygen-rich environment.	Effectiveness is very contaminant- and concentration-specific. Treatment has been demonstrated on a variety of organic compounds. Not effective on inorganics or radionuclides.	Various options are commercially available to produce contaminant degradation. Treatability tests are required to determine site-specific conditions.	Medium	Rejected because of limited applicability and difficult implementation.
	Anaerobic	Microbial degradation in an oxygen deficient environment.	Effectiveness is very contaminant and concentration specific. Treatment has been demonstrated on a variety of organic compounds. Not effective on inorganics or radionuclides.	Various options are commercially available to produce contaminant degradation. Treatability tests are required to determine site-specific conditions.	Medium	Rejected because of limited applicability and difficult implementation.
Disposal	Landfill Disposal	Place contaminated soil in an existing onsite landfill.	Does not reduce the soil contamination but moves all of the contamination to a more secure place.	Easily implemented if sufficient storage is available in an on-site landfill area.	Medium	Retained because of potential effectiveness and implementability.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Geologic Repository	Put the contaminated soil in a safe geologic repository.	Does not reduce the soil contamination, but is a very effective and long-term way of storing radionuclides. Probably unnecessary for nonradioactive waste.	Not easy to implement because of limited site availability, and permits for transporting radioactive wastes are hard to get.	High	Retained because of effectiveness on TRU wastes.
In Situ Thermal Treatment	Vitrification	Electrodes are inserted into the soil and a carbon/glass frit is placed between the electrodes to act as a starter path for initial melt to take place.	Effective in immobilizing radionuclides and most inorganics. Effectively destroys some organics through pyrolysis. Some volatilization of organics and inorganics may occur.	Potentially implementable. Implementability depends on site configuration, e.g., lateral and vertical extent of contamination. Treatability studies required.	High	Retained because of potential ability to immobilize radionuclides and destroy organics.
	Thermal Desorption	Soil is heated in situ by radio-frequency electrodes or other means of heating to temperatures in the 80 to 400°C (200 to 750°F) range thereby causing desorption of volatile and semi-volatile organics from the soil.	Effective for removal of volatile and semi-volatile organics from soil. Ineffective for most inorganics and radionuclides. Contaminants are transferred from soil to air.	Implementable for shallow organics contamination. Not implementable for radionuclides and inorganics. Emission treatment and treatability studies required.	Medium	Rejected because of limited applicability.
In Situ Chemical Treatment	Chemical Reduction	Reducing agent is added to the soil to change oxidation state of target contaminant.	Effective for certain inorganics, e.g., chromium. Ineffective for organics. Limited applicability.	Difficult to implement in situ because of distribution requirements for reducing agent.	Low	Rejected because of limited applicability and implementation problems.

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Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
In Situ Physical Treatment	Soil Flushing	Solutions are injected through injection system to flush and extract contaminants.	Potentially effective for all contaminants. Effectiveness depends on chemical additives and hydrology. Flushing solutions posing environmental threat likely to be needed. Difficult recovery of flushing solution.	Difficult to implement. Not implementable for complex solvents of contaminants. Flushing solution difficult to recover. Chemical additives likely to pose environmental threat.	Medium	Rejected because of implementation problem.
	Vapor Extraction	Vacuum is applied by use of wells inducing a pressure gradient that causes volatiles to flow through air spaces between soil particles to the extraction wells.	Effective for volatile organics. Ineffective for inorganics and radionuclides. Emission treatment required.	Easily implementable for proper site conditions. Requires emission treatment for organics and capture system for radionuclides and volatilized metals.	Medium	Retained for potential application to volatile organics.
	Grouting	Involves drilling and injection of grout to form barrier or injection to fill voids.	Effective in limiting migration of leachate, but difficult to maintain barrier integrity. Potentially effective in filling voids.	Implementable as barrier and for filling voids. Implementability depends on site conditions.	Medium	Retained because of ability to limit contaminant migration and potential use for filling void spaces.

Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
	Fixation/ Solidification/ Stabilization	Solidification agent is applied to soil by mixing in place.	Effective for inorganics and radionuclides. Potentially effective for organics. Effectiveness depends on site conditions and additives used.	Implementable. Treatability studies required to select proper additives. Thorough characterization of subsurface conditions and continuous monitoring required.	Medium	Retained because of potential effectiveness and implementability.
In Situ Biological Treatment	Aerobic	Microbial growth utilizing organic contaminants as substrate is enhanced by injection of or spraying with oxygen source and nutrients.	Effective for most organics at proper conditions. Ineffective for inorganics and radionuclides.	Difficult to implement. Treatability studies and thorough subsurface characterization required.	Low	Rejected because of limited applicability and difficult implementation.
	Anaerobic	Microbial growth utilizing organic contaminants as substrate is enhanced by addition of nutrients.	Effective for volatile and complex organics. Not effective for inorganics and radionuclides.	Difficult to implement. Anoxic ground conditions required. Treatability studies and thorough subsurface characterization necessary.	Low	Rejected because of limited applicability and difficult implementation.
BIOTA TECHNOLOGIES:						
No Action	No Action	Do nothing to clean-up the contamination or reduce the exposure pathways.	Not effective in reducing the contamination or exposure pathways.	Easily implemented, but might not be acceptable to regulatory agencies, local governments, and the public.	Low	Retained as a "baseline"case.
Land Use Restrictions	Deed Restrictions	Identify contaminated areas and prohibit certain land uses such as agriculture.	Effective if implementation is continued. Does not reduce contamination.	Administrative decision is easily implemented.	Low	Retained to be used in conjunction with other process options.

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Table 7-3. Screening of Process Options.

Technology Type	Process Option	Description	Effectiveness	Implementability	Relative Cost	Conclusions
Access Controls	Signs/Fences	Install a fence and signs around areas of contamination to keep people out and the biota in.	Effective if fencing is maintained.	Easily implemented. Restrictions on future land use.	Low	Retained to be used in conjunction with other process options.
	Entry Control	Install a guard/monitoring system to eliminate people from coming in contact with the contamination.	Very effective in keeping people out of the contaminated areas.	Equipment and personnel are easily implemented and readily available.	Low	Retained to be used in conjunction with other process options.
Monitoring	Monitoring	Take biota samples and test them for contaminants.	Does not reduce the contamination, but is very effective tracking the contaminant levels.	Easily implemented. Standard Technology.	Low	Retained to be used in conjunction with other process options.
Capping	Multimedia	Fine soils over synthetic membrane or other layers and covered with soil; applied over contaminated areas.	Effective in reducing the uptake of contaminants, not likely to crack. Likely to hold up over time.	Easily implemented. Restrictions on future land use will also be necessary.	Medium	Retained because of potential effectiveness and implementability.
Excavation	Standard Excavating Equipment	Remove affected biota and load it onto process system equipment.	Effective in moving and transporting biota to vehicles for transportation.	Equipment and workers are readily available.	Low	Retained because of potential effectiveness and implementability.
Disposal	Landfill Disposal	Place contaminated biota in an existing landfill.	Does not reduce the biota contamination but moves all of the contamination to a more secure place.	Easily implemented if sufficient storage is available in an offsite landfill area.	Medium	Retained because of potential effectiveness and implementability.

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
Tanks and Vaults						
241-B-361 Settling Tank	--	--	X	--	--	--
Cribs and Drains						
216-B-7A Crib	X	X	X	X	X	--
216-B-7B Crib	X	X	X	X	X	--
216-B-8TF Crib/Tile Field	X	X	X	X	X	--
216-B-9TF Crib/Tile Field	X	X	X	X	X	--
216-B-10A Crib	X	X	X	X	X	--
216-B-10B Crib	X	X	X	X	X	--
216-B-12 Crib	X	X	X	X	X	X
216-B-14 Crib	X	X	X	X	X	X
216-B-15 Crib	X	X	X	X	X	X
216-B-16 Crib	X	X	X	X	X	X
216-B-17 Crib	X	X	X	X	X	X
216-B-18 Crib	X	X	X	X	X	X
216-B-19 Crib	X	X	X	X	X	X
216-B-43 Crib	X	X	X	X	X	X
216-B-44 Crib	X	X	X	X	X	X
216-B-45 Crib	X	X	X	X	X	X
216-B-46 Crib	X	X	X	X	X	X
216-B-47 Crib	X	X	X	X	X	X

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Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
216-B-48 Crib	X	X	X	X	X	X
216-B-49 Crib	X	X	X	X	X	X
216-B-50 Crib	X	X	X	X	X	X
216-B-55 Crib[a]	X	X	X	X	X	--
216-B-56 Crib	X	X	X	X	X	--
216-B-57 Crib	X	X	X	X	X	--
216-B-60 Crib	X	X	X	X	X	--
216-B-61 Crib[b]	--	--	--	--	--	--
216-B-62 Crib[a]	X	X	X	X	X	--
CTF North of 2703-E	X	X	X	X	X	--
216-B-13 French Drain	X	X	X	X	X	--
216-B-51 French Drain	X	X	X	X	X	--
Reverse Wells						
216-B-4 Reverse Well	X	X	--	--	--	--
216-B-5 Reverse Well	X	X	--	--	--	--
216-B-6 Reverse Well	X	X	--	--	--	--
216-B-11A Reverse Well	X	X	--	--	--	--
216-B-11B Reverse Well	X	X	--	--	--	--
Ponds, Ditches, and Trenches						
216-B-3 Pond[a]	X	X	X	--	--	--
216-B-3A Pond[a]	X	X	X	--	--	--

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
216-B-3B Pond[a/]	X	X	X	--	--	--
216-B-3C Pond[a/]	X	X	X	--	--	--
216-A-25 Pond	X	X	X	--	--	--
216-E-28 Contingency Pond[a/]				--	--	--
216-N-8 Pond	X	X	X	--	X	X
216-B-2-1 Ditch	X	X	X	X	X	--
216-B-2-2 Ditch	X	X	X	X	X	--
216-B-2-3 Ditch	X	X	X	X	X	--
216-B-3-1 Ditch	X	X	X	X	X	X
216-B-3-2 Ditch	X	X	X	X	X	X
216-B-3-3 Ditch[a/]	X	X	X	X	X	X
216-B-20 Trench	X	X	X	X	X	X
216-B-21 Trench	X	X	X	X	X	X
216-B-22 Trench	X	X	X	X	X	X
216-B-23 Trench	X	X	X	X	X	X
216-B-24 Trench	X	X	X	X	X	X
216-B-25 Trench	X	X	X	X	X	X
216-B-26 Trench	X	X	X	X	X	X
216-B-27 Trench	X	X	X	X	X	X
216-B-28 Trench	X	X	X	X	X	X
216-B-29 Trench	X	X	X	X	X	X

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Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
216-B-30 Trench	X	X	X	X	X	X
216-B-31 Trench	X	X	X	X	X	X
216-B-32 Trench	X	X	X	X	X	X
216-B-33 Trench	X	X	X	X	X	X
216-B-34 Trench	X	X	X	X	X	X
216-B-35 Trench	X	X	X	X	X	--
216-B-36 Trench	X	X	X	X	X	--
216-B-37 Trench	X	X	X	X	X	--
216-B-38 Trench	X	X	X	X	X	--
216-B-39 Trench	X	X	X	X	X	--
216-B-40 Trench	X	X	X	X	X	--
216-B-41 Trench	X	X	X	X	X	--
216-B-42 Trench	X	X	X	X	X	--
216-B-52 Trench	X	X	X	X	X	X
216-B-53A Trench	X	X	X	X	X	--
216-B-53B Trench	X	X	X	X	X	--
216-B-54 Trench	X	X	X	X	X	--
216-B-58 Trench	X	X	X	X	X	--
216-B-63 Trench[a]	X	X	X	X	X	--

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
Septic Tanks and Associated Drain Fields						
2607-E1 Septic Tank[a/ b/]	X	X	X	--	--	--
2607-E2 Septic Tank[a/ b/]	X	X	X	--	--	--
2607-E3 Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-E4 Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-E7B Septic Tank[a/ b/]	X	X	X	--	--	--
2607-E8 Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-E9 Septic Tank[a/ b/]	X	X	X	--	--	--
2607-E11 Septic Tank[a/ b/]	X	X	X	--	--	--
2607-EB Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-EH Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-EK Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-EM Septic Tank[a/ b/]	X	X	X	--	--	--
2607-EN Septic Tank[a/ b/]	X	X	X	--	--	--
2607-EO Septic Tank[a/ b/]	X	X	X	--	--	--
2607-EP Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-EQ Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--
2607-ER Septic Tank[a/ b/]	X	X	X	--	--	--
2607-GF Septic Tank/Drain Field[a/ b/]	X	X	X	--	--	--

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Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
Retention Basins						
207-B Retention Basin[a]	X	X	X	X	X	--
216-B-59B Retention Basin[a]	X	X	X	X	X	--
216-B-64 Retention Basin	X	X	X	X	X	--
Burial Sites						
218-E-2 Burial Ground	X	X	X	--	--	--
218-E-2A Burial Ground[b]	--	--	--	--	--	--
218-E-3 Burial Ground[b]	--	--	--	--	--	--
218-E-4 Burial Ground	X	X	X	--	--	--
218-E-5 Burial Ground	X	X	X	--	--	--
218-E-5A Burial Ground	X	X	X	--	--	--
218-E-6 Burial Ground[b]	--	--	--	--	--	--
218-E-7 Burial Ground	X	X	X	--	--	--
218-E-9 Burial Ground	X	X	X	--	--	--
200 Area Construction Pit[b]	--	--	--	--	--	--
Unplanned Releases						
UN-200-E-7	X	X	X	X	--	--
UN-200-E-9	X	X	X	X	--	--
UN-200-E-14[c]	--	--	--	--	--	--
UN-200-E-41[d]	--	--	--	--	--	--
UN-200-E-43	X	--	X	--	--	--

Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
UN-200-E-44	X	X	X	X	--	--
UN-200-E-52	X	--	X	--	--	--
UN-200-E-54	X	--	X	--	--	--
UN-200-E-55[e/]	--	--	--	--	--	--
UN-200-E-61[e/]	--	--	--	--	--	--
UN-200-E-63	X	--	X	--	--	--
UN-200-E-64	X	--	X	--	--	--
UN-200-E-69	--	--	X	--	--	--
UN-200-E-79	X	X	X	X	--	--
UN-200-E-80	X	X	X	X	X	--
UN-200-E-83	--	--	X	--	--	--
UN-200-E-87	X	X	X	X		
UN-200-E-90	--	--	X	--	--	--
UN-200-E-92[e/]	--	--	--	--	--	--
UN-200-E-95	X	--	X	--	--	--
UN-200-E-101	X	--	X	--	--	--
UN-200-E-103	X	X	X	X	--	--
UN-200-E-112[e/]	--	--	--	--	--	--
UN-200-E-140	X	X	X	X	--	X
UPR-200-E-4	X	X	X	--	--	--
UPR-200-E-32	X	X	X	X	--	--

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Table 7-4. Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites.

Waste Management Unit or Unplanned Release	Alt. 1 Multimedia Cover With or Without Vertical Barriers	Alt. 2 In Situ Grouting	Alt. 3 Excavation and Treatment	Alt. 4 In Situ Vitrification	Alt. 5 Excavation, Treatment, and Geologic Disp of TRU Soil	Alt. 6 In Situ Soil Vapor Extraction for VOC's
UPR-200-E-34	X	X	X	--	--	--
UPR-200-E-51	X	X	X	--	--	--
UPR-200-E-84	X	X	X	X	--	--
UPR-200-E-138	X	X	X	X	--	--

[a]Active unit.
[b]No record of hazardous and/or radioactive use; no applicable alternative was identified.
[c]Records indicate that all environment contamination was been removed and disposed; no applicable alternative was identified.
[d]Non-soil contamination occurred; an alternative other than listed will be employed.

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8.0 DATA QUALITY OBJECTIVES

As described in Section 1.2.2, this aggregate area management study (AAMS) process, as part of the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a), is designed to focus the remedial investigation (RI)/feasibility study (FS) process toward comprehensive cleanup or closure of all contaminated areas at the earliest possible date and in the most effective manner. The fundamental principle of the *Hanford Site Past-Practice Strategy* is a "bias for action" which emphasizes the maximum use of existing data to expedite the RI/FS process as well as allow decisions about work that can be done at the site early in the process, such as expedited response actions (ERAs), interim remedial measures (IRMs), limited field investigations (LFIs), and focused feasibility studies (FFS). The data have already been described in previous sections (2.0, 3.0, and 4.0). Remediation alternatives are described in Section 7.0. However, data, whether existing or newly acquired, can only be used for these purposes if it meets the requirements of data quality as defined by the data quality objective (DQO) process developed by the U.S. Environmental Protection Agency (EPA) for use at Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sites (EPA 1987). This section implements the DQO process for this, the scoping phase in the B Plant Aggregate Area.

In the guidance document for DQO development (EPA 1987), the process is described as involving three stages which have been used in the organization of the following sections:

- Stage 1--Identify decision types (Section 8.1)
- Stage 2--Identify data uses and needs (Section 8.2)
- Stage 3--Design a data collection program (Section 8.3).

8.1 DECISION TYPES (STAGE 1 OF THE DQO PROCESS)

Stage 1 of the DQO process is undertaken to identify:

- The decision makers (thus data users) relying on the data to be developed (Section 8.1.1)
- The data available to make these decisions (Section 8.1.2)
- The quality of these available data (Section 8.1.3)
- The conceptual model into which these data must be incorporated (Section 8.1.4)
- The objectives and decisions that must evolve from the data (Section 8.1.5).

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These issues serve to define, from various sides, the types of decisions that will be made on the basis of the B Plant AAMS.

8.1.1 Data Users

The data users for the B Plant AAMS and subsequent investigations such as LFIs, RI/FSs, and Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI) are the following:

- The decision makers for policies and strategies on remedial action at the Hanford Site. These are the signatories of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) including the U.S. Department of Energy (DOE), EPA, and the Washington State Department of Ecology (Ecology).

  Nominally these responsibilities are assigned to the managers of these agencies (the Director of Ecology, the Administrator of EPA, and the Secretary of Energy for DOE), although the political process requires that more local policy-makers (such as the Regional Administrator of EPA and the head of the U.S. Department of Energy, Richland Field Office [DOE/RL]) and, to a great extent, technical and policy-assessment staff of these agencies will have a major say in the decisions to be evolved through this process.

- Unit managers of Westinghouse Hanford and potentially other Hanford Site contractors who will be tasked with implementing remedial activities at the B Plant Aggregate Area. Staff of these contractors will have to make the lower level (tactical) decisions about appropriate scheduling of activities and allocation of resources (funding, personnel, and equipment) to accomplish the recommendations of the AAMS.

- Concerned members of the wide community involved with the Hanford Site. These may include:

  - Other state (Washington, Oregon, and other states) and federal agencies
  - Affected Indian tribes
  - Special interest groups
  - The general public.

These groups will be involved in the decision process through the implementation of the Community Relations Plan (CRP) (Ecology et al. 1989), and will apply their concerns through the "primary" data users, the signatories of the Tri-Party Agreement.

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The needs of these users will have a pivotal role in issues of data quality. Some of this influence is already imposed by the guidance of the Tri-Party Agreement.

8.1.2 Available Information

The *Hanford Site Past-Practice Strategy* specifies a "bias for action" that intends to make the maximal use of existing data on an initial basis for decisions about remediation. This emphasis can only be implemented if the existing data are adequate for the purpose.

Available data for the B Plant Aggregate Area are presented in Sections 2.0, 3.0, and 4.0 and in Topical Reports prepared for this study. As described in Section 1.2.2, these data should address several issues:

- Issue 1: Facility and process descriptions and operational histories for waste sources (Sections 2.2, 2.3, and 2.4)
- Issue 2: Waste disposal records defining dates of disposal, waste types and waste quantities (Section 2.4)
- Issue 3: Sampling events of waste effluents and affected media (Section 4.1)
- Issue 4: Site conditions including the site physiography, topography, geology, hydrology, meteorology, ecology, demography, and archaeology (Section 3.0)
- Issue 5: Environmental monitoring data for affected media including air, surface water, sediment, soil, groundwater and biota (Section 4.1, except that groundwater data is presented in the separate 200 East Groundwater Aggregate Area Management Study Report, AAMSR).

A major requirement for adequate characterization of many of these issues is identification of chemical and radiological constituents associated with the sites, with a view to determine the contaminants of concern there and the extent of their distribution in the soils beneath each of the waste management units in the B Plant Aggregate Area. There was found to be a limited amount of data in this regard. The data reported for the various waste management units in the B Plant Aggregate Area (see Section 4.1 and Tables 4-1, 4-2, and 4-3) have been found to describe:

- Inventory--generally estimated from chemical process data and emphasizing radionuclides (Issues 1 and 2). These data are especially limited regarding reconstruction of early operations activities, and even the most recent data are based on very few sampling events, possibly non-representative of the long-term activity of the waste management units.

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- Surface radiological surveys--undifferentiated radiation levels, without identification of radionuclides present, presented in terms of extent of radiation and maximal levels (Issue 5). These historical data are extremely difficult to relate to the present-day distribution and nature of the radioactive contamination they purport to measure because of the lack of radionuclide identification and the likelihood that changes have occurred (at least to surface soils) since the time of the surveys.

- External radiation monitoring--similar to the surface radiological surveys but provide even less information because with a fixed-point thermoluminescent dosimeter (TLD) no spatial distribution is provided. In addition, data are also available for some TLDs placed at points not associated with specific waste management units. The TLD data do not differentiate radionuclide species.

- Waste, soil, or sediment sampling: these include sediment sampling in basins, ponds and ditches (Ponds 216-B-3, 216-B-3A, 216-B-3C, 216-N-8, and 2101-M and Ditch 216-B-3-3). The quality of these data will be addressed based on the criteria presented in Section 8.3. Changes at the release sites since the time of the sampling may make the data inapplicable to determination of the present-day distribution of contamination (Issue 5). Such changes might include cleanup activities which could alter the location of waste or cause soil particle fractionation, chemical leaching of contaminants, or contaminant reactions in the environment which could alter the nature of the contamination.

  There are also some sets of data of soil sampling and analysis that were conducted for several years on a grid pattern, so cannot be assigned to a particular waste management unit. These data would indicate impacts of historical operations at the Hanford Site, and in the vicinity of the grid points, but the impacts cannot be ascribed to a particular unit and so do not assist in decision making on a unit-by-unit basis.

- Biota sampling--in the 216-B-3, 216-B-3C, and 216-N-8 Ponds as well as the 216-B-3-3 Ditch and 216-B-63 Trench. These data could assist assessment of bio-uptake and bio-transfer pathways from this unit (Issue 5).

- Borehole geophysics--these data, for a number of units which discharged to the soil column (cribs, french drains, reverse wells, ponds, trenches, and ditches) and the single-shell tanks, were designed to detect the presence of radionuclides (by their gamma-ray radiation) in the subsurface and to indicate whether these materials are migrating vertically (Issue 5). A list of these surveys that have been conducted in the B Plant Aggregate Area is included in the *B Plant Geologic and Geophysics Data Package for the 200 Aggregate Area Management Study* prepared for this study (Chamness et al. 1992). These data are limited by the method's inability to identify specific radionuclides and, thus, to differentiate

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naturally occurring radioactive materials from possible releases. Variations in quality control further limit their comparability and possible use for estimation of concentrations.

Besides these historic data, additional borehole geophysical data will be available through the Radionuclide Logging System (RLS), being carried out at the time of this report and in support of the AAMS process. Like the previous (gross gamma) logging conducted at waste management units in the B Plant Aggregate Area, the RLS depends on gamma rays and so cannot detect some species of radionuclides. However, unlike the gross gamma surveys, the RLS is designed to identify individual radionuclide species through their characteristic gamma ray photon energy levels. It should thus be able to differentiate naturally-occurring radionuclides from those resulting from releases. It will also (like gross gamma logging) determine the vertical extent of the presence of the radionuclides. It will be conducted in about ten wells located in the B Plant Aggregate Area.

Note: A remedial investigation work plan for the 200-BP-1 Operable Unit is complete. Borehole geophysics data collection has begun but findings have not yet been published.

Based on the above summary, the data are considered to be of varying quality. These data have not been validated, a process generally required for risk assessment or final Record of Decision (ROD) purposes. Most of the data are based on field methods, which are generally applicable only for screening purposes and can be used to focus future activities (e.g., sampling and analysis plans).

These data are considered to be deficient in one or more of the following ways:

- The methods are unable to differentiate the various radionuclides that may have been present at the time of the survey.

- The release locations have been changed (especially by remediation activities) since the time of the survey or sampling, and it is likely that contaminant distributions have changed.

- The survey or sampling has been done at a location different from the waste management unit or release, and so would not be representative of the concentrations in the zone of release. This deficiency applies to horizontal and vertical differences in location: the borehole geophysics data may be at the correct depths, but the distance of the borehole from the waste management unit can severely attenuate the gamma-radiation that is used to indicate contamination; surface sampling and surveys similarly cannot establish subsurface contaminant concentrations or even disprove the possible presence of some radioactive constituents (particularly alpha-emitting transuranic, TRU, elements).

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- There has been virtually no measurement of non-radioactive hazardous constituents in the sampling and analysis of media in the B Plant Aggregate Area. One exception to this is the remedial investigation activities recently begun in the 200-BP-1 Operable Unit.

As a result of these deficiencies, the data are not considered to be usable for input to a quantitative risk assessment or for comparison to applicable or relevant and appropriate requirements (ARARs).

In addition to these data, there are also data regarding site conditions (Issue 2) which do not directly relate to the presence of environmental releases but which will assist in the assessment of its potential migration if present. These data are generally summarized in the topical reports prepared for this AAMSR. Those include the following:

- *B Plant Geologic and Geophysics Data Package for the 200 AAMS* (Chamness et al. 1992), contains tables of wells in which borehole geophysics have been conducted, the types and dates of the tests, and a reference to indicate the physical location of the logs. The package also includes a list of the data available from the drilling of each well located in the B Plant Aggregate Area, such as the logs available (driller's or geologist's; indication of their physical location; grain size, carbonate, moisture, and chemical/radiological analyses; lists of depths, dates, elevation, and coordinates for all wells; and copies of the boring logs and well completion (as-built) summaries for a selection of wells in the B Plant Aggregate Area.

- *Geologic Setting of the 200 East Area: An Update* (Lindsey et al. 1992) includes descriptions of regional stratigraphy, structural geology, and local (200 East Area) stratigraphy, with revised structure and isopach maps of the various unconsolidated strata found beneath the 200 East Area.

The data in these topical reports was obtained for the AAMS study based on a review of driller's and geologist's logs for wells drilled in the B Plant Aggregate Area. A selection of 15 of those logs was made which best represented the geologic structures below the aggregate area and are presented in Chamness et al. (1992). Lindsey et al. (1992) then used these wells (and others from other aggregate areas in the 200 East Area) to develop cross-sections, structure maps, and isopach maps, which were in turn adapted to the specific needs of this report and presented in Section 3. Only existing logs were used; no new wells were drilled as part of this study. The quality of the data varies among the logs according to the time they were drilled and the scope of the study they were supporting, but the data are sufficient for the general geological characterization of the site. Issues involving the potential of contaminant migration at specific sites, based on stratigraphic concerns, may not be fully addressed through any existing borings or wells because appropriate borings may not be located in close proximity; these issues should be addressed during subsequent field investigations at locations where contaminant migration is considered likely.

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Another class of data which was gathered in the general area of the 200 West Area, and thus potentially appropriate to the B Plant Aggregate Area, is the result of a set of studies which were performed for the Basalt Waste Isolation Project (BWIP) (DOE 1988), in the attempt to site a high-level radioactive waste geologic repository in the basalt beneath and in the vicinity of the Hanford Site. The proposed Reference Repository Site included the 200 West Area and some distance beyond it, mainly to the west. For this siting project, a number of geologic techniques were used, and some of the data generated by the drilling program has been used for the stratigraphic interpretation presented in Section 3.4 (all the wells denoted with an alias "BH-.." were drilled for the BWIP project) and a number of the figures used in this and other sections of Section 3.0. The program also included a number of geophysical studies, using the following techniques:

- Gravity
- Magnetics
- Seismic reflection
- Seismic refraction
- Magnetotellurics.

These data, as presented in Section 1.3.2.2.3 of DOE (1988), were reviewed for their relevance to the present B Plant (source area) Aggregate Area Management Study. The limitations of these studies include the following aspects:

- Most of the studies covered a regional scale with lines or coverages that may have crossed the B Plant Aggregate Area (or even the 200 East Area) only in passing. Some of the surveys (e.g., the grid of gravity stations) specifically avoided the 200 East Area ("due to restricted access").

- Many of the techniques are more sensitive to the basalt than to the suprabasalt sediments of specific interest in the AAMS program, and even less sensitive to the features which are closer to the surface, as is applicable to the source area AAMS. Basalt is by nature much denser than the unconsolidated sediments (and thus also has a characteristic seismic signature) and has more consistent magnetic properties. In addition, the analysis of the data emphasized the basalt features which were apparent in the data. All this is appropriate to a study of the basalt, but does not make the studies applicable to the present study.

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- Even when features potentially caused by shallow sediments are identified, they are interpreted either very generally (e.g., "erosional features in the Hanford and (or) Ringold Formations") or as complications (e.g., "shallow sediment velocity variations causing stacking velocity correction errors"). There are only a very few features (and none in the B Plant Aggregate Area) which are interpreted as descriptive of the structure of the suprabasalt sediments.

- Lastly, some of the anomalies which are interpreted in terms of a sedimentary stratigraphic cause (e.g., "erosion of Middle Ringold") do not bear up under the more detailed stratigraphic interpretation carried out under the Topical Reports for the AAMS (Lindsey et al. 1992, Chamness et al. 1992).

However, these data will be reviewed in more detail for the purposes of the 200 East Groundwater AAMSR, since deeper features (including in the basalt) are of more concern for that study.

Other data presented in Sections 2.0, 3.0, and 4.0 are broad-scale rather than site-specific, as are the contaminant concentrations. These include topography, meteorology, surface hydrology, environmental resources, human resources, and contaminant characteristics. These data are generally of acceptable quality for the purposes of planning remedial actions in the B Plant Aggregate Area.

8.1.3 Evaluation of Available Data

The EPA (1987) has specified indicators of data quality, the five "PARCC" parameters (precision, accuracy, representativeness, completeness, and comparability), which can be used to evaluate the existing data and to specify requirements for future data collection.

- Precision--the reproducibility of the data.

- Accuracy--the lack of a bias in the data.

  Much of the existing data are of limited precision and accuracy due to the analytical methods which have been used historically. The gross gamma borehole geophysical logging in particular is limited by methodological problems although reproducibility has been generally observed in the data. Conditions that have contributed to lack of precision and/or accuracy include: improvements in analytical instrumentation and methodology making older data incompatible; effects of background levels (particularly regarding radioactivity and inorganics); and lack of quality control on data acquisition.

  The limitations in precision and accuracy in existing data are mainly due to the progress of analytical methodologies and quality assurance (QA) procedures since the time they were collected. The *Hanford Site Past-Practice Strategy*

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(DOE/RL 1992a) recommends that existing data be used to the maximum extent possible, at two levels: first to formulate the conceptual model, conduct a qualitative risk assessment, and prepare work plans, but also as an initial data set which can be the basis for a fully-qualified data set through a process of review, evaluation, and confirmation.

- Representativeness--the degree to which the appropriate environmental parameters or media have been sampled.

  This parameter highlights a shortcoming of most of the historical data. Limitations include the observation only of gross gamma radiation rather than differentiating it by radionuclide (e.g., through spectral surveying methods as are being used by the RLS program), the analysis of samples only for radionuclides rather than for chemicals and radionuclides, and the failure to sample (especially in the subsurface) for the full potential extent of contaminant migration.

  The data are incomplete primarily because of the lack of subsurface sampling for extent of contamination. Subsurface investigation activities have recently begun with the commencement of remedial investigation work in the 200-BP-1 Operable Unit but data has not yet been published. The lack of these data is also caused by concerns to limit the potential exposure to radioactivity of workers who would have to drill in contaminated areas and the possible release or spread of contamination through these intrusive procedures. The result of this data gap is that none of the sites can be demonstrated to have contamination either above or below levels of regulatory concern, and a full quantitative risk assessment cannot be conducted.

  In addition, in many cases it has been necessary to use general data (i.e., from elsewhere in the 200 East Area or even from the vicinity of the 200 Areas) rather than data specific to a particular waste management unit. For most purposes of characterization for transport mechanisms, this procedure is acceptable given the screening level of the present study. For example, while it is appropriate to use a limited number of boring logs to characterize the stratigraphy in the Aggregate Area (Chamness et al. 1992, Lindsey et al. 1992), the later, waste management unit specific, field sampling plans will require detailed consideration of more of the logs of boreholes drilled in the immediate vicinity, whatever their quality, as a starting point to conceptually model the geology specifically beneath that unit.

- Completeness--the fraction of samples which are considered "valid."

  None of the data that have been previously gathered in the B Plant Aggregate Area has been "validated" in the EPA Contract Laboratory Program (CLP) sense with the exception of the remedial investigation work recently begun in the 200-BP-1 Operable Unit), although varying levels of quality control have been applied to the sampling and analysis procedures. The data are generally adequate

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for characterization purposes but may not be suitable for use in a formal risk assessment. The best indication of the validity of the data is the reproducibility of the results, at least as far as precision is concerned (accuracy requires proof of a lack of bias).

- Comparability -- the confidence that can be placed in the comparison to two data sets (e.g., separate samplings).

  With varying levels of quality control and varying procedures for sample acquisition and analysis, this parameter is also generally poorly met. Much of this is due to the more recent development of QA procedures.

While these limitations cannot in most cases be quantified (and some such as representativeness are specifically only qualitative), most of the data gathered in the B Plant Aggregate Area can be cited as failing one or more of the PARCC parameters. These data should, however, be used to the maximum extent in the development of work plans for site field investigations, prioritization of the various units, and to determine, to the extent possible, where contamination is or is not present.

In addition to these site-specific data, there are also a limited number of non site-specific sampling events that are being developed to determine background levels of naturally occurring constituents (Hoover and LeGore 1991). These data can be used to differentiate the effect of the environmental releases from naturally occurring background levels.

8.1.4 Conceptual Model

The initial conceptual model of the waste management units in the B Plant Aggregate Area is presented and described in Section 4.2 (Figure 4-3). The model is based on best estimates of where contaminants were discharged and their potential for migration from release points. The conceptual model is designed to be conservatively inclusive in the face of a lack of data. This means that a migration pathway was included if there is any possibility of contamination travelling on it, historically or at present. In most cases there may not be a significant flux of such contamination migration for many of the pathways shown on the figure.

The pathways from the cribs, reverse wells, trenches, ditches, and ponds leading to adsorption of transuranic elements on vadose-zone soils are possibly the most significant. Specifically, the cribs of the 200-BP-1 Operable Unit (the "BY cribs") and the 216-B-5 Reverse Well are of particular concern. The cribs exceeded their specific retention capacity by a large amount and the reverse well discharged directly to groundwater. These and other pathways can be traced on the conceptual model. All are possible; only a few are likely because of the conservatism inherent in including all conceivable pathways. More importantly, even if a pathway carries significant levels of a contaminant, it still may not have carried contamination to the ultimate receptors, human or ecological. This can only be

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assessed by sampling at the exposure point on this pathway, or sampling at some other point and extrapolation to the exposure point, to indicate the dosage to the receptors.

There are significant uncertainties in the contaminant levels in the contaminant migration pathways shown on the conceptual model, yet almost none of these pathways has been sampled (an exception is the 200-BP-1 Operable Unit) to determine whether any contamination still exists in any of the locations implicated from the conceptual model, and if so which constituents, how much, and to what extent.

8.1.5 Aggregate Area Management Study Objectives and Decisions

The specific objectives of the B Plant AAMS are listed in Section 1.3. They include the following:

- Assemble site data (as described in Section 8.1.2)
- Describe site conditions (see Section 3.0)
- Conduct limited new site characterization work (see separate topical reports)
- Develop a preliminary site conceptual model (see Section 8.1.4)
- Identify contaminants of concern and their distribution (Section 4.0)
- Identify preliminary applicable, or relevant and appropriate, regulations (ARARs, Section 6.0)
- Define preliminary remedial action objectives and screen potential remedial technologies to prepare preliminary remedial action alternatives (Section 7.0) and provide recommendations for FFS (Section 9.4.1) and treatability studies (Section 9.5).
- Recommend ERA, IRM, LFI, or other actions (Section 9.0)
- Redefine and prioritize, as data allow, operable unit, their boundaries, and work plan activities with emphasis on supporting early cleanup actions and records of decision (Sections 8.3 and 9.0).
- Integrate RCRA TSD closure activities with past-practice activities (Section 9.3.4).

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The decisions that will have to be made on the basis of this AAMS can best be described according to the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) flow chart (Figure 1-2 in Section 1.0) that must be conducted on a site-by-site basis. Decisions are shown on the flow chart as diamond-shaped boxes, and include the following:

- Is an ERA justified?
- Is less than six months response needed (is the ERA time critical)?
- Are data sufficient to formulate the conceptual model and perform a qualitative risk assessment?
- Is an IRM justified?
- Can the remedy be selected?
- Can additional required data be obtained by LFI?
- Are data (from field investigations) sufficient to perform risk assessment?
- Can an Operable Unit/Aggregate Area Record of Decision (ROD) be issued?

(The last two questions will only be asked after additional data are obtained through field investigations, and so are DQO issues only in assessing scoping for those investigations.)

Most of these decisions are actually a complicated mixture of many smaller questions, and will be addressed in Section 9.0 in a more detailed flowchart for assessing the need for remediation or investigation.

Similarly, the tasks that will need to be performed after the AAMS that drive the data needs for the study are found in the rectangular boxes on the flow chart. These include the following:

- ERA (if justified)
- Definition of threshold contamination levels, and formulation of conceptual model, performance of qualitative risk assessment and FS screening (IRM preliminaries)
- FFS for IRM selection
- Determination of minimum data requirements for IRM path

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- Negotiation of Scope of Work, relative priority, and incorporation into integrated schedule, performance of LFI

- Determination of minimum data needs for risk assessment and final Remedy Selection (preparation of RI/FS pathway).

These stages of the investigation must be considered in assessing data needs (Section 8.2.2).

8.2 DATA USES AND NEEDS (STAGE 2 OF THE DQO PROCESS)

Stage 2 of the DQO development process (EPA 1987) defines data uses and specifies the types of data needed to meet the project objectives. These data uses and needs are based on the Stage 1 results, but must be more specific. The elements of this stage of the DQO process include:

- Identifying data uses (Section 8.2.1)

- Identifying data types (Section 8.2.2.1)

- Identifying data quality needs (Section 8.2.2.2)

- Identifying data quantity needs (Section 8.2.2.3)

- Evaluating sampling/analysis options (Section 8.2.2.4)

- Reviewing data quality parameters (Section 8.2.2.5)

- Summarizing data gaps (Section 8.2.3).

Stage 2 is developed on the basis of the conceptual model and the project objectives. These following sections discuss these issues in greater detail.

8.2.1 Data Uses

For the purposes of the remediation in the B Plant Aggregate Area, most data uses fall into one or more of four general categories:

- Site characterization

- Public health evaluation and human health and ecological risk assessments

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- Evaluation of remedial action alternatives
- Worker health and safety.

Site characterization refers to a process that includes determination and evaluation of the physical and chemical properties of any wastes and contaminated media present at a site, and an evaluation of the nature and extent of contamination. This process normally involves the collection of basic geologic, hydrologic, and meteorologic data but more importantly for the B Plant Aggregate Area waste management units, data on specific contaminants and sources that can be incorporated into the conceptual model to indicate the relative significance of the various pathways. Site characterization is not an end in itself, as stressed in the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a), but rather the data must work toward the ultimate objectives of assessing the need for remediation (according to risk assessment methods, either qualitative or quantitative or compliance with ARARs) and providing appropriate means of remediation (through an FFS, FS, or CMS). The understanding of the site characterization, based on existing data, is presented in Sections 2.0, 3.0, and 4.0, and summarized in the conceptual model (Section 4.2).

Data required to conduct a public health evaluation, and human health and ecological risk assessments at the sites in the B Plant Aggregate Area include the following: input parameters for various performance assessment models (e.g., the Multimedia Environmental Pollutant Assessment System); site characteristics; and contaminant data required to evaluate the threat to public and environmental health and welfare through exposure to the various media. These needs usually overlap with site characterization needs. An extensive discussion of risk assessment data uses and needs is presented in the *Risk Assessment Guidance for Superfund* (EPA 1989a, c). The EPA Region 10 has also developed its preferred methodology for these risk assessment activities (EPA 1989a, 1991a). The ecological and human health risk assessments will follow the guidance outlined in the approved M-29-03 milestone document, *Hanford Site Baseline Risk Assessment Methodology*. The data requirements for an ecological risk assessment include (1) identification of critical species, (2) identification of habitat within and surrounding the Hanford Site, (3) feeding relationships among species of concern, and (4) contaminant concentrations in environmental media and species of interest. The main deficiency in the data available for waste management units in the B Plant Aggregate Area is that a quantitative assessment of contaminant concentrations for the purposes of risk assessment cannot be performed. The present understanding of site risks is presented in the selection of constituents of concern (Section 4.0). The data needs for quantitative risk assessments will be considered in developing site-specific sampling and analysis plans according to the *Hanford Site Past-Practice Strategy*.

Data collected to support evaluation of remedial action alternatives for ERAs, IRMs, FFSs, or the full RI/FS, include site screening of alternatives, feasibility-level design, and preliminary cost estimates. Once an alternative is selected for implementation, much of the data collected during site investigations (LFI or RI) can also be used for the final engineering design. Generally, collection of information during the investigations specifically for use in

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the final design is not cost effective because many issues must be decided about appropriate technologies before effective data gathering can be undertaken. It is preferable to gather such specific information during a separate predesign investigation or at the time of remediation (i.e., the "observational approach" of the *Hanford Site Past-Practice Strategy* [DOE/RL 1992a]). Based on the existing data, broad remedial action technologies and objectives have been identified in Section 7.0.

The worker health and safety category includes data collected to establish the required level of protection for workers during various investigation activities. These data are used to determine if there is concern for the personnel working in the vicinity of the aggregate area. The results of these assessments are also used in the development of the various safety documents required for field work (see Health and Safety Plan, Appendix B).

It should be noted that each of these data use categories (site characterization, risk assessment needs, remedial actions, and health and safety) will be required at each decision point on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) flow chart, as discussed at the end of Section 8.1.5. To the extent possible, however, not all sites will be investigated to the same degree but only those with the highest priority. These results will then be extended to the other, analogous sites which have similar geology and disposal histories (see Section 9.2.3).

The existing data can presently be used for two main purposes:

- Development of site-specific sampling plans (site characterization use)
- Screening for health and safety (worker health and safety use).

Table 8-1 presents a summary of the availability of existing data for these two uses.

For the purposes of developing sampling plans, existing information is available for:

- The location of waste management units and unplanned releases: many of the units or releases have surface expressions, markers, or have been surveyed in the past. The unplanned releases in particular are lacking in this information, as well as the 216-E-25 Pond and the 2607-EB, 2607-EH, 2607-GF, 2607-E3, and 2607-E7B Septic Tanks.
- Possible contamination found at the waste management units: these data are derivable from the inventories for the waste management units (mainly for the specific retention trenches, cribs and other disposal facilities) as well as from the limited sampling which has been done at the 216-B-3, 216-B-3A, 216-B-3C, 216-N-8, and 2101-M Ponds and their tributary ditches (i.e., 216-B-3-3).
- The likely depth of contaminants: this information is mainly obtained from the gross gamma borehole logging for many of the units.

Two types of information are available for the purposes of worker health and safety, and will be used for the development of health and safety documents:

- Levels of surface radiation: derived from the on-going periodic radiological surveys done under the Environmental Surveillance program (Schmidt et al. 1992). Table 8-1 shows where surveys have indicated no detectable levels of surface radiation and so no additional survey is required before surface activities can be conducted.

- Expected maximum contaminant levels: these data can be based mainly on the results of subsurface soil sampling. Site-specific sampling of this type has been conducted for several B Plant Aggregate Area waste management units including the 216-B-3 Pond System, the 2101-M Pond, and the work being done for the remedial investigation of the 200-BP-1 Operable Unit.

Table 8-1 also presents a first expression of the data needs for the individual waste management units in the B Plant Aggregate Area, which must be addressed for remediation approaches to be developed.

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8.2.2 Data Needs

The data needs for the B Plant Aggregate Area are discussed in the following sections according to the categories of types of data (Section 8.2.2.1), quality (Section 8.2.2.2), quantity (Section 8.2.2.3), options for acquiring the data (Section 8.2.2.4), and appropriate DQO (PARCC) parameters (Section 8.2.2.5). These considerations are summarized for each category of waste management unit site in the B Plant Aggregate Area (Section 8.2.3).

8.2.2.1 Data Types. Data use categories described in Section 8.2.1 define the general purpose of collecting additional data. Based on the intended uses, a concise statement regarding the data types needed can be developed. Data types specified at this stage should not be limited to chemical and radionuclide parameters, but should also include necessary physical parameters such as bulk density, moisture, and hydraulic conductivity. Precipitation recharge, chemical distribution coefficients, and organic complexation data appear adequate, but may require additional study based on the results of future evaluations. Since environmental media and source materials are interrelated, data types used to evaluate one media may also be useful to characterize another media.

Identifying data types by media indicates that there are overlapping data needs. Data objectives proposed for collection in the site investigations at waste management units and unplanned releases in the B Plant Aggregate Area are discussed in Section 8.3 to provide focus to investigatory methods that may be employed. The data type requirements for the preliminary remedial action alternatives developed in Section 7.4 are summarized in Table 8-2.

8.2.2.2 Data Quality Needs. The various tasks and phases of a CERCLA investigation may require different levels of data quality. Important factors in defining data quality include selecting appropriate analytical levels and validation and identifying contaminant levels of concern as described below. The Westinghouse Hanford document, *A Proposed Data Quality Strategy for Hanford Site Characterization,* will be used to help define these levels (McCain and Johnson 1990). The DQOs will also be developed and defined on an operable unit basis in the work plans and, specifically, in the Quality Assurance Project Plans (QAPjPs) which will guide investigation activities.

Chemical and radionuclide laboratory analysis will be one of the most important data types, and is required at virtually all the waste management units in the B Plant Aggregate Area. In general, increasing accuracy, precision, and lower detection limits are obtained with increasing cost and time. Therefore, the analytical level used to obtain data should be commensurate with the intended use. Table 8-3 defines five analytical levels associated with different types of characterization efforts. While the bulk of the analysis during LFIs/RIs will be screening level (DQO Level I or II), these data will require confirmation sampling and analysis to allow final remedial decisions through quantitative risk assessment methods. Individual DQO analytical PARCC parameters for Level III or IV analytical data associated with each contaminant anticipated in the B Plant Aggregate Area (as developed in Section 5) are given in Table 8-4. These parameters will be used for the development of site-specific sampling and analysis plans and quality assurance plans for investigations and remediations in the aggregate area.

Before laboratory or even field data can be used in the selection of the final remedial action, they must first be validated. Exceptions are made for initial evaluations of the sites using existing data, which may not be appropriate for validation but will be used on a screening basis based on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a). Other screening data (e.g., estimates of contaminant concentration inferred from field analyses) may also be excepted. Validation involves determining the usability and quality of the data. Once data are validated, they can be used to successfully complete the remedial action selection process. Activities involved in the data validation process include the following:

- Verification of chain-of-custody and sample holding times
- Confirmation that laboratory data meet Quality Assurance/Quality Control (QA/QC) criteria
- Confirmation of the usability and quality of field data, which includes geological logs, hydrologic data, and geophysical surveys
- Proper documentation and management of data so that they are usable.

Validation may be performed by qualified Westinghouse Hanford personnel from the Office of Sample Management (OSM), other Westinghouse Hanford organizations, or a qualified independent participant subcontractor. Data validation of laboratory analyses will

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be performed in accordance with *A Proposed Data Quality Strategy for Hanford Site Characterization* (McCain and Johnson 1990) and standards set forth by Westinghouse Hanford.

To accomplish the second point, all laboratory data must meet the requirements of the specific QA/QC parameters as set up in the QAPjP for the project before it can be considered usable. The QA/QC parameters address laboratory precision and accuracy, method blanks, instrument calibration, and holding times.

The usability of field data must be assessed by a trained and qualified person. The project geohydrologist/geophysicists will review the geologic logs, hydrologic data, geophysical surveys, and results of physical testing, on a daily basis, and senior technical reviews will be conducted periodically throughout the project.

Data management procedures are also necessary for the validation. Data management includes proper documentation of field activities, sample management and tracking, and document and inventory control. Specific consistent procedures are discussed in the Information Management Overview (Appendix D).

8.2.2.3 Data Quantity Needs. The number of samples that need to be collected during an investigation can be determined by using several approaches. In instances where data are lacking or are limited (such as for contamination in the vadose zone soils), a phased sampling approach will be appropriate. In the absence of any available data, an approach or rationale will need to be developed to justify the sampling locations and the numbers of samples selected. This will be accomplished and documented in the production of work plans and field sampling plans for each aggregate area, under the guidance and review of the Tri-Party Agreement participants. Specific locations and numbers of samples will be determined based on data collected during screening activities. For example, the number and location of beta/gamma spectrometer probe locations can be based on results of surface geophysical and radiation surveys. These may help locate some subsurface features which may not be adequately documented. Details of any higher DQO level subsurface soil sampling scheme will depend on results of screening investigations such as geophysics surveys, surface radiation surveys, field chemical screening, and beta/gamma spectrometer probe surveys. In situations where and when available data are more complete, statistical techniques may be useful in determining the additional data required.

8.2.2.4 Sampling and Analysis Options. Data collection activities are structured to obtain the needed data in a cost-effective manner. Developing a sampling and analysis approach that ensures that appropriate data quality and quantity are obtained with the resources available may be accomplished by using field screening techniques and focusing the higher DQO level analyses on a limited set of samples at each site. The investigations on waste management units in the B Plant Aggregate Area should take advantage of this approach for a comprehensive characterization of the site in a cost-effective manner.

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A combination of lower level (Levels I and II), higher level analytical data (Levels III, and IV), and special analytical data (Level V) should be collected. This approach would provide the certainty necessary to determine contaminants present near the sources. Samples collected from the other media (i.e., subsurface soils, sediments) will be analyzed by *Test Methods for Evaluating Solid Wastes* (EPA 1986), Contract Laboratory Program (EPA 1988a, 1989b), *Methods for Chemical Analysis of Water and Wastes* (EPA 1983), or *Prescribed Procedures for Measurement of Radioactivity in Drinking Water* (EPA 1980).

8.2.2.5 Data Quality Parameters. The PARCC parameters are indicators of data quality. Ideally, the end use of the data collected should define the necessary PARCC parameters. Once the PARCC requirements have been identified, then appropriate analytical methods can be chosen to meet established goals and requirements. Definitions of the PARCC parameters are presented in Section 8.1.2.

In general, the precision and accuracy objectives are governed by the capabilities of the available methodologies and in most cases these are more than adequate for the needs of the investigations. Chemical analyses can usually attain parts per billion detection range in soils and water, and this level is adequate to the needs of the risk assessment for most analytes. Radiological analyses reach similar levels. Table 8-4 shows detection levels, generally obtained from the method description such as the document *Test Methods for Evaluating Solid Wastes* (EPA 1986) or from experience with laboratory analysis. Some constituents (e.g., arsenic) would require analysis to much lower levels, but this is impossible because of the limitations of analytical methods and the effects of natural background levels. For example, EPA Method 200.62-C-CLP can analyze to detection levels of 500 mg/kg in soils, while the Model Toxics Control Act (MTCA) Method C industrial soils cleanup level is 50 μg/kg. In some cases, special analytical methods can be developed to obtain lower detection levels. In addition, risk assessment is conventionally computed only to a single digit of precision and uses conservative assumptions, which reduce the impact of measurements with lower accuracy.

For other measurements, such as physical parameters, the precision and accuracy capabilities of existing measurement technologies are sufficient for the evaluation methods used to produce characterization data, so the objectives are based on the limitations of the analysis methodologies.

Representativeness is maintained by fitting the sampling program to the governing aspects of the sources and transport processes of the site, as demonstrated in the site conceptual model (Section 4.2). Initial sampling should concentrate on sources, which are fairly well-understood, and on representative locations of anticipated transport mechanisms. If necessary, following activities can focus on aspects or locations that were not anticipated but were demonstrated by the more general results.

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Completeness is generally attained by specifying redundancy on critical samples and maintaining quality control on their acquisition and analysis. As with representativeness, the initial sampling program may lead to modifications of which samples should be considered critical during subsequent sampling activities.

Comparability will be met through the use of Westinghouse Hanford standard procedures generally incorporated into the *Environmental Investigation and Site Characterization Manual* (WHC 1988d).

8.2.3 Data Gaps

Considering the data needs developed in Section 8.2.2, and the data available to meet these needs as presented in Section 8.1.2, it is apparent that a number of data gaps can be identified. These are summarized, on a waste management unit category basis, in Table 8-5, and should be the focus of LFIs on a waste management unit category basis, using the analogue sites approach. The contaminant concentration data are the highest priority because of the need to assess the need for remediation (through quantitative risk assessment and evaluation of compliance with ARARS) and appropriate remedial actions for each site.

In addition to these data needs specifically addressing contamination problems at sites included for consideration in this aggregate area, there are general data needs which will be required for characterization of the possible transport pathways, as presented in the conceptual model, at locations away from the individual units. These general, non-site specific needs include characterization of the following:

- Geologic stratigraphy, particularly for possible perched water zones
- Transport through the vadose zone (mobilization through natural or artificial recharge or drainage)
- Air transport of contamination
- Ecological impacts and transport mechanisms (bio-uptake, bio-concentration, secondary receptors through predation)
- Potential releases from process effluent lines between facilities and to waste disposal sites.

All of these needs will have to be addressed in the data collection program (Section 8.3). In addition, data gaps that impact groundwater are also addressed in the 200 East Groundwater AAMSR.

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8.3 DATA COLLECTION PROGRAM (STAGE 3 OF THE DQO PROCESS)

The data collection program is Stage 3 of the process to develop DQOs. Conducting an investigation with a mixture of screening and higher-level data is a common method for optimizing the quantity and quality of the data collected. It would be very inefficient and overly expensive to specify beforehand all the types of samples and analyses that will yield the most complete and accurate understanding of the contamination and physical behavior of the site. Data adequate to achieve all the goals and objectives for remedial action decisions are obtained at a lower cost by using the information obtained in the field to focus the ongoing investigation and remediation process.

Initial sampling should collect new data believed most necessary to confirm and refine the conceptual model particularly at priority sites. Sampling may then be extended to further reduce uncertainty, to fill in remaining data gaps, to collect more detailed information for certain points where such information is required, or to conduct any needed treatability studies or otherwise support the data needs of the remedial action selection process. An alternative of extrapolating the data from a limited number of sites to other analogous ones will also be used. The need for subsequent investigation phases will be assessed throughout the investigation and remediation activities as data become available. Assessing completeness of the investigation data through a formal statistical procedure is not possible, given the complexity and uncertainty of the parameters required to describe the site and the time to make decisions. Rather, the use of engineering judgement is considered sufficient to the decision process.

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8.3.1 General Rationale

The general rationale for the investigation of sites in the B Plant Aggregate Area is to collect needed data that are not available. Because of the size of the aggregate area, the complexity of past operations, and the number of unplanned releases and waste management units, a large amount of new information will be required such as the specific radionuclides and chemicals present, their spatial distribution and form, and the presence of special migration pathways (such as perched groundwater systems).

The following work plan approach will be used for LFIs and RI/FS in the B Plant Aggregate Area. The results are described in Sections 8.3.2 and 8.3.3 in a general form.

- Existing data as described in Sections 2.0, 3.0, and 4.0 should be used to the maximum extent possible. Although existing data are not validated fully, the data are still useful in developing a preliminary conceptual model (Section 4.2) and in helping to focus and guide the planning of investigations, expedited actions, and interim measures.

- Additional data at validated and screening levels should be collected to obtain the maximum amount of useful information for the amount of time and resources invested in the investigation.

- Data should be collected to support the intended data uses identified in Section 8.2.1.

- Nonintrusive sampling (e.g., geophysical surveys, surface radiation surveys, soil gas, and spectral gamma probe surveys) and surficial and source sampling should be conducted early in any investigation effort to identify necessary interim response actions (i.e., additional ERAs or IRMs).

- Data collected from initial investigation activities should be used to confirm and refine the conceptual model (Section 4.2), refine the analyte constituents of concern, and provide information to conduct interim response actions or risk assessment activities.

- Additional investigation activities are proposed to support (if needed) quantitative baseline risk assessments for final cleanup actions and further refine the conceptual model.

- Field investigation techniques should be used to minimize the amount of hazardous or mixed waste generated. Any waste generated will be in accordance with EII 4.2, "Interim Control of Unknown Suspected Hazardous and Mixed Waste" (WHC 1988d).

8.3.2 General Strategy

The overall objective of any field investigation (LFI, IRM, or RI) of the sites in the B Plant Aggregate Area will be to gather additional information to support risk assessment and remedial action selection according to the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) flow chart discussed in Section 8.1.5. The general approach or strategy for obtaining this additional information is presented below.

- Analytical parameter selection should be based on verifying overall conditions and then narrowed to specific constituents of concern, in consideration with regulatory requirements and site conditions. Periodic analyses of the long list of parameters should be conducted to verify that the list of constituents of concern has not changed, either because new constituents are identified or some of those considered as a potential concern do not appear to be significant.

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- Similarly, investigations should work from a screening level (DQO Levels I or II, e.g., surface radiation surveys) to successively more specific sampling and analysis methodologies (e.g., beta/gamma spectral probes, then DQO Level III or IV soil sampling and analysis) without time consuming remobilizations.

- Dangerous and radioactive wastes may be generated during the field investigation. While efforts should be made to minimize these wastes, any waste generated will be handled in accordance with EII 4.3, "Control of CERCLA and Other Past-Practice Investigation Derived Waste" (WHC 1988d). The analyses of samples for constituents of concern analytes will allow wastes generated to be adequately designated.

8.3.3 Investigation Methodology

Initial field investigations (mainly LFIs, but also associated with IRMs at appropriate sites and possibly some RIs) may include some or all of the following integrated methodologies:

- Source Investigation (Section 8.3.3.1)
- Geological Investigation (Section 8.3.3.2)
- Surface Water Sediment Investigation (Section 8.3.3.3)
- Soil Investigation (Section 8.3.3.4)
- Air Investigation (Section 8.3.3.5)
- Ecological Investigation (Section 8.3.3.6)
- Geophysical Stratigraphic Survey (Section 8.3.3.7)
- Process Effluent Pipeline Integrity Assessment (Section 8.3.3.8)
- Geodetic Survey (Section 8.3.3.9).
- Cultural Resource Investigation (Section 8.3.3.10).

Each investigation methodology is briefly outlined in the following sections. Specific survey methods (such as electromagnetics or ground-penetrating radar) have not been recommended to allow flexibility in the development of field sampling plans which can be sensitive to very local conditions. A summary of the applicable methods for each waste management unit is presented in Table 8-6. In addition, some of the data needs must be addressed on an area-wide basis (e.g., stratigraphy interpretation). More detailed

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descriptions and specific methods and instrumentation will be included in site-specific work plans, sampling and analysis plans, and field sampling plans for LFIs/IRMs at waste management units that require these investigations.

These investigations are presented in the approximate priority of their need, with the source investigation first because of its importance to the decisions about remedial action on a site-by-site basis. The other investigations are of lower priority, and should be conducted according to the need to determine whether contamination has been transported beyond the immediate vicinity of the waste management units. To some extent this need will depend on the results of the source investigation.

8.3.3.1 Source Investigation. The purpose of source investigation activities in the B Plant Aggregate Area is to characterize the known waste management units and unplanned releases that exist in the area and that may contribute to contamination of surface soil, vadose zone, surface water, sediment, air, and biota. The completeness of the characterization effort will be assessed according to the needs of risk assessment, ARARs compliance, and remedial action selection, which will also determine what levels of the various constituents of concern comprise "contamination."

Source sampling should be conducted at waste management units or unplanned release locations where the available data indicate that dangerous, mixed, or radioactive wastes may be present. Activities which are proposed to be performed during the source investigations include the following:

- Compile and evaluate additional existing data for the purpose of: verifying locations, specifications of engineered facilities, and pipelines, and waste stream characteristics; assessment of the construction and condition of boreholes/wells that exist in the operable unit and their suitability for use for investigation activities, QA/QC information, and raw data regarding radiological and hazardous substances monitoring; and integrating any additional environmental modeling data into the conceptual model. This has been done (on an aggregate area basis) in this report; the process will be extended to site-specific planning and on-going assessments of the investigation/remediation as it is carried out.

- Conduct surface radiological survey of suspected or known source areas to verify locations and nature of surface and subsurface radiological contamination. Conditions at specific sources within a waste management unit should also be noted in order to plan sampling/remediation activities and worker health and safety.

- Conduct nonintrusive surface geophysical surveys at specific waste management units such as the 216-E-25 Pond (Section 2.3.5.5) and the 2607-EB, 2607-EH, 2607-GF, 2607-E3, and 2607-E7B Septic Tanks (Sections 2.3.6.1, 2.3.6.2, 2.3.6.8, 2.3.6.13, and 2.3.6.15), and unplanned release locations to verify locations and physical characteristics of source locations. Data generated from

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these activities can be used in planning intrusive source sampling activities and in locating buried structure identified with waste management units.

- Conduct beta/gamma spectrometer probe survey to screen for near-surface contamination and to confirm the absence or presence of some specific radionuclides, which may be of particular concern. Existing boreholes will be used to the maximum extent, but new boreholes may be needed at many locations (to be decided based on screening results). Logging will be done both by NaI detectors or μR meters for rapid screening as well as the RLS high purity germanium logging system. Westinghouse Hanford will develop an EII Procedure for the beta/gamma spectrometer probe survey. The beta/gamma spectrometer probe survey serves two purposes depending on the source conditions: to confirm absence of contamination in the near-surface soils, and to serve as a screening tool to choose locations and quantities of vadose zone soil borings. The RLS procedure could demonstrate "assay quality" data for radionuclide concentrations, but will probably continue to require supporting Level III and IV soil analysis data to allow a risk assessment before final remedial decisions. The need to conduct this survey will be based (at least in part) on the screening results of the surface survey and on information about site burial.

- Soil gas surveys should be conducted at waste management units (such as cribs) where volatile organic chemicals are suspected, as a screening method to identify compounds such as solvents and degreasers that may have been used in separate processes or decontamination activities. The soil gas survey should not be considered conclusive that volatile organic compounds at lower concentrations may not be present. Data from the soil gas survey can be used to help locate surface and near-surface samples and vadose zone borings.

- Collect surface and near-surface samples of contaminated soils and/or waste materials at selected locations. Specific sampling sites will be chosen to assess particular facilities or releases. Additional sampling sites may be specified based on results from nonintrusive investigations.

8.3.3.2 Geologic Investigation. A geologic investigation should be performed to better characterize the vadose zone and the nature of unsaturated soils that make up this system. The geologic investigation will include the following tasks:

- Borings may be advanced into zones where an accurate interpolation of the subsurface stratigraphy is important to understanding migration pathways in the vadose zone.

- Geologic data collected during the ongoing vadose zone soil (Section 8.3.3.4) and other (deeper) investigations (e.g., geologic and geophysical logs from

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groundwater well installations for groundwater AAMSs) will be compared, compiled, and evaluated.

8.3.3.3 Surface Water Sediment Investigation. A surface water sediment investigation should be conducted. The investigation will include:

- Radiation survey along ditches, trenches, and ponds for health and safety purposes and to locate areas of elevated radiation for selection of specific sediment sampling locations.

- Sampling of sediment in any ditches, ponds, and trenches that still contain water. This will probably be limited to the 216-B-3-3 and 216-B-63 Ditches, the 207-B Retention Basin, and the 216-N-8, 216-B-3, and 216-B-3C Ponds.

8.3.3.4 Soil Investigation. The purpose of soil investigations is to determine the physical and chemical properties of the soil and to determine the nature, type, and extent of soil contamination associated with waste management units and unplanned releases. The investigations will support interim remedial actions and help assess the quantitative risk at other sites. The soil investigations will also support studies conducted under the direction of the Groundwater AAMSRs, such as contaminant transport through the vadose zone. Sampling will include:

- Samples of vadose zone soil will be collected and analyzed for contaminants of concern when wells are drilled for other studies (i.e., groundwater investigations) in the vicinity of a waste management unit or unplanned release with reported liquid disposals or spills. Organic vapor (at sites with suspected volatiles) and radiation sampling should also be performed with samples selected by onsite screening.

- Data collected during this investigation will be evaluated to further understand the deposition of contaminants to the vadose zone from specific waste management units and/or unplanned releases and to better define the hydrology and water quality in the vadose zone system through moisture content profiles, tracking of specific contaminants, and soil hydraulic characteristics. However, the issue of contaminant transport through the vadose zone is more appropriate to studies conducted under the direction of the Groundwater AAMSRs.

8.3.3.5 Air Investigation. Air investigations (on an aggregate area scale) should consist of onsite particle sampling as part of the health and safety program. In addition, high-volume air samplers should be placed in appropriate locations onsite based on evaluation of existing meteorological data. The purpose of these samplers will be to determine if any migration of airborne contaminants occurs.

8.3.3.6 Ecological Investigation. Ecological investigation activities, on an sitewide scale, should include a literature search and data review, and a site walkthrough. Data collected

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during the soils characterization activities are expected to be sufficient to evaluate biota remediation technologies. These activities are intended to identify potential biota concerns which need to be addressed in the site investigation. Particular emphasis should be given to identifying potential exposure pathways to biota that migrate offsite or that introduce contaminants into the food web. Data obtained in this survey will be used to both refine the conceptual model as well as to conduct the ecological risk assessment.

8.3.3.7 Geophysical Stratigraphic Survey. Additional information needs to be gathered to better define the depth and lateral extent of the perched water zones and the caliche layer (an important aquitard) in the Plio-Pleistocene unit. This information may be obtained using a number of subsurface characterization techniques such as magnetic and seismic surveys and borehole logging.

8.3.3.8 Process Effluent Pipeline Integrity Assessment. An assessment of process effluent pipeline integrity should be conducted early in site investigation activities to look for potential leaks and therefore possible areas of contamination. Initially, as part of this effort, drawings of the process lines and encasements within the aggregate area (Section 2.3.7) should be reviewed and their construction, installation, and operation evaluated. Specific lines will then be selected for integrity assessment with emphasis on lines serving the waste management units that have received large volumes of liquid (e.g., cribs). Investigation of operating high level waste transfer lines will be deferred to their respective programs. Results of the integrity assessments will be evaluated and additional sampling activities may be recommended for subsequent studies.

8.3.3.9 Geodetic Survey. Geodetic surveys will be conducted after the installation and completion of each investigation activity. The survey will be to locate the horizontal locations of surface and near-surface soil samples; corners of geophysics, soil gas, and beta/gamma probe surveys; and surface water and sediment sample locations. Horizontal and vertical locations of all vadose zone soil borings and perched zone wells will be surveyed. The geodetic survey should be conducted by a professional surveyor licensed in the state of Washington and should be referenced to both historic (e.g., Hanford coordinates) and current coordinate datums (e.g., North American Datum of 1983 - NAD-83), both vertical and horizontal.

8.3.3.10 Cultural Resource Investigation. A cultural resource investigation should be conducted for investigating locations outside the 200 East Area to verify the locations of known archaeological sites by reviewing existing data. The focus of the investigation will be to confirm that no archaeological resources are present at proposed drilling sites.

8.3.4 Data Evaluation and Decision Making

Data will be evaluated as soon as results (e.g., soil gas, radiation screening, drilling results) become available for use in restructuring and focusing the investigation activities. Data reports will be developed that summarize and interpret new data. This includes

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groundwater sampling and RLS borehole logging as part of the AAMS. Data will be used to refine the conceptual model, further assess potential contaminant-specific ARARs, develop the quantitative risk assessment, and assess remedial action alternatives.

The objectives of data evaluation are:

- To reduce and integrate data to ensure that data gaps are identified and that the goals and objectives of the B Plant AAMS are met

- To confirm that data are representative of the media sampled and that QA/QC criteria have been met.

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Table 8-1. Uses of Existing Data for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Type of Unit	Development of Sampling Plans			Health and Safety	
		Field Located	Possible Contamination	Depth Contamination	Surface[a] Radiation	Expected Max. Level
Tanks and Vaults						
241-B-361	Settling Tank	•	•	--	•	--
Cribs and Drains						
216-B-7A	Crib	•	•	•	--	•
216-B-7B	Crib	•	•	•	--	•
216-B-8TF	Crib/Tile Field	•	•	•	--	•
216-B-9TF	Crib/Tile Field	•	•	•	•	•
216-B-10A	Crib	•	•	•	--	•
216-B-10B	Crib	•	•	--	--	•
216-B-12	Crib	•	•	•	--	•
216-B-14	Crib	•	•	•	•	•
216-B-15	Crib	•	•	•	•	•
216-B-16	Crib	•	•	•	•	•
216-B-17	Crib	•	•	•	•	•
216-B-18	Crib	•	•	•	•	•
216-B-19	Crib	•	•	•	•	•
216-B-43	Crib	•	•	•	•	•
216-B-44	Crib	•	•	•	•	•
216-B-45	Crib	•	•	•	•	•
216-B-46	Crib	•	•	•	•	•
216-B-47	Crib	•	•	•	•	•
216-B-48	Crib	•	•	•	•	•
216-B-49	Crib	•	•	•	•	•
216-B-50	Crib	•	•	•	•	•
216-B-55	Crib	•	•	•	--	•
216-B-56	Crib	•	--	--	--	--
216-B-57	Crib	•	•	•	•	•
216-B-60	Crib	--	•	--	--	--
216-B-61	Crib	•	--	--	--	--

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Table 8-1. Uses of Existing Data for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Type of Unit	Development of Sampling Plans: Field Located	Development of Sampling Plans: Possible Contamination	Development of Sampling Plans: Depth Contamination	Health and Safety: Surface[a] Radiation	Expected Max. Level
216-B-62	Crib	•	•	•	--	•
CTF N. of 2703-E	--	--	--	--	--	--
216-B-13	French Drain	•	•	•	•	--
216-B-51	French Drain	•	•	--	•	--
Reverse Wells						
216-B-4	Reverse Well	•	•	•	--	•
216-B-5	Reverse Well	•	•	•	•	•
216-B-6	Reverse Well	•	•	•	--	•
216-B-11A	Reverse Well	•	•	•	•	•
216-B-11B	Reverse Well	•	•	•	•	•
Ponds, Ditches, and Trenches						
216-B-3	Pond	•	•	•	--	•
216-B-3A	Pond	•	•	--	•	--
216-B-3B	Pond	•	•	--	•	--
216-B-3C	Pond	•	•	--	•	--
216-A-25	Pond	•	•	•	•	•
216-E-28	Pond	•	--	--	•	--
216-N-8	Pond	--	--	--	--	•
216-B-2-1	Ditch	•	•	•	--	•
216-B-2-2	Ditch	•	•	•	--	•
216-B-2-3	Ditch	•	•	•	--	•
216-B-3-1	Ditch	•	•	•	•	--
216-B-3-2	Ditch	•	•	•	•	--
216-B-3-3	Ditch	•	•	•	•	--
216-B-20	Trench	•	•	•	--	•
216-B-21	Trench	•	•	•	--	•

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Table 8-1. Uses of Existing Data for B Plant Aggregate Area Waste Management Units.

		Development of Sampling Plans			Health and Safety	
Waste Management Unit	Type of Unit	Field Located	Possible Contamination	Depth Contamination	Surface[a] Radiation	Expected Max. Level
216-B-22	Trench	•	•	•	–	•
216-B-23	Trench	•	•	•	–	•
216-B-24	Trench	•	•	•	–	•
216-B-25	Trench	•	•	•	–	•
216-B-26	Trench	•	•	•	–	•
216-B-27	Trench	•	•	•	–	•
216-B-28	Trench	•	•	•	–	•
216-B-29	Trench	•	•	•	–	•
216-B-30	Trench	•	•	•	–	•
216-B-31	Trench	•	•	•	–	•
216-B-32	Trench	•	•	•	–	•
216-B-33	Trench	•	•	•	–	•
216-B-34	Trench	•	•	•	–	•
216-B-35	Trench	•	•	•	–	•
216-B-36	Trench	•	•	•	–	•
216-B-37	Trench	•	•	•	–	•
216-B-38	Trench	•	•	•	–	•
216-B-39	Trench	•	•	•	–	•
216-B-40	Trench	•	•	•	–	•
216-B-41	Trench	•	•	•	–	•
216-B-42	Trench	•	•	•	–	•
216-B-52	Trench	•	•	•	•	•
216-B-53A	Trench	•	•	–	–	•
216-B-53B	Trench	•	•	•	–	•
216-B-54	Trench	•	•	•	•	•
216-B-58	Trench	•	•	–	–	•
216-B-63	Ditch	•	•	•	–	•

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Table 8-1. Uses of Existing Data for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Type of Unit	Development of Sampling Plans			Health and Safety	Expected Max. Level
		Field Located	Possible Contamination	Depth Contamination	Surface[a] Radiation	
Septic Tanks and Associated Drain Fields						
2607-E1	Septic Tank	•	–	–	–	–
2607-E2	Septic Tank/Drain Field	•	–	–	–	–
2607-E3	Septic Tank/Drain Field	•	–	–	–	–
2607-E4	Septic Tank/Drain Field	•	•	–	–	–
2607-E7B	Septic Tank/Drain Field	–	–	–	–	–
2607-E8	Septic Tank/Drain Field	•	–	–	–	–
2607-E9	Septic Tank	–	–	–	–	–
2607-E11	Septic Tank	•	–	–	–	–
2607-EB	Septic Tank/Drain Field	•	–	–	–	–
2607-EH	Septic Tank/Drain Field	–	–	–	–	–
2607-EK	Septic Tank/Drain Field	•	–	–	–	–
2607-EM	Septic Tank	–	–	–	–	–
2607-EN	Septic Tank	–	–	–	–	–
2607-EO	Septic Tank	•	–	–	–	–
2607-EP	Septic Tank/Drain Field	•	–	–	–	–

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Table 8-1. Uses of Existing Data for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Type of Unit	Development of Sampling Plans: Field Located	Development of Sampling Plans: Possible Contamination	Development of Sampling Plans: Depth Contamination	Health and Safety: Surface[a] Radiation	Health and Safety: Expected Max. Level
2607-EQ	Septic Tank/Drain Field	•	--	--	--	--
2607-ER	Septic Tank	--	--	--	--	--
2607-GF	Septic Tank/Drain Field	--	--	--	--	--
Basins						
207-B	Retention Basin	•	•	--	--	--
216-B-59B	Retention Basin	•	•	•	--	•
216-B-64	Retention Basin	•	•	--	•	--
Burial Sites						
218-E-2	Burial Ground	•	•	•	•	•
218-E-2A	Burial Ground	•	--	•	--	--
218-E-3	Burial Ground	--	--	•	--	--
218-E-4	Burial Ground	•	•	--	--	•
218-E-5	Burial Ground	•	•	--	•	--
218-E-5A	Burial Ground	•	•	--	•	--
218-E-6	Burial Ground	--	--	--	--	--
218-E-7	Burial Ground	•	•	•	•	•
218-E-9	Burial Ground	•	•	--	•	--
200 Area Construction Pit		--	--	--	--	--
Unplanned Releases						
UN-200-E-7		--	•	--	--	--
UN-200-E-9		•	•		•	--

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Table 8-1. Uses of Existing Data for B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Type of Unit	Development of Sampling Plans			Health and Safety	
		Field Located	Possible Contamination	Depth Contamination	Surface[a] Radiation	Expected Max. Level
UN-200-E-14		–	–	–	–	–
UN-200-E-41		–	•	–	•	–
UN-200-E-43		–	•	–	•	•
UN-200-E-44		–	•	•	•	•
UN-200-E-52		–	•	•	•	•
UN-200-E-54		–	–	–	–	–
UN-200-E-55		–	–	–	–	–
UN-200-E-61		•	–	–	–	–
UN-200-E-63		•	–	–	•	–
UN-200-E-64		•	•	–	•	–
UN-200-E-69		–	•	–	•	•
UN-200-E-79		–	•	•	•	–
UN-200-E-80		–	–	•	•	–
UN-200-E-83		•	•	–	•	–
UN-200-E-87		•	–	•	–	•
UN-200-E-90		•	–	–	•	–
UN-200-E-92		–	–	–	–	–
UN-200-E-95		•	•	–	•	•
UN-200-E-101		–	–	–	•	–
UN-200-E-103		–	•	•	•	–
UN-200-E-112		–	–	–	•	–
UN-200-E-140		–	–	–	–	–
UPR-200-E-4		–	•	–	•	•
UPR-200-E-32		–	•	•	•	–
UPR-200-E-34		–	•	•	•	–
UPR-200-E-51		–	–	–	–	–
UPR-200-E-84		–	•	•	•	•
UPR-200-E-138		–	•	•	–	–

[a] A "•" indicates that the site has been surveyed and surface contamination has not been found to be present.

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Table 8-2. Data Needs for Preliminary Remedial Action Alternatives B Plant Aggregate Area.

Alternative	Physical Attribute	Chemical/Radiochemical Attribute
1. Multimedia Cover (plus possible vertical barriers)	• areal extent • depth of contamination • structural integrity (collapse potential) • run-off/run-on potential • cover properties (permeability)	• surface radiation • biologic transport potential
2. In Situ Grouting/ Stabilization	• areal extent • depth • particle size • hydraulic properties (permeability/porosity) • stratigraphy • borehole spacing • grout/additive mix parameters	• solubility • reactivity • leachability from grout medium
3. Excavation, Soil Treatment, and Disposal	• areal extent[a] • depth[a] • particle size • silt-size (dust) content • excavation stability	• toxicity/radioactivity • levels of contaminants • solubility/reactivity • soil chemistry (relative affinity) • concentrations in PM-10 fraction • spent solvent treatment/disposal options
4. In Situ vitrification	• areal extent • depth • soil/waste conductivity • thermal properties • moisture contact • voids	• volatility • reactivity • leachability/integrity • off-gas treatment waste disposal options
5. Excavation, Above Ground Treatment, and Geologic Disposal	• areal extent[a] • depth[a] • mineralogy of soil/waste • particle size • silt-size (dust) content • excavation stability • treatment parameters	• concentrations of TRU • toxicity/radioactivity • levels of contaminants • concentrations in PM-10 fraction • reactivity • leachability/integrity of final waste form
6. In Situ Soil Vapor Extraction	• areal extent • depth • locations/depth of highest concentrations (vapors, adsorbed) • stratigraphy • soil permeability/porosity • voids	• volatility of constituents (Henry's Law Constant) • non-volatile organics • levels • volatile radionuclides (Radon) • treatability (catalytic oxidization)

[a] May be obtained during remediation using the observational approach recommended by the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a).

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Table 8-3. Analytical Levels for the B Plant Aggregate Area.

Level	Description
LEVEL I	Field screening. This level is characterized by the use of portable instruments which can provide real-time data to assist in the optimization of sampling point locations and for health and safety support. Data can be generated regarding the presence or absence of certain contaminants (especially volatiles) at sampling locations.
LEVEL II	Field analysis. This level is characterized by the use of portable analytical instruments which can be used onsite, or in mobile laboratories stationed near a site (close-support laboratories). Depending on the types of contaminants, sample matrix, and personnel skill, qualitative and quantitative data can be obtained.
LEVEL III	Laboratory analysis using methods other than the Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level is used primarily in support of engineering studies using standard EPA-approved procedures. Some procedures may be equivalent to CLP RAS without the CLP requirements for documentation.
LEVEL IV	Contract Laboratory Program (CLP) Routine Analytical Services (RAS). This level is characterized by rigorous QA/QC protocols and documentation and provides qualitative and quantitative analytical data. Some regions have obtained similar support via their own regional laboratories, university laboratories, or other commercial laboratories.
LEVEL V	Nonstandard methods. Analyses which may require method modification and/or development are considered Level V by CLP Special Analytical Services (SAS).

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Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
RADIONUCLIDES								
Gross Alpha	900.0 M	TBD	±30	±25	900.0	10	±25	±25
Gross Beta	900.0 M	TBD	±30	±25	900.0	5	±25	±25
Gamma Scan	D3699 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Actinium-225	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Actinium-227	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-241	Am-01	TBD	±30	±25	Am-03	TBD	±25	±25
Americium-242	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-242m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Americium-243	Am-01	TBD	±30	±25	Am-03	TBD	±25	±25
Antinomy-126	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Antimony-126m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Barium-137m	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Bismuth-210	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-211	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-213	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Bismuth-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Carbon-14	C-01 M	TBD	±30	±25	TBD	TBD	±25	±25
Cesium-134	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Cesium-135	901.0 M	TBD	±30	±25	901.0	TBD	±25	±25
Cesium-137	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Cobalt-60	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Curium-242	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Curium-244	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Curium-245	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Europium-152	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25

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Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Europium-155	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Francium-221	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Iodine-129	902.0 M	TBD	±30	±25	902.0	TBD	±25	±25
Lead-209	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-210	Pb-01 M	TBD	±30	±25	Pb-01	TBD	±25	±25
Lead-211	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-212	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Lead-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Neptunium-237	907.0 M	TBD	±30	±25	907.0	TBD	±25	±25
Neptunium-239	D35649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Nickel-59	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Nickel-63	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Niobium-93m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Plutonium	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-238	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-239/240	Pu-02	TBD	±30	±25	Pu-10	TBD	±25	±25
Plutonium-241	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-214	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-215	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Polonium-218	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Potassium-40	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Protactinium-231	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Protactinium-234m	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Radium	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (pCi/g)	Precision (RPD)	Accuracy (%)
RADIONUCLIDES (cont.)								
Radium-225	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Radium-226	Ra-04	TBD	±30	±25	Ra-05	TBD	±25	±25
Ruthenium-106	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Samarium-151	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Selenium-79	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Sodium-22	D3649 M	TBD	±30	±25	D3649 M	TBD	±25	±25
Strontium-90	Sr-02	TBD	±30	±25	Sr-02	TBD	±25	±25
Technetium-99	Tc-01 M	TBD	±30	±25	Tc-01	TBD	±25	±25
Thallium-207	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Thorium-227	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-229	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-230	00-06	TBD	±30	±25	00-07	TBD	±25	±25
Thorium-231	TBD	TBD	±30	±25	TBD	TBD	±25	±25
Tritium	906.0 M	TBD	±30	±25	906.0	300	±25	±25
Uranium	U-04	TBD	±30	±25	U-04	TBD	±25	±25
Uranium-233	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-234	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-235	U	TBD	±30	±25	908.0	TBD	±25	±25
Uranium-238	U	TBD	±30	±25	908.0	TBD	±25	±25
Yttrium-90	Sr-02	TBD	±30	±25	Sr-02	TBD	±25	±25
Zirconium-93	TBD	TBD	±30	±25	TBD	TBD	±25	±25

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Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (mg/kg)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (μg/L)	Precision (RPD)	Accuracy (%)
INORGANICS								
Arsenic	7061	0.02	±25	±30	7061	10	±20	±25
Barium	6010	0.02	±25	±30	6010	20	±20	±25
Boron	6010	TBD	±25	±30	6010	TBD	±20	±25
Cadmium	6010	0.09	±25	±30	6010	1	±20	±25
Chromium	6010	0.07	±25	±30	6010	10	±20	±25
Copper	6010	0.06	±25	±30	220.2	10	±20	±25
Cyanide	9010	TBD	±25	±30	335.3	50	±20	±25
Fluoride	300 M	TBD	±25	±30	300	50	±20	±25
Iron	6010	20	±25	±30	6010	70	±20	±25
Lead	6010	0.45	±25	±30	6010	450	±20	±25
Manganese	6010	0.02	±25	±30	6010	20	±20	±25
Mercury	7471	0.02	±25	±30	245.2	2	±20	±25
Nickel	6010	1.5	±25	±30	6010	50	±20	±25
Nitrate	300 M	TBD	±25	±30	300	130	±20	±25
Nitrite	300 M	TBD	±25	±30	300	40	±20	±25
Selenium	6010	0.75	±25	±30	270.2	20	±20	±25
Silver	6010	2	±25	±30	272.2	10	±20	±25
Titanium	6010	TBD	±25	±30	6010	TBD	±20	±25
Vanadium	6010	0.08	±25	±30	286.2	40	±20	±25
Zinc	6010	0.02	±25	±30	6010	20	±20	±25

Table 8-4. Data Quality Objective Parameters for Chemical/Radiochemical Analyses.

	Soil/Sediment				Water			
	Analysis Method	Practical Quantitation Limit (mg/kg)	Precision (RPD)	Accuracy (%)	Analysis Method	Practical Quantitation Limit (μg/L)	Precision (RPD)	Accuracy (%)
ORGANICS								
Acetone	8240	0.1	±25	±30	8240	100	±20	±25
Carbon tetrachloride	8240	0.005	±25	±30	8240	1	±20	±25
Chloroform	8240	0.005	±25	±30	8240	5	±20	±25
Kerosene	8015	20	±35	±30	8015	500	±35	±25
Methylene chloride	8240	0.005	±25	±30	8240	5	±20	±25
1,1,1-Trichloroethane	8240	0.005	±25	±30	8240	5	±20	±25
Toluene	8240	0.005	±25	±30	8240	5	±20	±25
Tributyl phosphate	TBD	TBD	±25	±30	TBD	TBD	±30	±25

TBD = To Be Determined.
M = Method modified to include extraction from the solid medium, extraction method is matrix and laboratory-specific.
RPD = Relative Percent Difference.
Prescribed Procedures for Measurement of Radioactivity in Drinking Water (EPA 1980)
Test Methods for Evaluating Solid Wastes (SW 846) Third Edition (EPA 1986)
Methods for Chemical Analysis of Water and Wastes (EPA 1983)
Precision and accuracy are goals. Since these parameters are highly matrix dependent they could vary greatly from the goals listed.

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Table 8-5. Data Gaps by Site Category.

Site Category	Identified Data Gaps
Tanks and Vaults	• Contaminant concentrations in waste management units other than single-shell tanks • Distribution of contaminants in subsurface soils released in leaks • Constituents concentrations in related surface contamination
Cribs and Drains	• Containment concentrations in cribs • Containment concentrations in soils beneath cribs • Specific constituents (especially organic chemicals) • Distribution and vertical/lateral extent of contamination
Reverse Wells	• Containment concentrations in subsurface soils impacted by discharges • Specific constituents (especially organics) • Extent of contamination
Ponds, Ditches, and Trenches	• Distribution/extent of subsurface contamination • Buried contaminant concentrations in stabilized portions/units • Extent of contamination in pond sediments
Septic Tanks and Associated Drain Fields	• Actual discharge levels • Possible discharge and presence/level of non-sanitary wastes (e.g., laboratory drains)
Transfer Facilities, Diversion Boxes, and Pipelines	• Contamination constituents and concentrations • Direct radiation levels in facilities • Constituents/concentrations in related surface contamination • Integrity of transfer lines
Basins	• Constituents and concentrations in sediments • Distribution/extent of subsurface contamination
Burial Sites	• Identify subsurface location of burial sites • Distribution/extent of subsurface contamination
Unplanned Releases	• Surface soil constituents and concentrations • Buried contamination constituents and concentrations

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Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
Tanks and Vaults									
241-B-361 Settling Tank	•	•	–	–	•	–	–	•	–
Cribs and Drains									
216-B-7A Crib	•	•	–	–	•	–	–	•	–
216-B-7B Crib	•	•	–	–	•	–	–	•	–
216-B-8TF Crib/Tile Field	•	•	–	–	•	–	–	•	–
216-B-9TF Crib/Tile Field	•	•	–	–	•	–	–	•	–
216-B-10A Crib	–	•	–	–	•	–	–	•	–
216-B-10B Crib	–	•	–	–	•	–	–	•	–
216-B-12 Crib	•	•	–	–	•	–	–	•	–
216-B-14 Crib	•	•	–	–	•	–	–	•	–
216-B-15 Crib	•	•	–	–	•	–	–	•	–
216-B-16 Crib	•	•	–	–	•	–	–	•	–
216-B-17 Crib	•	•	–	–	•	–	–	•	–
216-B-18 Crib	•	–	–	–	•	–	–	•	–
216-B-19 Crib	•	•	–	–	•	–	–	•	–
216-B-43 Crib	•	•	–	–	•	–	–	•	–
216-B-44 Crib	•	•	–	–	•	–	–	•	–
216-B-45 Crib	•	•	–	–	•	–	–	•	–
216-B-46 Crib	•	•	–	–	•	–	–	•	–

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Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
216-B-47 Crib	•	•	–	–	•	–	–	•	–
216-B-48 Crib	•	•	–	–	•	–	–	•	–
216-B-49 Crib	•	•	–	–	•	–	–	•	–
216-B-50 Crib	•	•	–	–	•	–	–	•	–
216-B-55 Crib	•	•	–	–	•	–	–	•	–
216-B-56 Crib	–	–	–	–	–	–	–	–	–
216-B-57 Crib	•	•	–	–	•	–	–	•	–
216-B-60 Crib	–	•	–	–	–	–	–	•	–
216-B-61 Crib	–	•	–	–	–	–	–	•	–
216-B-62 Crib	•	•	–	–	•	–	–	•	–
CTF N. of 2703-E	•	–	–	•	•	–	–	•	–
216-B-13 French Drain	–	•	–	–	–	–	–	•	–
216-B-51 French Drain	–	•	–	–	•	–	–	•	–
Reverse Wells									
216-B-4 Reverse Well	–	•	–	–	–	–	–	•	–
216-B-5 Reverse Well	•	•	–	–	•	–	–	•	–
216-B-6 Reverse Well	–	•	–	–	–	–	–	•	–
216-B-11A Reverse Well	•	•	–	–	•	–	–	•	–
216-B-11B Reverse Well	•	•	–	–	•	–	–	•	–

Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
Ponds, Ditches, and Trenches									
216-B-3 Pond	•	•	–	–	–	–	•	•	–
216-B-3A Pond	•	•	–	–	–	–	•	•	–
216-B-3B Pond	•	•	–	–	–	–	–	•	–
216-B-3C Pond	•	•	–	–	–	–	•	•	–
216-A-25 Pond	•	•	–	–	–	–	–	•	–
216-E-28 Pond	–	–	–	–	–	–	–	–	–
216-N-8 Pond	–	•	–	–	–	–	•	•	–
216-B-2-1 Ditch	•	•	–	–	•	–	–	•	–
216-B-2-2 Ditch	•	•	–	–	•	–	–	•	–
216-B-2-3 Ditch	•	•	–	–	•	–	–	•	–
216-B-3-1 Ditch	•	•	–	–	•	–	–	•	–
216-B-3-2 Ditch	•	•	–	–	•	–	–	•	–
216-B-3-3 Ditch	•	•	–	–	–	–	•	•	–
216-B-63 Trench	•	•	–	–	–	–	•	•	–
216-B-20 Trench	•	•	–	–	•	–	–	•	–
216-B-21 Trench	•	•	–	–	•	–	–	•	–
216-B-22 Trench	•	•	–	–	•	–	–	•	–
216-B-23 Trench	•	•	–	–	•	–	–	•	–
216-B-24 Trench	•	•	–	–	•	–	–	•	–

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Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
216-B-25 Trench	•	•	–	–	•	–	–	•	–
216-B-26 Trench	•	•	–	–	•	–	–	•	–
216-B-27 Trench	•	•	–	–	•	–	–	•	–
216-B-28 Trench	•	•	–	–	•	–	–	•	–
216-B-29 Trench	•	•	•	–	•	–	–	•	–
216-B-30 Trench	•	•	–	–	•	–	–	•	–
216-B-31 Trench	•	•	–	–	•	–	–	•	–
216-B-32 Trench	•	•	–	–	•	–	–	•	–
216-B-33 Trench	•	•	–	–	•	–	–	•	–
216-B-34 Trench	•	•	–	–	•	–	–	•	–
216-B-35 Trench	–	•	–	–	•	–	–	•	–
216-B-36 Trench	–	•	–	–	•	–	–	•	–
216-B-37 Trench	–	•	–	–	•	–	–	•	–
216-B-38 Trench	–	•	–	–	•	–	–	•	–
216-B-39 Trench	–	•	–	–	•	–	–	•	–
216-B-40 Trench	–	•	–	–	•	–	–	•	–
216-B-41 Trench	–	•	–	–	•	–	–	•	–
216-B-42 Trench	–	•	–	–	•	–	–	•	–
216-B-52 Trench	•	•	–	–	•	–	–	•	–
216-B-53A Trench	•	•	•	–	•	–	–	•	–

Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
216-B-53B Trench	•	•	–	–	•	–	–	•	–
216-B-54 Trench	•	•	–	–	•	–	–	•	–
216-B-58 Trench	•	•	–	–	•	–	–	•	–
Septic Tanks and Associated Drain Fields									
2607-E1 Septic Tank	–	•	–	–	–	–	–	•	–
2607-E2 Septic Tank	–	•	–	–	–	–	–	•	–
2607-E3 Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-E4 Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-E7B Septic Tank	–	•	–	–	–	–	–	•	–
2607-E8 Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-E9 Septic Tank	–	•	–	–	–	–	–	•	–
2607-E11 Septic Tank	–	•	–	–	–	–	–	•	–
2607-EB Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-EH Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-EK Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-EM Septic Tank	–	•	–	–	–	–	–	•	–
2607-EN Septic Tank	–	•	–	–	–	–	–	•	–

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Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
2607-EO Septic Tank	–	•	–	–	–	–	–	•	–
2607-EP Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-EQ Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
2607-ER Septic Tank	–	•	–	–	–	–	–	•	–
2607-GF Septic Tank/Drain Field	–	•	–	–	–	–	–	•	–
Basins									
207-B Retention Basin	•	–	–	–	–	–	•	•	–
216-B-59B Retention Basin	–	•	–	–	–	–	•	•	–
216-B-64 Retention Basin	•	–	–	–	–	–	–	–	–
Burial Sites									
218-E-2 Burial Ground	•	–	•	–	•	–	–	•	–
218-E-2A Burial Ground	•	–	•	–	–	–	–	–	–
218-E-3 Burial Ground	•	–	–	–	–	–	–	–	–
218-E-4 Burial Ground	•	–	•	–	•	–	–	•	–
218-E-5 Burial Ground	•	–	•	–	•	–	–	•	–
218-E-5A Burial Ground	•	–	•	–	•	–	–	•	–
218-E-6 Burial Ground	–	–	–	–	–	–	–	–	–
218-E-7 Burial Ground	•	–	–	–	•	–	–	•	–

Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
218-E-9 Burial Ground	•	–	•	–	•	–	–	•	–
200 Area Construction Pit	•	–	–	–	–	–	–	–	–
Unplanned Releases									
UN-200-E-7	•	–	–	–	•	–	–	•	–
UN-200-E-9	•	–	–	–	•	–	–	•	–
UN-200-E-14	•	–	–	–	•	–	–	–	–
UN-200-E-41	•	–	–	–	–	–	–	–	–
UN-200-E-43	•		–	–	•	–	–	–	–
UN-200-E-44	•	–	–	–	•	–	–	•	–
UN-200-E-52	•	–	–	–	–	–	–	•	–
UN-200-E-54	•	–	–	–	–	–	–	–	–
UN-200-E-55	•	–	–	–	–	–	–	–	–
UN-200-E-61	•	–	–	–	–	–	–	–	–
UN-200-E-63	•	–	–	–	–	–	–	–	–
UN-200-E-64	•	–	–	–	•	–	–	–	–
UN-200-E-69	•	–	–	–	•	–	–	–	–
UN-200-E-79	•	•	–	–	•	–	–	•	–
UN-200-E-80	•	–	–	–	•	–	–	•	–
UN-200-E-83	•	–	–	–	–	–	–	–	–
UN-200-E-87	•	–	–	–	•	–	–	•	–

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Table 8-6. Applicable Characterization Investigation Methods at B Plant Aggregate Area Waste Management Units.

	Source Investigation Method								
Waste Management Unit	Surface Radiation Survey	Subsurface Spectral Geophysics	Surface Geophysics	Soil Gas Survey	Surface Soil Sampling	Wipe Samples	Surface Water Sediment Sampling	Subsurface Soil Sampling	Remarks
UN-200-E-90	•	–	–	–	•	–	–	–	–
UN-200-E-92	•	–	–	–	–	–	–	–	–
UN-200-E-95	•	–	–	–	•	–	–	–	–
UN-200-E-101	•	–	–	–	•	–	–	–	–
UN-200-E-103	•	–	–	–	•	–	–	–	–
UN-200-E-112	•	–	–	–	–	–	–	–	–
UN-200-E-140		–	–	•	•	–	–	–	–
UPR-200-E-4	•	–	–	–	•	–	–	•	–
UPR-200-E-32	•	•	–	–	•	–	–	•	–
UPR-200-E-34	•	•	–	–	•	–	–	•	–
UPR-200-E-51	•	–	–	–	•	–	–	–	–
UPR-200-E-84	•	–	–	–	•	–	–	•	–
UPR-200-E-138	•	•	–	–	•	–	–	•	–

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9.0 RECOMMENDATIONS

The purpose of the aggregate area management study (AAMS) is to compile and evaluate the existing body of knowledge to support the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) decision making process. A primary task in achieving this purpose is to assess each waste management unit and unplanned release within the aggregate area to determine the most expeditious path for remediation within the statutory requirements of the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) and *Resource Conservation and Recovery Act of 1976* (RCRA). The existing body of pertinent knowledge regarding the B Plant Aggregate Area waste management units and unplanned releases has been summarized and evaluated in the previous sections of this study. A data evaluation process has been established that uses the existing data to develop preliminary recommendations on the appropriate remediation path for each waste management unit. This data evaluation process is a refinement of the *Hanford Site Past-Practice Strategy* (Figure 1-2) and establishes criteria for selecting appropriate *Hanford Site Past-Practice Strategy* paths (expedited response action, ERA; interim remedial measures, IRM; limited field investigation, LFI; and final remedy selection) for individual waste management units and unplanned releases within the 200 Areas. A discussion of the criteria for path selection and the results of the data evaluation process are provided in Sections 9.1 and 9.2, respectively. Figure 9-1 provides a flowchart of the data evaluation process that will be discussed. Table 9-1 provides a summary of the results of data evaluation assessment of each unit. Table 9-2 provides the decision matrix patterns which each unit followed.

This section presents recommended assessment paths for the waste management units and unplanned releases at the B Plant Aggregate Area. These recommendations are only proposed at this time and are subject to adjustment and change. Factors that may affect development of final recommendations include, but are not limited to, comments and advice from the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), or U.S. Department of Energy (DOE); identification and development of new information; and modification of the criteria used in the assessment path decision making process. The data evaluation process depicted in Figure 9-1 and discussed in Section 9.1 was developed to facilitate only the technical data evaluation step shown on the *Hanford Site Past-Practice Strategy* (Box A, Figure 1-2). Procedural and administrative requirements for implementation of the recommendations provided in this AAMS will be performed in accordance with the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) (Ecology et al. 1990) and the *Hanford Site Past-Practice Strategy*. Changes in recommendations will be addressed, and more detail on recommended assessment paths for waste management units and unplanned releases will be included in work plans as they are developed for the actual investigation and remediation activities.

A majority of waste management units and unplanned releases do not have information regarding the nature and extent of contamination necessary for quantitative or qualitative risk assessment, especially with regard to hazardous constituents, and were recommended for additional investigation (e.g., LFI). One unit, the 216-B-5 Reverse Well, was recommended

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for an ERA to assess whether the liquid waste discharged into the groundwater could present time critical migration problems. Several units and releases assessed within the ERA path were recommended for actions that fall within the scope of existing operational programs. Wooden cribs and other waste management units with collapse potential as well as sites with elevated levels of surface radionuclide contamination are addressed by the Radiation Area Remedial Action (RARA) program.

Waste management units and unplanned releases which are addressed entirely by other programs were not subjected to the data evaluation process. This includes units and unplanned releases which are within the scope of the Single-Shell Tank Closure Program, Decommissioning and RCRA Closure Program, and Waste Management Program. Table 9-3 provides a list of the units not included in the data evaluation.

A majority of waste management units not addressed in the data evaluation fall within the scope of the Single-Shell Tank Closure Program. The activities associated with the closure of the 200-BP-7 Operable Unit single-shell tanks have separate *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) milestones and any recommendations for disposition of these units and associated unplanned releases will be developed as part of the ongoing program addressing the single-shell tanks. The units associated with the 241-B, -BX, and -BY Single-Shell Tank Farms that were not evaluated include single-shell tanks and associated diversion boxes, catch tanks, receiver tanks, vaults, and high-level waste transfer lines (Table 9-3).

A discussion of the four decision-making paths shown on Figure 9-1: ERA, IRM, LFI, and final remedy selection, is provided in Section 9.1. Section 9.2 provides a discussion of the waste management units grouped under each of these paths. A discussion of regrouping and prioritization of the waste management units is provided in Section 9.3. Recommendations for redefining operable unit boundaries and prioritizing operable units for work plan development are also provided in Section 9.3. No additional aggregate area-based field characterization activities are recommended to be undertaken as a continuation of the AAMS. All recommendation for future characterization needs (see Section 8.0) will be more fully developed and implemented through work plans. Plan development and submittal will be accomplished in accordance with requirements of the *Hanford Site Past-Practice Strategy* and the Tri-Party Agreement (Ecology et al. 1990) and could include remedial investigation (RI)/feasibility study (FS); RCRA Facility Investigation (RFI)/Corrective Measures Study (CMS) work plans. Sections 9.4 and 9.5 provide recommendations for focused feasibility and treatability studies, respectively.

9.1 DECISION MAKING CRITERIA

The criteria used to assess the most expeditious remediation process path are based primarily on urgency for action and whether site data are adequate to proceed along a given path (Figure 9-1). All waste management units and unplanned releases that are not completely addressed under other Hanford Site programs are assessed in the data evaluation

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process. All of the units and releases that are addressed in the data evaluation process are initially evaluated as candidates for an ERA. Sites where a release has occurred or is imminent are considered candidates for ERAs. Conditions that might trigger an ERA are the determination of an unacceptable health or environmental risk or a short time-frame available to mitigate the problem (DOE/RL 1992a). As a result, candidate ERA units were evaluated against a set of criteria to determine whether potential for exposure to unacceptable health or environmental risks exist. Waste management units and unplanned releases that are recommended for ERAs will undergo a formal evaluation following the selection process outlined in *Prioritizing Sites for Expedited Response Actions at the Hanford Site* (WHC 1991b).

Waste management units and unplanned releases that are not recommended for consideration as an ERA continue through the data evaluation process. Sites continuing through the process that potentially pose a high risk (refer to Section 5.0), become candidates for consideration as an IRM. The criteria used to determine a potential for high risk, thereby indicating a high priority site, were the Hazard Ranking System (HRS) score used for nominating waste management units for CERCLA cleanup (40 CFR 300), the modified Hazard Ranking System (mHRS) scores, surface radiation survey data, and rankings by the Environmental Protection Program (Huckfeldt 1991b). Units and unplanned releases with HRS or mHRS scores greater than 28.5 (the CERCLA cleanup criterion) were designated as candidate sites for IRM consideration. Units and unplanned releases that did not have an HRS score were compared to similar sites to establish an estimated HRS score. As discussed in Sections 5.2.1 and 5.2.2, waste management units with surface contamination greater than 2 mR/h exposure rate, 100 ct/min beta/gamma above background, or alpha greater than 20 dis/min were also designated as candidate IRM sites. In addition, surface contamination sites that had an Environmental Protection Program ranking of greater than 7 were also designated as candidate IRM sites. A value of 7 was chosen because it represents the approximate midpoint of the scoring range. The candidate IRM sites are listed in Table 5-1, which summarizes the high priority units. The four risk indicators are based on limited data (refer to Section 8.0) and therefore may not adequately represent the actual risk posed by the unit. Technical judgement, including assessment of similarities in site operational histories, was used to include sites not ranked as high priority in the list of units under consideration for an IRM. Candidate IRM units were then further evaluated to determine if an IRM is appropriate for the unit. Candidate IRM units that did not meet the IRM criteria were placed into the final remedy selection path. As future data become available the list of units recommended for consideration as IRM units may be altered.

For certain waste management units and unplanned releases, it was recognized that remedial actions could be undertaken under an existing operational or other Hanford Site program (e.g., Single-Shell Tank Closure, RARA, Waste Management, or Decommissioning and RCRA Closure Programs). As a result, recommendations were made that remedial actions be undertaken (partially or completely) outside the 200 AAMS past practice program. Units or unplanned releases that could be addressed only in part by another program (e.g., surface contamination cleanup under the RARA program) remained in the 200 AAMS data evaluation process for further consideration. If it cannot be demonstrated that these units

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will be addressed under the operational program within a time frame compatible with the past practice program, they will be readdressed by the 200 AAMS process. Tracking of waste management units included inoperational programs will be discussed in the work plans developed for each operable unit/aggregate area.

Units and unplanned releases recommended for complete disposition under another program (e.g., single-shell tanks and associated structures under the Single-Shell Tank Closure Program) were not considered in the 200 AAMS data evaluation process. In addition, potentially new units that were identified during the AAMS were also not considered. It is recommended that a formal determination be made regarding the regulatory status of all new sites following established procedures before they are considered further under the 200 AAMS data evaluation process.

Specific criteria used to develop initial recommendation for ERA, LFI, and IRM for units and unplanned releases within the aggregate area are provided in Sections 9.1.1 and 9.1.2. Units and unplanned releases not initially addressed as an ERA, LFI, or IRM will be evaluated under the final remedy selection path discussed in Section 9.1.3.

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9.1.1 Expedited Response Action Path

Candidate ERA sites are evaluated to determine if they pose an unacceptable health or environmental risk and a short time-frame to mitigate the problem exists. All waste management units and unplanned releases other than those recommended for complete disposition under another Hanford program are assessed against the ERA criteria. The *Hanford Site Past-Practice Strategy* describes conditions that might trigger abatement of a candidate waste management unit or unplanned released release under an ERA. Generally, these conditions would rely on a determination of, or suspected, existing or future unacceptable health or environmental risk, and a short time-frame available to mitigate the problem. Conditions include, but are not limited to:

- Actual or potential exposure to nearby human populations, biota, or the food chain from hazardous substances and radioactive or mixed waste contaminants
- Actual or potential contamination of drinking water supplies or sensitive ecosystems
- Threats of release of hazardous substances and radioactive or mixed waste contaminants
- High levels of hazardous substances and radioactive or mixed waste contaminants in soils that pose or may pose a threat to human health or the environment, or have the potential for migration

- Weather conditions that may increase potential for release or migration of hazardous substances and radioactive or mixed waste contaminants
- The availability of other appropriate federal or state response mechanisms to respond to the release
- Time required to develop and implement a final remedy
- Further degradation of the medium which may occur if a response action is not expeditiously initiated
- Risks of fire or explosion or potential for exposure as a result of an accident or failure of a container or handling system
- Other situations or factors that may pose threats to human health or welfare or the environment.

These conditions were used as the initial screening criteria to identify candidate waste management units and unplanned releases for ERAs. Candidate waste management units and releases that did not meet these conditions were not assessed through the ERA evaluation path. Additional criteria for further, detailed screening of ERA candidates were developed based on the conditions outlined in the *Hanford Site Past-Practice Strategy*. Quantification of the criteria for further screening were developed. These screening criteria are shown in Figure 9-1 and are described below.

The next decision point on Figure 9-1 used to assess each ERA candidate is whether a driving force to an exposure pathway exists or is likely to exist. Units or unplanned releases with contamination that is migrating or is likely to significantly migrate to a medium that can result in exposure and harm to humans required additional assessment under the ERA process. Waste management units or unplanned releases where contamination could migrate and, therefore, potentially require significantly more extensive remedial action if left unabated were also assessed in the ERA path.

Waste management units and unplanned releases with a driving force were assessed to determine if an unacceptable health or environmental risk and a short time-frame available to mitigate the problem exists from the release. The criteria used to determine unacceptable risks are based on the quantity and concentration of the release. If the release or imminent release is greater than 100 times the CERCLA reportable quantity for any constituent, the unit or unplanned release will remain in consideration for an ERA. If the release or imminent release contains hazardous constituents at concentrations that are 100 times the most applicable standard, the unit or unplanned release continues to be considered for an ERA. Application of the criterion of 100 times applicable standards is for quantification of the *Hanford Site Past-Practice Strategy* criteria which addresses "high levels of hazardous substances and radioactive or mixed waste contaminants...." The factor of 100 is based on best engineering judgment of what constitutes a high level of contamination warranting

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expedited action. In some cases, engineering judgment was used to estimate the quantity and concentration of a postulated release. Standards applied include Model Toxics Control Act (MTCA) standards for industrial sites and DOE and Westinghouse Hanford radiation criteria (refer to Section 6.0). The application of these standards does not signify they are recognized as ARARs.

The ERA screening criteria, in addition to those presented in the *Hanford Site Past-Practice Strategy* were applied to provide a consistent quantitative basis for making recommendations in the AAMS. The decision to implement the recommendations developed in AAMS will be made collectively between DOE, EPA, and Ecology based only on the criteria established in the *Hanford Site Past-Practice Strategy*.

If a release is unacceptable with respect to health or environmental risk, a technology must be readily available to control the release for a unit or unplanned release to be considered for an ERA. An example that would require substantial technology development before implementation of cleanup would be a tritium release since no established treatment technology is available to separate low concentrations of tritium from water.

The next step in the ERA evaluation path involves determining whether implementation of the available technology would have adverse consequences that would offset the benefits of an ERA. Examples of adverse consequences include: (1) use of technologies that result in risks to cleanup personnel that are much greater than the risks of the release; (2) the ERA would foreclose future remedial actions; and (3) the ERA would prevent or greatly hinder future data collection activities. If adverse consequences are not expected, the site remains in consideration for an ERA.

The final criterion is to determine if the candidate ERA is within the scope of an operational program. Maintenance and operation of active waste management facilities are within the scope of activities administered by the Waste Management Program. Active facilities include certain transfer lines, diversion boxes, catch tanks, and the 244-BX Receiver Tank. Generally, active facilities will not be included in past-practice investigations unless operation is discontinued prior to initiation of the investigation. The Decommissioning and RCRA Closure Program is responsible for safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities and RCRA closures at the Hanford Site. The Decommissioning and RCRA Closure Program is also responsible for RARA activities that include surveillance, maintenance, decontamination, and/or stabilization of inactive burial grounds, cribs, ponds, trenches, and unplanned release sites.

If the proposed ERA will not address all the contamination present, the unit or unplanned release continues through the process to be evaluated under a second path. For example, surface contamination cleanup under the RARA program may not address subsurface contamination and, therefore, additional investigation may be needed.

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Final decisions regarding the conduct of ERAs in the aggregate area will be made among the EPA, Ecology, and the DOE based, at least in part, on the recommendations provided in this section, and results of the final selection process outlined in *Prioritizing Sites for Expedited Response Actions at the Hanford Site* (WHC 1991b).

9.1.2 Limited Field Investigation and Interim Remedial Measure Paths

High priority waste management units and unplanned release sites were evaluated to determine if sufficient need and information exists such that an IRM could be pursued. An IRM is desired for high priority waste management units and unplanned releases where extensive characterization is not necessary to reach defensible cleanup decisions. Implementation of IRMs at waste management units and unplanned releases with minimal characterization is expected to rely on observational data acquired during remedial activities. Successful execution of this strategy is expected to reduce both time and cost for cleanup of waste management units and unplanned releases without impacting the effectiveness of the implemented action.

The initial step in the IRM evaluation path is to categorize the units. The exposure pathways of interest are similar for each waste management unit in a category; therefore, it is effective to evaluate candidate units as a group. The groupings used in Section 2.3 (e.g., cribs; tanks and vaults; etc.) will continue to be used to group the units for IRM assessment. This grouping approach is especially effective in reducing characterization requirements. As is being done in the 100 Areas using the observational approach, the LFIs can be used to characterize a representative unit or units in detail to develop a remedial alternative for the group of units. Observational data obtained during implementation of the remedial alternative could be used to meet unit specific needs. Similarities of waste management units may make it possible to remediate them using the observational approach after first characterizing only a few units. It is expected, therefore, that a LFI would provide sufficient information to proceed with an IRM for groups of similar high priority waste management units.

Data adequacy is assessed in the next step. The existing data are evaluated to determine if: (1) existing data were sufficient to develop a conceptual model and qualitative risk assessment; (2) the IRM will work for this path; (3) implementing the IRM will have adverse impacts on the environment, future remediation activities or data collection efforts; and (4) the benefits of implementing the IRM are greater than the costs. If data are not adequate an assessment was made to determine if an LFI might provide enough data to determine if an IRM is justified, and also to perform an IRM. If an LFI would not collect sufficient data, the unit was addressed in the final remedy selection path.

The final step in the IRM evaluation process is to assess if the IRM will work without significant adverse consequences. This includes: will the IRM be successful? will it create significant adverse environmental impacts (e.g., environmental releases)? will the costs

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outweigh the benefits? will it preclude future cleanup or data collection efforts? and will the risks of the cleanup be greater than the risks of no action? Units where remediation is considered to be possible without adverse consequences outweighing the benefits of the remediation are recommended for IRMs. Low priority unplanned releases at candidate IRM units will be included in the IRM evaluations of the candidate units.

Final decisions will be made among DOE, EPA, and Ecology regarding the conduct of IRMs in the B Plant Aggregate Area based, at least in part, on the recommendations provided in this AAMSR, and the results of a supporting LFI.

9.1.3 Final Remedy Selection Path

Sites recommended for initial consideration in the final remedy selection path are those not recommended for IRMs, LFIs, or ERAs and those considered to be low priority sites. It is recognized that all waste management units and unplanned releases within the operable unit or aggregate area will eventually be addressed collectively under the final remedy path to support a final aggregate area or operable unit Record of Decision (ROD).

The initial step in the final remedy selection process path is to assess whether the combined data from the AAMS, and any completed ERAs, IRMs, and LFIs are adequate for performing a risk assessment (RA) and selecting a final remedy. Whereas the scope of an ERA, IRM, and LFI is limited to individual waste management units or groups of similar waste management units, the final remedy selection path will likely address an entire operable unit or aggregate area.

If the data are collectively sufficient, an operable unit or aggregate area RA will be performed. If sufficient data are not available, additional needs will be identified and collected.

9.2 PATH RECOMMENDATIONS

Initial recommendations for ERA, IRM, and LFI are discussed in Section 9.2.1 through 9.2.3, respectively. Waste management units and unplanned releases proposed for initial consideration under the final remedy selection path are discussed in Section 9.2.4. Table 9-1 provides a summary of the data evaluation process path assessment. A summary of the responses to the decision points on the flowchart that led to the recommendations is provided in Table 9-2. A listing of sites that will be addressed by other operational programs is presented in Table 9-3. Ten waste management units lie within the 200-BP-1 Operable Unit and are not evaluated because work is already in progress under the 200-BP-1 RI/FS Work Plan. These waste management units are the 216-B-43 through 216-B-50 Cribs, the 216-B-57 Crib, and the 216-B-61 Crib. Following approval by DOE, EPA, and Ecology, these recommendations will be further developed and implemented in work plans.

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9.2.1 Proposed Sites for Expedited Response Actions

Fifty-one waste management units and unplanned releases meet all the criteria for an ERA prior to determining whether the proposed action was within the scope of an operational program (Table 9-2). One unit, the 216-B-5 Reverse Well, was recommended for an ERA. The remaining fifty-one candidate ERA units have collapse potential and/or surface contamination and are recommended for disposition under the RARA program. Nine active waste management units receiving liquid discharges were evaluated as candidate ERA units (Section 9.2.1.2). The active units are within the scope the Waste Management Program to discontinue discharges from liquid effluent to the soil column. A discussion of the recommendations for these waste management units are included in this section. Since the anticipated response actions are not expected to fully remediate the ERA candidates, all of the units will be included for further data evaluation in the assessment paths.

9.2.1.1 Cribs and Trenches with Collapse Potential. Thirteen of the older cribs are open wooden structures that could fail catastrophically. Two cribs, 216-B-18 and 216-B-12, have already collapsed. Also, twenty specific retention trenches, two reverse wells, and one burial ground contain wooden structures that could collapse. A sudden collapse could bring contaminated dust from the buried crib, trench, or burial ground to the surface. Based on the inventory data from these units, dust derived from the bottom of the cribs, trenches, and burial ground would be expected to contain radionuclides at several orders of magnitude above reportable quantities and concentration standards. Cribs with potential collapse problems include:

- 216-B-7A
- 216-B-7B
- 216-B-8TF
- 216-B-9TF
- 216-B-10A
- 216-B-10B
- 216-B-12 (already collapsed)
- 216-B-14
- 216-B-15
- 216-B-16
- 216-B-17
- 216-B-18 (already collapsed)
- 216-B-19.

Trenches with potential collapse problems include:

- 216-B-20
- 216-B-23
- 216-B-21
- 216-B-24
- 216-B-22
- 216-B-25

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- 216-B-26
- 216-B-27
- 216-B-28
- 216-B-29
- 216-B-30
- 216-B-53A
- 216-B-54
- 216-B-31
- 216-B-32
- 216-B-33
- 216-B-34
- 216-B-52
- 216-B-53B
- 216-B-58.

The reverse wells with collapse potential are:

- 216-B-11A & 216-B-11B.

The burial ground with collapse potential is:

- 216-E-7.

Maintenance and contamination control measures for cribs, trenches, reverse wells, and burial grounds with collapse potential are implemented under the RARA program. Therefore, actions to mitigate environmental releases from these facilities will be performed under the RARA program. An engineering study has begun under the RARA program to evaluate the potential for crib collapse.

Response actions such as the addition of clean fill material over the cribs or pressure grouting void areas within the crib to prevent collapse may be considered for these waste management units. Evaluation and recommendation of response actions for these facilities will be performed under the RARA program.

9.2.1.2 Active Waste Management Units. Nine active liquid effluent units evaluated by this AAMS operate within the B Plant Aggregate Area; 216-B-55 Crib, 216-B-62 Crib, 216-B-3 Pond, 216-B-3A Pond, 216-B-3B Pond, 216-B-3C Pond, 216-B-3-3 Ditch, 207-B Retention Basin, and 216-B-59B Retention Basin. The 2101-M Pond is an active RCRA facility that is not included in this AAMS. Operation of these facilities provides a potential for migration of radioactive contaminants to the groundwater. Efforts are currently underway to evaluate an alternative that could be implemented that would result in deactivation of these facilities by June 1995. In the interim, hazardous wastes will not be discharged to these units. Evaluation and deactivation of these facilities will remain with the ongoing program and will not be included as part of the past practices investigation. In addition, investigation of contamination associated with the facilities will be deferred until after deactivation of the facilities.

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9.2.1.3 Sites With Significant Surface Contamination. There are forty-five units evaluated by this AAMS (200-BP-1 units excluded) with levels of surface contamination that are high enough to be of immediate concern. Surface contamination is immediately accessible to humans (i.e., workers) and biota. The potential for transport by the wind or biota is also significant and so surface migration is also a problem. It is expected that the releases of radionuclides and potential radiation exposure levels at these sites would be greater than 100 times reportable quantities and quality standards. The corrective actions for these surface contamination sites are addressed within the scope of the RARA program.

Surface contamination exists in areas around the 216-B-7A & -7B, 216-B-8, and 216-B-55 Cribs as well as the 216-B-51 French Drain. Some of these areas include unplanned releases. These areas are recommended for evaluation and stabilization under the RARA program.

The 216-B-5, -11A, and -11B Reverse Wells have surface contamination. These units are being stabilized under the RARA program. The 216-B-5 Reverse Well is also recommended for an ERA.

The 216-B-3 Pond, and the 216-B-2-1, -2-2, and -2-3 Ditches have surface contamination present in localized hot spots. These units are being stabilized under the RARA program.

Surface contamination exists in an area around the 216-B-20 through 216-B-34 and 216-B-52, 216-B-53A & B, 216-B-54, and 216-B-58 Trenches. These areas are recommended for evaluation and implementation under the RARA program.

Surface contamination exists at the 207-B Retention Basin and in an area west of the 216-B-64 Retention Basin. The 216-B-64 Retention Basin has never been used and the contamination present near it may be the result of leakage from the 270-E Tank. Unplanned release UN-200-E-64 is associated with the 216-B-64 Retention Basin. These units are recommended for evaluation and implementation under the RARA program.

The 218-E-2, 216-E-4, 216-E-5, 216-E-5A, and 216-E-9 Burial Grounds have significant surface contamination present. These sites are being stabilized as part of the RARA program.

Surface contamination exists at the sites of six unplanned releases, UN-200-E-63, UN-200-E-64, UN-200-E-83, UN-200-E-95, UPR-200-E-32, and UPR-200-E-84. Unplanned releases UN-200-E-64 and -83 cover a very large area of several square miles. These sites are recommended for evaluation and implementation under the RARA program.

9.2.1.4 Non-ERA Sites. The primary reason most waste management units were not recommended for ERAs was because of the lack of driving force to an exposure pathway. Inactive cribs, ponds, ditches, and trenches are no longer receiving waste and, therefore, no longer have artificial recharge as a driving force to move subsurface contaminants. Natural

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recharge from local precipitation was not considered a significant short-term driving force. Specifics for each waste management unit or unplanned release are provided in Table 9-2.

9.2.2 Proposed Sites for Interim Remedial Measures

Sixty-one of the 139 waste management units and unplanned releases addressed in the B Plant Aggregate Area data evaluation process were identified as high priority waste management units (refer to Section 5.0) and were assessed as candidates for IRMs. NIneteen of the 61 waste management units and unplanned releases were designated as high priority units because of high HRS and mHRS scores. Thirty-eight of the other waste management units and unplanned releases were designated as high priority because of surface radiation measurements. The Environmental Protection rankings added one unit to the high priority list. The remaining three high priority waste management units were designated so because of their similarity to other high priority units (see Section 5.3). Septic tanks and drain fields were not considered in the IRM path.

Nine of the 61 high priority units are being addressed under the 200-BP-1 RI/FS Work Plan. One of the other high priority units, the 216-B-5 Reverse Well, is recommended for an ERA. Therefore, a total of 51 units are considered as IRM candidates for this AAMS.

All of the 51 candidate IRM waste management units or releases met the criteria for IRM designation with the exception of having adequate data. It was determined that an LFI could gather sufficient data for an IRM, therefore all of the sites remain IRM candidates. A discussion of the LFIs is provided in Section 9.2.3.

9.2.3 Proposed Sites for Limited Field Investigation Activities

Seventy-three of the 139 waste management units and unplanned releases are recommended to undergo LFIs (See Table 9-1). Fifty-one of the 73 units are categorized as high priority units (see Section 9.2.2). An additional six cribs, three ditches, one trench, one pond and eleven unplanned releases were included in the LFI group because of their association with LFI sites. The initial decision point in the IRM path is to assess whether data are adequate to conduct an IRM. For each of the 73 units, with the exception of the five units comprising the 216-B-3 Pond System (216-B-3, -3A, -3B, & -3C Ponds, and 216-B-3-3 Ditches), only screening level field data and inventory estimates are available. For the active 216-B-3 Pond System units, sampling is underway (WHC 1991c) as a part of ongoing RCRA closure activities and the early data from this sampling is summarized in Table 4-21. Additional sampling will be required to describe the nature and extent of contamination as a part of LFIs before IRMs can be implemented. The LFIs/IRMs should be integrated with the RCRA closure activities to ensure maximum efficiency, compatibility of remedial measures, and minimal duplication of efforts. This integration is discussed further in Section 9.3.4.4. For the remaining units, no data are available describing the nature and extent of contamination, so LFIs are required before IRMs may be implemented. The rationale for

IRMs and LFIs will be more completely developed in work plans, however, the following addresses possible considerations during work plan development.

Possible LFI objectives would be to:

- Evaluate the potential for releases from the waste management unit to impact underlying groundwater quality.
- Determine if contamination exists in the soil beneath the waste management unit and, if so, assess the extent.
- Assess the nature and extent of contaminant migration from the units in support of focused feasibility studies.

Each waste management unit that is recommended for an LFI will be studied as part of an analogous group. The analogous site concept is presented in the *Hanford Site Past-Practice Strategy*.

This concept emphasizes that characterization activities can be reduced by identifying select sites (analogue sites) for characterization that are representative of group sites (analogous groups). This concept is particularly applicable to operable units which contain a number of waste management units that are similar in design, disposal history, and geology.

Appropriate confirmatory characterization, as necessary to support remedial action, can then be performed at the sites within each analogous group during remediation. Collection of confirmatory data can again be reduced during remediation activities by emphasizing in work plans the use of the observational approach discussed in the *Hanford Site Past-Practice Strategy*.

To facilitate the implementation of these strategies in work plans, individual LFIs are assembled into analogous groups for study. Six analogous groups have been identified in the B Plant Aggregate Area: (1) cribs and french drains, (2) reverse wells, (3) ponds and ditches, (4) retention basins, (5) specific retention trenches, and (6)burial grounds. Specific waste management units are then identified that are considered to be representative of the analogous groups. Considerations used to select an analogue site for an analogous group include, but are not limited to, the following:

- Disposal history (including type and quantity of waste received)
- Physical and chemical setting.

Generally, the selection process favored as analogue sites those units or releases that received the most waste and were considered as conservative samples in terms of release mechanism, media of concern, exposure routes, and receptors.

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9.2.3.1 Crib and French Drains. Fourteen cribs and one french drain have been recommended for LFIs as an analogous group. These units are:

- 216-B-7A Crib
- 216-B-7B Crib
- 216-B-8TF Crib
- 216-B-9TF Crib
- 216-B-10A Crib
- 216-B-10B Crib
- 216-B-12 Crib (collapsed)
- 216-B-14 Crib
- 216-B-15 Crib
- 216-B-16 Crib
- 216-B-17 Crib
- 216-B-18 Crib (collapsed)
- 216-B-19 Crib
- 216-B-55 Crib
- 216-B-51 French Drain.

The cribs and french drain are grouped together because of their similar physical configuration and function and because they have similar release points. The physical and chemical settings for the releases from these waste management units that are generally similar are:

- Relatively large-scale liquid releases (greater than 1,000,000 L [264,000 gal]) occurred at these waste management units and wastewater probably reached the unconfined aquifer beneath the units (Table 4-14).

- The waste management units were completed at about the same depths and in the same stratigraphic horizons. The depth to groundwater is also similar for all of the units (62 to 99 m [200 to 320 ft]).

- The vadose zone stratigraphy is generally uniform beneath the aggregate area and would tend to favor the downward movement of fluid with little lateral spreading (Section 3.0).

The 216-7A and -7B Cribs are selected as analogue sites because they received the largest inventory of plutonium of any of the analogue cribs and because they are typical in construction details for the wooden cribs. They each contain a hollow structure containing plutonium sludges that has a collapse potential. The two cribs are located only 6 m (20 ft) apart so they will be investigated as a single unit rather than attempting to investigate one or the other separately. These cribs are representative of the 216-B-8TF, 216-9-TF, 216-B-10A, 216-B-10B Cribs, and the 216-B-51 French Drain based on their physical configuration and the waste streams they received (2nd cycle waste supernatant, plutonium concentration waste from 224-B, and laboratory waste from 222-B).

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The 216-B-12 Crib is selected as an analogue unit because it received the largest volume of the two cribs which received large volumes of evaporator condensate. This crib is representative of the 216-B-55 Crib based on the type and volume of waste received.

The 216-B-14 Crib is selected as an analogue unit because it received the largest volume of the six cribs which received scavenged tributyl phosphate waste in the BC crib area. This crib is representative of the 216-B-15, 216-B-16, 216-B-17, 216-B-18, and 216-B-19 Cribs based on the physical configuration, type and volume of waste received.

Thirteen of these cribs have collapse potential and will be addressed under the RARA Program (Section 9.2.1). The french drain will also be addressed under the RARA program for surface contamination. The actions implemented under the RARA Program will precede the LFI activities.

The cribs and french drain with surface contamination were addressed in the IRM path after first being assessed in the ERA path. The actions recommended for the units will not address the subsurface contaminations in the facilities; therefore, they were included for assessment under the remaining criteria.

9.2.3.2 Reverse Wells. Four reverse wells have been recommended for LFIs as an analogous group. The reverse wells are:

- 216-B-4 Reverse Well
- 216-B-6 Reverse Well
- 216-B-11A Reverse Well
- 216-B-11B Reverse Well.

The four reverse wells are proposed as an analogous group due to their similar operational history (less than 5 year operating life), similar physical configuration, and wastes received (stack drainage, cooling water, sample slurper wastes, process condensate) which were generally had lower levels of contamination than wastes disposed of at other sites.

The physical and chemical setting for releases from these waste management units is also similar:

- Relatively large-scale liquid releases, up to 29,600,000 L (7,820,000 gal) occurred at these waste management units and wastewater probably reached the unconfined aquifer beneath the units (Table 4-14).

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- The waste management units were completed at about the same depths (12 to 33 m [40 to 110 ft]) and in the same stratigraphic horizons. The depth to groundwater is also similar for all of the units (26 to 48 m [85 to 157 ft]).

- The vadose zone stratigraphy is generally uniform beneath the aggregate area and would tend to favor the downward movement of fluid with little lateral spreading.

The 216-B-11A Reverse Well is proposed as an analogue site for these waste management units. This unit received the largest volume of waste and contains the largest inventory of radionuclides of the units in this group.

The 216-B-11A and 216-B-11B Reverse Wells were identified as having collapse potential based on the most recent radiological survey. These wells will be addressed under the RARA program (Section 9.2.1). The actions implemented under the RARA program will precede the LFI activities.

9.2.3.3 Ponds and Ditches. Five ponds, six ditches, and one trench (the 216-B-63 Trench is being redesignated as a ditch) have been recommended for LFIs. These units have insufficient data to conduct an IRM and have been assigned to this analogous group based on similarities in the waste streams handled and in their physical configuration as surface water bodies which provide infiltration of the waste waters received. The units are:

- 216-B-3 Pond
- 216-B-3A Pond
- 216-B-3B Pond
- 216-B-3C Pond
- 216-A-25 Pond
- 216-B-2-1 Ditch
- 216-B-2-2 Ditch
- 216-B-2-3 Ditch
- 216-B-3-1 Ditch
- 216-B-3-2 Ditch
- 216-B-3-3 Ditch
- 216-B-63 Trench/Ditch.

The physical and chemical setting for releases from these waste management units are also similar:

- Similar, large-scale liquid releases have occurred at these waste management units and wastewater probably reached the unconfined aquifer beneath each unit (Table 4-14).

- All of the waste management units were installed near the surface in the upper gravel unit of the Hanford formation. The depth to groundwater is also similar for all of the units (45 to 76 m [148 to 250 ft]).

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- The vadose zone stratigraphy is generally uniform beneath the aggregate area and would tend to favor the downward movement of fluid with little lateral spreading.

The 216-B-2-1 Ditch is proposed as an analogue unit for study. This unit received a waste volume as large as the largest volume of liquid waste received by any of the six ditch waste management units. It is typical in construction, design and function for this type of waste management unit and contains a relatively large inventory of radionuclides as a result of Unplanned Release UPR-200-E-32. Unplanned Release UPR-200-E-138 released a similar large inventory of radionuclides to the 216-B-2-2 Ditch. The 216-B-2-1 Ditch is believed to be representative of the 216-B-2-2, 216-B-2-3, 216-B-3-1, 216-B-3-2, 216-B-3-3 Ditches, and the 216-B-63 Trench/Ditch.

The 216-B-3 Pond is proposed as an analogue unit for study. This unit has the longest operational history and has received the largest volume of waste of any of the pond waste management units included in this analogous group. This unit is representative of the 216-B-3A Pond.

The four ponds have been included in the LFI program due to the releases that have been introduced into the pond system and the lack of data to differentiate the individual units. They were assessed under the ERA path but were not selected due to the reportable quantity criteria or because they were covered under operational programs.

The 216-B-2-1, -2, and -3 Ditches have all been included because of surface contamination and are to be included under the RARA Program activities (Section 9.2.1). The RARA activities will precede LFI action. The 216-B-3-1, -2, and -3 Ditches are included because of their similarity to the 216-B-2 Ditches. The 216-B-63 Ditch is included because of its close proximity to the 216-B-2-1 Ditch.

9.2.3.4 Retention Basins. Two retention basins located in the B Plant Aggregate Area have been recommended for LFIs. The two units are the 207-B Retention Basin and the 216-B-64 Retention Basin and both were cited for inclusion as an LFI due to surface contamination. Both were evaluated on the ERA path. The 207-B Retention Basin was eliminated from consideration due to quantity consideration. The 216-B-64 Retention Basin is recommended for Operational Programs status as a RARA program site. This waste management unit is associated with unplanned release UN-200-E-64.

These two sites will be investigated separately because the only contamination associated with the 216-B-64 Retention Basin is that which resulted in unplanned release UN-200-E-64. The unplanned release has now spread to a size of about 2 acres due to burrowing ants.

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9.2.3.5 Specific Retention Trenches. The following twenty specific retention trenches are recommended for LFIs as an analogous group.

- 216-B-20 Trench
- 216-B-21 Trench
- 216-B-22 Trench
- 216-B-23 Trench
- 216-B-24 Trench
- 216-B-25 Trench
- 216-B-26 Trench
- 216-B-27 Trench
- 216-B-28 Trench
- 216-B-29 Trench
- 216-B-30 Trench
- 216-B-31 Trench
- 216-B-32 Trench
- 216-B-33 Trench
- 216-B-34 Trench
- 216-B-52 Trench
- 216-B-53A Trench
- 216-B-53B Trench
- 216-B-54 Trench
- 216-B-58 Trench.

These trenches are grouped together because of their similar operational history, and the similarities in the waste they received and the purpose for which they were used. Additionally, the trenches are all in close proximity. These trenches all received overflow from the ferrocyanide tank scavenging process that was used to reduce waste volume (Section 2.4.8). The trenches were all built to a similar plan.

The physical and chemical setting for releases from these waste management units is also similar.

- Similar, large-scale volumes of scavenging overflow or Plutonium Recycle Test Reactor from the 300 Area waste liquid were released at the trenches and wastewater probably reached the unconfined aquifer beneath the units (Table 4-14).

- The waste management units were completed to about the same depths and in the same stratigraphic horizons. The depth to groundwater is also similar for all of the units (101m [330 ft]).

- The vadose zone stratigraphy is generally uniform beneath the aggregate area (Section 3.0) and would tend to favor the downward movement of fluid with little lateral spreading.

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The 216-B-26 is proposed as an analogue unit because it received the second largest volume of liquid waste, the largest inventory of ^{90}Sr, and the second-highest inventory of ^{137}Cs. The 216-B-26 Trench is considered representative of the 216-B-20, -21, -22, -23, -24, -25, -27, -28, -29, -30, -31, -32, -33, and -34 Trenches basad on their physical configuration and the waste streams they received.

The 216-B-52 and -53A Trenches are proposed as analogous units. The 216-B-52 Trench received the large volume of liquid and the largest inventory of ferrocyanide and nitrate. The 216-B-53A Trench has the largest inventory of plutonium. The 216-B-52 and -53A Trenches are considered representative of the 216-B-53B, -54, and -58 Trenches based on their physical configuration and the waste streams they received.

All twenty trenches have been included for LFI because of surface contamination and are to be included under the RARA Program activities. The RARA activities will precede LFI action.

9.2.3.6 Burial Grounds. The following five burial grounds are recommended for LFIs as an analogous group.

- 218-E-2
- 218-E-4
- 218-E-5
- 218-E-5A
- 218-E-9.

The burial ground waste management units have been grouped together because they are similar in construction and received similar types of contaminated solid waste. They are similar in details of construction although they vary in physical size.

The physical and chemical setting for releases from these waste management units is also similar:

- Radionuclide-contaminated solid waste was disposed using similar methods at these sites.
- The units all have similar depths to groundwater.
- The vadose zone stratigraphy is generally uniform beneath the aggregate area (Section 3.0).

The 218-E-5A Burial Ground is proposed as the analogue site for these waste management units. This unit is the largest in area and contains the largest inventory of plutonium. It also received the largest waste volume.

All five burial grounds were considered high priority due to surface contamination but all lacked sufficient information to determine if an IRM is justified.

9.2.3.7 Unplanned Releases. Fifteen unplanned releases are suggested for LFI status. Five are included due to surface radiation and the remainder are included due to their history of proximity to other LFI sites. The fifteen unplanned release recommended for LFI are listed below.

- UN-200-E-41
- UN-200-E-44
- UN-200-E-63
- UN-200-E-69
- UN-200-E-83
- UN-200-E-95
- UPR-200-E-32
- UPR-200-E-138.
- UN-200-E-43
- UN-200-E-52
- UN-200-E-64
- UN-200-E-80
- UN-200-E-90
- UN-200-E-103
- UPR-200-E-84

9.2.4 Proposed Sites for Final Remedy Selection

A number of unplanned releases, along with several diverse waste management units which are unique because of design, contaminants received, or operational history, have been proposed for the final remedy selection path. No sites have been proposed for direct inclusion in the final remedy risk assessment (RA). Direct inclusion in the final remedy selection RI is recommended for the remainder of the waste management units and unplanned releases due to the lack of information to perform RAs and select final remedies. These waste management units and unplanned releases are discussed in Section 9.2.4.1.

Ten waste management units are in the 200-BP-1 Operable Unit. Work is in progress in this operable unit under the 200-BP-1 RI/RS Work Plan. These waste management units will not be discussed further.

9.2.4.1 Proposed Sites for Remedial Investigation. A RI has been recommended for the B Plant Aggregate Area, which includes several groups of waste management units and unplanned releases. The first group generally contains a mix of unique units that were assessed in the IRM path but had insufficient data to conduct an IRM. The second group consists of low priority trenches (dry trenches) that generally received one time transfers of waste, and cribs, ditches, ponds, and french drains that did not meet the high priority

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criteria. The third group contains septic tanks and drain fields that require confirmatory sampling to show that the sites do not contain hazardous or radioactive substances. The fourth group contains burial sites that require confirmatory sampling to show no contamination exists. The fifth group contains low priority unplanned releases that have unique contamination histories.

9.2.4.1.1 Retention Basin and Settling Tank. Two waste management units within this group were assessed in the IRM path prior to designation as final remedy sites. The sites include:

- 241-B-361 Settling Tank
- 216-B-59B Retention Basin.

The settling tank was assigned a low HRS score and is not sufficiently similar to high priority units to warrant evaluation under the IRM path, so it could not be recommended for a LFI.

The retention basin is currently an operational unit and no unplanned releases have been associated with it. It was originally constructed as a crib and received a small quantity of waste early in its operational history prior to conversion to a retention basin.

Insufficient data exists at these sites to conduct a RA. A RI is recommended that would include each of these sites to provide nature and extent of contamination information to perform a risk assessment for final remedy selection.

9.2.4.1.2 Cribs, French Drains, Ponds, Ditches, and Trenches. Cribs, french drains, ponds, ditches, and trenches are grouped as a single class because of their similarity. These waste management units were all designed to dispose of wastewater by discharging it to the soil column in a relatively shallow excavation. The water entered the soil column through the bottom of the excavated area and penetrated the soil column. The contaminants were either contained within the excavation or passed into the soil column and are suspended in the soil column below the waste management unit. The waste management units included in this group are:

- 216-B-56 Crib
- 216-B-60 Crib
- 216-B-62 Crib
- Chemical TF North of 2703-E
- 216-B-13 French Drain.
- 216-N-8 Pond
- 216-E-28 Contingency Pond
- 216-B-35 through 216-B-42 Trenches

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All of these waste management units are low priority units based on their HRS score. Insufficient data exists to determine the nature and extent of contamination at these sites. Therefore, a RI that includes each unit was recommended to provide data adequate to perform a RA and select a final remedy for the units.

9.2.4.1.3 Septic Tanks and Drain Fields. Confirmatory investigation levels should be performed at each of the eighteen septic tanks and drain fields:

- 2607-E1 Septic Tank
- 2607-E2 Septic Tank
- 2607-E3 Septic Tank/Drain Field
- 2607-E4 Septic Tank/Drain Field
- 2607-E7B Septic Tank
- 2607-E8 Septic Tank/Drain Field
- 2607-E9 Septic Tank
- 2607-E11 Septic Tank
- 2607-EB Septic Tank/Drain Field
- 2607-EH Septic Tank/Drain Field
- 2607-EK Septic Tank/Drain Field
- 2607-EM Septic Tank
- 2607-EN Septic Tank
- 2607-EO Septic Tank
- 2607-EP Septic Tank/Drain Field
- 2607-EQ Septic Tank/Drain Field
- 2607-ER Septic Tank
- 2607-GF Septic Tank/Drain Field.

These sites have all been assigned low HRS scores by comparison with other units. These sites were all used to dispose of sanitary waste and are considered unlikely to have chemical or radiological contamination present.

There are no sampling or inventory data for any of the sites and so a RA cannot be performed. The purpose of a limited sampling program is to confirm that no contamination exists in the tanks and drain fields. If no contamination were to be found, then no further action would likely be recommended.

9.2.4.1.4 Burial Grounds. Five burial grounds have been grouped together as a single class because of their similarity. The burial ground sites are:

- 218-E-2A Burial Ground
- 218-E-3 Burial Ground
- 218-E-6 Burial Ground

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- 218-E-7 Burial Ground
- 200 East Area Construction Pit.

Two sites, the 200 Area Construction Pit and the 218-E-2A Burial Ground, were not used to dispose of contaminated materials. Confirmatory investigation levels should be conducted at these sites. If no contamination were to be found, then no further action would likely be recommended.

The other three burial ground sites were used to dispose of contaminated solid materials and contain subsurface radioactive contamination. Insufficient sampling and inventory data exists for these sites to perform a RA. Therefore, a RI that includes each unit was recommended to provide data adequate to perform a RA and select a final remedy for the units. The unique nature of the units will not allow for investigation of a representative unit and applying the information to the other sites.

9.2.4.1.5 Unplanned Releases. Fifteen unplanned releases with known contamination are candidates for inclusion in an aggregate area or operable unit RI. These sites are:

- UN-200-E-7
- UN-200-E-9
- UN-200-E-14
- UN-200-E-54
- UN-200-E-55
- UN-200-E-61
- UN-200-E-79
- UN-200-E-87
- UN-200-E-92.
- UN-200-E-101
- UN-200-E-112
- UN-200-E-140
- UPR-200-E-4
- UPR-200-E-34
- UN-200-E-51

The unplanned releases all had low HRS scores and surface radiation levels and were classified as low priority. The low priority releases are assessed under the final remedy selection path. A lack of soil sample data and inconsistent or incomplete survey data make RA completion impossible. A RI needs to be performed to identify the contaminants and their extent.

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9.3 SOURCE OPERABLE UNIT REDEFINITION AND PRIORITIZATION

The investigation process can be made more efficient if waste management units with similar histories and waste constituents are studied together. The data needs and remedial actions required for similar waste management units are generally the same. It is much easier to ensure a consistent level of effort and investigation methodology if like waste management units are grouped together. Economies of scale also make the investigation process more cost effective if similar waste management units are studied together.

9.3.1 Units Addressed by Other Aggregate Areas or Programs

The investigation of several sites in the B Plant Aggregate Area will be addressed by other programs for investigation. The programs include the Decommissioning and RCRA Closure Program (D&RCP), the Waste Management Program (WMP), and Single-Shell Tank Closure Program (SSTCP). Table 9-3 lists the waste management units and unplanned releases that are within the scope of these programs. No waste management units within the B Plant aggregate area are recommended for deferral to another aggregate area.

The waste management unit recommended for the Decommissioning and RCRA Closure Program:

- 270-E Condensate Neutralization Tank.

Remediation of this unit can be most effectively addressed through the Decommissioning and RCRA Closure Program.

Many of the waste management units associated with the operation of the 241-B, 241-BX, and 241-BY Single-Shell Tank Farms are addressed by the Single-Shell Tank Closure Program. The units include all of the diversion boxes, catch tanks, vaults, receiving tanks, and associated process piping in the B Plant Aggregate Area as well as the unplanned releases that are located in the tank farms and associated with these waste management units.

Deactivation of active liquid effluent units should remain within the existing Waste Management Program. The active liquid effluent facilities are listed in Table 9-1. Investigation of these facilities will be deferred until after deactivation.

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9.3.2 B Plant Aggregate Area Operable Unit Redefinition

Redefinition of the B Plant Aggregate Area operable units is suggested based on the data evaluation in this report. General redefinition is recommended as follows:

- Investigation of groundwater should be removed from the scope and included in a 200 East Aggregate Area Groundwater operable unit. Groundwater beneath the B Plant Aggregate Area operable units interacts with all surrounding operable units since it is not confined by the geographic boundaries. Contamination from nearby operable units can migrate beneath any of the B Plant operable units. Similarly, the contamination originating from the operable unit may migrate outside the boundaries of the operable unit. These interactions with other operable units will necessitate the integration of groundwater response actions throughout the 200 East Area. This integration will be discussed in the 200 East Groundwater Aggregate Area Management Study.

- High-level waste transfer facilities and encased pipelines should remain within the scope of the Waste Management Program and the Decommissioning and RCRA Closure Program. The facilities are also structures with no unplanned releases and can be dealt with more efficiently in these existing Hanford programs. The Tri-Party Agreement does not include these lines within the scope of the past-practices investigation.

- Waste management units fully addressed by other programs which should not be included in the aggregate area investigations (e.g., 2101-M Pond, active waste management units, etc.) are listed in Table 9-3.

Specific redefinition of the operable units are as follows:

- The 200-BP-8 Operable Unit should be combined into the 200-BP-11 Operable Unit. The 200-BP-8 Operable Unit contains similar waste management units to those of 200-BP-11 with interrelated process histories. The investigation of these waste management units associated with B Pond should be collectively addressed as one operable unit.

- The 216-A-29 Ditch in the 200-PO-5 Operable Unit in the PUREX Plant Aggregate Area should be reassigned to the 200-BP-11 Operable Unit. This waste management unit has a process history and contaminant inventory similar to the 216-B-3-3 Ditch and the 216-B-3 Pond System and is better investigated with those waste management units in the 200-BP-11 Operable Unit.

- The 200-BP-8 Designator Unit should be reassigned as a groundwater operable unit, the scope of which will be defined by the 200 East Groundwater AAMS.

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9.3.3 Investigation Prioritization

Very little data exist to rank the waste management units and unplanned releases within the B Plant Aggregate Area on a risk-related basis. The HRS and surface contamination data that were used to sort the waste management units and unplanned releases into either high or low priority are indicators of potential risk but are not suitable to develop a risk-related ranking. The most useful data for indicating potential risk are probably the waste inventories and facility construction or operation information.

Based on inventories of contaminants intentionally discharged, the eight cribs located in the 200-BP-1 Operable Unit north of the 241-BY Tank Farm received the largest quantities of contamination. This has resulted in priority being given to 200-BP-1. A work plan has been approved for the 200-BP-1 Operable Unit and the RI Phase I field work is complete. Currently, the RI report is being prepared.

The RCRA closure activities are underway for the 200-BP-11 Operable Unit. Phase I and III sampling has been completed and further work will be initiated following approval of the 216-B-3 Pond Closure/Postclosure Plan. This activity must be scheduled so that Tri-Party Agreement milestone dates are met. This requires that the 200-BP-11 Operable Unit be prioritized ahead of the remaining operable units.

Two of the operable units, 200-BP-5 and 200-BP-4, contain waste management units which received relatively large inventories of plutonium. The 200-BP-5 Operable Unit contain the 216-B-5 Reverse Well that received plutonium contamination which may have entered groundwater. The 216-B-5 Reverse Well has been selected for an ERA. The remainder of the 200-BP-5 Operable Unit will be given a lower priority following completion of the ERA for the 216-B-5 Reverse Well. The 200-BP-4 Operable Unit contains the 216-B-7A and -7B Cribs which received a waste stream containing plutonium similar to that which discharged to the 216-B-5 Reverse Well. The plutonium inventory gives the 200-BP-4 Operable Unit the highest priority after 200-BP-11.

The 200-BP-2 and 200-BP-3 Operable Units contain specific retention trenches and cribs which received relatively large inventories of contaminants. An unplanned release from the 200-BP-2 Operable Unit has covered a large area south of the operable unit. Based on the inventories of radionuclides discharged to the trenches and their potential for continuing release to the environment, the 200-BP-2 and 200-BP-3 Operable Units should be investigated next.

The 200-BP-5 Operable Unit will be investigated after the 200-BP-3 Operable Unit. The completion of the ERA for the 216-B-5 Reverse Well reduces the priority for investigation of the remaining waste management units within the operable unit.

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Based on inventory, the order for investigation for the remaining operable units should be 200-BP-9, 200-IU-6, 200-BP-8, 200-BP-10, 200-BP-6, and 200-SS-1. The 200-BP-7 Operable Unit includes the Single-Shell Tank Farms and is recommended for dispositioning under the Single-Shell Tank Closure Program.

The summarized priority for investigation is:

- 200-BP-11
- 200-BP-4
- 200-BP-2
- 200-BP-3
- 200-BP-5
- 200-BP-9
- 200-IU-6
- 200-BP-8
- 200-BP-10
- 200-BP-6
- 200-SS-1.

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9.3.4 RCRA Facility Interface

A number of RCRA waste management units exist in the B Plant Aggregate Area. They include:

- Liquid Effluent Retention Facility (LERF)
- 218-E-10 Burial Ground
- 200 East Powerhouse Ashpit
- 244-BX Receiver Tank
- B Plant Waste Concentrator

- B Plant Waste Piles
- B Plant Radioactive Organic Waste Solvent Tanks Nos. 1 through 7
- 2101-M Pond
- 200-E-8 Borrow Pit Demolition Site
- Tank systems in the 241-B, 241-BX, and 241-BY Tank Farms
- 216-B-63 Trench
- 216-B-3-3 Ditch
- 216-B-3 Pond
- 216-B-3A Pond
- 216-B-3B Pond
- 216-B-3C Pond.

In addition, the 216-A-29 Ditch, which has been recommended for transfer from the 200-PO-5 Operable Unit to the 200-BP-11 Operable Unit, is also identified as a RCRA Part A interim status waste management unit. The ditch has been deactivated and stabilized, and a closure plan is being developed.

9.3.4.1 Active RCRA TSD Facilities. The LERF is currently under construction and is being built to meet the requirements for a RCRA TSD facility. A Part B final status permit will be issued for LERF. The 218-E-10 Burial Ground, the 200 East Powerhouse Ashpit, the 244-BX Receiver Tank, and operational equipment and storage sites within the B Plant Aggregate Area described in Section 2.6 are currently operating under RCRA Part A interim status. A Part B final status disposal permit is being sought for the 218-E-10 Burial Ground. A Part B permit application has been submitted to Ecology for review; approval is expected by 1995. Likewise, a treatment and storage Part B final status permit is being sought for several units at the 221-B Building. These units are the B Plant Waste Concentrator, the B Plant Waste Piles, and the B Plant Radioactive Organic Waste Solvent Tanks No. 1 through 7.

All of the units described in the preceding paragraph will continue to be active, operating facilities. Closure is not anticipated to occur for some time. Thus, there will be no need to interface with the past practices program for these units at this time. In the event that any of these RCRA TSD facilities are closed while past practices investigation or remediation activities are still occurring, it will be necessary at that time for the RCRA TSD closure activities to interface with the past practices program. Currently, it is recommended

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that closure of LERF, 218-E-10 Burial Ground, 200 East Powerhouse Ashpit, 244-BX Receiver Tank, B Plant Waste Concentrator, B Plant Waste Piles, and B Plant Radioactive Organic Waste Solvent Tanks be conducted completely under the RCRA TSD Program.

9.3.4.2 RCRA Clean Closures. The 2101-M Pond will undergo RCRA clean closure. The RCRA closure sampling and analysis plan for pond soil sampling and analysis, groundwater monitoring, and sediment sampling was completed in 1991. Administrative and physical controls to assure that no dangerous wastes are discharged have been implemented. All discharges of water to the 2101-M Pond are scheduled to cease by June 1995. To date, sampling and analyses have not detected any significant chemical or radionuclide contamination. It is recommended that closure and, if necessary, future remediation of the pond remain completely under the RCRA Program.

A RCRA clean closure plan is being prepared for the 200-E-8 Borrow Pit. The closure plan for the pit is to be submitted to Ecology and EPA in November 1992. Approval is expected by 1996. It is not expected that past practices at the pit affect other past practice units or activities in the B Plant Aggregate Area. Therefore, it is recommended that closure and, if necessary, remediation of the 200-E-8 Borrow Pit be performed completely under the RCRA Program.

Clean closure is also anticipated for a number of units included in the B Pond System; these are discussed in Section 9.3.4.4.

9.3.4.3 RCRA Single-Shell Tanks. The RCRA regulated 241-B, 241-BX, and 241-BY Tank Farms and associated facilities will be addressed under the Single-Shell Tank Closure Program and are under a separate Tri-Party Agreement 30-year schedule. Therefore, although there will be RCRA interfaces on these tanks, these interfaces are not addressed under this AAMS.

9.3.4.4 B Pond System. As discussed in Section 9.3.2, it is recommended that the waste management units in the 200-BP-8 Operable Unit be consolidated into the 200-BP-11 Operable Unit. It will also be recommended that the 216-A-29 Ditch be transferred from the 200-PO-5 Operable Unit to the 200-BP-11 Operable Unit. This would result in the 200-BP-11 Operable Unit including the ponds, ditches and trench associated with the B Pond System.

The waste management units in the B Pond System have been recommended for consideration under the IRM path. To be successful, the LFIs/IRMs should be integrated with ongoing RCRA closure activities to ensure maximum efficiency, compatibility of remedial measures, and minimal duplication of efforts. Recommendations for such integration are discussed in detail, below.

All of the RCRA TSDs in the B Pond System are scheduled to undergo closure, with some of the units expected to be subject to post-closure care. Closure plans have been

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prepared for a number of the units. To date, these closure plans have not completely incorporated the necessary components of the RFI/CMS process. As presently written, the closure plans also pose the potential that radionuclide contamination would have to be addressed through follow-up investigations and, if necessary, remediation. Thus, it is recommended that TSD facility closure activities and the RFI/CMS investigation and remediation activities for past practice units in the B Pond System be integrated. To accomplish the integration, it is recommended that the existing B Pond closure plan be amended to include the past practice program. The resulting document would be a combined B Pond closure plan and RFI/CMS work plan that would include closure plans for the 216-A-29 Ditch and 216-B-63 Trench.

It is recommended that risk assessment and determination of clean closure be performed in a consistent manner for all units in the B Pond System. To accomplish this, all units would be evaluated in accordance with the risk assessment methodology being developed and agreed to between DOE, EPA, and Ecology under Tri-Party Agreement Milestone M-29-03. The latest presentation of the risk assessment protocols appears in *The Hanford Site Baseline Risk Assessment Methodology* (DOE/RL 1992b). It is expected that these risk assessment protocols will be at least as conservative as the guidelines established under the proposed 40 CFR Part 264 Subpart S EPA regulations published in the July 27, 1990 Federal Register. The Subpart S guidelines will provide the bases for closing RCRA units in a manner that will prevent future threats to human health and the environment. Use of the Milestone M-29-03 methodology would both satisfy the past practices risk assessment procedures and allow evaluation of whether or not clean closure of RCRA TSD units had been accomplished.

9.3.4.4.1 216-B-63 Trench. The 216-B-63 Trench has received mixed wastes. It is an active unit, although it is not receiving any wastes at this time, and is currently slated for RCRA closure. It is proposed that the 216-B-63 Trench undergo RCRA closure, integrated with the closure activities proposed for the 216-B-3 Pond system. The RCRA closure plan would include sampling of the trench to determine the nature and extent of the suspected contamination.

It is recommended that the LFIs/IRMs recommended for the 216-B-2-1, 216-B-2-2, 216-B-2-3 Ditches and the 216-B-63 Trench be integrated. This will require interfacing with the RCRA Program. The LFI/IRM work plans should be integrated with anticipated closure activities at the 216-B-63 Trench.

9.3.4.4.2 216-B-3-3 Ditch and 216-A-29 Trench. The 216-B-3-3 Ditch and 216-A-29 Trench are currently operating under RCRA Part A interim status. The 216-B-3-3 Ditch is included under a RCRA closure/postclosure plan submitted for the 216-B-3 Pond system to Ecology and EPA in March 1990. Sampling of vadose zone soil near the ditch will occur and the ditch will be interim stabilized. Interim stabilization will involve backfilling the 216-B-3-3 Ditch. A closure plan is to be developed for the 216-A-29 Trench, which is discussed in detail in the PUREX AAMS report.

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It is recommended that the LFIs/IRMs recommended for the 216-B-3-1, 216-B-3-2, and 216-B-3-3 Ditches and the 216-A-29 Trench be integrated. The required interfacing with the RCRA Program should ensure that the LFI/IRM work plans appropriately account for anticipated closure activities.

9.3.4.4.3 216-B-3 Pond System. The 216-B-3 Pond system is a group of currently active waste management units that have received a variety of mixed wastes since 1945. The 216-B-3 Pond system includes the 216-B-3, 216-B-3A, 216-B-3B, and 216-B-3C Ponds (as well as the 216-B-3-3 Ditch, already discussed above). All of these units are currently operating under RCRA Part A interim status. A RCRA closure/postclosure plan was submitted to Ecology and EPA in March 1990. Approval of a final version of the plan is expected by 1994. The closure plan for the 216-B-3 Pond system includes several steps, as discussed below.

The 216-B-3A, 216-B-3B, and 216-B-3C Ponds are planned for clean closure under RCRA. Clean closure will be contingent upon the results of ongoing soil sampling activities at the ponds. Based on their operational history and sampling to date, none of the ponds are expected to contain significant contamination. If contamination above clean closure limits is found, the contaminated soil will be removed to the 216-B-3 Pond. The RCRA closure plan will address closure activities and additional verification sampling to be conducted at the 216-B-3A, 216-B-3B, and 216-B-3C Ponds.

At this time, it is not expected that the 216-B-3 Pond can be clean closed under RCRA. Thus, it will likely be closed as a landfill and subject to post-closure care and monitoring. Current plans call for sampling vadose zone soils at the pond, followed by interim stabilization. The interim stabilization will be accomplished by placing a cover of clean soil on top of the 216-B-3 Pond, following the contour of the current pond with the minimum required thickness rather than backfilling to grade. After sampling and interim stabilization activities are completed, a risk assessment will be conducted (based on the proposed 40 CFR Part 264 Subpart S standards) to determine the design and size of a RCRA closure cover to be placed over the pond. A detailed cover design will not be included in the closure plan, but will be developed as a part of the RFI/CMS process. Following installation of the closure cover, post-closure care will be performed by maintenance of the closure cover, monitoring the groundwater, preventing run-on and run-off, and protecting against potential causes of cover damage.

It is recommended that the LFIs/IRMs recommended for the 216-B-3, 216-B-3A, 216-B-3B, and 216-B-3C Ponds be integrated with the ongoing closure activities. In particular, it is recommended that interim stabilization measures anticipated for the 216-B-3 Pond be reviewed relative to radionuclide contaminants to ensure consistency with IRM path considerations. The required interfacing with the RCRA Program should ensure that the LFI/IRM work plans appropriately account for anticipated closure activities.

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9.4 FEASIBILITY STUDY

Two types of the FS will be conducted to support remediation in the 200 Areas including focused and the final FS. Focused feasibility studies (FFSs) are studies in which a limited number of waste management units or remedial alternatives are considered. Final FS will be prepared to provide the data necessary to support the preparation of final ROD. Insufficient data exists to prepare either a focused or final FS for any waste management units or group of units within the B Plant Aggregate Area. Sufficient data are considered available to prepare a FFS on selected remedial alternatives.

9.4.1 Focused Feasibility Study

Both LFIs and IRMs are planned for the B Plant Aggregate Area for individual waste management units or waste management unit groups. The IRMs will be implemented as they are approved, and the FFS will be prepared to support their implementation. The FFS applied in this manner is intended to examine a limited number of alternatives for a specific site or groups of sites. The FFS supporting IRMs will be based on the technology screening process applied in Section 7.0, engineering judgement, and/or new characterization data such as that generated by an LFI.

Recommendations for the FFS in support of IRMs are not provided in this report because the of limited data availability. In most cases, LFIs will be conducted at sites initially identified for IRMs. The information gathered is considered necessary prior to making a final determination whether an IRM is actually necessary or whether a remedy can be selected.

Rather than being driven by an IRM, the FFS will also be prepared to evaluate select remedial alternatives. In this case the FFS focuses on technologies or alternatives that are considered to be viable based on their implementability, cost, and effectiveness and have broad application to a variety of sites. The following recommendations are made for FFS that focus on a particular technology or alternative:

- Capping
- Ex situ treatment of contaminated soils
- In situ stabilization.

These recommendations reflect select technologies developed in Section 7.0 of this report.

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The FFS is intended to provide a detailed analysis of select remedial alternatives. The results of the detailed analysis provide the basis for identifying preferred alternatives. The detailed analysis for alternatives consists of the following components:

- Further definition of each alternative, if appropriate, with respect to the volumes or areas of contaminated environmental media to be addressed, the technologies to be used, and any performance requirements associated with those technologies. Remedial investigations and treatability studies, if conducted, will also be used to further define applicable alternatives.

- An assessment and summary of each alternative against evaluation criteria specified in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (EPA 1988b).

- A comparative analysis of the alternatives that will facilitate the selection of a remedial action.

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9.4.2 Final Feasibility Study

To complete the remediation process for an aggregate area, a final or summary FS will be prepared. This study will address those sites not previously evaluated and will summarize the results of preceding evaluations. The overall study and evaluation process for an aggregate area will consist of a number of FFSs, field investigations, and interim RODs. All of this study information will be summarized in one final FS to provide the data necessary for the final ROD. The summary FS will likely be conducted on an aggregate area basis; however, future considerations may indicate that a larger scope is appropriate.

9.5 TREATABILITY STUDIES

A range of technologies which are likely to be considered for remediation of sites within the B Plant Aggregate Area were discussed in Section 7.3. The range of technologies included:

- Engineered multimedia cover

- In situ grouting

- Excavation and soil treatment

- In situ vitrification

- Excavation, treatment, and disposal of transuranic (TRU) radionuclides

- In situ soil vapor extraction of volatile organic compounds (VOCs).

Treatability testing will be required to conduct a detailed analysis for most of the technologies. Relevant EPA guidance will be relied upon to conduct these future treatability studies. A summary of treatability testing needs outlined in Section 7.3 is as follows:

- Engineered multimedia cover--performance testing (pilot-scale testing) of conceptual designs is needed.

- In situ grouting--testing required to optimize injection properties of grout and verify effectiveness in stabilizing contaminants.

- Excavation and soil treatment--testing of dust control measures, soil treatment reagents, and contacting methods will be required. Some limited soil washing bench scale studies have been initiated.

- In situ vitrification--testing required to verify contaminant stabilization effectiveness and to establish operating parameters. Some vitrification pilot testing is ongoing.

- Excavation, treatment, and disposal of TRU radionuclides--testing to evaluate dust control measures and stabilization or vitrification effectiveness and to establish operating parameters is required.

- In situ soil vapor extraction of VOCs--extraction effectiveness needs to be verified and operating parameters require development. A program is currently under way for field testing of vapor extraction techniques.

As treatability testing of the various alternatives progresses, other parameters are likely to be identified which require further development.

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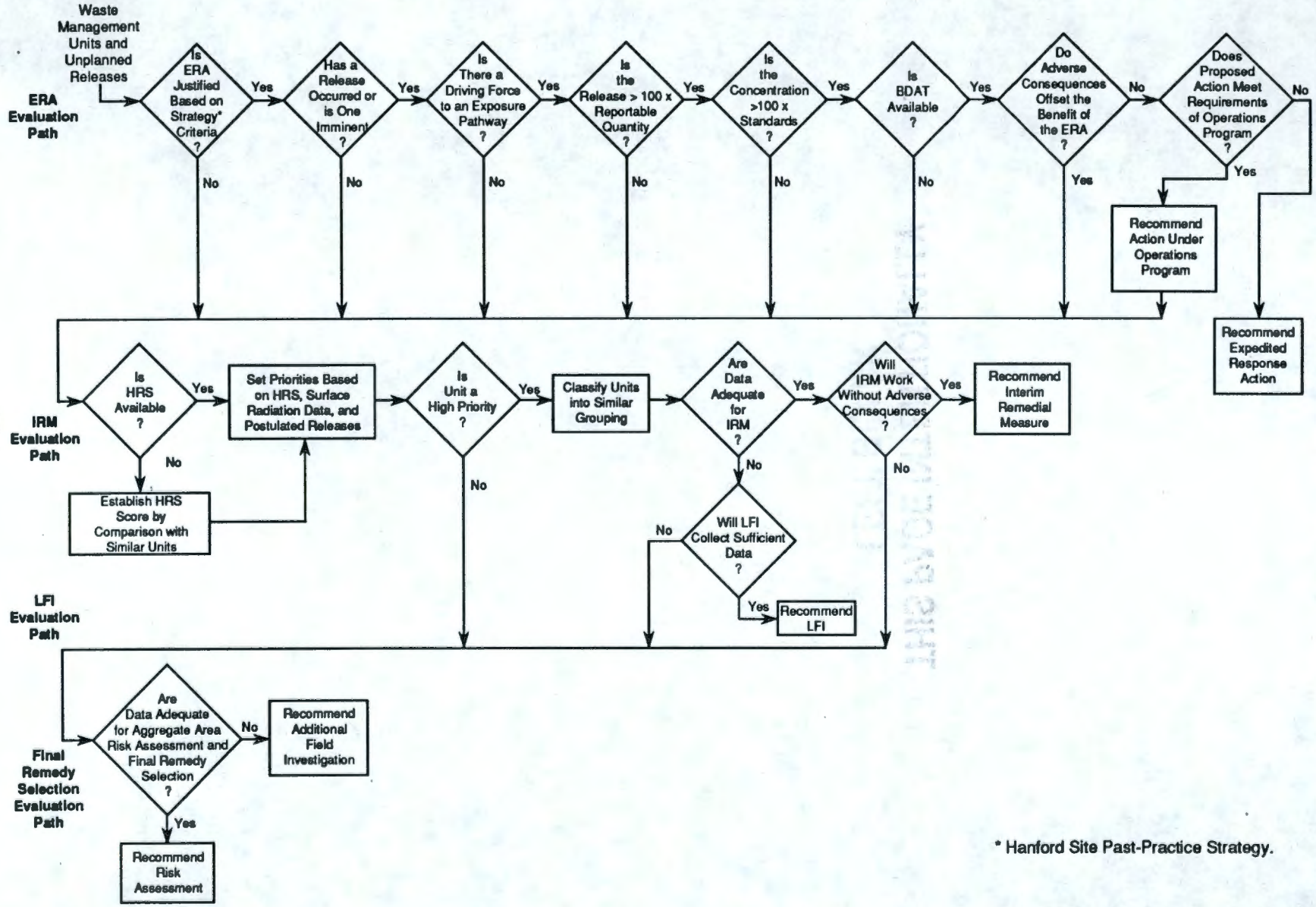

* Hanford Site Past-Practice Strategy.

Figure 9-1. 200 Aggregate Area Management Studies Decision Making Flowchart.

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Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Tanks and Vaults							
241-B-361 Settling Tank	--	--	--	--	X	--	D&RCP
Cribs and Drains							
216-B-7A Crib	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-7B Crib	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-8TF Crib/Tile Field	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-9TF Crib/Tile Field	--	X	X	--	--	X	RARA-Collapse Potential
216-B-10A Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-10B Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-12 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-14 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-15 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-16 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-17 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-18 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-19 Crib	--	X	X	--	--	X	RARA-Collapse Potential
216-B-43 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-44 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-45 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-46 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-47 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-48 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-49 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-50 Crib	--	--	--	--	X	--	Work in progress under 200-BP-1 RI/FS Work Plan

Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-B-55 Crib	–	X	X	–	–	–	Active-WMP/Surface Contamination
216-B-56 Crib	–	–	–	–	X	–	Never Used
216-B-57 Crib	–	–	–	–	X	–	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-60 Crib	–	–	–	–	X	–	–
216-B-61 Crib	–	–	–	–	X	–	Work in progress under 200-BP-1 RI/FS Work Plan
216-B-62 Crib	–	–	–	–	X	–	Active-WMP
CTF North of 2703-E	–	–	–	–	X	–	–
216-B-13 French Drain	–	–	–	–	X	–	–
216-B-51 French Drain	–	X	X	–	–	X	RARA-Surface Contamination
Reverse Wells							
216-B-4 Reverse Well	–	X	X	–	–	–	–
216-B-5 Reverse Well	X	–	–	–	–	–	Surface Contamination
216-B-6 Reverse Well	–	X	X	–	–	–	–
216-B-11A Reverse Well	–	X	X	–	–	X	RARA-Collapse Potential/Surface Contamination
216-B-11B Reverse Well	–	X	X	–	–	X	RARA-Collapse Potential/Surface Contamination
Ponds, Ditches, and Trenches							
216-B-3 Pond	–	X	X	–	–	X	Active-WMP/D&RCP/RARA-Surface Contamination
216-B-3A Pond	–	X	X	–	–	–	Active-WMP/D&RCP
216-B-3B Pond	–	X	X	–	–	–	Active-WMP/D&RCP
216-B-3C Pond	–	X	X	–	–	–	Active-WMP/D&RCP
216-A-25 Pond	–	X	X	–	–	–	–
216-E-28 Contingency Pond	–	–	–	–	X	–	–
216-N-8 Pond	–	–	–	–	X	–	–

Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-B-2-1 Ditch	--	X	X	--	--	X	RARA-Surface Contamination
216-B-2-2 Ditch	--	X	X	--	--	X	RARA-Surface Contamination
216-B-2-3 Ditch	--	X	X	--	--	X	RARA-Surface Contamination
216-B-3-1 Ditch	--	X	X	--	--	--	--
216-B-3-2 Ditch	--	X	X	--	--	--	--
216-B-3-3 Ditch	--	X	X	--	--	--	Active-WMP
216-B-20 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-21 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-22 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-23 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-24 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-25 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-26 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-27 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-28 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-29 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-30 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-31 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-32 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-33 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-34 Trench	--	X	X	--	--	X	RARA-Collapse Potential/Surface Contamination
216-B-35 Trench	--	--	--	--	X	--	--
216-B-36 Trench	--	--	--	--	X	--	--
216-B-37 Trench	--	--	--	--	X	--	--

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Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-B-38 Trench	–	–	–	–	X	–	–
216-B-39 Trench	–	–	–	–	X	–	–
216-B-40 Trench	–	–	–	–	X	–	–
216-B-41 Trench	–	–	–	–	X	–	–
216-B-42 Trench	–	–	–	–	X	–	–
216-B-52 Trench	–	X	X	–	–	X	RARA-Surface Contamination
216-B-53A Trench	–	X	X	–	–	X	RARA-Surface Contamination
216-B-53B Trench	–	X	X	–	–	X	RARA-Surface Contamination
216-B-54 Trench	–	X	X	–	–	X	RARA-Surface Contamination
216-B-58 Trench	–	X	X	–	–	X	RARA-Collapse Potential/Surface Contamination
216-B-63 Trench/Ditch	–	X	X	–	–	–	D&RCP/WMP Grouped with 216-B-2-1 Ditch
Septic Tanks and Associated Drain Fields							
2607-E1 Septic Tank	–	–	–	–	X	–	Active
2607-E2 Septic Tank	–	–	–	–	X	–	Active
2607-E3 Septic Tank/Drain Field	–	–	–	–	X	–	Active
2607-E4 Septic Tank	–	–	–	–	X	–	Active
2607-E7B Septic Tank	–	–	–	–	X	–	Active
2607-E8 Septic Tank	–	–	–	–	X	–	Active
2607-E9 Septic Tank	–	–	–	–	X	–	Active
2607-E11 Septic Tank	–	–	–	–	X	–	Active
2607-EB Septic Tank	–	–	–	–	X	–	Active
2607-EH Septic Tank	–	–	–	–	X	–	Active
2607-EK Septic Tank	–	–	–	–	X	–	Active

Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
2607-EM Septic Tank	--	--	--	--	X	--	Active
2607-EN Septic Tank	--	--	--	--	X	--	Active
2607-EO Septic Tank	--	--	--	--	X	--	Active
2607-EP Septic Tank	--	--	--	--	X	--	Active
2607-EQ Septic Tank	--	--	--	--	X	--	Active
2607-ER Septic Tank	--	--	--	--	X	--	Active
2607-GF Septic Tank	--	--	--	--	X	--	Active
Basins							
207-B Retention Basin	--	X	X	--	--	--	Active-WMP/Surface Contamination
216-B-59B Retention Basin	--	--	--	--	X	--	Active-WMP
216-B-64 Retention Basin	--	X	X	--	--	X	RARA-Surface Contamination
Burial Sites							
218-E-2 Burial Ground	--	X	X	--	--	X	RARA-Surface Contamination
218-E-2A Burial Ground	--	--	--	--	X	--	--
218-E-3 Burial Ground	--	--	--	--	X	--	Exhumed/Released
218-E-4 Burial Ground	--	X	X	--	--	X	RARA-Surface Contamination
218-E-5 Burial Ground	--	X	X	--	--	X	RARA-Surface Contamination
218-E-5A Burial Ground	--	X	X	--	--	X	RARA-Surface Contamination
218-E-6 Burial Ground	--	--	--	--	X	--	Exhumed/Released
218-E-7 Burial Ground	--	--	--	--	X	X	RARA-Collapse Potential
218-E-9 Burial Ground	--	X	X	--	--	X	RARA-Surface Contamination
200 Area Construction Pit	--	--	--	--	X	--	--

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Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
Unplanned Releases							
UN-200-E-7	--	--	--	--	X	--	--
UN-200-E-9	--	--	--	--	X	--	--
UN-200-E-14	--	--	--	--	X	--	--
UN-200-E-41	--	X	X	--	--	--	Grouped with UN-200-E-69
UN-200-E-43	--	X	X	--	--	--	Grouped with 216-B-57
UN-200-E-44	--	X	X	--	--	--	--
UN-200-E-52	--	X	X	--	--	--	Grouped with UN-200-E-69
UN-200-E-54	--	--	--	--	X	--	--
UN-200-E-55	--	--	--	--	X	--	--
UN-200-E-61	--	--	--	--	X	--	--
UN-200-E-63	--	X	X	--	--	X	RARA-Surface Contamination
UN-200-E-64	--	X	X	--	--	X	RARA-Surface Contamination
UN-200-E-69	--	X	X	--	--	--	--
UN-200-E-79	--	--	--	--	X	--	--
UN-200-E-80	--	X	X	--	--	--	--
UN-200-E-83	--	X	X	--	--	X	RARA-Surface Contamination
UN-200-E-87	--	--	--	--	X	--	--
UN-200-E-90	--	X	X	--	--	--	--
UN-200-E-92	--	--	--	--	X	--	--
UN-200-E-95	--	X	X	--	--	X	RARA-Surface Contamination
UN-200-E-101	--	--	--	--	X	--	--
UN-200-E-103	--	X	X	--	--	--	Grouped with UN-200-E-44
UN-200-E-112	--	--	--	--	X	--	--

Table 9-1. Summary of the Results of Remediation Process Path Assessment.

Waste Management Unit	ERA	IRM	LFI	RA	RI	OPS	Remarks
UN-200-E-140	--	--	--	--	X	--	--
UPR-200-E-4	--	--	--	--	X	--	--
UPR-200-E-32	--	X	X	--	--	X	RARA-Surface Contamination
UPR-200-E-34	--	--	--	--	X	--	--
UPR-200-E-51	--	--	--	--	X	--	--
UPR-200-E-84	--	X	X	--	--	X	RARA-Surface Contamination
UPR-200-E-138	--	X	X	--	--	--	Grouped with 216-B-2-2 Ditch

ERA - Expedited Response Action
IRM - Interim Remedial Measure
LFI - Limited Field Investigation
RA - Risk Assessment
RI - Remedial Investigation
OPS - Operational Programs
WMP - Waste Management Program
RARA - Radiation Area Remedial Action Program
D&RCP - Decommissioning and RCRA Closure Program

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Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
Tanks and Vaults													
241-B-361 Settling Tank	Y	N	–	–	–	–	–	–	N	–	–	–	N
Cribs and Drains													
216-B-7A Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-7B Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-8TF Crib/Tile Field	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-9TF Crib/Tile Field	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-10A Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-10B Crib	Y	Y	Y	Y	Y	Y	N	Y	Y[b]	N	–	Y	–
216-B-12 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-14 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y[b]	N	–	Y	–
216-B-15 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y[b]	N	–	Y	–
216-B-16 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-17 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y[b]	N	–	Y	–
216-B-18 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y[b]	N	–	Y	–
216-B-19 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y[b]	N	–	Y	–
216-B-43 Crib[a]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-44 Crib[a]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-45 Crib[a]	–	–	–	–	–	–	–	–	–	–	–	–	–

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Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
216-B-46 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-47 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-48 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-49 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-50 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-55 Crib	Y	Y	Y	N	–	–	–	–	Y	N	–	Y	–
216-B-56 Crib	N	–	–	–	–	–	–	–	N	–	–	–	N
216-B-57 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-60 Crib	N	–	–	–	–	–	–	–	N	–	–	–	N
216-B-61 Crib[a/]	–	–	–	–	–	–	–	–	–	–	–	–	–
216-B-62 Crib	Y	Y	Y	N	–	–	–	–	N	–	–	–	N
CTF North of 2703-E	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-13 French Drain	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-51 French Drain	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
Reverse Wells													
216-B-4 Reverse Well	Y	Y	Y	Y	N	–	–	–	Y	N	–	Y	–
216-B-5 Reverse Well	Y	Y	Y	Y	Y	Y	N	N	Y	–	–	–	–
216-B-6 Reverse Well	Y	Y	Y	Y	N	–	–	–	Y	N	–	Y	–
216-B-11A Reverse Well	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–

Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
216-B-11B Reverse Well	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
Ponds, Ditches, and Trenches													
216-B-3 Pond	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-3A Pond	Y	Y	Y	N	–	–	–	–	Y	N	–	Y	–
216-B-3B Pond	Y	Y	Y	N	–	–	–	–	Y[b/]	–	–	–	N
216-B-3C Pond	Y	Y	Y	N	–	–	–	–	Y	N	–	Y	–
216-A-25 Pond	N	–	–	–	–	–	–	–	Y	N	–	Y	–
216-E-28 Contingency Pond	N	–	–	–	–	–	–	–	N	–	–	–	N
216-N-8 Pond	Y	Y	Y	Y	N	–	–	–	N	–	–	–	N
216-B-2-1 Ditch	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-2-2 Ditch	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-2-3 Ditch	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-3-1 Ditch	Y	Y	Y	N	–	–	–	–	Y[b/]	N	–	Y	–
216-B-3-2 Ditch	Y	Y	Y	N	–	–	–	–	Y[b/]	N	–	Y	–
216-B-3-3 Ditch	Y	Y	Y	N	–	–	–	–	Y[b/]	N	–	Y	–
216-B-20 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-21 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-22 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-23 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-24 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–

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Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
216-B-25 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-26 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-27 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-28 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-29 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-30 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-31 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-32 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-33 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-34 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-35 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-36 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-37 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-38 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-39 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-40 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-41 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-42 Trench	Y	Y	N	–	–	–	–	–	N	–	–	–	N
216-B-52 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-53A Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-53B Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–

Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
216-B-54 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-58 Trench	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
216-B-63 Trench	Y	Y	Y	Y	N	–	–	–	Y[a]	N	–	Y	–
Septic Tanks and Associated Drain Fields													
2607-E1 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E2 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E3 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E4 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E7B Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E8 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E9 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-E11 Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EB Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EH Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EK Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EM Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EN Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EO Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EP Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-EQ Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
2607-ER Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N

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Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
2607-GF Septic Tank	N	–	–	–	–	–	–	–	N	–	–	–	N
Basins													
207-B Retention Basin	Y	Y	Y	N	–	–	–	–	Y	N	–	Y	–
216-B-59B Retention Basin	Y	Y	Y	N	–	–	–	–	N	–	–	–	N
216-B-64 Retention Basin	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
Burial Sites													
218-E-2 Burial Ground	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
218-E-2A Burial Ground	N	–	–	–	–	–	–	–	N	–	–	–	N
218-E-3 Burial Ground	N	–	–	–	–	–	–	–	N	–	–	–	N
218-E-4 Burial Ground	Y	Y	Y	N	–	–	–	–	Y	N	–	Y	–
218-E-5 Burial Ground	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
218-E-5A Burial Ground	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
218-E-6 Burial Ground	N	–	–	–	–	–	–	–	N	–	–	–	N
218-E-7 Burial Ground	Y	Y	Y	Y	Y	Y	N	Y	N	–	–	–	N
218-E-9 Burial Ground	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
200-East Area Construction Pit	N	–	–	–	–	–	–	–	N	–	–	–	N
Unplanned Releases													
UN-200-E-7	Y	Y	N	–	–	–	–	–	N	–	–	–	N

Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
UN-200-E-9	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-14	N	–	–	–	–	–	–	–	N	–	–	–	N
UN-200-E-41	Y	Y	N	–	–	–	–	–	Y[b/]	–	–	–	N
UN-200-E-43	Y	Y	N	–	–	–	–	–	Y[b/]	–	–	–	N
UN-200-E-44	Y	Y	Y	Y	N	–	–	–	Y[b/]	N	–	Y	–
UN-200-E-52	Y	Y	Y	N	–	–	–	–	Y[b/]	–	–	–	N
UN-200-E-54	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-55	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-61	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-63	Y	Y	Y	Y	Y	Y	N	Y	Y[b/]	N	–	Y	–
UN-200-E-64	Y	Y	Y	Y	N	–	–	–	Y[b/]	N	–	Y	–
UN-200-E-69	Y	Y	Y	N	–	–	–	–	Y[b/]	N	–	Y	–
UN-200-E-79	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-80	Y	Y	Y	N	–	–	–	–	Y[b/]	N	–	Y	–
UN-200-E-83	Y	Y	Y	Y	Y	Y	N	Y	Y[b/]	N	–	Y	–
UN-200-E-87	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-90	Y	Y	Y	N	–	–	–	–	Y[b/]	N	–	Y	–
UN-200-E-92	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-95	Y	Y	Y	N	–	–	–	–	Y	N	–	Y	–
UN-200-E-101	Y	Y	Y	N	–	–	–	–	N	–	–	–	N
UN-200-E-103	Y	Y	N	–	–	–	–	–	Y[b/]	–	–	–	N

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Table 9-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
Waste Management Unit	Is an ERA Justified?	Release?	Pathway?	Quantity?	Concentration?	Treatment Availability?	Adverse Consequences?	Operational Programs?	High Priority?	Data Adequate?	Adverse Consequences?	Collect Data	Data Adequate?
UN-200-E-112	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UN-200-E-140	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UPR-200-E-4	Y	Y	N	–	–	–	–	–	N	–	–	–	N
UPR-200-E-32	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
UPR-200-E-34	Y	Y	Y	Y	N	–	–	–	N	–	–	–	N
UPR-200-E-51	Y	Y	Y	Y	N	–	–	–	N	–	–	–	N
UPR-200-E-84	Y	Y	Y	Y	Y	Y	N	Y	Y	N	–	Y	–
UPR-200-E-138	Y	Y	Y	Y	N	–	–	–	N	–	–	–	N

[a] Work is in progress under the 200-BP-1 RI/FS Work Plan

[b] This unit was not a high priority listed in Table 5-1, but was evaluated through high priority based on similarities to other units.

* DOE/RL 1991a

Other information from WIDS and HISS database

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Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs.

Waste Management Unit	Site Type	Program	Active/ Inactive	Operable Unit
2703-E	Hazardous Waste Staging Area	WMP	Active	200-SS-1
2704-E	Hazardous Waste Staging Area	WMP	Active	200-SS-1
2715-EA	Hazardous Waste Staging Area	WMP	Active	200-SS-1
226-B	Hazardous Waste Staging Area	WMP	Active	200-BP-6
Tanks and Vaults				
241-B-101	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-102	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-103	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-104	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-105	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-106	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-107	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-108	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-109	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-110	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-111	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-112	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-201	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-202	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-203	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-204	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-101	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-102	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-103	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-104	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-105	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-106	Single-Shell Tank	SSTCP	Inactive	200-BP-7

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Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs.

Waste Management Unit	Site Type	Program	Active/ Inactive	Operable Unit
241-BY-107	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-108	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-109	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-110	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-111	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BY-112	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-101	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-102	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-103	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-104	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-105	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-106	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-107	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-108	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-109	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-110	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-111	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-BX-112	Single-Shell Tank	SSTCP	Inactive	200-BP-7
241-B-301B	Catch Tank	SSTCP	Inactive	200-BP-7
241-B-302B	Catch Tank	SSTCP	Inactive	200-BP-5
241-BX-302A	Catch Tank	SSTCP	Inactive	200-BP-7
241-BX-302B	Catch Tank	SSTCP	Inactive	200-BP-6
241-BX-302C	Catch Tank	SSTCP	Inactive	200-BP-6
241-ER-311	Catch Tank	SSTCP	Active	200-BP-9
270-E	Condensate Neutralization Tank	D&RCP	Inactive	200-BP-6
244-BX	Receiving Tank	RCRA	Active	200-BP-7
244-BXR	Vault	SSTCP	Inactive	200-BP-7

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Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs.

Waste Management Unit	Site Type	Program	Active/ Inactive	Operable Unit
Ponds, Ditches, and Trenches				
2101-M	Pond	RCRA	Active	200-SS-1
Transfer Facilities, Diversion Boxes, and Pipelines				
241-B-151	Diversion Box	SSTCP	Inactive	200-BP-7
241-B-152	Diversion Box	SSTCP	Inactive	200-BP-7
241-B-153	Diversion Box	SSTCP	Inactive	200-BP-7
241-B-154	Diversion Box	SSTCP	Inactive	200-BP-5
241-B-252	Diversion Box	SSTCP	Inactive	200-BP-7
241-BR-152	Diversion Box	SSTCP	Inactive	200-BP-7
241-BX-153	Diversion Box	SSTCP	Inactive	200-BP-7
241-BX-154	Diversion Box	SSTCP	Inactive	200-BP-6
241-BX-155	Diversion Box	SSTCP	Inactive	200-BP-6
241-BXR-151	Diversion Box	SSTCP	Inactive	200-BP-7
241-BXR-152	Diversion Box	SSTCP	Inactive	200-BP-7
241-BXR-153	Diversion Box	SSTCP	Inactive	200-BP-7
241-BYR-152	Diversion Box	SSTCP	Inactive	200-BP-7
241-BYR-153	Diversion Box	SSTCP	Inactive	200-BP-7
241-BYR-154	Diversion Box	SSTCP	Inactive	200-BP-7
241-ER-151	Diversion Box	SSTCP	Inactive	200-BP-9
241-ER-152	Diversion Box	SSTCP	Active	200-BP-6
241-B-151	Diversion Box	SSTCP	Inactive	200-BP-9
Burial Sites				
200-E	Powerhouse Ash Pit	WMP	Active	200-SS-1
200-E-8	Burrow Pit	RCRA	Active	200-BP-10
218-E-10	Burial Ground	WMP	Active	200-BP-10

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Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs.

Waste Management Unit	Site Type	Program	Active/ Inactive	Operable Unit
Unplanned Releases				
UN-200-E-1		SSTCP	Inactive	200-BP-6
UN-200-E-2		SSTCP	Inactive	200-BP-6
UN-200-E-3		SSTCP	Inactive	200-BP-6
UN-200-E-45		SSTCP	Inactive	200-BP-5
UN-200-E-76		SSTCP	Inactive	200-BP-7
UN-200-E-85		SSTCP	Inactive	200-BP-6
UN-200-E-89		SSTCP	Inactive	200-BP-1
UN-200-E-105		SSTCP	Inactive	200-BP-7
UN-200-E-109		SSTCP	Inactive	200-BP-7
UN-200-E-110		SSTCP	Inactive	200-BP-1
UPR-200-E-5		SSTCP	Inactive	200-BP-7
UPR-200-E-6		SSTCP	Inactive	200-BP-7
UPR-200-E-38		SSTCP	Inactive	200-BP-7
UPR-200-E-73		SSTCP	Inactive	200-BP-7
UPR-200-E-74		SSTCP	Inactive	200-BP-7
UPR-200-E-75		SSTCP	Inactive	200-BP-7
UPR-200-E-77		SSTCP	Inactive	200-BP-5
UPR-200-E-78		SSTCP	Inactive	200-BP-6
UPR-200-E-108		SSTCP	Inactive	200-BP-7
UPR-200-E-116		SSTCP	Inactive	200-BP-7
UPR-200-E-127		SSTCP	Inactive	200-BP-7
UPR-200-E-128		SSTCP	Inactive	200-BP-7
UPR-200-E-129		SSTCP	Inactive	200-BP-7
UPR-200-E-130		SSTCP	Inactive	200-BP-7
UPR-200-E-131		SSTCP	Inactive	200-BP-7
UPR-200-E-132		SSTCP	Inactive	200-BP-7
UPR-200-E-133		SSTCP	Inactive	200-BP-7

9 3 1 2 8 9 6 1 4 0 3

Table 9-3. Waste Management Units and Unplanned Releases to be Addressed by Other Programs.

Waste Management Unit	Site Type	Program	Active/ Inactive	Operable Unit
UPR-200-E-134		SSTCP	Inactive	200-BP-7
UPR-200-E-135		SSTCP	Inactive	200-BP-7

* DOE/RL 1991a
Other information from WIDS and HISS database
WMP - Waste Management Program
SSTCP - Single-Shell Tank Closure Program
D&RCP - Decommissioning and RCRA Closure Program

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B PLANT AGGREGATE AREA (East of Purex)
PLATE 6 – Monitor Wells & Sample Locations

LEGEND

Aggregate Area Boundary

Security Systems/Fences

Perimeter Boundary

Buildings

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PLANT AGGREGATE AREA (East of Purex)
LATE 5 - Topography

EGEND

Aggregate Area Boundary

Security Systems/Fences

Perimeter Boundary

Buildings

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B PLANT AGGREGATE AREA (East of Purex)
PLATE 4 - Facilities, Sites, & Unplanned Releases

LEGEND

Aggregate Area Boundary

Security Systems/Fences

Perimeter Boundary

Buildings

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B PLANT AGGREGATE AREA (West of Purex)
PLATE 3 - Monitor Wells & Sample Locations

LEGEND

Aggregate Area Boundary

Security Systems/Fences

Perimeter Boundary

Buildings

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B PLANT AGGREGATE AREA (West of Purex)
PLATE 2 - Topography

LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings

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B PLANT AGGREGATE AREA (West of Purex)
PLATE 1 - Facilities, Sites, & Unplanned Releases

LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings

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B PLANT AGGREGATE AREA (North of Purex)
PLATE 7 – Facilities, Sites, Unplanned Releases, Topography, Monitor Wells & Sample Locations

LEGEND

Aggregate Area Boundary

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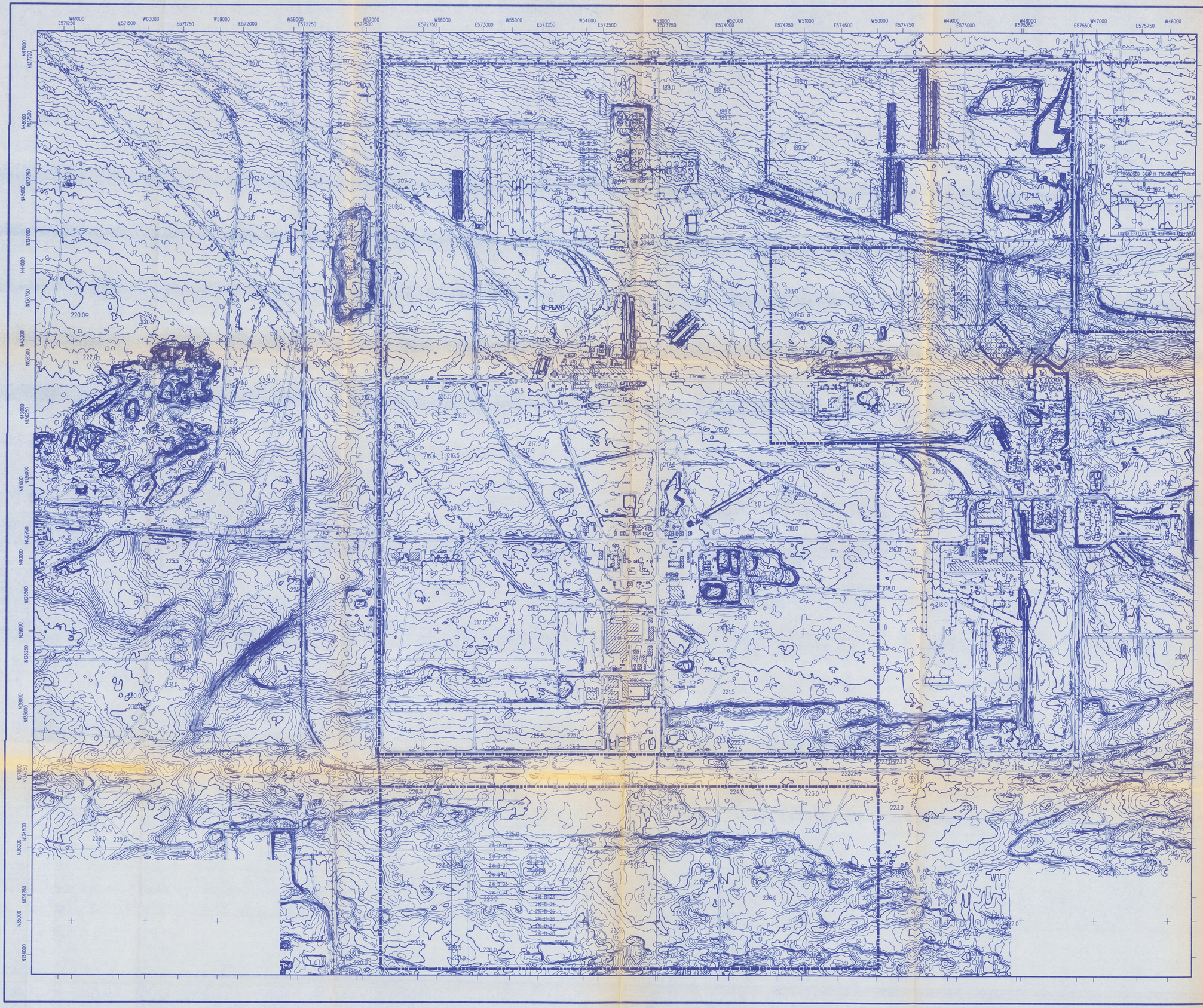
Aggregate Area Management Studies
B PLANT AGGREGATE AREA (West of Purex)
PLATE 1 – Facilities, Sites, & Unplanned Releases
LEGEND
Aggregate Area Boundary
Security Systems/Fences
Perimeter Boundary
Buildings
Waste Management Units
Unplanned Releases
Other Waste Mgmt Units
Scale in Feet
0
1000
2000
Scale in Meters
0
100
500
218-E-10
UPR-200-E-61
200-E8 BPDS
200 CP
216-B-61
216-B-43 THRU 50
UPR-200-E-89
UPR-200-E-63
216-B-51
216-B-57
2607-EB
UPR-200-E-43
UPR-200-E-110
UPR-200-E-105
UPR-200-E-134
UPR-200-E-116,135
216-B-8TF
216-B-41
216-B-40
216-B-39
216-B-38
216-B-37
216-B-36
216-B-35
216-B-42
241-BY
241-BX
241-B
UPR-200-E-133
UPR-200-E-5
UPR-200-E-131
UPR-200-E-132
216-B-11A & B
216-B-7A & B
UPR-200-E-129
UPR-200-E-130
241-B-252
241-B-301B
UPR-200-E-109
UPR-200-E-128
UPR-200-E-127
UPR-200-E-108
242-B-151
244-BX RT
244-BXR VAULT
241-BX-153
241-BR,BXR,BYR
241-BX-302A
241-B-153
UPR-200-E-6,75,76
242-B EVAP
UPR-200-E-101
UPR-200-E-79
2607-E9
UPR-200-E-138
216-B-63
216-B-2-1
216-B-2-2
216-B-2-3
241-B-151
UPR-200-E-73
241-B-152
UPR-200-E-38,74
218-E-5A
218-E-5
218-E-2
218-E-9
218-E-2A
UPR-200-E-95
UPR-200-E-32
207-B RB
UPR-200-E-112
241-BX-155
241-BX-302C
UPR-200-E-78
UPR-200-E-4
216-B-9TF
UPR-200-E-7
218-E-4
216-B-62
B PLANT
216-B-5
241-B-361
216-B-59
216-B-56
2607-E3
216-B-12
216-B-55
UPR-200-E-41
UPR-200-E-69
UPR-200-E-52
241-BX-302B
UPR-200-E-1
UPR-200-E-3
UPR-200-E-2
241-BX-154
217-B NU
UPR-200-E-140
UPR-200-E-54
270-E CNT
216-B-64
225-B
2607-E4
CANYON PROCESSING
UPR-200-E-80
UPR-200-E-85
UPR-200-E-77
241-B-302B
241-B-154
UPR-200-E-45
UPR-200-E-44,103
216-B-60
UPR-200-E-64
UPR-200-E-55
226-B HWSA
UPR-200-E-87
221-B NANU & SHNU
224-B CF
224-B
216-B-6
222-B
216-B-4
216-B-13
UPR-200-E-90
218-E-6
218-E-7
218-E-8
216-B-10A
216-B-10B
241-ER-151
241-ER-311
241-ER-152
UPR-200-E-84
HWVP
INTERCONNECTION PIPELINE (BELOW GROUND)
UPR-200-E-92
FORMER PUREX COOLING WATER LINE
PROPOSED C018 H TREATMENT FACILIT
LIQUID EFFLUENT RETENTION FACILITY
216-B-3-1
216-B-3-2
216-B-3-3
UPR 200-E-51
2607-E1
2607-GF
2703-E CFTN
2711-E
2703-E HWSA
2704-E HWSA
2607-E7B
200-E PAP
200-E
2715-EA HWSA
RESERVOIR
2607-EH
2101-M
2607-E8
2607-EK
2101-M POND
2607-EQ
2752-E
2750-E
2753-E
2751-E
2607-ER
2607-EM
2607-EP
218-E-3
216-B-29
216-B-30
216-B-31
216-B-32
216-B-33
216-B-34
216-B-53A
216-B-53B
216-B-54
216-B-58
216-B-22
216-B-21
216-B-20
216-B-15
216-B-14
216-B-17
216-B-16
216-B-19
216-B-18
216-B-52
216-B-23
216-B-24
216-B-25
216-B-26
216-B-27
216-B-28
UPR-200-E-83
12TH STREET
7 TH STREET
4TH STREET
1ST STREET
FRONT ST.
ROUTE 3
ROUTE 4 SOUTH
ATLANTA AVENUE
BALTIMORE AVENUE
GROUT DR.
4TH STREET LOOP
CANTON AVENUE



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Aggregate Area Management Studies

B PLANT AGGREGATE AREA (West of Purex)
PLATE 2 – Topography

LEGEND

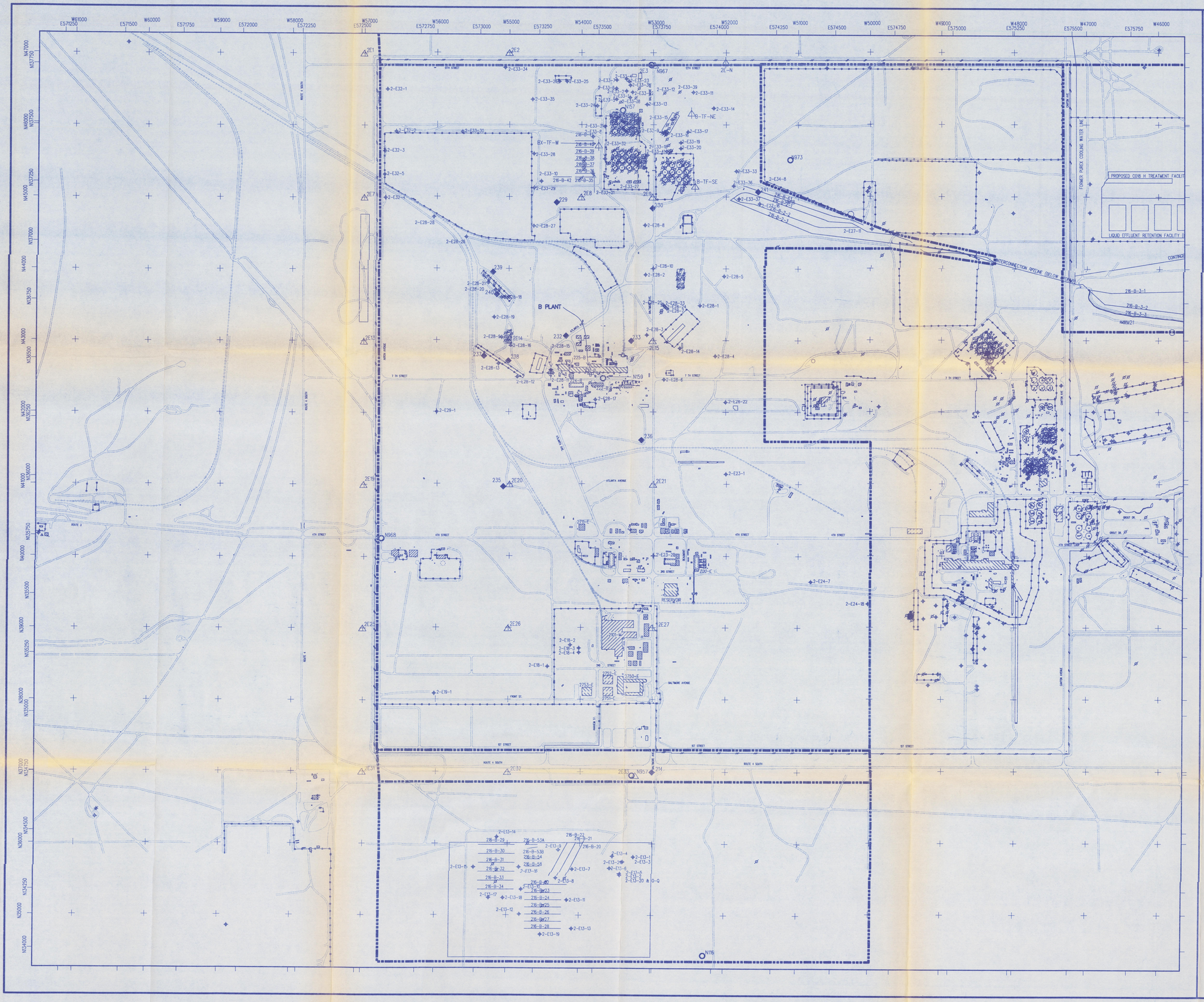
- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings

Contour Interval .5 Meter

N

Scale in Feet
0 1000 2000

Scale in Meters
0 100 500



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B PLANT AGGREGATE AREA (West of Purex)
PLATE 3 – Monitor Wells & Sample Locations

LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings
- Monitoring Wells
- Other Wells

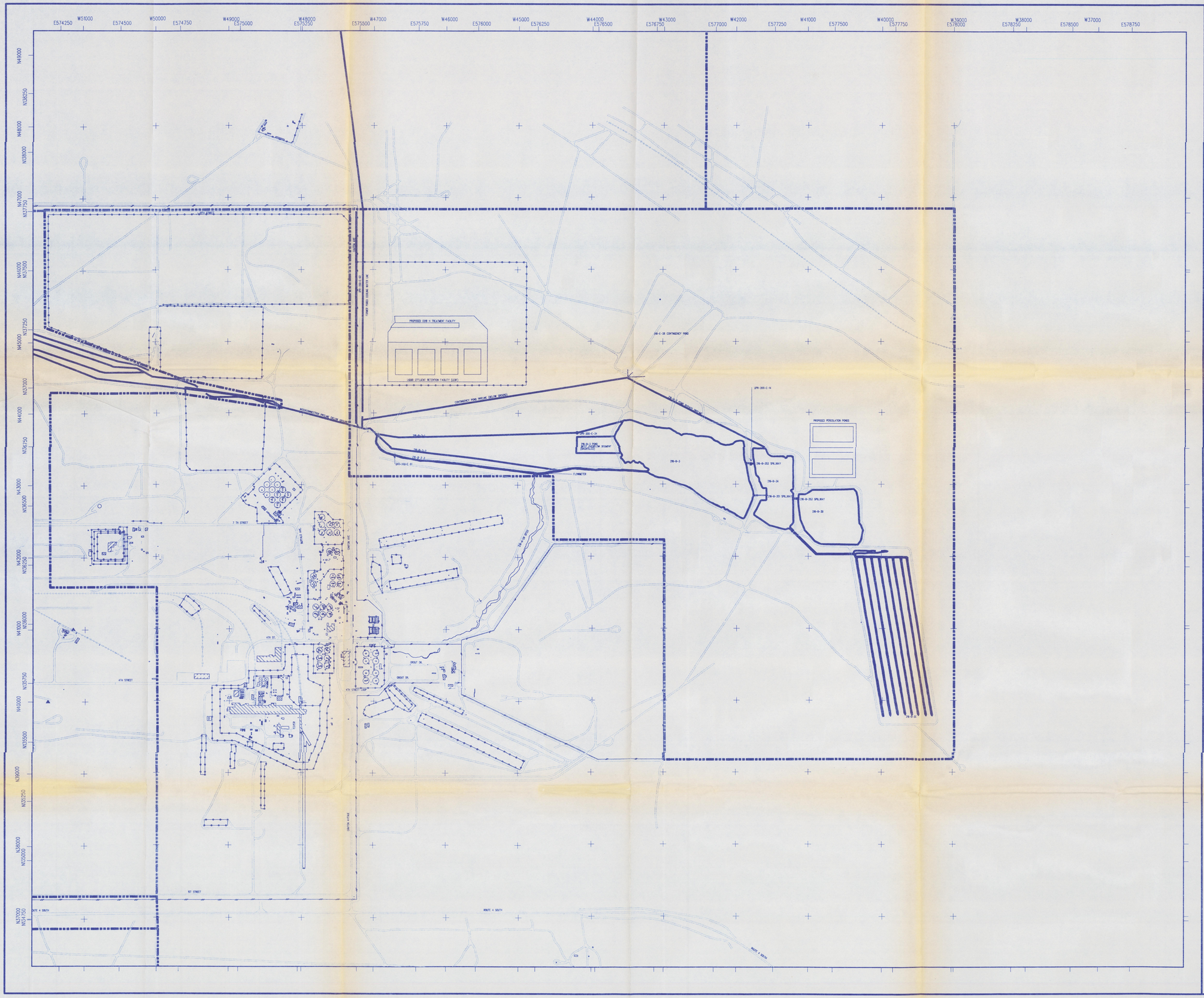
SAMPLING LOCATIONS (Approximate)

Soil Sampling Locations

- Former Locations (to 1989) --including TLDs
- New Sampling Locations (1990 and following)
- Fenceline Sampling Locations
- Surface Water Sampling Locations
- Air Sampling Locations
- New TLD Sampling Locations

Scale in Feet: 0 – 1000 – 2000

Scale in Meters: 0 – 100 – 500



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Aggregate Area Management Studies

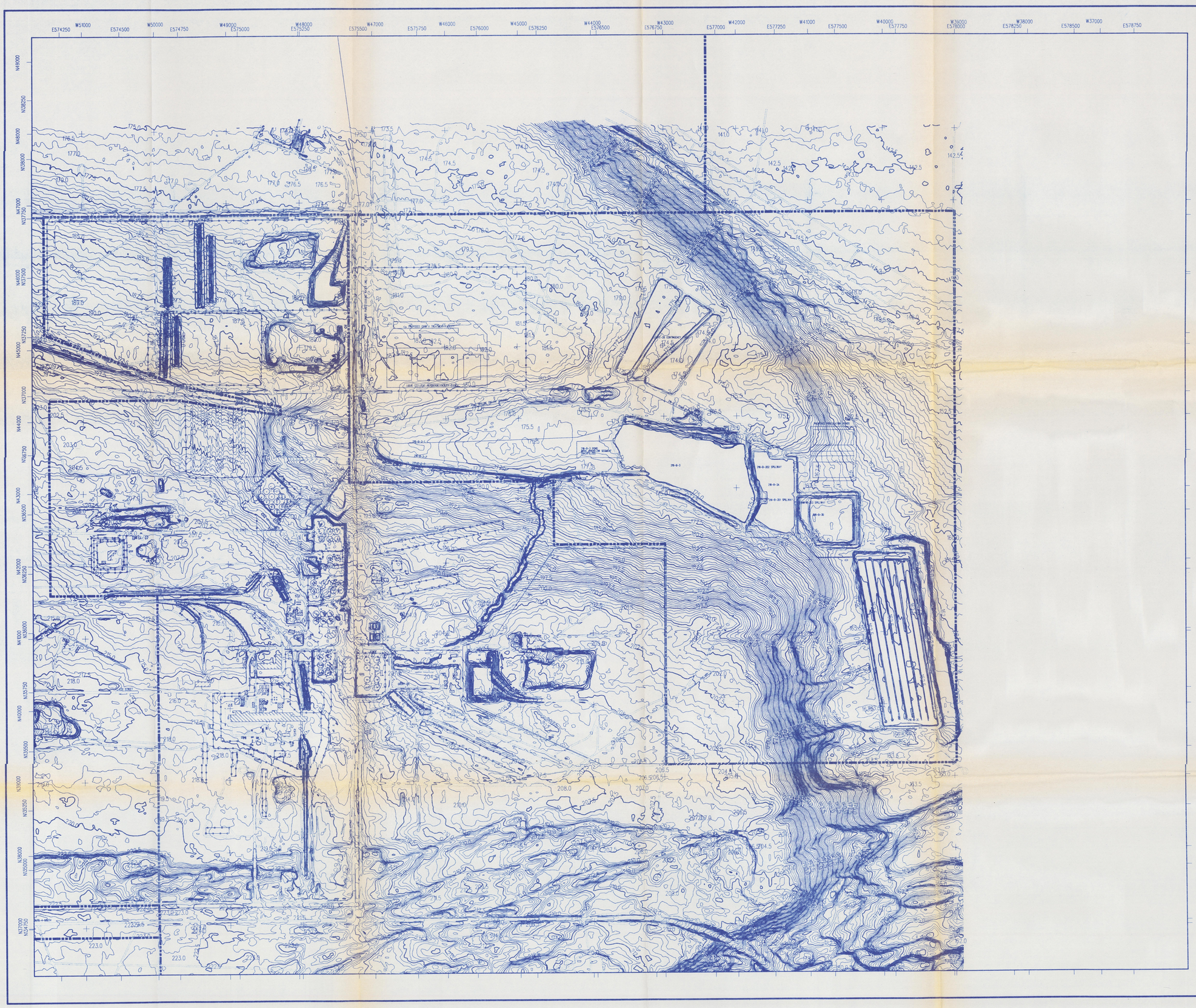
B PLANT AGGREGATE AREA (East of Purex)
PLATE 4 - Facilities, Sites, & Unplanned Releases

LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings
- Waste Management Units
- Unplanned Releases
- Other Waste Mgmt Units

Scale in Feet
0 1000 2000

Scale in Meters
0 500 500



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Aggregate Area Management Studies

B PLANT AGGREGATE AREA (East of Purex)
PLATE 5 - Topography

LEGEND

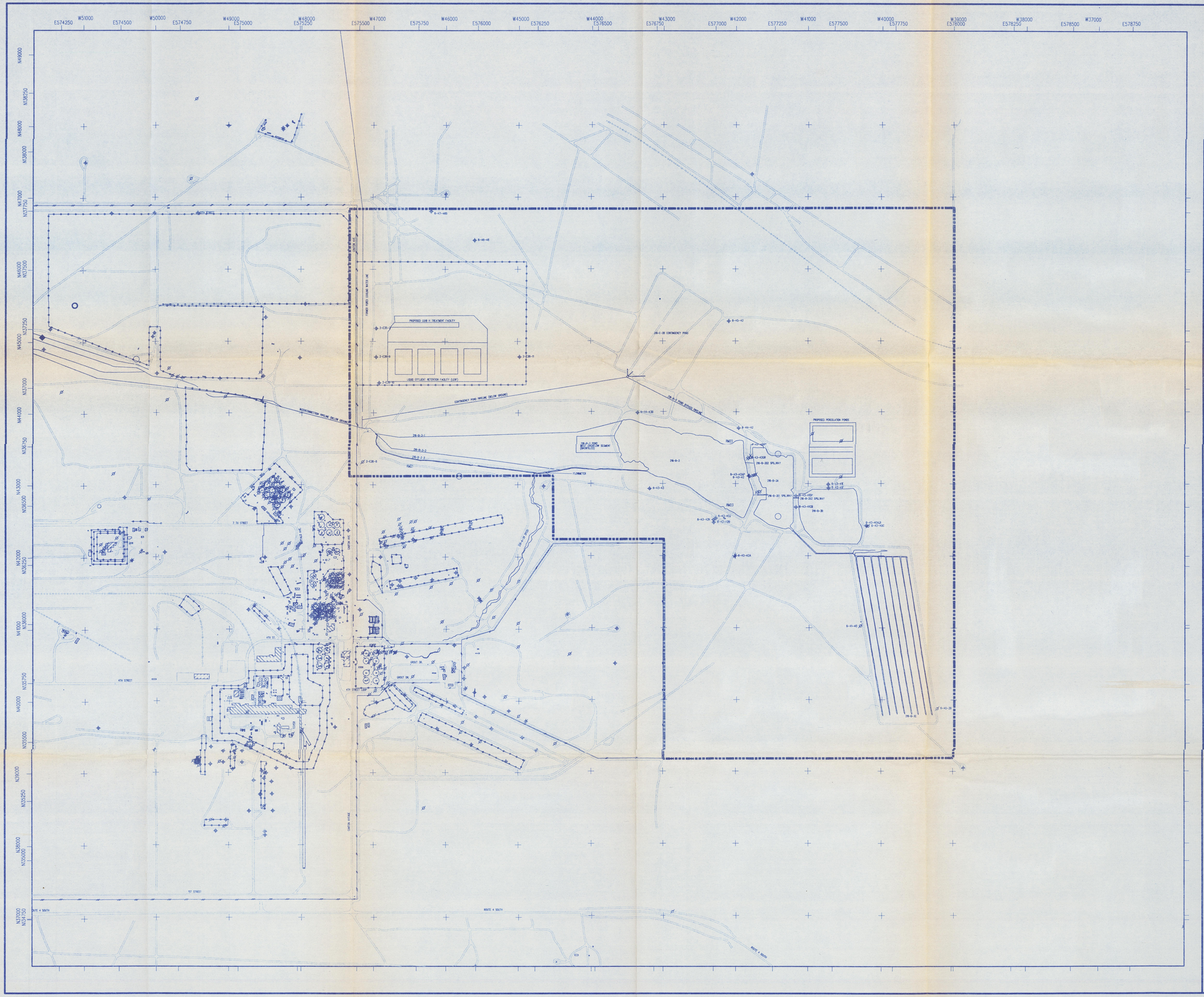
- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings

Contour Interval .5 Meter

N

Scale in Feet
0 1000 2000

Scale in Meters
0 100 500



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Aggregate Area Management Studies

B PLANT AGGREGATE AREA (East of Purex)
PLATE 6 – Monitor Wells & Sample Locations

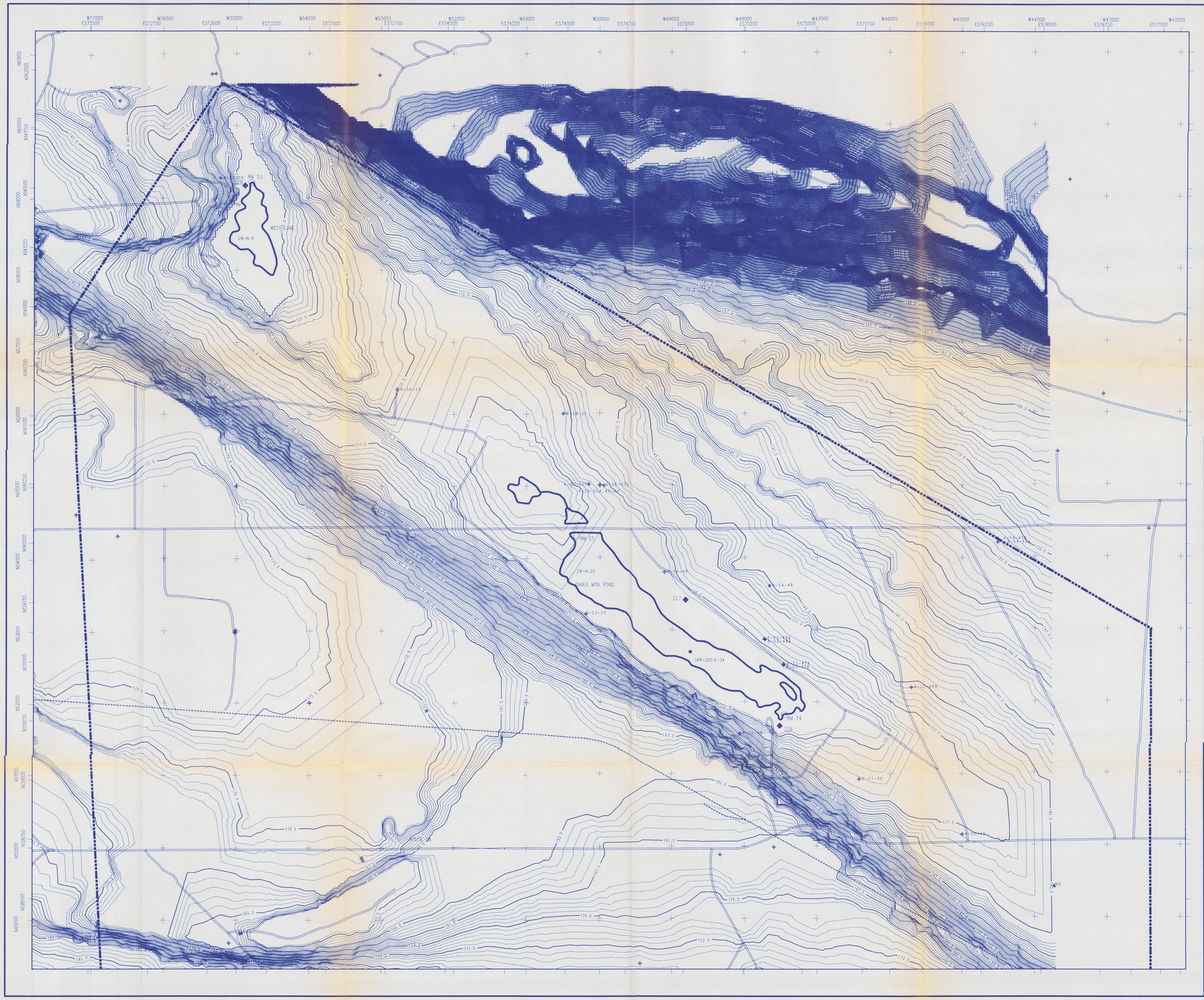
LEGEND

- Aggregate Area Boundary
- Security Systems/Fences
- Perimeter Boundary
- Buildings
- Monitoring Wells
- Other Wells
- SAMPLING LOCATIONS (Approximate)
  - Soil Sampling Locations
    - Former Locations (to 1989) --including TLDs
    - New Sampling Locations (1990 and following)
    - Fenceline Sampling Locations
  - Surface Water Sampling Locations
  - Air Sampling Locations
  - New TLD Sampling Locations

N

Scale in Feet
0 1000 2000

Scale in Meters
0 100 500



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Aggregate Area Management Studies

B PLANT AGGREGATE AREA (North of Purex)
PLATE 7 – Facilities, Sites, Unplanned Releases, Topography, Monitor Wells & Sample Locations

LEGEND

- Aggregate Area Boundary
- Buildings
- Waste Management Units
- Unplanned Releases
- Monitoring Wells
- SAMPLING LOCATIONS (Approximate)
  - *Soil Sampling Locations*
    - Former Locations (to 1989) --including TLDs
    - New Sampling Locations (1990 and following)
    - Fenceline Sampling Locations
  - Surface Water Sampling Locations
  - Air Sampling Locations
  - New TLD Sampling Locations

Contour Interval .5 Meters

N

Scale in Feet
0 1000 2000

Scale in Meters
0 100 500

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APPENDIX A

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A-1.1 INTRODUCTION

Geophysical well logging has been conducted in monitoring wells located within the 200 East and West Areas since 1954 and in the B Plant Aggregate Area since at least as early as 1958. Such logging can be used to map lithologic boundaries (Additon et al. 1978; Last et al. 1989; Brodeur and Koizumi 1989), soil moisture content (Lane 1990) and to evaluate the location and extent of radionuclides in the subsurface due to waste disposal activities (Fecht et al. 1977; Additon et al. 1978; Lane 1990). The geophysical borehole logging techniques that have been used include density, neutron, temperature and gross gamma radiation logging. The most successful of these for mapping lithologic boundaries and monitoring radionuclides in the subsurface has been the gross gamma logging. The other techniques have been less successful either because they are not suitable for use in cased holes or they do not measure radiation (Lane 1990).

Previous studies based on the gross gamma logs collected from wells monitoring various waste management units in the 200 East and West Areas were conducted in 1964, 1969, 1977, 1978, and 1986. The tank farms located in the 200 East and West Areas were not considered in these reports. Additon et al. (1978) report that the 1964 study (Raymond and McGhan 1964) discusses the disposition of radionuclides beneath most of the waste management units active between 1945 and 1963. The 1969 study (Tillson and McGhan 1969) is reported by Additon et al. (1978) to be a discussion of the waste management units where significant changes in the gross gamma logs were observed after 1963. The report by Fecht et al. (1977) is a qualitative study of the distribution, redistribution and decay of radionuclides beneath approximately 100 waste management units in the 200 East and West Areas. Fecht et al. (1977) included a summary of the waste disposal history of each facility evaluated and based their conclusions on approximately 300 selected gross gamma logs collected between 1954 and 1976. Plots of the logs used were provided with the report. Additon et al. (1978) provide a complete summary of the logging systems used and a discussion of the limitations of using gross gamma logs to evaluate the distribution and composition of radionuclides in the subsurface. The methodologies employed to qualitatively evaluate the gross gamma logs collected from wells monitoring the waste disposal facilities in the 200 East and West Areas were also summarized. Plots of the gross gamma logs collected from 154 monitoring wells outside the tank farms in the 200 East Area was included in the report by Additon et al. (1978). Chamness (1986) reviewed gross gamma logs available from selected wells in the 200 Areas and qualitatively summarized any changes in the logs between 1976 and 1986.

In the B Plant Aggregate Area 87 active and inactive waste management units that are monitored by wells where gross gamma logs were collected were evaluated in this study. These waste management units were grouped into 16 geographically related areas and were qualitatively evaluated in terms of the location and extent of radionuclides in the subsurface, any evidence of vertical or lateral migration, and the potential for radionuclides reaching the groundwater (Figure A1-1). The results of the evaluations for these waste management units are summarized in Table A1-1. Additionally, logs from the three inactive single-shell tank

farms in the B Plant Aggregate Area were reviewed and the approximate extent, location and source of radionuclides in the subsurface summarized. The results of the tank farm evaluations are summarized in Table A1-1.

A-1.2 GROSS GAMMA LOGGING

Borehole gross gamma radiation measurements were used to determine the level of gamma activity with depth in the vicinity of the well bore. These measurements do not differentiate between the mechanisms through which gamma radiation is produced or the energy of the gamma radiation photons detected. The response of the gamma radiation detector to different energy levels is generally unknown, except perhaps for the lowest energy photon detectable (Arthur 1990). Gross gamma logs cannot be used to determine the isotopic composition of the subsurface since this is determined through the analysis of the energy spectra of the gamma radiation detected. The capability to measure the spectra of gamma radiation detected in the subsurface and assay the types and amounts of isotopes present is currently being developed, but has not yet reached the stage of practical application (Lane 1990; Price et al. 1990).

The bulk of the gamma logs available for the B Plant Aggregate Area were collected with scintillation probes by Pacific Northwest Laboratories (PNL) or by the Tank Farm Surveillance Analysis and Support group (TFSA&S). Scintillation probes detect the flash of light produced by the interaction between a gamma photon and a crystal of thallium-activated sodium iodide (NaI(Tl)) with a photomultiplier tube. The resulting pulse of electricity is amplified, routed through a signal generator and sent through the logging cable to the surface. The pulses are separated from the electrical signal with a discriminator, amplified, counted by a rate meter and output to a pen plotter which is driven at a rate determined by the logging speed (Fecht et al. 1977; Additon et al. 1978; Brodeur and Koizumi 1989; Arthur 1990).

The accuracy and precision of gamma activity measurements in the subsurface is determined by details of the logging system instrumentation, the field data acquisition methodology, the surrounding media and the radionuclides present. The relationship between the gamma activity detected by a scintillation probe and the actual activity, the distance gamma radiation may travel through geologic materials before being completely attenuated and the vertical resolution of changes in activity by the logging systems used will be discussed below.

The time required for the logging system to process a detected gamma photon, or "dead time," is an important limitation in the measurement gamma activity (Brodeur and Koizumi 1989; Arthur 1990). During this short span of time, no other photons will be processed by the instrument. The "dead time" computed for the PNL system currently in use is 17.8 microseconds (Arthur 1990). Based upon this value, the maximum count rate this logging system is capable of is about 56,000 ct/sec. If the activity is above that level, the

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system becomes "paralyzed" and will read 0 ct/sec until it resets itself. The maximum count rate of the TFSA&S system currently in use is about 100,000 ct/sec with Probe 4 (Strong 1980). This suggests that the "dead time" of their logging system is about 10 microseconds. There is no evidence that TFSA&S's system will become paralyzed if this activity level is exceeded.

The actual gamma activity on an interval may be computed by multiplying the "dead time" corrected activity by a factor consistent with the amount of attenuation due to well construction. The amount of attenuation the gamma radiation experiences in penetrating well casing is significant. A single string of casing reduces the count rate measured by the scintillation probe by about 25%, groundwater in an uncased hole reduces the observed count rate by 11%, and groundwater in a cased hole reduces the observed count rate by about 33% (Brodeur and Koizumi 1989; Arthur 1990).

The relationship between the gamma activity observed with a scintillation probe and the actual activity is linear over much of the system's range. However, above some threshold activity level, the relationship between the observed and actual activity becomes nonlinear. At this point the tool is said to be saturated. The gross gamma logging system currently in use by PNL becomes saturated around 14,500 ct/sec (Brodeur and Koizumi 1989; Arthur 1990), and that currently in use by TFSA&S with Probe 4 becomes saturated around 70,000 ct/sec (Strong 1980).

Where the relationship between the observed and actual gamma activity is linear, and complete details of well construction are available, the activity may be converted to standard units related to decay rates or to concentrations of specific radionuclides (thorium or uranium for example). Such conversions allow the direct comparison of data collected by different logging systems and quantitative analyses of the concentrations of gamma emitters with depth. To achieve this, it is necessary to calibrate the scintillation probes used with a model borehole containing intervals with known activities (Strong 1980; Brodeur and Koizumi 1989; Arthur 1990). The rigorous procedures and facilities necessary for calibrating scintillation probes have not yet been completed.

A scintillation probe is calibrated by periodically adjusting the components of the system to meet established specifications and by logging a test well with intervals of known activity under standard conditions. The probe's calibration is then verified in the field before and after each logging run using portable equipment and procedures that are correlated with those of the calibration procedure. Standard conditions are established by constructing the test borehole in a known geologic environment with background radiation levels similar to those found in the area where the probe is used. The test well should be constructed in a similar fashion to the wells to be logged by the probe (Brodeur and Koizumi 1989).

The average distance through which gamma radiation penetrates geologic and well construction materials and is still detected by the scintillation probe is known as the radius of investigation. This distance is determined by the density of the media surrounding the borehole, the well construction materials, and the energy and intensity of the gamma radiation. The average radius of investigation for gross gamma radiation measurements in an

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open hole is about 0.3 m (1 ft) from the wall of the borehole in sedimentary rocks (Schlumberger 1972). The radius of investigation is larger on intervals where there are high concentrations of radionuclides since higher intensities of gamma radiation will penetrate a greater thickness of a given material. The radius of investigation is decreased by well casing, grout, and groundwater since they increase the effective density of sediments. Another factor in determining the radius of investigation is the tool response to low energy (frequency) gamma photons. The scintillation probe currently used by PNL has a low energy cutoff of between 46.5 and 59.5 keV (Arthur 1990). Gamma radiation with energies below this value will not be detected by that probe. The low energy cutoff for the probes used by TFSA&S is unknown.

The vertical resolution and apparent location of a change in the gamma activity measured by a scintillation probe depends upon details of how the probe signal is processed by the rate meter and the logging speed. The rate meter used in PNL's logging system differs from that used by TFSA&S. The rate meter used by PNL smooths its output using an electronic circuit (an RC circuit). The amount of smoothing is determined by the time constant of the circuit used. This removes statistical variations in the signal detected by the scintillation probe and improves the reproducibility and sensitivity of the data. However, a "lag" is introduced between the depth at which a change in the gamma activity is first encountered by the scintillation probe and the depth at which it is plotted. The size of this "depth lag" is the distance traveled before half of the amplitude of the change in activity is recorded. One time constant is required to reach 63% of the amplitude of any change in activity. So, the "depth lag" is approximately the product of the logging speed and the time constant used (Schlumberger 1972). Before 1989, the logging speed used by PNL had been 4.6 m/min (15 ft/min) (0.25 ft/sec) and the time constant used had been 3 seconds. This results in a depth lag of 0.2 m (0.75 ft). The thinnest interval of elevated activity that could have been resolved was also 0.2 m (0.75 ft) on these older profiles. In 1989, the logging speed was reduced to 1.5 m (5 ft/min) (1 in./sec) and the time constant to 1 second. The expected vertical resolution and "depth lag" of these logs is 1 in. (2.54 cm).

The rate meter used by TFSA&S sums the pulses over the period of time required for the probe to ascend through 0.3 m (1 ft) and averages the reading over time. This process does not remove the statistical variations from the data so the data are less reproducible. Since no time constant is used, no "lag" between the depth a change in gamma activity is encountered and the depth where it is plotted is introduced. However, the vertical resolution of changes in activity on these logs is 0.3 m (1 ft), the distance over which the activity is averaged.

A-1.3 TECHNICAL APPROACH

Scintillation probe profiles collected periodically from monitoring wells within the B Plant Aggregate Area have been used to qualitatively assess the location and extent of radionuclides in the subsurface, any evidence of vertical or lateral migration, and the

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potential for radionuclides from waste disposal activities reaching the groundwater. The approach used here is similar to that of Fecht et al. (1977). Scintillation probe profiles collected from wells monitoring a facility or group of facilities were compiled and analyzed to understand the subsurface distribution of gamma emitters from waste disposal activities. Each analysis was accompanied by a summary of the types and sources of wastes handled, the service dates and the volume of wastes disposed of or stored at a given facility. The conclusions reached in these evaluations should not be considered final since they are based on a limited data set which can only be used for qualitative purposes.

The approach used here differs from that of Fecht et al. (1977) and other previous evaluations in the manner in which the data were compiled and analyzed. The 87 waste management units evaluated were grouped into 16 geographic areas and evaluated as a whole (Figure A1-1). The three tank farms for which summary evaluations were made account for three additional areas. Geological methods of analysis were used extensively that incorporated cross sections and maps of subsurface attributes such as the thickness of zones of elevated gamma radiation and relevant lithologic horizons. The advantages of this approach are the clearer representation of potential subsurface conditions around the waste disposal facilities, and identification of data deficiencies. It is assumed that the activity detected on the gamma logs represent diffuse, continuous sources of radiation.

Fecht et al. (1977) attempted to "normalize" the scintillation probe profiles used in their evaluations to a level consistent with the profiles collected in 1976. This normalization scheme involved scaling the profiles from each vintage using an average "peak to background" ratio and bulk shifting the corrected curves to correspond to the 1976 profiles. Since there are distinct differences between the response characteristics of each logging system and their modifications (in the saturation levels, low energy cutoff, etc.), there are doubts to the validity of such an exercise. The logs used in the evaluations presented here have not been normalized.

There has been no attempt to quantitatively compare the activity levels detected by different vintages of scintillation probes in the evaluations presented here. If gross changes in the profiles are evident, they have been noted in a qualitative sense. The criteria used to identify radionuclide decay are the significant, consistent decline of activity levels and the "narrowing" of the features representing elevated radiation on the logs over time. However, such changes may also be indicative of lateral migration of radionuclides away from a particular well. Identification of lateral migration is generally uncertain. The most reliable criteria for identifying lateral migration of radionuclides is the notable increase of activity on an interval in a well that is down gradient (of a stratigraphic or hydrologic boundary) from other wells with elevated activity on a similar interval. It is very important to consider the spacial and temporal context of the scintillation probe data in determining if lateral migration has occurred, even on a qualitative level.

Although the activity measured by the scintillation probes cannot be quantified to known standards, the activity in the subsurface may be reliably located. The location of features in the scintillation probe profiles such as the top and bottom of intervals of elevated gamma radiation are generally found at the same depth on successive logs. Care must be

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taken in comparing the logs collected by TFSA&S and PNL. Depth discrepancies of up to 5 ft have been noted between these logs. This error is due in part to the "depth lag" of the PNL logging system. This "depth lag" will place equivalent features on PNL logs (collected before 1989) 0.2 m (0.75 ft) shallower than those on TFSA&S logs. Also, differences in the responses of the PNL and TFSA&S systems may account for some of this discrepancy.

Three criteria were used to establish downward migration of radionuclides in the vicinity of a well. The most important of these was an unambiguous downward displacement of the top and bottom of a region of elevated radiation with time. Downward migration of other correlatable features on an interval of elevated activity may be used in support of this evidence. Secondly, the total amount of downward migration should exceed the vertical resolution of the logging system used (0.2m, 0.75 ft, for the PNL pre-1989 logs and 0.3 m, 1 ft, for TFSA&S logs). Finally, any change in the point from which depths are measured during logging should be identified and accounted for; this can be inferred from stationary subsurface features, such as lithologic boundaries and bottoms of casing strings.

All of the available well data were reviewed for each area evaluated, and selected logs were used to construct cross sections representative of subsurface conditions. These cross sections were correlated with stratigraphic information from nearby wells, regional cross sections and regional mapping. Boundaries of zones of elevated gamma radiation were also marked. Any mappable attributes that could be used to represent the location and extent of the region of elevated gamma radiation were compiled into maps. The evaluation of the scintillation probe profiles referenced these graphical representations to describe the location and extent of any zones of elevated gamma radiation, and the behavior of this zone over time, particularly in regards to vertical or lateral migration. Any evidence of gamma emitters reaching the groundwater was also noted.

To represent the logs used in the cross sections in a clear, yet compact format and to help compare different vintages of data, it was necessary to digitize the original logs and to redisplay them on a semilogarithmic scale. Depth in feet from the top of casing was represented on the linear scale, and activity in ct/sec on the logarithmic scale. The logs used in these evaluations collected before 1976, and some of the 1976 vintage logs, had been previously digitized by PNL, who provided text files of the information. Unfortunately, it was not realized until late in the evaluations that the 1970 vintage and earlier logs had been plotted on a scale of ct/min. The reader should be aware that these logs are not plotted in ct/sec, but in ct/min. The apparent wide difference between these earlier logs and those collected in 1976 and later is due to an error in scaling. Logs plotted on a scale of ct/min were denoted on the legend for each plot of scintillation probe profiles. Additionally the cross sections are not scaled horizontally. To obtain a true picture of the spacial relationship between the wells used in the cross sections, the reader is instructed to inspect the location map provided on each figure containing cross sections.

Features that were mapped in the evaluations for the B Plant Aggregate Area include the thickness of the interval of elevated gamma radiation, the top of the elevated gamma radiation and the top of any correlatable lithologic horizon which is useful in explaining the distribution of radionuclides in the subsurface. The most commonly used map was the

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thickness of the interval of elevated gamma radiation. Although such maps do not give any indication of gamma activity, they do provide a reasonable representation of the potential extent of gamma emitters. Use of activity data was avoided since the data are not suitable to be used in such a quantitative fashion.

A-1.4 EVALUATION OF WASTE MANAGEMENT UNITS AREAS

A-1.4.1 216-B-43 through -50, -57, and -61 Cribs

Evaluation of Scintillation Probe Profiles

The 216-B-43 through -50 Cribs, also known as the BY Cribs, the 216-B-57 Crib and the 216-B-61 Crib are all located within the 200-BP-1 Operable Unit, immediately north of the 241-BY Tank Farm. The 216-B-43 through -50 Cribs are monitored by Wells E33-1, -2, -3, -4, -5, -6, -7, -13, -22, -23 and -90. The 216-B-57 Crib is monitored by Well E33-24 and the 216-B-61 Crib is monitored by Wells E33-25 and -26. Details of these monitoring wells and the scintillation probe profiles used in this evaluation are given in Table A1-2.

Scintillation probe profiles from the wells monitoring the 216-B-43 through -50 Cribs were evaluated by Fecht et al. (1977) and Chamness (1986). Fecht et al. (1977) found high levels of activity from near the surface to the water table beneath these cribs. They noted that levels of activity had been slowly declining since waste disposal activities ceased in these units. No evidence of radionuclide migration was found. They concluded that gamma emitters from these cribs may have reached the groundwater in this area. Profiles from selected wells in the 216-B-43 to -50 Crib area were reviewed by Chamness (1986). The activity in those wells was found to be slowly declining over time. The results of this evaluation do not differ significantly from those of these previous studies.

Scintillation probe profiles from the wells monitoring the 216-B-57 and -61 Cribs have been evaluated by Fecht et al. (1977). They concluded that the increased gamma activity over time in the well monitoring the 216-B-57 Crib was due to continuing waste disposal activities in that crib. They also concluded that radionuclides had not reached the water table in that area. Low levels of activity on an unspecified interval in the wells monitoring the 216-B-61 Crib were noted by Fecht et al. (1977). The results of this evaluation for the 216-B-57 and -61 Cribs do not differ from those of Fecht et al. (1977).

Scintillation probe profiles from wells monitoring the 216-B-43 through -50, -57 and -61 waste management units were compiled into cross sections and correlated with the stratigraphy found in Well E33-4 and with regional maps of the lithologic units (Lindsey et al. 1992) (Figures A1-2 and A1-3). The lithologic correlations used should be considered approximate since high levels of gamma activity on many of the profiles obscured the subtle features caused by lithologic changes.

High levels of gamma activity over a thick interval of the subsurface is evident on the scintillation probe profiles collected from the wells monitoring the 216-B-43 through -50 and -57 waste management units (Figures A1-2 and A1-3). The thickness of this interval and the area beneath the 216-B-43 through -50 Cribs where elevated levels reach the top of the basalt were mapped (Figure A1-4). The region of elevated gamma radiation under the 216-B-43 through -50 and -57 Cribs appears to have a considerable lateral extent, reaching the area of the 216-B-57 Crib, 75 m (250 ft) to the west-southwest, and to Well E33-13, 75 m (250 ft) to the east-southeast. No well control is available to the north and east of the 216-B-43 through -50 Cribs.

There are several explanations for the distribution of radionuclides beneath the 216-B-43 to -50 Cribs. The simplest of these is that during operations, the radionuclides disposed of in the 216-B-43 to -50 Cribs migrated downward and laterally with little influence by lithologic conditions. This is supported by the southerly extent of the gamma emitters, against the northerly dip of the alluvium (Lindsey et al. 1992) and by the fair to poor correlation between a silty interval found in Well E33-4 and features on the scintillation probe profiles from the wells monitoring this area. Alternative explanations for the lateral distribution of radionuclides below the 216-B-43 to -50 Cribs include contributions from the 216-B-57 Crib and the 241-BY Tank Farm, and local features in the lithologic units. The scintillation probe profile data are inadequate to evaluate these alternative explanations.

It appears that the silty interval within the Hanford sand found in Well E33-4 acted as a barrier to the downward movement of wastes under the 216-B-57 Crib while it was active. The top of this layer correlates with the base of the plume in this area. The lateral extent of the gamma emitters detected in this area cannot be delineated with the data available from the single well monitoring this crib.

The top of the interval of elevated gamma radiation detected under the 216-B-43 through -50 and -57 Cribs is commonly 2 to 3 m (6 to 10 ft) below the surface, but may be found at the surface near Well E33-22 and at a depth of 15 m (50 ft) near Wells E33-38 and -90 (Figures A1-2 and A1-3). The shallowest depths to the elevated radiation are found under cribs 216-B-46, -49 and -50, in an area adjacent to cribs 216-B-43 and -44, and beneath crib 216-B-57. This is consistent with the waste disposal activities which occurred in those areas.

In Well E33-90, elevated levels of gamma radiation near the ground surface are evident on the scintillation probe profiles collected in 1965 and 1968 (Figure A1-2). An unplanned release (UN-200-E-63) discovered in 1981 is located in the vicinity of Well E33-90. However, the details of this unplanned release suggest that its location was in the area of the BC Cribs, well south of the BY Crib area. Alternatively, the elevated levels detected near the surface in Well E33-90 may be related to those detected below the 216-B-43 through -50 Cribs. This seems unlikely since gamma emitters would have had to travel upwards to reach the surface elevation of Well E33-90. It is possible that the top of casing (TOC) for this well is in error on the GIS listing used. The actual TOC for Well E33-90 may be closer to that of the other wells in the area. However, if a more consistent TOC is used for

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Well E33-90, the scintillation probe profiles for that well do not correlate with those of the neighboring wells. Without more current logs, it is not possible to determine the present conditions in the near surface in the vicinity of Well E33-90.

There is no evidence of measurable vertical or lateral migration of radionuclides beneath the 216-B-43 through -50, -57 and -61 waste management units. No changes in the scintillation probe profiles over time are evident except for those associated with radionuclide decay.

Elevated gamma radiation levels are detected in the groundwater in all of the monitoring wells reaching the water table around the 216-B-43 through -50, -57 and -61 waste management units, except in Well E33-38. The background gamma radiation levels found below the water table in Well E33-38 could be due to actual conditions in the groundwater or by contamination of the neighboring wells by gamma emitters. The simplest explanation is that the measurements in Well E33-38 represent the most current conditions below the water table and since 1987 radiation levels have been at background. Another possibility is that elevated radiation levels are found everywhere but in the vicinity of Well E33-38. Perhaps the basalt surface is higher or lower in this area, and radionuclides in the groundwater do not reach the well. It is also possible that the elevated gamma activity detected below the water table by the other wells monitoring the 216-B-43 through -50, -57 and -61 waste management units is due to radionuclides adhering to rust in the casing of these wells (Smith 1980). Since Well E33-38 was drilled in late 1990 and was probably constructed with stainless steel components, such an effect is not seen.

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A-1.4.2 216-B-14 through -19 Cribs

Evaluation of Scintillation Probe Profiles

The 216-B-14 through 19 Cribs are located in the eastern part of the 200-BP-2 Operable Unit. The cribs are monitored by eight monitoring wells. Well E-13-1 monitors crib 216-B-14. Well E13-2 monitors crib 216-B-15. There is a discrepancy between the location of Well E13-2 given by the GIS coordinates and the location used by Fecht et al. (1977). This evaluation uses the location of Fecht et al. (1977). Wells E13-3 and E13-21 monitor crib 216-B-16. Well E13-4 monitors crib 216-B-17. Well E13-5 monitors crib 216-B-18. Well E13-6 monitors crib 216-B-19. Well E13-20 is also used in evaluating crib 216-B-18. Table A1-3 provides details on the construction of the wells used in this evaluation.

Cribs 216-B-14 through -19 have been previously evaluated by Fecht et al. (1977). They concluded that measurable migration of contaminants has occurred beneath all the cribs and that possible breakthrough to the water table has occurred under cribs 216-B-14 and 216-B-16. The conclusions of the present evaluation agrees with the previous evaluation of Fecht et al. (1977).

The wells monitoring the 216-B-14 through -19 Cribs were compiled into two cross sections (Figure A1-5) and correlated with the lithologic columns from Wells E13-14 and E13-18 (Lindsey et al. 1991) and the regional mapping of Lindsey et al. (1992). Although the expression of the lithologic changes is subtle on the scintillation profiles, the correlation is probably a reasonable one since Wells E13-14 and E13-18 are located about 450 m (1,500 ft) from the area.

Intervals of elevated gamma radiation occur in all of the monitoring wells in the 216-B-14 through -19 area. The thickness and extent of elevated areas of gamma radiation are shown in Figure A1-6. The distribution of the monitoring wells around the crib area is inadequate to fully define the lateral extent and potential for lateral migration of radionuclides in the subsurface.

Vertical migration of radionuclides may be in part controlled by the top of a fine silty layer that occurs at a depth of 29 m (95 ft) in Well E13-18. This is supported by the fact that elevated gamma readings are limited to a maximum depth of 29 m (95 ft) in all but two wells in the crib area. Previous high gamma activity below 29 m (95 ft) has declined to near background levels due to radionuclide decay. This suggests that strong gamma emitters with long half-lives were retained about the fine silty layer. Evaluation of older gamma logs indicate that in all but two wells elevated gamma activity did not reach the water table.

Elevated gamma activity is detected in Wells E13-1 and E13-21 from just below the ground surface to the water table. This indicates that gamma emitters may have reached the groundwater below the 216-B-14 and 216-B-16 Cribs. There is a discrepancy between the thicknesses of the intervals of elevated gamma radiation detected in Wells E13-21 and E13-3 which monitor the 216-B-16 Crib. Well E13-3 shows elevated gamma readings to a depth of 23 m (75 ft) whereas Well E13-21 has elevated readings to a depth greater than 90 m (300 ft). This difference may have been caused by a greater amount of waste concentrated on the west side of Crib 216-B-16. An alternative explanation is that waste may have traveled along a pathway provided by the E13-21 Monitoring Well.

An evaluation of scintillation probe profiles from Wells E13-6 and E13-2 taken prior to disposal to the 216-B-15 and 216-B-19 Cribs indicates that lateral migration had occurred in the crib area. Elevated gamma radiation was recorded both in Well E13-6 from 3 m (8 ft) to a depth of 23 m (75 ft), and in Well E13-2 to 32 m (105 ft), even before the cribs they were monitoring became active. The gamma emitters that migrated to Wells E13-2 and -6 may have come from cribs 216-B-14, -16, -17, or -18.

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A-1.4.3 216-B-20 through -34, -52, -53A, -53B, -54, and -58 Trenches

Evaluation of Scintillation Probe Profiles

The 216-B-20 through -34, -52, -53A, -53B, -54 and -58 Cribs are located in Operable Unit 200-BP-2. The crib area is monitored by 23 wells: Wells E13-7 through E13-19 and Wells E13-51, E13-52, E13-54 through E13-61. Table A1-4 provides details of the wells used in this evaluation.

This waste management unit area has previously been evaluated by Fecht et al. (1977). Fecht et al. (1977) concluded that contamination of the groundwater was not indicated and that vertical migration of contaminants had stopped. The conclusions of this present evaluation are consistent with Fecht et al. (1977).

Scintillation probe profiles from Wells E13-52, E13-59, E13-60, E13-17, E13-14, E13-9, E13-54, E13-56, E13-57, and E13-19 were used to construct two cross sections of the crib area (Figure A1-7). These cross sections were correlated with the geology of Lindsey et al. (1992) and the E13-14 boring log.

Intervals of elevated gamma radiation occur in most of the vadose wells located in between the cribs. Several wells (E13-52, E13-54, E13-56 and E13-57) do not extend below the interval of elevated gamma radiation, therefore the depth to which radionuclides may have migrated beneath the cribs is uncertain. It is therefore possible that radionuclides may have reached the groundwater, but groundwater wells do not indicate breakthrough has occurred.

The thickness and extent of elevated areas of gamma radiation are shown in Figure A1-8. Some lateral migration occurred around the cribs. Evidence for lateral migration is indicated by 1958 gross gamma logs. In the 1958 logs, most of the perimeter wells, E13-7 through E13-19, record elevated gamma activity. The extent of lateral migration cannot be ascertained as the monitoring wells are placed immediately adjacent to the waste management units. The elevated gamma activity has declined to background levels in all of the wells except E13-7.

A-1.4.4 216-B-35 through -42 Trenches

Evaluation of Scintillation Probe Profiles

The 216-B-35 through -42 Trenches are located within the 200-BP-3 Operable Unit, in the northwest portion of the 200 East Area. The 216-B-35 Trench is monitored by Well E33-286, the 216-B-36 Trench by Well E33-21, the 216-B-37 Trench by Wells E33-287 and -288, the 216-B-38 Trench by Wells E33-289 and -290, and the 216-B-41 Trench by Well E33-8. The 216-B-39, -40 and -42 Trenches have no monitoring wells in their immediate vicinity. Wells E33-10, -28, -29 and -32 lie on the perimeter of the 216-B-35

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through -42 waste management unit area. These outlying wells were used to define the lateral extent of radionuclides originating from these trenches. All of the monitoring wells in this area are occasionally logged by PNL. Details of the monitoring wells and the scintillation probe profiles used in this evaluation are given in Table A1-5.

Fecht et al. (1977) evaluated the scintillation probe profiles from Wells E33-8 and -21, which monitor the 216-B-41 and -36 Trenches respectively. They concluded that the interval of elevated gamma radiation, found between 7.1 and 18.9 m (23 and 62 ft) in Well E33-8 and between the surface and 16.8 m (55 ft) in Well E33-21, was not migrating and that activity levels were declining over time. Activity below 16.8 m (55 ft) in Well E33-21 was reported to be minor and had reached background by 1976.

The evaluation in this report is consistent with that of Fecht et al. (1977) except for the interpretation of the activity detected in Well E33-21. The significant gamma activity reaches 70 ft (21.3 m) rather than 16.8 m (55 ft) as reported by Fecht et al. (1977). Also, Fecht et al. (1977) made no mention of the development of a peak below the water table, at a depth of 82.3 to 85.4 m (270 to 280 ft), between 1970 and 1976.

The scintillation probe profiles from the wells monitoring the 216-B-35 through -42 Trenches were compiled into 2 cross sections and correlated with the stratigraphy for the area (Lindsey et al. 1992; Last et al. 1989) (Figure A1-9). The correlation between the scintillation probe profiles and the lithology is good because complete stratigraphic information is available for many of the wells in this area. Well construction data is also available for Wells E33-29 and -32 (Figure A1-9). There is a clear correlation between the scintillation probe profiles and the various lengths of telescoping casing used in the construction of these wells.

High levels of gamma radiation are detected within the top of the Hanford upper coarse and a gravelly interval at the top of the Hanford sand. The thickness and lateral extent of the elevated activity are shown in Figure A1-10. The top of the elevated activity is found at the surface in Wells E33-21, -288 and -289 and at a depth of 8.5 m (28 ft) in Well E33-8. The bottom of this interval is found between 13.1 and 21.3 m (43 and 70 ft) in Wells E33-10 and E33-21, respectively.

The vertical and lateral extent of gamma emitters in the vadose zone is poorly constrained due to a lack of adequate well control. Although Wells E33-286, -287, -288, -289 and -290 are well placed to define the vertical extent of gamma emitters, they do not penetrate the interval of elevated gamma radiation (Figure A1-9). The lateral extent of the region of elevated gamma radiation is well constrained to the east and to the southeast. However, no wells have been placed in optimal locations to constrain the northerly or southerly extent of radionuclides which originated from the 216-B-35 through -42 Trenches (Figure A1-10).

There appears to be an interval of slightly elevated gamma radiation extending from the top of the Hanford sand to a clay layer found at its base in Well E33-21 (Figure A1-9). This interval is interpreted to be spurious, due perhaps to the calibration of the scintillation probe,

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conditions within the well itself or to local lithologic conditions. The apparent activity on this interval declines with depth to background levels between 42.7 and 64 m (140 and 210 ft). The character of the scintillation probe profiles from Well E33-8 mimics this behavior, although the activity detected is consistent with background levels. Additionally, the activity detected within the Hanford sand in Well E33-21 is exaggerated by the log scale used to represent the scintillation probe profiles.

There is no evidence of vertical or lateral migration of radionuclides in the vadose zone in the area of the 216-B-35 through -42 Trenches. The temporal control upon which this conclusion is based is only fair. Wells E33-8, -10, and -21 were emplaced in they 1950's, so many vintages of scintillation probe profiles are available for comparison. The most recent profiles for these wells were collected in 1976. More recent logs are available for the remaining wells in this area, but these wells were emplaced in the 1980's or in 1990, so fewer vintages of logs are available for comparison.

Elevated levels of gamma radiation is detected in the groundwater beneath the 216-B-35 through -42 Trenches and appears to represent gamma emitters moving along the top of the basalt in a southerly direction. In Well E33-8, the northernmost well in this area, gamma levels below the water table declined to near background between 1970 and 1976 while those detected in Wells E33-10 and -21, located in the southerly part of this area, increased in this span of time (Figure A1-9). The more recent profiles available from Wells E33-28, -29, and -32 are consistent with the temporal changes in the logs from E33-8, -10, and -21. Low levels of gamma radiation were detected below the water table in Well E33-29, located in the southern part of this area, in 1987 while background levels were detected in Wells E33-28 and 32, located in the central part of this area, in 1987 and 1989, respectively (Figure A1-9). The distribution in time and space of the elevated gamma radiation detected in the groundwater beneath the 216-B-35 through -42 area suggests that the source of gamma emitters is located to the north or northeast, possibly in the BY Crib area or in the 241-BY Tank Farm (Figure A1-10).

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A-1.4.5 216-B-7A & B and -8 Cribs, -11 Reverse Well, and -51 French Drain

Evaluation of Scintillation Probe Profiles

The inactive 216-B-7A & B, -8, -11 and -51 waste management units are located within the 200-BP-4 Operable Unit. The B and BY Tank Farms border this Operable Unit on the south and west respectively. The 216-B-7A and -7B Cribs are monitored by Wells E33-18, -58, -59, -72 and -75. The 216-B-8 Crib is monitored by Wells E33-16, -66, -67, -68, -69, -70, -71 and -89. The 216-B-8 Tile Field is monitored by Wells E33-15, -73, -64 and -76. The 216-B-11A and -11B Reverse Wells are monitored by Wells E33-20 and -19 respectively. The 216-B-51 French Drain is monitored by Wells E33-11 and -39. Wells located on the boundary of the area containing these waste management units are E33-12, -14, -61 and -84. All of these wells are occasionally logged by PNL. Details of these wells and the logs used in this evaluation are given in Table A1-6.

Scintillation probe profiles from the wells monitoring the 216-B-7, -8, -11 and -51 waste management units were reviewed by Fecht et al. (1977). They concluded that no measurable migration of radionuclides had occurred in the unsaturated zone beneath these waste management units and radionuclides had not reached the groundwater. No mention was made of elevated radiation levels in the groundwater. The conclusions of the current evaluation in regards to the gamma activity detected in the unsaturated zone do not differ significantly from those of Fecht et al. (1977). Chamness (1986) reported that two wells near the 216-B-8 Crib could not be logged due to safety concerns about the crib's wooden structure; this may account for the lack of recent scintillation probe profiles from most of the wells in the area.

Scintillation probe profiles from 16 of the 26 wells located in the vicinity of the 216-B-7, -8, -11 and -51 waste management units were compiled into three cross sections (Figures A1-11, A1-12 and A1-13). These cross sections were correlated with the lithologic column available for Well E33-19 and the regional mapping of Lindsey et al. (1992). The correlation between the lithology and features on the scintillation probe profiles was poor due to low contrast in the natural gamma radiation signatures of the lithologies present. This reflects the uniform character of the lithologic facies in the Hanford formation.

Elevated levels of gamma radiation is detected in the unsaturated zone beneath the 216-B-8 Crib and Tile Field and beneath the 216-B-7A and -7B Cribs and the 216-B-11A and -11B Reverse Wells. The thickness the interval of elevated activity in these two areas was mapped and the extent of the gamma emitters estimated (Figure A1-14). The interval of elevated gamma activity under the 216-B-8 Crib is between 3 and 40 m (10 and 130 ft) below the surface. Elevated activity is detected between 3 and 15 m (10 and 50 ft) beneath the 216-B-8 Tile Field (Figure A1-12). The interval of elevated radiation under the 216-B-7A and -7B Cribs and the 216-B-11A and -11B Reverse Wells is between 5 and 30 m (15 and 100 ft) below the surface (Figures A1-12 and A1-13).

A "leaky" geologic barrier of some sort is postulated to exist in the subsurface beneath the 216-B-8 Crib and Tile Field. Scintillation probe profiles from wells located next to the 216-B-8 Crib have a blocky character while those removed a short distance from the crib have a distinctly digitate character (Figure A1-12). This suggests that a "leaky" geologic barrier is present within the Hanford sand, between 15 and 20 m (50 and 70 ft) below the surface. While the 216-B-8 Crib was active, this barrier impeded the downward movement of gamma emitters, causing them to move laterally. The available lithologic information is inadequate to verify this hypothesis.

Elevated gamma activity is only detected under the southwestern end of the tile field, closest to the 216-B-8 Crib. This activity is only found to a depth of 15 m (50 ft), corresponding to the uppermost "digit" found in the profiles from wells offset from the 216-B-8 Crib itself (Figure A1-12). This supports the existence of the postulated "leaky" geologic barrier within the Hanford sand.

Although the scintillation probe profiles from the wells monitoring the 216-B-7 and -11 waste management units do not have digitate character (Figures A1-12 and A1-13), the

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relationships between the profiles suggests that the distribution gamma emitters from these waste management units was controlled by similar subsurface conditions as those found under the 216-B-8 Crib and Tile Field. Elevated gamma radiation is found between 6 and 15 m (20 and 50 ft) on the western side of the B-7 Cribs, in Wells E33-59 and -75 (Figure A1-13). This corresponds to the upper "digit" found in scintillation probe profiles from wells removed from the 216-B-8 Crib. Under the 216-B-11A and -11B Reverse Wells, elevated radiation is found on a thin interval between 23 and 30 m (75 and 100 ft) below the surface. This correlates with an interval of silty material found in Well E33-19 (Lindsey et al. 1992). The disposal depth of these wells was 12 m (40 ft), which may have penetrated the postulated geological barrier and allowed gamma emitters to reach this deeper silty layer.

It appears that gamma emitters from the B-7 Cribs have moved laterally under the 216-B-11 Reverse Wells and commingled with any radionuclides from those waste management units. Evidence for this includes the correlation between the depth to which radionuclides reached in the vicinity of Well E33-58 and the depth of the radionuclides detected under the 216-B-11 Reverse Wells. The apparent dip of the base of the elevated radiation in this area also supports the proposed lateral migration of gamma emitters from the 216-B-7 Cribs.

There is no evidence that the radionuclides residing in the unsaturated zone beneath the 216-B-7, -8 and -11 waste management units are migrating vertically or laterally. However, there are very few current scintillation probe profiles available from the wells monitoring these structures. Without adequate temporal control, the potential for migration of gamma emitters in the subsurface cannot be properly evaluated.

Although elevated gamma radiation is detected below the water table in the area of the 216-B-7, -8, -11 and -51 waste management units, there is no evidence that radionuclides placed in these structures ever reached the water table. The top of the elevated gamma activity below the water table is flat in this area and lends no clue of the source of gamma emitters or the direction of groundwater flow. The elevation of the top of the elevated radiation is about 123 m (410 ft), which is above the elevation of the current water table (Last et al. 1989). The scintillation probe profile from Well E33-39, which was emplaced in 1991, indicates that only background levels of gamma radiation are found in the groundwater. Without current logs from the other wells in the area, it is not possible to determine if the elevated gamma activity detected in 1976 was due to gamma emitters in the groundwater or to gamma emitters adhering to rust in the well screen (Smith 1980).

A-1.4.6 216-B-5 Reverse Well and 241-B-361 Settling Tank

Evaluation of Scintillation Probe Profiles

The 216-B-5 Reverse Well and the 241-B-361 Settling Tank are located in Operable Unit 200-BP-5, northwest of the 221-B Building. The monitoring wells located within the area of these waste management units are E28-1, 28-7, E28-23, E28-24, E28-25, E28-73 and

E28-74. Wells E28-1, E28-7, E28-24, E28-73 and E28-74 have been logged by PNL. Wells E28-23 and E28-25 have not been logged. Details of the monitoring wells in this area are given in Table A1-7.

Waste management units 216-B-5 and 241-B-361 have been studied by Smith (1980) and Fecht et al. (1977). Significant levels of gamma activity above and below the water table were reported in both studies. Based on scintillation probe profiles and radionuclide analyses of soil and water samples, Smith (1980) reported elevated levels of radionuclides on an interval consistent with the perforated interval of the 216-B-5 Reverse Well. Elevated radionuclide content in the groundwater was found to extend 600 m (2,000 ft) laterally from the 216-B-5 Reverse Well. The source of radionuclides in the ground water was attributed to the 216-B-5 Reverse Wells and to the BY Cribs (waste management units 216-B-43 through -50), which are northeast of this area. No evidence of leakage of radionuclides from the 241-B-361 Settling Tank was found. Based upon the scintillation probe profiles from Well E28-1, Fecht et al. (1977) also determined that elevated gamma radiation below the water table extended 600 m (2,000 ft) from the 216-B-5 Reverse Well. The results of this evaluation do not conflict with the findings of these previous studies.

Scintillation probe profiles from wells located near the 216-B-5 and 241-B-361 waste management units were compiled into two cross sections and correlated with the lithologic section presented by Smith (1980) and the regional mapping of Lindsey et al. (1992) (Figure A1-15). The lithologic section from Smith (1980) was modified to include the lithologic units mapped by Lindsey et al. (1992). The features on the scintillation probe profiles correlated well with the stratigraphy of Smith (1980) and Lindsey et al. (1992).

Elevated levels of gamma radiation is detected above and below the water table, within the Hanford lower coarse and the Ringold A (Figure A1-15). The source of the gamma emitters detected in the unsaturated Hanford lower coarse is attributed to waste disposal activities in the 216-B-5 Reverse Well (Smith 1980). The lateral extent of the gamma emitters detected above the water table cannot be adequately characterized with the available scintillation probe profiles. Elevated gamma radiation levels within the unsaturated Hanford lower coarse are only detected in Well E25-24, located 6 m (20 ft) southeast of the 216-B-5 Reverse Well. Based on soil samples from Wells E25-23 and 25, radionuclides in the Hanford lower coarse are found at least 6 m (20 ft) to the northwest of the 216-B-5 Reverse Well (Smith 1980). The distribution of the radionuclides above the water table are likely to be controlled by the dip of the layering in the Hanford lower coarse. The top of this unit dips to the south-southwest and the top of the Ringold A dips to the south beneath the 216-B-5 and 241-B-361 waste management units (Lindsey et al. 1992). Wells E25-73 and 74 are located down dip, 23 and 31 m (77 and 101 ft) south-southwest respectively, of the 216-B-5 Reverse Well. However, they are not logged to this depth and cannot lend any clues as to the lateral distribution of radionuclides in the unsaturated lower coarse from the reverse well.

Elevated gamma activity is detected below the water table, near the top of the basalt in Wells E28-1, 7 and 24 in the area of the 216-B-5 and B-361 waste management units. There have been no significant changes in the character of the scintillation probe profiles from these

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wells over time. The radionuclides detected in the groundwater has been attributed to waste disposal activities in the B-5 Reverse Wells. Since the 216-B-5 Reverse Well reaches the water table, it is certain that radionuclides were discharged into the groundwater. Smith (1980) proposed that the BY cribs, located about 900 m (3,000 ft) northwest of this area, were also a source of gamma emitters in the groundwater. This hypothesis was based upon water chemistry data (Smith 1980) and cannot be verified using gross gamma radiation measurements alone.

There is some evidence that gamma emitters may reside near the top of the Hanford sand in the area of the 216-B-5 and 216-B-361 waste management units. Slightly elevated readings are found on this interval in Well E28-24 (Figure A1-15). In Wells E28-73 and -74, near the 241-B-361 Settling Tank, slightly elevated levels may also be present near the top of the Hanford sand (Figure A1-15). Given the proximity of these wells to the tank itself, it is unclear if the elevated levels are due to the contents of the tank, to gamma emitters in the soil or to the attenuation of the natural gamma radiation by the near surface construction of the wells.

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A-1.4.7 216-B-9 Crib, 241-BX-155 Diversion Box, and 241-BX-302C Catch Tank

Evaluation of Scintillation Probe Profiles

The 216-B-9 Crib and Tile Field is located in the northwest area of Operable Unit 200-BP-5. The 241-BX-155 Diversion Box and the 241-BX-302C Catch Tank are located in the northeast corner of the 200-BP-6 Operable Unit about 260 m (750 ft) northwest of the 216-B-9 Crib and Tile Field. The 216-B-9 Crib and Tile Field is monitored by Wells E28-53, E28-54, E28-55, E28-56, E28-57, E28-58, E28-59, E28-60 and E28-61. Well E28-5 is located 200 m (600 ft) east of 216-B-9, and Well E28-2 is located about 120 m (350 ft) northwest of 216-B-9 and 120 m (350 ft) southeast of 241-BX-155 and 241-BX-302C. Details of these wells are given in Table A1-8.

The 216-B-9 Crib and Tile Field has previously been evaluated by Fecht et al. (1977). They concluded that measurable migration of radionuclides beneath the 216-B-9 Crib and Tile Field had not occurred since 1963 and that breakthrough to the groundwater was not indicated. This present evaluation is consistent with Fecht et al. (1977). It should be noted that no newer well logs are available for the wells in the zone of elevated gamma activity.

Scintillation probe profiles from Wells E28-53, E28-54, E28-57 and E28-59 were compiled into a cross section and correlated with the regional mapping of Lindsey et al. (1992) (Figure A1-16). Elevated gamma radiation is present in the 1976 well logs for Wells E28-53, E28-54, E28-55, E28-57 and E28-61. These well logs indicate that radionuclides are present from a depth of 4 to 13 m (12 to 42 ft) beneath the crib area and beneath the secondary tile field lateral immediately south of the E28-57 Well in the tile field. The thickness and lateral extent of the elevated gamma readings is illustrated in Figure A1-16. Lateral migration of radionuclides is not indicated as Wells E28-59, E28-56,

E28-58 and E28-60 do not have elevated gamma readings. Vertical migration of gamma emitters has not occurred since 1963 and breakthrough to groundwater is not indicated.

The presence of elevated gamma radiation in the vadose zone around 241-BX-155 and 241-BX-302C cannot be evaluated because the closest monitoring well, E28-2, is 120 m (350 ft) away to the southeast. Well E28-2 does not have elevated gamma readings within the vadose zone. Elevated gamma radiation occurs in the groundwater, in Wells E28-2 and E28-5. The source of groundwater contamination may be from the 216-B-5 Reverse Well, located 200 m (600 ft) south of Well E28-2 and 300 m (900 ft) southwest of Well E28-5.

A-1.4.8 216-B-56 Crib, -59B Retention Basin, 241-B-154 Diversion Box, and 241-B-302B Catch Tank

Evaluation of Scintillation Probe Profiles

The 216-B-56 Crib, -59B Retention Basin (originally the 216-B-59 Trench), the 241-B-154 Diversion Box and the 241-B-302B Catch Tank are located along the western side of the 200-BP-5 Operable Unit. Well E28-14 monitors 216-B-56. Wells E28-6, E28-4, and E28-3 are located in the vicinity of these waste management units. Details of the wells are given in Table A1-9.

The 216-B-56 Crib has previously been evaluated by Fecht et al. (1977). They detected only background radiation around the crib and noted that the crib had never been used. The findings of this present evaluation do not conflict with this previous study.

The 1979 and 1987 logs for Well E28-14 are correlated with a lithologic column constructed from the geology of Lindsey et al. (1992) in Figure A1-18. All the wells used in this evaluation have gamma activity at background levels in the vadose zone. Well E28-14, which reaches the groundwater, has elevated gamma activity approximately 10 m (30 ft) below the water table. This elevated activity first appeared in the 1976 log. The source of these elevated gamma readings may be the 216-B-5 Reverse Well, which is located 220 m (600 ft) northwest of Well E28-14.

The data available for this evaluation indicates that breakthrough to the groundwater has not occurred from these waste management units.

A-1.4.9 216-B-6 Reverse Well and 216-B-10A & B Cribs

Evaluation of Scintillation Probe Profiles

The 216-B-6 Reverse Well and the 216-B-10A and -10B Cribs are located south of building 222-B, within the 200-BP-6 Operable Unit. These waste management units are monitored by Well E28-17, which is occasionally logged by PNL. The location of this Well

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relative to the B-6 and -10 waste management units is shown in Figure A1-19. No scintillation probe profiles were available from any other wells in the area.

Fecht et al. (1977) reviewed the scintillation probe profiles from Well E28-17 and concluded that gamma emitters from the 216-B-10A and -10B Cribs and concluded that radionuclides had not reached the groundwater in this area. Fecht et al. based their conclusions on the volume and composition of wastes disposed of in the 216-B-10 Cribs since elevated gamma radiation was never detected in the E28-17 Well. The conclusions of this report do not differ from those of Fecht et al. (1977).

The scintillation probe profiles for Well E28-17 were compiled and correlated with the lithologic column for that well (Lindsey et al. 1992). The regional mapping of the tops of the lithologic units present in this area indicates that this well is up dip from the 216-B-6 and -10 waste management units. This suggests that the well is not optimally placed to detect gamma emitters from these units.

Since no elevated gamma activity has ever been detected in Well E28-17, there is no evidence that radionuclides from the 216-B-6 and -10 waste management units are migrating in the vadose zone or have reached the water table. However, this is inconclusive because the well is probably not optimally placed to detect gamma emitters from the 216-B-6 and -10 waste management units.

A-1.4.10 216-B-2-1, -2-2, -2-3 Ditches, and 216-B-63 Trench

Evaluation of Scintillation Probe Profiles

The 216-B-2-1, -2-2, -2-3 Ditches and the 216-B-63 Trench are located in the 200-BP-8 Operable Unit. Gross gamma logs are available from eight wells located in the vicinity of the ditches. Details of Monitoring Wells E33-33, E33-36, E33-37, E27-16, E27-11, E27-8, E27-9 and E34-8 are provided in Table A1-10.

No elevated gamma readings were recorded in any of the wells monitoring the ditches. Scintillation probe profiles from Wells E33-37, E27-11 and E27-9 were compiled into a cross section and correlated with the regional mapping of Lindsey et al. (1992). (Figure A1-20). The wells appear to be well located for monitoring the ditches, but no elevated gamma activity has been recorded in the well logs despite unplanned releases into the ditches. The data available indicate that breakthrough to the groundwater has not occurred at this site.

A-1.4.11 216-B-12 and -55 Cribs, and 216-B-64 Retention Basin

Evaluation of Scintillation Probe Profiles

The 216-B-12 and -55 Cribs, and the 216-B-64 Retention Basin are all located on the eastern side of the 200-BP-9 Operable Unit, between 300 and 600 m (1,000 and 2,000 ft) west of Building 221-B. The 216-B-55 Crib is currently active and the 216-B-64 Retention Basin has never been used. Wells E28-9, -16, -64, -65, -66 and -76 monitor the inactive 216-B-12 Crib. Wells E28-12 and -13 monitor the 216-B-55 Crib. No wells are in place to monitor the 216-B-64 Retention Basin. All of the monitoring wells in the area have been occasionally logged by PNL. Well E28-12 (02-55-04) is also logged semi-annually by TFSA&S. Details of these monitoring wells and the scintillation probe profiles used in this evaluation are given in Table A1-11.

The scintillation probe profiles from the wells monitoring the 216-B-12 and -55 Cribs were reviewed by Fecht et al. (1977). Elevated levels of activity were detected from the base of the 216-B-12 Crib to an unknown depth. Only background levels of radiation were detected beneath the 216-B-55 Crib. No evidence of radionuclides reaching the groundwater was found in the area. The conclusions of this evaluation do not differ substantially from those of Fecht et al. (1977).

Scintillation probe profiles from most of the wells in the area of the 216-B-12, -55 and -64 waste management units were compiled into two cross sections and correlated with the lithologic column from Well E28-17 (Figure A1-21) (Lindsey et al. 1992). Well E28-17 is located about 300 m (1,000 ft) southeast of this area. Although the features on the scintillation probe profiles due to changes in lithology are very subtle in this area, the consistent character of the profiles and the background conditions detected in most of the wells make the correlation between the logs and the lithology fair to good.

Elevated gamma radiation is detected beneath the 216-B-12 Crib from the bottom of the crib to an unknown depth. The four wells in the immediate vicinity of this crib (E28-64, -65, -66 and -76) do not penetrate the interval of elevated radiation (Figure A1-21). The top of the elevated gamma radiation correlates closely with the top of the Hanford sand, suggesting that this lithologic boundary may control the distribution of radionuclides in the subsurface. The elevated radiation is shallowest near the southern end of the crib, and is deeper to the north. This is consistent with the northerly dip of the top of the Hanford sand (Lindsey et al. 1992). Scintillation probe profiles from Well E28-16 suggest that gamma emitters placed in the B-12 Crib may reach a depth of about 37 m (120 ft). An interval of elevated gamma radiation was detected between 28 and 37 m (90 and 120 ft) in 1976 (Fecht et al. 1977). This well is located about 24 m (80 ft) south of the B-12 Crib, up the regional dip of the top of the Hanford sand.

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Background levels of gamma radiation are detected in the two wells which monitor the active 216-B-55 Crib. This is inconsistent with the history of waste disposal for this crib. Wells E28-12 and -13 are both located up dip from the 216-B-55 Crib (Lindsey et al. 1992). These wells are probably not optimally located to detect radionuclides from the crib in the vadose zone.

It is possible that the interval of elevated gamma activity detected in Well E28-16, attributed to radionuclides from the 216-B-12 Crib, is due to lateral migration of radionuclides from the 216-B-55 Crib. Evidence in favor of this hypothesis includes the down dip location of the E28-16 Well from the 216-B-55 Crib and the absence of elevated radiation in the E28-9 Well, located 30 m (100 ft) west of the 216-B-12 Crib, suggests that there may be another source of radionuclides in the area of the E28-16 Well. Evidence against this hypothesis includes the apparent lack of a lithologic boundary within the Hanford sand which would facilitate the lateral migration of radionuclides over the 70 m (225 ft) between the B-55 Crib and the E28-16 Well.

There is no evidence that gamma emitters from the 216-B-12 and -55 Cribs have reached the groundwater. Background levels of gamma radiation are detected in all of the wells reaching the groundwater in this area. These wells are well placed to detect any changes in the conditions within the groundwater due to disposal activities in the 216-B-12 and B-55 Cribs.

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A-1.4.12 216-B-62 Crib

Evaluation of Scintillation Probe Profiles

The active 216-B-62 Crib is located within the 200-BP-9 Operable Unit, 460 m (1,500 ft) northwest of Building 221-B. This crib is monitored by Wells E28-18, -20, -21 and -75. All of these wells are logged occasionally by PNL. Wells E28-20 and -75 are also logged semi-annually by TFSA&S. Details of the wells monitoring the B-62 Crib and the logs used in this evaluation are given in Table A1-12.

The subsurface distribution of radionuclides from the 216-B-62 Crib and their potential for migration were evaluated by Fecht et al. (1977). They found that radionuclides from the crib were confined to an interval in the near surface and had not reached the water table. This current evaluation does not differ from the findings of Fecht et al. (1977).

Scintillation probe profiles from the four wells which monitor the 216-B-62 waste management unit were compiled into a cross section and correlated with the lithologic column available for Well E28-18 (Lindsey et al. 1992) (Figure A1-22). The correlation between features on the scintillation profiles and lithologic boundaries can be considered fair to poor since the expression of lithologic changes is very subtle on profiles from wells in this area.

The gamma emitting radionuclides disposed of in the 216-B-62 Crib appear to reside near its southeastern end. The top of the interval where elevated levels of gamma radiation are detected is found at a depth of about 10 m (34 ft). This corresponds to the top of the Hanford sand in the area of the B-62 Crib. The interval of elevated radiation is about 24 m (80 ft) thick. There is no evidence of gamma emitters moving downwards over time or of gamma emitters in the groundwater.

The data are inadequate to define the lateral extent and potential for lateral migration of radionuclides from the 216-B-62 Crib. It is likely that the lateral distribution of gamma emitters is controlled by the northward dip of the top of the Hanford sand in this area (Lindsey et al. 1992). This is supported by the correlation between the top of the interval of elevated radiation and the Hanford sand. However, the elevated radiation detected in Well E28-18, located south of the crib, conflicts with this hypothesis. One possible explanation is that there may be some local features in the top of the Hanford sand which are not shown by the regional mapping of Lindsey et al. (1992). Another possibility is that the distribution of radionuclides is not controlled by the lithology at all.

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A-1.4.13 218-E-2, -2A, -4, -5, -5A, -9, and -10 Burial Grounds

Evaluation of Scintillation Probe Profiles

The 218-E-2, -2A, -4, -5, -5A, -9 and -10 Burial Grounds are located within Operable Unit 200-BP-10, immediately south and west of the 241-BX and 241-BY Tank Farms. Monitoring Wells E28-2, -8, -26, -27, -28, E32-1, -2, -3, -4, -5, E33-28, -29, -30, -34 and -35 are located on the edges of these waste management units. Few vintages of logs were available from most of these wells either because they were drilled recently or because logs could not be located. Details of the monitoring wells in the area and the available scintillation probe profiles are given in Table A1-13.

The 218-E-10 Burial Ground was studied in an interim hydrogeologic report by Last et al. (1989). The history of waste disposal activities in this waste management unit and the hydrogeology of the area were discussed in that report. Data used in the report by Last et al. included boring logs, scintillation probe profiles and other geophysical logs. No discussion of radionuclides in the vadose zone was given.

Scintillation probe profiles from most of the wells in this area were compiled into three cross sections and correlated with the stratigraphic information from Last et al. (1989) and Lindsey et al. (1992) (Figure A1-23). The correlation between the lithology and features on the gamma logs was poor because there is very little difference in the gamma response of the lithologic units encountered. The most pronounced features on the scintillation profiles are due to the telescoping casing strings used in many of the wells in this area.

There is no evidence of elevated gamma activity beneath the 218-E-2, -2A, -4, -5, -5A, -9 and -10 Burial Grounds. This is consistent with the solid nature of the wastes disposed of in these waste management units. However, the current monitoring program in place in this area is mainly concerned with radionuclides in the groundwater (Last et al. 1989). No monitoring wells have been located within the individual burial grounds, where gamma emitters residing within the vadose zone might be more easily detected. Also, the telescoping casing used in many of the wells monitoring these waste management units (Figure A1-23) may attenuate the gamma activity in the near surface by as much as 99% where the greatest number casing strings are used (4 casing strings attenuating the signal by 33% each). Two casing strings are typically used to a depth of about 60 m (200 ft) in these wells. This will attenuate the gamma activity by about 90%. The attenuation of the measured gamma activity by the multiple strings of well casing may make it impossible to detect low concentrations of radionuclides within the vadose zone with the parameters currently used in the logging program.

A-1.4.14 216-B-3, -3A, -3B, & -3C Ponds, 216-B-3-1, -3-2, -3-3 Ditches, and 216-E-28 Pond

Evaluation of Scintillation Probe Profiles

The 216-B-3 Ponds, 216-B-3-1 through -3 Ditches and the 216-E-28 Pond are located in Operable Unit 200-BP-11. Scintillation probe profiles were obtained for 30 wells located in and around the area of these waste management units. Details of these wells are given in Table A1-14.

With the exception of moderately elevated gamma activity at a depth of 122 m (400 ft) in Well 699-42-42A (DB-8) and 101 m (330 ft) in Well 699-42-40C, no elevated gamma activity is recorded in any of the wells. The monitoring wells are located in such a way as to monitor for lateral migration of radionuclides (Luttrell et al. 1989). The lack of elevated gamma readings indicates that lateral migration of gamma emitters through the vadose zone has not occurred. Scintillation probe profiles from E26-8, 699-43-42J and 699-41-40 were compiled into a cross section and correlated with a composite lithologic column constructed from wells logs from Wells 699-43-42J and 699-41-40 (BP-6) and the geology of Lindsey et al. (1992) (Figure A1-24).

The moderately elevated gamma activity at a depth of 122 m (400 ft) in Well 699-42-42A (DB-8) and at 330 feet in Well 699-42-40C corresponds with the Rattlesnake Ridge interbed between the Elephant Mountain and Pomona Members of the Columbia River Basalt Group. These moderate peaks may represent naturally higher gamma radiation associated with the interbed. Alternatively these elevated readings may represent contamination of the Rattlesnake Ridge confined aquifer.

A-1.4.15 218-E-3 Burial Ground

Evaluation of Scintillation Probe Profiles

The 216-E-3 Burial Ground is located in the southwest corner of the 200-SS-1 Operable Unit. The scintillation probe profile of Well E19-1, located about 200 m (600 ft) northeast of 216-E-3, was examined. No elevated gamma readings are present in this log.

The E19-1 Well is probably located too far away from the E-3 Burial Ground to monitor the vadose zone beneath burial ground. In addition Well E19-1 is located up dip from the burial ground. However, the E-3 Burial Ground was exhumed and removed from radiation status in 1971.

A-1.4.16 216-A-25 and 216-N-8 Ponds

Evaluation of Scintillation Probe Profiles

The 216-A-25 and 216-N-8 ponds (Gable Mountain and West Ponds) are located in Operable Unit 200-UI-6. Scintillation probe profiles were obtained for Wells 699-50-45, 699-50-48, 52-46A, 52-48, 54-45B, 54-42, 55-44, 56-53, 55-55, and 60-57. Details of the monitoring wells are given in Table A1-15.

No elevated gamma activity is recorded within the vadose zone in these wells. Moderately elevated gamma radiation is recorded in the logs from the southeastern part of Operable Unit 200-UI-6 (Wells 699-50-48, 699-50-45, 699-52-48 and 699-52-46A). The elevated activity is at depths well below the water table and within the Columbia River Basalt Group. The scintillation probe profile of Well 699-50-45B, located 1,050 m (3,500 ft) southeast of the Gable Mountain Pond, is shown in Figure A1-25.

The elevated gamma activity may represent naturally higher gamma radiation associated with an interbed of sediment or paleosoil between basalt layers. Well 600-42-42A (DB-8) in the B Pond area has a similar sized and shaped peak at a depth of 122 m (400 ft) within the Columbia River Basalt Group. Alternatively the elevated activity may represent contamination of one of the upper unconfined aquifers.

A-1.4.17 241-B Tank Farm

The 241-B Tank Farm is located within the 200-BP-7 Operable Unit, east of the 241-BX Tank Farm and south of the 216-B-7 Cribs and 216-B-11 Reverse Wells. The 241-B Tank Farm contains 16 single-shell, carbon steel-lined, concrete reinforced tanks. Twelve of the tanks, 241-B-101 through -112 have individual capacities of 2,017,000 L (533,000 gal). Four tanks, 241-B-201 through 204 have individual capacities of 208,000 L (55,000 gal). The B-Tanks were constructed in an excavation, about 12 m (39 ft) deep and backfilled with the excavated material. The backfill material consists of poorly sorted

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cobbles, pebbles, very coarse to medium sands and silt. All of tanks contain wastes in the form of salt cake, or sludge with drainable interstitial liquid (Hanlon 1991). All of the tanks have been interim isolated. Tanks 241-B-110 and -201 are confirmed leakers, and tanks 241-B-101, -103, -107, -108, -111, -112, -203, -204 are assumed leakers (Hanlon 1991).

Scintillation probe profiles from selected drywells used to monitor the B Tanks were reviewed and general conclusions reached about the distribution of radionuclides in the subsurface in the B Tank Farm area. All of the scintillation probe profits used were collected by TFSA&S, which logs the monitoring wells in the 241-B Tank Farm on a periodic basis.

Elevated levels of gamma activity are detected within the backfill material around the tanks and near the surface, and within the Hanford sand beneath the bottom of the tanks. The near surface elevated gamma activity is not necessarily directly related to tank leakage; it may be partly due to gamma emitters contained within near surface utilities. Elevated gamma activity at the base of the backfill and extending into the upper reaches of the Hanford sand occurs near tanks 241-B-101, -105, -106, -107, and -110.

Downward migration of gamma emitters is indicated beneath the 241-B-101, -106, and -108 Tanks. The criteria used to deduce whether or not migration is occurring include instances where increasing levels of radioactivity are found, gross changes in the character of the scintillation probe profiles or the consistent displacement and broadening of peaks over time on the scintillation probe profiles.

Because of the limited depth of the wells, the possibility that gamma emitters may have reached the groundwater cannot be ruled out.

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A-1.4.18 241-BX Tank Farm

The 241-BX Tank Farm is located within the 200-BP-7 Operable Unit, south of the 241-BX Tank Farm and west of the 241-B Tank Farm. The 241-BX Tank Farm contains 12 buried single-shell, carbon steel-lined, concrete reinforced tanks. The tanks have individual capacities of 2,017,000 L (53,000 gal). The BX Tanks were constructed in an excavation, about 13 m (42 ft) deep and backfilled with the excavated material. The backfill material consists of poorly sorted cobbles, pebbles, course to medium sand and silt. All the tanks contain mixed waste in the form of salt cake and sludge with interstitial liquid (Hanlon 1991). All of the tanks have been interim isolated and undergone initial stabilization. Tank 241-BX-102 is a confirmed leaker. Tanks 241-BX-101, -108, -110, and -111 are assumed leakers. Unplanned releases have occurred at Tanks 241-BX-102, -103, and -104. Tanks 241-BX-102, -107, -108, -110 and -111 are included in the Watch List Tanks because they contain ferrocyanide.

Scintillation probe profiles from selected drywells used to monitor the BX Tanks were reviewed and general conclusions reached about the distribution of radionuclides in the subsurface in the 241-BX Tank Farm area. All of the scintillation probe profiles used were collected by TFSA&S, which logs the monitoring wells in the 241-BX Tank Farm on a periodic basis.

Elevated gamma activity is present within the backfill material around the tanks and near the surface. In addition elevated gamma activity is indicated beneath the BX-107 and -111 tanks within the Hanford sand. Some of the elevated gamma activity within the backfill and near the surface may be due to gamma emitters contained within near surface utilities.

No definite downward migration is in evidence for the scintillation probe profiles available. Because of the limited depth of the wells, the possibility that gamma emitters may have reached the groundwater cannot be ruled out.

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A-1.4.19 241-BY Tank Farm

The 241-BY Tank Farm is located within the 200-BP-7 Operable Unit, north of the 241-BX Tank Farm and south of the BY Cribs. The 241-BY Tank Farm contains 12 single-shell tanks with a capacity of 2,870,000 L (758,000 gal). The BY Tanks were constructed in an excavation, about 14 m (46 ft) below grade, and buried using native soil (Welty 1988). All of these tanks contain noncomplexed wastes in the form of salt cake, sludge or drainable interstitial liquid (Hanlon 1991). Except for tanks 241-102-BY and 109-BY, the remaining BY Tanks contain ferrocyanide and are monitored closely for changes in temperature and waste volume (Hanlon 1991). All of the BY Tanks have been partially or interim isolated. Tanks 241-103-BY, 105-BY, 106-BY, 107-BY and 108-BY are classified as assumed leakers. Of these assumed leaking tanks, only 241-106-BY has not been stabilized (Hanlon 1991).

Scintillation probe profiles from selected drywells used to monitor the BY Tanks were reviewed and general conclusions reached about the distribution of radionuclides in the subsurface in the 241-BY Tank Farm area. All of the scintillation probe profiles used were collected by TFSA&S, which periodically logs the monitoring wells in the 241-BY Tank Farm. In general, levels of gamma activity appear to be declining over time. There is also evidence of migration of radionuclides in the subsurface. The criteria used to deduce whether or not migration is occurring include instances where increasing levels of radioactivity are found, gross changes in the character of the scintillation probe profiles or the consistent displacement and broadening of peaks over time on the scintillation probe profiles.

Elevated levels of gamma activity are detected within the backfill material around the tanks and near the surface, and within the Hanford sand beneath the bottom of the tanks. Elevated gamma activity at or near the surface is evident on profiles from wells near all of the tanks in the BY Farm except for 241-105-BY and 241-106-BY. This near surface activity is not directly related to any leakage from the tanks themselves, and may be partly

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due to gamma emitters contained within near surface utilities. Elevated gamma radiation unrelated to surface activity is detected within the backfill materials near all of the BY Tanks but 241-102-BY and 241-105-BY. These elevated levels extend into the upper reaches of the Hanford sand near tanks 241-101-BY, 241-103-BY, 241-106-BY, 241-108-BY, 241-109-BY, 241-111-BY and 241-112-BY. The gamma emitters responsible for this intra-fill activity are mobile in the vicinity of tanks 241-102-BY, 241-103-BY, 241-106-BY, 241-111-BY and 241-112-BY. Radionuclides are detected within the Hanford sand in the vicinity most of the tanks in the 241-BY Tank Farm except for tanks 241-101-BY, 241-102-BY, 241-111-BY and 241-112-BY. Evidence of migrating gamma emitters is evident on profiles from wells located near tanks 241-103-BY, 241-104-BY, 241-105-BY, 241-106-BY, 241-107-BY and 241-108-BY. Elevated gamma radiation is detected to the total depth of wells located near tanks 241-102-BY, 241-103-BY, 241-104-BY, 241-105-BY, 241-107-BY and 241-108-BY. The possibility that gamma emitters in these areas may have reached the groundwater cannot be ruled out.

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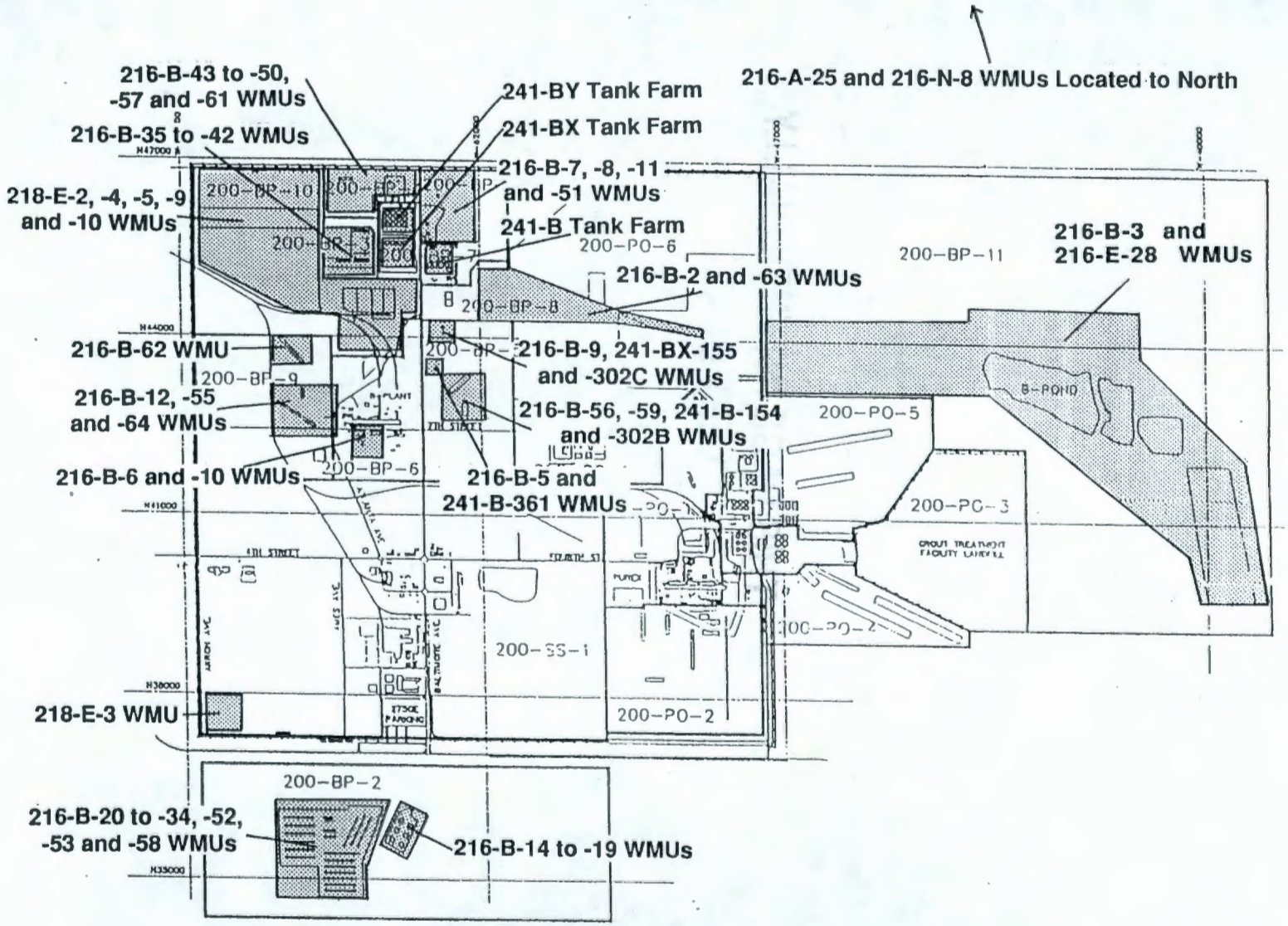

Figure A1-1. B Plant Aggregate Area.

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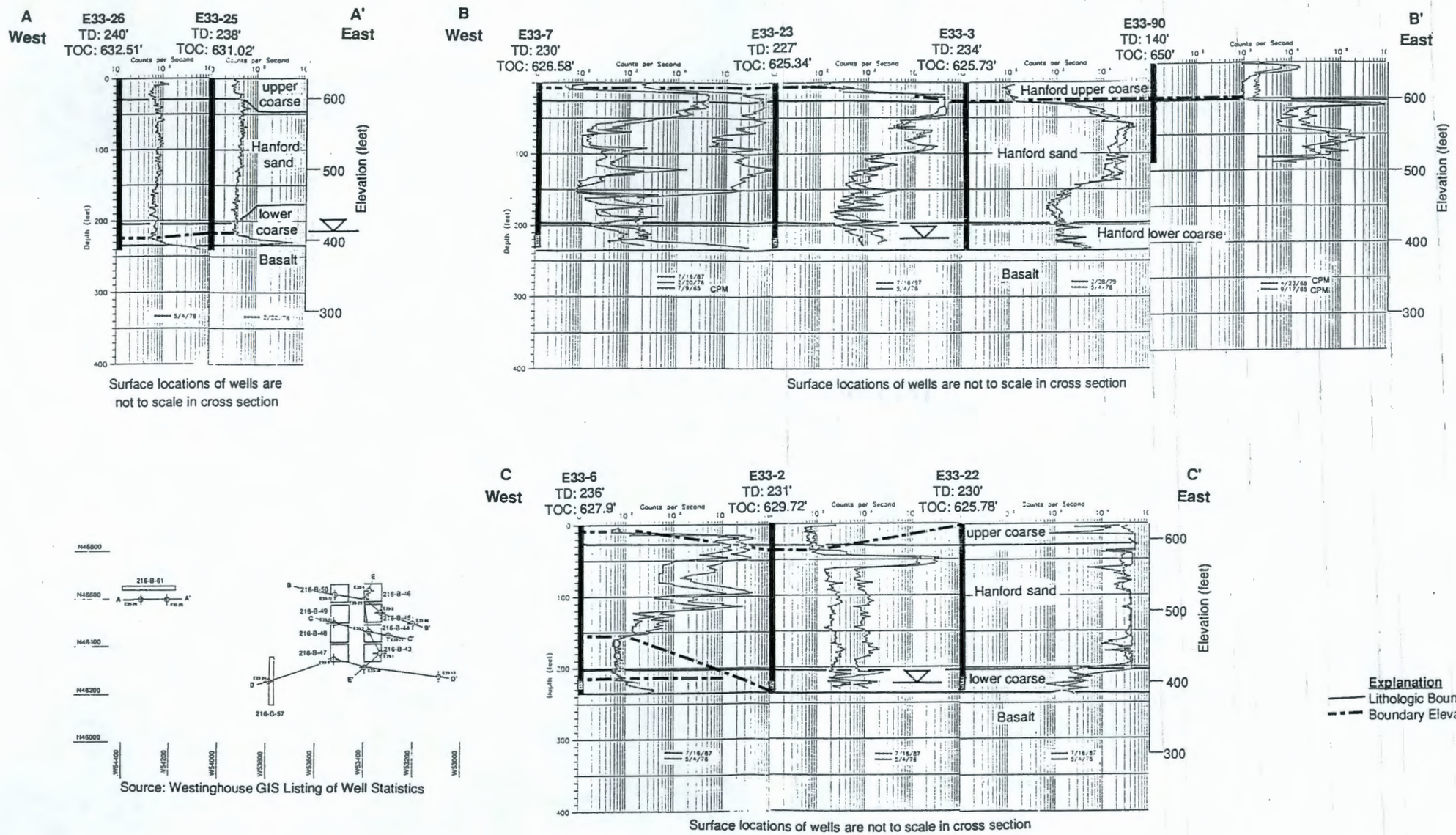

Figure A1-2. 216-B-43 through -50, -57, and -61 Cribs: Scintillation Probe Profile Cross Sections A-A', B-B', and C-C'.

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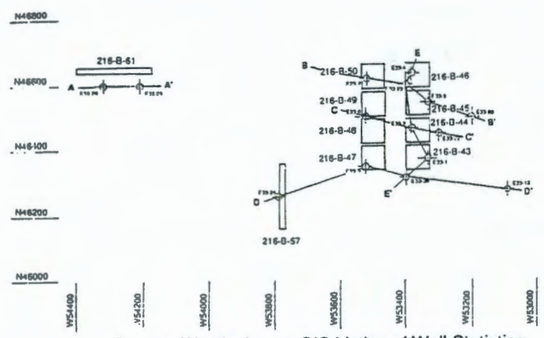
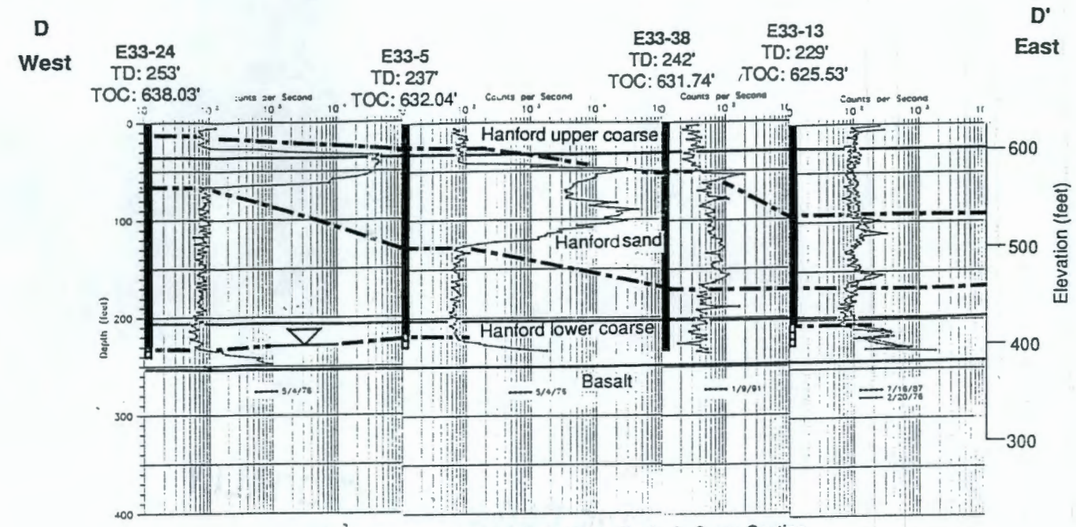
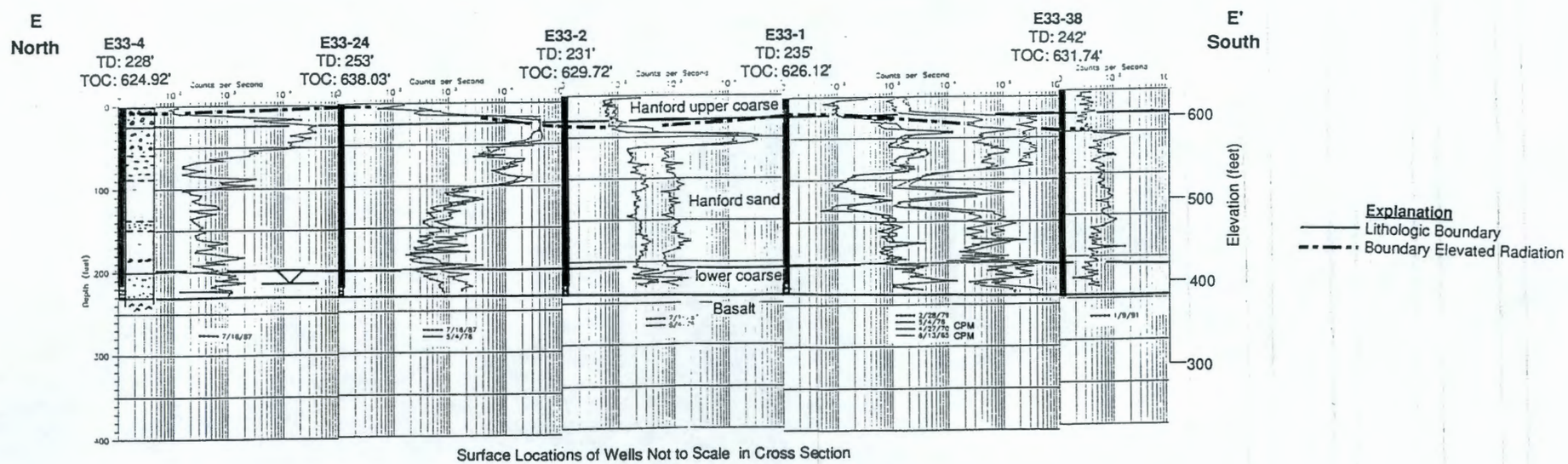


Source: Westinghouse GIS Listing of Well Statistics



Surface Locations of Wells Not to Scale in Cross Section



Surface Locations of Wells Not to Scale in Cross Section

Figure A1-3. 216-B-43 through -50, -57, and -61 Cribs: Scintillation Probe Profile Cross Sections D-D' and E-E'.

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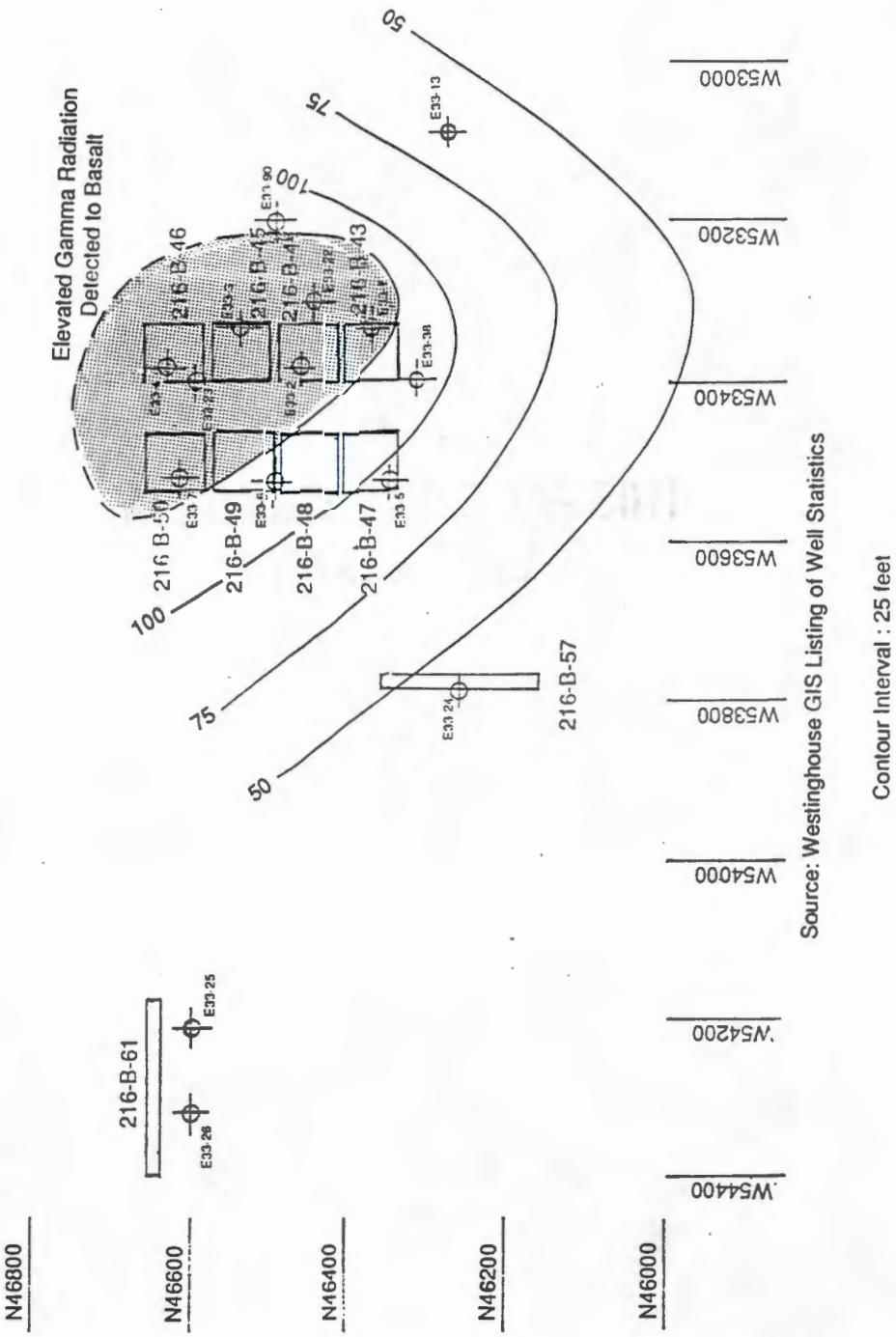
Figure A1-4. 216-B-43 through -50, -57, and -61 Cribs: Elevated Gamma Radiation Isopach Map.



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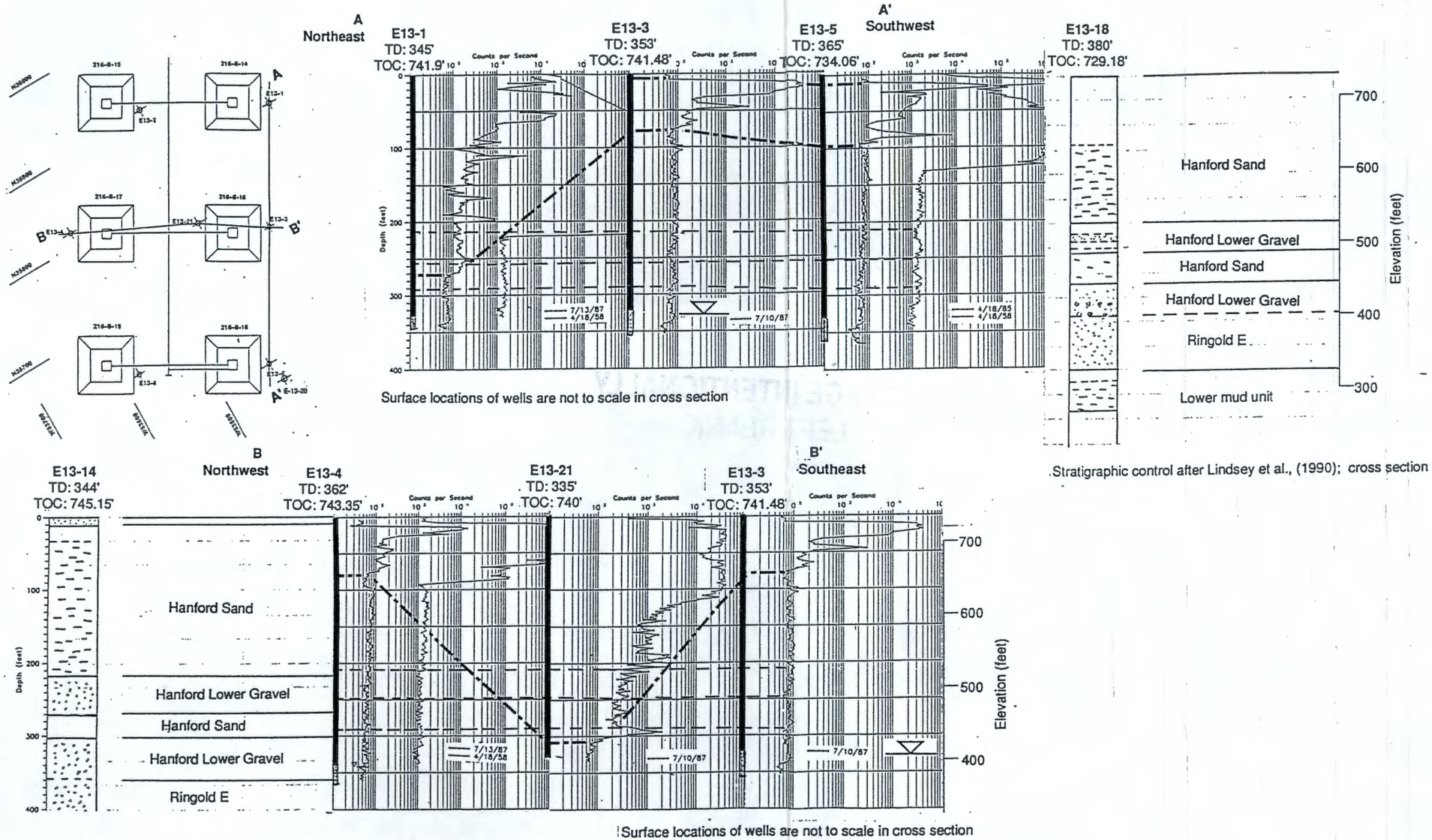

Figure A1-5. 216-B-14 through -19 Cribs: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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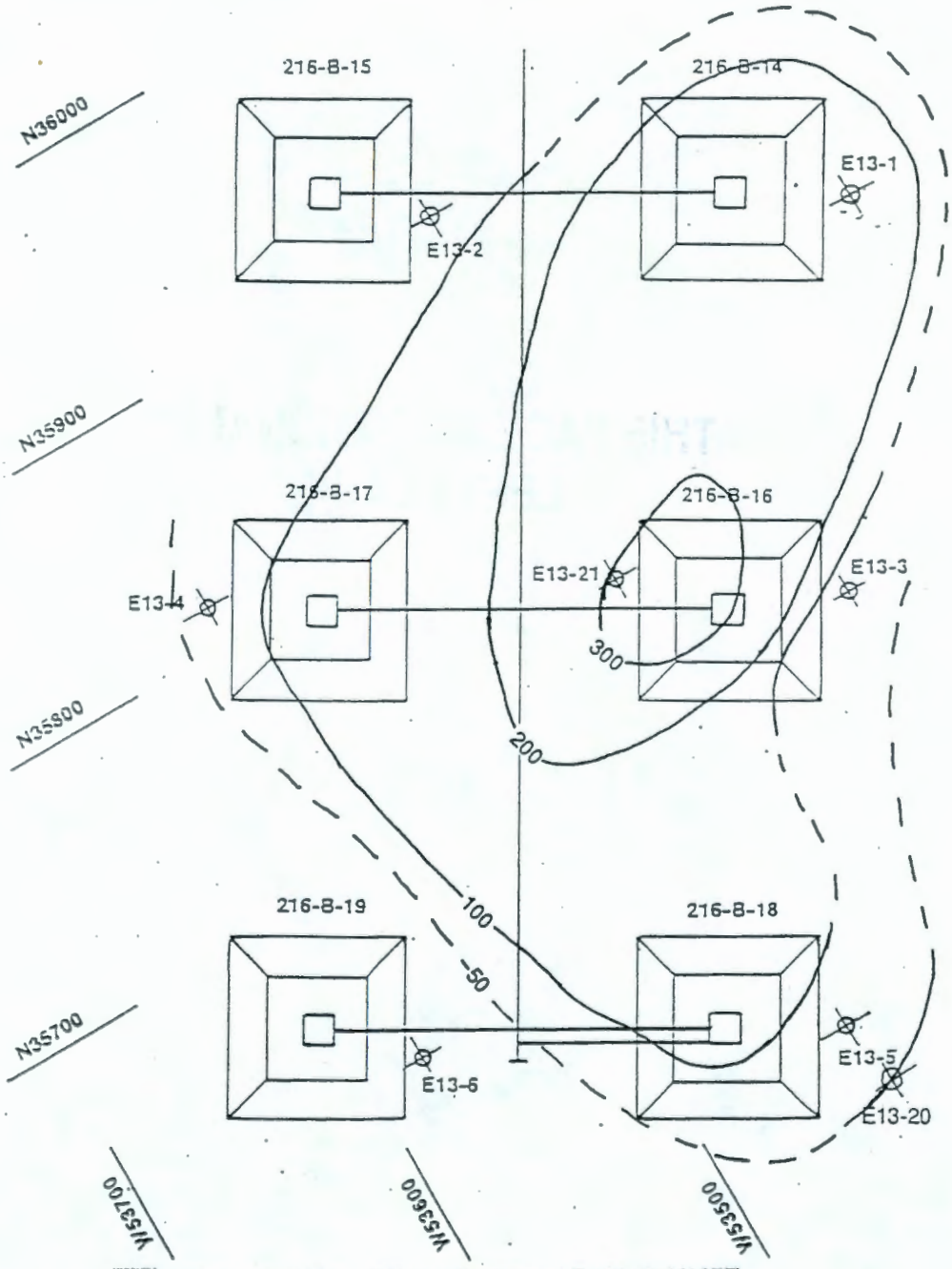
Figure A1-6. 216-B-14 through -19 Cribs: Elevated Gamma Radiation Isopach Map.



Well locations plotted from GIS coordinates and Fecht et al (1977).
Crib locations are from Fecht et al (1977).

Contour Interval :100 feet
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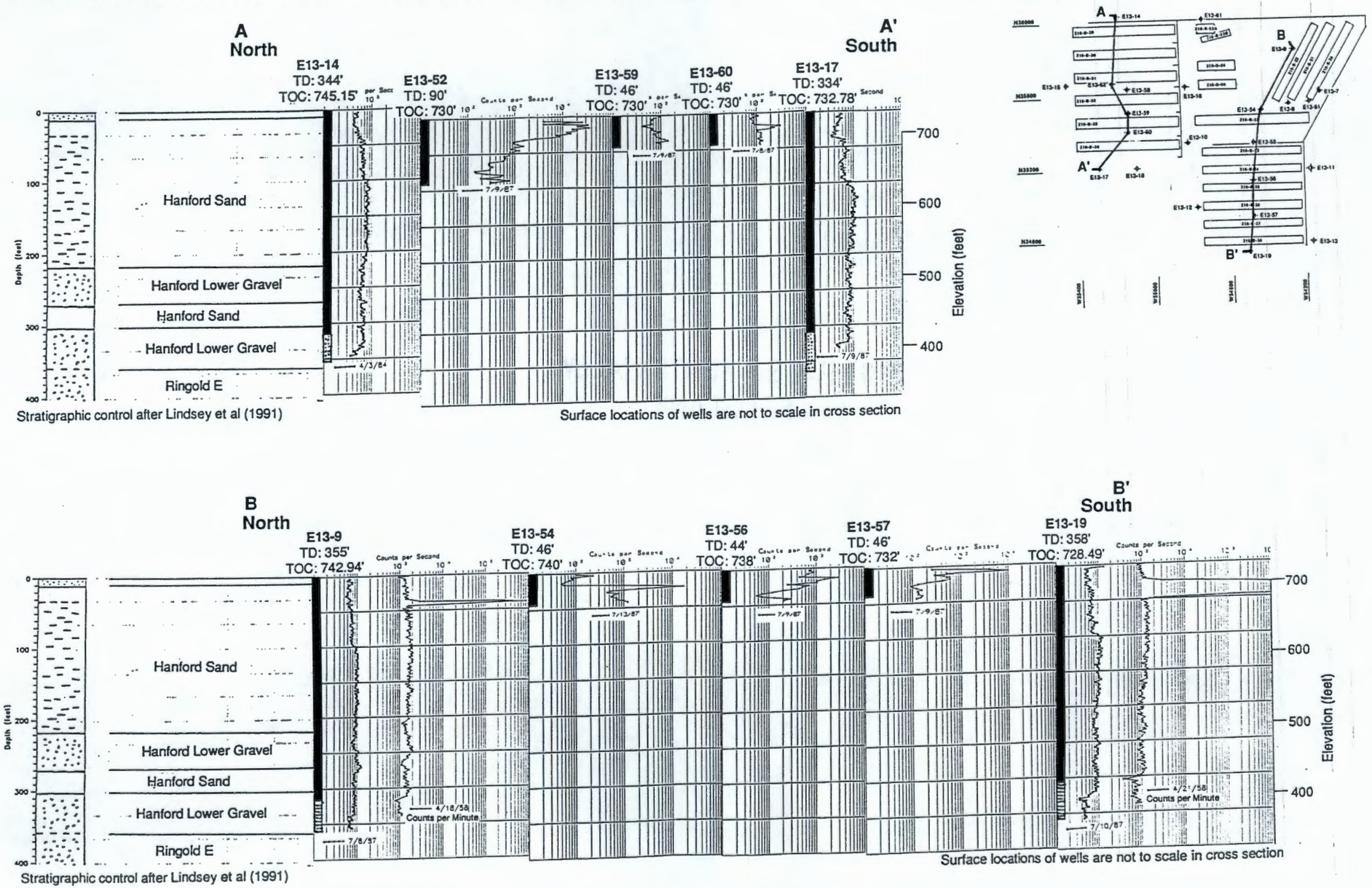

Figure A1-7. 216-B-20 through -34, -52, -53A & B, -54, and -58 Trenches: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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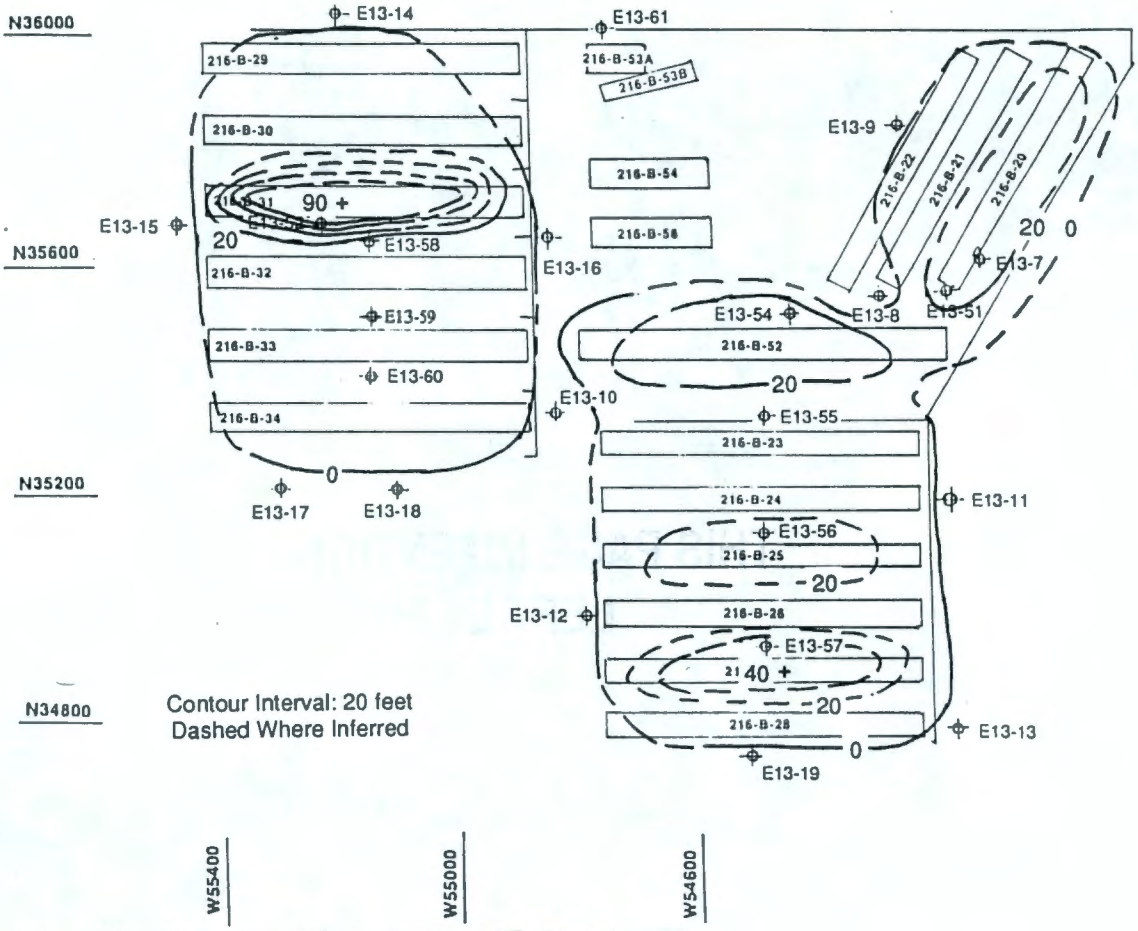
Figure A1-8. 216-B-20 through -34, -52, -53A & B, -54 and -58 Trenches: Elevated Gamma Radiation Isopach Map.



Well locations plotted from GIS coordinates and Fecht et al (1977)
Crib locations from Fecht et al (1977)

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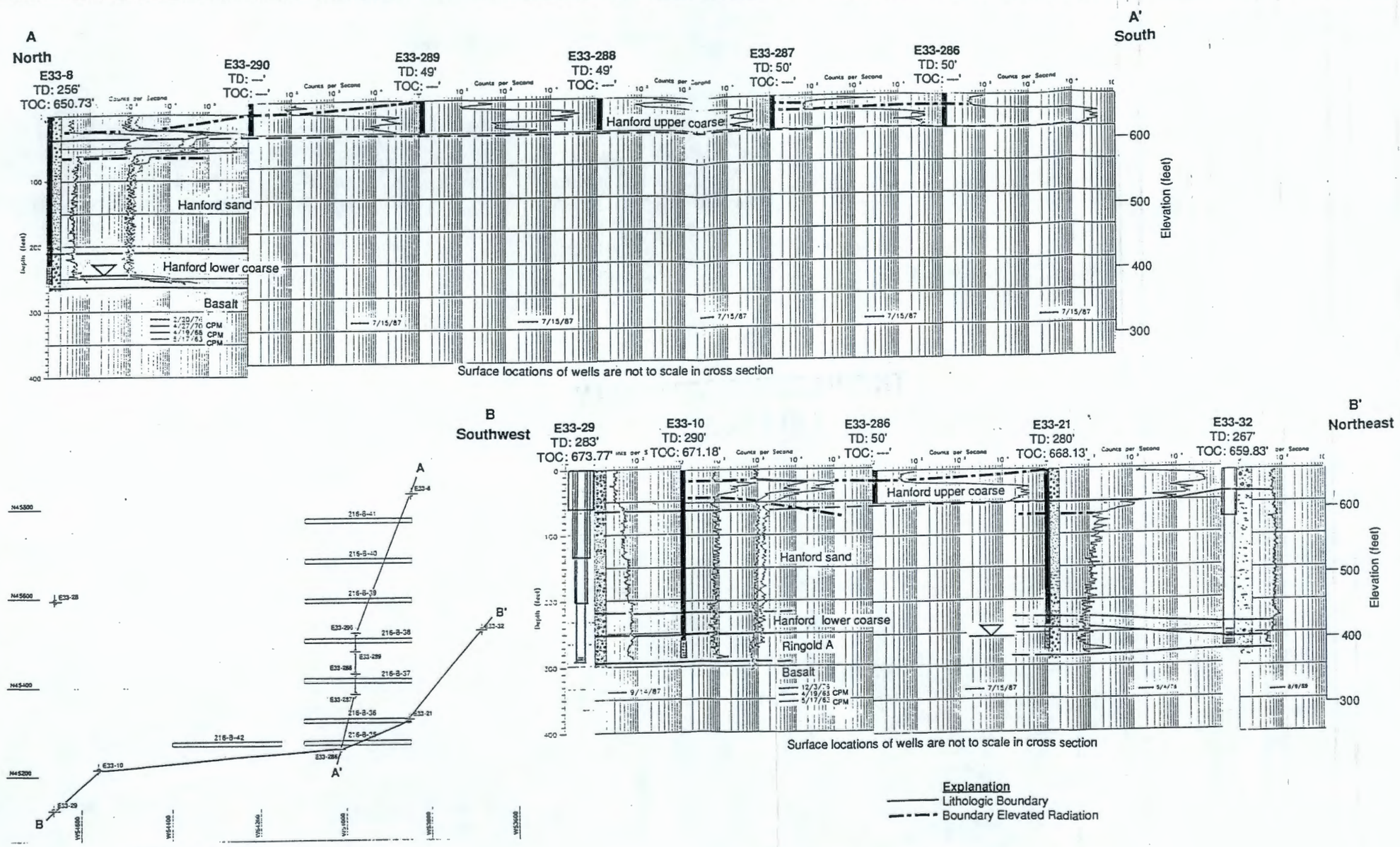

Figure A1-9. 216B-35 through -42 Trenches: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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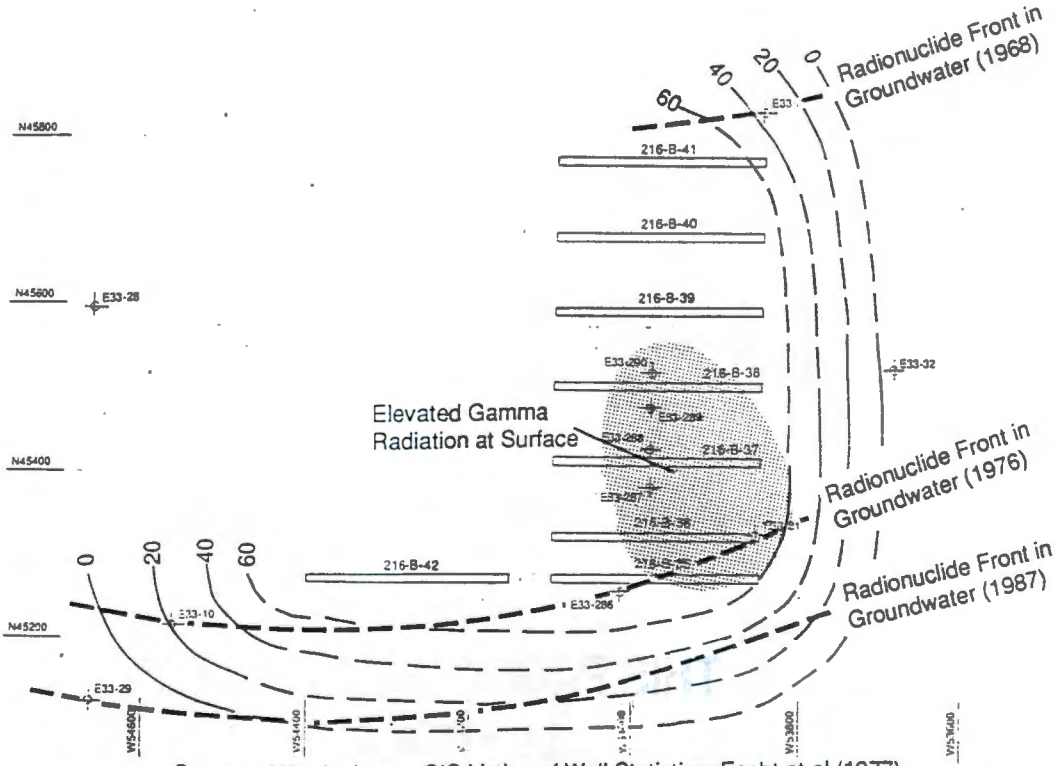
Figure A1-10. 216-B-35 through -42 Trenches: Elevated Gamma Radiation Isopach Map.



Sources: Westinghouse GIS Listing of Well Statistics; Fecht et al (1977).

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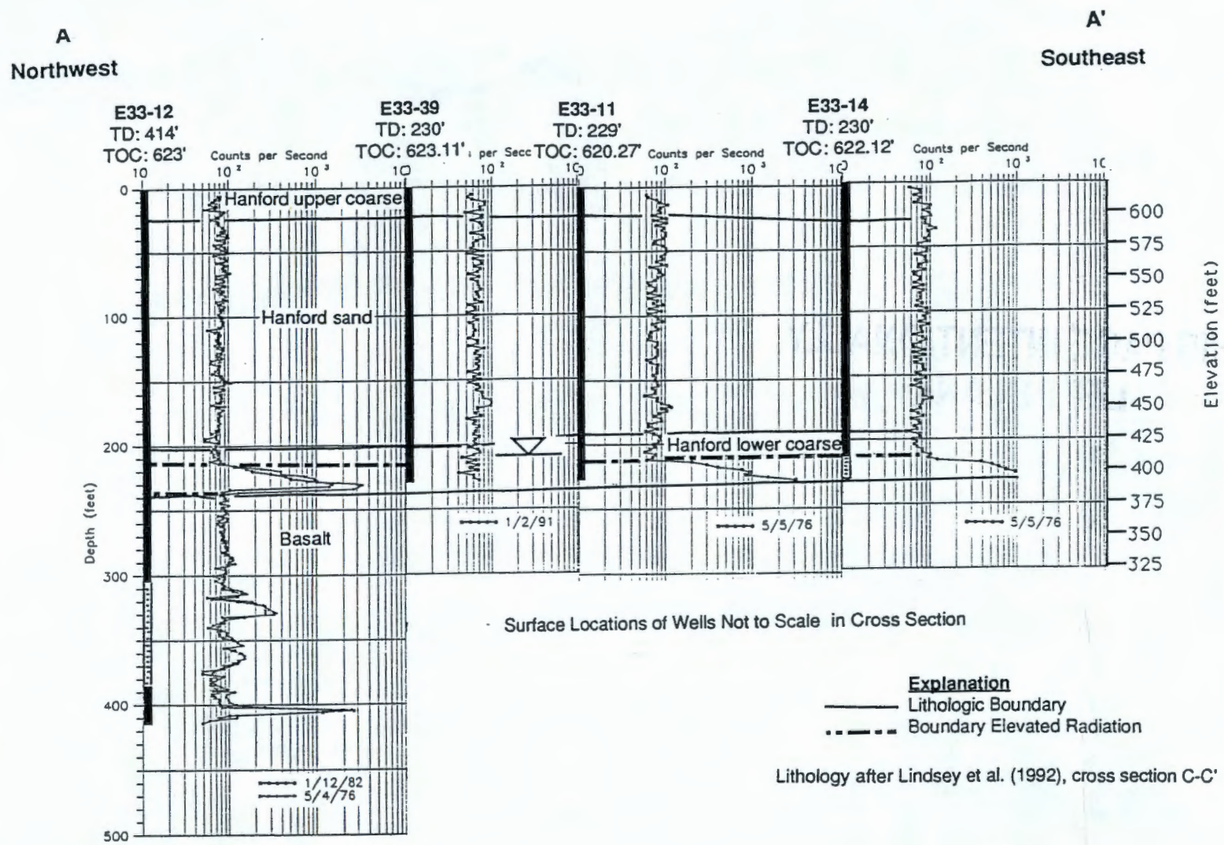

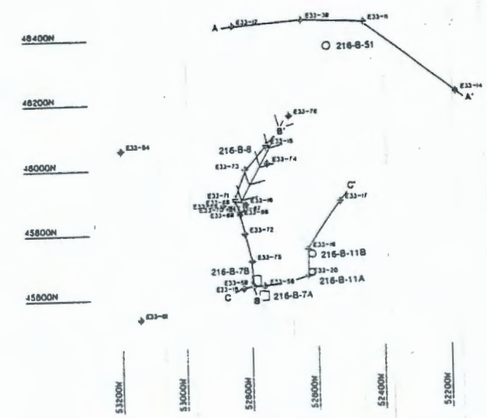

Source: Westinghouse GIS Listing of Well Statistics

Figure A1-11. 216-B-7A & B and -8 Cribs, -11 Reverse Well, and -51 French Drain: Scintillation Probe Profile Cross Section A-A'.

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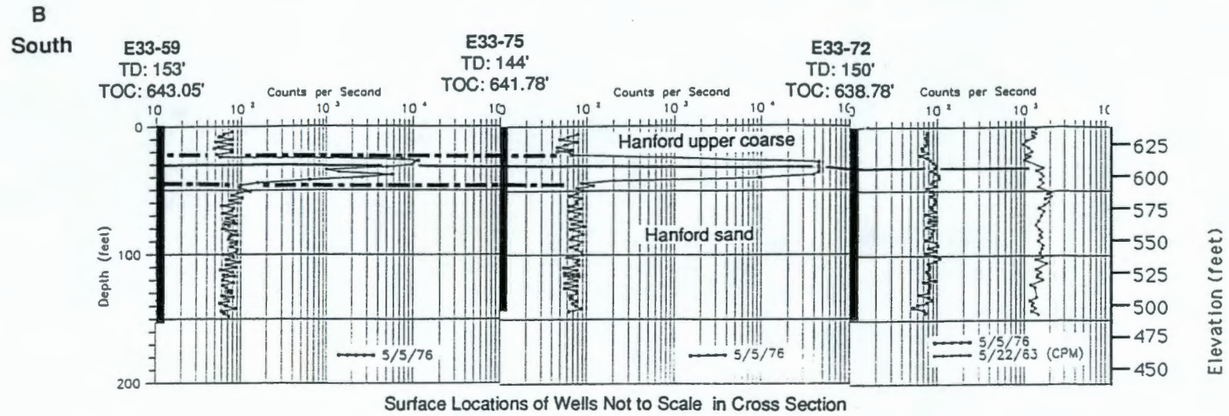
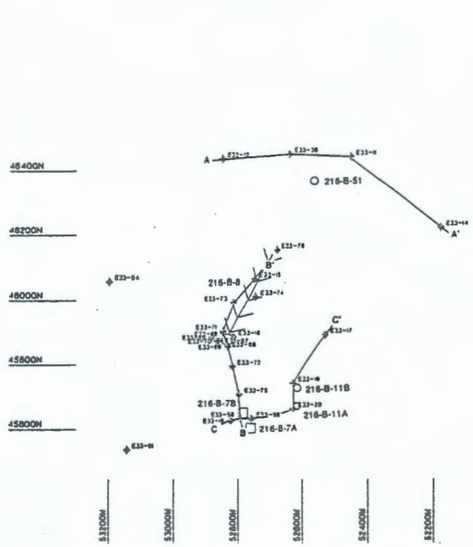


Explanation
Lithologic Boundary
Boundary Elevated Radiation

Lithology after Lindsey et al. (1992), cross section C-C'



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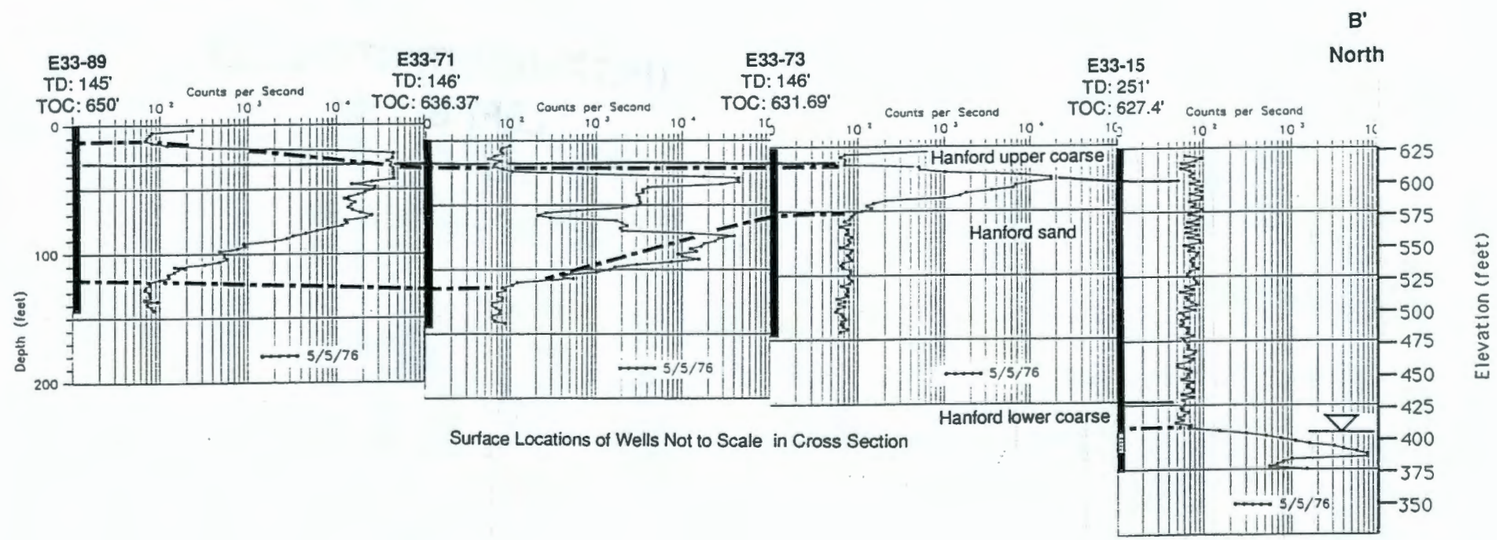

Figure A1-12. 216-B-7A & B and -8 Cribs, -11 Reverse Well, and -51 French Drain: Scintillation Probe Profile Cross Section B-B'.

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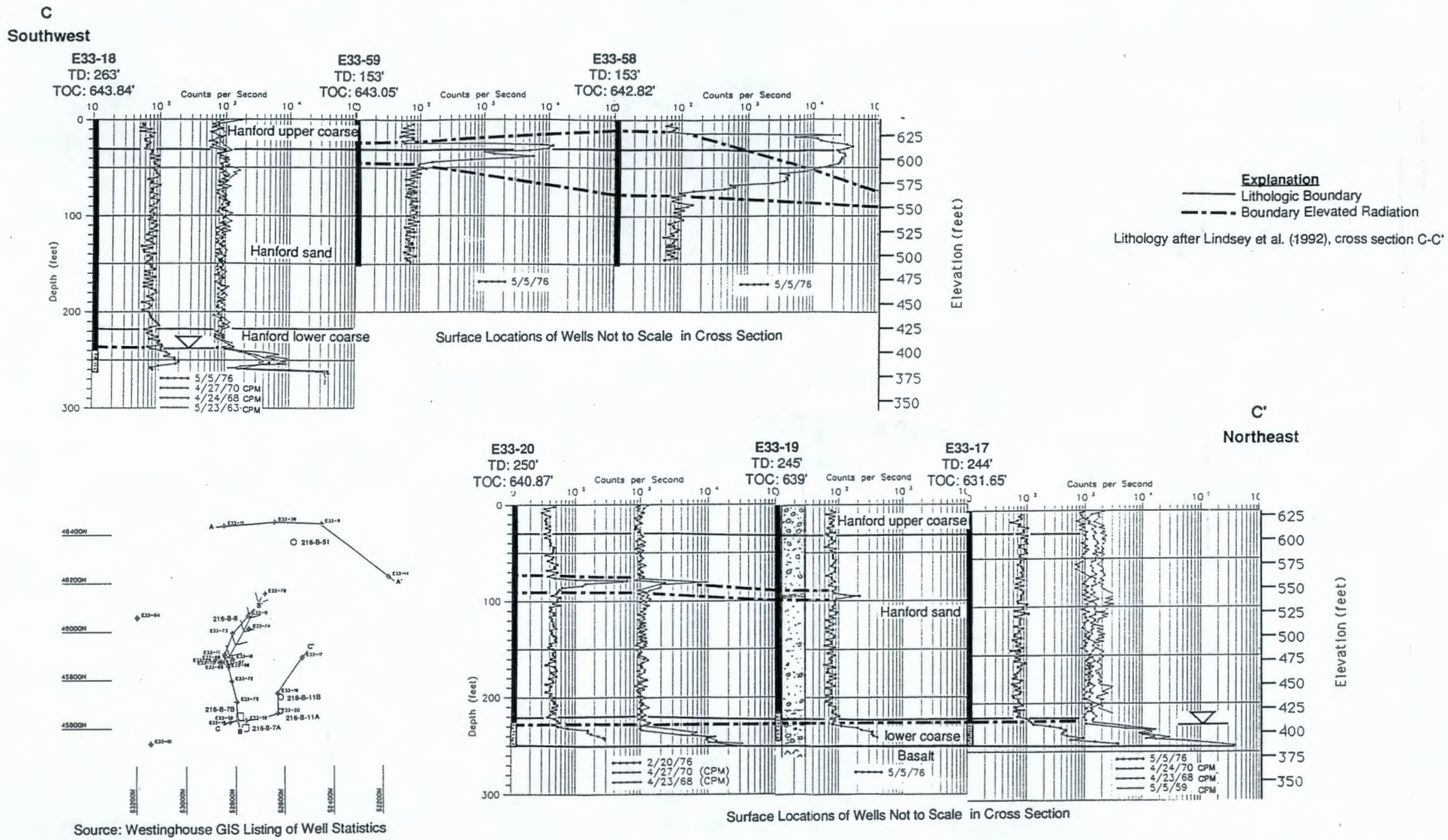

Figure A1-13. 216-B-7A & B and -8 Cribs, -11 Reverse Well, and -51 French Drain: Scintillation Probe Profile Cross Section C-C'.

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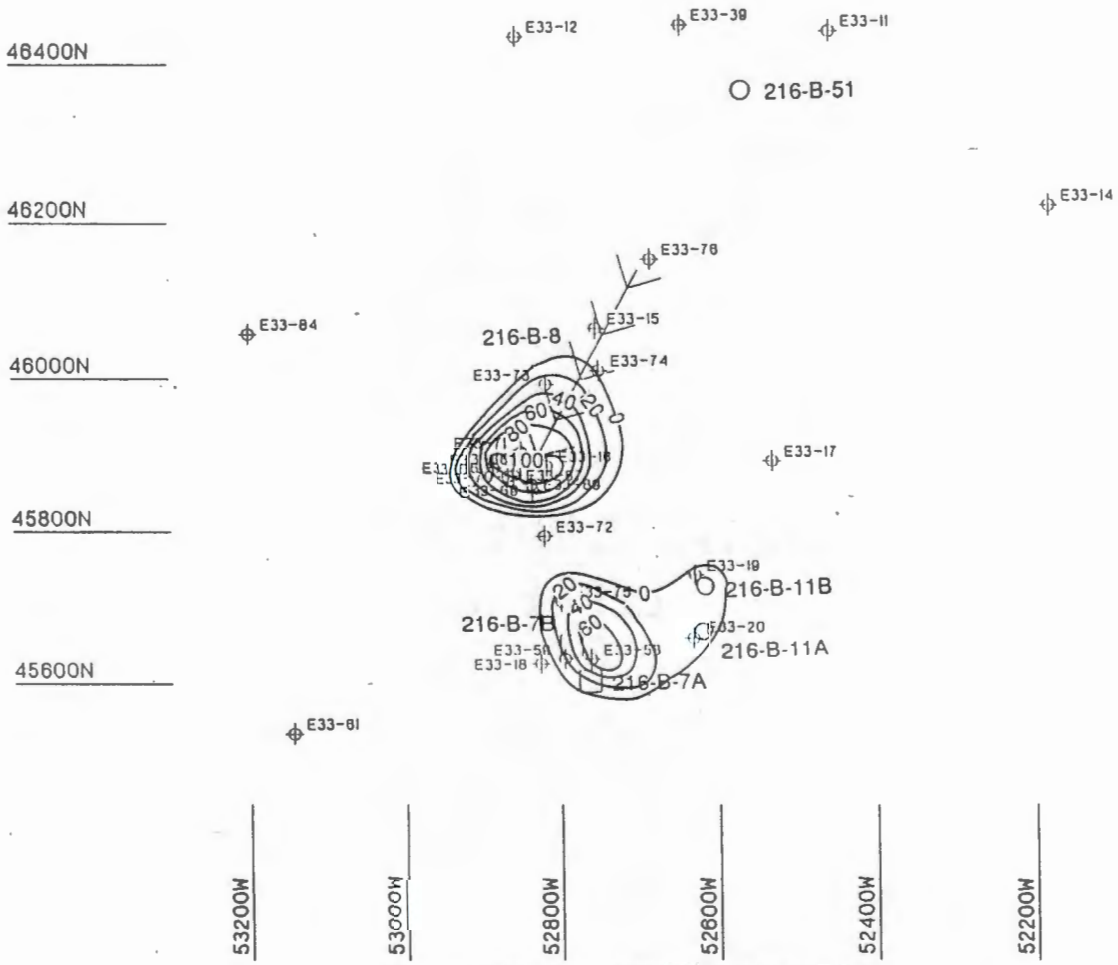
Figure A1-14. 216-B-7A & B and -8 Cribs, -11 Reverse Well, and -51 French Drain: Elevated Gamma Radiation Isopach Map.



Source: Westinghouse GIS Listing of Well Statistics

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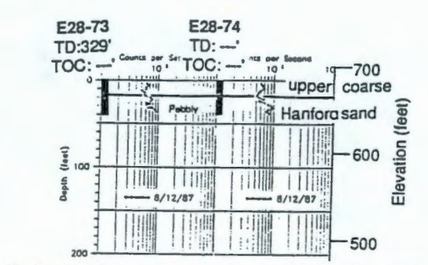
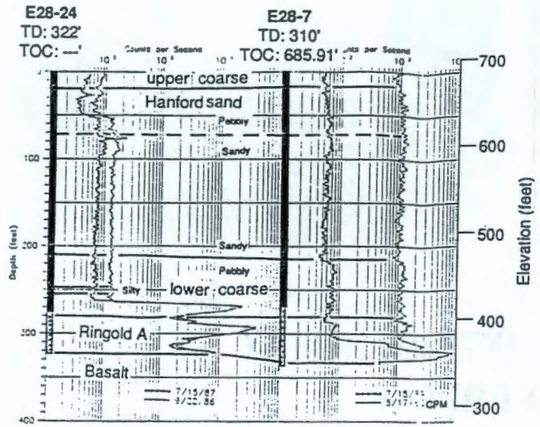
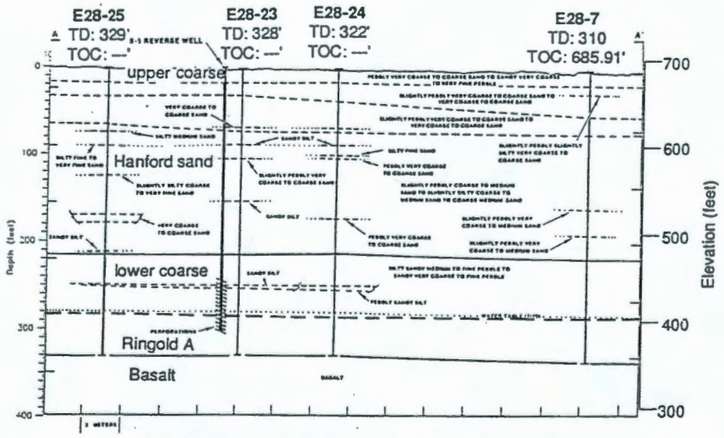


Surface locations of wells are not to scale in cross section



Surface locations of wells are not to scale in cross section



Stratigraphic control after Smith (1980) and Lindsey et al., (1992).

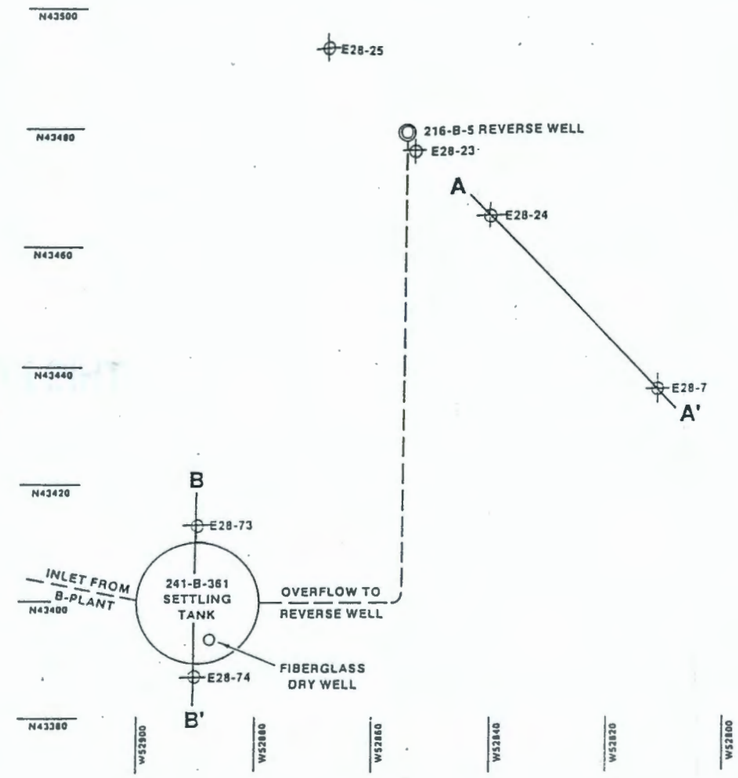


Figure A1-15. 216-B-5 Reverse Well and 216-B-361 Settling Tank: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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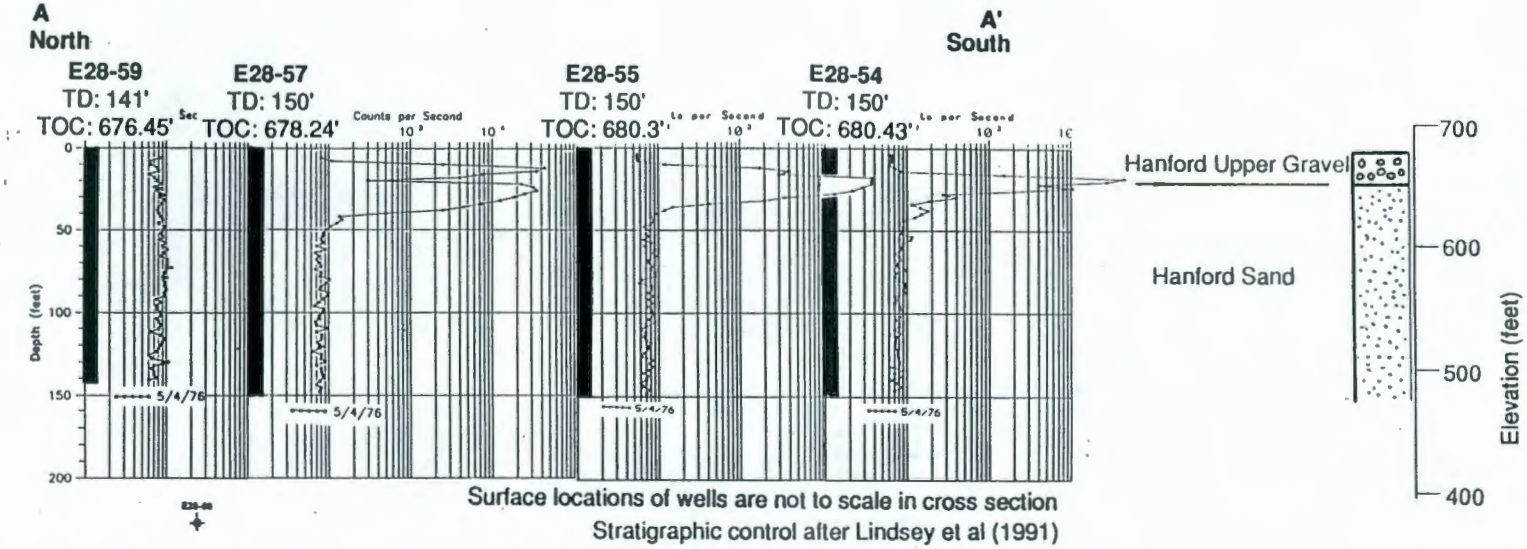

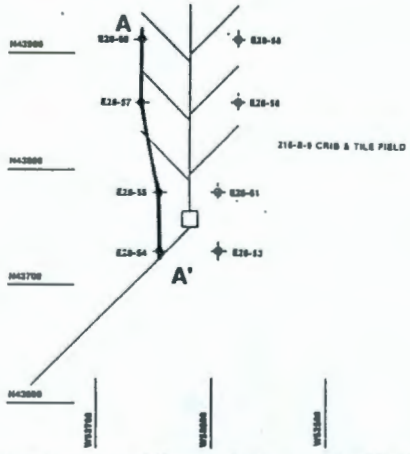

Well locations from GIS coordinates and Fecht et al (1977)

Figure A1-16. 216-B-9 Crib: Scintillation Probe Profile Cross Section A-A'.

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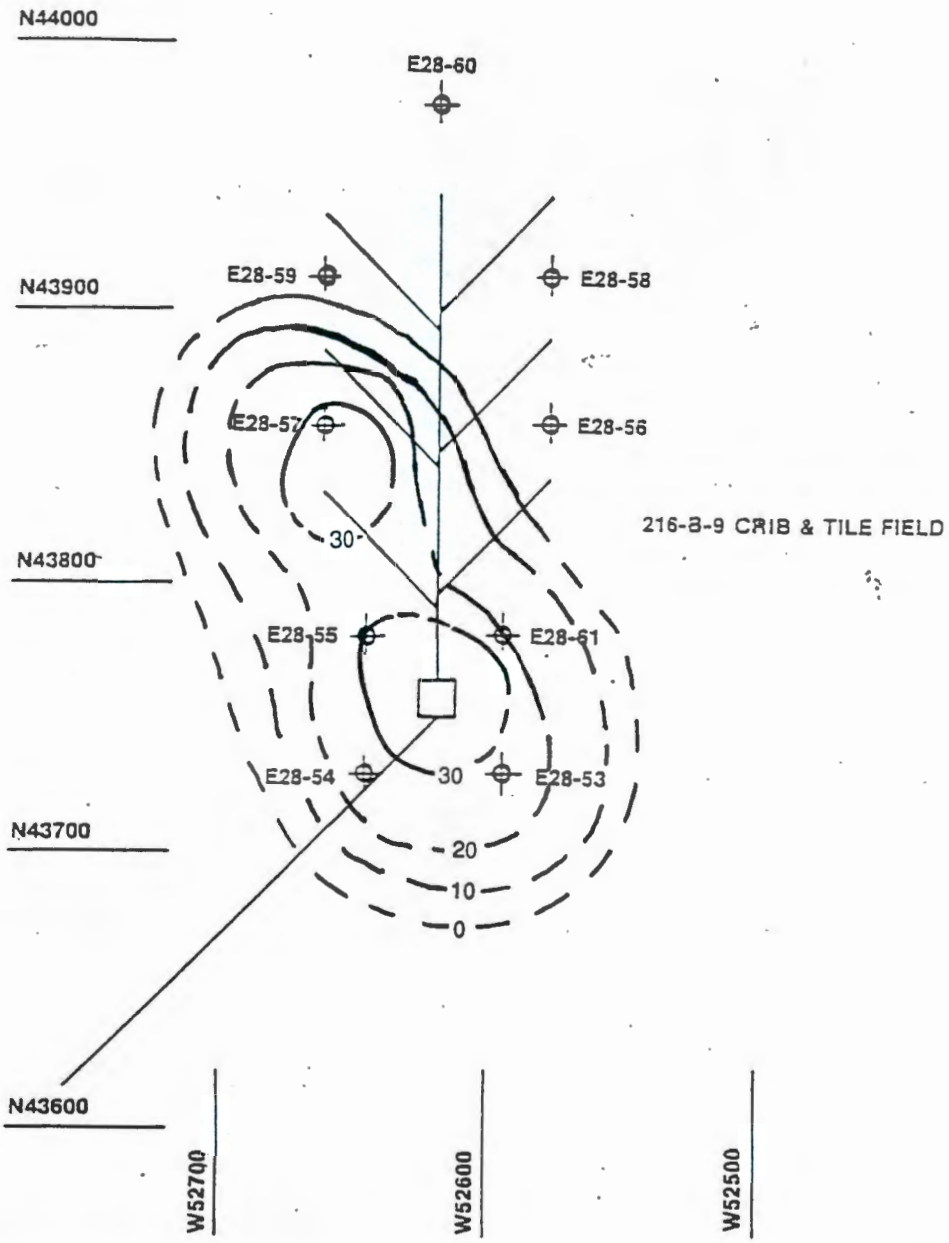
Figure A1-17. 216-B-9 Crib: Elevated Gamma Radiation Isopach Map.



Well locations plotted from GIS coordinates and Fecht et al (1977).

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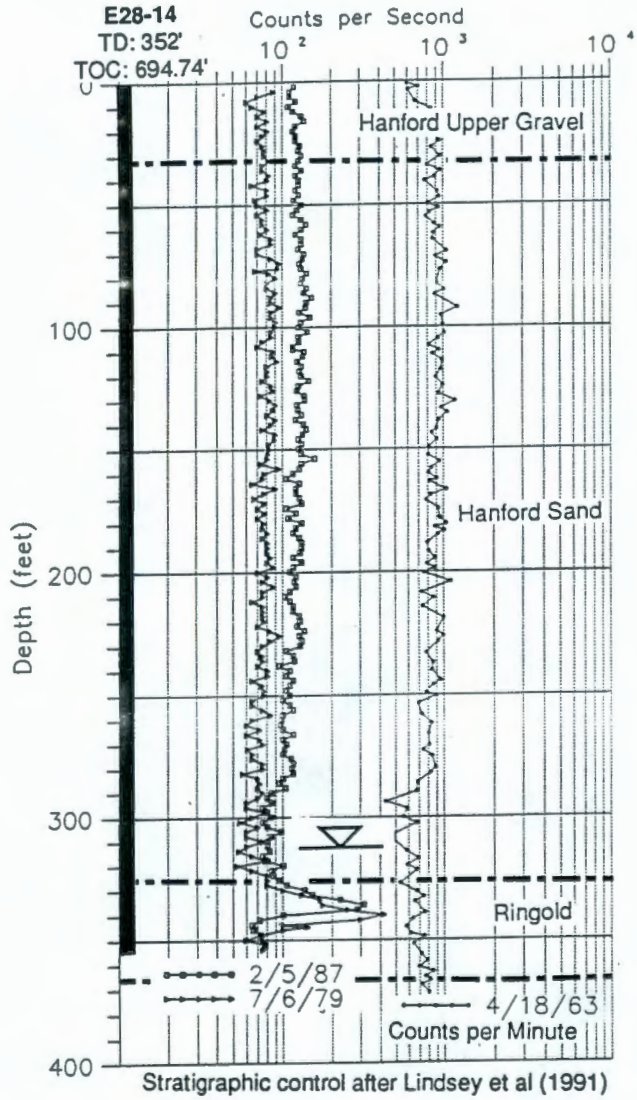
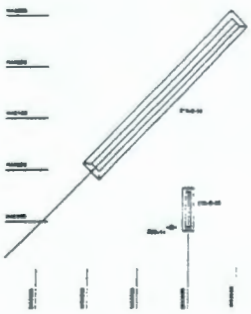
Figure A1-18. 216-B-56 Crib and 216-B-59B Retention Basin: Scintillation Probe Profile of Well 299-E28-14.





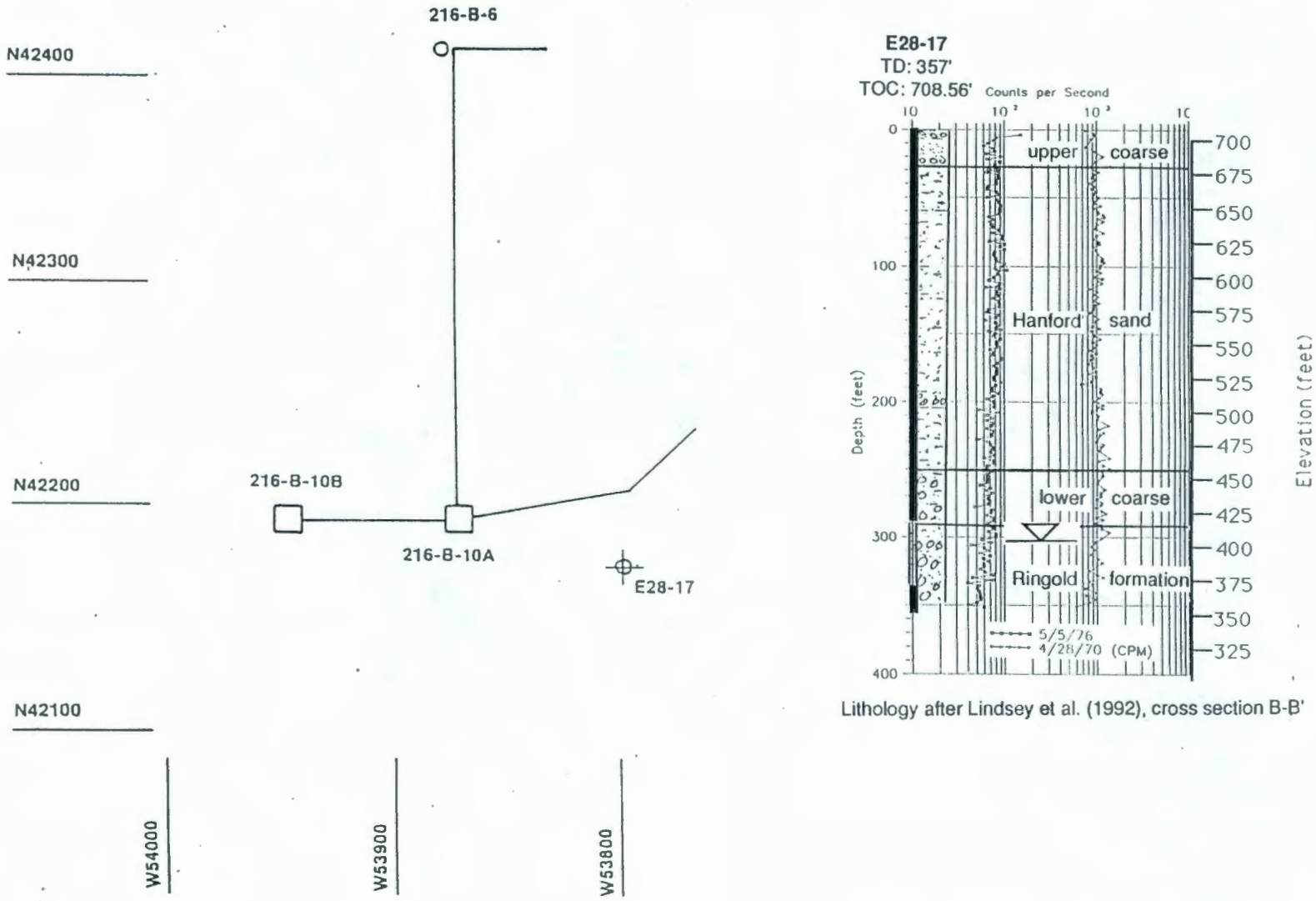
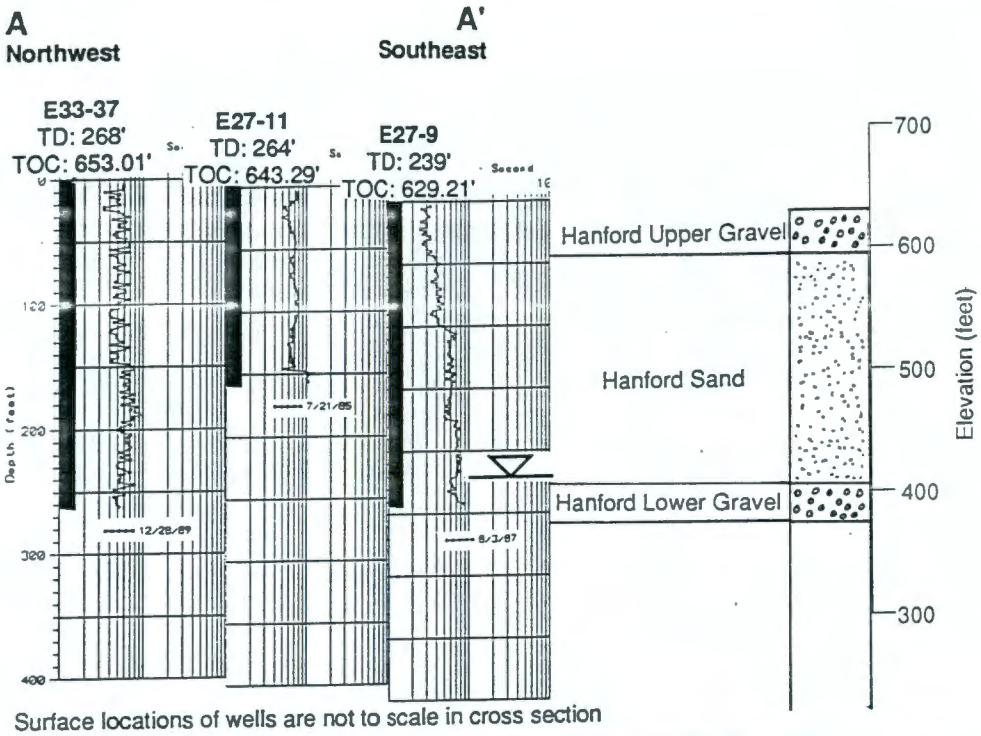
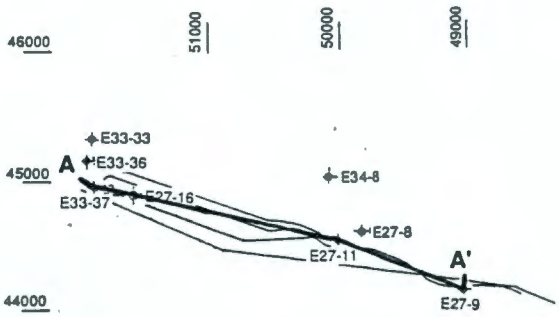


Figure A1-19. 216-B-6 Reverse Well and 216-B-10A & B Cribs: Scintillation Probe Profile of Well 299-E18-17.

Figure A1-20. 216-B-2-1, -2-2, and -2-3 Ditches and 216-B-63 Trench: Scintillation Probe Profile Cross Section A-A'.





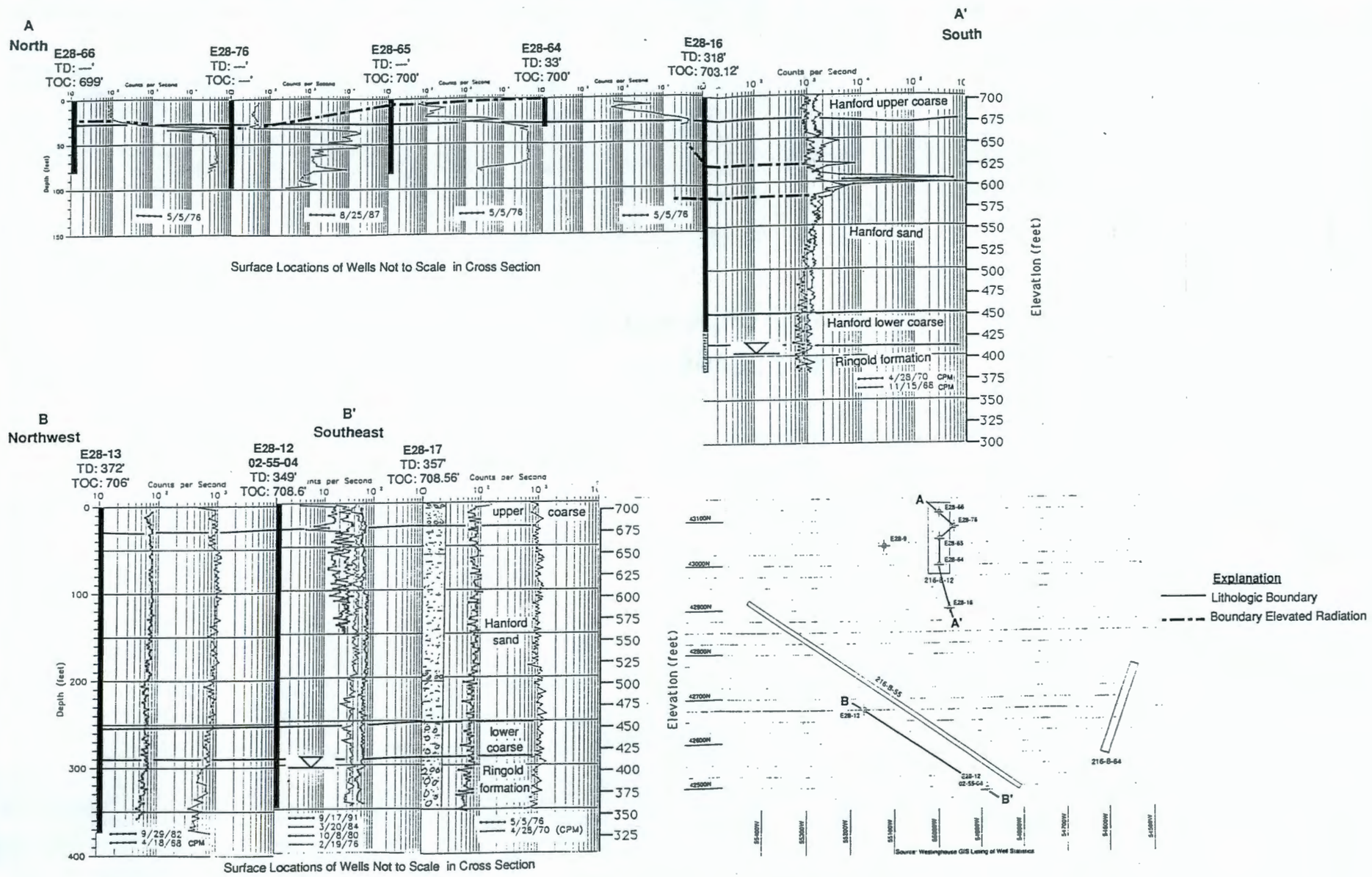


Figure A1-21. 216-B-12 and -55 Cribs and 216-B-64 Retention Basin: Scintillation Probe Profile Cross Sections A-A' and B-B'.

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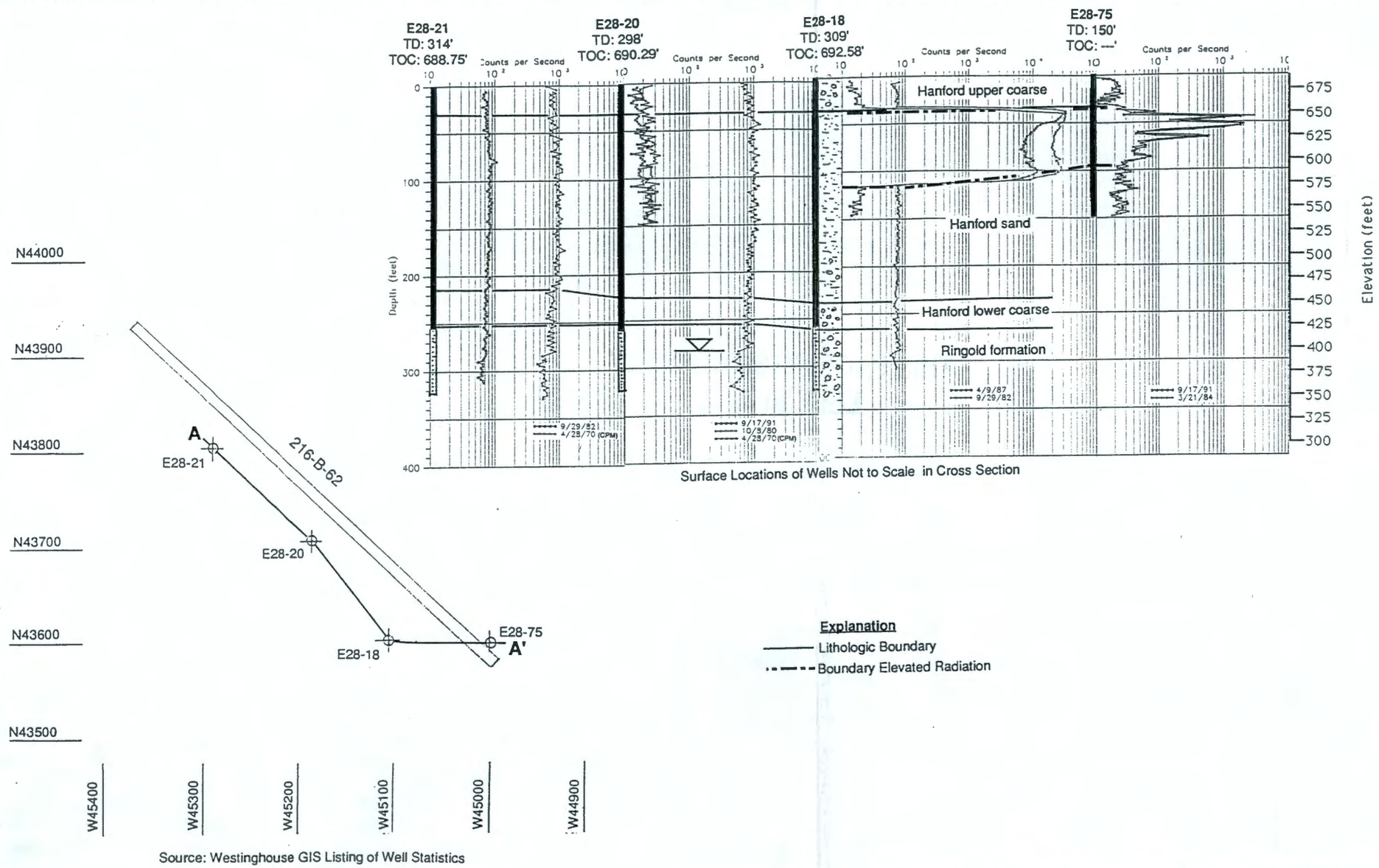

Source: Westinghouse GIS Listing of Well Statistics

Figure A1-22. 216-B-62 Crib: Scintillation Probe Profile Cross Section A-A'.

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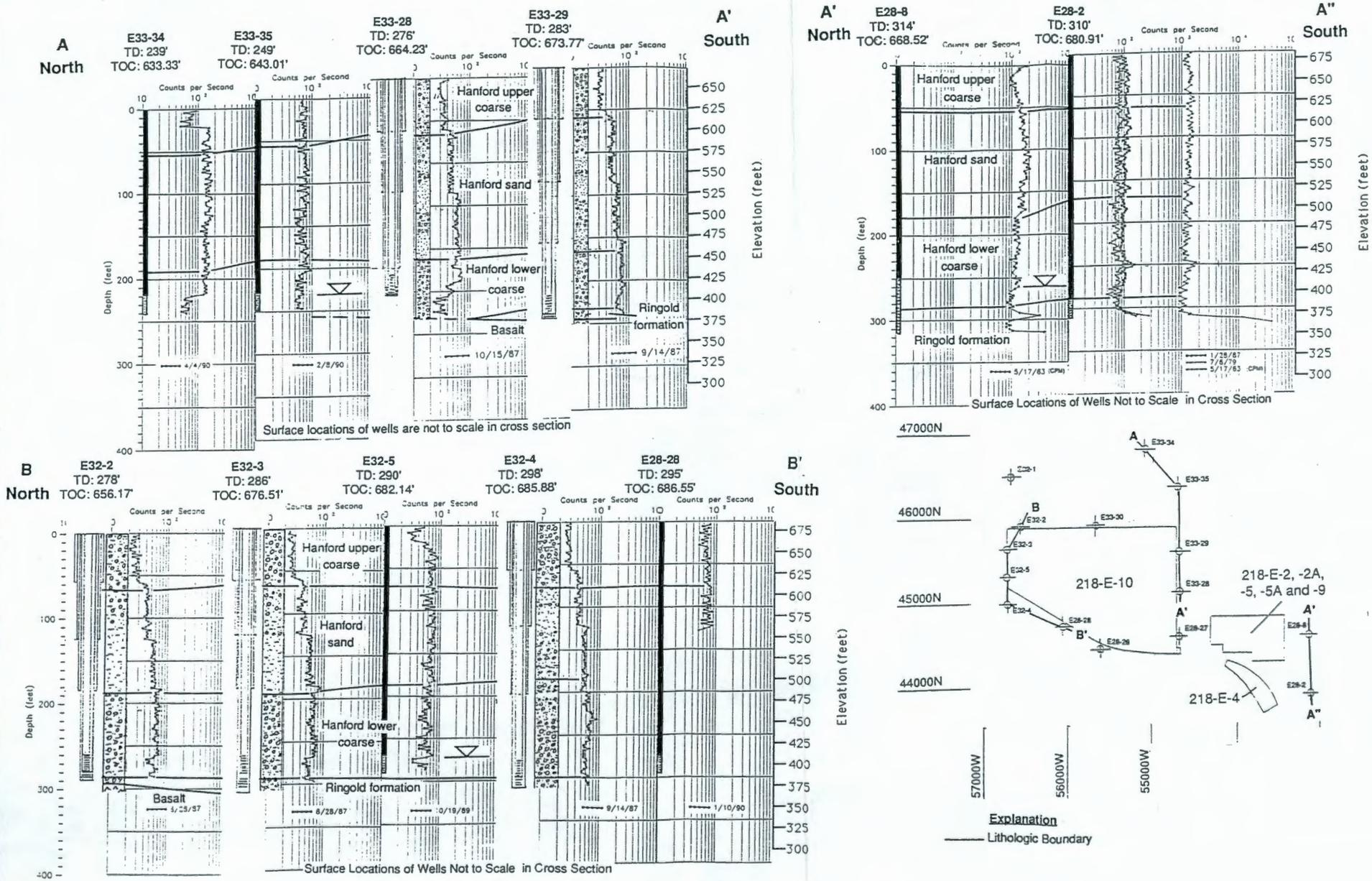

Figure A1-23. 216-E-2, -2A, -4, -5, -5A, -9, and -10 Burial Grounds: Scintillation Probe Profile Cross Sections A-A', A'-A", and B-B'.

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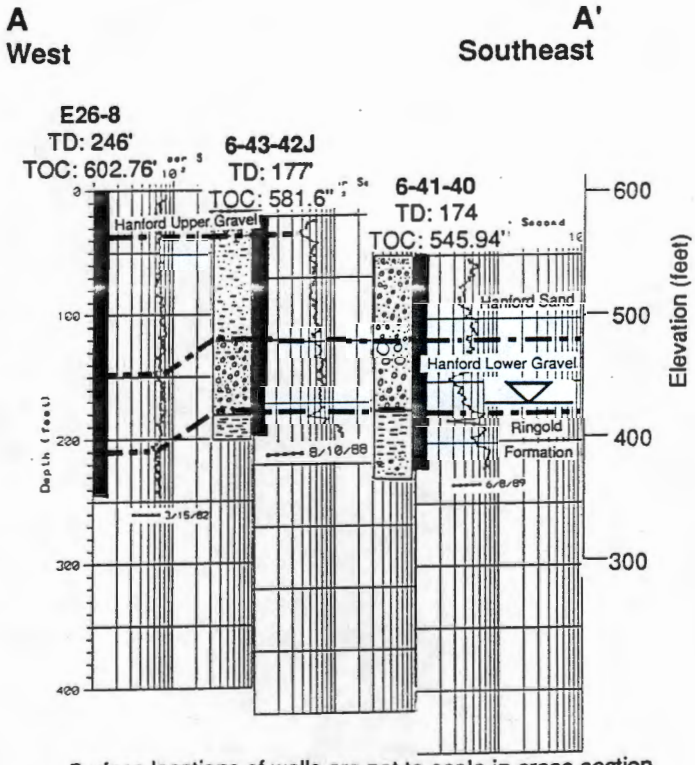
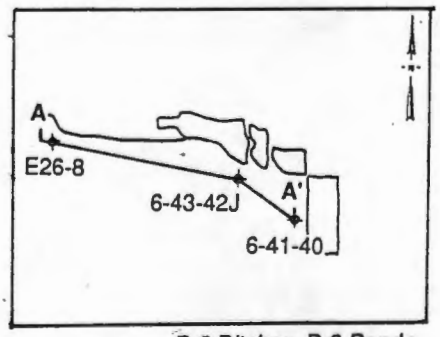
Figure A1-24. 216-B-3, -3A, -3B, and -3C Ponds and 216-B-3-3 Ditch: Scintillation Probe Profile Cross Section A-A'.



Surface locations of wells are not to scale in cross section
Stratigraphic control after Lindsey et al (1991)



B-3 Ditches B-3 Ponds

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Figure A1-25. 216-A-25 Pond: Scintillation Probe Profile of Well 6-50-45.

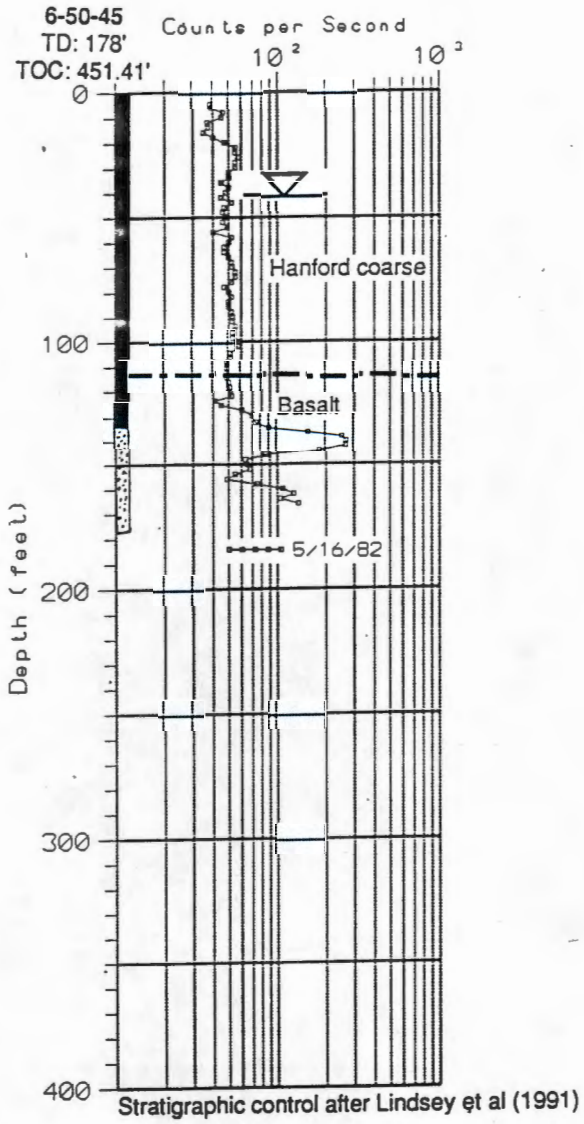

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Table A-1.1. Summary of Waste Management Unit Evaluation Results. (Page 1 of 3)

WMU	Description	Radiation Detected	Depth Interval (ft)	Evidence of Migration	Detected in Groundwater
216-B-43	Crib	Yes	24-230	No	Yes*
216-B-44	Crib	Yes	39-230	No	Yes*
216-B-45	Crib	Yes	28-230	No	Yes*
216-B-46	Crib	Yes	5-230	No	Yes*
216-B-47	Crib	Yes	40-125	No	Yes*
216-B-48	Crib	Yes	10-153	No	Yes*
216-B-49	Crib	Yes	10-153	No	Yes*
216-B-50	Crib	Yes	10-230	No	Yes*
216-B-57	Crib	Yes	25-68	No	Yes*
216-B-61	Crib	Yes	---	No	Yes*
216-B-14	Crib	Yes	0-268	No	No
216-B-15	Crib	Yes	---	No	No
216-B-16	Crib	Yes	0-306	No	No
216-B-17	Crib	Yes	12-70	No	No
216-B-18	Crib	Yes	12-90	No	No
216-B-19	Crib	Yes	---	No	No
216-B-20	Trench	Yes	15-40	No	No
216-B-21	Trench	No	Unknown	---	No
216-B-22	Trench	No	Unknown	---	No
216-B-24	Trench	No	Unknown	---	---
216-B-25	Trench	Yes	4-??	No	Unknown
216-B-26	Trench	No	Unknown	---	---
216-B-27	Trench	Yes	4-22	No	Unknown
216-B-28	Trench	No	Unknown	---	No
216-B-29	Trench	No	Unknown	---	No
216-B-30	Trench	---	---	---	---
216-B-31	Trench	Yes	4-??	No	Unknown
216-B-32	Trench	Yes	34-36	No	Unknown
216-B-33	Trench	Yes	22-30	No	Unknown
216-B-34	Trench	No	Unknown	---	No
216-B-52	Trench	---	---	---	---
216-B-53A	Trench	No	Unknown	---	---
216-B-53B	Trench	---	---	---	---
216-B-58	Trench	---	---	---	---
216-B-35	Trench	Yes	20-??	No	Unknown
216-B-36	Trench	Yes	0-70	No	Unknown
216-B-37	Trench	Yes	0-??	No	Unknown
216-B-38	Trench	Yes	0-??	No	Unknown
216-B-39	Trench	---	---	---	Unknown
216-B-40	Trench	---	---	---	Unknown
216-B-41	Trench	Yes	27-63	No	Yes
216-B-42	Trench	Yes	18-37	No	No

* Gamma radiation detected in groundwater possibly spurious.
• Unit is Currently Active.

Table A-1.1. Summary of Waste Management Unit Evaluation Results. (Page 2 of 3)

WMU	Description	Radiation Detected	Depth Interval (ft)	Evidence of Migration	Detected in Groundwater
216-B-7A&B	Cribs	Yes	12-75	No	Yes*
216-B-8	Crib &	Yes	12-120	No	Yes*
	Tile Field		22-50	No	---
216-B-11A&B	Reverse Wells	Yes	75-98	No	Yes*
216-B-51	French Drain	No	---	---	Yes*
216-B-5	Reverse Well	No	---	---	Yes
241-B-361	Settling Tank	No	---	---	---
216-B-9	Crib &	Yes	8-42	No	Unknown
	Tile Field	Yes	8-42	No	Unknown
241-BX-155	Diversion Box	No	Unknown	---	Unknown
241-BX-302C	Catch Tank	No	Unknown	---	Unknown
216-B-56	Crib	No	---	---	Yes
216-B-59	Trench	---	---	---	---
216-B-59B	Retention Basin	---	---	---	---
241-B-154	Diversion Box	---	---	---	---
241-B-302B	Catch Tank	---	---	---	---
216-B-6	Reverse Well	---	---	---	---
216-B-10A	Crib	No	---	---	No
216-B-10B	Crib	No	---	---	No
216-B-2-1	Ditch	No	---	---	No
216-B-2-2	Ditch	No	---	---	No
216-B-2-3	Ditch	No	---	---	No
216-B-63	Ditch	No	---	---	No
216-B-12	Crib	Yes	0-125	No	No
216-B-55	Crib	No	---	---	No
216-B-64	Retention Basin	---	---	---	---
216-B-62	Crib	Yes	32-114	No	No
218-E-2	Burial Ground	No	---	---	Yes*
218-E-2A	Burial Ground	No	---	---	Yes*
218-E-4	Burial Ground	No	---	---	Yes*
218-E-5	Burial Ground	No	---	---	Yes*
218-E-5A	Burial Ground	No	---	---	Yes*
218-E-9	Burial Ground	No	---	---	Yes*
218-E-10	Burial Ground	No	---	---	No
216-B-3	Pond	No	Unknown	---	No
216-B-3A	Pond	No	Unknown	---	No
216-B-3B	Pond	No	Unknown	---	No
216-B-3C	Pond	No	Unknown	---	No
216-B-3-1	Ditch	No	---	---	No
216-B-3-2	Ditch	No	---	---	No
216-B-3-3	Ditch	No	---	---	No
216-E-25	Pond	---	---	---	---

* Gamma radiation detected in groundwater possibly spurious.
° Unit is Currently Active.

Table A-1.1. Summary of Waste Management Unit Evaluation Results. (Page 3 of 3)

WMU	Description	Radiation Detected	Depth Interval (ft)	Evidence of Migration	Detected in Groundwater
218-E-3	Burial Ground	No	---	---	No
216-A-25	Pond	Yes	125-165	No	Yes
216-N-8	Pond	Yes	125-165	No	Yes
241-B-101 to 112	Tank Farm	Yes	B-??	Yes	Unknown
241-BX-101 to 112	Tank Farm	Yes	0-??	No	Unknown
241-BY-101 to 112	Tank Farm	Yes	0-??	Yes	Unknown

* Gamma radiation detected in groundwater possibly spurious.
• Unit is Currently Active.

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Table A-1.2. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-43 Through -50, -57, and -61.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used	
E33-1	46375	53335	626.12	235	215-235	2/28/79	*
						5/4/76	*
						4/27/70	*
						4/19/68	
						8/13/65	*
						5/23/63	
						1/28/58	
E33-2	46466	53384	629.72	231	220-233	7/16/87	*
						5/4/76	*
						4/27/70	
						5/23/63	
						5/11/59	
E33-3	46547	53331	625.73	234	---	2/28/79	*
						5/4/76	*
						4/27/70	
						5/23/63	
						1/28/59	
E33-4	46635	53384	624.92	228	215-231	7/16/87	*
						5/20/76	
						4/27/70	
						5/23/63	
						1/28/59	
E33-5	46352	53523	632.04	237	218-235	5/4/76	*
						4/27/70	
						5/23/69	
						5/4/59	
E33-6	46503	53524	627.9	236	214-229	7/16/87	*
						5/4/76	*
						4/29/70	
						5/23/63	
						5/11/59	
E33-7	46619	53520	626.58	230	215-230	7/16/87	*
						2/20/76	*
						4/19/68	
						7/9/65	*
						1/28/59	
E33-13	46278	53093	625.53	229	210-235	7/16/87	*
						2/20/76	*
E33-22	46450°	53300°	625.78	230	212-231	7/16/87	*
						5/4/76	*
						9/17/65	
E33-23	46600°	53350°	625.34	227	218-230	7/16/87	*
						5/4/76	*
						4/27/70	
						9/20/65	
E33-24	46260	53790	638.03	253	219-241	5/4/76	*
						4/27/70	
						4/19/69	
E33-25	46600	54210	631.02	238	199-233	2/20/76	*
						4/24/70	
E33-26	46600	54315	632.51	240	---	5/4/76	*
E33-38	46312	53469	631.74	242	---	1/9/91	*
E33-90	46500	53200	650	140	---	9/17/65	*

*Digitized Logs
°Discrepancy between GIS coordinates and map location in Fecht et al. (1977).
Sources: Westinghouse GIS Listing of Well Statistics; Fecht et al. (1976).

9 3 1 2 8 6 1 4 8 7

Table A-1.3. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-14 Through -19.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E13-1	35800	53260	741.9	345	329-364	7/13/87	*
						4/18/58	*
						4/30/70	
						4/29/68	
						5/9/63	
						5/14/59	
						3/9/56	
E13-2	35564°	53446	743.49	346	335-367	7/13/87	*
						4/18/58	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/14/59	
						3/9/56	
E13-3	35734	53408	741.48	353	327-362	7/10/87	*
						4/30/76	
						4/24/68	
						5/9/63	
						4/14/59	
						3/9/56	
E13-21	35730	53420	740	335	0-0	7/10/87	*
						4/30/76	
						4/24/68	
						7/5/66	
E13-4	35809	53550	743.5	362	337-367	7/13/87	*
						4/18/58	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/14/59	
						3/9/56	
E13-5	35565	53447	734.06	365	330-365	4/18/85	*
						4/18/58	*
						4/30/76	
						4/24/68	
						5/9/63	
						5/14/59	
						3/9/56	
E13-6	35641	53589	742.4	363	341-362	7/10/87	*
						4/18/58	*
						2/20/76	
						4/24/68	
						5/10/63	
						5/14/59	
						3/9/56	
E13-20	35543	53440	742.92	357	334-384	7/10/87	*

* Digitized Logs
°Discrepancy between GIS coordinates and location used by Fecht et al (1977)
Source: Westinghouse GIS Listing of Well Statistics

Table A-1.4. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-20 Through -34, -53, -54, -56, and -58. (Page 1 of 2)

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E13-7	35631	54107	742.94	355	323-365	7/8/87	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/26/59	
E13-8	35508	54323	740.7	356	317-362	7/9/87	*
						2/20/76	
						4/24/68	
						5/10/63	
						5/14/59	
						4/18/58	*
E13-9	35900	54297	744.03	361	319-362	7/8/87	*
						4/30/76	
						4/24/68	
						5/10/63	
						5/26/59	
						4/18/58	*
E13-10	35348	54798	738.84	346	310-342	7/9/87	*
						4/30/76	
						4/24/68	
						5/13/63	
						5/14/59	
						5/2/58	*
E13-11	35199	54170	734.97	350	310-364	3/22/84	*
						4/30/76	
						5/26/69	
E13-12	35001	54820	731.34	342	308-360	7/9/87	*
						4/30/76	
						5/26/69	
E13-13	34800	54100	726.06	349	302-356	5/10/63	
						5/26/59	
E13-14	36080	55150	745.15	344	320-353	4/3/84	*
						5/3/76	
						4/23/68	
						5/13/63	
						5/27/59	
E13-15	35660	55470	734.55	362	315-365	7/9/87	*
						5/3/76	
						4/23/68	
						5/13/63	
						5/27/59	

* Digitized Log
\+ Have Log, Not Digitized
Source: Westinghouse GIS Listing of Well Statistics.

Table A-1.4. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-20 Through -34, -53, -54, -56, and -58. (Page 2 of 2)

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E13-16	35660	54840	744.51	347	308-365	7/9/87	*
						3/21/84	*
						4/30/76	
						4/25/68	
						5/13/63	
						5/26/59	
E13-17	35230	55250	732.78	334	308-356	7/9/87	*
						5/3/76	
						5/27/59	
E13-18	35230	55050	729.18	380	305-410	7/9/87	*
						5/3/76	*
						5/13/63	
						5/27/59	
						5/2/58	*
E13-19	34720	54530	728.49	358	310-360	7/10/87	*
						4/24/68	
						5/13/63	
						5/26/59	
						4/21/58	*
E13-51	35500	54200	738	---	---	7/8/87	*
						2/9/67	+
						7/5/66	+
E13-52	35700	55200	730	---	---	7/9/87	*
						4/23/68	+
						7/5/66	+
E13-54	35445	54460	---	---	---	7/13/87	*
E13-55	35320	54495	---	---	---	7/9/87	*
E13-56	35120	54495	---	---	---	7/9/87	*
E13-57	34920	54495	---	---	---	7/9/87	*
E13-58	35747	51550	---	---	---	7/9/87	*
E13-59	35617	55150	---	---	---	7/8/87	*
E13-60	35453	55150	---	---	---	7/8/87	*
E13-61	35995	54720	---	---	---	7/13/87	*

* Digitized Log
\+ Have Log, Not Digitized
Source: Westinghouse GIS Listing of Well Statistics.

9 3 1 2 8 9 6 1 4 9 0

Table A-1.5. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-35 Through -42.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used	
E33-8	45832	53851	650.73	256	230-257	2/20/76	*
						4/27/70	*
						4/19/68	*
						5/17/63	*
						5/4/59	
E33-10	45216	54566	671.18	290	259-285	12/3/76	*
						4/17/68	*
						5/17/63	*
E33-21	45324	53855	668.13	280	235-275	5/4/76	*
						4/27/70	
						5/17/63	
						5/4/59	
						7/13/57	*
E33-28	45596	54668	664.23	276	256-276	10/15/87	*
E33-29	45124	54665	673.77	283	263-283	9/14/87	*
E33-32	45524	53689	659.83	267	246-267	8/9/89	*
E33-286	45257	54017	---	50	---	7/15/87	*
E33-287	45383	53980	---	50	---	7/15/87	*
E33-288	45428	53980	---	49	---	7/15/87	*
E33-289	45479	53980	---	49	---	7/15/87	*
E33-290	45520	53980	---	---	---	7/15/87	*

*Digitized Logs
Source: Westinghouse GIS Listing of Well Statistics; Last et al. (1989).

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Table A-1.6. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-7, -8, and -51. (Page 1 of 2)

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used
E33-11	46444	52452	620.27	229	---	5/5/76 *
						4/24/70
						5/20/63
						5/5/59
E33-12	46436	52850	623	414	305-385	1/12/82 *
						5/4/76 *
E33-14	46223	52177	622.12	230	212-227	5/5/76 *
						4/24/70
						5/20/63
						5/5/59
E33-15	46066	52751	627.4	251	222-237	5/5/76 *
						5/5/59
E33-16	45887	52815	635.51	258	231-246	2/20/76 *
						4/28/68
						5/22/63
						5/5/59
E33-17	45894	52529	631.65	244	220-244	5/5/76 *
						4/27/70 *
						4/23/68 *
						5/5/59 *
E33-18	45627	52825	643.84	263	240-260	5/5/76 *
						4/27/70 *
						4/24/68 *
						5/23/63 *
						5/5/59
E33-19	45744	52629	639	245	217-248	5/5/76 *
						5/5/59
E33-20	45664	52629	640.87	250	225-251	2/20/76 *
						4/27/70 *
						4/23/68 *
						5/22/63
						5/5/59
E33-39	46451	52641	623.11	230	---	1/21/91 *
E33-58	45633	52761	642.82	153	---	5/5/76 *
						5/23/63
E33-59	45633	52794	643.05	153	---	5/5/76 *
						5/23/63
E33-61	45537	53145	653.23	150	---	5/27/63 *
						8/26/59 *
E33-66	45885	52883	635.89	142	---	5/5/76 *
						5/22/63
E33-67	45875	52857	637.71	150	---	5/5/76 *
						5/22/63
E33-68	45897	52845	636.88	150	---	5/5/76 *
						5/22/63
E33-69	45855	52833	636.46	145	---	5/5/76 *
						5/22/63
E33-70	45873	52865	637.58	150	---	5/5/76 *
						5/22/63
E33-71	45905	52847	636.37	146	---	5/5/76 *
						5/22/63
E33-72	45795	52819	638.78	150	---	5/5/76 *
						5/22/63 *

* Digitized Log

Source: Westinghouse GIS Listing of Well Statistics.

Table A-1.6. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-7, -8, and -51. (Page 2 of 2)

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used	
E33-73	45993	52815	631.69	146	---	5/5/76 5/22/63	*
E33-74	46011	52747	629.92	145	---	5/5/76 5/22/63	*
E33-75	45709	52798	641.78	144	---	5/5/76 5/22/63	*
E33-76	46155	52681	625.31	143	---	5/5/76 5/22/63	* *
E33-84	46058	53198	649.18	150	40-100	5/27/63	*
E33-89	45863	52835	650	145	---	5/5/76 5/22/63	*

* Digitized Log

Source: Westinghouse GIS Listing of Well Statistics.

Table A-1.7. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-5 and 241-B-361.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used
E28-1	43480	52355	685.2	322	277-311	5/4/76 *
						5/11/59 *
E28-7	43437	52812	685.91	310	270-335	7/15/89 *
						5/4/76
						5/17/63 *
						8/26/59
E28-23	43477	52852	---	328	278-328	Not Available
E28-24	43466	52841	---	322	277-327	7/15/87 *
						9/22/86 *
E28-25	43494	52869	---	329	279-328	Not Available
E28-73	43415	52890	---	---	---	8/12/87 *
E28-74	43385	52890	---	---	---	8/12/87 *

*Digitized Logs

Source: Westinghouse GIS Listing of Well Statistics.

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Table A-1.8. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-9, 241-BX-155, and 241-BX-302C.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E28-53	43732	52593	680.6	25	---	5/4/76	*
						5/24/63	
E28-54	43732	52643	680.43	150	---	8/25/87	*
						5/4/76	*
						5/24/63	
E28-55	43782	52643	680.3	150	---	5/4/76	*
						5/24/63	
E28-56	43862	52578	676.25	150	---	5/4/76	*
E28-57	43862	52660	678.24	150	---	5/4/76	*
E28-58	43916	52575	675.78	145	---	5/4/76	*
						5/24/63	
E28-59	43916	52660	676.45	141	---	5/4/76	*
E28-60	43977	52618	674.65	145	---	5/4/76	*
E28-61	43782	52593	680.51	150	---	5/4/76	*
						5/24/63	
E28-5	43887	52024	672.32	325	---	5/4/76	*
E28-2	---	---	---	---	---	7/6/79	*
						1/28/78	*

* Digitized Log

Source: Westinghouse GIS Listing of Well Statistics

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Table A-1.9. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-56, -59, 241-B-154, and -302B.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used
E28-3	43071	53093	692.86	318	314-324	01/28/87 *
						07/06/79 *
E28-4	42773	52148	691.55	312	295-321	01/28/87 *
						07/06/79 *
E28-6	42445	52855	700.11	334	310-340	07/15/87
						05/13/65
						05/17/63
E28-14	42885	52635	694.74	352		02/05/87 *
						07/06/79 *
						05/04/76 *
						04/18/63 *

* Digitized Logs

Source: Westinghouse GIS Listing of Well Statistics

9 3 1 2 8 0 6 1 4 9 6

Table A-1.10. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-2-1, -2, -3, and -63.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E27-8	44496	49642	637.83	281	241-281	06/14/87	+
E27-9	44484	49122	629.21	239	---	08/03/87	*
E27-11	44558	49990	643.29	264	231-251	07/21/89	*
						07/12/89	*
E27-16	51544	44897	652.13	268	---	02/08/90	+
						12/22/89	+
E33-33	45348	51868	640.17	248	227-248	08/08/89	+
E33-36	45145	51906	646.67	264	---	12/28/89	*
E33-37	44965	51832	653.01	268	---	12/28/89	*
E34-8	45175	51454	640.52	249	229-249	03/30/90	+

* Digitized Logs
+ Have Log, Not Digitized
Source: Westinghouse GIS Listing of Well Statistics

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Table A-1.11. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-12, -55, and -64.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used	
E28-9	43044	55101	700.77	350	290-340	8/25/87	*
						5/5/76	*
						4/28/70	*
						5/15/63	*
E28-12	42490	54885	708.6	349	---	9/17/91	*
02-55-04						3/20/84	*
						10/8/80	*
						2/19/76	*
						4/28/70	
						4/18/68	
E28-13	42675	55145	706	372	---	9/29/82	*
						4/18/68	*
E28-16	42927	54975	703.12	318	270-323	5/5/76	
						4/28/70	*
						11/15/68	*
E28-19	43324	55205	697.49	308	260-325	3/20/84	*
						4/28/70	*
E28-64	43000	55000	700	33	---	5/5/76	*
						9/21/67	
E28-65	43060	55000	700	---	---	5/5/76	*
						9/27/68	
E28-66	43120	55000	699	---	---	5/5/76	*
						9/27/68	
E28-76	43088	54965	---	---	---	8/25/87	*

* Digitized Log

Sources: Westinghouse GIS Listing of Well Statistics; Welty & Vermeulen (1989).

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Table A-1.12. Details of Wells and Logs Used in Evaluation of Waste Management Unit 216-B-62.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used	
E28-18	43603	55105	692.58	309	260-325	4/9/87	*
02-62-05						9/29/82	*
						2/19/76	
E28-20	43705	55188	690.29	298	260-325	9/17/91	*
02-62-06						10/8/80	*
						5/4/76	
						4/28/70	*
E28-21	43806	55290	688.75	314	257-325	9/29/82	*
						5/3/76	
						4/28/70	*
E28-75	43600	55000	---	150	---	9/17/91	*
02-62-04						3/21/84	*

* Digitized Log

Sources: Westinghouse GIS Listing of Well Statistics; Welty & Vermeulen (1989).

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Table A-1.13. Details of Wells and Logs Used in Evaluation of Waste Management Units 218-E-2, -2A, -4, -5, -5A, -9, and -10.

Well #	Northing	Westing	TOC	TD	Perforations	Logs Used	
E28-2	43915	53105	680.91	310	288-318	1/28/87	*
						7/6/79	*
						5/17/63	*
						6/25/58	
E28-8	44603	53124	668.52	314	250-294	5/17/63	*
E28-26	44446	55606	687.26	299	279-299	N/A	
E28-27	44595	54670	680.37	290	270-290	N/A	
E28-28	44724	56056	686.55	295	275-295	1/10/90°	*
E32-1	46488	56684	656.17	274	241-271	5/11/58	
E32-2	45904	56565	670.06	278	258-278	8/28/87	*
E32-3	45631	56721	676.51	286	266-286	8/28/87	*
E32-4	44985	56713	685.88	298	278-298	9/14/87	*
E32-5	45306	56725	682.14	290	270-290	10/19/89	*
E33-28	45596	54668	664.23	276	256-276	10/15/87	*
E33-29	45124	54665	673.77	283	263-283	9/14/87	*
E33-30	45903	55660	663.7	275	255-275	9/15/87	*
E33-34	46796	55065	633.33	239	219-239	4/4/90	*
E33-35	46351	54685	643.01	249	228-249	2/8/90	*

* Digitized Log

°Log from upper portion of well only.

Sources: Westinghouse GIS Listing of Well Statistics; Last et al. (1989).

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Table A-1.14. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-B-3 and 216-E-28.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
E26-8	43317	47142	602.76	246	326-396	03/15/82	*
						07/14/82	+
E26-9	44780	46960	602.9	201.5	---	08/01/90	|
						07/25/90	|
						07/16/90	|
E26-10	44420	46919	601.49	206	---	09/06/90	|
						08/20/90	|
						08/09/90	|
						08/01/90	|
						07/25/90	|
E26-11	44779	44972	599.7	205.8	---	09/06/90	|
						07/28/90	|
						07/11/90	|
						06/28/90	|
E35-1	45867	47339	598.31	234	23-251	08/29/89	*
E35-2	45180	46959	602.12	---	---	09/05/90	|
						07/13/90	|
						07/07/90	|
6-39-39	39044	38851	536.65	180	110-194	05/06/80	*
6-40-39	39678	39224	541.84	212	201-212	06/27/89	|
						04/25/89	|
6-40-40A	---	---	---	227	---	09/17/91	|
						08/30/91	|
6-40-40B	---	---	---	202	---	09/19/91	|
						08/12/91	|
						07/31/91	|
						07/24/91	|
6-40-43	---	---	---	135	---	10/24/91	*
6-41-40	41030	40285	545.94	174	164-174	06/08/89	*
						05/23/89	+
6-42-39A	---	---	---	---	---	08/02/91	+
6-42-40C	42414	40181	546.16	385	306-390	07/14/82	+
						01/12/82	+
6-42-41	---	---	---	---	---	07/30/91	*
6-42-42A	42004	42012	602.2	1092	174-301	07/02/80	*
6-42-42B	42473	42301	583.23	203	---	09/14/88	*
6-43-40	---	---	---	137	---	08/27/91	*
6-43-41E	42995	40723	550.86	146	136-146	07/30/91	*
6-43-41F	42945	40721	551.01	176.07	---	04/28/89	|
						04/18/89	|
6-43-42	41817	43116	566.36	223	---	05/27/80	*
6-43-42J	42532	42274	581.68	177	---	08/10/88	*
6-43-42K	42509	42304	581.38	262	---	11/18/88	*
6-43-43	42942	43184	579.37	177	---	09/01/88	*
6-43-45	42977	44644	597.68	203	183-203	06/01/89	*
6-44-42	43783	41965	579.22	172	---	09/19/88	*
6-44-43B	43998	43363	580.12	176	156-176	05/18/89	*
6-45-42	42099	45274	577.33	173	158-180	08/18/80	*
6-47-46A	47039	45994	580.14	205	168-181	08/15/80	*

* Digitized Logs
| Multiple Logging Runs Digitized Together
\+ Have Log, Not Digitized
Source: Westinghouse GIS Listing of Well Statistics

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Table A-1.15. Details of Wells and Logs Used in Evaluation of Waste Management Units 216-A-25 and 216-N-8.

Well #	Northing	Easting	TOC	TD	Perforations	Logs Used	
6-50-45	50150	44992	451.41	178	133-178	05/06/82	*
6-50-48A	49877	48333	551.92	248	---	06/04/80	*
6-52-46	52196	45706	455.61	225	170-225	05/01/80	*
6-52-48	51556	48076	466.06	195	145-195	03/34/80	*
6-54-42	54396	42431	511.49	140	100-200	05/07/80	*
6-54-45B	54250	44510	492.94	---	299-314	07/19/82	*
6-55-44	55462	43677	519.67	152	140-150	03/10/80	*
6-55-55	55000	55000	---	---	---	11/13/90	|
						10/17/90	|
6-56-53	56343	52779	434.34	270	190-270	07/19/82	*
6-60-57	60350	56612	469.64	154	---	06/12/81	+
						05/15/81	*

* Digitized Logs

| Mulitple Logging Runs Digitized Together

\+ Have Log, Not Digitized

Source: Westinghouse GIS Listing of Well Statistics

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APPENDIX A-2

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A-2.4 Results of Air Monitoring (pCi/m^3) A2T-4

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Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location 2E-N											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<1.20E-02	2.90E-02	<-7.60E-03	3.60E-02	-5.72E-02	9.29E-02	-1.76E-02
Ce-144	–	–	–	–	–	–	–	–	-8.70E-02	1.27E-01	-8.70E-02
Co-58	–	–	–	–	<-3.30E-03	1.30E-02	–	–	7.90E-03	2.54E-02	2.30E-03
Co-60	–	–	–	–	1.60E-02	1.30E-02	–	–	4.66E-03	1.54E-02	1.03E-02
Cs-134	–	–	–	–	6.50E-02	1.70E-02	<1.40E-02	2.00E-02	-1.70E-02	1.81E-02	2.28E-02
Cs-137	–	–	–	–	9.10E+00	9.20E-01	1.20E+01	1.20E+00	6.84E+00	6.95E-01	9.42E+00
Eu-152	–	–	–	–	9.40E-02	6.80E-02	<8.30E-02	9.10E-02	1.12E-01	6.62E-02	9.75E-02
Eu-154	–	–	–	–	<3.30E-02	4.20E-02	<6.50E-03	5.40E-02	-5.63E-02	5.37E-02	-5.60E-03
Eu-155	–	–	–	–	7.10E-02	5.80E-02	<4.40E-02	7.70E-02	6.19E-02	5.94E-02	5.90E-02
K-40	–	–	–	–	–	–	–	–	1.58E+01	1.75E+00	1.58E+01
Mn-54	–	–	2.90E-02	2.40E-02	2.70E-02	1.30E-02	<6.40E-03	1.80E-02	1.69E-02	1.77E-02	1.98E-02
Nb-95	–	–	–	–	–	–	–	–	1.34E-02	6.48E-02	1.34E-02
Pb-212	–	–	–	–	–	–	–	–	8.38E-01	9.59E-02	8.38E-01
Pb-214	–	–	–	–	–	–	–	–	6.92E-01	1.00E-01	6.92E-01
Pu-238	–	–	–	–	<2.00E-04	2.90E-04	<-3.20E-05	4.00E-04	–	–	-3.20E-05
Pu-239	–	–	–	–	6.00E-03	1.40E-03	4.30E-03	1.60E-03	–	–	4.30E-03
Ru-106	–	–	–	–	<7.90E-02	1.60E-01	<6.20E-02	2.00E-01	-1.45E-01	1.82E-01	-1.33E-03
Sr-90	–	–	1.65E+00	3.06E-01	1.90E+00	4.70E-01	1.10E+00	2.10E-01	–	–	1.55E+00
U (total)	–	–	–	–	2.80E-01	1.30E-01	8.70E-02	3.50E-02	–	–	8.70E-02
Zn-65	–	–	–	–	<-3.60E-02	3.40E-02	–	–	-6.85E-02	4.72E-02	-5.23E-02
Zr-95	–	–	–	–	4.80E-03	2.40E-02	<3.50E-03	3.40E-02	-3.64E-03	5.38E-02	1.55E-03

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location B-TF-NE											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<1.60E-02	5.40E-02	<-8.00E-02	1.30E-01	-5.08E-02	3.48E-02	-3.83E-02
Ce-144	–	–	–	–	<-5.80E-02	1.80E-01	–	–	1.51E-01	4.52E-01	4.65E-02
Co-58	*	–	–	–	1.20E-02	1.10E-02	–	–	-5.39E-03	2.82E-02	3.31E-03
Co-60	*	–	–	–	1.80E-02	1.20E-02			1.48E-02	1.81E-02	1.64E-02
Cs-134	*	–	–	–	<1.30E-02	1.80E-02	<9.70E-03	8.80E-02	-5.51E-02	6.18E-02	-1.08E-02
Cs-137	8.10E+01	–	–	–	2.80E+01	2.80E+00	1.90E+02	1.90E+01	2.00E+02	2.00E+01	1.57E+02
Eu-152	*	–	–	–	<1.20E-02	7.40E-02	1.20E-01	9.00E-02	-3.54E-02	7.42E-02	4.23E-02
Eu-154	*	–	–	–	<01.10E-02	5.10E-02	<-1.20E-01	7.00E-02	-1.04E-02	5.25E-02	-4.71E-02
Eu-155	*	–	–	–	<2.50E-02	1.00E-01	<2.10E-01	3.00E-01	4.69E-02	2.10E-01	9.40E-02
K-40	–	–	–	–	–	–	–	–	1.39E+01	1.57E+00	1.39E+01
Mn-54	*	–	–	–	1.10E-02	1.10E-02	<1.60E-O2	2.20E-02	-9.63E-03	1.89E-02	5.79E-03
Nb-95	*	–	–	–	–	–	–	–	-3.71E-02	6.65E-02	-3.71E-02
Pb-212	–	–	–	–	–	–	–	–	4.31E-01	1.43E-01	4.31E-01
Pb-214	–	–	–	–	–	–	–	–	5.57E-01	2.14E-01	5.57E-01
Pu-238	*	–	–	–	<1.80E-04	4.60E-04	2.60E-04	1.60E-04	–	–	2.60E-04
Pu-239	*	–	–	–	9.90E-03	2.10E-03	7.40E-03	1.10E-03	–	–	7.40E-03
Ru-106	*	–	4.44E-01	3.79E-01	<-5.30E-02	2.60E-01	<-4.40E-01	9.50E-01	-3.98E-01	6.59E-01	-1.12E-01
Sr-90	1.00E+01	–	5.75E+00	1.03E+00	8.20E+00	2.00E+00	6.30E+00	1.20E+00	–	–	7.56E+00
U(total)	*	–	–	–	5.50E-02	3.90E-02	3.20E-01	1.00E-01	–	–	3.20E-01
Zn-65	*	–	–	–	<-1.50E-02	3.70E-02	–	–	-7.63E-02	4.85E-02	-4.57E-02
Zr-95	*	–	6.30E-02	5.40E-02	<-3.10E-02	2.90E-02	<1.20E-02	4.10E-02	7.64E-02	6.37E-02	2.41E-02

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location B-TF-SE											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	5.20E-02	4.70E-02	<-4.40E-03	5.20E-02	-6.96E-02	7.72E-02	-7.33E-03
Ce-144	–	–	–	–	<-1.90E-02	1.60E-01	–	–	-6.61E-02	9.82E-02	-4.26E-02
Co-58	*	–	–	–	<7.20E-03	1.40E-02	–	–	7.19E-03	2.47E-02	7.20E-03
Co-60	*	–	1.80E-02	1.70E-02	2.40E-02	1.30E-02	–	–	-1.39E-02	1.82E-02	9.37E-03
Cs-134	*	–	–	–	2.20E-02	2.10E-02	<-4.30E-03	2.90E-02	-3.67E-02	1.61E-02	-6.33E-03
Cs-137	1.08E+01	7.43E-01	–	–	1.40E+01	1.40E+00	3.80E+01	3.80E+00	4.76E-01	6.04E-02	1.64E+01
Eu-152	*	–	–	–	<2.20E-03	7.30E-02	<3.50E-02	6.80E-02	-5.40E-03	8.24E-02	1.48E-02
Eu-154	1.43E-01	8.30E-02	–	–	<-2.50E-03	4.60E-02	7.20E-02	4.30E-02	-1.57E-02	5.65E-02	4.92E-02
Eu-155	*	–	–	–	<7.50E-02	9.30E-02	<4.20E-02	1.10E-01	1.88E-02	5.57E-02	4.53E-02
K-40	–	–	–	–	–	–	–	–	1.43E+01	1.61E+00	1.43E+01
Mn-54	*	–	2.30E-02	1.70E-02	<3.40E-03	1.50E-02	<1.20E-03	1.30E-02	1.24E-03	1.89E-02	7.21E-03
Nb-95	*	–	–	–	–	–	–	–	-4.84E-02	6.28E-02	-4.84E-02
Pb-212	–	–	–	–	–	–	–	–	6.78E-01	7.95E-02	6.78E-01
Pb-214	–	–	–	–	–	–	–	–	5.84E-01	8.19E-02	5.84E-01
Pu-238	3.00E-04	2.00E-04	–	–	<6.30E-05	2.70E-04	4.50E-04	3.30E-04	–	–	3.75E-04
Pu-239	6.00E-03	7.00E-03	–	–	5.50E-03	1.30E-03	1.30E-02	2.30E-03	–	–	9.50E-03
Ru-106	*	–	–	–	<-7.00E-02	2.00E-01	<-1.90E-01	2.80E-01	9.21E-02	1.35E-01	-5.60E-02
Sr-90	7.12E+00	1.29E+00	3.30E+00	5.99E-01	6.40E+00	1.60E+00	1.10E+01	2.10E+00	–	–	6.96E+-00
U (total)	1.84E-01	6.80E-02	–	–	1.30E-01	6.70E-02	6.00E-02	2.80E-02	–	–	1.22E-01
Zn-65	*	–	–	–	5.60E-02	3.10E-02	–	–	-8.34E-02	5.76E-02	-1.37E-02
Zr-95	*	–	–	–	3.80E-02	2.80E-02	<-2.20E-03	2.60E-02	9.32E-03	5.44E-02	1.50E-02

Table A-2.1. Results of Fenceline Soil Sampling (pCi/g).

Location BX-TF-W											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<-2.60E-02	5.10E-02	<6.50E-03	3.00E-02	2.54E-02	1.17E-01	1.97E-03
Ce-144	–	–	–	–	<1.10E-01	1.70E-01	–	–	-1.22E-01	1.54E-01	-6.00E-03
Co-58	*	–	–	–	<-2.10E-02	1.60E-02	–	–	-2.03E-02	2.74E-02	-2.07E-02
Co-60	*	–	–	–	<-2.20E-02	1.80E-02	–	–	3.40E-03	1.74E-02	-9.30E-03
Cs-134	*	–	–	–	4.50E-02	2.10E-02	<-4.70E-02	1.90E-02	1.45E-02	1.93E-02	4.17E-03
Cs-137	2.43E+00	2.20E-01	–	–	2.30E+01	2.30E+00	2.50E+00	2.70E-01	9.17E+00	9.30E-01	4.70E+00
Eu-152	*	–	–	–	1.90E-01	5.70E-02	1.30E-01	8.20E-02	4.10E-02	7.70E-02	8.55E-02
Eu-154	*	–	–	–	<1.10E-02	4.50E-02	<-4.90E-02	6.00E-02	-4.86E-02	5.74E-02	-2.89E-02
Eu-155	*	–	–	–	<7.00E-04	9.30E-02	<-5.40E-03	7.10E-02	4.80E-02	7.87E-02	1.44E-02
K-40	–	–	–	–	–	–	–	–	1.33E+01	1.53E+00	1.33E+01
Mn-54	*	–	–	–	<-2.80E-03	1.60E-02	<1.00E-02	1.60E-02	1.55E-02	1.83E-02	7.57E-03
Nb-95	*	–	–	–	–	–	–	–	-6.80E-02	6.69E-02	-6.80E-02
Pb-212	–	–	–	–	–	–	–	–	5.89E-01	7.79E-02	5.89E-01
Pb-214	–	–	–	–	–	–	–	–	5.62E-01	9.21E-02	5.62E-01
Pu-238	2.00E-04	2.00E-04	–	–	<-1.00E-04	2.20E-04	2.70E-04	1.60E-04	–	–	2.35E-04
Pu-239	4.00E-03	1.00E-03	–	–	2.70E-03	9.60E-04	5.90E-03	9.00E-04	–	–	4.95E-03
Ru-106	*	–	–	–	<-8.60E-02	2.30E-01	<4.00E-02	1.60E-01	-1.70E-02	2.03E-01	-2.10E-02
Sr-90	1.37E-01	3.00E-02	–	–	2.70E-01	7.20E-02	4.00E-01	7.80E-02	–	–	2.69E-01
U (total)	2.64E-01	9.10E-02	–	–	3.30E-01	1.60E-01	4.00E-01	1.20E-01	–	–	3.32E-01
Zn-65	1.40E-01	6.00E-02	–	–	<-4.00E-02	3.90E-02	–	–	-1.03E-02	4.58E-02	2.99E-02
Zr-95	*	–	–	–	<-3.80E-02	2.80E-02	<1.50E-02	3.10E-02	1.29E-02	5.15E-02	-3.37E-03

Source: Schmidt et al. 1990: Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E1											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-7.70E-03	6.50E-02	–	–	-7.70E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	<-7.30E-03	1.60E-02	<3.50E-03	1.70E-02	–	–	-1.90E-03
Cs-134	–	–	–	–	4.30E-02	1.60E-02	–	–	–	–	4.30E-02
Cs-137	1.64E-02	1.06E-01	–	–	1.60E-01	2.60E-02	9.30E-02	2.40E-02	–	–	8.98E-02
Eu-152	*	–	–	–	<4.20E-02	6.50E-02	<6.60E-02	7.40E-02	–	–	5.40E-02
Eu-154	*	–	–	–	<8.20E-03	4.80E-02	5.40E-02	5.30E-02	–	–	3.11E-02
Eu-155	*	–	–	–	<9.60E-03	3.50E-02	<2.80E-02	4.20E-02	–	–	1.88E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	–	–	–	–	–	–	–
Nb-95	2.03E-02	1.46E-02	–	–	3.00E-02	1.90E-02	<-2.50E-02	6.20E-02	–	–	8.43E-03
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	4.00E-04	3.00E-04	–	–	–	–	–	–	–	–	4.00E-04
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	2.15E-01	6.58E-02	–	–	–	–	–	–	–	–	2.15E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	<-1.30E-02	3.00E-02	<2.50E-02	5.60E-02	–	–	6.00E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E2											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-7.70E-03	6.60E-02	–	–	-7.70E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	2.82E-02	1.52E-02	–	–	–	–	<8.70E-03	1.50E-02	–	–	1.85E-02
Cs-134	–	–	9.86E-02	4.46E-02	–	–	6.10E-02	1.60E-02	–	–	7.98E-02
Cs-137	1.58E-01	2.47E-02	1.78E-01	5.11E-02	–	–	5.70E-01	6.50E-02	–	–	3.02E-01
Eu-152	6.76E-02	5.95E-02	–	–	–	–	<6.20E-02	6.40E-02	–	–	6.48E-02
Eu-154	*	–	–	–	–	–	<4.10E-02	4.60E-02	–	–	4.10E-02
Eu-155	*	–	–	–	–	–	<6.20E-03	3.60E-02	–	–	6.20E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	6.00E-02	5.30E-02	–	–	6.00E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	3.04E-01	2.86E-01	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<3.50E-02	4.70E-02	–	–	3.50E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E3											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	2.61E+00	3.61E-01	–
Ce-141	–	–	–	–	–	–	<-2.30E-02	6.40E-02	-1.27E-02	2.18E-02	-1.79E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	<1.30E-02	1.40E-02	<3.50E-03	1.70E-02	5.09E-02	2.25E-02	2.25E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	5.07E-01	5.49E-01	–	–	4.20E-01	5.10E-02	4.60E-01	5.40E-02	4.64E-01	5.86E-02	4.63E-01
Eu-152	*	–	–	–	<-3.30E-02	6.10E-02	<-3.30E-02	7.40E-02	-5.63E-03	8.07E-02	-2.39E-02
Eu-154	*	–	–	–	<-3.80E-02	4.70E-02	<3.10E-02	5.50E-02	3.80E-02	5.79E-02	1.03E-02
Eu-155	*	–	–	–	<1.80E-01	3.10E-02	<3.20E-04	3.80E-02	-9.08E-03	4.17E-02	5.71E-02
I-129	–	–	–	–	–	–	–	–	-2.29E-01	3.22E-01	-2.29E-01
K-40	–	–	–	–	–	–	–	–	1.10E+01	1.30E+00	1.10E+01
Nb-95	*	–	–	–	<-2.70E-02	1.90E-02	<-2.50E-02	6.20E-02	-1.52E-02	2.17E-02	-2.24E-02
Pb-212	–	–	–	–	–	–	–	–	-4.25E-01	3.25E-02	-4.25E-01
Pb-214	–	–	–	–	–	–	–	–	5.33E-02	3.22E-02	5.33E-02
Pu-238	*	–	–	–	–	–	–	–	1.22E-04	1.45E-04	1.22E-04
Pu-239	*	–	–	–	–	–	–	–	7.26E-04	3.17E-04	7.26E-04
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	2.48E-01	4.92E-02	2.48E-01
Tc-99	–	–	–	–	–	–	–	–	6.07E-01	1.14E+00	6.07E-01
Zr-95	*	–	–	–	<-4.00E-03	2.50E-02	<2.50E-02	5.60E-02	-6.30E-03	3.02E-02	6.79E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E7											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-5.20E-02	6.80E-02	–	–	-5.20E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-3.10E-03	1.70E-02	–	–	-3.10E-03
Cs-134	–	–	–	–	–	–					
Cs-137	*	–	–	–	–	–	8.60E-01	2.50E-02	–	–	8.60E-02
Eu-152	*	–	–	–	–	–	<-2.30E-02	8.50E-02	–	–	-2.30E-02
Eu-154	*	–	–	–	–	–	<7.10E-02	5.80E-02	–	–	-7.10E-02
Eu-155	*	–	–	–	–	–	<-2.20E-03	4.30E-02	–	–	-2.20E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<6.24E-04	6.40E-02	–	–	6.24E-04
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<-3.70E-02	6.00E-02	–	–	-3.70E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E8											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	1.77E+00	2.51E-01	–
Ce-141	–	–	–	–	–	–	<-2.00E-02	7.60E-02	-1.08E-02	1.77E-02	-1.54E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<6.70E-03	1.60E-02	2.04E-02	1.40E-02	1.36E-02
Cs-134	–	–	1.45E-01	3.70E-02	–	–	–	–	–	–	1.45E-01
Cs-137	2.86E-02	2.10E-02	3.66E-01	5.78E-02	–	–	7.00E-02	2.00E-02	6.33E-02	1.97E-02	1.32E-01
Eu-152	2.02E-01	7.84E-02	1.08E-01	9.78E-02	–	–	<2.10E-02	6.50E-02	8.22E-03	6.13E-02	8.48E-02
Eu-154	7.10E-02	6.20E-02	–	–	–	–	<3.30E-02	5.80E-02	2.21E-02	4.44E-02	1.34E-02
Eu-155	1.13E-01	6.40E-02	–	–	–	–	<1.60E-02	3.90E-03	2.59E-02	3.00E-02	5.16E-02
I-129	–	–	–	–	–	–	–	–	6.43E-01	2.28E-01	6.43E-02
K-40	–	–	–	–	–	–	–	–	1.09E+01	1.26E+00	1.09E+01
Nb-95	3.03E-02	2.25E-02	–	–	–	–	<1.30E-02	5.00E-02	7.69E-02	1.78E-03	1.70E-02
Pb-212	–	–	–	–	–	–	–	–	5.21E-02	1.80E-02	5.21E-02
Pb-214	–	–	–	–	–	–	–	–	3.91E-02	2.69E-02	3.91E-02
Pu-238	–	–	–	–	–	–	–	–	9.34E-05	1.04E-04	9.34E-05
Pu-239	–	–	–	–	–	–	–	–	1.80E-03	5.01E-04	1.80E-03
Ru-103	*	–	1.94E-01	9.74E-02	–	–	–	–	–	–	1.94E-01
Ru-106	*	–	4.94E-01	2.73E-01	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	5.50E-02	1.30E-02	3.12E-02	7.86E-03	4.31E-02
Tc-99	–	–	–	–	–	–	–	–	8.03E-02	1.10E+00	8.03E-02
Zr-95	*	–	–	–	–	–	<-2.90E-02	5.00E-02	1.78E-03	2.60E-02	-1.36E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E9											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	1.77E+00	2.51E-01	–
Ce-141	–	–	–	–	–	–	<2.30E-02	7.10E-02	-1.08E-02	1.77E-02	6.10E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	3.52E-02	3.10E-02	–	–	–	–	<-8.80E-03	1.80E-02	2.04E-02	1.40E-01	1.56E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	2.24E-01	4.29E-02	2.15E-01	4.72E-02	–	–	4.00E-01	5.20E-02	6.33E-02	1.97E-02	2.26E-01
Eu-152	1.72E-01	1.13E-01	–	–	–	–	<1.20E-02	7.10E-02	8.22E-03	6.13E-02	6.41E-02
Eu-154	*	–	–	–	–	–	<3.10E-02	5.30E-02	2.21E-03	4.44E-02	1.66E-02
Eu-155	*	–	–	–	–	–	<3.90E-02	4.20E-02	2.59E-02	3.00E-02	3.25E-02
I-129	–	–	–	–	–	–	<2.60E-01	4.10E-01	6.43E-01	2.28E-01	1.62E-01
K-40	–	–	–	–	–	–	–	–	1.09E+01	1.26E+00	1.09E+01
Nb-95	*	–	–	–	–	–	<-1.50E-02	6.30E-02	7.69E-03	1.78E-02	-3.66E-03
Pb-212	–	–	–	–	–	–	–	–	5.21E-02	1.80E-02	5.21E-02
Pb-214	–	–	–	–	–	–	–	–	3.91E-02	2.69E-02	3.91E-02
Pu-238	*	–	–	–	–	–	<-1.50E-05	3.90E-05	9.34E-05	1.04E-04	3.92E-05
Pu-239	*	–	–	–	–	–	1.70E-03	6.00E-04	1.80E-03	5.01E-04	1.75E-03
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	8.00E-01	1.50E-01	3.12E-02	7.86E-03	4.16E-01
Tc-99	–	–	–	–	–	–	<6.40E-01	2.90E+00	8.03E-02	1.10E-+00	3.60E-01
Zr-95	*	–	–	–	–	–	<-2.80E-04	5.80E-02	1.78E-03	2.60E-02	7.50E-04

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E13											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	3.02E+00	4.09E-01	–
Ce-141	–	–	–	–	–	–	<2.10E-03	9.70E-02	-1.25E-02	2.02E-02	-5.20E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<3.90E-03	2.20E-02	3.58E-03	1.96E-02	3.74E-03
Cs-134	–	–	1.19E-01	3.16E-02	–	–	–	–	–	–	1.19E-01
Cs-137	3.38E-02	1.22E-02	2.59E-01	4.44E-02	–	–	3.60E-02	2.50E-02	9.90E+01	2.31E-02	2.48E+01
Eu-152	*	–	1.20E-01	7.65E-02	–	–	<4.20E-02	8.90E-02	2.52E-02	6.82E-02	6.24E-02
Eu-154	*	–	–	–	–	–	<-2.80E-02	7.50E-02	8.52E-03	6.03E-02	-9.74E-03
Eu-155	*	–	–	–	–	–	<-7.90E-03	6.30E-02	-1.07E-02	4.19E-02	-9.30E-03
I-129	–	–	–	–	–	–	–	–	1.29E-01	1.69E-01	1.29E-01
K-40	–	–	–	–	–	–	–	–	1.27E+01	1.46E+00	1.27E+01
Nb-95	1.67E-02	1.32E-02	–	–	–	–	<1.80E-02	6.90E-02	1.66E-02	2.05E-02	1.71E-02
Pb-212	–	–	–	–	–	–	–	–	6.24E-02	3.29E-02	6.24E-02
Pb-214	–	–	–	–	–	–	–	–	7.09E-02	3.08E-02	7.09E-02
Pu-238	*	–	–	–	–	–	–	–	2.20E-03	6.71E-04	2.20E-03
Pu-239	*	–	–	–	–	–	–	–	5.79E-03	1.19E-03	5.79E-03
Ru-103	*	–	1.75E-01	7.12E-02	–	–	–	–	–	–	1.75E-01
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	1.21E-01	2.42E-02	1.21E-01
Tc-99	–	–	–	–	–	–	–	–	4.26E-01	1.12E+00	4.26E-01
Zr-95	3.06E-02	2.00E-02	–	–	–	–	<6.10E-03	6.70E-02	-6.54E-03	2.84E-02	1.01E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E14											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	3.02E+00	4.09E-01	–
Ce-141	–	–	–	–	–	–	<-1.60E-02	5.80E-02	-1.25E-02	2.02E-02	-1.43E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	4.72E-02	2.49E-02	–	–	<-4.20E-03	1.40E-02	<8.10E-04	1.70E-02	3.58E-03	1.96E-02	1.18E-02
Cs-134	–	–	3.91E-02	2.45E-02	–	–	–	–	–	–	3.91E-02
Cs-137	6.04E-01	5.95E-02	9.48E-01	2.98E-02	8.20E-01	9.30E-02	8.70E-02	1.90E-02	9.90E-02	2.31E-02	5.12E-01
Eu-152	*	–	–	–	<2.40E-02	7.30E-02	<4.30E-02	6.20E-02	2.52E-02	6.82E-02	3.07E-02
Eu-154	*	–	–	–	<1.20E-02	4.30E-02	<1.70E-02	4.90E-02	8.52E-03	6.03E-02	1.25E-02
Eu-155	*	–	–	–	<1.90E-03	4.00E-02	<1.30E-02	4.00E-02	-1.07E-02	4.19E-02	1.40E-03
I-129	–	–	–	–	<5.80E-02	3.20E-01	<3.30E-02	3.60E-01	1.20E-01	1.69E-01	3.17E-02
K-40	–	–	–	–	–	–	–	–	1.27E+01	1.46E+00	1.27E+01
Nb-95	*	–	–	–	<-1.90E-02	2.40E-02	<1.30E-02	4.70E-02	1.66E-02	2.05E-02	3.53E-03
Pb-212	–	–	–	–	–	–	–	–	6.24E-02	3.29E-02	6.24E-02
Pb-214	–	–	–	–	–	–	–	–	7.09E-02	3.08E-02	7.09E-02
Pu-238	*	–	–	–	–	–	–	–	2.20E-03	6.71E-04	2.20E-03
Pu-239	*	–	–	–	–	–	–	–	5.79E-03	1.19E-03	5.79E-03
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	6.34E-01	1.89E-01	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	2.20E-02	8.50E-03	1.21E-01	2.42E-02	7.15E-02
Tc-99	–	–	–	–	<3.10E-01	8.50E-01	–	–	4.26E-01	1.12E+00	3.68E-01
Zr-95	*	–	–	–	3.70E-02	2.50E-02	<5.20E-03	4.50E-02	-6.54E-03	2.84E-02	1.19E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E15											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<3.50E-02	6.20E-02	–	–	3.50E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-1.40E-03	1.30E-02	–	–	-1.40E-03
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	1.95E-01	3.28E-02	1.12E-01	4.94E-02	–	–	2.20E-01	3.10E-02	–	–	1.76E-01
Eu-152	*	–	–	–	–	–	<5.70E-02	6.00E-02	–	–	5.70E-02
Eu-154	*	–	–	–	–	–	<-8.90E-03	3.80E-02	–	–	-8.90E-03
Eu-155	6.16E-02	5.73E-02	–	–	–	–	<9.80E-03	3.90E-02	–	–	3.57E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<1.50E-02	4.70E-02	–	–	1.50E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	1.04E-01	1.02E-01	–	–	–	–	–	–	1.04E-01
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<-7.10E-02	4.10E-02	–	–	-7.10E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E19											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-2.10E-02	5.40E-02	–	–	-2.10E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	<7.30E-03	1.70E-02	2.00E-02	1.60E-02	–	–	1.37E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	7.82E-02	2.74E-02	–	–	2.50E-02	1.10E-01	2.70E-02	1.40E-02	–	–	4.34E-02
Eu-152	*	–	–	–	<-2.20E-02	7.30E-02	<2.60E-02	7.20E-02	–	–	2.00E-03
Eu-154	*	–	–	–	5.80E-02	5.10E-02	<3.80E-02	5.30E-02	–	–	4.80E-02
Eu-155	1.82E-01	7.08E-02	–	–	<9.70E-03	4.00E-02	<-1.00E-02	3.40E-02	–	–	6.06E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	<-1.30E-02	2.70E-02	<7.20E-03	5.40E-02	–	–	-2.90E-03
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	-	1.70E-01	3.50E-02	–	–	1.70E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	<2.70E-02	3.30E-02	<2.60E-03	5.20E-02	–	–	1.48E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E20											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	2.10E+00	3.56E-01	–
Ce-141	–	–	–	–	–	–	<-1.40E-02	6.10E-02	-1.63E-02	2.76E-02	-1.52E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-1.30E-02	1.70E-02	-4.36E-03	1.95E-02	-8.68E-03
Cs-134	–	–	6.10E-01	1.11E-01	–	–	–	–	–	–	6.10E-01
Cs-137	6.63E-02	1.91E-02	8.24E-01	1.38E-01	–	–	1.70E-01	2.80E-02	1.67E-02	3.11E-02	3.07E-01
Eu-152	*	–	–	–	–	–	<9.90E-03	7.30E-02	2.70E-02	7.84E-02	1.85E-02
Eu-154	*	–	–	–	–	–	<7.90E-03	4.90E-02	1.85E-02	6.11E-02	1.32E-02
Eu-155	*	–	–	–	–	–	<1.40E-02	3.70E-02	-4.61E-03	5.07E-02	4.70E-03
I-129	–	–	–	–	–	–	–	–	3.21E-01	2.30E-01	3.21E-01
K-40	–	–	–	–	–	–	–	–	1.04E+01	1.24E+00	1.04E+01
Nb-95	*	–	2.68E-01	1.68E-01	–	–	<4.90E-02	5.60E-02	-8.40E-04	2.63E-02	1.05E-01
Pb-212	–	–	–	–	–	–	–	–	1.10E-01	3.78E-02	1.10E-01
Pb-214	–	–	–	–	–	–	–	–	6.68E-02	3.26E-02	6.68E-02
Pu-238	*	–	–	–	–	–	–	–	1.47E-04	1.44E-04	1.47E-04
Pu-239	*	–	–	–	–	–	–	–	3.17E-03	7.56E-04	3.17E-03
Ru-103	*	–	2.46E-01	1.51E-01	–	–	–	–	–	–	2.46E-01
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	2.80E-01	5.40E-02	2.41E-01	4.87E-02	2.61E-01
Tc-99	–	–	–	–	–	–	–	–	9.33E-01	1.22E+00	9.33E-01
Zr-95	*	–	–	–	–	–	<1.10E-02	5.00E-02	-1.30E-02	3.76E-02	-1.00E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E21											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<2.60E-02	5.50E-02	–	–	2.60E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	1.87E-02	1.20E-02	–	–	–	–	<1.10E-02	1.30E-02	–	–	1.49E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	9.12E-02	1.29E-02	–	–	–	–	1.70E-01	2.50E-02	–	–	1.31E-01
Eu-152	*	–	–	–	–	–	<3.40E-02	5.90E-02	–	–	3.40E-02
Eu-154	*	–	–	–	–	–	<-1.60E-02	4.40E-02	–	–	-1.60E-02
Eu-155	*	–	–	–	–	–	<-6.50E-03	3.20E-02	–	–	-6.50E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<2.80E-03	4.60E-02	–	–	2.80E-03
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	3.95E-02	1.43E-02	–	–	–	–	–	–	–	–	3.95E-02
Ru-106	3.70E-01	1.00E-01	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<1.50E-02	4.60E-02	–	–	1.50E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E25											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-3.20E-03	7.80E-02	–	–	-3.20E-03
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-1.70E-02	1.80E-02	–	–	-1.70E-02
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	9.29E-02	4.04E-02	–	–	–	–	2.20E-01	3.50E-02	–	–	1.56E-01
Eu-152	*	–	–	–	–	–	<3.40E-02	8.00E-02	–	–	3.40E-02
Eu-154	*	–	–	–	–	–	<2.40E-02	5.70E-02	–	–	2.40E-02
Eu-155	1.18E-01	9.90E-02	–	–	–	–	<-8.50E-04	5.30E-02	–	–	5.86E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<2.30E-02	6.10E-02	–	–	2.30E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	7.94E-02	7.25E-02	–	–	–	–	<-1.30-02	5.80E-02	–	–	3.32E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E26											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<3.00E-02	7.70E-02	–	–	3.00E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	–	–	–	–	–	–	<-1.80E-03	1.90E-02	–	–	-1.80E-03
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	–	–	–	–	–	–	9.60E-02	2.20E-02	–	–	9.60E-02
Eu-152	–	–	–	–	–	–	6.30E-02	6.20E-02	–	–	6.30E-02
Eu-154	–	–	–	–	–	–	<1.30E-02	5.40E-02	–	–	1.30E-02
Eu-155	–	–	–	–	–	–	<3.70E-02	4.50E-02	–	–	3.70E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	–	–	–	–	–	–	<2.90E-02	6.00E-02	–	–	2.90E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	–	–	–	–	–	–	–	–	–	–	–
Pu-239	–	–	–	–	–	–	–	–	–	–	–
Ru-103	–	–	–	–	–	–	–	–	–	–	–
Ru-106	–	–	–	–	–	–	–	–	–	–	–
Sr-90	–	–	–	–	–	–	4.90E-02	1.20E-02	–	–	4.90E-02
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	–	–	–	–	–	–	<1.10E-02	5.10E-02	–	–	1.10E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E27											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-8.40E-02	7.60E-02	–	–	-8.40E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<1.10E-02	1.90E-02	–	–	1.10E-02
Cs-134	–	–	5.60E-02	2.87E-02	–	–	–	–	–	–	5.60E-02
Cs-137	2.69E-01	7.94E-02	6.94E-02	2.98E-02	–	–	8.00E-02	2.40E-02	–	–	1.39E-01
Eu-152	*	–	–	–	–	–	<3.10E-02	7.00E-02	–	–	3.10E-02
Eu-154	*	–	–	–	–	–	<-6.30E-03	5.30E-02	–	–	-6.30E-03
Eu-155	*	–	–	–	–	–	<2.60E-02	4.60E-02	–	–	2.60E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<-1.30E-02	6.60E-02	–	–	-1.30E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	8.95E-02	7.47E-02	–	–	–	–	–	–	8.95E-02
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	–	–	–	–	–
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<4.90E-02	6.00E-02	–	–	4.90E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E31											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<3.50E-02	7.00E-02	–	–	3.50E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<-5.60E-03	1.90E-02	–	–	-5.60E-03
Cs-134	–	–	2.32E-01	4.97E-02	–	–	–	–	–	–	2.32E-01
Cs-137	7.56E-02	3.86E-02	4.71E-01	7.22E-02	–	–	2.90E-02	1.60E-02	–	–	1.92E-01
Eu-152	1.57E-01	1.22E-01	–	–	–	–	<2.80E-02	6.90E-02	–	–	9.25E-02
Eu-154	*	–	–	–	–	–	<4.90E-02	5.90E-02	–	–	4.90E-02
Eu-155	*	–	–	–	–	–	<3.30E-03	4.90E-02	–	–	3.30E-03
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	*	–	–	–	–	–	<-5.10E-02	6.00E-02	–	–	-5.10E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	1.70E-03	6.00E-04	–	–	–	–	–	–	–	–	1.70E-03
Ru-103	*	–	2.06E-01	9.28E-02	–	–	–	–	–	–	2.06E-01
Ru-106	*	–	4.35E-01	2.34E-01	–	–	–	–	–	–	–
Sr-90	7.87E-01	1.68E-01	1.21E-01	4.12E-02	–	–	–	–	–	–	4.54E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	1.02E-01	8.45E-02	–	–	<2.50E-02	5.10E-02	–	–	6.35E-02

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E32											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	--	--	--	--	--	--	--	--	--	--	--
Ce-141	--	--	--	--	--	--	<-8.60E-03	7.40E-02	--	--	-8.60E-03
Co-58	--	--	--	--	--	--	--	--	--	--	--
Co-60	*	--	--	--	--	--	<-8.40E-03	2.00E-02	--	--	-8.40E-03
Cs-134	--	--	3.13E-01	7.60E-02	--	--	--	--	--	--	3.13E-01
Cs-137	6.58E-02	3.80E-02	5.62E-01	9.43E-02	--	--	1.30E-01	2.80E-02	--	--	2.54E-01
Eu-152	*	--	--	--	--	--	<-6.50E-02	9.20E-02	--	--	-6.50E-02
Eu-154	*	--	--	--	--	--	<6.70E-03	6.50E-02	--	--	6.70E-03
Eu-155	*	--	--	--	--	--	<1.80E-02	4.70E-02	--	--	1.80E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Nb-95	*	--	--	--	--	--	<-2.20E-02	6.30E-02	--	--	-2.20E-02
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	--	--	--	--	--
Pu-238	*	--	--	--	--	--	--	--	--	--	--
Pu-239	*	--	--	--	--	--	--	--	--	--	--
Ru-103	*	--	1.90E-01	1.21E-01	--	--	--	--	--	--	1.90E-01
Ru-106	*		4.90E-01	3.03E-01	--	--	--	--	--	--	--
Sr-90	*	--	--	--	--	--	--	--	--	--	--
Tc-99	--	--	--	--	--	--	--	--	--	--	--
Zr-95	*	--	--	--	--	--	<-2.70E-03	5.60E-02	--	--	-2.70E-03

Table A-2.2. Results of Vegetation Soil Sampling (pCi/g).

Location 2E33											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Be-7	–	–	–	–	–	–	–	–	–	–	–
Ce-141	–	–	–	–	–	–	<-5.20E-02	9.60E-02	–	–	-5.20E-02
Co-58	–	–	–	–	–	–	–	–	–	–	–
Co-60	*	–	–	–	–	–	<4.60E-03	2.20E-02	–	–	4.60E-03
Cs-134	–	–	–	–	–	–	–	–	–	–	–
Cs-137	6.92E-02	2.97E-02	–	–	–	–	1.30E-01	4.10E-02	–	–	9.96E-02
Eu-152	*	–	–	–	–	–	<3.30E-02	1.10E-01	–	–	3.30E-02
Eu-154	*	–	–	–	–	–	<-1.80E-02	7.90E-02	–	–	-1.80E-02
Eu-155	*	–	–	–	–	–	<5.20E-02	6.60E-02	–	–	5.20E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Nb-95	–	–	–	–	–	–	<-2.60E-02	9.00E-02	–	–	-2.60E-02
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	–	–	–	–	–
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	*	–	–	–	–	–	–	–	–	–	–
Ru-103	*	–	–	–	–	–	–	–	–	–	–
Ru-106	*	–	–	–	–	–	–	–	–	–	–
Sr-90	*	–	–	–	–	–	1.80E-01	3.40E-02	–	–	1.80E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
Zr-95	*	–	–	–	–	–	<-2.90E-02	8.40E-02	–	–	-2.90E-02

Source: Schmidt et al. 1990; Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E1											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<-9.40E-03	3.00E-02	–	–	–	–	-9.40E-03
Ce-144	–	–	–	–	<-1.30E-02	9.00E-02	<-4.30E-02	1.10E-01	–	–	-2.80E-02
Co-58	–	–	–	–	<3.40E-03	1.50E-02	<-9.30E-03	1.80E-02	–	–	-2.95E-03
Co-60	–	–	–	–	<-8.00E-03	1.60E-02	<-3.70E-03	1.80E-02	–	–	-5.85E-03
Cs-134	–	–	–	–	3.70E-02	1.90E-02	<-9.00E-02	2.40E-02	–	–	-2.65E-02
Cs-137	–	–	–	–	1.70E+00	1.80E-01	3.20E+00	3.30E-01	–	–	2.45E+00
Eu-152	–	–	–	–	1.00E-01	6.00E-02	9.30E-02	7.70E-02	–	–	9.65E-02
Eu-154	–	–	–	–	<-4.10E-02	5.00E-02	<-2.10E-02	5.80E-02	–	–	-3.10E-02
Eu-155	–	–	–	–	<2.40E-02	4.90E-02	<5.40E-02	6.70E-02	–	–	3.90E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	<8.60E-03	1.50E-02	1.80E-02	1.60E-02	–	–	1.33E-02
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	7.00E-01	9.80E-02	–	–	7.00E-01
Pu-238	–	–	–	–	4.70E-04	2.70E-04	3.60E-03	7.50E-04	–	–	2.04E-03
Pu-239	–	–	–	–	2.60E-02	3.20E-03	2.20E-01	2.40E-02	–	–	1.23E-01
Ru-106	–	–	–	–	<2.00E-02	1.30E-01	<-1.80E-01	1.70E-01	–	–	-8.00E-02
Sr-90	–	–	–	–	2.40E-01	6.10E-02	4.40E-01	8.30E-02	–	–	3.40E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	–	–	–	–	1.80E-01	5.50E-02	1.30E-01	4.70E-02	–	–	1.55E-01
Zn-65	–	–	–	–	<1.40E-02	3.10E-02	<-8.20E-02	4.70E-02	–	–	-3.40E-02
Zr-95	–	–	–	–	<-9.00E-03	3.30E-02	<2.70E-02	3.40E-02	–	–	9.00E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E2											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<2.10E-04	8.60E-02	–	–	-2.10E-04
Co-58	*	–	3.00E-02	2.00E-02	–	–	<4.70E-03	1.70E-02	–	–	1.74E-02
Co-60	*	–	–	–	–	–	1.80E-02	1.70E-02	–	–	1.80E-02
Cs-134	8.20E-02	4.30E-02	5.00E-02	3.00E-02	–	–	<-1.20E-02	1.30E-02	–	–	4.00E-02
Cs-137	6.80E+00	4.61E-01	1.10E-01	3.00E-02	–	–	2.50E-01	3.70E-02	–	–	2.39E+00
Eu-152	*	–	2.10E-01	9.00E-02	–	–	<5.00E-02	7.40E-02	–	–	1.30E-01
Eu-154	*	–	1.10E-01	6.00E-02	–	–	<1.40E-02	5.70E-02	–	–	6.20E-02
Eu-155	*	–	1.00E-01	7.00E-02	–	–	6.70E-02	4.80E-02	–	–	8.35E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	4.00E-02	.200E-02	–	–	<6.00E-03	1.60E-02	–	–	2.30E-02
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	7.90E-01	9.70E-02	–	–	7.90E-01
Pu-238	1.50E-03	6.00E-04	–	–	–	–	<-1.60E-05	1.00E-04	–	–	7.42E-04
Pu-239	3.20E-02	4.00E-03	3.00E-03	1.00E-03	–	–	2.00E-03	5.60E-04	–	–	1.23E-02
Ru-106	*	–	–	–	–	–	<0.00E+00	1.30E-01	–	–	–
Sr-90	3.90E-01	8.30E-02	5.00E-02	2.00E-02	–	–	7.90E-02	1.70E-02	–	–	1.73E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	2.36E-01	8.30E-02	2.70E-01	9.00E-02	–	–	1.30E-01	4.70E-02	–	–	2.12E-01
Zn-65	*	–	–	–	–	–	<-1.20E-01	4.50E-02	–	–	-1.20E-01
Zr-95	*	–	–	–	–	–	<-7.30E-03	2.70E-02	–	–	-7.30E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E3											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<1.20E-03	4.80E-02	–	–	-5.06E-02	1.53E-01	-2.59E-02
Ce-144	–	–	–	–	<-5.10E-02	1.50E-01	<1.10E-01	1.60E-01	-1.68E-03	2.40E-01	1.91E-02
Co-58	*	–	–	–	<1.20E-02	1.70E-02	<-6.80E-03	1.60E-02	3.34E-03	3.06E-02	2.85E-03
Co-60	*	–	–	–	<3.00E-03	1.50E-02	<0.00E+00	1.60E-02	1.44E-02	1.87E-02	5.80E-03
Cs-134	5.20E-02	3.70E-02	–	–	4.80E-02	2.10E-02	<-9.70E-02	2.90E-02	-9.00E-03	3.59E-02	-1.50E-03
Cs-137	3.17E+01	1.90E+00	–	–	1.30E+01	1.03E+00	1.40E+01	1.40E+00	2.99E+01	3.00E+00	2.22E+01
Eu-152	*	–	–	–	<4.80E-02	6.90E-02	1.20E-01	8.30E-02	1.39E-01	1.02E-01	1.02E-01
Eu-154	8.30E-02	6.00E-02	–	–	<3.20E-02	4.70E-02	<-1.30E-02	6.60E-02	9.04E-03	6.95E-02	2.78E-02
Eu-155	–	–	–	–	<7.40E-02	8.20E-02	<8.20E-02	9.20E-02	1.65E-01	1.28E-01	1.07E-01
I-129	–	–	–	–	–	–	–	–	-1.68E+00	6.47E-01	-1.68E+00
K-40	–	–	–	–	–	–	–	–	1.52E+01	1.75E+00	1.52E+01
Mn-54	*	–	–	–	1.90E-02	1.70E-02	<1.60E-03	1.80E-02	1.83E-02	2.21E-02	1.30E-02
Nb-95	*	–	–	–	–	–	–	–	-4.12E-02	7.22E-02	-4.12E-02
Pb-212	–	–	–	–	–	–	–	–	8.84E-01	1.17E-01	8.84E-01
Pb-214	–	–	–	–	–	–	7.20E-01	1.30E-01	7.28E-01	1.32E-01	7.24E-01
Pu-238	9.00E-04	5.00E-04	–	–	<8.00E-04	4.20E-04	2.60E-04	2.00E-04	1.64E-03	4.31E-04	9.00E-04
Pu-239	3.60E-02	4.00E-03	–	–	2.30E-02	3.00E-03	2.10E-02	2.80E-03	4.21E-02	4.61E-03	3.05E-02
Ru-106	*	–	–	–	<1.50E-01	2.00E-01	<1.50E-01	2.40E-01	-8.59E-02	3.92E-01	7.14E-02
Sr-90	7.69E-01	1.47E-01	–	–	<7.80E-01	2.00E-01	9.60E-01	1.90E-01	1.13E+00	2.22E-01	9.10E-01
Tc-99	–	–	–	–	–	–	–	–	4.80E-01	1.08E+00	4.80E-01
U (total)	2.82E-01	9.60E-02	–	–	2.30E-01	7.10E-02	1.00E-01	4.10E-02	2.18E-01	7.12E-02	2.08E-01
Zn-65	*	–	–	–	<-3.60E-02	4.60E-02	<-9.20E-02	5.10E-02	-1.13-01	6.68E-02	-8.03E-02
Zr-95	*	–	–	–	<-2.30E-03	3.60E-02	<1.80E-02	3.10E-02	3.71E-04	5.97E-02	5.36E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E7											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<4.40E-02	1.00E-01	–	–	4.40E-02
Co-58	–	–	–	–	–	–	<8.00E-03	1.50E-02	–	–	8.00E-03
Co-60	–	–	–	–	–	–	<-1.40E-03	1.70E-02	–	–	-1.40E-03
Cs-134	–	–	–	–	–	–	<-1.00E-02	1.60E-02	–	–	-1.00E-02
Cs-137	–	–	–	–	–	–	1.80E+00	1.90E-01	–	–	1.80E+00
Eu-152	–	–	–	–	–	–	8.10E-02	7.80E-02	–	–	8.10E-02
Eu-154	–	–	–	–	–	–	<2.40E-02	5.30E-02	–	–	2.40E-02
Eu-155	–	–	–	–	–	–	6.60E-02	5.80E-02	–	–	6.60E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	–	–	<-5.90E-03	1.60E-02	–	–	-5.90E-03
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	7.20E-01	9.40E-02	–	–	7.20E-01
Pu-238	–	–	–	–	–	–	4.60E-04	2.30E-04	–	–	4.60E-04
Pu-239	–	–	–	–	–	–	3.80E-01	4.30E-03	–	–	3.80E-01
Ru-106	–	–	–	–	–	–	<-4.70E-02	1.50E-01	–	–	-4.70E-02
Sr-90	–	–	–	–	–	–	3.30E-01	6.40E-02	–	–	3.30E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	–	–	–	–	–	–	2.90E-01	9.30E-02	–	–	2.90E-01
Zn-65	–	–	–	–	–	–	<-4.60E-02	4.20E-02	–	–	-4.60E-02
Zr-95	–	–	–	–	–	–	<-5.50E-03	3.00E-02	–	–	-5.50E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E8											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<-9.00E-03	3.10E-02	–	–	7.03E-02	9.61E-02	3.07E-02
Ce-144	–	–	–	–	<-9.30E-03	1.00E-01	<9.70E-02	1.40E-01	-1.06E-01	1.50E-01	-6.10E-03
Co-58	*	–	*	–	<-7.80E-03	1.60E-02	<1.20E-02	2.00E-02	2.05E-02	2.60E-02	8.23E-03
Co-60	3.80E-02	1.70E-02	–	–	<1.20E-02	1.70E-02	<1.10E-02	2.00E-02	-1.52E-02	2.05E-02	1.15E-02
Cs-134	*	–	4.00E-02	3.00E-02	4.90E-02	2.00E-02	<-9.60E-02	2.80E-02	2.46E-03	2.01E-02	-1.14E-03
Cs-137	1.24E+01	7.82E-01	5.80E+00	6.00E-01	3.80E+00	3.90E-01	8.50E+00	8.70E-01	6.51E+00	6.65E-01	7.40E+00
Eu-152	*	–	2.00E-01	1.20E-01	8.90E-02	7.20E-02	<6.60E-02	9.40E-02	7.84E-02	8.39E-02	1.08E-01
Eu-154	8.80E-02	8.60E-02	–	–	<-4.40E-02	5.70E-02	<-4.30E-02	6.90E-02	8.79E-02	5.43E-02	2.22E-02
Eu-155	*	–	–	–	6.10E-02	5.60E-02	<6.20E-02	8.10E-02	4.47E-02	6.55E-02	5.59E-02
I-129	–	–	–	–	<-2.60E-01	4.20E-01	–	–	-1.76E-01	4.28E-01	-2.18E-01
K-40	–	–	–	–	–	–	–	–	1.38E+01	1.59E+00	1.38E+01
Mn-54	*	–	–	–	2.30E-02	1.50E-02	2.40E-02	1.90E-02	2.47E-02	2.12E-02	2.39E-02
Nb-95	*	–	–	–	–	–	–	–	-1.56E-01	6.08E-02	-1.56E-01
Pb-212	–	–	–	–	–	–	–	–	8.95E-01	1.05E-01	8.95E-01
Pb-214	–	–	–	–	–	–	7.20E-01	1.10E-01	7.10E-01	1.03E-01	7.15E-01
Pu-238	2.20E-03	8.00E-03	8.00E-04	5.00E-04	6.80E-04	3.10E-04	8.70E-04	4.70E-04	2.21E-03	5.28E-04	1.23E-03
Pu-239	9.70E-02	1.00E-02	3.30E-02	4.00E-03	2.40E-02	3.00E-03	5.40E-02	6.40E-03	6.63E-02	7.05E-03	5.49E-02
Ru-106	*	–	–	–	<8.20E-02	1.50E-01	<-2.20E-01	2.30E-01	1.18E-02	2.06E-01	-4.21E-02
Sr-90	6.94E-01	1.30E-01	7.60E-01	1.40E-01	4.00E-01	9.90E-02	5.10E-01	9.90E-02	4.13E-01	7.75E-02	5.55E-01
Tc-99	–	–	–	–	<4.70E-01	1.10E+00	–	–	4.85E-01	1.08E+00	4.78E-01
U (total)	3.07E-01	1.04E-01	3.00E-01	1.00E-01	2.70E-01	8.10E-02	2.90E-01	9.40E-02	3.16E-01	9.71E-02	2.97E-01
Zn-65	*	–	–	–	<-2.40E-02	3.80E-02	<-8.80E-02	5.70E-02	-4.24E-02	4.95E-02	-5.15E-02
Zr-95	*	–	–	–	<2.00E-02	2.90E-02	3.70E-02	3.40E-02	3.05E-02	5.74E-02	2.92E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E9											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	-8.10E-02	1.05E-01	-8.10E-02
Ce-144	–	–	–	–	–	–	<-8.20E-02	1.60E-01	4.49E-02	1.56E-01	-1.86E-02
Co-58	*	–	3.00E-02	2.00E-02	–	–	<-4.80E-03	1.50E-02	-8.64E-03	2.10E-02	5.52E-03
Co-60	3.40E-02	2.10E-02	–	–	–	–	<-2.20E-03	1.60E-02	-1.50E-02	1.59E-02	5.60E-03
Cs-134	*	–	4.00E-02	2.00E-02	–	–	<1.40E-02	2.30E-02	-1.06E-01	2.77E-02	-1.73E-02
Cs-137	1.28E+01	8.06E-01	1.67E+01	1.68E+00	–	–	2.20E+01	2.30E+00	1.79E+01	1.80E+00	1.74E+01
Eu-152	2.35E-01	9.30E-02	–	–	–	–	1.10E-01	7.90E-02	9.98E-02	5.89E-02	1.48E-01
Eu-154	*	–	–	–	–	–	<-3.50E-03	4.90E-02	-2.23E-02	5.20E-02	-1.29E-02
Eu-155	*	–	–	–	–	–	<2.40E-04	8.60E-02	1.08E-04	7.73E-02	1.74E-04
I-129	–	–	–	–	–	–	–	–	8.29E-02	2.85E-01	8.29E-02
K-40	–	–	–	–	–	–	–	–	1.32E+01	1.46E+00	1.32E+01
Mn-54	*	–	2.00E-02	2.00E-02	–	–	<-1.60E-01	1.60E-02	8.30E-03	1.59E-02	-4.39E-02
Nb-95	*	–	–	–	–	–	–	–	-5.88E-02	4.97E-02	-5.88E-02
Pb-212	–	–	–	–	–	–	–	–	6.87E-01	8.48E-02	6.87E-01
Pb-214	–	–	–	–	–	–	7.20E-01	1.30E-01	5.64E-01	9.18E-02	6.42E-01
Pu-238	5.00E-04	4.00E-04	–	–	–	–	<4.20E-04	5.20E-04	2.09E-03	5.08E-04	1.00E-03
Pu-239	2.00E-02	3.00E-03	1.70E-02	3.00E-03	–	–	1.70E-02	3.10E-03	2.58E-02	3.03E-03	2.00E-02
Ru-106	*	–	–	–	–	–	<8.60E-02	2.20E-01	1.17E-01	2.30E-01	1.29E-01
Sr-90	2.61E+00	4.72E-01	1.60E+00	3.00E-01	–	–	2.00E+00	3.80E-01	2.90E+00	5.46E-01	2.28E+00
Tc-99	–	–	–	–	–	–	–	–	3.28E-01	1.07E+00	3.28E-01
U (total)	2.77E-01	9.50E-02	1.90E-01	6.00E-02	–	–	1.40E-01	5.30E-02	3.43E-01	1.05E-01	2.38E-01
Zn-65	*	–	–	–	–	–	<-3.60E-02	3.60E-02	-1.39E-01	5.00E-02	-8.75E-02
Zr-95	*	–	–	–	–	–	<4.00E-03	2.60E-02	-1.16E-03	4.56E-02	1.42E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E13											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	3.44E-02	6.34E-02	3.44E-02
Ce-144	–	–	–	–	–	–	<1.20E-02	9.50E-02	8.11E-02	8.34E-02	4.66E-02
Co-58	*	–	–	–	–	–	<1.30E-03	1.60E-02	5.16E-03	2.26E-02	3.23E-03
Co-60	*	–	–	–	–	–	<1.30E-02	1.70E-02	1.67E-03	1.46E-02	7.34E-03
Cs-134	5.30E-02	2.80E-02	–	–	–	–	<-3.70E-03	1.30E-02	5.33E-02	1.64E-02	3.42E-02
Cs-137	1.19E+00	1.15E-01	1.00E+00	1.20E-01	–	–	4.90E-01	6.00E-02	4.08E-01	5.10E-02	7.72E-01
Eu-152	1.32E-01	1.14E-01	–	–	–	–	8.10E-02	7.60E-02	9.26E-02	6.18E-02	1.02E-01
Eu-154	1.46E-01	8.90E-02	–	–	–	–	<-7.20E-02	5.70E-02	4.67E-02	4.87E-02	4.02E-02
Eu-155	*	–	1.90E-01	1.00E-01	–	–	<2.30E-02	6.30E-02	2.24E-02	4.42E-02	7.85E-02
I-129	–	–	–	–	–	–	–	–	9.19E-02	3.50E-01	9.19E-02
K-40	–	–	–	–	–	–	–	–	1.36E+01	1.49E+00	1.36E+01
Mn-54	*	–	–	–	–	–	<-4.40E-03	1.50E-02	9.04E-03	1.48E-02	2.32E-03
Nb-95	*	–	–	–	–	–	–	–	2.31E-02	4.94E-02	2.31E-02
Pb-212	–	–	–	–	–	–	–	–	6.37E-01	7.27E-02	6.37E-01
Pb-214	–	–	–	–	–	–	5.70E-01	7.80E-02	5.05E-01	6.60E-02	5.38E-01
Pu-238	*	–	1.09E-02	1.80E-03	–	–	8.70E-04	3.70E-04	5.19E-05	8.00E-05	3.94E-03
Pu-239	1.30E-02	5.00E-03	1.70E-02	3.00E-03	–	–	1.10E-01	1.20E-02	8.31E-03	1.19E-03	3.71E-02
Ru-106	*	–	–	–	–	–	<0.00E+00	1.20E-01	5.66E-02	1.33E-01	2.83E-02
Sr-90	2.67E-01	5.40E-02	2.80E-01	6.00E-02	–	–	1.30E-01	2.60E-02	1.18E-01	2.42E-02	1.99E-01
Tc-99	–	–	–	–	–	–	–	–	9.95E-01	1.12E+00	9.95E-01
U (total)	2.79E-01	9.50E-02	4.40E-01	1.40E-01	–	–	2.60E-01	8.50E-02	2.39E-01	7.59E-02	3.05E-01
Zn-65	6.30E-02	5.20E-02	–	–	–	–	<-2.60E-02	3.70E-02	9.93E-02	4.63E-02	4.54E-02
Zr-95	*	–	–	–	–	–	<1.10E-02	2.70E-02	3.21E-02	4.20E-02	2.16E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E14											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<9.50E-03	3.40E-02	–	–	1.79E-02	8.13E-02	1.37E-02
Ce-144	–	–	–	–	<-4.70E-02	1.20E-01	<2.70E-02	1.20E-01	6.71E-03	1.11E-01	-4.43E-03
Co-58	*	–	–	–	<1.60E-03	1.40E-02	<-1.10E-02	1.70E-02	1.12E-02	2.99E-02	6.00E-04
Co-60	*	–	–	–	1.90E-02	1.60E-02	<4.70E-03	1.40E-03	1.23E-02	1.75E-02	1.20E-02
Cs-134	5.30E-02	2.80E-02	4.00E-02	3.00E-02	4.50E-02	2.00E-02	<-6.90E-02	2.10E-02	9.01E-03	1.51E-02	1.56E-02
Cs-137	1.19E+00	1.15E-01	2.29E+01	2.31E+00	2.90E+00	3.00E-01	2.50E+00	2.60E-01	1.01E+00	1.13E-01	6.10E+00
Eu-152	1.16E-01	8.10E-02	–	–	<-4.50E-02	8.90E-02	1.40E-01	8.60E-02	5.16E-02	7.55E-02	6.57E-02
Eu-154	*	–	–	–	<-8.10E-02	6.40E-02	<-3.00E-02	6.50E-02	4.38E-03	5.85E-02	-3.55E-02
Eu-155	1.08E-01	8.80E-02	–	–	<4.60E-02	6.80E-02	<7.20E-02	7.20E-02	5.22E-02	5.32E-02	6.96E-02
I-129	–	–	–	–	<2.90E-01	3.20E-01	–	–	8.64E-02	3.76E-01	1.88E-01
K-40	–	–	–	–	–	–	–	–	1.48E+01	1.66E+00	1.48E+01
Mn-54	*	–	5.00E-02	2.00E-02	<1.30E-02	1.50E-02	<3.10E-03	1.60E-02	2.58E-03	1.90E-02	1.72E-02
Nb-95	*	–	–	–	–	–	–	–	1.03E-01	6.69E-02	1.03E-01
Pb-212	–	–	–	–	–	–	–	–	1.85E-01	9.05E-02	1.85E-01
Pb-214	–	–	–	–	–	–	6.50E-01	8.90E-02	6.92E-01	9.22E-02	6.71E-01
Pu-238	6.00E-04	4.00E-04	3.00E-04	3.00E-04	4.00E-04	2.60E-04	4.00E-04	2.20E-04	1.90E-04	1.58E-04	3.78E-04
Pu-239	1.30E-02	5.00E-03	1.50E-02	2.00E-03	1.30E-02	1.80E-02	1.60E-02	2.10E-03	1.91E-02	2.46E-03	1.52E-02
Ru-106	*	–	–	–	<-9.08E-02	1.50E-01	<-5.20E-02	1.60E-01	1.08E-01	1.59E-01	-1.40E-02
Sr-90	2.37E-01	5.00E-02	1.50E+00	2.80E-01	5.00E-01	1.20E-03	1.10E+00	2.10E-01	1.25E-01	2.58E-02	6.92E-01
Tc-99	–	–	–	–	<4.00E-01	1.10E+00	–	–	3.43E-02	1.04E+00	2.17E-01
U (total)	2.73E-01	9.30E-02	1.90E-01	6.00E-02	2.00E-01	6.20E-02	1.80E-01	6.30E-02	3.56E-01	1.08E-01	2.40E-01
Zn-65	*	–	6.00E-02	4.00E-02	<-9.60E-03	3.70E-02	<-9.00E-02	5.10E-02	4.83E-02	4.76E-02	2.18E-03
Zr-95	*	–	–	–	<8.10E-03	3.30E-02	<3.90E-03	3.10E-02	4.96E-02	5.42E-02	2.05E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E15											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<-7.70E-03	1.10E-01	–	–	-7.70E-03
Co-58	*	–	–	–	–	–	<-1.30E-02	1.70E-02	–	–	-1.30E-02
Co-60	*	–	–	–	–	–	<-1.50E-03	1.80E-02	–	–	-1.50E-03
Cs-134	4.40E-02	3.00E-02	–	–	–	–	<-8.50E-03	1.70E-02	–	–	1.78E-02
Cs-137	1.38E+00	1.23E-01	2.09E+00	2.40E-01	–	–	1.70E+00	1.80E-01	–	–	1.35E+00
Eu-152	*	–	1.80E-01	1.10E-01	–	–	<4.90E-02	7.70E-02	–	–	1.13E-01
Eu-154	*	–	–	–	–	–	<5.70E-02	5.70E-02	–	–	5.70E-02
Eu-155	*	–	–	–	–	–	<4.10E-02	6.20E-02	–	–	4.10E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	–	–	–	–	<6.40E-03	1.80E-02	–	–	6.40E-03
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	6.60E-01	9.00E-02	–	–	6.60E-01
Pu-238	4.00E-04	3.00E-04	9.00E-04	5.00E-04	–	–	5.60E-04	2.70E-04	–	–	5.90E-04
Pu-239	1.90E-02	3.00E-03	5.90E-02	7.00E-03	–	–	7.40E-02	8.20E-03	–	–	3.98E-02
Ru-106	*	–	–	–	–	–	<-4.00E-02	1.60E-01	–	–	-4.00E-02
Sr-90	9.89E-01	1.85E-01	1.25E+00	2.30E-01	–	–	9.10E-01	1.80E-01	–	–	1.05E+00
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	2.84E-01	9.70E-02	5.90E-01	1.90E-01	–	–	2.30E-01	7.60E-02	–	–	3.24E-01
Zn-65	*	–	–	–	–	–	<-3.90E-02	4.70E-02	–	–	-3.90E-02
Zr-95	*	–	–	–	–	–	<5.90E-03	3.10E-02	–	–	5.90E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E19											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	<-1.80E-02	3.20E-02	--	--	--	--	-1.80E-02
Ce-144	--	--	--	--	1.40E-01	9.60E-02	<2.30E-02	1.20E-01	--	--	8.15E-02
Co-58	--	--	--	--	<-2.10E-02	1.70E-02	<-1.60E-02	1.80E-02	--	--	-1.85E-02
Co-60	--	--	--	--	1.50E-02	1.40E-02	<-8.80E-03	1.90E-02	--	--	3.10E-03
Cs-134	--	--	--	--	4.20E-02	2.00E-02	<-2.60E-02	1.60E-02	--	--	8.00E-03
Cs-137	--	--	--	--	7.30E-01	8.30E-02	9.00E-01	1.00E-01	--	--	9.00E-01
Eu-152	--	--	--	--	9.30E-02	6.30E-02	<5.80E-02	9.70E-02	--	--	5.80E-02
Eu-154	--	--	--	--	<-2.40E-02	5.70E-02	<6.30E-03	6.10E-02	--	--	-8.85E-03
Eu-155	--	--	--	--	<3.00E-02	5.90E-02	8.30E-02	7.10E-02	--	--	5.65E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	--	--	--	--	<1.40E-02	1.70E-02	<1.20E-02	1.70E-02	--	--	-1.00E-03
Nb-95	--	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	4.30E-04	2.70E-04	7.20E-01	9.50E-02	--	--	3.60E-01
Pu-238	--	--	--	--	2.00E-02	2.70E-03	7.40E-04	3.90E-04	--	--	7.04E-04
Pu-239	--	--	--	--	--	--	2.70E-02	3.50E-03	--	--	2.70E-02
Ru-106	--	--	--	--	<-9.20E-02	1.30E-01	<1.10E-01	1.50E-01	--	--	9.00E-03
Sr-90	--	--	--	--	1.90E-01	4.90E-02	1.90E-01	3.70E-02	--	--	1.90E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	--	--	--	--	1.40E-01	4.50E-02	2.80E-01	9.00E-02	--	--	2.80E-01
Zn-65	--	--	--	--	<2.20E-03	3.50E-02	<-7.80E-02	4.80E-02	--	--	-3.79E-02
Zr-95	--	--	--	--	3.70E-02	2.70E-02	<1.50E-02	3.10E-02	--	--	2.60E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E20											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	5.20E-02	1.27E-01	5.20E-02
Ce-144	–	–	–	–	–	–	<-7.00E-03	1.00E-01	-6.31E-02	1.69E-01	-3.51E-02
Co-58	3.90E-02	2.30E-02	–	–	–	–	<-7.00E-04	1.60E-02	1.91E-02	2.88E-02	1.91E-02
Co-60	2.70E-02	2.60E-02	–	–	–	–	<-2.10E-02	1.70E-02	1.45E-02	1.92E-02	6.83E-03
Cs-134	4.60E-02	3.00E-02	4.00E-02	3.00E-02	–	–	-2.10E-04	1.50E-02	-5.06E-02	2.86E-02	8.80E-03
Cs-137	1.92E+00	1.54E-01	1.49E+00	1.70E-01	–	–	7.00E-01	8.20E-02	8.31E+00	8.44E-01	2.52E+00
Eu-152	1.65E-01	1.09E-01	1.40E-01	1.00E-01	–	–	1.00E-01	7.90E-02	4.58E-02	9.61E-02	1.10E-01
Eu-154	*	–	1.40E-01	9.00E-02	–	–	8.00E-02	5.50E-02	-5.94E-03	6.89E-02	7.14E-02
Eu-155	1.06E-01	1.03-01	–	–	–	–	<5.50E-02	6.40E-02	8.74E-02	9.11E-02	8.28E-02
I-129	–	–	–	–	–	–	–	–	-5.94E-01	4.82E-01	-5.94E-01
K-40	–	–	–	–	–	–	–	–	1.51E+01	1.71E+00	1.51E+01
Mn-54	2.60E-02	2.30E-02	–	–	–	–	<2.10E-03	1.70E-02	1.19E-02	2.60E-02	1.33E-02
Nb-95	*	–	–	–	–	–	–	–	-3.70E-04	7.78E-02	-3.70E-04
Pb-212	–	–	–	–	–	–	–	–	7.79E-01	9.64E-02	7.79E-01
Pb-214	–	–	–	–	–	–	6.50E-01	8.90E-02	6.44E-01	1.04E-01	6.47E-01
Pu-238	7.00E-04	4.00E-04	5.00E-04	4.00E-04	–	–	<1.10E-04	1.20E-04	6.43E-04	2.62E-04	4.71E-04
Pu-239	6.20E-02	7.00E-03	3.90E-02	5.00E-03	–	–	1.60E-02	2.10E-03	3.82E-02	4.24E-03	3.20E-02
Ru-106	*	–	–	–	–	–	<-1.00E-01	1.30E-01	1.22E-01	2.40E-01	1.10E-02
Sr-90	4.82E-01	9.30E-02	3.20E-01	6.00E-02	–	–	1.90E-01	3.80E-02	1.47E+00	2.90E-01	6.16E-01
Tc-99	–	–	–	–	–	–	–	–	1.26E-01	1.05E+00	1.26E-01
U (total)	3.03E-01	1.02E-01	4.90E-01	1.60E-01	–	–	3.20E-01	1.00E-01	3.73E-01	1.13E-01	3.29E-01
Zn-65	*	–	–	–	–	–	<-4.80E-02	4.30E-02	-1.44E-01	6.74E-02	-9.60E-02
Zr-95	*	–	–	–	–	–	3.80E-02	3.00E-02	2.27E-02	6.13E-02	3.04E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E21											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<-4.70E-02	4.00E-02	–	–	–	–	-4.70E-02
Ce-144	–	–	–	–	<1.50E-02	1.30E-01	<-6.20E-02	9.60E-02	–	–	-3.85E-02
Co-58	*	–	–	–	<7.40E-03	1.60E-02	<-7.00E-04	1.60E-02	–	–	3.35E-03
Co-60	3.40E-02	1.60E-02	–	–	<-9.10E-04	1.70E-02	<-2.10E-02	1.70E-02	–	–	4.03E-03
Cs-134	3.30E-02	3.00E-02	–	–	3.10E-02	2.20E-02	<-2.50E-03	1.40E-02	–	–	2.05E-02
Cs-137	1.02E+00	9.40E-02	–	–	6.40E-01	7.80E-02	7.20E-01	8.50E-02	–	–	8.70E-01
Eu-152	1.52E-01	1.12E-01	–	–	1.00E-01	7.90E-02	<1.20E-02	7.90E-02	–	–	8.20E-02
Eu-154	*	–	–	–	<3.40E-02	4.40E-02	<4.00E-02	5.70E-02	–	–	3.70E-02
Eu-155	*	–	–	–	8.40E-02	7.50E-02	<1.70E-02	5.50E-02	–	–	5.05E-02
I-129	–	–	–	–	<-9.10E-02	5.10E-01	–	–	–	–	-9.10E-02
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	–	–	3.00E-02	1.40E-02	<2.10E-03	1.70E-02	–	–	1.61E-02
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	6.60E-01	8.60E-02	–	–	6.60E-01
Pu-238	5.00E-05	3.00E-04	–	–	4.10E-04	2.50E-04	7.50E-04	3.70E-04	–	–	4.00E-04
Pu-239	2.60E-02	3.00E-03	–	–	2.30E-02	2.80E-03	4.80E-02	6.00E-03	–	–	3.70E-02
Ru-106	*	–	–	–	<-2.40E-03	1.60E-01	<3.70E-02	1.40E-01	–	–	1.73E-02
Sr-90	4.24E-01	8.20E-02	–	–	2.00E-01	5.20E-02	1.90E-01	3.80E-02	–	–	2.71E-01
Tc-99	–	–	–	–	<4.60E-01	1.10E+00	–	–	–	–	4.60E-01
U (total)	3.42E-01	1.13E-01	–	–	2.10E-01	6.40E-02	2.30E-01	7.70E-02	–	–	2.86E-01
Zn-65	*	–	–	–	<2.60E-02	3.70E-02	<-4.80E-02	4.30E-02	–	–	-1.10E-02
Zr-95	*	–	–	–	6.90E-02	2.90E-02	<-2.30E-02	3.00E-02	–	–	2.30E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E25											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<-3.10E-02	8.30E-02	–	–	-3.10E-02
Co-58	–	–	–	–	–	–	1.60E-02	1.40E-02	–	–	1.60E-02
Co-60	–	–	–	–	–	–	<5.80E-03	1.40E-02	–	–	5.80E-03
Cs-134	–	–	–	–	–	–	<-8.10E-03	1.30E-02	–	–	-8.10E-03
Cs-137	–	–	–	–	–	–	4.60E-01	5.70E-02	–	–	4.60E-01
Eu-152	–	–	–	–	–	–	7.50E-02	5.60E-02	–	–	7.50E-02
Eu-154	–	–	–	–	–	–	<1.10E-02	4.50E-02	–	–	1.10E-02
Eu-155	–	–	–	–	–	–	5.00E-02	5.00E-02	–	–	5.00E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	–	–	1.70E-02	1.20E-02	–	–	1.70E-02
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	5.60E-01	7.20E-02	–	–	5.60E-01
Pu-238	–	–	–	–	–	–	4.90E-04	2.40E-04	–	–	4.90E-04
Pu-239	–	–	–	–	–	–	1.30E-02	1.70E-03	–	–	1.30E-02
Ru-106	–	–	–	–	–	–	<0.00E+00	1.20E-01	–	–	–
Sr-90	–	–	–	–	–	–	4.20E-02	9.90E-03	–	–	4.20E-02
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	–	–	–	–	–	–	3.00E-01	9.40E-02	–	–	3.00E-01
Zn-65	–	–	–	–	–	–	<-5.20E-02	4.00E-02	–	–	-5.20E-02
Zr-95	–	–	–	–	–	–	1.50E-02	2.50E-02	–	–	1.50E-02

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Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E26											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<-1.10E-02	3.50E-02	–	–	–	–	-1.10E-02
Ce-144	–	–	–	–	<-5.70E-03	1.20E-01	<3.00E-02	1.20E-01	–	–	1.22E-02
Co-58	–	–	–	–	<1.30E-03	1.70E-02	<-7.70E-03	1.50E-02	–	–	-3.20E-03
Co-60	–	–	–	–	<-1.10E-02	2.10E-02	<-6.80E-03	1.80E-02	–	–	-8.90E-03
Cs-134	–	–	–	–	5.00E-02	2.30E-02	<-2.60E-03	1.50E-02	–	–	2.63E-02
Cs-137	–	–	–	–	6.80E-01	8.20E-02	8.00E-01	9.40E-02	–	–	7.40E-01
Eu-152	–	–	–	–	<-5.10E-02	1.00E-01	<7.80E-02	8.10E-02	–	–	1.35E-02
Eu-154	–	–	–	–	<3.20E-02	5.40E-02	<5.50E-02	5.70E-02	–	–	4.35E-02
Eu-155	–	–	–	–	<4.60E-02	7.00E-02	<5.80E-02	6.20E-02	–	–	5.20E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	–	–	–	–	<1.00E-02	1.80E-02	1.30E-02	1.70E-02	–	–	1.15E-02
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	6.50E-01	9.10E-02	–	–	6.50E-01
Pu-238	–	–	–	–	4.60E-04	2.50E-04	5.40E-04	2.80E-04	–	–	5.00E-04
Pu-239	–	–	–	–	1.50E-02	2.00E-03	1.60E-02	2.10E-03	–	–	1.55E-02
Ru-106	–	–	–	–	<1.30E-01	1.30E-01	<1.20E-02	1.40E-01	–	–	7.10E-02
Sr-90	–	–	–	–	2.10E-01	5.30E-02	6.80E-01	1.30E-01	–	–	4.45E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	–	–	–	–	1.70E-01	5.40E-02	4.00E-01	1.20E-01	–	–	2.85E-01
Zn-65	–	–	–	–	<1.50E-03	3.80E-02	<4.20E-02	4.40E-02	–	–	-2.03E-02
Zr-95	–	–	–	–	<-5.70E-04	3.40E-02	<-4.60E-03	3.30E-02	–	–	-2.59E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E27											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<4.70E-02	7.30E-02	–	–	4.70E-02
Co-58	2.80E-02	2.70E-02	–	–	–	–	<5.90E-03	1.20E-02	–	–	1.70E-02
Co-60	*	–	–	–	–	–	<3.20E-03	1.40E-02	–	–	3.20E-03
Cs-134	3.50E-02	3.00E-02	–	–	–	–	<-4.10E-03	1.20E-02	–	–	1.55E-02
Cs-137	3.21E-01	5.20E-02	3.20E-01	5.00E-02	–	–	1.30E-01	2.50E-02	–	–	2.57E-01
Eu-152	*	–	1.30E-01	8.00E-02	–	–	<2.90E-02	6.30E-02	–	–	7.95E-02
Eu-154	1.38E-01	7.00E-02	8.00E-02	5.00E-02	–	–	<2.20E-02	4.40E-02	–	–	8.00E-02
Eu-155	*	–	–	–	–	–	<3.60E-02	4.00E-02	–	–	3.60E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	–	–	–	–	2.40E-02	1.40E-02	–	–	2.40E-02
Nb-95	–	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	5.60E-01	7.40E-02	–	–	5.60E-01
Pu-238	*	–	–	–	–	–	–	–	–	–	–
Pu-239	5.00E-03	3.00E-03	6.00E-03	2.00E-03	–	–	<9.90E-05	1.50E-04	–	–	3.70E-03
Ru-106	*	–	–	–	–	–	<1.80E-03	4.50E-04	–	–	1.80E-03
Sr-90	2.45E-01	5.10E-02	1.20E-01	3.00E-02	–	–	8.10E-01	1.50E-01	–	–	3.92E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	3.16E-01	1.06E-01	4.70E-01	1.50E-01	–	–	3.10E-01	9.60E-02	–	–	3.65E-01
Zn-65	*	–	–	–	–	–	<-1.40E-01	4.60E-02	–	–	-1.40E-01
Zr-95	*	–	–	–	–	–	<1.30E-03	2.40E-02	–	–	1.30E-03

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E31											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	--	--	--	--	--	--	--	--	--	--	--
Ce-144	--	--	--	--	--	--	<-6.30E-02	6.80E-02	--	--	-6.30E-02
Co-58	*	--	--	--	--	--	<1.80E-03	1.20E-02	--	--	1.80E-03
Co-60	*	--	4.00E-02	3.00E-02	--	--	<1.10E-02	1.40E-02	--	--	2.55E-02
Cs-134	6.20E-02	3.70E-02	4.00E-02	3.00E-02	--	--	<-6.90E-03	1.30E-02	--	--	3.17E-02
Cs-137	4.25E-01	6.30E-02	5.00E-01	7.00E-02	--	--	4.50E-01	5.70E-02	--	--	4.58E-01
Eu-152	1.55E-01	1.45E-01	--	--	--	--	7.80E-02	5.80E-02	--	--	1.17E-01
Eu-154	*	--	7.00E-02	7.00E-02	--	--	<2.30E-02	4.70E-02	--	--	4.65E-02
Eu-155	*	--	--	--	--	--	<3.50E-02	3.90E-02	--	--	3.50E-02
I-129	--	--	--	--	--	--	--	--	--	--	--
K-40	--	--	--	--	--	--	--	--	--	--	--
Mn-54	*	--	3.00E-02	2.00E-02	--	--	<1.00E-02	1.40E-02	--	--	2.00E-02
Nb-95	*	--	--	--	--	--	--	--	--	--	--
Pb-212	--	--	--	--	--	--	--	--	--	--	--
Pb-214	--	--	--	--	--	--	5.70E-01	7.40E-02	--	--	5.70E-01
Pu-238	*	--	4.00E-04	3.00E-04	--	--	6.30E-04	2.50E-04	--	--	5.15E-04
Pu-239	7.00E-03	2.00E-03	9.00E-03	2.00E-03	--	--	1.30E-02	1.60E-03	--	--	9.67E-03
Ru-106	3.97E-01	2.60E-01	--	--	--	--	<4.60E-02	1.10E-01	--	--	2.22E-01
Sr-90	5.57E-01	1.07E-01	1.30E-01	3.00E-02	--	--	1.60E-01	3.20E-02	--	--	2.82E-01
Tc-99	--	--	--	--	--	--	--	--	--	--	--
U (total)	4.14E-01	1.35E-01	3.90E-01	1.30E-01	--	--	1.50E-01	5.30E-02	--	--	3.18E-01
Zn-65	*	--	--	--	--	--	<-3.80E-02	3.50E-02	--	--	-3.80E-02
Zr-95	*	--	--	--	--	--	<2.70E-02	2.70E-02	--	--	2.70E-02

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E32											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	<2.50E-02	3.20E-02	–	–	–	–	2.50E-02
Ce-144	–	–	–	–	<1.40E-02	1.00E-01	<-7.10E-02	9.40E-02	–	–	-2.85E-02
Co-58	*	–	–	–	<-9.00E-03	1.60E-02	<-1.70E-02	1.80E-02	–	–	-1.30E-02
Co-60	*	–	–	–	<-2.00E-02	2.00E-02	<-2.30E-03	1.50E-02	–	–	-1.12E-02
Cs-134	4.40E-02	1.90E-02	7.00E-02	3.00E-02	3.40E-02	2.00E-02	<-1.80E-02	1.50E-02	–	–	3.25E-02
Cs-137	1.38E+00	1.01E-01	7.70E-01	1.00E-01	4.70E-01	5.90E-02	7.30E-01	8.50E-02	–	–	8.38E-01
Eu-152	*	–	1.30E-01	1.20E-01	9.10E-02	7.20E-02	<8.20E-03	7.80E-02	–	–	7.64E-02
Eu-154	8.20E-02	4.80E-02	–	–	<-2.50E-02	6.00E-02	<-4.60E-02	5.10E-02	–	–	3.67E-03
Eu-155	5.90E-02	5.30E-02	1.80E-01	1.20E-01	<5.60E-02	6.10E-02	<3.30E-02	5.40E-02	–	–	8.20E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	*	–	–	–	2.10E-02	1.60E-02	<4.80E-03	1.60E-02	–	–	1.29E-02
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	6.10E-01	8.00E-02	–	–	6.10E-01
Pu-238	*	–	–	–	<-2.60E-05	7.20E-05	1.30E-04	1.10E-04	–	–	5.20E-05
Pu-239	2.60E-02	5.00E-03	1.40E-02	3.00E-03	2.70E-03	6.00E-04	1.20E-02	1.50E-03	–	–	1.37E-02
Ru-106	*	–	–	–	<-4.60E-02	1.300E-01	<2.60E-02	1.30E-01	–	–	-1.00E-02
Sr-90	1.06E+00	1.97E-01	7.20E-01	1.40E-01	1.20E-01	3.10E-02	5.00E-01	9.40E-02	–	–	6.00E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	3.57E-01	1.18E-01	4.10E-01	1.30E-01	1.30E-01	4.40E-02	2.60E-01	8.40E-01	–	–	2.89E-01
Zn-65	*	–	–	–	<-2.40E-02	4.30E-02	<-5.60E-02	4.00E-02	–	–	-4.00E-02
Zr-95	3.50E-02	3.10E-02	–	–	<-3.60E-02	3.60E-02	<2.60E-03	2.90E-02	–	–	5.33E-04

Table A-2.3. Results of Grid Soil Sampling (pCi/g).

Location 2E33											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Ce-141	–	–	–	–	–	–	–	–	–	–	–
Ce-144	–	–	–	–	–	–	<-5.00E-03	7.50E-02	–	–	-5.00E-03
Co-58	*	–	–	–	–	–	1.70E-02	1.30E-02	–	–	1.70E-02
Co-60	*	–	–	–	–	–	<-4.50E-03	1.50E-02	–	–	-4.50E-03
Cs-134	*	–	–	–	–	–	<-1.50E-03	1.20E-02	–	–	-1.50E-03
Cs-137	5.80E-02	2.40E-02	–	–	–	–	5.90E-02	1.90E-02	–	–	5.85E-02
Eu-152	*	–	–	–	–	–	<5.70E-02	7.10E-02	–	–	5.70E-02
Eu-154	*	–	–	–	–	–	<-1.70E-02	4.90E-02	–	–	-1.70E-02
Eu-155	*	–	–	–	–	–	4.50E-02	4.10E-02	–	–	4.50E-02
I-129	–	–	–	–	–	–	–	–	–	–	–
K-40	–	–	–	–	–	–	–	–	–	–	–
Mn-54	2.00E-02	1.60E-02	–	–	–	–	<1.70E-03	1.40E-02	–	–	1.09E-02
Nb-95	*	–	–	–	–	–	–	–	–	–	–
Pb-212	–	–	–	–	–	–	–	–	–	–	–
Pb-214	–	–	–	–	–	–	5.10E-01	6.70E-02	–	–	5.10E-01
Pu-238	*	–	–	–	–	–	1.70E-04	1.30E-04	–	–	1.70E-04
Pu-239	1.00E-03	0.00E+00	–	–	–	–	8.00E-04	2.80E-04	–	–	9.00E-04
Ru-106	*	–	–	–	–	–	<-5.10E-02	1.10E-01	–	–	-5.10E-02
Sr-90	2.92E-01	6.00E-02	–	–	–	–	7.20E-02	1.60E-02	–	–	1.82E-01
Tc-99	–	–	–	–	–	–	–	–	–	–	–
U (total)	2.60E-01	9.00E-02	–	–	–	–	2.20E-01	7.20E-02	–	–	2.40E-01
Zn-65	*	–	–	–	–	–	<-4.50E-02	4.00E-02	–	–	-4.50E-02
Zr-95	6.70E-02	3.20E-02	–	–	–	–	<1.40E-02	2.60E-02	–	–	4.05E-02

Source: Schmidt et al. 1990: Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N116: North of BC Cribs											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 9.85E-04	--	5.38E-03	--	4.42E-04	--	4.10E-04	1.80E-04	1.72E-04	1.18E-04	--
	Min 1.27E-04	--	3.35E-04	--	2.73E-04	--	1.50E-04	9.40E-05	3.34E-05	6.15E-05	--
	Avg. 4.20E-04	9.79E-04	1.89E-03	4.69E-03	3.33E-04	1.52E-04	2.20E-04	1.30E-04	8.06E-05	8.60E-05	5.89E-04
Cs-137	Max 2.91E-04	--	1.26E-03	--	2.35E-04	--	7.30E-04	4.80E-04	3.62E-04	4.24E-04	--
	Min 8.82E-05	--	-1.68E-04	--	-1.59E-04	--	<-2.6E-04	6.20E-04	1.00E-09	3.96E-04	--
	Avg. 1.84E-04	2.04E-04	5.51E-04	1.24E-03	8.00E-06	3.97E-04	2.30E-04	4.20E-04	2.05E-05	4.54E-04	9.94E-04
Pu-239	Max 2.93E-05	--	6.56E-05	--	5.75E-06	--	4.00E-06	3.50E-06	1.06E-05	5.45E-06	--
	Min 7.99E-06	--	5.49E-07	--	-5.96E-08	--	<1.1E-06	2.00E-06	6.05E-07	1.67E-06	--
	Avg. 1.66E-05	2.24E-05	1.78E-05	6.38E-05	2.27E-06	4.93E-06	5.10E-06	6.50E-06	3.64E-06	2.83E-06	4.54E-05
U (tot)	Max 3.16E-04	--	4.07E-05	--	2.06E-05	--	<6.2E-06	2.20E-05	1.01E-04	3.72E-05	--
	Min 5.97E-05	--	1.82E-05	--	4.25E-06	--	<-8.3E-06	1.80E-05	0.00E+00	1.84E-05	--
	Avg. 1.74E-04	2.61E-04	3.07E-05	2.04E-05	1.36E-05	1.37E-05	-4.70E-06	8.20E-06	3.86E-05	2.42E-05	2.52E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N157: 241-BY Tank Farm											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 1.24E-03	–	4.70E-04	–	2.45E-04	–	1.80E-04	1.00E-04	1.13E-04	1.06E-04	–
	Min 2.94E-04	–	1.01E-04	–	4.06E-05	–	<4.30E-05	9.80E-05	6.11E-06	5.61E-05	–
	Avg. 6.97E-04	7.89E-04	2.82E-04	3.63E-04	1.35E-04	1.78E-04	1.10E-04	5.90E-05	3.94E-05	7.66E-05	2.95E-04
Cs-137	Max 1.23E-02	–	8.19E-03	–	5.00E-03	–	4.00E-03	1.10E-03	4.79E-03	9.55E-04	–
	Min 6.12E-03	–	3.88E-03	–	2.75E-03	–	1.00E-03	7.40E-04	9.18E-04	6.28E-04	–
	Avg. 8.24E-03	5.78E-03	5.70E-03	3.69E-03	3.61E-03	2.00E-03	2.20E-03	1.50E-03	2.37E-03	7.92E-04	2.21E-02
Pu-239	Max 1.82E-05	–	4.02E-06	–	1.38E-05	–	1.30E-05	6.90E-06	3.09E-05	8.76E-06	–
	Min 6.14E-06	–	1.52E-06	–	1.07E-06	–	<-5.60E-07	2.10E-06	0.00E+00	1.15E-06	–
	Avg. 1.19E-05	1.20E-05	3.24E-06	2.35E-06	7.72E-06	1.05E-05	3.60E-06	6.90E-06	8.41E-06	3.71E-06	3.49E-05
U (tot)	Max 1.21E-04	–	5.42E-05	–	2.52E-05	–	<1.80E-05	2.30E-05	5.80E-05	2.53E-05	–
	Min 3.82E-05	–	2.59E-05	–	2.07E-06	–	<-3.30E-06	1.90E-05	0.00E+00	1.92E-05	–
	Avg. 7.78E-05	6.95E-05	3.86E-05	2.43E-05	1.36E-05	2.02E-05	3.00E-06	1.00E-05	2.58E-05	2.07E-05	1.59E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N159: B Plant											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 6.49E-04	–	4.35E-04	–	3.85E-04	–	1.70E-04	9.90E-05	1.35E-04	4.57E-04	–
	Min 2.12E-04	–	1.43E-04	–	3.70E-05	–	8.20E-05	8.00E-05	1.61E-05	6.76E-05	–
	Avg. 3.90E-04	3.73E-04	2.41E-04	2.74E-04	1.46E-04	3.26E-04	1.40E-04	4.10E-05	6.34E-05	1.69E-04	9.80E-04
Cs-137	Max 3.58E-03	–	1.75E-02	–	2.62E-02	–	8.50E-04	6.90E-04	2.32E-03	9.63E-04	–
	Min 6.70E-04	–	1.35E-03	–	9.69E-04	–	<4.50E-05	5.40E-04	4.56E-04	4.72E-04	–
	Avg. 1.89E-03	2.44E-03	5.57E-03	1.59E-02	7.60E-03	2.48E-02	4.90E-04	4.10E-04	9.84E-04	7.29E-04	1.65E-02
Pu-239	Max 4.27E-05	–	1.20E-04	–	4.00E-05	–	1.60E-05	7.70E-06	1.22E-05	5.61E-06	–
	Min 8.53E-06	–	6.88E-06	–	3.10E-06	–	<1.1E-06	2.50E-06	5.35E-06	3.93E-06	–
	Avg. 2.88E-05	3.04E-05	3.97E-05	1.07E-04	1.89E-05	3.53E-05	6.90E-06	6.80E-06	8.60E-06	4.62E-06	1.03E-04
U (tot)	Max 1.13E-04	–	5.25E-05	–	1.43E-05	–	<6.40E-06	2.10E-05	5.56E-05	2.37E-05	–
	Min 4.06E-05	–	1.33E-05	–	2.13E-08	–	<9.50E-07	1.90E-05	0.00E+00	2.03E-05	–
	Avg. 7.38E-05	7.61E-05	3.49E-05	3.30E-05	9.11E-06	1.32E-05	8.50E-07	4.40E-06	2.47E-05	2.06E-05	1.43E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N957: BC Cribs											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 7.26E-04	–	1.94E-03	–	3.17E-04	–	4.20E-04	1.60E-04	2.30E-04	1.14E-04	–
	Min 1.33E-04	–	1.07E-04	–	3.96E-05	–	<3.10E-05	6.70E-05	0.00E+00	5.48E-05	–
	Avg. 3.01E-04	5.68E-04	5.98E-04	1.79E-03	1.21E-04	2.64E-04	1.80E-04	1.70E-04	5.51E-05	6.91E-05	1.26E-03
Cs-137	Max 5.80E-04	–	1.49E-03	–	4.22E-04	–	<4.00E-04	6.00E-04	5.97E-04	5.06E-04	–
	Min -1.91E-04	–	-7.35E-05	–	0.00E+00	–	<-2.00E-04	7.60E-04	-3.37E-05	5.41E-04	–
	Avg. 1.57E-04	6.43E-04	5.87E-04	1.34E-03	1.77E-04	4.02E-04	1.90E-04	3.00E-04	7.45E-05	4.60E-04	1.19E-03
Pu-239	Max 1.41E-05	–	6.49E-06	–	3.31E-06	–	2.50E-05	9.70E-06	3.69E-06	3.05E-06	–
	Min 2.15E-06	–	0.00E+00	–	1.10E-06	–	<1.90E-06	3.00E-06	3.83E-08	1.23E-06	–
	Avg. 9.01E-06	1.01E-05	3.07E-06	6.37E-06	2.03E-06	1.85E-06	9.50E-06	1.10E-05	1.21E-06	2.08E-06	2.48E-05
U (tot)	Max 2.29E-04	–	5.82E-05	–	3.18E-05	–	<2.10E-06	2.00E-05	5.14E-05	2.24E-05	–
	Min 5.56E-05	–	3.05E-05	–	9.49E-06	–	<4.30E-07	2.00E-05	3.81E-06	1.96E-05	–
	Avg. 1.17E-04	1.60E-04	5.09E-05	2.73E-05	1.85E-05	1.93E-05	-2.30E-06	5.30E-06	2.33E-05	1.96E-05	2.07E-04

Table A-2.4. Results of Air Monitoring (pCi/m^3).

Location N967: North of B and BY Tank Farms											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 3.87E-04	--	1.48E-04	--	1.10E-04	--	2.70E-04	1.30E-04	3.52E-04	1.42E-04	--
	Min 9.94E-05	--	5.42E-05	--	2.14E-05	--	<4.80E-05	7.10E-05	1.41E-06	6.33E-05	--
	Avg. 2.33E-04	2.37E-04	1.17E-04	8.84E-05	5.96E-05	8.57E-05	1.40E-04	1.10E-04	9.66E-05	8.39E-05	6.46E-04
Cs-137	Max 2.45E-03	--	2.18E-03	--	9.25E-04	--	7.10E-04	6.60E-04	8.19E-04	5.17E-04	--
	Min 1.07E-03	--	3.43E-04	--	2.64E-04	--	<1.70E-04	5.20E-04	3.74E-04	6.60E-04	--
	Avg. 1.62E-03	1.18E-03	1.00E-03	1.62E-03	5.34E-04	5.59E-04	3.50E-04	2.70E-04	6.33E-04	5.74E-04	4.14E-03
Pu-239	Max 1.96E-05	--	9.96E-06	--	6.68E-06	--	<1.90E-06	2.80E-06	1.55E-06	1.89E-06	--
	Min 3.31E-06	--	0.00E+00	--	1.12E-06	--	<5.50E-07	2.30E-06	0.00E+00	1.42E-06	--
	Avg. 1.19E-05	1.38E-05	5.46E-06	9.81E-06	4.55E-06	4.95E-06	9.60E-07	7.60E-07	7.24E-07	1.64E-06	2.36E-05
U (tot)	Max 7.94E-05	--	4.85E-05	--	4.87E-05	--	<8.60E-06	2.20E-05	4.07E-05	1.94E-05	--
	Min 3.18E-05	--	2.50E-05	--	-3.50E-06	--	<-5.10E-06	1.80E-05	0.00E+00	1.90E-05	--
	Avg. 5.25E-05	4.13E-05	3.30E-05	2.12E-05	1.75E-05	4.51E-05	-7.30E-07	6.50E-06	1.84E-05	1.85E-05	1.21E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N968: 200 East Area West Gate											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 3.29E-04	–	2.77E-04	–	9.28E-05	–	1.40E-04	1.20E-04	7.89E-05	7.85E-05	–
	Min 7.47E-05	–	8.69E-05	–	1.14E-05	–	<4.60E-05	7.20E-05	0.00E+00	6.10E-05	–
	Avg. 1.79E-04	2.38E-04	1.58E-04	1.76E-04	6.53E-05	7.48E-05	9.30E-05	4.70E-05	9.98E-06	6.26E-05	5.05E-04
Cs-137	Max 5.94E-04	–	1.64E-03	–	5.02E-04	–	<3.30E-04	5.40E-04	2.29E-04	4.59E-04	–
	Min 1.32E-04	–	9.55E-05	–	1.83E-04	–	<0.00E+00	4.90E-04	-5.88E-04	6.38E-04	–
	Avg. 3.71E-04	4.75E-04	5.99E-04	1.41E-03	3.49E-04	2.74E-04	4.70E-06	2.50E-04	-1.73E-04	5.28E-04	1.15E-03
Pu-239	Max 2.15E-05	–	7.35E-06	–	3.12E-05	–	6.20E-06	3.70E-06	2.67E-06	2.68E-06	–
	Min 8.83E-06	–	3.34E-06	–	-5.31E-07	–	<2.50E-08	1.20E-06	0.00E+00	1.65E-06	–
	Avg. 1.32E-05	1.15E-05	4.98E-06	3.52E-06	1.69E-05	2.93E-05	1.90E-06	3.20E-06	1.19E-06	1.95E-06	3.82E-05
U (tot)	Max 1.21E-04	–	8.66E-05	–	4.99E-05	–	4.10E-05	2.70E-05	6.99E-05	2.74E-05	–
	Min 3.77E-05	–	4.71E-05	–	2.03E-05	–	<-7.90E-06	1.80E-05	6.31E-06	2.03E-05	–
	Avg. 6.21E-05	7.89E-05	6.16E-05	3.47E-05	3.21E-05	2.62E-05	1.30E-05	2.30E-05	3.65E-05	2.34E-05	2.05E-04

Table A-2.4. Results of Air Monitoring (pCi/m³).

Location N157: 241-BY Tank Farm											
	1985		1986		1987		1988		1989		
Radio-nuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Average Result
Sr-90	Max 7.89E-04	--	1.56E-04	--	1.99E-04	--	1.70E-04	1.00E-04	1.87E-04	1.05E-04	--
	Min 1.05E-04	--	6.79E-05	--	7.89E-05	--	<6.70E-05	7.40E-05	5.78E-07	8.39E-05	--
	Avg. 3.82E-04	5.83E-04	1.11E-04	8.69E-05	1.37E-04	1.02E-04	1.30E-04	5.00E-05	1.35E-04	9.80E-05	8.95E-04
Cs-137	Max 4.02E-03	--	2.04E-03	--	2.09E-03	--	8.60E-04	6.70E-04	1.06E-03	6.94E-04	--
	Min 1.20E-03	--	-5.34E-04	--	2.56E-04	--	<-3.90E-04	6.70E-04	-6.81E-05	4.84E-04	--
	Avg. 2.27E-03	2.61E-03	8.17E-04	2.11E-03	9.92E-04	1.57E-03	3.40E-04	5.30E-04	4.29E-04	5.20E-04	4.85E-03
Pu-239	Max 8.68E-05	--	6.18E-06	--	1.01E-05	--	6.10E-06	3.80E-06	9.88E-04	1.06E-04	--
	Min 1.38E-05	--	1.83E-06	--	5.86E-07	--	<1.80E-07	3.00E-06	1.03E-06	1.87E-06	--
	Avg. 3.29E-05	7.19E-05	3.61E-06	3.72E-06	4.81E-06	9.77E-06	3.20E-06	2.60E-06	2.48E-04	2.82E-05	2.93E-04
U (tot)	Max 1.06E-04	--	6.86E-05	--	3.48E-05	--	<5.80E-06	2.00E-05	5.96E-05	2.43E-05	--
	Min 1.46E-05	--	2.12E-05	--	1.38E-06	--	<-8.90E-06	1.80E-05	0.00E+00	1.94E-05	--
	Avg. 5.31E-05	7.66E-05	4.57E-05	3.97E-05	1.74E-05	2.74E-05	-4.80E-06	7.20E-06	2.72E-05	2.14E-05	1.39E-04

Source: Schmidt et al. 1990: Elder et al. 1986, 1987, 1988, 1989.
Negative values indicate concentrations at or near background levels of radioactivity.
Shaded areas indicate a positive detection, the result is greater than the error.
An asterisk (*) indicates that radionuclide concentration is less than detectable. The detection limits are as follows: Mn-54=2.0E-02, Co-58=2.0E-02, Co-60=2.0E-02, Zn-65=4.0E-02, Sr-90=5.0E-03, Nb-95=3.0E-02, Zr-95=3.0E-02, Ru-106=1.7E-01, Cs-134=2.0E-02, Cs-137=2.0E-02, Eu-152=1.1E-01, Eu-154=5.0E-02, Eu-155=5.0E-02, Pu-238=6.0E-04, Pu-239=6.0E-04, and U (total) = 1.0E-02.

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APPENDIX B

HEALTH AND SAFETY PLAN

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1.0 GENERAL CONSIDERATIONS AND REQUIREMENTS

1.1 INTRODUCTION

The purpose of this Health and Safety Plan (HSP) is to outline standard health and safety procedures for Westinghouse Hanford employees and contractors engaged in investigation activities for the B Plant Aggregate Area Management Study (AAMS). These activities will include surface investigation, drilling and sampling boreholes, and environmental sampling in areas of known chemical and radiological contamination. Appropriate site-specific safety documents (e.g., Hazardous Waste Operations Permit [HWOP] or Job Safety Analysis [JSA]) will be written for each task or group of tasks. A more complete discussion of Westinghouse Hanford environmental safety procedures is presented in the Westinghouse Hanford manual *Health and Safety for Hazardous Waste Field Operations*, WHC-CM-4-3 Vol. 4 (WHC 1992).

All employees of Westinghouse Hanford or any other contractors who are participating in onsite activities for the B Plant AAMS shall read the site-specific safety document and attend a pre-job safety or tailgate meeting to review and discuss the task.

1.2 DESIGNATED SAFETY PERSONNEL

The field team leader and site safety officer are responsible for site safety and health. Specific individuals will be assigned on a task-by-task basis by project management, and their names will be properly recorded before the task is initiated.

All activities onsite must be cleared through the field team leader. The field team leader has responsibility for the following:

- Allocating and administering resources to successfully comply with all technical and health and safety requirements
- Verifying that all permits, supporting documentation, and clearances are in place (e.g., electrical outage requests, welding permits, excavation permits, HWOP or JSA, sampling plan, radiation work permits [RWPs], and onsite/offsite radiation shipping records)
- Providing technical advice during routine operations and emergencies
- Informing the appropriate site management and safety personnel of the activities to be performed each day
- Coordinating resolution of any conflicts that may arise between RWPs and the implementation of the HWOP or JSA with health physics

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- Handling emergency response situations as may be required
- Conducting pre-job and daily tailgate safety meetings
- Interacting with adjacent building occupants and/or inquisitive public.

The site safety officer is responsible for implementing the HWOP at the site. The site safety officer shall do the following:

- Monitor chemical, physical, and (in conjunction with the health physics technician) radiation hazards to assess the degree of hazard present; monitoring shall specifically include organic vapor detection, radiation screening, and confined space evaluation where appropriate.
- Determine protection levels, clothing, and equipment needed to ensure the safety of personnel in conjunction with the health physics department.
- Monitor the performance of all personnel to ensure that the required safety procedures are followed.
- Halt operations immediately, if necessary, due to safety or health concerns.
- Conduct safety briefings as necessary.
- Assist the field team leader in conducting safety briefings as necessary.

The health physics technician is responsible for ensuring that all radiological monitoring and protection procedures are being followed as specified in the Radiation Protection Manual and in the appropriate RWP. Westinghouse Hanford Industrial Safety and Fire Protection personnel will provide safety overview during drilling operations consistent with Westinghouse Hanford policy and, as requested, will provide technical advice. Also, downwind sampling for hazardous materials and radiological contaminants and other analyses may be requested from appropriate contractor personnel as required.

The ultimate responsibility and authority for employee's health and safety lies with the employee and the employee's colleagues. Each employee is responsible for exercising the utmost care and good judgment in protecting his or her personal health and safety and that of fellow employees. Should any employee observe a potentially unsafe condition or situation, it is the responsibility of that employee to immediately bring the observed condition to the attention of the appropriate health and safety personnel, as designated previously. In the event of an immediately dangerous or life-threatening situation, the employee automatically has temporary "stop work" authority and the responsibility to immediately notify the field team leader or site safety officer. When work is temporarily halted because of a safety or

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health concern, personnel will exit the exclusion zone and meet at a predetermined place in the support zone. The field team leader, site safety officer, and health physics technician will determine the next course of action.

1.3 MEDICAL SURVEILLANCE

All field team members engaged in operable unit activities at sites governed by an HWOP must have baseline physical examinations and be participants in Westinghouse Hanford (or an equivalent) hazardous waste worker medical surveillance program.

Medical examinations will be designed to identify any pre-existing conditions that may place an employee at high risk, and will verify that each worker is physically able to perform the work required by this plan without undue risk to personal health. The physician shall determine the existence of conditions that may reduce the effectiveness or prevent the employee's use of respiratory protection. The physician shall also determine the presence of conditions that may pose undue risk to the employee while performing the physical tasks of this work plan using level B personal protection equipment. This would include any condition that increases the employee's susceptibility to heat stress.

The examining physician's report will not include any nonoccupational diagnoses unless directly applicable to the employee's fitness for the work required.

1.4 TRAINING

Before engaging in any onsite activities, each team member is required to have received 40 hours of health and safety training related to hazardous waste site operations and at least 8 hours of refresher training each year thereafter as specified in 29 Code of Federal Regulations (CFR) 1910.120. In addition, each inexperienced employee (never having performed site characterization) will be directly supervised by a trained/experienced person for a minimum of 24 hours of field experience.

The field team leader and the site safety officer shall receive an additional 8 hours of training (in addition to the refresher training previously discussed).

1.5 TRAINING FOR VISITORS

For the purposes of this plan, a visitor is defined as any person visiting the Hanford Site, who is not a Westinghouse Hanford employee or a Westinghouse Hanford contractor directly involved in the Resource Conservation and Recovery Act (RCRA)/Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) facility investigation activities, including but not limited to those engaged in surveillance, inspection, or observation activities.

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Visitors who must, for whatever reason, enter a controlled (either contamination reduction or exclusion) zone, shall be subject to all of the applicable training, respirator fit testing, and medical surveillance requirements discussed in Westinghouse Hanford Environmental Investigations Instructions (EII) 1.1 and Appendix B to EII 1.1 (WHC 1991).

All visitors shall be informed of potential hazards and emergency procedures by their escorts and shall conform to EII 1.1 (WHC 1991).

1.6 RADIATION DOSIMETRY

All personnel engaged in onsite activities shall be assigned dosimeters according to the requirements of the RWP applicable to that activity. All visitors shall be assigned basic dosimeters, as a minimum, that will be exchanged annually.

1.7 REQUIREMENTS FOR THE USE OF RESPIRATORY PROTECTION

All employees of Westinghouse Hanford and subcontractors who may be required to use air-purifying or air-supplied respirators must be included in the medical surveillance program and be approved for the use of respiratory protection by the Hanford Environmental Health Foundation (HEHF) or other licensed physician. Each team member must be trained in the selection, limitations, and proper use and maintenance of respiratory protection (existing respiratory protection training may be applicable towards the 40-hour training requirement).

Before using a negative pressure respirator, each employee must have been fit-tested (within the previous year) for the specific make, model, and size according to Westinghouse Hanford fit-testing procedures. Beards (including a few days' growth), large sideburns, or moustaches that may interfere with a proper respirator seal are not permitted.

Subcontractors must provide evidence to Westinghouse Hanford that personnel are participants in a medical surveillance and respiratory protection program that complies with 29 CFR 1910.120 and 29 CFR 1910.134, respectively.

2.0 GENERAL PROCEDURES

The following personal hygiene and work practice guidelines are intended to prevent injuries and adverse health effects. A hazardous waste site poses a multitude of health and safety concerns because of the variety and number of hazardous substances present. These guidelines represent the minimum standard procedures for reducing potential risks associated with this project and are to be followed by all job-site employees at all times.

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2.1 GENERAL WORK SAFETY PRACTICES

2.1.1 Work Practices

The following work practices must be observed:

- Eating, drinking, smoking, taking certain medications, chewing gum, and similar actions are prohibited within the exclusion zone. All sanitation facilities shall be located outside the exclusion zone; decontamination is required before using such facilities.

- Personnel shall avoid direct contact with contaminated materials unless necessary for sample collecting or required observation. Remote handling of such things as casings and auger flights will be practiced whenever practical.

- While operating in the controlled zone, personnel shall use the "buddy system" where appropriate, or be in visual contact with someone outside of the controlled zone.

- The buddy system will be used where appropriate for manual lifting.

- Requirements of Westinghouse Hanford radiation protection and RWP manuals shall be followed for all work involving radioactive materials or conducted within a radiologically controlled area.

- Onsite work operations shall only be carried out during daylight hours, unless the entire control zone is adequately illuminated with artificial lighting. A new tour (shift) will operate the drilling rig after completion of each shift.

- Do not handle soil, waste samples, or any other potentially contaminated items unless wearing the protective equipment specified in the HWOP or JSA.

- Whenever possible, stand upwind of excavations, boreholes, well casings, drilling spoils, and the like, as indicated by an onsite windsock.

- Stand clear of trenches during excavation. Always approach an excavation from upwind.

- Be alert to potentially changing exposure conditions as evidenced by such indications as perceptible odors, unusual appearance of excavated soils, or oily sheen on water.

- Do not enter any test pit or trench deeper than 1.2 m (4 ft) unless in accordance with procedures specified in the HWOP.

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- Do not under any circumstances enter or ride in or on any backhoe bucket, materials hoist, or any other similar device not specifically designed for carrying passengers.

- All drilling team members must make a conscientious effort to remain aware of their own and others' positions in regards to rotating equipment, cat heads, or u-joints. Drilling operations members must be extremely careful when assembling, lifting, and carrying flights or pipe to avoid pinch-point injuries and collisions.

- Tools and equipment will be kept off the ground whenever possible to avoid tripping hazards and the spread of contamination.

- Personnel not involved in operation of the drill rig or monitoring activities shall remain a safe distance from the rig as indicated by the field team leader.

- Follow all provisions of each site-specific hazardous work permit as addressed in the HWOP, including cutting and welding, confined space entry, and excavation.

- Catalytic converters on the underside of vehicles are sufficiently hot to ignite dry prairie grass. Team members should not drive over dry grass that is higher than the ground clearance of the vehicle and should be aware of the potential fire hazard posed by catalytic converters at all times. Never allow a running or hot vehicle to sit in a stationary location over dry grass or other combustible materials.

- Follow all provisions of each site-specific RWP.

- Team members will attempt to minimize truck tire disturbance of all stabilized sites.

2.1.2 Personal Protective Equipment

- Personal protective equipment will be selected specifically for the hazards identified in the HWOP. The site safety officer in conjunction with Westinghouse Hanford Health Physics and Industrial Hygiene and Safety is responsible for choosing the appropriate type and level of protection required for different activities at the job site.

- Levels of protection shall be appropriate to the hazard to avoid either excessive exposure or additional hazards imposed by excessive levels of protection. The HWOP will contain provisions for adjusting the level of protection as necessary.

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These personal protective equipment specifications must be followed at all times, as directed by the field team leader, health physics technician, and site safety officer.

- Each employee must have a hard hat, safety glasses, and substantial protective footwear available to wear as specified in the HWOP or JSA.

- The exclusion zone around drilling or other noisy operations will be posted "Hearing Protection Required" and team members will have had noise control training.

- Personnel should maintain a high level of awareness of the limitations in mobility, dexterity, and visual impairment inherent in the use of level B and level C personal protective equipment.

- Personnel should be alert to the symptoms of fatigue, heat stress, and cold stress and their effects on the normal caution and judgment of personnel.

- Rescue equipment as required by Occupational Safety and Health Administration (OSHA), Washington Industrial Safety and Health Act (WISHA), or standards for working over water will be available and used.

2.1.3 Personal Decontamination

- The HWOP will describe in detail methods of personnel decontamination, including the use of contamination control corridors and step-off pads when appropriate.

- Thoroughly wash hands and face before eating or putting anything in the mouth to avoid hand-to-mouth contamination.

- At the end of each work day or each job, disposable clothing shall be removed and placed in (chemical contamination) drums, plastic-lined boxes or other containers as appropriate. Clothing that can be cleaned may be sent to the Hanford Site laundry.

- Individuals are expected to thoroughly shower before leaving the work site or Hanford Site if directed to do so by the health physics technician, site safety officer, or field team leader.

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2.1.4 Emergency Preparation

- A multipurpose dry chemical fire extinguisher, a fire shovel, a complete field first-aid kit, and a portable pressurized spray wash unit shall be available at every site where there is potential for personnel contamination.

- Prearranged hand signals or other means of emergency communication will be established when respiratory protection equipment is to be worn, because this equipment seriously impairs speech.

- The Hanford Fire Department shall be initially notified before the start of the site investigation project. This notification shall include the location and nature of the various types of field work activities as described in the work plan. A site location map shall be included in this notification.

2.2 CONFINED SPACE/TEST PIT ENTRY PROCEDURES

The following procedures apply to the entry of any confined space, which for the purpose of this document shall be defined as any space having limited egress (access to an exit) and the potential for the presence or accumulation of a toxic or explosive atmosphere. This includes manholes, certain trenches (particularly those through waste disposal areas), and all test pits greater than 1 m (4 ft) deep. If confined spaces are to be entered as part of the work operations, a hazardous work permit (filled out for confined space entry) must be obtained from Industrial Safety and Fire Protection.

The identified remedial investigation activities on the B Plant AAMS should not require confined space entry. Nevertheless, the hazards associated with confined spaces are of such severity that all employees should be familiar with the safe work discussed in the following paragraphs.

No employee shall enter any test pit or trench deeper than 1 m (4 ft) unless the sides are shored or laid back to a stable slope as specified in OSHA 29 CFR 1926.652 or equivalent state occupational health and safety regulations.

When an employee is required to enter a pit or trench 1 m (4 ft) deep or more, an adequate means of access and egress, such as a slope of at least 2:1 to the bottom of the pit or a secure ladder or steps shall be provided.

Before entering any confined space, <u>including any test pit</u>, the atmosphere will be tested for flammable gases, oxygen deficiency, and organic vapors. If other specific contamination, such as radioactive materials or other gases and vapors may be present, additional testing for those substances shall be conducted. Depending on the situation, the space may require ventilation and retesting before entry.

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An employee entering a confined or partially confined space must be equipped with an appropriate level of respiratory protection in keeping with the monitoring procedures discussed previously and the action levels for airborne contaminants (see "Warnings and Action Levels" in HWOP).

No employee shall enter any test pit requiring the use of level B protection, unless a backup person also equipped with a pressure-demand self-contained breathing apparatus (SCBA) is present. No backup person shall attempt any emergency rescue unless a second backup person equipped with an SCBA is present, or the appropriate emergency response authorities have been notified and additional help is on the way.

3.0 SITE BACKGROUND

Specific details on the B Plant AAMS background and known and suspected contamination are described in Sections 2.0 through 10.0 of the plan. The B Plant Aggregate Area is situated within the 200 East Area of the U.S. Department of Energy's (DOE) Hanford Site, in the south-central portion of the state of Washington. The 200 East Area is located in Benton County in the central portion of the Hanford Site. It is adjacent to the 200 West Area, located roughly 5 km (3 mi) to the east.

The B Plant Aggregate Area at the Hanford Site was used by the U.S. Government as a chemical separations area in the process to produce plutonium for nuclear weapons. These operations resulted in the release of chemical and radioactive wastes into the soil, air, and water of the area. Each waste site in the aggregate area is described separately in this document. Close relationships between waste units, such as overflow from one to another, are also discussed.

4.0 SCOPE OF WORK AND POTENTIAL HAZARDS

While the information presented in Sections 2.0 through 10.0 of the plan are believed to be representative of the constituents and quantities of wastes at the time of discharge, the present chemical nature, location, extent, and ultimate fate of these wastes in and around the liquid disposal facilities are largely unknown. The emphasis of the investigation in the B Plant AAMS will be to characterize the nature and extent of contamination in the vadose (unsaturated subsurface soil) zone.

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4.1 WORK TASKS

Work tasks are described in Section 5.0 of the plan.

4.2 POTENTIAL HAZARDS

Onsite tasks will involve noninvasive surface sampling procedures and invasive soil sampling either directly in or immediately adjacent to areas known or suspected to contain potentially hazardous chemical substances, toxic metals, and radioactive materials.

Surface radiological contamination and fugitive dust will be the potential hazards of primary concern during noninvasive mapping and sampling activities.

Existing data indicate that hazardous substances may be encountered during invasive sampling; these include radionuclides, heavy metals, and corrosives. In addition, volatile organics may also be associated with certain facilities such as the solvent storage buildings or underground storage tanks.

Potential hazards include the following:

- External radiation (gamma and to a lesser extract, beta) from radioactive materials in the soil
- Internal radiation resulting from radionuclides present in contaminated soil entering the body by ingestion or through open cuts and scratches
- Internal radiation resulting from inhalation of particulate (dust) contaminated with radioactive materials
- Inhalation of toxic vapors or gases such as volatile organics or ammonia
- Inhalation or ingestion of particulate (dust) contaminated with inorganic or organic chemicals, and toxic metals
- Dermal exposure to soil or groundwater contaminated with radionuclides
- Dermal exposure to soil or groundwater contaminated with inorganic or organic chemicals, and toxic metals
- Physical hazards such as noise, heat stress, and cold stress
- Slips, trips, falls, bumps, cuts, pinch points, falling objects, other overhead hazards, crushing injuries, and other hazards typical of a construction-related job site

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- Unknown or unexpected underground utilities
- Biological hazards; snakes, spiders, etc.

4.3 ASSESSMENT AND MITIGATION OF POTENTIAL HAZARDS

The likelihood of significant exposure (100 mR/h or greater) to external radiation is remote and can be readily monitored and controlled by limiting exposure time, increasing distance, and employing shielding as required.

Internal radiation by inhalation or inadvertent ingestion of contaminated dust is a realistic concern and must be continuously evaluated by the health physics technician. Appropriate respiratory protection, protective clothing, and decontamination procedures will be implemented as necessary to reduce potential inhalation, ingestion, and dermal exposure to acceptable levels.

Dermal exposure to toxic chemical substances is not expected to pose a significant problem for the identified tasks given the use of the designated protective clothing. The appropriate level of personal protective clothing and respiratory protection will vary from work site to work site.

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5.0 ENVIRONMENTAL AND PERSONAL MONITORING

The site safety officer or authorized delegate shall be present at all times during work activities which require an HWOP, and shall be in charge of all environmental/personal monitoring equipment. Industrial Hygiene and Safety shall review all activities involving or potentially involving radiological exposure or contamination control and shall prescribe the appropriate level of technical support and/or monitoring requirements. Other equipment deemed necessary by the site safety officer or Industrial Hygiene and Safety shall be obtained at their direction; work will be initiated or continued until such equipment is in place. These instruments are to be used only by persons who are trained in their usage and who understand their limitations. No work shall be done unless instrumentation is available and in proper working order.

Air sampling may be required downwind of the referenced waste sites to monitor particulates and vapors before job startup. Siting of such sampling devices will be determined by Health Physics, the site safety officer, and HEHF, if appropriate. Any time personnel exposure monitoring, other than radiological, is required to determine exposure levels, it must be done by HEHF. Discrete sampling of ambient air within the work zone and breathing zones will be conducted using a direct-reading instrument, as specified in the

site-specific safety document, and other methods as deemed appropriate (e.g., pumps with tubes, O_2 meters). The following standards will be used in determining critical levels:

- "Radionuclide Concentrations in Air," in Chapter XI, DOE Order 5480.1B (DOE 1986)
- "Air Contaminants - Permissible Exposure Limits," in 29 CFR 1910.1000
- *Threshold Limit Values and Biological Exposure Indices for 1990-1991* (ACGIH 1991)
- *Occupational Safety and Health Standards*, 29 CFR 1910.1000
- *Pocket Guide to Chemical Hazards* (NIOSH 1991), which provides National Institute for Occupational Safety and Health (NIOSH)-recommended exposure limits for substances that do not have either a threshold limit value or a permissible exposure limit.

5.1 AIRBORNE RADIOACTIVE AND RADIATION MONITORING

An onsite health physics technician will monitor airborne radioactive contamination levels and external radiation levels. Action levels will be consistent with derived air concentrations and applicable guidelines as specified in the radiation protection manual WHC-CM-4-10 (WHC 1988).

Appropriate respiratory protection shall be required when conditions are such that the airborne contamination levels may exceed an 8-hour derived air concentration (e.g., the presence of high levels of uncontained, loose contamination on exposed surfaces or operations that may raise excessive levels of dust contaminated with airborne radioactive materials, such as excavation or drilling under extremely dry conditions).

Specific conditions requiring the use of respiratory protection because of radioactive materials in air will be incorporated into the RWP. If, in the judgment of the health physics technician, any of these conditions arise, work shall cease until appropriate respiratory protection is provided.

6.0 PERSONAL PROTECTIVE EQUIPMENT

The level of personal protective equipment required initially at a site will be specified in the site-specific safety document for each task or group of tasks. Personal protective

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clothing and respiratory protection shall be selected to limit exposure to anticipated chemical and radiological hazards. Work practices and engineering controls may be used to control exposure.

7.0 SITE CONTROL

The field team leader, site safety officer, and health physics technician are designated to coordinate access control and security on the site. Special site control measures will be necessary to restrict public access. The zones will be clearly marked with rope and/or appropriate signs. The size and shape of the control zone will be dictated by the types of hazards expected, the climatic conditions, and specific operations required.

Control zone boundaries may be increased or decreased based on results of field monitoring, environmental changes, or work technique changes. The site RWP and the contractor's standard operating procedures for radiation protection may also dictate the boundary size and shape. All team members must be surveyed for radioactive contamination when leaving the controlled zone if in a radiation zone.

The onsite command post and staging area will be established near the upwind side of the control zone as determined by an onsite windsock. Exact location for the command post is to be determined just before start of work. Vehicle access, availability of utilities (power and telephone), wind direction, and proximity to sample locations should be considered in establishing a command post location.

8.0 DECONTAMINATION PROCEDURES

Remedial investigation activities will require entry into areas of known chemical and radiological contamination. Consequently, it is possible that personnel and equipment could be contaminated with hazardous chemical and radiological substances.

During site activities, potential sources of contamination may include airborne vapors, gases, dust, mists, and aerosols; splashes and spills; walking through contaminated areas; and handling contaminated equipment. Personnel who enter the exclusion zone will be required to go through the appropriate decontamination procedures on leaving the zone. Decontamination procedures shall be consistent with EII 5.4, "Field Decontamination of Drilling, Well Development, and Sampling Equipment," and EII 5.5, "Decontamination of Equipment for RCRA/CERCLA Sampling" (WHC 1991), or other approved decontamination procedures.

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9.0 CONTINGENCY AND EMERGENCY RESPONSE PLANS

As a general rule, in the event of an unanticipated, potentially hazardous situation indicated by instrument readings, visible contamination, unusual or excessive odors, or other indications, team members shall temporarily cease operations and move upwind to a predesignated safe area as specified in the site-specific safety documentation.

10.0 REFERENCES

ACGIH, 1991, *Threshold Limit Values and Biological Exposure Indices for 1990-1991*, American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio.

DOE, 1986, *Environment, Safety & Health Program for DOE Operations*, DOE Order 5480.1B, U.S. Department of Energy, Washington, D.C.

NIOSH, 1991, *Pocket Guide to Chemical Hazards, National Institute for Occupational Safety and Health*, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Washington, D.C.

WHC, 1988, *Radiation Protection*, WHC-CM-4-10, Westinghouse Hanford Company, Richland, Washington.

WHC, 1991, *Environmental Investigations and Site Characterization Manual*, WHC-CM-7-7, Westinghouse Hanford Company, Richland, Washington.

WHC, 1992, *Health and Safety for Hazardous Waste Field Operations*, WHC-CM-4-3, Vol. 4, Westinghouse Hanford Company, Richland, Washington.

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APPENDIX C

PROJECT MANAGEMENT PLAN

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1.0 INTRODUCTION

This Project Management Plan (PMP) defines the administrative and institutional tasks necessary to support the B Plant Aggregate Area investigations at the Hanford Site. Also, this PMP defines the responsibilities of the various participants, the organizational structure, and the project tracking and reporting procedures. This PMP is in accordance with the provisions of the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) dated August 1990 (Ecology et al. 1990). Any revisions to the Tri-Party Agreement that would result in changes to the project management requirements would supersede the provisions of this chapter.

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 INTERFACE OF REGULATORY AUTHORITIES AND THE U.S. DEPARTMENT OF ENERGY

The B Plant Aggregate Area consists of active and inactive waste management units to be remedied under either the Resource Conservation and Recovery Act (RCRA) or the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA). The U.S. Environmental Protection Agency (EPA) has been designated as the lead regulatory agency, as defined in the Tri-Party Agreement. Accordingly, EPA is responsible for overseeing remedial action activity at this aggregate area and ensuring that the applicable authorities of both the Washington State Department of Ecology (Ecology) and the U.S. Department of Energy (DOE) are applied. The specific responsibilities of EPA, Ecology, and DOE are detailed in the Tri-Party Agreement.

2.2 PROJECT ORGANIZATION AND RESPONSIBILITIES

The project organization for implementing remedial activities at the B Plant Aggregate Area is shown in Figure C-1. The following sections describe the responsibilities of the individuals shown in Figure C-1.

2.2.1 Project Managers

The EPA, DOE, and Ecology have each designated one individual as project manager for remedial activities at the Hanford Site. These project managers will serve as the primary point of contact for all activities to be carried out under the Tri-Party Agreement. The responsibilities of the project managers are given in Section 4.1 of the Tri-Party Agreement.

2.2.2 Unit Managers

As shown in Figure C-1, EPA, DOE, and Ecology will each designate an individual as a unit manager for the B Plant Aggregate Area.

The unit manager from EPA will serve as the lead unit manager. The EPA unit manager will be responsible for regulatory oversight of all activities required for the B Plant Aggregate Area.

The unit manager from Ecology will be responsible for making decisions related to issues for which the supporting regulatory agency maintains authority. All such decisions will be made in consideration of recommendations made by the EPA unit manager.

The unit manager from DOE will be responsible for maintaining and controlling the schedule and budget and keeping the EPA and Ecology unit managers informed as to the status of the activities at the B Plant Aggregate Area, particularly the status of agreements and commitments.

2.2.3 Quality Assurance Lead

The quality assurance lead will be a designated person within the Westinghouse Hanford Quality Assurance Organization. This designated person will be responsible for monitoring overall environmental restoration activities for this project. The designated personnel shall have the necessary organizational independence and authority to identify conditions adverse to quality and to systematically seek corrective action.

This individual is responsible for the preplanned surveillance and audit activities for this project. A quality assurance report shall be provided to the technical lead, annually as a minimum, for inclusion in the project final report generated by the technical organization. The quality assurance report shall summarize the surveillance and audit activities as well as associated corrective actions that may have been taken during the interval.

2.2.4 Health and Safety Officer (Environmental Division/ Environmental Field Services)

The health and safety officer is responsible for monitoring all potential health and safety hazards, including those associated with radioactive, volatile, and/or toxic compounds during sample handling and sampling decontamination activities. The health and safety officer has the responsibility and authority to halt field activities resulting from unacceptable health and safety hazards.

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2.2.5 Technical Lead

The technical lead will be a designated person within the Westinghouse Hanford Environmental Engineering Group. The responsibilities of the technical lead will be to plan, authorize, and control work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound.

2.2.6 Remedial Investigation/Feasibility Study Coordinators

The remedial investigation (RI) and feasibility study (FS) coordinators will be responsible for coordinating all activities related to the RI and FS, respectively, including data collection, analysis, and reporting. The RI and FS coordinators will be responsible for keeping the technical lead informed as to the RI and FS work status and any problems that may arise.

2.2.7 Resource Conservation and Recovery Act Facility Investigation/ Corrective Measures Study Contractor

Figure C-1 shows the organizational relationship of an offsite contractor. Assuming a contractor is used to perform the RI/FS for the B Plant Aggregate Area, the contractor would assume responsibilities of the RI and FS coordinators, as described above. In this instance, the contractor will be directly responsible for planning data collection activities and for analyzing and reporting the results of the data-gathering in the RI and FS reports. However, the Westinghouse Hanford coordinator would retain the responsibility for securing and managing the field sampling efforts of the Hanford Site technical resource teams, described below. Figure C-2 shows a sample organizational structure for an RI/FS contractor team.

2.2.8 Hanford Site Technical Resources

The various technical resources available on the Hanford Site for performing the field studies are shown in Table C-1. These resources will be responsible for performing data collection activities and analyses, and for reporting the results of specific technical activities. Figures C-3 through C-6 show the detailed organizational structure of specific technical teams. Internal and external work orders and subcontractor task orders will be written by the Westinghouse Hanford technical lead to use these technical resources, which are under the control of the technical lead. Statements of work will be provided to the technical teams and will include a discussion of authority and responsibility, a schedule with clearly defined milestones, and a task description including specific requirements. Each technical team will keep the coordinator informed of the work status performed by that group and any problems that may arise.

3.0 DOCUMENTATION AND RECORDS

All plans and reports will be categorized as either primary or secondary documents as described by Section 9.1 of the Tri-Party Agreement. The process for document review and comment will be as described in Section 9.2 of the Tri-Party Agreement. Revisions, should they become necessary after finalization of any document, will be in accordance with Section 9.3 of the Tri-Party Agreement. Changes in the work schedule, as well as minor field changes, can be made without having to process a formal revision. The process for making these changes will be as stated in Section 12.0 of the Tri-Party Agreement. Administrative records, which must be maintained to support the Hanford Site activities, will be in accordance with Section 9.4 of the Tri-Party Agreement.

4.0 FINANCIAL AND PROJECT TRACKING REQUIREMENTS

4.1 MANAGEMENT CONTROL

Westinghouse Hanford will have the overall responsibility for planning and controlling the investigation activities, and providing effective technical, cost, and schedule baseline management. If a contractor is used, the contractor will assume the direct day-to-day responsibilities for these management functions. The management control system used for this project must meet the requirements of DOE Order 4700.1, Project Management System and DOE Order 2250.1C, Cost and Schedule Control Systems Criteria. The Westinghouse Hanford Management Control System (MCS) meets these requirements. The primary goals of the Westinghouse Hanford MCS are to provide methods for planning, authorizing, and controlling work so that it can be completed on schedule and within budget, and to ensure that all planning and work performance activities are technically sound and in conformance with management and quality requirements.

The schedule developed for the B Plant Aggregate Area will be updated at least annually, to expand the new current fiscal year and the follow-on year. In addition, any approved schedule changes (see Section 12.0 of the Tri-Party Agreement for the formal change control system) would be incorporated at this time, if not previously incorporated. This update will be performed in the fourth quarter of the previous fiscal year (e.g., July to September) for the upcoming current fiscal year. The work schedule can be revised at any time during the year if the need arises, but the changes would be restricted to major changes that would not be suitable for the change control process.

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4.2 MEETINGS AND PROGRESS REPORTS

Both project and unit managers must meet periodically to discuss progress, review plans, and address any issues that have arisen. The project managers' meeting will take place at least quarterly, and is discussed in Section 8.1 of the Tri-Party Agreement.

Unit managers shall meet monthly to discuss progress, address issues, and review near-term plans pertaining to their respective operable units and/or treatment, storage, and disposal groups/units. The meetings shall be technical in nature, with emphasis on technical issues and work progress. The assigned DOE unit manager for the B Plant Aggregate Area will be responsible for preparing revisions to the aggregate area schedule prior to the meeting. The schedule shall address all ongoing activities associated with the B Plant Aggregate Area, including actions on specific source units (e.g., sampling). This schedule will be provided to all parties and reviewed at the meeting. Any agreements and commitments (within the unit manager's level of authority) resulting from the meeting will be prepared and signed by all parties as soon as possible after the meeting. Meeting minutes will be issued by the DOE unit manager and will summarize the discussion at the meeting, with information copies given to the project managers. The minutes will be issued within five working days following the meeting. The minutes will include, at a minimum, the following information:

- Status of previous agreements and commitments
- Any new agreements and commitments
- Schedules (with current status noted)
- Any approved changes signed off at the meeting in accordance with Section 12.1 of the Tri-Party Agreement.

Project coordinators for each operable unit also will meet on a monthly basis to share information and to discuss progress and problems.

The DOE shall issue a quarterly progress report for the Hanford Site within 45 days following the end of each quarter. Quarters end on March 31, June 30, September 30, and December 31. The quarterly progress reports will be placed in the public information repositories as discussed in Section 10.2 of the Tri-Party Agreement. The report shall include the following:

- Highlights of significant progress and problems.
- Technical progress with supporting information, as appropriate.

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- Problem areas with recommended solutions. This will include any anticipated delays in meeting schedules, the reason(s) for the potential delay, and actions to prevent or minimize the delay.

- Significant activities planned for the next quarter.

- Work schedules (with current status noted).

5.0 REFERENCES

Ecology, EPA, and DOE, 1990, *Hanford Federal Facility Agreement and Consent Order*, (First Amendment), 89-10, Rev.1, Olympia, Washington.

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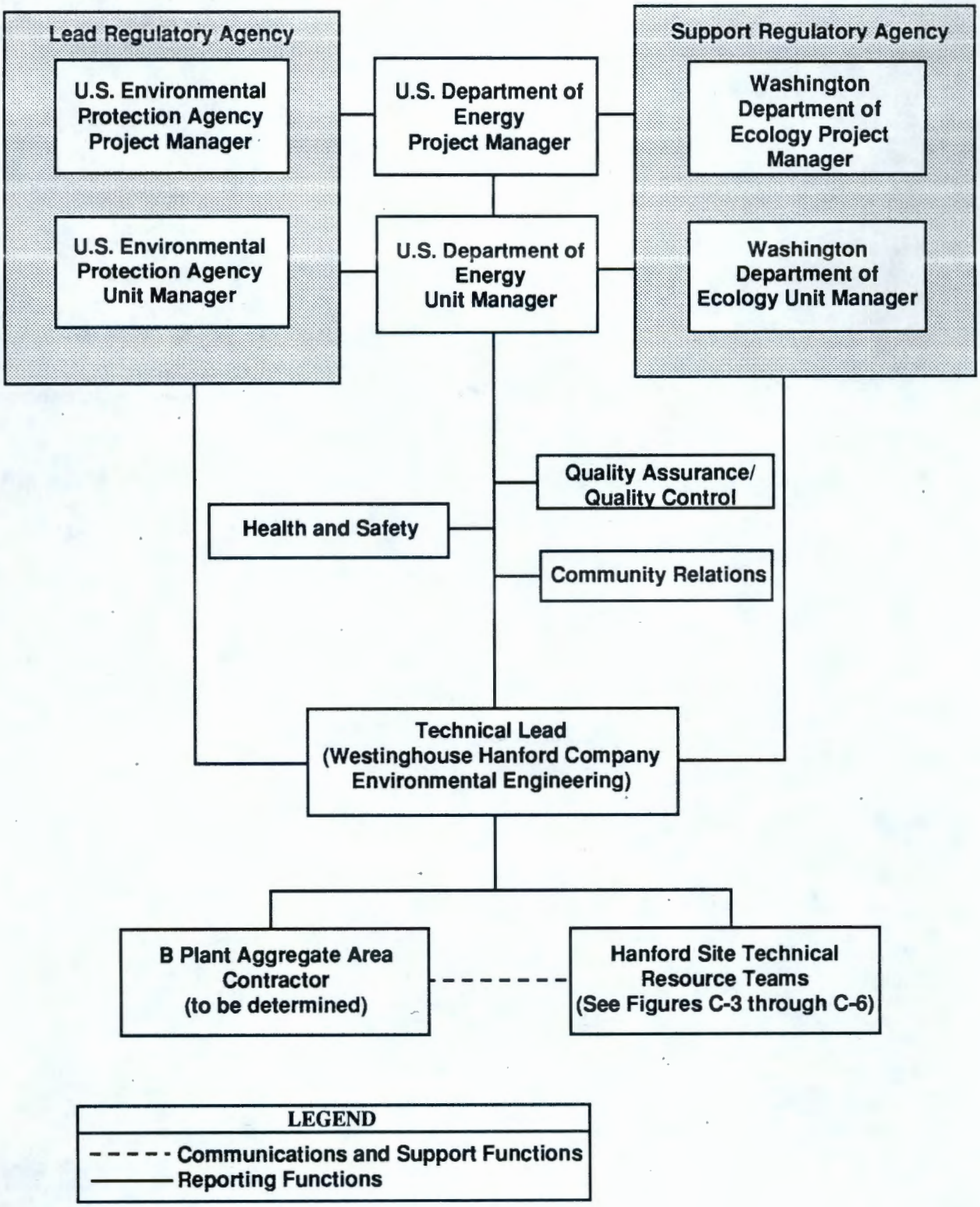
Figure C-1. Project Organization for the B Plant Aggregate Area Project.



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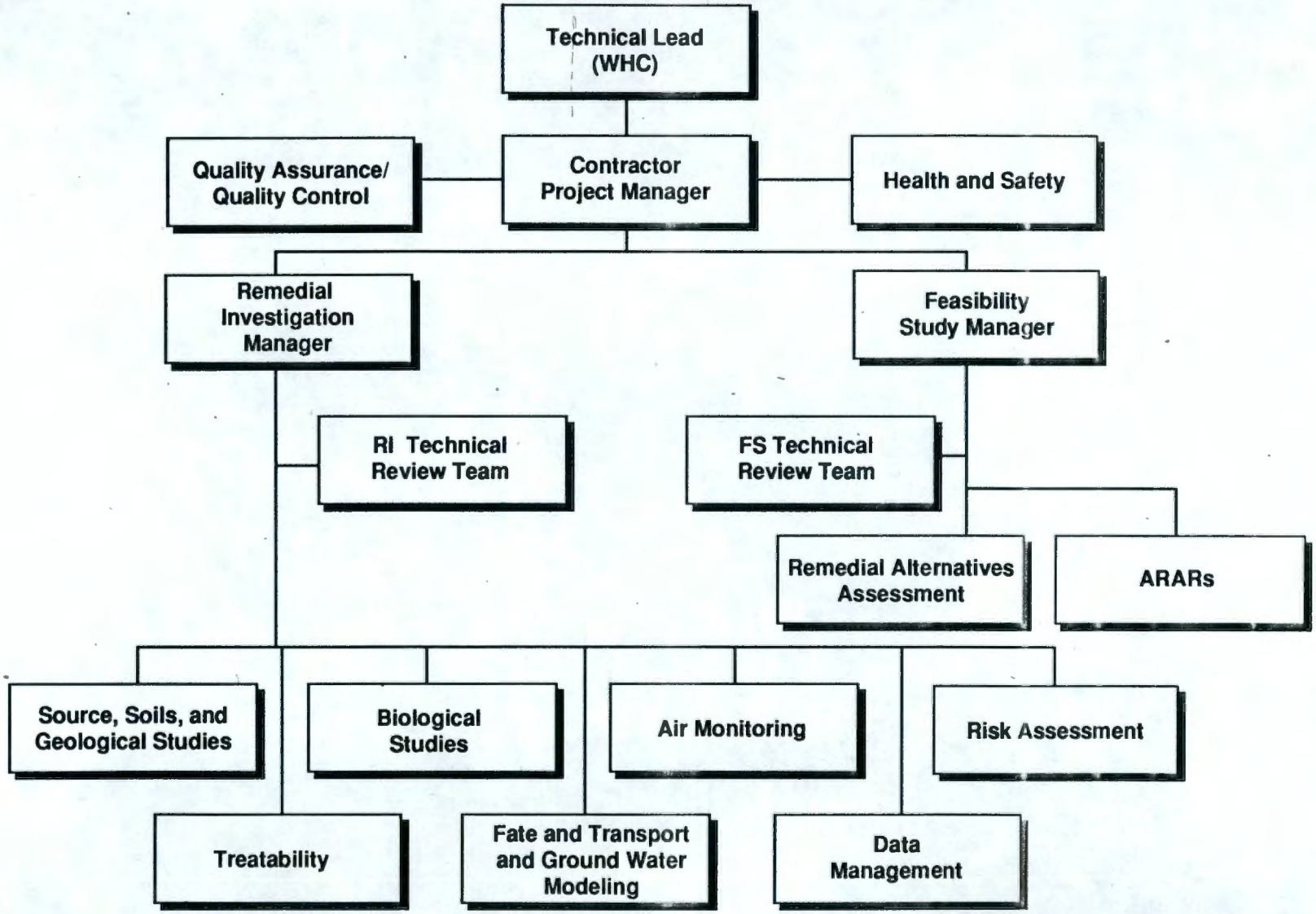

Figure C-2. Example Project Organization for the B Plant Aggregate Area.

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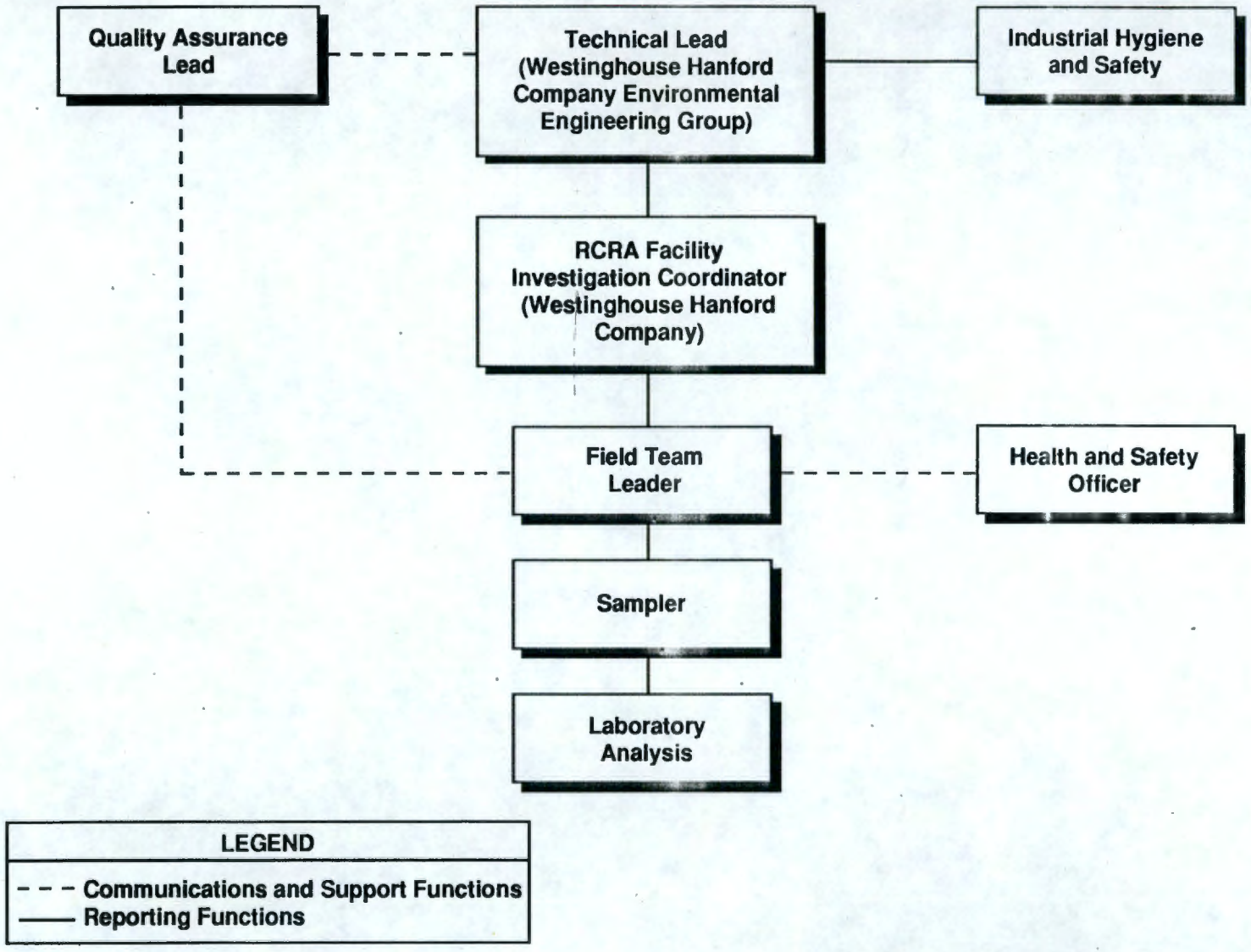

Figure C-3. The Hanford Site Soil Sampling Team.

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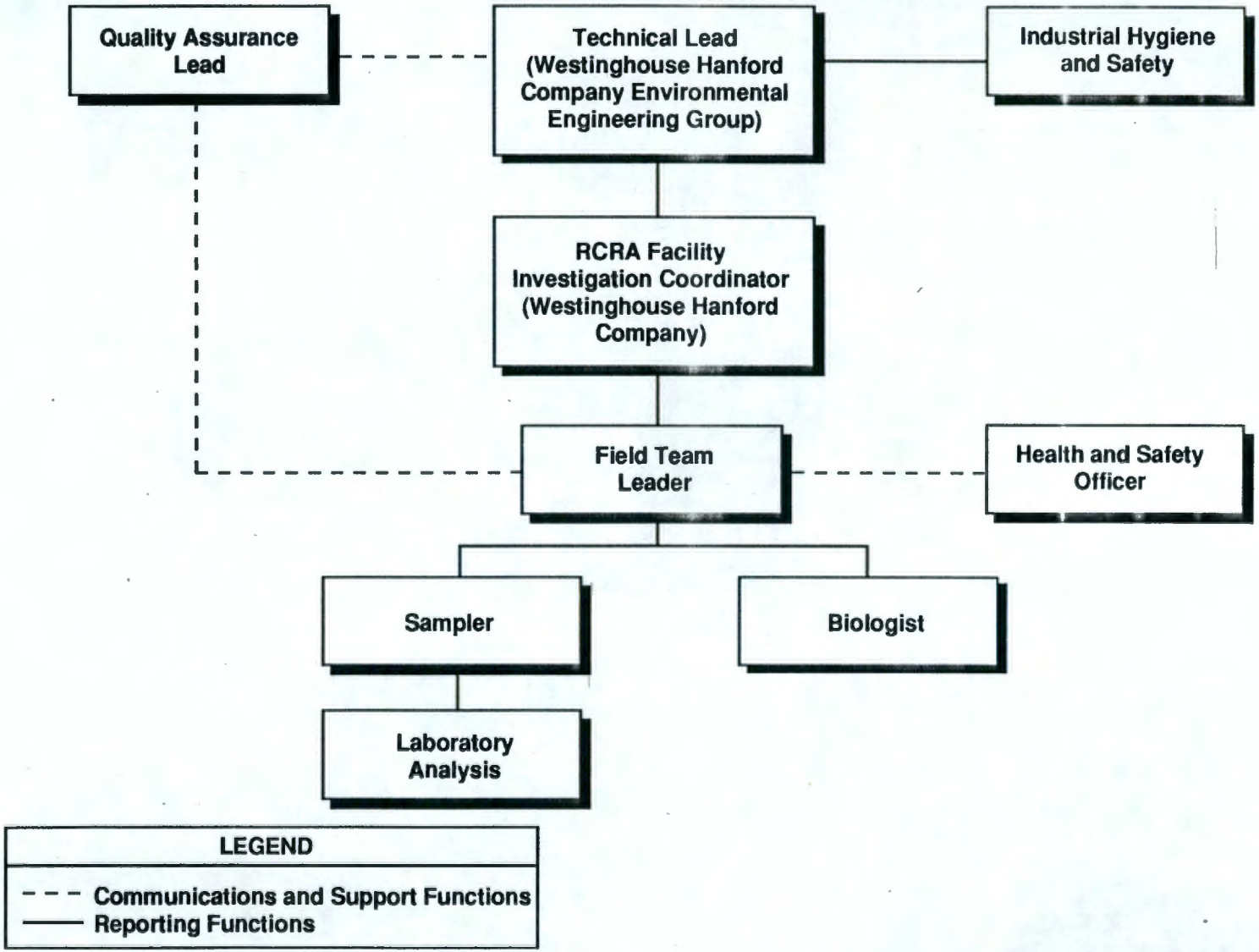

Figure C-4. The Hanford Site Biological Sampling Team.

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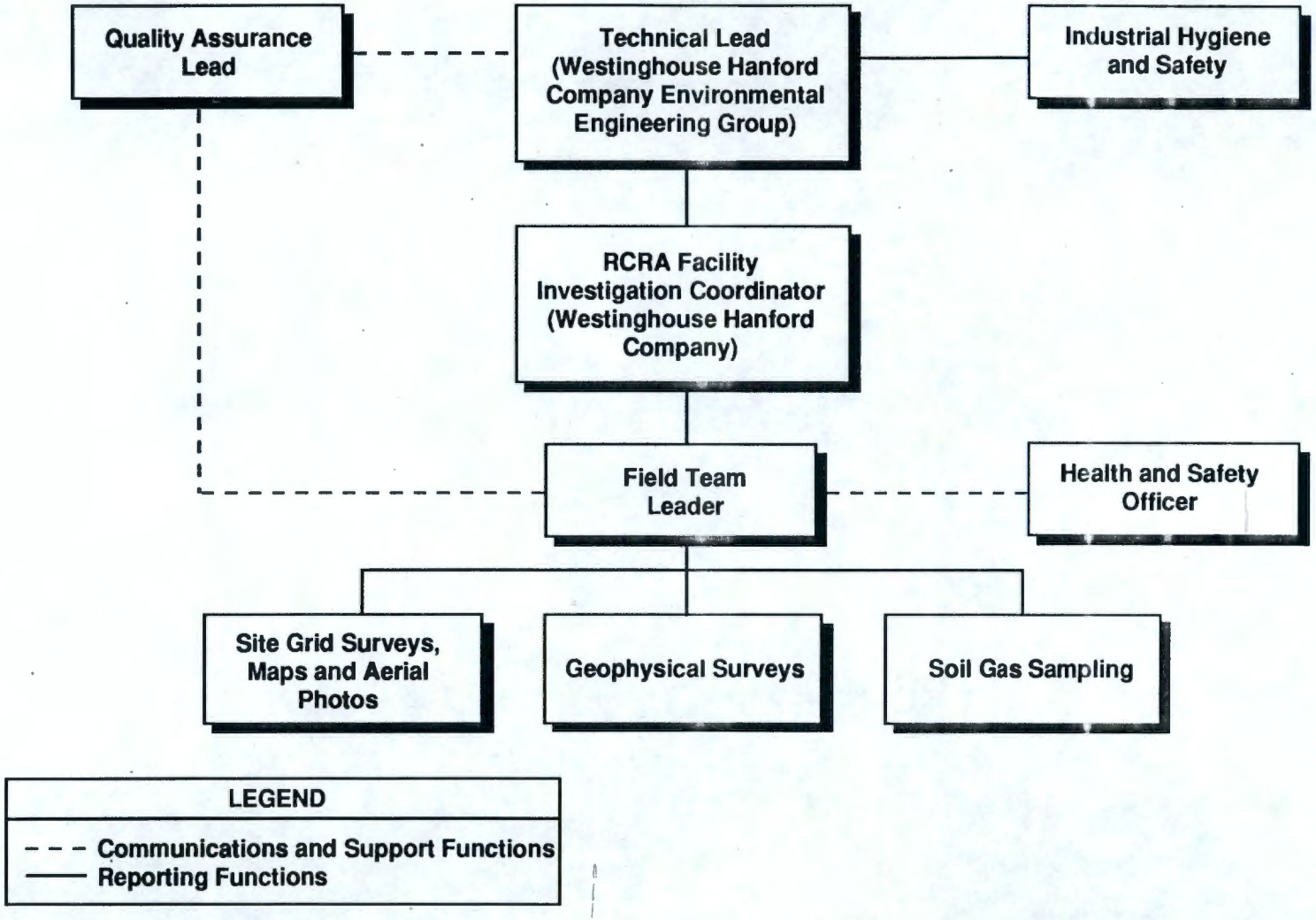

Figure C-5. The Hanford Site Physical and Geophysical Survey Team.

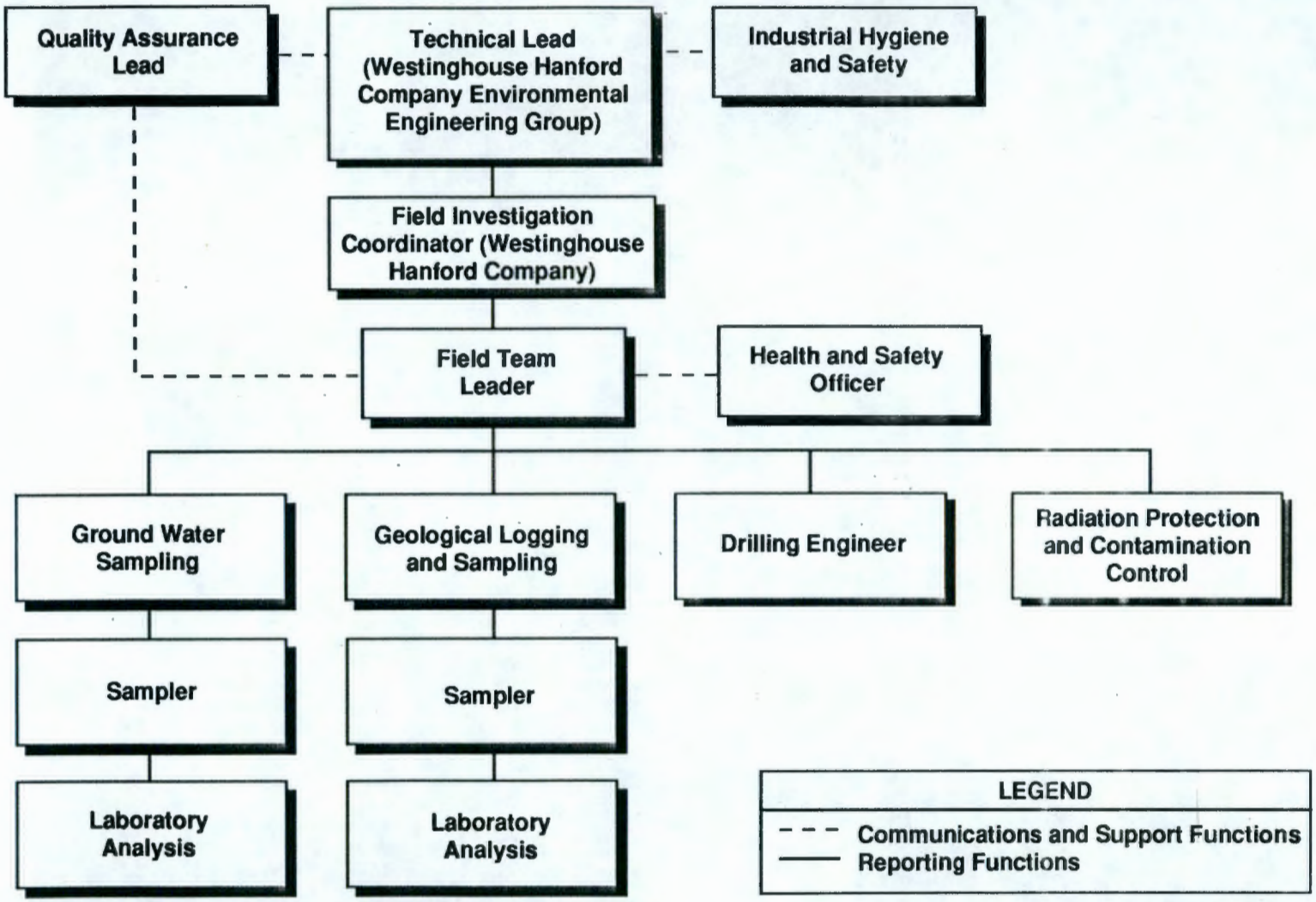

Figure C-6. Drilling, Sampling, and Well-Development Team.

Table C-1. Hanford Site RI/FS Technical Resources. Sheet 1 of 2

	Technical Resources	
Subject/Activity	RI	FS
Hydrology and geology	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/Geosciences
Toxicology and risk/endangerment assessment	Westinghouse Hanford/Environmental Technology PNL/Earth and Environmental Sciences Center PNL/Life Sciences Center	Westinghouse Hanford/ Environmental Technology
Environmental chemistry	Westinghouse Hanford/Geosciences PNL/Earth and Environmental Sciences Center	Westinghouse Hanford/Geosciences
Geotechnical and civil engineering	Westinghouse Hanford/Geosciences (Planning) Environmental Field Services	NA
Geotechnical and civil engineering	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Groundwater treatment engineering	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Waste stabilization and treatment	NA	Westinghouse Hanford/ Environmental Engineering PNL/Waste Technology Center
Surveying	Kaiser Engineers Hanford	NA

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Table C-1. Hanford Site RI/FS Technical Resources. Sheet 2 of 2

Subject/Activity	Technical Resources	
	RI	FS
Soil and water sampling and analysis	Westinghouse Hanford/Environmental Engineering Westinghouse Office of Sampling Management PNL/Earth and Environmental Sciences Center PNL/Materials and Chemical Sciences Center	NA
Drilling and well installation	Westinghouse Hanford/Geosciences Environmental Field Services Kaiser Engineers	NA
Radiation monitoring	Westinghouse Hanford/Operational Health Physics	NA

NA = Not applicable.

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APPENDIX D

INFORMATION MANAGEMENT OVERVIEW

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TABLE:

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DEFINITIONS OF TERMS

Action Plan. Action plan for implementation of the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990). A negotiation between the U.S. Environmental Protection (EPA), the U.S. Department of Energy (DOE), and the State of Washington Department of Ecology (Ecology). The Action Plan defines the methods and processes by which hazardous waste permits will be obtained, and by which closure and post-closure actions under the *Resource Conservation and Recovery Act of 1976* (RCRA) and by which remedial actions under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) will be conducted on the Hanford Site.

Administrative Record (AR). In CERCLA, the official file that contains all information that was considered or relied on by the regulatory agency in arriving at a final remedial action decision, as well as all documentation of public participation throughout the process. In RCRA, the official file that contains all documents to support a final RCRA permit determination.

Administrative Record File. The assemblage of documents compiled and maintained by an agency pertaining to a proposed project of administrative action and designated as AR or that are candidates for inclusion in the AR once a record of decision (ROD) is attained.

Data Management. The planning and control of activities affecting data.

Data Quality. The totality of features and characteristics of data that bears on its ability to satisfy a given purpose. The characteristics of major importance are accuracy, precision, completeness, representativeness, and comparability.

Data Validation. The process whereby data are accepted or rejected based on a set of criteria. This aspect of quality assurance involves establishing specified criteria for data validation. The quality assurance project plan (QAPP) must indicate the specified criteria that will be used for data validation.

ENCORE. The name given to the combination of hardware, software, and administrative subsystems that serve to integrate the management of the Hanford Site environmental data.

Environmental Data Management Center (EDMC). The central facility and services that provide a files management system for processing environmental information.

Environmental Information. Data related to the protection or improvement of the Hanford Site environment, including data required to satisfy environmental statutes, applicable DOE orders, or the Tri-Party Agreement.

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Field File Custodian. An individual who is responsible for receipt, validation, storage, maintenance, control, and disposition of information or other records generated in support of Environmental Division activities.

Hanford Environmental Information System (HEIS). A computer-based information system under development as a resource for the storage, analysis, and display of investigative data collected for use in site characterization and remediation activities. Subject areas currently being developed include geophysics/soil gas, vadose zone soil (geologic), atmospherics, and biota.

Information System. Collection of components relate to the management of data and reporting of information. Information systems typically include computer hardware, computer software, operating systems, utilities, procedures, and data.

Lead Agency. The regulatory agency (EPA or Ecology) that is assigned the primary administrative and technical responsibility with respect to actions at a particular operable unit.

Nonrecord Material. Copies of material that are maintained for information, reference, and operating convenience and for which another office has primary responsibility.

Operable Unit. An operable unit at the Hanford Site is a group of land disposal and groundwater sites placed together for the purposes of doing a remedial investigation/ feasibility study. The primary criteria for placement of a site into an operable unit are geographic proximity, similarity of waste characteristics and site types, and the possibility for economies of scale.

Primary Document. A document that contains information on which key decisions are made with respect to the remedial action or permitting process. Primary documents are subject to dispute resolution and are part of the administrative record file.

Project Manager. The individual responsible for implementing the terms and conditions of the Action Plan on behalf of his respective party. The EPA, DOE, and Ecology will each designate one project manager.

Quality Affecting Record. Information contained on any media, including but not limited to, hard copy, sample material, photo copy, and electronic systems, that is complete in terms of appropriate content and that furnishes evidence of the quality of items and/or activities affecting quality.

Quality Assurance. The systematic actions necessary to provide adequate confidence that a material, component, system, process, or facility performs satisfactorily or as planned in service.

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Quality Assured Data. Data developed under an integrated program for assurance of the reliability of data.

Raw Data. Unprocessed or unanalyzed information.

Record Validation. A review to determine that records are complete, legible, and meet records requirements. Documents are considered valid records only after the validation process has been completed.

Retention Period. The length of time records must be held before they can be disposed of. The time is usually expressed in years from the date of the record, but may also be expressed as contingent on the occurrence of an event.

Secondary Document. A document providing information that does not, in itself, reflect or support key decisions. A secondary document is subject to review by the regulatory agencies and may be part of the administrative record field. It is not subject to dispute resolution.

Validated Data. Data that meet criteria contained in an approved company procedure.

Verified Data. Data that have been checked for accuracy and consistency following a transfer action (e.g., from manual log to computer, or from distributed database to centralized data repository).

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1.0 INTRODUCTION AND OBJECTIVES

1.1 INTRODUCTION

An extensive amount of data will be generated over the next several years in connection with the activities planned for the B Plant Aggregate Area. The quality of these data are extremely important to the full remediation of the aggregate area as agreed on by the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), the Washington State Department of Ecology (Ecology), and interested parties.

The Information Management Overview (IMO) provides an overview of the data management activities at the operable unit level. It identifies the type and quantity of data to be collected and references the procedures which control the collection and handling of data. It provides guidance for the data collector, aggregate area investigator, project manager, and reviewer to fulfill their respective roles.

This IMO addresses handling of data generated from activities associated with the aggregate area activities. All data collected will be in accordance with the Environmental Investigations Instructions (EII) contained in the Westinghouse Hanford Company's (Westinghouse Hanford) *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

Development of a comprehensive plan for the management of all environmental data generated at the Hanford Site is under way. The *Environmental Information Management Plan* (EIMP) (Steward et al. 1989), released in March 1989, described activities in the Environmental Data Management Center (EDMC) and long-range goals for management of scientific and technical data. The scientific and technical data part of the EIMP was reviewed, revised, and expanded in fiscal year 1990 (Michael et al. 1990). An *Environmental Restoration Remedial Action Program Records Management Plan* (WHC 1991b) issued in July 1991, enables the program office to identify, control, and maintain the quality assurance (QA), decisional, or regulatory prescribed records generated and used in support of the Environmental Restoration Remedial Action (ERRA) Program.

1.2 OBJECTIVES

This IMO describes the process for the collection and control procedures for validated data, records, documents, correspondence, and other information associated with this aggregate area. This IMO addresses the following:

- Types of data to be collected
- Plans for managing data
- Organizations controlling data
- Databases used to store the data

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- EIMP
- Hanford Environmental Information System (HEIS).

2.0 TYPES OF DATA

2.1 TYPES OF DATA

The general types of technical data to be collected and the associated controlling procedures are as follows:

Type of data	Procedure
Historical reports	EII 1.6
Aerial photos	EII 1.6
Chart recordings	EII 1.6
Technical memos	EII 1.6
Validated samples analyses	EII 1.6
Reports	EII 1.6
Logbooks	EII 1.5
Chain-of-custody forms	EII 5.1
Sample quality assurance/ quality control (QA/QC)	Office of Sample Management (OSM)

All such data are submitted to the EDMC for entry into the administrative record (AR).

General types of related administrative data is shown in Table D-1, which is organized in terms of general types of personnel and compliance/regulatory data. Table D-1 references the appropriate procedures and the record custodians. Data associated with aggregate area investigations will be submitted to the EDMC for entry into the AR, as appropriate.

2.2 DATA COLLECTION

Data will be collected according to the aggregate area sampling and analysis plans and the Quality Assurance Project Plan (QAPP). Section 2.1 listed the controlling procedures for data collection and handling before turnover to the organization responsible for data storage. All procedures for data collection shall be approved in compliance with the Westinghouse Hanford *Environmental Investigations and Site Characterization Manual* (WHC 1991a).

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2.3 DATA STORAGE AND ACCESS

Data will be handled and stored according to procedures approved in compliance with applicable Westinghouse Hanford procedures (WHC 1988). The EDMC is the central files manager and process facility. All data entering the EDMC will be indexed, recorded, and placed into safe and secure storage. Data designated for placement into the AR will be copied, placed into the Hanford Site AR file, and distributed by the EDMC to the user community. The hard copy files are the primary sources of information; the various electronic data bases are secondary sources.

Normal access to data is through EDMC which is responsible for the AR. The Administrative Record Public Access Room is located in the 345 Hills Street Facility in Richland, Washington. This facility includes AR file documents (including identified guidance documents and technical literature).

Project participants may access data that are not in the AR by requesting it at the monthly unit managers' meeting for the operable unit of concern. As the project moves to completion, it is expected that all of the relevant data will be contained in the AR and the need to access data will be minimal.

The following types of data will be accessed from and reside in locations other than the EDMC:

Data type	Data location
• QA/QC laboratory data	OSM (Westinghouse Hanford)
• Sample status	OSM (Westinghouse Hanford)
• Archived samples	Laboratory performing analyses
• Training records	Technical Training Support Section (Westinghouse Hanford)
• Meteorological data	Hanford Meteorological Station (HMS) (Pacific Northwest Laboratory [PNL])
• Health and safety records	Hanford Environmental Health Foundation (HEHF)
• Personal protective fitting	Environmental Health and Pesticide Services Section (Westinghouse Hanford)
• Radiological exposure	Pacific Northwest Laboratory.

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2.4 DATA QUANTITY

Data quantities for the investigative activities will be estimated based on the sampling and analysis plans developed for investigation of sites within the aggregate area.

3.0 DATA MANAGEMENT

3.1 OBJECTIVE

A considerable amount of data will be generated through the implementation of the aggregate area sampling and analysis plans. The QAPP will provide the specific procedural direction and control for obtaining and analyzing samples in conformance with requirements to ensure quality data results. The sampling and analysis plans will provide the basis for selecting the location, depth, frequency of collection, etc., of media to be sampled and methods to be employed to obtain samples of selected media for cataloging, shipment, and analysis. Figure D-1 displays the general data management model for data generated through work plan activities.

3.2 ORGANIZATIONS CONTROLLING DATA

This section addresses the organizations that will receive data generated from aggregate area activities.

3.2.1 Environmental Engineering Group

The Westinghouse Hanford Environmental Engineering Group provides the operable unit technical coordinator. The technical coordinator is responsible for maintaining and transmitting data to the designated storage facility.

3.2.2 Office of Sample Management

The Westinghouse Hanford OSM will validate all analytical data packages received from the laboratory. Validated summary data (sample results and copies of chain-of-custody forms) will be forwarded to the technical coordinator. Nonvalidated data will be forwarded to the technical coordinator on request. Preliminary data will be clearly labeled as such. The OSM will maintain raw sample data, QA/QC laboratory data, and the archived sample index.

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3.2.3 Environmental Data Management Center

The EDMC is the Westinghouse Hanford Environmental Division's central facility and service that provides a file management system for processing environmental information. The EDMC manages and controls the AR and Administrative Record Public Access Room at the Hanford Site. Part 1 of the EIMP (Michael et al. 1990) describes the central file system and services provided by the EDMC. The following procedures address data transmittal to the EDMC:

- EII 1.6, Records Management (WHC 1991a)
- EII 1.11, Technical Data Management (WHC 1991a)
- TPA-MP-02, Information Transmittals and Receipt Controls (DOE/RL 1990)
- TPA-MP-07, Administrative Record Collection and Management (DOE/RL 1990).

3.2.4 Information Resource Management

Information Resource Management is the designated records custodian (permanent storage) for Westinghouse Hanford. The procedural link from the EDMC to the Information Resource Management is currently under development.

3.2.5 Hanford Environmental Health Foundation

The HEHF performs the analyses on the nonradiological health and exposure data (Section 3.3.2) and forwards summary reports to the Fire and Protection Group and the Environmental Health and Pesticide Services Section within the Westinghouse Hanford Environmental Division. Nonradiological and health exposure data are maintained also for other Hanford Site contractors (PNL and Kaiser Engineers Hanford [KEH]) associated with aggregate area activities. The HEHF provides summary data to the appropriate site contractor. EII 2.1, Preparation of Hazardous Waste Operations Permits, and EII 2.2, Occupational Health Monitoring (WHC 1991a) address the preparation of health and safety plans and occupational health monitoring, respectively.

3.2.6 Environmental Health and Pesticide Services Section

The Westinghouse Hanford Environmental Health and Pesticide Services Section maintains personal protective equipment fitting records and maintains nonradiological health field exposure and exposure summary reports provided by HEHF for Westinghouse Hanford Environmental Division and subcontractor personnel.

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3.2.7 Technical Training Records and Scheduling Section

The Westinghouse Hanford Technical Training Records and Scheduling Section provides training and maintains training records (Section 3.3.4).

3.2.8 Pacific Northwest Laboratory

The PNL operates the HMS and collects and maintains meteorological data (Section 3.3.1). Data management is discussed in Andrews (1988).

The PNL collects and maintains radiation exposure data (Section 3.3.3).

3.3 DATABASES

This section addresses databases that will receive data generated from the aggregate area activities. These and other databases are described in the EIMP (Michael et al. 1990). All of these databases exist independently of this aggregate area and serve other site functions. Data pertinent to the operable unit, housed in these databases, will be submitted to the AR.

3.3.1 Meteorological Data

The HMS collects and maintains meteorological data. Their database contains meteorological data from 1943 to the present, and Andrews (1988) is the document containing meteorological data management information.

3.3.2 Nonradiological Exposure and Medical Records

The HEHF collects and maintains data for all nonradiological exposure records and medical records.

3.3.3 Radiological Exposure Records

The PNL collects and maintains data on occupational radiation exposure. This database contains respiratory personal protective equipment fitting records, work restrictions, and radiation exposure information.

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3.3.4 Training Records

Training records for Westinghouse Hanford and subcontractor personnel are managed by the Westinghouse Hanford Technical Training Support Section. Other Hanford Site contractors (PNL and KEH) maintain their own personnel training records. Training records for non-Westinghouse personnel are entered into the Westinghouse (soft reporting) database to document compliance.

Training records include:

- Initial 40-h hazardous waste worker training
- Annual 8-h hazardous waste worker training update
- Hazardous waste generator training
- Hazardous waste site specific training
- Radiation safety training
- Cardiopulmonary resuscitation
- Scott air pack
- Fire extinguisher
- Noise control
- Mask fit.

3.3.5 Environmental Information/Administrative Record

Environmental information and the AR are managed by Westinghouse Hanford EDMC personnel. They provide an index and key information on all data transmitted to the EDMC. This database is used to assist in data retrieval and to produce index lists as required.

3.3.6 Sample Status Tracking

The OSM maintains the sample status tracking database. This database contains information about each sample. Information maintained includes sample number, ship date, receipt date, and laboratory identification.

4.0 ENVIRONMENTAL INFORMATION AND RECORDS MANAGEMENT PLAN

This section briefly discusses the EIMP (Michael et al. 1990) that was developed to provide an overview of an integrated approach to managing Hanford Site environmental data, and the *Environmental Restoration Remedial Action Program Records Management Plan* (WHC 1991b).

4.1 ENVIRONMENTAL INFORMATION MANAGEMENT PLAN

The EIMP provides an overview of how information is managed throughout the lifetime of Hanford Site environmental programs.

The Environmental Division of Westinghouse Hanford is responsible for the protection and improvement of the Hanford Site environment. To fulfill responsibility, the Environmental Division has assumed a management role with respect to Hanford Site environmental information. This management role includes (1) establishing standards for how data are validated and controlled, (2) developing and maintaining a supporting computer-based environment, and (3) sustaining a centralized file management system.

Hanford Site environmental information is defined as data related to the protection or improvement of the Hanford Site environment, including data required to satisfy environmental statutes, applicable DOE orders, or the *Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1990) (Tri-Party Agreement).

Environmental information falls into several overlapping categories, such as administrative versus technical and electronic versus manual or hard copy. A considerable amount of data are recorded in documents, which are governed by company-wide document and records control practices. Other data are collected or generated by computer and, therefore, exist in electronic form. The name ENCORE has been given to the combination of administrative, hardware, and software systems that serve to integrate the management of this electronic data.

Administrative information (e.g., budgets and schedules) is subject to accounting and other standard business practices. Scientific and technical data are subject to a different set of legal, classification, release, and engineering requirements.

Superimposed over these categories is the files management system for environmental information. This management system, has been developed to meet a number of Environmental Division needs, including requirements for compilation of AR files. The AR files are compilations of all material related to environmental restoration and remedial action records of decision (ROD) for each operable unit and treatment, storage, and disposal (TSD) group described in the Tri-Party Agreement.

Data in electronic form flows from information systems in the ENCORE realm to both scientific/technical and administrative documents. Environmental documents distributed within the Hanford Site and from regulatory agencies are received by the EDMC for storage and future processing.

Part I of the EIMP describes the overall Westinghouse Hanford systems that are generally applied to documents and records. Part I also describes, in greater detail, the files management system developed to manage the AR file information. The EDMC compiles the AR files and provides controlled distribution of specified information to the AR files held by

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DOE, Ecology, and the EPA. The EDMC also provides controlled distribution of specified community relations information to regional information repositories.

Part II addresses computer-based information, with an emphasis on scientific and technical data. The long-term nature of environmental programs and the complex interrelationships of environmental data require that the data be preserved, retrievable, traceable, and sufficient for future use. To ensure data availability for response to regulatory and agency requirements, the plan is directed toward optimizing the use of automated techniques for managing data. The current processing environment and the proposed ENCORE realm are described, and the plans for implementation of ENCORE are addressed.

4.2 ENVIRONMENTAL RESTORATION REMEDIAL ACTION PROGRAM RECORDS MANAGEMENT PLAN

The ERRA Program records management plan was developed to fulfill the requirements of the U.S. Department of Energy, Richland Operations Office (DOE/RL) *Environmental Restoration Field Office Management Plan* (FOMP) (DOE/RL 1989). The FOMP describes the plans, organization, and control systems to be used for management of the Hanford Site ERRA Program. The Westinghouse Hanford ERRA Program Office has developed this ERRA Program records management plan to fulfill the requirements of the FOMP. This records management plan will enable the program office to identify, control, and maintain the quality assurance, decisional, or regulatory prescribed records generated and used in support of the ERRA Program.

The ERRA Program records management plan describes how the applicable records management requirements will be implemented for the ERRA Program. The plan also develops the criteria for identifying the appropriate requirements for each individual piece of information related to ERRA work activities.

This records management plan applies to all ERRA Program records and documents generated, used, or maintained in support of ERRA-funded work activities on the Hanford Site. The terms, information, documents, nonrecord material, records, record material, and QA records used throughout the ERRA records management plan are interpreted as ERRA information, ERRA documents, ERRA nonrecord material, ERRA records, ERRA record material, and ERRA QA records.

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5.0 HANFORD ENVIRONMENTAL INFORMATION SYSTEM

5.1 OBJECTIVE

The Hanford Environmental Information System (HEIS) has been developed by PNL for Westinghouse Hanford as a primary resource for computerized storage, retrieval, and analysis of quality-assured technical data associated with *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA) remedial investigation/ feasibility study (RI/FS) activities and RCRA Facility Investigation/Corrective Measures Study (RFI/CMS) activities being undertaken at the Hanford Site. The HEIS will provide a means of interactive access to data sets extracted from other databases relevant to implementation of the Tri-Party Agreement (Ecology et al. 1990). The HEIS will support graphics analysis, including a geographic information system. Implementation of HEIS will serve to ensure that data consistency, quality, traceability, and security are achieved through incorporation of all environmental data within a single controlled database.

The following is a list of data subjects proposed to be entered into HEIS:

- Geologic
- Geophysics
- Atmospheric
- Biotic
- Site characterization
- Soil gas
- Waste site information
- Surface monitoring
- Groundwater.

5.2 STATUS OF THE HANFORD ENVIRONMENTAL INFORMATION SYSTEM

The HEIS, a computerized database containing technical data and information used to support the Hanford environmental restoration (ER) activities, is operational. The data for the Hanford groundwater wells and groundwater samples is currently accessible via the Hanford Local Area Network (HLAN) to local users and to offsite users via a modem link to the HEIS database computer. Additional data, including geologic, biota, and other pertinent environmental sample results, are being entered into the HEIS database.

The *Hanford Environmental Information System (HEIS) User's Manual* (WHC 1990) was issued in October 1990. An operator manual is being prepared and is expected to be issued in 1992.

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The HEIS geographic information system (GIS) will display detailed maps for the Hanford restoration sites including data from the HEIS database. Such spatially related data will be used to support analysis of waste site technical issues and restoration options. The combination of the HEIS for data and the GIS spatial displays offers some powerful tools for many users to analyze and collectively evaluate the environmental data from the ER and site-wide monitoring programs.

6.0 REFERENCES

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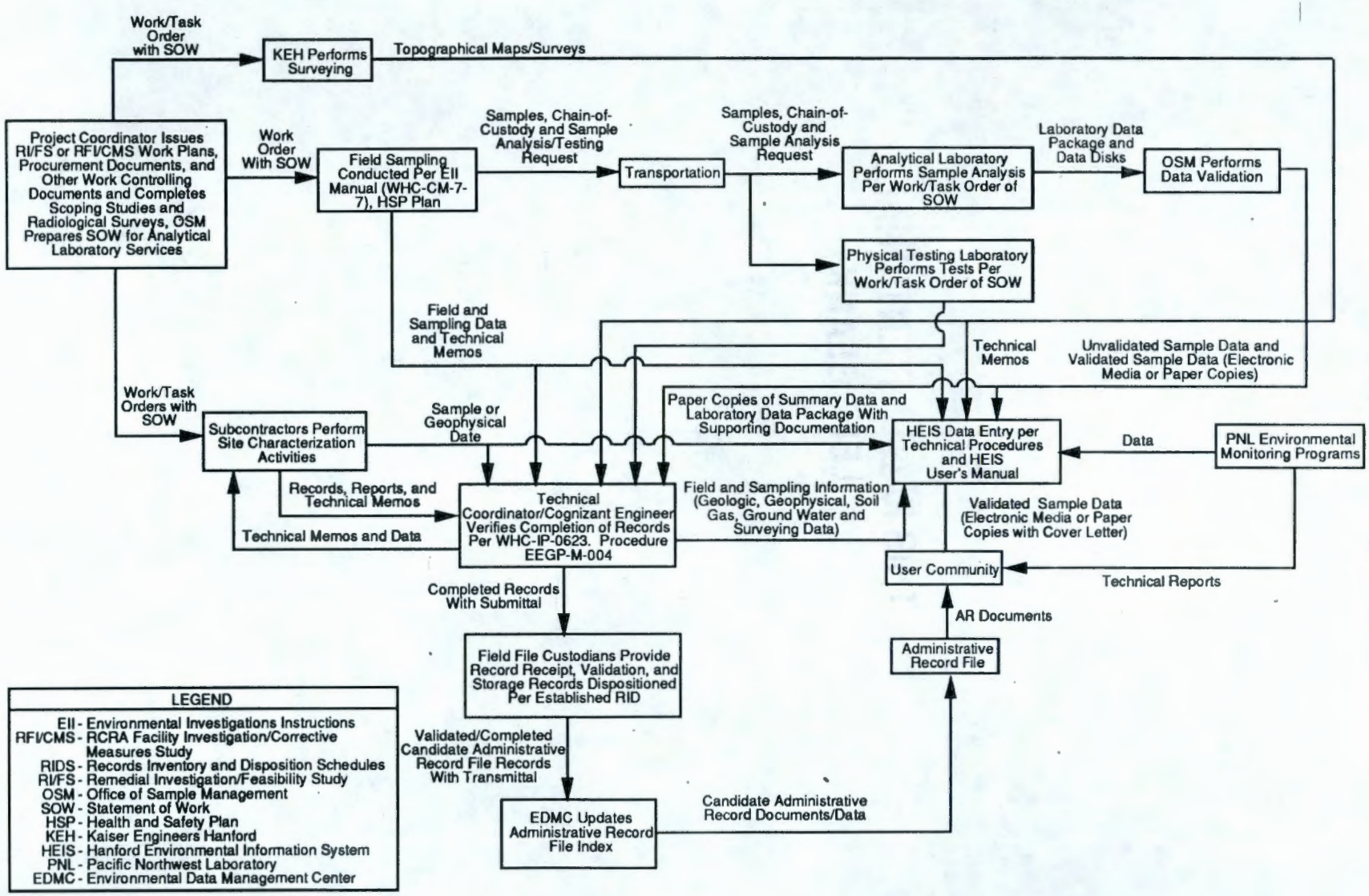

Figure D-1. Environmental Engineering, Technology, and Permitting Data Management Team.

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Table D-1. Types of Related Administrative Data.

Type of Data	Controlling document/procedure	Record Custodians				
		TR	HEHF	PNL	EDMC	EHPSS
Personnel						
Personnel training and qualifications	EII 1.7[a]	X				
Occupational exposure records (nonradiological)	EII 2.2[a]		X			X
Radiological exposure records				X		
Respiratory protection fitting						X
Personnel health and safety records	EII 2.1[a]		X			X
Compliance/regulatory						
Action-specific requirements/screening levels	EII 1.6[a]				X	
Guidance document tracking	EII 1.6[a]				X	
Compliance issues	EII 1.6[a]				X	
Problem resolution	EII 1.6[a]				X	
Administrative record	TPA-MP-11[b]				X	

[a]WHC 1991a, *Environmental Investigations and Site Characterization Manual.*

[b]DOE/RL 1990, *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement) Handbook.*

EDMC = Environmental Data Management Center (Westinghouse Hanford Company).
EHPSS = Environmental Health and Pesticide Services Section (Westinghouse Hanford Company).
EII = Environmental Investigations Instructions.
HEHF = Hanford Environmental Health Foundation.
TR = Training records (Westinghouse Hanford Company, Pacific Northwest Laboratory [PNL], Kaiser Engineers Hanford [KEH]).

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