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SECTION 1 OF 2

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B Plant Source Aggregate Area Management Study Report

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B PLANT SOURCE AAMS EXECUTIVE SUMMARY

This report presents the results of an aggregate area management study (AAMS) for the B Plant Aggregate Area in the 200 Areas of the U.S. Department of Energy (DOE) Hanford Site in Washington State. This scoping level study provides the basis for initiating Remedial Investigation/Feasibility Study (RI/FS) activities under the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA) or Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI) and Corrective Measures Studies (CMS) under RCRA. This report also integrates select RCRA treatment, storage or disposal (TSD) closure activities with CERCLA and RCRA past practice investigations.

Through the experience gained to date on developing work plans, closure plans, and permit applications at the Hanford Site, the parties to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement) have recognized that all past practice investigations must be managed and implemented under one characterization and remediation strategy, regardless of the regulatory agency lead (as defined in the Tri-Party Agreement). In particular, the parties have identified a need for greater efficiency over the existing RI/FS and RFI/CMS investigative approaches, and have determined that, to expedite the ultimate goal of cleanup, much more emphasis needs to be placed on initiating and completing waste site cleanup through interim measures.

This streamlined approach is described and justified in The *Hanford Federal Facility Agreement and Consent Order Change Package*, dated May 16, 1991 (Ecology et al. 1991). To implement this approach, the three parties have developed the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) for streamlining the past practice remedial action process. This strategy provides new concepts for:

- Accelerating decision-making by maximizing the use of existing data consistent with data quality objectives (DQOs)
- Undertaking expedited response actions (ERAs) and/or interim remedial measures (IRMs), as appropriate, to either remove threats to human health and welfare and the environment, or to reduce risk by reducing toxicity, mobility, or volume of contaminants.

The *Hanford Site Past-Practice Strategy* (DOE/RL 1992a) describes the concepts and framework for the RI/FS (or RFI/CMS) process in a manner that has a bias-for-action through optimizing the use of interim remedial actions, culminating with decisions on final remedies on both an operable-unit and aggregate-area scale. The strategy focuses on reaching early decisions to initiate and complete cleanup projects, maximizing the use of existing data, coupled with focused short time-frame investigations, where necessary. As more data become available on contamination problems and associated risks, the details of the longer term investigations and studies will be better defined.

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The strategy includes three paths for interim decision-making and a final remedy-selection process for the operable unit that incorporates the three paths and integrates sites not addressed in those paths. The three paths for interim decision-making include the ERA, IRM, and limited field investigation (LFI) paths. The strategy requires that aggregate area management study reports (AAMSRs) be prepared to provide an evaluation of existing site data to support initial path decisions. This AAMSR is one of ten reports that will be prepared for each of the ten aggregate areas defined in the 200 Areas.

The near-term past practice strategy for the 200 Areas provides for ERAs, IRMs, and LFIs for individual waste management units, waste management unit groups and groundwater plumes, and recommends separate source and groundwater operable units. Initial site-specific recommendations for each of the waste management units within the B Plant Aggregate Area are provided in the report. Work plans starting with the 200-BP-1 Operable Unit Work Plan will initially focus on limited intrusive investigations at the highest priority waste management units or waste management unit groups as established in the AAMSR. The goal of this initial focus is to establish whether IRMs are justified. Waste management units identified as candidate ERAs in Section 9.0 of the AAMS will be further evaluated following the *Site Selection Process for Expedited Response Actions at the Hanford Site* (Gustafson 1991).

While these elements may mitigate specific contamination problems through interim actions, the process of final remedy selection must be completed for the operable unit or aggregate area to reach closure. The aggregation of information obtained from the LFIs and interim actions may be sufficient to perform the cumulative risk assessment and to define the final remedy for the operable unit or aggregate area. If the data are not sufficient, additional investigations and studies will be performed to the extent necessary to support final remedy selection. These investigations would be performed within the framework and process defined for RI/FS programs.

Several integration issues exist that are generic to the overall past practice process for the 200 Areas and include the following:

Future Work Plan Scope. Although the current practice for implementing RI/FS (RFI/CMS) activities is through operable unit based work plans, individual LFI/IRMs may be more efficiently implemented using LFI/IRM-specific work plans.

Groundwater Operable Units. A general strategy recommended for the 200 Areas is to define separate operable units for groundwater affected by 200 Areas source terms. This requires that groundwater be removed from the scope of existing source operable units and new groundwater-specific operable units be established. Recommendations for groundwater operable units will be developed in the groundwater AAMSRs.

Work Plan Prioritization. Although priorities are established in the AAMSR for operable units within the aggregate area, priorities between aggregate areas have yet to be established. The integration of priorities at the 200 Areas level is considered a prerequisite for establishing a schedule for past practice activities in the 200 Areas.

It is intended that these integration issues be resolved following the completion of all ten AAMSRs (Draft A) scheduled for September 1992. Resolution of these issues will be based on a decisions/consensus process among the U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and DOE. Following resolution of these issues a schedule for past practice activities in the 200 Areas will be prepared.

Background, environmental setting, and known contamination data are provided in Sections 2.0, 3.0, and 4.1. This information provides the basis for development of the preliminary conceptual model in Section 4.2 and for assessing health and environmental concerns in Section 5.0. Preliminary applicable or relevant and appropriate requirements (ARARs) (Section 6.0) and preliminary remedial action technologies (Section 7.0) are also developed based on this data. Section 8.0 provides a discussion of the data quality objectives. Data needs identified in Section 8.0 are based on data gaps determined during the development of the conceptual model, human health and environmental concerns, ARARs, and remedial action technologies. Recommendations in Section 9.0 are developed using all the information provided in the sections which precede it.

The Hanford Site, operated by the DOE, occupies about 1,450 km² (560 mi²) of the southeastern part of Washington north of the confluence of the Yakima and Columbia Rivers. The Hanford Site was established in 1943 to produce plutonium for nuclear weapons using production reactors and chemical processing plants. The B Plant Aggregate Area is located within the 200 East Area, near the middle of the Hanford Site. There are thirteen operable units within the B Plant Aggregate Area.

Between 1945 and 1952, the 221-B Building (B Plant) was utilized to recover plutonium from irradiated fuel elements using the bismuth phosphate process. The use of the bismuth phosphate process at B Plant was discontinued in 1952. Also in 1952, the 221-U Building (U Plant) began processing the liquid waste stored in the single-shell tanks in the B Plant Aggregate Area (and other aggregate areas) to recover the uranium from the process solution produced at B Plant. The B Plant Aggregate Area received some of the U Plant waste generated from the uranium recovery process (at U Plant) until the cessation of the recovery process in 1958. In 1968, B Plant began (a second mission) recovering cesium and strontium fission products from liquid wastes stored in the single-shell tanks in the B Plant Aggregate Area and from wastes produced by PUREX processing. In 1974, processing began in the new Waste Encapsulation and Storage Facility (WESF) to precipitate and encapsulate the recovered cesium and strontium. This processing ended in 1984, but storage of the encapsulated cesium and strontium continues to the present.

The B Plant Aggregate Area contains a large variety of waste disposal and storage facilities. High-level wastes were stored in underground single-shell tanks. Low-level wastes such as cooling and condensate water were allowed to infiltrate into the ground through cribs, ditches, trenches, reverse wells, and open ponds. Based on construction, purpose, or origin, the B Plant Aggregate Area waste management units fall into one of ten subgroups as follows:

- 4 (No. of waste management units) Plants, Buildings, and Storage Areas
- 50 Tanks and Vaults
- 30 Cribs and Drains
- 5 Reverse Wells
- 43 Ponds, Ditches, and Trenches
- 18 Septic Tanks and Associated Drain Fields
- 18 Transfer Facilities, Diversion Boxes, and Pipelines
- 3 Basins
- 13 Burial Sites
- 59 Unplanned Releases.

Detailed descriptions of these waste management units are provided in Section 2.3.

There are several ongoing programs that affect buildings and waste management units in the B Plant Aggregate Area (Section 2.7). These programs include RCRA, the Hanford Decommissioning and RCRA Closure Program, the Radiation Area Remedial Action (RARA) Program, the Single-Shell Tank Closure Program, and the Waste Management Program. One hundred four units (primarily single-shell tanks and associated transfer facilities as listed in Table 9-3) fall completely within the scope of one of these programs and, therefore, recommendations on these units will be made by the respective programs rather than in this AAMSR. An additional forty-nine waste management units will be partially addressed by Operational Programs (as listed in Table ES-1) in addition to the actions recommended in the B Plant AAMSR. Ten waste management units are within the 200-BP-1 Operable Unit and are not evaluated because a remedial investigation is already underway.

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Discussions of surface hydrology and geology are provided on a regional, Hanford Site, and aggregate area basis in Section 3.0. The interpretation is based on a limited number of wells, and this limitation does not support a detailed delineation of waste management unit-specific features. The section also describes the flora and fauna, land use, water use, and human resources of the 200 East Area and vicinity. Groundwater of the 200 East Area is described in detail in a separate Groundwater AAMSR.

A preliminary site conceptual model is presented in Section 4.0. Section 4.1 presents the chemical and radiological data that are available for the different media types (including surface soil, vadose zone soil, air, surface water, and biota) and site-specific data for each waste management unit and unplanned release.

A preliminary assessment of potential impacts to human health and the environment is presented in Section 4.2. This assessment includes a discussion of release mechanisms, potential transport pathways, and a preliminary conceptual model of human and ecological exposure based on these pathways. Physical, radiological, and toxicological characteristics of the known and suspected contaminants at the aggregate area are also discussed.

Health and environmental concerns are presented in Section 5.0. The preliminary qualitative evaluation of potential human health concerns is intended to provide input to the waste management unit recommendation process. The evaluation includes (1) an identification of contaminants of potential concern for each exposure pathway that is likely to occur within the B Plant Aggregate Area, (2) identification of exposure pathways applicable to individual waste management units, and (3) estimates of relative hazard based on four available indicators of risk; the CERCLA Hazard Ranking System (HRS) and modified HRS (mHRS), surface radiation survey data, and Westinghouse Environmental Protection Group site scoring.

Potential ARARs to be used in developing and assessing various remedial action alternatives at the B Plant Aggregate Area are discussed in Section 6.0. Specific potential requirements pertaining to hazardous and radiological waste management, remediation of contaminated soils, surface water protection, and air quality are discussed.

Preliminary remedial action technologies are presented in Section 7.0. The process includes identification of remedial action objectives (RAOs), determination of general response actions, and identification of specific process options associated with each option type. The process options are screened based on their effectiveness, implementability and cost. The screened process options are combined into alternatives and the alternatives are described.

Data quality is addressed in Section 8.0. Identification of chemical and radiological constituents associated with the units and their concentrations, with a view to determine the contaminants of concern and their action levels, is a major requirement to execute the *Hanford Site Past-Practice Strategy*. There was found to be a limited amount of data in this

regard. The section provides a summary of data needs identified for each of the waste management units in the B Plant Aggregate Area. The data needs provide the basis for development of detailed DQOs in subsequent work plans.

Section 9.0 provides management recommendations for the B Plant Aggregate Area based on the *Hanford Site Past-Practice Strategy*. Criteria for selecting appropriate *Hanford Site Past-Practice Strategy* paths (ERA, IRM, and final remedy selection) for individual waste management units and unplanned releases in the B Plant Aggregate Area are developed in Section 9.1. As a result of the data evaluation process, one waste management unit was recommended for an ERA, 73 units were recommended for LFIs which could lead to IRMs and 65 units were recommended for final remedy selection (RI). A discussion of the data evaluation process is provided in Section 9.2. Table ES-1 provides a summary of the results of the data evaluation assessment of each unit. Table ES-2 provides the decision matrix patterns each unit followed in reaching the recommendation. Recommendations for redefining operable unit boundaries and prioritizing operable units for work plan development are provided in Section 9.3. Included in Section 9.3.4 are the interactions with RCRA required to disposition the waste management units which are operating under RCRA permits. All recommendations for future characterization needs will be more fully developed and implemented through work plans. Sections 9.4 and 9.5 provide recommendations for focused feasibility and treatability studies, respectively.

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Table ES-1. Summary of the Results of Data Evaluation Process 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

EST-1a

DOE/RL-92-05, Rev. 0

Table ES-1. Summary of the Results of Data Evaluation Process 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	--	--

EST-1b

DOE/RL-92-05, Rev. 0

Table ES-1. Summary of the Results of Data Evaluation Process 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	--	--

EST-1c

DOE/RL-92-05, Rev. 0

Table ES-1. Summary of the Results of Data Evaluation Process 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

EST-1P

DOE/RL-92-05, Rev. 0

Table ES-1. Summary of the Results of Data Evaluation Process 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	--	--

EST-1e

DOE/RL-92-05, Rev. 0

Table ES-1. Summary of the Results of Data Evaluation Process 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	--	--

EST-1f

DOE/RL-92-05, Rev. 0

Table ES-1. Summary of the Results of Data Evaluation Process 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 ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-lease?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment Avail-ability?	Adverse Conse-quences?	Opera-tional Pro-grams?	High Priority?	Data Ade-quate?	Adverse Conse-quences?	Collect Data	Data Ade-quate?
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	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	N	-	Y	-
216-B-15 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	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	N	-	Y	-
216-B-18 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-B-19 Crib	Y	Y	Y	Y	Y	Y	N	Y	Y	N	-	Y	-
216-B-43 Crib ^u	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-44 Crib ^u	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-45 Crib ^u	-	-	-	-	-	-	-	-	-	-	-	-	-

EST-2a

DOE/RL-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-lease?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment Avail-ability?	Adverse Conse-quences?	Opera-tional Pro-grams?	High Priority?	Data Ade-quate?	Adverse Conse-quences?	Collect Data	Data Ade-quate?
216-B-46 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-47 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-48 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-49 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-50 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-55 Crib	Y	Y	Y	N	-	-	-	-	Y	N	-	Y	-
216-B-56 Crib	N	-	-	-	-	-	-	-	N	-	-	-	N
216-B-57 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
216-B-60 Crib	N	-	-	-	-	-	-	-	N	-	-	-	N
216-B-61 Crib ^v	-	-	-	-	-	-	-	-	-	-	-	-	-
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	-

EST-2b

DOE/RL-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-lease?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment Avail-ability?	Adverse Conse-quences?	Opera-tional Pro-grams?	High Priority?	Data Ade-quate?	Adverse Conse-quences?	Collect Data	Data Ade-quate?
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	-	-	-	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	N	-	Y	-
216-B-3-2 Ditch	Y	Y	Y	N	-	-	-	-	Y	N	-	Y	-
216-B-3-3 Ditch	Y	Y	Y	N	-	-	-	-	Y	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	-

EST-2c

DOE/RL-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-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	--

EST-2d

DOE/RL-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-lease?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment Avail-ability?	Adverse Conse-quences?	Opera-tional Pro-grams?	High Priority?	Data Ade-quate?	Adverse Conse-quences?	Collect Data	Data Ade-quate?
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	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

EST-2e

DOE/RI-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-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

EST-2f

DOE/RL-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-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	--	--	--	N
UN-200-E-43	Y	Y	N	--	--	--	--	--	Y	--	--	--	N
UN-200-E-44	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
UN-200-E-52	Y	Y	Y	N	--	--	--	--	Y	--	--	--	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	N	--	Y	--
UN-200-E-64	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
UN-200-E-69	Y	Y	Y	N	--	--	--	--	Y	N	--	Y	--
UN-200-E-79	Y	Y	N	--	--	--	--	--	N	--	--	--	N
UN-200-E-80	Y	Y	Y	N	--	--	--	--	Y	N	--	Y	--
UN-200-E-83	Y	Y	Y	Y	Y	Y	N	Y	Y	N	--	Y	--
UN-200-E-87	Y	Y	N	--	--	--	--	--	N	--	--	--	N
UN-200-E-90	Y	Y	Y	N	--	--	--	--	Y	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	--	--	--	N

EST-2g

DOE/RL-92-05, Rev. 0

Table ES-2. B Plant Aggregate Area Data Evaluation Decision Matrix.

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Re-lease?	Path-way?	Quan-tity?	Concen-tration?	Treat-ment Avail-ability?	Adverse Conse-quences?	Opera-tional Pro-grams?	High Priority?	Data Ade-quate?	Adverse Conse-quences?	Collect Data	Data Ade-quate?
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
 References: DOE 1986, DOE/RL 1991a, DOE/RL 1992a, and WHC 1991a

EST-2h

DOE/RL-92-05, Rev. 0

ACRONYMS AND ABBREVIATIONS

AAMS	aggregate area management study
AAMSR	aggregate area management study report
AEA	Atomic Energy Act
AFAN	ammonium fluoride - ammonium nitrate
AKART	all known, available, and reasonable treatment technologies
ALARA	as low as reasonably achievable
AMU	aqueous makeup unit
ANSI	American National Standards Institute
ARARs	applicable or relevant and appropriate requirements
ARCL	allowable residual contamination level
ASD	ammonia scrubber distillate
ASIL	acceptable source impact level
ASME	American Society of Mechanical Engineers
BAT	best available technology
BDAT	best demonstrated available treatment technologies
BWIP	Basalt Waste Isolation Project
CCW	constituent concentrations in waste
CCWE	constituent concentrations in waste extract
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMS	Corrective Measures Studies
CRP	Community Relations Plan
CSL	chemical sewer
CWA	Clean Water Act
CWL	cooling water
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DOE/RL	U.S. Department of Energy, Richland Field Office
DWMP	Defense Waste Management Program
DQO	data quality objective
EC	evaporator - crystallizer
Ecology	Washington State Department of Ecology
EDMC	Environmental Data Management Center
EHPSS	Environmental Health and Pesticide Services Section
EII	Environmental Investigations Instructions
EIMP	Environmental Information Management Plan
EIS	environmental impact statement
EPA	U.S. Environmental Protection Agency
ERA	expedited response actions

ACRONYMS AND ABBREVIATIONS (cont.)

ERRA	Environmental Restoration Remedial Action
ES&H	Environment, Safety, and Health
FFS	focused feasibility study
FOMP	Field Office Management Plan
FRS	final remedy selection
FS	feasibility study
FWQC	Federal Water Quality Criteria
GTR	Grout Treatment Facility
HAPO	Hanford Atomic Products Operation
Health	Washington State Department of Health
HEDL	Hanford Engineering and Development Laboratory
HEHF	Hanford Environmental Health Foundation
HEIS	Hanford Environmental Information System
HEPA	high efficiency particulate air
HISS	Hanford Inactive Site Survey
HMS	Hanford Meteorological Station
HRS	Hazard Ranking System
HWOP	Hazardous Waste Operations Permit
HWSA	Hazardous Waste Staging Area
ICRP	International Commission on Radiological Protection
IRM	interim remedial measure
ITS	In-Tank Solidification
JSA	Job Safety Analysis
LDR	land disposal restriction
LFI	limited field investigation
LLRW	low-level radioactive waste
LSC	liquid scintillation counting
MCL	maximum contaminant levels
MCS	Management Control System
MEPAS	Multimedia Environmental Pollutant Assessment System
mHRS	modified Hazard Ranking System
MTCA	Model Toxics Control Act
NAAQS	National Ambient Air Quality Standards
NCP	National Contingency Plan
NCRP	National Council on Radiation Protection
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NFA	no further action
NIOSH	National Institute for Occupational Safety and Health
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NRC	Nuclear Regulatory Commission

ACRONYMS AND ABBREVIATIONS (cont.)

NSPS	New Source Performance Standards
OSHA	Occupational Safety and Health Administration
OSM	Office of Sample Management
P&O	pipe and operating
PARCC	precision, accuracy, representativeness, completeness, comparability
PA	preliminary assessment
PDD	process condensate
PNL	Pacific Northwest Laboratory
PSPL	Puget Sound Power and Light Company
PUREX	plutonium uranium extraction
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RA	risk assessment
RAO	remedial action objective
RARA	Radiation Area Remedial Action
RAS	Routine Analytical Services
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
REDOX	reduction and oxidation
RI	remedial investigation
RFI	RCRA Facility Investigations
RLS	Radionuclide Logging System
ROD	record of decision
RTECS	Registry of Toxic Effects of Chemical Systems
RWP	Radiation Work Permit
SARA	Superfund Amendments and Reauthorization Act
SCIR	Surveillance and Compliance Inspection Report
SDWA	Safe Drinking Water Act
SI	site inspection
SWP	special work permit
TAP	Toxic Air Pollutant
T-BACT	toxic best available control technology
TBC	to-be-considered material
TCLP	toxicity characteristic leaching procedure
TLD	thermoluminescent dosimeter
TOC	total organic carbon
TRAC	Tracks Radioactive Components
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic

ACRONYMS AND ABBREVIATIONS (cont.)

TSD	treatment, storage or disposal
UO ₃	uranium trioxide
USC	U.S. Code
USGS	U.S. Geological Survey
VOC	volatile organic compound
WAC	Washington Administrative Code
WIDS	Waste Information Data System
WIPP	Waste Isolation Pilot Plant
WISHA	Washington Industrial Safety and Health Act
WMP	Waste Management Plan
WPCA	Washington State Water Pollution Control Act

9 8 1 9 3 2 6 0 7 9 8

CONTENTS

	<u>Page</u>
1.0 INTRODUCTION	1-1
1.1 OVERVIEW	1-1
1.1.1 Tri-Party Agreement	1-2
1.1.2 Hanford Site Past Practice Strategy	1-2
1.2 200 NPL SITE AGGREGATE AREA MANAGEMENT STUDY PROGRAM	1-4
1.2.1 Overall Approach	1-4
1.2.2 Process Overview	1-5
1.3 PURPOSE, SCOPE, AND OBJECTIVES	1-8
1.4 QUALITY ASSURANCE	1-10
1.5 ORGANIZATION OF REPORT	1-10
2.0 FACILITY, PROCESS AND OPERATIONAL HISTORY DESCRIPTIONS . . .	2-1
2.1 LOCATION	2-1
2.2 HISTORY OF OPERATIONS	2-1
2.3 FACILITIES, BUILDINGS, AND STRUCTURES	2-3
2.3.1 Plants, Buildings, and Storage Areas	2-5
2.3.2 Tanks and Vaults	2-11
2.3.3 Cribs and Drains	2-16
2.3.4 Reverse Wells	2-30
2.3.5 Ponds, Ditches, and Trenches	2-32
2.3.6 Septic Tanks and Associated Drain Fields	2-50
2.3.7 Transfer Facilities, Diversion Boxes, and Pipelines	2-53
2.3.8 Basins	2-60
2.3.9 Burial Sites	2-62
2.3.10 Unplanned Releases	2-65
2.4 WASTE GENERATING PROCESSES	2-66
2.4.1 221-B Building Bismuth Phosphate Plutonium Recovery Process . . .	2-66
2.4.2 221-B Building Strontium and Cesium Recovery	2-68
2.4.3 221-B Building Waste Concentration Process	2-71
2.4.4 225-B Building Waste Encapsulation and Storage Facility	2-72
2.4.5 242-B Evaporator System	2-73
2.4.6 In-Tank Solidification Process	2-73
2.4.7 Wastes Generated at the 221-U Building	2-74
2.4.8 In-Tank Scavenging	2-74
2.4.9 Wastes Generated at the 202-A Building	2-75
2.4.10 Wastes Generated at S Plant	2-75
2.4.11 Analytical Laboratory Programs	2-75
2.5 INTERACTIONS WITH OTHER AGGREGATE AREAS OR OPERABLE UNITS	2-76

CONTENTS (cont.)

	<u>Page</u>
2.6 INTERACTION WITH RESOURCE CONSERVATION AND RECOVERY ACT PROGRAM	2-77
2.7 INTERACTIONS WITH OTHER HANFORD PROGRAMS	2-79
3.0 SITE CONDITIONS	3-1
3.1 PHYSIOGRAPHY AND TOPOGRAPHY	3-1
3.2 METEOROLOGY	3-2
3.2.1 Precipitation	3-2
3.2.2 Winds	3-3
3.2.3 Temperature	3-3
3.3 SURFACE HYDROLOGY	3-3
3.3.1 Regional Surface Hydrology	3-4
3.3.2 Surface Hydrology of the Hanford Site	3-4
3.3.3 B Plant Aggregate Area Surface Hydrology	3-5
3.4 GEOLOGY	3-6
3.4.1 Regional Tectonic Framework	3-7
3.4.2 Regional Stratigraphy	3-9
3.4.3 200 East Area and B Plant Aggregate Area Geology	3-15
3.5 HYDROGEOLOGY	3-19
3.5.1 Regional Hydrogeology	3-19
3.5.2 Hanford Site Hydrogeology	3-20
3.5.3 B Plant Aggregate Area Hydrogeology	3-28
3.6 ENVIRONMENTAL RESOURCES	3-31
3.6.1 Flora and Fauna	3-31
3.6.2 Land Use	3-35
3.6.3 Water Use	3-36
3.7 HUMAN RESOURCES	3-36
3.7.1 Demography	3-36
3.7.2 Archaeology	3-36
3.7.3 Historical Resources	3-37
3.7.4 Community Involvement	3-37
4.0 PRELIMINARY CONCEPTUAL SITE MODEL	4-1
4.1 KNOWN AND SUSPECTED CONTAMINATION	4-1
4.1.1 Affected Media	4-3
4.1.2 Site Specific Data	4-9
4.2 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT	4-49
4.2.1 Release Mechanisms	4-50
4.2.2 Transport Pathways	4-51

9 3 1 9 9 5 1 7 3 0

CONTENTS (cont.)

	<u>Page</u>
4.2.3 Conceptual Model	4-57
4.2.4 Characteristics of Contaminants	4-60
5.0 HEALTH AND ENVIRONMENTAL CONCERNS	5-1
5.1 CONCEPTUAL FRAMEWORK FOR RISK-BASED SCREENING	5-2
5.2 POTENTIAL EXPOSURE SCENARIOS AND HUMAN HEALTH CONCERNS	5-3
5.2.1 External Exposure	5-4
5.2.2 Ingestion of Soil or Inhalation of Fugitive Dust	5-4
5.2.3 Inhalation of Volatiles	5-5
5.2.4 Migration to Groundwater	5-6
5.3 ADDITIONAL SCREENING CRITERIA	5-6
5.4 SUMMARY OF SCREENING RESULTS	5-7
6.0 IDENTIFICATION OF POTENTIALLY APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE B PLANT AGGREGATE AREA	6-1
6.1 INTRODUCTION	6-1
6.2 CONTAMINANT-SPECIFIC REQUIREMENTS	6-2
6.2.1 Federal Requirements	6-3
6.2.2 State of Washington Requirements	6-5
6.3 LOCATION-SPECIFIC REQUIREMENTS	6-8
6.4 ACTION-SPECIFIC REQUIREMENTS	6-9
6.4.1 Federal Requirements	6-9
6.4.2 State of Washington Requirements	6-13
6.5 OTHER CRITERIA AND GUIDANCE TO BE CONSIDERED	6-15
6.5.1 Health Advisories	6-15
6.5.2 International Commission of Radiation Protection/ National Council on Radiation Protection	6-15
6.5.3 Environmental Protection Agency Proposed Corrective Actions for Solid Waste Management Units	6-15
6.5.4 Department of Energy Standards for Radiation Protection	6-15
6.6 POINT OF APPLICABILITY	6-17
6.7 POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS EVALUATION	6-18
7.0 PRELIMINARY REMEDIAL ACTION TECHNOLOGIES	7-1
7.1 PRELIMINARY REMEDIAL ACTION OBJECTIVES	7-2
7.2 PRELIMINARY GENERAL RESPONSE ACTIONS	7-3
7.3 TECHNOLOGY SCREENING	7-5

CONTENTS (cont.)

	<u>Page</u>
7.4 PRELIMINARY REMEDIAL ACTION ALTERNATIVES	7-7
7.4.1 Development of Remedial Alternatives	7-7
7.4.2 Alternative 1--Engineered Multimedia Cover with or without Vertical Barriers	7-10
7.4.3 Alternative 2--In-Situ Grouting or Stabilization of Soil	7-10
7.4.4 Alternative 3--Excavation, Soil Treatment, and Disposal	7-11
7.4.5 Alternative 4--In-Situ Vitrification of Soil	7-12
7.4.6 Alternative 5--Excavation, Above-Ground Treatment and Geologic Disposal of Soil with Transuranic Radionuclides	7-12
7.4.7 Alternative 6--In-Situ Soil Vapor Extraction for Volatile Organic Compounds	7-13
7.5 PRELIMINARY REMEDIAL ACTION ALTERNATIVES APPLICABLE TO WASTE MANAGEMENT UNITS AND UNPLANNED RELEASE SITES	7-15
8.0 DATA QUALITY OBJECTIVES	8-1
8.1 DECISION TYPES (STAGE 1 OF THE DQO PROCESS)	8-1
8.1.1 Data Users	8-2
8.1.2 Available Information	8-3
8.1.3 Evaluation of Available Data	8-8
8.1.4 Conceptual Model	8-10
8.1.5 Aggregate Area Management Study Objectives and Decisions	8-11
8.2 DATA USES AND NEEDS (STAGE 2 OF THE DQO PROCESS)	8-13
8.2.1 Data Uses	8-13
8.2.2 Data Needs	8-16
8.2.3 Data Gaps	8-20
8.3 DATA COLLECTION PROGRAM (STAGE 3 OF THE DQO PROCESS)	8-21
8.3.1 General Rationale	8-21
8.3.2 General Strategy	8-22
8.3.3 Investigation Methodology	8-23
8.3.4 Data Evaluation and Decision Making	8-27
9.0 RECOMMENDATIONS	9-1
9.1 DECISION MAKING CRITERIA	9-2
9.1.1 Expedited Response Action Path	9-4
9.1.2 Limited Field Investigation and Interim Remedial Measure Path	9-7
9.1.3 Final Remedy Selection Path	9-8

CONTENTS (cont.)

	<u>Page</u>
9.2 PATH RECOMMENDATIONS	9-8
9.2.1 Proposed Sites for Expedited Response Actions	9-9
9.2.2 Proposed Sites for Interim Remedial Measures	9-12
9.2.3 Proposed Sites for Limited Field Investigation Activities	9-12
9.2.4 Proposed Sites for Final Remedy Selection	9-20
9.3 SOURCE OPERABLE UNIT REDEFINITION AND PRIORITIZATION	9-24
9.3.1 Units Addressed by Other Aggregate Areas or Programs	9-24
9.3.2 B Plant Aggregate Area Operable Unit Redefinition	9-25
9.3.3 Investigation Prioritization	9-26
9.3.4 RCRA Facility Interface	9-27
9.4 FEASIBILITY STUDY	9-32
9.4.1 Focused Feasibility Study	9-32
9.4.2 Final Feasibility Study	9-33
9.5 TREATABILITY STUDIES	9-33
10.0 REFERENCES	10-1
APPENDIX A SUPPLEMENTAL DATA	
APPENDIX B HEALTH AND SAFETY PLAN	
APPENDIX C PROJECT MANAGEMENT PLAN	
APPENDIX D INFORMATION MANAGEMENT OVERVIEW	

9 3 1 2 8 9 5 3 7 3

CONTENTS (cont.)

	<u>Page</u>
FIGURES:	
1-1 Hanford Site Map	1F-1
1-2 Hanford Past Practice Strategy Flow Chart	1F-2
1-3 200 East Aggregate Areas	1F-3
1-4 200 West Aggregate Areas	1F-4
1-5 200 NPL Site Isolated Operable Units	1F-5
2-1 Location of Plants, Buildings, and Storage Units	2F-1
2-2 Location of Tank and Vaults	2F-2
2-3 Location of Tank and Vaults in the Single-Shell Tank Farms	2F-3
2-4 Location of Cribs, Drains, and Reverse Wells	2F-4
2-5 Location of Ponds, Ditches, and Trenches: Western Portion Operable Units	2F-5
2-6 Location of Ponds, Ditches, and Trenches: 200-BP-11 Operable Unit	2F-6
2-7 Location of Ponds and Unplanned Releases: 200-IU-6 Operable Unit	2F-7
2-8 Location of Septic Tanks and Drain Fields	2F-8
2-9 Location of Transfer Facilities, Diversion Boxes, and Pipelines: Western Portion Operable Units	2F-9
2-10 Location of Basins	2F-10
2-11 Location of Burial Sites	2F-11
2-12 Location of Unplanned Releases: Western Portion Operable Units	2F-12
2-13 Location of Unplanned Releases: 200-BP-11 Operable Unit	2F-13
2-14 Process History of B Plant Aggregate Area	2F-14
2-15 Fuel Separations Processing at B Plant (1945-1954)	2F-15
2-16 B Plant Aggregate Area Uranium Recovery Processing and Tank Scavenging Processes	2F-16
2-17 B Plant Aggregate Area Waste Management Unit Operational History	2F-17
2-18 216-B-3 Pond System and Associated Waste Management Units Operational History	2F-18
2-19 Representative Single-Shell Tank	2F-19
2-20 Representative Wooden Cribs	2F-20
2-21 Cross-sections of the 216-B-14 through 216-B-19 Cribs	2F-21
2-22 Cross-section and Plan View of the 216-B-43 through -50 Cribs	2F-22
2-23 Schematic of Wooden Crib and Tile Field	2F-23
2-24 Typical Crib Construction for 216-B-55 through 216-B-62 Cribs	2F-24
2-25 216-B-5 Reverse Well Disposal System	2F-25
3-1 Topography and Location Map for the Hanford Site	3F-1
3-2 Divisions of the Columbia Intermontane Province and Adjacent Snake River Plains Province	3F-2
3-3 Geomorphic Units Within the Central Highlands and Columbia Basin Subprovinces that Contain the Columbia River Basalt Group	3F-3
3-4 Landforms of the Pasco Basin and the Hanford Site	3F-4

CONTENTS (cont.)

	<u>Page</u>
FIGURES (cont.):	
3-5 Geomorphic Features Surrounding the 200 Areas	3F-5
3-6 Hanford Site Wind Roses 1979 through 1982	3F-6
3-7 Hydrologic Basins Designated for the Washington State Portion of the Columbia Plateau	3F-7
3-8 The Columbia Plateau and Surrounding Structural Provinces	3F-8
3-9 Structural Subprovinces of the Columbia Plateau	3F-9
3-10 Structural Elements of the Yakima Fold Belt Subprovince	3F-10
3-11 Geologic Structures of the Pasco Basin and the Hanford Site	3F-11
3-12 Generalized Stratigraphy of the Hanford Site	3F-12
3-13 Generalized Stratigraphy of the Suprabasalt Sediments Beneath the Hanford Site	3F-13
3-14 Location of Geologic Cross-sections	3F-14
3-15 Legend for Cross-sections	3F-15
3-16 Geologic Cross-section - H-H'	3F-16
3-17 Geologic Cross-section - B-B'	3F-17
3-18 Geologic Cross-section - C-C'	3F-18
3-19 Structure Contour Map for Surface of the Top of Basalt	3F-19
3-20 Isopach Map of the Ringold Gravel Unit A	3F-20
3-21 Structure Map of the Ringold Gravel Unit A	3F-21
3-22 Isopach Map of the Top of the Ringold Lower Mud Sequence, Ringold Formation	3F-22
3-23 Structure Map of the Top of the Ringold Lower Mud Sequence, Ringold Formation	3F-23
3-24 Isopach Map of the Ringold Gravel Unit E	3F-24
3-25 Structure Map of the Ringold Gravel Unit E	3F-25
3-26 Structure Map of the Top of the Ringold Formation	3F-26
3-27 Isopach Map of the Lower Gravel Sequence, Hanford Formation	3F-27
3-28 Structure Map of the Top of the Lower Gravel Sequence, Hanford Formation . .	3F-28
3-29 Isopach Map of the Sandy Sequence, Hanford Formation	3F-29
3-30 Structure Map of the Top of the Sandy Sequence, Hanford Formation	3F-30
3-31 Isopach Map of the Upper Coarse Gravel Sequence, Hanford Formation	3F-31
3-32 Isopach Map of the Entire Hanford Formation	3F-32
3-33 Conceptual Geologic Column for the Hanford Site	3F-33
3-34 Wetting and Drying Curves for Well 299-W18-21	3F-34
3-35 Particle-Size Distribution and Water Retention Characteristics of Soil From Hanford Site Lysimeters	3F-35
3-36 200 Areas Water Table Map, June 1990	3F-36
3-37 Conceptual Hydrogeologic Column for the B Plant Aggregate Area	3F-37
4-1 Gamma Isoradiation Contour Map of the 200 East Area	4F-1

CONTENTS (cont.)

Page

FIGURES (cont.):

4-2	Surface, Underground and Migrating Map of the 200 East Area	4F-2
4-3	Conceptual Model of the B Plant Aggregate Area	4F-3
4-4	Physical Conceptual Model of Contamination Distribution	4F-4
7-1	Development of Candidate Remedial Alternatives for B Plant Aggregate Area	7F-1
7-2	Alternative 1: Multimedia Cover with Vertical Barriers	7F-2
7-3	Alternative 2: In Situ Grouting of Soil	7F-3
7-4	Alternative 3: Excavation, Treatment and Disposal	7F-4
7-5	Alternative 4: In Situ Vitrification of Soil	7F-5
7-6	Alternative 5: Excavation, Vitrification, and Geologic Disposal of Soil with TRU Radionuclides	7F-6
7-7	Alternative 6: Soil Vapor Extraction for Volatile Organic Compounds (VOCs)	7F-7
9-1	200 Aggregate Area Management Studies Decision Making Flowchart	9F-1

PLATES:

Plate 1	Facilities, Sites, and Unplanned Releases in the West Operable Units
Plate 2	Topography of the West Operable Units
Plate 3	Monitor Wells and Sample Locations in the West Operable Units
Plate 4	Facilities, Sites, and Unplanned Releases in the 200-BP-11 Operable Unit
Plate 5	Topography of the 200-BP-11 Operable Unit
Plate 6	Monitor Wells and Sample Locations in the 200-BP-11 Operable Unit
Plate 7	Facilities, Sites, and Unplanned Releases; Topography; and Monitor Wells and Sample Locations in the 200-IU-6 Operable Unit

TABLES:

Page

1-1	Overall Aggregate Area Management Study (AAMS) Schedule for the 200 NPL Site	1T-1
2-1	Summary of B Plant Aggregate Area Waste Management Units	2T-1
2-2	Description of B Plant Aggregate Single-Shell Tanks	2T-2
2-3	Radionuclide Waste Inventory Summary	2T-3
2-4	Chemical Waste Inventory Summary	2T-4
2-5	Partial Inventory of Radionuclides Disposed to the 218-E-2, -2A, -3, -4, -5, -5A, -6, -7, -9, and -10 Burial Grounds	2T-5
2-6	Description of Unplanned Releases	2T-6
2-7	Summary of Waste-Producing Processes in the B Plant Aggregate Area	2T-7
2-8	Chemicals Used in Separation/Recovery Processes	2T-8
2-9	Radionuclides and Chemicals Disposed of to B Plant Aggregate Area Waste Management Units	2T-9
2-10	General 200 East Area Single-Shell Tank Information Reference Locator	2T-10
3-1	Hydraulic Parameters for Various Areas and Geologic Units at the Hanford Site	3T-1
3-2	Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments	3T-2
3-3	Endangered, Threatened, and Sensitive Plant Species Reported on or Near the Hanford Site	3T-3
3-4	Federal and State Classifications of Animals that Could Occur on the 200 Area Plateau	3T-4
4-1	Types of Data for the B Plant Aggregate Area Waste Management Units	4T-1
4-2	Summary of Radionuclide Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units	4T-2
4-3	Summary of Chemical Contamination in Various Affected Media for B Plant Aggregate Area Waste Management Units	4T-3
4-4	Summary of Gamma-Ray Logs	4T-4
4-5	Results of External Monitoring, 1985 through 1989: TLDs (mrem/yr)	4T-5
4-6	Results of External Radiation Monitoring for 1990: TLDs (mrem/yr)	4T-6
4-7	Results of External Radiation Surveys	4T-7
4-8	Summary of B Plant Grid Soil Sampling Results (pCi/g)	4T-8
4-9	Summary of Fenceline Soil Sampling Results	4T-9
4-10	Summary of Vegetation Sampling Results (pCi/g)	4T-10
4-11	Summary of Air Monitoring Results (pCi/m ³)	4T-11
4-12	Summary of Surface Water Sampling (pCi/L)	4T-12
4-13	Summary of Single-Shell Tank Waste Sampling Data	4T-13
4-14	Evaluation of Potential Groundwater Contamination	4T-14
4-15	TRAC Inventory Data	4T-15
4-16	Summary of Tank Farm Vadose Zone Borehole Geophysical Logging Data	4T-16
4-17	Cesium Inventories for Single-Shell Tank Leak Unplanned Releases	4T-17

CONTENTS (cont.)

	<u>Page</u>
TABLES (cont.):	
4-18 Radionuclide Inventories for Burial Sites	4T-18
4-19 Summary of Sediment Monitoring for the 216-B-5 Reverse Well	4T-19
4-20 Summary of Sanitary Wastewater and Sewage Received Daily by B Plant Aggregate Area Septic Tanks	4T-20
4-21 Summary of Sediment Sampling for the 216-B-3 Pond System	4T-21
4-22 Candidate Contaminants of Potential Concern for the B Plant Aggregate Area	4T-22
4-23 Summary of Known and Suspected Contamination at Plant Aggregate Area Waste Management Units and Unplanned Releases	4T-23
4-24 Contaminants of Potential Concern for the B Plant Aggregate Area	4T-24
4-25 Soil-Water Distribution Coefficient K_d for Radionuclides and Inorganics of Concern at B Plant Waste Management Units	4T-27
4-26 Mobility of Inorganic Species in Soil	4T-28
4-27 Physical/Chemical Properties of Organic Contaminants of Concern for B Plant Aggregate Area Waste Management Units	4T-27
4-28 Radiological Properties of Potential Radionuclides of Concern in B Plant Aggregate Area Waste Management Units	4T-28
4-29 Comparison of Radionuclide Relative Risks or Radionuclides of Concern at the B Plant Aggregate Area	4T-29
4-30 Potential Chronic Health Effects of Chemicals Detected or Disposed of at the B Plant Aggregate Area	4T-30
5-1 Hazard Ranking Scores for B Plant Aggregate Area	5T-1
6-1 Potential Contaminant-Specific ARARs and TBCs for Preliminary Inorganic and Organic Contaminants of Concerns	6T-1
6-2 Potential Location-Specific ARARs	6T-2
7-1 Preliminary Remedial Action Objectives and General Response Actions	7T-1
7-2 Preliminary Remedial Action Technologies	7T-2
7-3 Screening of Process Options	7T-3
7-4 Preliminary Remedial Action Alternatives Applicable to Waste Management Units and Unplanned Release Sites	7T-4
8-1 Uses of Existing Data for B Plant Aggregate Area Waste Management Units	8T-1
8-2 Data Needs for Preliminary Remedial Action Alternatives B Plant Aggregate Area	8T-2
8-3 Analytical Levels for the B Plant Aggregate Area	8T-3
8-4 Data Quality Objective Parameters for Chemical/Radiochemical Analyses	8T-4

CONTENTS (cont.)

Page

TABLES (cont.):

8-5	Data Gaps by Site Category	8T-5
8-6	Applicable Characterization Methods at B Plant Aggregate Area Waste Management Units	8T-6
9-1	Summary of the Remediation Process Path Assessment Results for the B Plant Aggregate Area	9T-1
9-2	B Plant Aggregate Area Data Evaluation Decision Matrix	9T-2
9-3	Waste Management Units and Unplanned Releases to be Addressed by Other Programs	9T-3

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1.0 INTRODUCTION

The U.S. Department of Energy (DOE) Hanford Site in Washington State is organized into numerically designated operational areas including the 100, 200, 300, 400, 600, and 1100 Areas (Figure 1-1). The U.S. Environmental Protection Agency (EPA), in November 1989, included the 200 Areas of the Hanford Site on the National Priorities List (NPL) under the *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (CERCLA). Inclusion on the NPL initiates the Remedial Investigation (RI) and Feasibility Study (FS) process for characterizing the nature and extent of contamination, assessing risks to human health and the environment, and selection of remedial actions.

This report presents the results of an aggregate area management study (AAMS) for the B Plant Aggregate Area located in the 200 Areas. The study provides the basis for initiating RI/FS under CERCLA or under the Resource Conservation and Recovery Act (RCRA) Facility Investigations (RFI) and Corrective Measures Studies (CMS). This report also integrates RCRA treatment, storage or disposal (TSD) closure activities with CERCLA and RCRA past-practice investigations.

This chapter describes the overall AAMS approach for the 200 Areas, defines the purpose, objectives, and scope of the AAMS, and summarizes the quality assurance (QA) program and contents of the report.

1.1 OVERVIEW

The 200 Areas, located near the center of the Hanford Site, encompasses the 200 West, East, and North Areas which contain reactor fuel processing and waste management facilities.

Under the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), signed by the Washington State Department of Ecology (Ecology), DOE, and EPA (Ecology et al. 1990), the 200 NPL Site encompasses the 200 Areas and selected portions of the 600 Area. The 200 NPL Site is divided into 8 waste area groups largely corresponding to the major processing plants (e.g., B Plant and T Plant), and a number of isolated operable units located in the surrounding 600 Area. Each waste area group is further subdivided into one or more operable units based on waste disposal information, location, facility type, and other site characteristics. The 200 NPL site includes a total of 44 operable units including 20 in the 200 East Area, 17 in the 200 West Area, 1 in the 200 North Area, and 6 isolated operable units. The intent of defining operable units was to group associated waste management units together, such that they could be effectively characterized and remediated under one work plan.

The Tri-Party Agreement also defines approximately 25 RCRA TSD groups within the 200 Areas which will be closed or permitted (for operation or postclosure care) in accordance with the Washington State Dangerous Waste Regulations (WAC 173-303). The TSD facilities are often associated with an operable unit and are required to be addressed concurrently with past-practice activities under the Tri-Party Agreement.

This AAMS is one of ten studies that will provide the basis for past practice activities for operable units in the 200 Areas. In addition, the AAMS will be collectively used in the initial development of an area-wide groundwater model, and conduct of an initial site-wide risk assessment. Recent changes to the Tri-Party Agreement (Ecology et al. 1991), and the *Hanford Site Past-Practice Strategy* document (DOE/RL 1992a) establish the need and provide the framework for conducting AAMS in the 200 Areas.

1.1.1 Tri-Party Agreement

The Tri-Party Agreement was developed and signed by representatives from the EPA, Ecology, and DOE in May 1989, and revised in 1990 and 1991. The scope of the agreement covers all CERCLA past-practice, RCRA past-practice, and RCRA TSD activities on the Hanford Site. The purpose of the Tri-Party Agreement is to ensure that the environmental impacts of past and present activities are investigated and appropriately remediated to protect human health and the environment. To accomplish this, the Tri-Party Agreement provides a framework and schedule for developing, prioritizing, implementing, and monitoring appropriate response actions.

The 1991 revision to the Tri-Party Agreement requires that an aggregate area approach be implemented in the 200 Areas based on the *Hanford Site Past-Practice Strategy* (DOE/RL 1992a). This strategy requires the conduct of AAMS which are similar in nature to an RI/FS scoping study. The Tri-Party Agreement change package (Ecology et al. 1991) specifies that 10 Aggregate Area Management Study Reports (AAMSR) (major milestone M-27-00) are to be prepared for the 200 Areas. Further definition of aggregate areas and the AAMS approach is provided in Sections 1.2 and 1.3.

1.1.2 Hanford Site Past Practice Strategy

The *Hanford Site Past-Practice Strategy* was developed between Ecology, EPA, and DOE to streamline the existing RI/FS and RFI/CMS processes. A primary objective of this strategy is to develop a process to meet the statutory requirements and integrate CERCLA RI/FS and RCRA Past Practice RFI/CMS guidance into a singular process for the Hanford Site that ensures protection of human health and welfare and the environment. The strategy refines the existing past-practice decision-making process as defined in the Tri-Party Agreement. The fundamental principle of the strategy is a bias-for-action by optimizing the use of existing data, integrating past practice with RCRA TSD closure investigations,

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focusing the RI/FS process, conducting interim remedial actions, and reaching early decisions to initiate and complete cleanup projects on both operable-unit and aggregate-area scale. The ultimate goal is the comprehensive cleanup or closure of all contaminated areas at the Hanford Site at the earliest possible date in the most effective manner.

The process under this strategy is a continuum of activities whereby the effort is refined based upon knowledge gained as work progresses. Whereas the strategy is intended to streamline investigations and documentation to promote the use of interim actions to accelerate cleanup, it is consistent with RI/FS and RFI/CMS processes. An important element of this strategy is the application of the observational approach, in which characterization data are collected concurrently with cleanup.

For the 200 Areas the first step in the strategy is the evaluation of existing information presented in AAMSR. Based on this information, decisions are made regarding which strategy path(s) to pursue for further actions in the aggregate area. The strategy includes three paths for interim decision making and a final remedy-selection process that incorporates the three paths and integrates sites not addressed in those paths. As shown on Figure 1-2, the three paths for decision making are the following:

- Expedited response action (ERA) path, where an existing or near-term unacceptable health or environmental risk from a site is determined or suspected, and a rapid response is necessary to mitigate the problem
- Interim remedial measure (IRM) path, where existing data are sufficient to indicate that the site poses a risk through one or more pathways and additional investigations are not needed to screen the likely range of remedial alternatives for interim actions; if a determination is made that an IRM is justified, the process proceeds to select an IRM remedy and a focused feasibility study (FSS), if needed, to select a remedy
- Limited field investigation (LFI) path, where minimum site data are needed to support IRM or other decisions, and is obtained in a less formal manner than that needed to support a final Record of Decision (ROD). Data generated from a LFI may be sufficient to directly support an interim ROD. Regardless of the scope of the LFI, it is a part of the RI process, and not a substitute for it.

The process of final remedy selection must be completed for the aggregate area to reach closure. The aggregation of information obtained from LFI and interim actions may be sufficient to perform the cumulative risk assessment and to define the final remedy for the aggregate area or associated operable units. If the data are not sufficient, additional investigations and studies will be performed to the extent necessary to support final remedy selection. These investigations would be performed within the framework and process defined for RI/FS or RFI/CMS programs.

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1.2 200 NPL SITE AGGREGATE AREA MANAGEMENT STUDY PROGRAM

The overall approach and scope of the 200 Areas AAMS program is based on the Tri-Party Agreement and the *Hanford Site Past-Practice Strategy*.

1.2.1 Overall Approach

As defined in the 1991 revision to the Tri-Party Agreement, the AAMS program for the 200 Areas consists of conducting a series of ten AAMS for eight source (Figures 1-3, 1-4, and 1-5) and two groundwater aggregate areas delineated in the 200 East, West, and North Areas. Table 1-1 lists the aggregate areas, the type of study and associated operable units. With the exception of 200-IU-6, isolated operable units associated with the 200 NPL site (Figure 1-5) are not included in the AAMS program. Generally, the quantity of existing information associated with isolated operable units is not considered sufficient to require study on an aggregate area basis prior to work plan development. Operable unit 200-IU-6 is addressed as part of the B Plant AAMS because of similarities in waste management units (i.e., ponds).

The eight source AAMS are designed to evaluate source terms on a plant-wide scale. Source AAMS are conducted for the following aggregate areas (waste area groups) which largely correspond to the major processing plants including the following:

- U Plant
- Z Plant
- S Plant
- T Plant
- PUREX
- B Plant
- Semi-Works
- 200 North.

The groundwater beneath the 200 Areas is investigated under two groundwater AAMS on an Area-wide scale (i.e., 200 West and 200 East Areas). Groundwater aggregate areas were delineated to encompass the geography necessary to define and understand the local hydrologic regime, and the distribution, migration and interaction of contaminants emanating from source terms. The groundwater aggregate areas are considered an appropriate scale for developing conceptual and numerical groundwater models.

The U.S. Department of Energy, Richland Field Office (DOE/RL) functions as the "lead agency" for the 200 AAMS program. Depending on the specific AAMS, EPA and/or Ecology function as the "Lead Regulatory Agency" (Table 1-1). Through periodic (monthly) meetings information is transferred and regulators are informed of the progress of the AAMS such that decisions established under the *Hanford Site Past-Practice Strategy* (e.g., is an

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ERA justified?) (Figure 1-2) can be quickly and collectively made between the three parties. These meetings will continually refine the scope of AAMS as new information is evaluated, decisions are made and actions taken. Completion milestones for AAMS are defined in Ecology et al. (1991) and duplicated in Table 1-1. All AAMSR are submitted as Secondary Documents which are defined in the Tri-Party Agreement as informational documents.

1.2.2 Process Overview

Each AAMS consists of three steps: (1) the analysis of existing data and formulation of a preliminary conceptual model, (2) identification of data needs and evaluation of remedial technologies, and (3) conduct of limited field characterization activities. Steps 1 and 2 are components of an AAMSR. Step 3 is a parallel effort for which separate reports will be produced.

The first and primary task of the AAMS investigation process involves the search, compilation and evaluation of existing data. Information collected for these purposes includes the following:

- Facility and process descriptions and operational histories for waste sources
- Waste disposal records defining dates of disposal, waste types, and waste quantities
- Sampling events of waste effluents and effected media
- Site conditions including the site physiography, geology, hydrology, meteorology, ecology, demography, and archaeology
- Environmental monitoring data for affected media including air, surface water, sediment, soil, groundwater and biota.

Collectively this information is used to identify contaminants of concern, determine the scope of future characterization efforts, and to develop a preliminary conceptual model of the aggregate area. Although data collection objectives are similar, the types of information collected depend on whether the study is a source or groundwater AAMS. The data collection step serves to avoid duplication of previous efforts and facilitates a more focused investigation by the identification of data gaps.

Topical reports referred to as Technical Baseline Reports are initially prepared to summarize facility information. These reports describe individual waste management units and unplanned releases contained in the aggregate area as identified in the Waste Information Data System (WIDS) (WHC 1991a). The reports are based on review of current and historical Hanford Site reports, engineering drawings and photographs and are supplemented

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with site inspections and employee interviews. Information contained in the reports is summarized in the AAMSR. Other topical reports are used as sources of information in the AAMSR. These reports are as follows:

- U Plant Geologic and Geophysics Data Package
- Z Plant Geologic and Geophysics Data Package
- S Plant Geologic and Geophysics Data Package
- T Plant Geologic and Geophysics Data Package
- PUREX Geologic and Geophysics Data Package
- B Plant Geologic and Geophysics Data Package
- 200 N Geologic and Geophysics Data Package
- Semiworks Geologic and Geophysics Data Package
- Hydrologic Model for the 200 West Groundwater Aggregate Area
- Hydrologic Model for the 200 East Groundwater Aggregate Area
- Unconfined Aquifer Hydrologic Test Data Package for the 200 West Groundwater Aggregate Area
- Unconfined Aquifer Hydrologic Test Data Package for the 200 East Groundwater Aggregate Area
- Confined Aquifer Hydrologic Test Data Package for the 200 Groundwater Aggregate Area Management Studies
- Groundwater Field Characterization Report
- 200 West Area Borehole Geophysics Field Characterization
- 200 East Area Borehole Geophysics Field Characterization.

The general scope of the topical reports related to this AAMSR is described in Section 8.0.

Information on waste sources, pathways, and receptors is used to develop a preliminary conceptual model of the aggregate area. In the preliminary conceptual model, the release

mechanisms and transport pathways are identified. If the conceptual understanding of the site is considered inadequate, limited field characterization activities can be undertaken as part of the study. Field screening activities occurring in parallel with and as part of the AAMS process include the following:

- Expanded groundwater monitoring programs (non Contract Laboratory Program [CLP]) at approximately 80 select existing wells to identify contaminants of concern and refine groundwater plume maps
- In situ assaying of gamma-emitting radionuclides at approximately 10 selected existing boreholes per aggregate area to develop radioelement concentration profiles in the vadose zone.

Wells, boreholes, and analytes are selected based on a review of existing environmental data which is undertaken early in the AAMS process. Field characterization results will be presented later in topical reports.

After the preliminary conceptual model is developed, health and environmental concerns are identified. The purpose of this determination is to provide one basis for determining recommendations and prioritization for subsequent actions at waste management units. Potential applicable or relevant and appropriate requirements (ARARs) and potential remedial technologies are identified. In cases where the existing information is sufficient, the *Hanford Site Past-Practice Strategy* allows for a FFS or CMS to be initiated prior to the completion of the study.

Data needs are identified by evaluating the sufficiency of existing data and by determining what additional data are necessary to adequately characterize the aggregate area, refine the preliminary conceptual model and potential ARARs, and/or narrow the range of remedial alternatives. Determinations are made regarding the level of uncertainty associated with existing data and the need to verify or supplement the data. If additional data are needed, the intended data uses are identified, data quality objectives (DQO) established and data priorities set.

Each AAMSR results in management recommendations for the aggregate area including the following:

- The need for ERA, IRM, and LFI or whether to retain in the final remedy selection path
- Definition and prioritization of operable units
- Prioritization of work plan activities
- Integration of RCRA TSD closure activities

- The conduct of field characterization activities
- The need for treatability studies
- Identification of waste management units addressed entirely under other operational programs.

The waste management units recommended for ERA, IRM, or LFI actions are considered higher priority units. Lower priority waste management units will generally follow the conventional process for RI/FS. In spite of this distinction in the priority of sites, RI/FS activities will be conducted for all the waste management units. In the case of the higher priority waste management units, response operations will be followed by conventional RI/FS activities, although these activities may be modified because of knowledge gained through the remediation activities. In the case of the lower priority waste management units, an area-wide RI/FS will be prepared which encompasses these sites.

Based on the AAMSR, a decision is made on whether the study has provided sufficient information to forego further field investigations and prepare a FS. An RI/FS work plan (which may be limited to LFI activities) will be developed and executed. The background information normally required to support the preparation of a work plan (e.g., site description, conceptual model, DQO, etc.) is developed in the AAMSR. The future work plans will reference information from the AAMSR. They will also include the rationale for sampling and analysis, will present detailed, unit-specific DQO, and will further develop physical site models as the data allows. In some cases, there may be insufficient data to support any further analysis than is provided in the AAMSR, so an added level of detail in the work plan may not be feasible.

All ten AAMS are scheduled to be completed by September 1992. This will facilitate a coordinated approach to prioritizing and implementing future past practice activities for the entire 200 Areas.

1.3 PURPOSE, SCOPE, AND OBJECTIVES

The purpose of conducting an AAMS is to compile and evaluate the existing body of knowledge and conduct limited field characterization work to support the *Hanford Site Past-Practice Strategy* decision making process for an aggregate area. The AAMS process is similar in nature to the RI/FS scoping process prior to work plan development and is intended to maximize the use of existing data to allow a more focused RI/FS. Deliverables for an AAMS consist of the AAMSR and Health and Safety, Project Management, and Information Management Overview (IMO) Plans.

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Specific objectives of the AAMS include the following:

- Assemble and interpret existing data including operational and environmental data
- Describe site conditions
- Conduct limited new site characterization work if data or interpretation uncertainty could be reduced by the work (results from this work may not be available for the AAMSR, but will be included in subsequent topical reports)
- Develop a preliminary conceptual model
- Identify contaminants of concern, and their distribution
- Identify potential ARARs
- Define preliminary remedial action objectives, screen potential remedial technologies, and if possible provide recommendations for FFS
- Recommend treatability studies to support the evaluation of remedial action alternatives
- Define data needs, establish general DQO and set data priorities
- Provide recommendations for ERA, IRM, LFI or other actions
- Redefine and prioritize, as data allow, operable unit boundaries
- Define and prioritize, as data allow, work plan and other past practice activities with emphasis on supporting early cleanup actions and records of decisions
- Integrate RCRA TSD closure activities with past practice activities.

Information on single-shell and double-shell tanks is briefly presented in Sections 2.0 and 4.0 of applicable AAMSR. The AAMSR is not intended to address remediation related to the tanks. Nonetheless, the tank information is presented because known and suspected releases from the tanks may influence the interpretation of contamination data at nearby waste management units. Information on other facilities and buildings is also presented for this same reason. However, because these structures are addressed by other programs, the AAMSR does not include recommendations for further action at these structures.

Depending on whether an aggregate area is a source or groundwater aggregate area, the scope of the AAMS varies. Source AAMS focus on source terms, and the environmental media of interest include air, biota, surface water, surface soil, and the unsaturated

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subsurface soil. Accordingly, detailed descriptions of facilities and operational information are provided in the source AAMSR. In contrast, groundwater AAMS focus on the saturated subsurface and on groundwater contamination data. Descriptions of facilities in the groundwater AAMSR are limited to liquid disposal facilities and reference is made to source AAMSR for detailed descriptions. The description of site conditions in source AAMSR concentrate on site physiography, meteorology, surface water hydrology, vadose zone geology, ecology, and demography. Groundwater AAMSR summarize regional geohydrologic conditions and contain detailed information regarding the local geohydrology on an Area-wide scale. Correspondingly, other sections of the AAMSR vary depending on the environmental media of concern.

1.4 QUALITY ASSURANCE

A limited amount of field characterization work is performed in parallel with preparation of the AAMS report. To help ensure that data collected are of sufficient quality to support decisions, all work will be performed in compliance with *Quality Assurance*, DOE Order 5700.6C (DOE 1991), as well as Westinghouse Hanford's existing QA manual, WHC-CM-4-2 (WHC 1988a), and with procedures outlined in the QA program plan WHC-EP-0383 (WHC 1990a), specific to CERCLA RI/FS activities. This QA program plan describes the various plans, procedures, and instructions that will be used by Westinghouse Hanford to implement the QA requirements. Standard EPA guidance documents such as *USEPA Contract Laboratory Program Statement of Work for Organic Analysis* (EPA 1988a) will also be followed.

1.5 ORGANIZATION OF REPORT

In addition to this introduction, the AAMSR consists of the following nine sections and appendices:

- Section 2.0, Facility, Process and Operational History Descriptions, describes the major facilities, waste management units and unplanned releases within the aggregate area. A chronology of waste disposal activities is established and waste generating processes are summarized.
- Section 3.0, Site Conditions, describes the physical, environmental, and sociological setting including, geology, hydrology, ecology, meteorology, and demography.
- Section 4.0, Preliminary Conceptual Model, summarizes the conceptual understanding of the aggregate area with respect to types and extent of contamination, exposure pathways and receptors.

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- Section 5.0, Health and Environmental Concerns, identifies chemicals used or disposed within the aggregate area that could be of concern regarding public health and/or the environment and describes and applies the screening process for determining the relative priority of follow-up action at each waste management unit.
- Section 6.0, Potentially Applicable or Relevant and Appropriate Requirements, identifies federal and state standards, requirements, criteria, or limitations that may be considered relevant to the aggregate area.
- Section 7.0, Preliminary Remedial Action Technologies, identifies and screens potential remedial technologies and establishes remedial action objectives for environmental media.
- Section 8.0, Data Quality Objectives, reviews QA criteria on existing data, identifies data gaps or deficiencies, and identifies broad data needs for field characterization and risk assessment. The DQO and data priorities are established.
- Section 9.0, Recommendations, provides guidance for future past practice activities based on the results of the AAMS. Recommendations are provided for ERA at problem sites, IRM, LFI, refining operable unit boundaries, prioritizing work plans, and conducting field investigations and treatability studies.
- Section 10.0, References, list reports and documents cited in the AAMSR.
- Appendix A, Supplemental Data, provides supplemental data supporting the AAMSR.

The following plans are included and will be used to support past practice activities in the aggregate area:

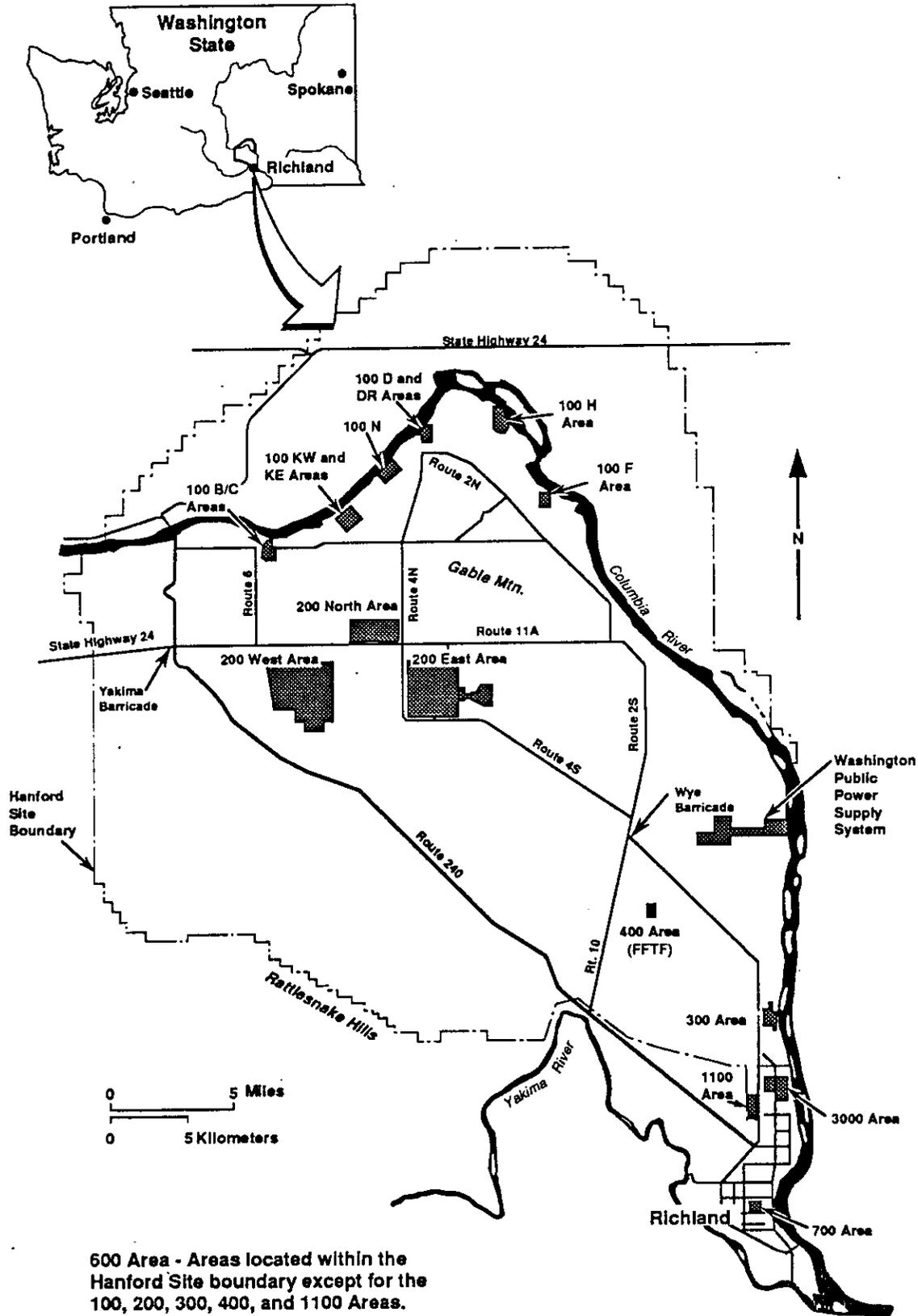
- Appendix B: Health and Safety Plan
- Appendix C: Project Management Plan
- Appendix D: Information Management Overview.

Community relations requirements for the B Plant Aggregate Area can be found in the *Community Relations Plan for the Hanford Federal Facility Agreement and Consent Order* (Ecology et al. 1989).

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Figure 1-1. Hanford Site Map.



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Hanford Past Practice RI/FS (RFI/CMS) Process

The process is defined as a combination of Interim cleanup actions (involving concurrent characterization), field investigations for final remedy selection where interim actions are not clearly justified, and feasibility/treatability studies.

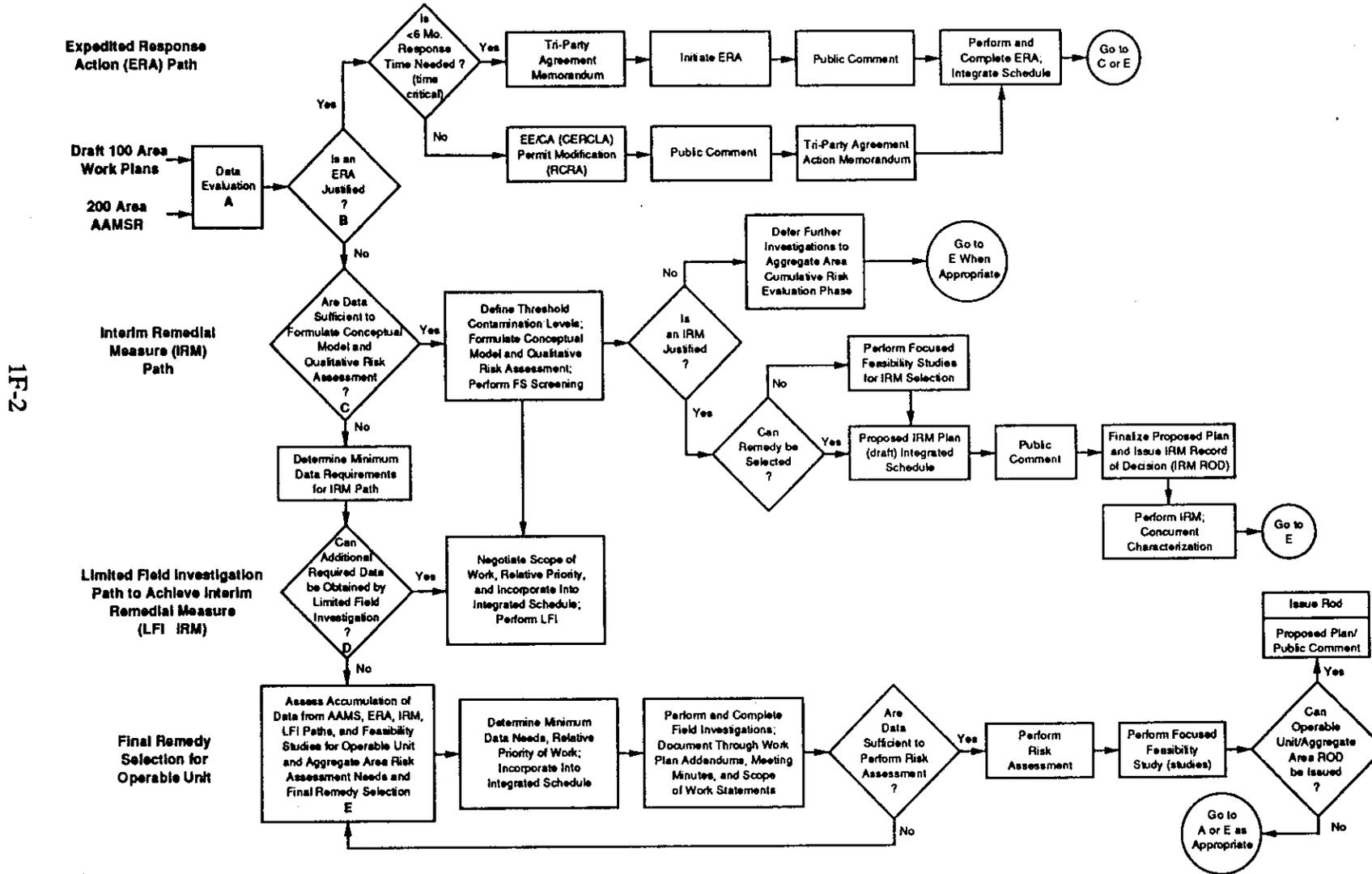


Figure 1-2. Hanford Past-Practice Strategy Flow Chart.

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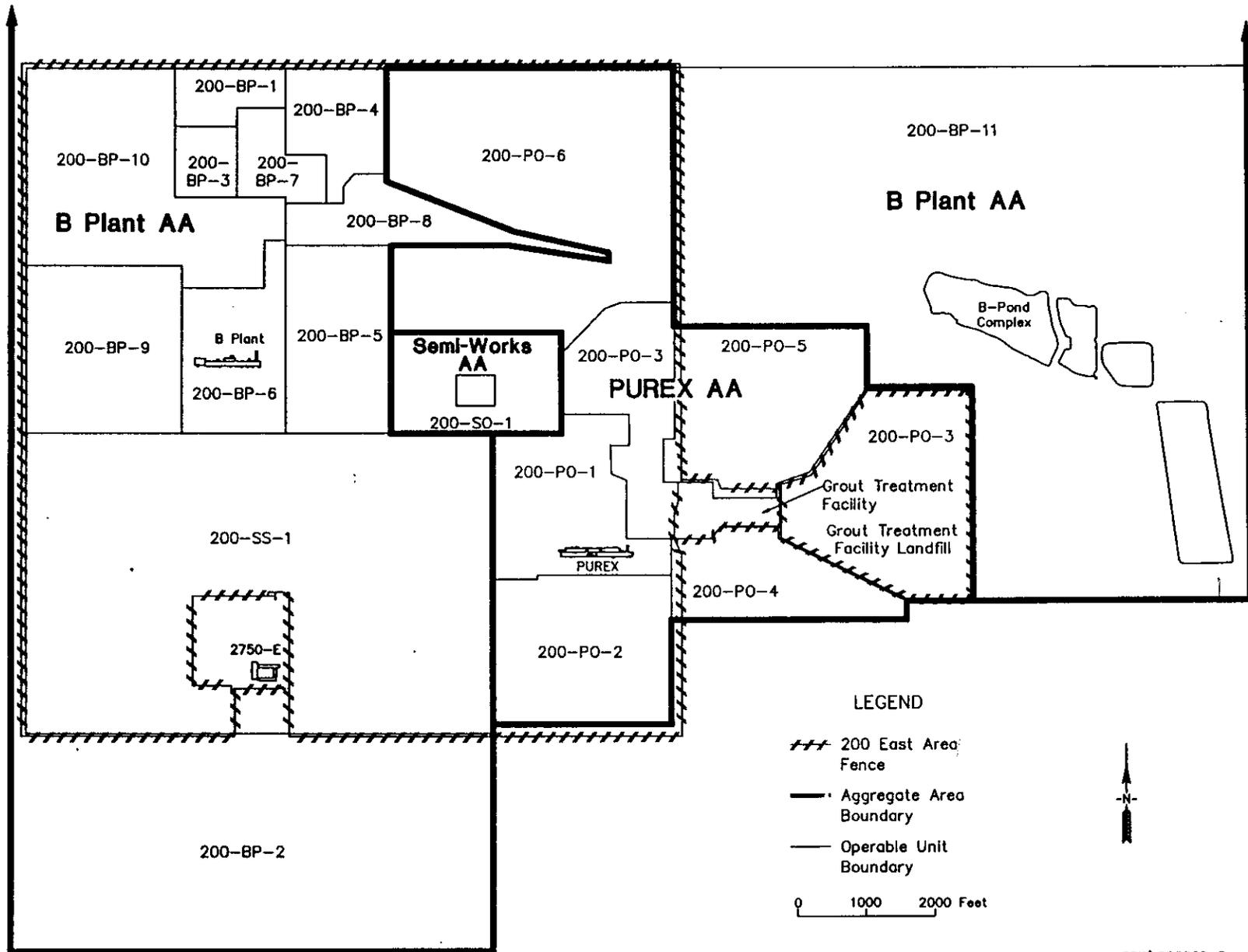
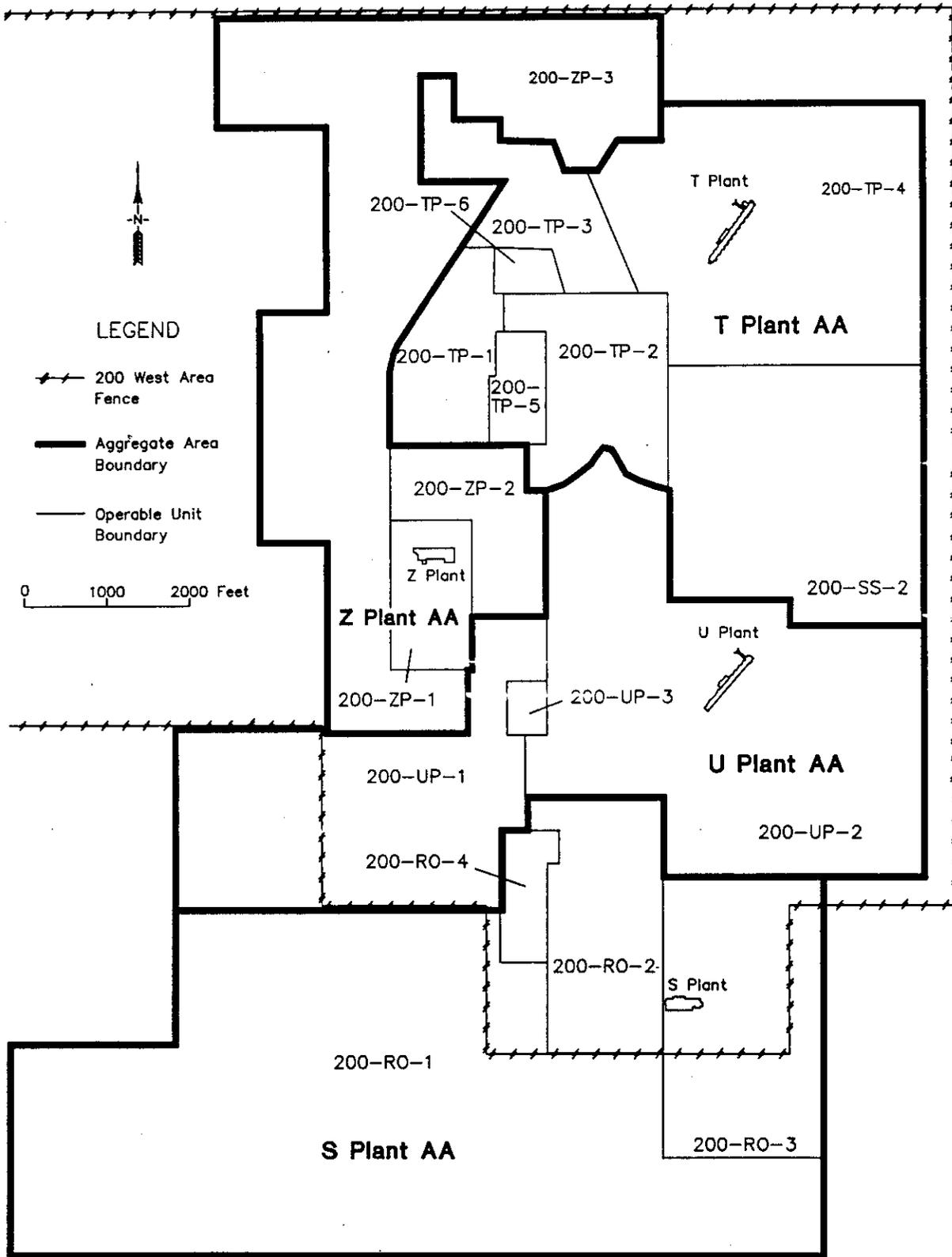


Figure 1-3. 200 East Aggregate Areas.

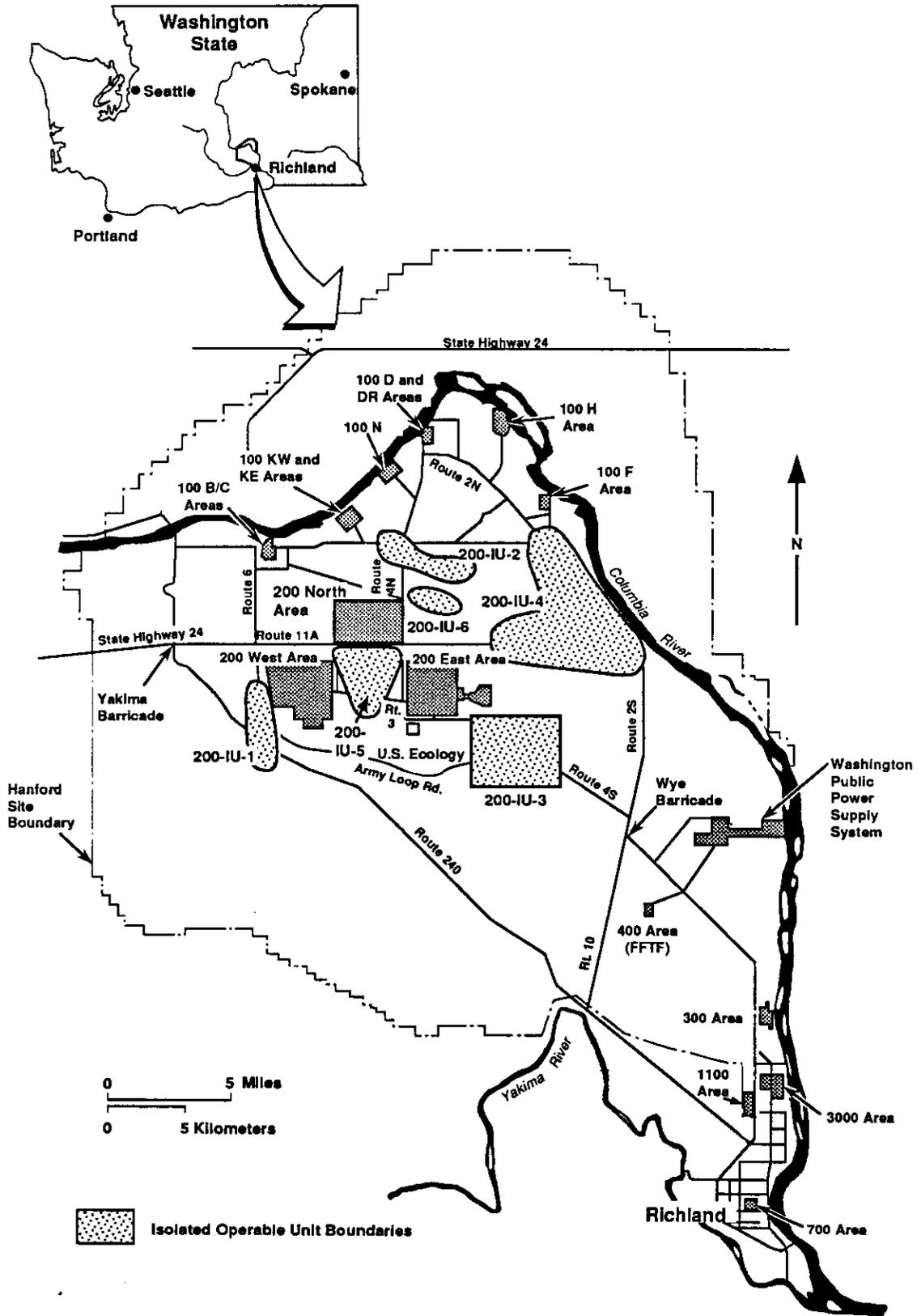
Figure 1-4. 200 West Aggregate Areas.



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Figure 1-5. 200 NPL Site Isolated.



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Table 1-1. Overall Aggregate Area Management Study (AAMS) Schedule for the 200 NPL Site.

AAMS Title	Operable Units	AAMS Type	Lead Regulatory Agency	M-27-00 Interim Milestones
U Plant	200-UP-1 200-UP-2 200-UP-3	Source	Ecology	M-27-02, January 1992
Z Plant	200-ZP-1 200-ZP-2 200-ZP-3	Source	EPA	M-27-03, February 1992
S Plant	200-RO-1 200-RO-2 200-RO-3 200-RO-4	Source	Ecology	M-27-04, March 1992
T Plant	200-TP-1 200-TP-2 200-TP-3 200-TP-4 200-TP-5 200-TP-6 200-SS-2	Source	EPA	M-27-05, April 1992
PUREX	200-PO-1 200-PO-2 200-PO-3 200-PO-4 200-PO-5 200-PO-6	Source	Ecology	M-27-06, May 1992
B Plant	200-BP-1 200-BP-2 200-BP-3 200-BP-4 200-BP-5 200-BP-6 200-BP-7 200-BP-8 200-BP-9 200-BP-10 200-BP-11 200-IU-6 200-SS-1	Source	EPA	M-27-07, June 1992
Semi-Works	200-SO-1	Source	Ecology	M-27-08, July 1992
200 North	200-NO-1	Source	EPA	M-27-09, August 1992
200 West	NA	Groundwater	EPA/Ecology	M-27-10, September 1992
200 East	NA	Groundwater	EPA/Ecology	M-27-11, September 1992

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2.0 FACILITY, PROCESS AND OPERATIONAL HISTORY DESCRIPTIONS

Section 2.0 of the aggregate area management study (AAMS) presents historical data on the B Plant Aggregate Area and detailed physical descriptions of the individual waste management units and unplanned releases. These descriptions include historical data on waste sources and disposal practices and are based on a review of current and historical Hanford Site reports, engineering drawings, site inspections, and employee interviews. Section 3.0 describes the environmental setting of the waste management units. The waste types and volumes are qualitatively and quantitatively assessed at each site in Section 4.0. Data from these three sections are used to identify contaminants and sites of concern (Section 5.0), potential applicable or relevant and appropriate requirements (ARARs) (Section 6.0), and current data gaps (Section 8.0).

This section describes the location of the B Plant Aggregate Area (Section 2.1), summarizes the history of operations (Section 2.2), describes facilities, buildings, and structures of the B Plant Aggregate Area (Section 2.3), and describes B Plant Aggregate Area waste generating processes (Section 2.4). Section 2.5 discusses interactions with the other aggregate areas or operable units. Sections 2.6 and 2.7 discuss interactions with the Resource Conservation and Recovery Act (RCRA) program and other Hanford programs.

2.1 LOCATION

The Hanford Site, operated by the U.S. Department of Energy (DOE), occupies about 1,450 km² (560 mi²) of the southeastern part of Washington State north of the confluence of the Yakima and Columbia Rivers (Figure 1-1). The 200 East Area is a controlled area of approximately 15 km² (6 mi²) near the middle of the Hanford Site. The 200 East Area is about 10 km (6 mi) from the Columbia River and 20 km (12 mi) from the nearest Hanford boundary. There are 20 operable units grouped into three aggregate areas in the 200 East Area (Figure 1-4). The B Plant Aggregate Area (consisting of operable units 200-BP-1 through 200-BP-11, 200-SS-1, and 200-IU-6) lies in the northeast and northcentral parts of the 200 East Area, and south of the 200 East Area (Figure 1-3). The locations of the buildings and waste management units are shown on Plates 1, 4, and 7. Plates 2, 5, and 7 shows the topography of the B Plant Aggregate Area. The media sampling locations are depicted on Plates 3, 6, and 7.

2.2 HISTORY OF OPERATIONS

The Hanford Site, established in 1943, was originally designed, built, and operated to produce plutonium for nuclear weapons using production reactors and chemical reprocessing plants. In March 1943, construction began on three reactor facilities (B, D, and F Reactors) and three chemical processing facilities (B, T, and U Plants). After World War II, six more

reactors were built (H, DR, KW, KE, and N Reactors). Beginning in the 1950's, energy research and development, isotope use, and other activities were added to the Hanford operation. In early 1964, a presidential decision was made to begin shut down of the reactors. Eight of the reactors were shut down by 1971. The N Reactor operated through 1987 and was placed on cold standby status in October 1989. Westinghouse Hanford was notified September 20, 1991 that they should cease preservation and proceed with activities leading to a decision on ultimate decommissioning of the reactor. These activities are scoped within a N Reactor shutdown program which is scheduled to be completed in 1999.

Operations in the 200 Areas (East and West) are mainly related to spent nuclear fuel separation. Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation. The 200 East Area has two primary, active processing areas and one inactive processing area (Figure 1-3):

- 221-B Building (B Plant), where the bismuth phosphate process was used to separate plutonium from spent uranium fuel rods, and later, the recovery of cesium, strontium, and other rare earth metals was performed using an acid-side, oxalate-precipitation process.
- 202-A Building (PUREX) Plant, where the tributyl phosphate process was used to separate plutonium from spent uranium fuel rods.
- C Plant (Hot Semiworks), where the plutonium separation technology was developed (inactive).

The 200 Areas also contain nonradioactive support facilities, including transportation maintenance buildings, service stations, coal-fired powerhouses for process steam production, steam transmission lines, raw water treatment plants, water-storage tanks, electrical maintenance facilities, and subsurface sewage disposal systems.

The major processes at the B Plant Aggregate Area involved extraction of plutonium from nuclear fuels; purification, precipitation, and encapsulation of cesium and strontium from PUREX-derived waste streams; various waste handling processes, such as evaporation and transfer of single-shell tank waste.

The 221-B Building is one of the primary B Plant Aggregate Area facilities. It began operation in 1945, separating plutonium using bismuth phosphate chemical methods. It ceased operation in 1952, then began various waste treatment operations in 1965. In 1968, it was used to recover cesium and strontium. Since 1968, several new structures have been added to the 221-B Building, such as the 225-B Waste Encapsulation and Storage Facility (WESF) and the 212-B Cask Transfer Facility.

Waste evaporators and in-tank solidification units were used in the 241-B, 241-BX, and 241-BY Single-Shell Tank Farms to minimize the volume of tank waste. Also, some B Plant Aggregate Area single-shell tank liquid waste was transferred to the U Plant Aggregate Area (221-U Building) for uranium recovery, then returned to the B Plant Aggregate Area and disposed to the ground.

2.3 FACILITIES, BUILDINGS, AND STRUCTURES

The B Plant Aggregate Area contains a large variety of waste disposal and storage facilities that were associated with B Plant missions. High-level liquid wastes were stored in underground single-shell tanks while low-level liquid wastes were allowed to infiltrate into the ground through cribs, french drains, reverse wells, ponds, and open ditches. These waste types are defined in DOE order 5820.2A (DOE 1988a):

- High-level waste is defined as: highly radioactive material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of transuranic (TRU) waste and fission products in concentrations as to require permanent isolation.
- TRU waste is defined as: without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay. Heads of Field Elements can determine that other alpha contaminated wastes peculiar to a specific site, must be managed as TRU waste.
- Low-Level Waste is defined as: Waste that contains radioactivity and is not classified as high-level waste, TRU waste, or spent nuclear fuel, or He(2) byproduct material as defined by this Order. Test specimens of fissionable material irradiated for research and development only, and not for the production of power or plutonium, may be classified as low-level waste, provided the concentration of TRU is less than 100 nCi/g.
- Byproduct Material is defined as: (a) Any radioactive material (except special nuclear material) yielded in, or made radioactive by, exposure to the radiation incident or to the process of producing or utilizing special nuclear material. For purposes of determining the applicability of the Resource Conservation and Recovery Act to any radioactive waste, the term "any radioactive material" refers only to the actual radionuclides dispersed or suspended in the waste substance. The nonradioactive hazardous waste component of the waste substance will be subject to regulation under the Resource Conservation and Recovery Act.
(b) The tailings or waste produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its source material content. Ore

bodies depleted by uranium solution extraction operations and which remain underground do not constitute "byproduct material."

Based on construction, purpose, or origin, the B Plant Aggregate Area waste management units fall into one of ten subgroups as follows:

- Plants, Buildings, and Storage Areas (Section 2.3.1)
- Tanks and Vaults (Section 2.3.2)
- Cribs and Drains (Section 2.3.3)
- Reverse Wells (Section 2.3.4)
- Ponds, Ditches, and Trenches (Section 2.3.5)
- Septic Tanks and Associated Drain Fields (Section 2.3.6)
- Transfer Facilities, Diversion Boxes, and Pipelines (Section 2.3.7)
- Basins (Section 2.3.8)
- Burial Sites (Section 2.3.9)
- Unplanned Releases (Section 2.3.10).

The locations of the individual waste management units are shown on Figures 2-1 through 2-13, and on Plates 1, 4, and 7. The process history timeline for the processes associated with the B Plant Aggregate Area are shown on Figure 2-14, and a schematic of the processes is provided in Figures 2-15 and 2-16. Figure 2-17 provides a timeline for the waste management unit operational histories, including all unplanned releases. Figure 2-18 shows the operational history for the 216-B-3 Pond System and associated waste management units. Figures 2-19 through 2-25 show representative construction details about individual waste management units.

Table 2-1 provides the source descriptions, waste volume received, contaminated soil volume, and operable unit, for the waste management units, excluding unplanned releases. The locations of waste management units are shown on separate figures for each waste management group and Plate 1. Table 2-2 provides additional information for the forty single-shell tanks in the B Plant Aggregate Area including integrity, total waste volume remaining, and drainable waste volume. Tables 2-3 and 2-4 provide available radionuclide and chemical inventory data, respectively, for the waste management units, excluding unplanned releases. These radionuclide and chemical inventory data have been compiled from the Waste Information Data System (WIDS) inventory sheets (WHC 1991a) and from the Hanford Inactive Site Survey (HISS) database. These inventories include all of the

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contaminants reported in the databases, but do not necessarily include all of the contaminants disposed of at each waste management unit. Table 2-5 provides a partial inventory of radionuclides disposed to the 218-E-2, -2A, -3, -4, -5, -5A, -6, -7, -9, and -10 Burial Grounds. Table 2-6 provides a summary of data for unplanned releases. Table 2-7 provides a summary of the waste producing processes in the B Plant Aggregate Area. Table 2-8 provides a list of the chemicals used in the separations/recovery processes associated with the B Plant aggregate area. Table 2-9 provides a list of radionuclides and chemicals disposed of to the B Plant waste management units and, Table 2-10 is a "reference locator" for additional single-shell tank information.

In the following sections, each waste management unit is described within the context of one of the waste management unit types. Unplanned releases designated with a "UPR" are releases from or within specific waste management units and are considered part of that unit for remediation purposes. Therefore, a "UPR" will be discussed with its respective waste management unit. Unplanned releases designated with a "UN" are a distinct waste management unit for remediation purposes. The available data for "UPRs" and "UNs" are summarized in Table 2-6.

2.3.1 Plants, Buildings, and Storage Areas

Plants and buildings are not generally identified as past practice waste management units according to the *Hanford Federal Facility Agreement and Consent Order* (Tri-Party Agreement), and will generally be addressed under the Decommissioning and RCRA Closure Program. The program is responsible for the surveillance, maintenance, and decommissioning of surplus facilities within the Environmental Restoration Programs. Section 2.7 details the interaction of the Hanford programs.

The B Plant Aggregate Area plants or buildings that were the primary generators of waste within the aggregate area include the 221-B Building, the 222-B Building, the 224-B Building, and the 225-B Building, and are described in Section 2.3.1.1. The Hazardous Waste Staging Areas in the B Plant Aggregate Area are considered as both a building and a waste management unit, and are described in Section 2.3.1.2. The plants or buildings that are, or contain RCRA treatment, storage, or disposal (TSD) facilities, are described in Section 2.6. The locations of plants, buildings, and storage areas in the aggregate area are shown on Figure 2-1.

Other buildings and structures located within the aggregate area are not addressed in this document because they are not thought to have released contaminants and will be closed through a separate decontamination and decommissioning process. The decontamination and

decommissioning program will address both contaminated and uncontaminated structures and is described in the *Hanford Surplus Facilities Program Plan* (Hughes et al. 1990). These structures include:

- 212-B Cask Transfer Facility (receives/ships batch quantities of feed product)
- 211-B Chemical Tank Farm (bulk storage area)
- 2711-E Vehicle Maintenance Shop.

Buildings and structures which lie outside of the B Plant Aggregate Area as shown on Figure 1-3 are not considered in this report.

2.3.1.1 Waste Generating Facilities.

2.3.1.1.1 221-B Building (B Plant). The 221-B Building (B Plant) was one of the primary sources of waste in the B Plant Aggregate Area and is the dominant physical structure in the area.

The 221-B Building was constructed in 1944, and brought on line in 1945, as one of the three original chemical separation plants (B, T, and U Plants) to support plutonium production during World War II. The plants were built to extract plutonium from fuel rods irradiated in the Hanford production reactors. Each plant was equipped to use the bismuth phosphate fuels-separation process, but U Plant was never used for that purpose because B Plant and T Plant were sufficient to meet plutonium production needs.

The 221-B Building is 267 x 26 x 31 m (875 x 85 x 102 ft) and is constructed entirely of concrete. Its process equipment is contained in small rooms, called cells, which are arranged in rows in an area spanned by a traveling crane. The cells are topped with 1.2 m (4 ft) thick concrete blocks that are removable by crane to provide access to the cell beneath. Above the blocks is a space equal in height to the cell depth providing headroom for manipulating the process equipment during maintenance operations. Heavy concrete shielding walls enclose this space up to the level of the crane rails, giving the appearance of a canyon (Ballinger and Hall 1991). The 221-B Building also encompasses several adjoining structures such as the 221-BB Condensate Building, the 221-BF Effluent Control Building, and the 221-BC Change House.

Plutonium separation began with the dissolution of the aluminum-jacketed fuel rods in a sodium hydroxide solution to which sodium nitrate was added to avoid formation of too much hydrogen. The resulting sodium aluminate-sodium nitrate solution was jetted (transferred via a steam jet) to waste as a component of the first cycle waste stream.

The remaining uranium metal slugs were rinsed with water and dissolved in 50 to 60% nitric acid. Sodium and bismuth nitrate and phosphoric acid were added to the dissolver solution, precipitating bismuth phosphate, which carried the plutonium. The solution was

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jetted to waste (the metal waste stream), and the precipitate was again dissolved in nitric acid. Dichromate solution was added to the sodium and bismuth nitrate and phosphoric acid, again precipitating bismuth phosphate, but changing the valence of the plutonium and causing it to remain in solution. The byproduct cake was dissolved in nitric acid and jetted to waste. The product solution was again treated to precipitate bismuth phosphate as the plutonium carrier, completing the "first decontamination cycle." The entire process was repeated, comprising the "second decontamination cycle" (Ballinger and Hall 1991).

The product from this process was a dilute plutonium solution that was transferred to the 224-B Building (Concentration Facility) where it was purified and its volume reduced. It was then transferred to the Isolation Building for final treatment before being shipped offsite (Ballinger and Hall 1991).

The coating removal waste, containing small amounts of fission products, was combined with first-cycle decontamination waste for storage in underground tanks as first cycle waste. Byproduct cake solution and waste solution from the first decontamination waste cycle contained about 10% of the original fission activity and 1% of the plutonium (Anderson 1990).

Metal waste contained all of the uranium, approximately 90% of the original fission products activity, and approximately 1% of the product. This waste was neutralized with 50% caustic and treated with an excess of sodium carbonate, then was sent to underground tanks (Anderson 1990; Ballinger and Hall 1991).

Second decontamination-cycle waste contained less than 0.1% of the fission product activity and about 1% of the plutonium. Stack drainage, initially combined with second-cycle waste, was combined with first decontamination-cycle waste in May 1951 (Anderson 1990).

The 5-6 Cell (Tank) located in the 221-B Building was used to received low salt, alkaline, radioactive liquid wastes from cell washings and other liquid wastes. The 5-6 Tank is considered a waste source for the 241-B-361 Settling Tank, the 216-B-5 Reverse Well, and the 216-B-7A and -7B Cribs.

2.3.1.1.2 224-B Concentration Facility. The 224-B Concentration Facility was used as a plutonium concentration facility. In it, the dilute plutonium nitrate solutions were purified, and the plutonium carrier changed from nitrate to lanthanum fluoride. The facility is 60 m (197 ft) long, 18 m (60 ft) wide, and 21 m (70 ft) high, and contains radioactive equipment and concrete. Hazardous constituents include mercury, polychlorinated biphenyls (PCBs), residual cleaning chemicals, and radionuclides consisting of about 35 Ci of plutonium, 5.2 Ci of ^{241}Am , 2.1 Ci of ^{90}Sr , 3.6 Ci of ^{60}Co , and 1 Ci of ^{137}Cs . The 224-B Concentration Facility has "Radiologically Controlled Area" and "Radioactive Material" warning signs on every door.

2.3.1.1.3 222-B Laboratory. The 222-B Laboratory located directly southeast of the 221-B Building was used from 1945 until 1952 for laboratory analysis in support of the B Plant Bismuth Phosphate Fuel Processing. Various small scale experiments were done inside the facility. The 222-B Laboratory is within the B Plant Aggregate Area and is a source of wastes, but it will be addressed under a separate decommissioning and decontamination program. This facility disposed of liquid waste to the 216-B-6 Reverse Well and the 216-B-10A Crib.

2.3.1.1.4 225-B Building. The 225-B Building, commonly called the Waste Encapsulation and Separations Facility (WESF), is physically attached to the west end of the 221-B Building. It covers an area of approximately 5,600 m² (60,000 ft²) and contains process cells similar to the cells in the 221-B Building. It was constructed in 1974 and contains thick concrete outer walls which provide shielding for radioactive materials. The building was built to house the processing systems needed to encapsulate recovered cesium and strontium and safely store the encapsulated material.

2.3.1.1.5 291-B Building. The 291-B Building consists of air filter systems, ventilation equipment, and an exhaust stack. It is located east of the 222-B Building and south of the 221-B Building. The equipment contained within this complex is used to collect and filter air from the 221-B Building before discharging it to the exhaust stack. Radioactive contaminants were present in the exhaust air as a result of the various dissolving steps during the fuel processing. The principal contaminants were ¹³¹I and krypton and xenon isotopes.

The airborne contaminants were removed with a variety of technologies that were implemented during the fuel processing operational period of B Plant from 1945 to 1952. Initially, sand filters were installed to filter out airborne particulate contaminants. Water scrubbers were installed in 1948 to reduce radioactive iodine concentrations in radioactive particles. In 1950, silver reactors were installed to further reduce ¹³¹I emissions. With this system, the gases from the fuel dissolving process (See Section 2.4.1) were heated to 230 °C (446 °F) and passed over a ceramic packing coated with fused silver nitrate. The iodine was removed by the formation of silver iodide on the ceramic packing. The hot gases were then filtered through a fine fiberglass mat. The 291-B Building is within the B Plant Aggregate Area and is a source of wastes, but it will be addressed under a separate decommissioning and decontamination program. This facility disposed of liquid waste to the 216-B-4 Reverse Well and the 216-B-13 French Drain.

2.3.1.1.6 292-B Building. The 292-B Building contained laboratory equipment used in connection with the operation of the exhaust gas processing equipment for the 291-B Building. The 292-B Building is located between the 291-B Building and the 222-B Building. The 292-B Building is within the B Plant Aggregate Area and is a source of wastes, but it will be addressed under a separate decommissioning and decontamination program. This facility disposed of liquid waste to the 216-B-4 Reverse Well.

2.3.1.1.7 242-B Building. The 242-B Building contains the 242-B Evaporator and is located immediately south of the 241-B Tank Farm. The 242-B Building is within the

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B Plant Aggregate Area and is a source of wastes, but it will be addressed under a separate decommissioning and decontamination program. This facility disposed of liquid waste to the 216-B-11A and 216-B-11B Reverse Wells and the 216-B-37 Trench.

2.3.1.1.8 284-E Powerhouse. The 284-E Powerplant facility consists of the 284-E Powerplant building and its associated boilers and machinery. Operation of the 284-E Powerhouse produces three wastewater streams: wastewater from routine operations, water softener wastewater, and boiler blowdown (WHC 1990a). This effluent is discharged to the 216-B-3 Pond system through the 216-B-3-3 Ditch.

Of the three contributors to the 284-E Powerhouse wastewater stream, the routine operations contributor is the largest. The sources for it are wastewaters from cooling operations within the powerplant. The cooling water is used for air compressors, turbines, generators, boiler water jackets, and feed pumps. It has a constant flow discharge and averages 12,300,000 L/month (3,250,000 gal/month). The other two contributing streams are discharges from batch processes. In the water softening process, a brine solution is used to regenerate zeolite water softener units. The softener regeneration operation produces the waste stream with the highest concentration of dissolved solids of approximately nine weight percent in sodium chloride. The flowrate for the softener regeneration is 1,140,000 L/month (300,000 gal/month). The effluent contribution due to boiler blowdown contains boiler treatment chemicals and has an average discharge of 378,000 L/month (100,000 gal/month) (WHC 1990a).

2.3.1.1.9 283-E Water Treatment Facility. The 283-E Water Treatment Facility purifies and treats Columbia River water and produces potable water for the 200 East Area. The raw water is pumped from the 100-B Area River Pumpouse and enters a reservoir near the 284-E Powerhouse where it is stored before being treated with alum and chlorine. After settling, the water is routed through a filter for the final purification. The filter layers consist of porcelain beads, gravel, sand, and anthracite coal (DOE/RL 1990b). Overflow water from the treatment steps is discharged to the 216-B-3 Pond System through the 216-B-3-3 Ditch.

2.3.1.1.10 2101-M Building. The 2101-M Building, shown in Figure 2-1, was constructed in 1953. It is a single-story building constructed with steel panels and beams on a concrete foundation. It has a concrete floor and a built-up asphalt and gravel roof (WHC 1990c). Different areas in the building are used for different purposes, such as soil testing laboratories, a spare parts warehouse, craft shops, and offices. Most of the spaces in the building are environmentally controlled by evaporative cooling and steam heating.

The 2101-M Building is serviced by an (8 in.) diameter sanitary water line. Other services include steam, a compressed air system, and a ventilation system. The drains in the laboratories have been either physically sealed or have administrative controls in place to stop chemical discharges from them to the soil column. Most of the effluent is from the heating, ventilation, and air conditioning system of the building. Sanitary effluents from the

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are discharged to a septic tank sanitary sewer system. Cooling water, and evaporative cooling overflow water is discharged to the 2101-M Pond

272-E Metal Shop. The 272-E Metal Shop is located approximately south of the 221-B Building, near the 2711-E Vehicle Maintenance Shop. The shop has discharged cutting oils and waste metals to the 2607-E7-B septic tank and a ceramic tile field north of 2703-E Hazardous Waste Storage Area. Little information is available about this site.

2703 Chemical Engineering Laboratory Building. The 2703 Chemical Engineering Laboratory Building is located approximately 1/2 mile south of the 2703-E Hazardous Waste Storage Area. Nonhazardous effluents from the laboratory building are disposed of at the field north of the 2703-E Hazardous Waste Storage Area.

Management Unit Buildings.

226-B Hazardous Waste Staging Area. The 226-B Hazardous Waste Staging Area (HWSA) is located north of the 221-B Building and is an active waste management unit for temporary storage of hazardous materials. Typical wastes contained in the area over the past year include about 184 kg (406 lb) of halogenated hydrocarbons, 1,000 kg (2,205 lb) of sodium hydroxide and alkaline liquids, 800 kg (1,764 lb) of organic liquids, 4 kg (4,061 lb) of acids, 580 kg (1,279 lb) of miscellaneous toxic process wastes, and 55 kg (2,546 lb) of methyl ethyl ketone and flammable solvents. The area consists of a concrete pad surrounded by a light chain barricade. The unit is designated as a "hazardous waste 90 day staging area" and "PCB 30 day storage."

2703-E Hazardous Waste Staging Area. Liquid hazardous waste is stored on an asphalt pad at the 2703-E HWSA before burial. Typical waste held in the area includes about 11,126 kg (24,529 lb) of alkaline liquids and sodium hydroxide, 1,000 kg (1,102 lb) of sodium dichromate containing process solutions, and 415 kg (915 lb) of waste acids.

2704-E Hazardous Waste Staging Area. The 2704-E HWSA is listed as a "hazardous waste 90 day staging area" in the *Hanford Site Waste Management Units Report* (DOE/RL 1991a), used for the temporary storage of hazardous materials. It is listed as an asphalt pad, and is located south of the 2711-E Garage and across the street from the former 2704-E Building. Wastes stored there have included antifreeze, grease, diesel fuel, and asphalt.

2715-EA Hazardous Waste Staging Area. Waste containers consisting of drums and thinning solvents are temporarily stored at this facility. The 2715-EA HWSA became operational in November 1984. Weekly documented inspections are conducted by plant personnel.

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The 2715-EA HWSA is a metal shed with a chain link fence as the front wall. A metal sign on the fence denotes site identification. Adjacent to the west side of the shed are two conex boxes and two chain-link fenced areas used as additional storage space.

2.3.2 Tanks and Vaults

Tanks and vaults were constructed on the Hanford site to handle and store liquid wastes generated by uranium and plutonium processing activities. Several types of tanks are present in the B Plant aggregate area including six catch tanks, one settling tank, one receiver tank (often referred to as a double-contained receiver tank), eighteen septic tanks, one condensate-neutralization tank, one vault, and forty single-shell tanks. Catch tanks are generally associated with diversion boxes and other transfer units, and were designed to accept overflows and spills. Settling tanks were used to settle suspended solids in fluid wastes prior to transfer to cribs. Receiver tanks were used, or are used, as a central receiving tank between single-shell tanks and/or from other waste generating facilities. The liquid wastes can be treated in the receiver tank if needed prior to pumping to other facilities. The septic tanks receive(d) sanitary wastewater and sewage from various facilities. The condensate-neutralization tank was used to neutralize acidic process condensate. Vaults generally house three or four tanks (less than 193,750 L [50,000 gal]) that were utilized like receiver tanks. Single-shell tanks were used to collect and store large quantities of mixed wastes. The catch tanks, settling tank, receiver tank, condensate-neutralization tank, and vault will be discussed individually in this section. The septic tanks are discussed in Section 2.3.6. The single-shell tanks will be addressed as a group below.

All single-shell tanks will be evaluated under the Single-Shell Tank Closure Program as discussed in Section 9.0 and, therefore, do not need to be discussed in detail in this AAMSR. General information related to the tanks will be described in this report but investigation and remediation strategies will be deferred to the Single-Shell Tank Closure Program. Tables 2-1 and 2-2 list single-shell tank information that is of importance to this report, including source description, tank integrity, waste volume remaining, drainable waste volume, and operable unit. Table 2-10 is a "reference locator" for additional SST information. Figure 2-17 provides a timeline for the tanks.

Sixteen of the forty single-shell tank waste management units in the B Plant Aggregate Area are contained within the 241-B Tank Farm, twelve are contained within the 241-BX Tank Farm, and twelve are contained within the 241-BY Tank Farm. The three tank farms are located in the same general vicinity. The 241-BX and -BY Tank Farms are contained within the same fence and are located north of B Plant about 845 m (2,770 ft). The 241-B Tank Farm is located across Baltimore Ave., directly west of 241-BX Tank Farm. The locations of the single-shell tank farms and tanks are shown on Figures 2-2 and 2-3.

The 241-B Tank Farm tanks were constructed from 1943 to 1944 using two different designs. In both designs, the tanks are vertical cylinders with a domed top, and constructed of reinforced concrete with a carbon steel liner on the base and sides of the vessel. The

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tanks are all underground with at least 1.8 m (6 ft) of earth cover above the tank dome. Twelve tanks each with the same design, numbered 241-B-101 through 241-B-112, have a 23 m (75 ft) diameter and a capacity of 2,006,000 L (530,000 gal). Four smaller tanks each with the same design, numbered 241-B-201 through 241-B-204, have a 6.1 m (20 ft) diameter and a capacity of 208,200 L (55,000 gal). The current waste volumes and drainable waste volumes for each tank are listed in Table 2-2. Figure 2-19 depicts a typical single-shell tank.

The 241-BX and 241-BY Tank Farm tanks were constructed from 1946 to 1947 and 1948 to 1949, respectively. The tanks were designed equally, with the exception of capacity (tank height), as vertical cylinders with a domed top, and constructed of reinforced concrete with a carbon steel liner on the base and sides of the vessel. The tanks are all underground with at least 2.1 m (7 ft) of earth cover above the tank dome. The twelve tanks in 241-BX Tank Farm are numbered 241-BX-101 through 241-BX-112 and have a 23 m (75 ft) diameter and a capacity of 2,006,000 L (530,000 gal). The twelve tanks in 241-BY Tank Farm are numbered 241-BY-101 through 241-BY-112 and have a 23 m (75 ft) diameter and a capacity of 2,869,000 L (758,000 gal). The current waste volumes and drainable waste volumes for each tank are listed in Table 2-2. Figure 2-19 depicts a typical single-shell tank.

Single-shell tank stabilization and isolation are two objectives of single-shell tank engineering. Interim Stabilization criteria for single-shell waste storage and auxiliary tanks is set forth in *Tank Farms Facility Interim Stabilization Evaluation* (Hamrick 1988). Generally, a 100 series tank (tanks greater than 2,000,000 L) is considered Interim Stabilized (IS) if the tank contains less than 19,000 L (5,000 gal) of supernatant and less than 189,000 L (50,000 gal) of drainable liquid (Hanlon 1992). A 200 series tank (specifically a 208,200 L tank) is considered Interim Stabilized if it contains less than 1500 L (400 gal) supernatant. Interim Isolation (II) is an administrative designation reflecting the completion of the physical effort required to minimize the unplanned addition of liquids into a tank. Partially Interim Isolated (PI) is an administrative designation reflecting the completion of the physical effort required for Interim Isolation except for isolation of risers and piping that are required for stabilization (pumping) efforts. Interim Isolation and Interim Stabilization have been performed on the SSTs to varying degrees as listed in Table 2-2.

All single-shell tanks are classified as either "sound" or as an "assumed leaker," as listed in Table 2-1. A "sound" tank is an integrity classification of a waste storage tank for which surveillance data indicate no loss of liquid attributed to a breach of integrity. An "assumed leaker" is an integrity classification of a waste storage tank for which surveillance data indicate a loss of liquid attributed to a breach of integrity (Hanlon 1992).

All single-shell tanks have been inactive (have not received waste) since at least 1980. However, several activities continue on, in, and/or around single-shell tanks on a case-by-case basis and, therefore, the status of any individual single-shell tank may change. These activities include pumping of liquid waste (stabilization), sealing tank pits, penetrations and piping (isolation), surface level monitoring, liquid level monitoring, temperature monitoring, waste sampling, core sampling, in-tank photography, filter changing, surveying,

and day-to-day operations activities. The current status of the single-shell tanks are documented in several "living" documents with two of the most informative being, *Tank Farm Surveillance and Waste Status Summary Report* (Hanlon 1992), and *Waste Storage Tank Status and Leak Detection Criteria* (Welty 1989). The *Tank Farm Surveillance and Waste Status Summary Report* is updated monthly and the *Waste Storage Tank Status and Leak Detection Criteria* is revised as needed. General SST information found in these two documents, and others, is listed in Table 2-10.

Leak detection and air monitoring are performed continuously within the single-shell tank farms. Leak detection is performed via surface level measuring devices, drywells, and in some cases by liquid observation wells (LOW). The criteria for leak detection monitoring is described in the *Waste Storage Tank Status and Leak Detection Criteria* (Welty 1989). The results of the monitoring are maintained as quality records in the 200 East Area by the Surveillance and Data Acquisition Group. Air monitoring data is accumulated and documented in WHC-EP-0527-1, and updated yearly.

2.3.2.1 241-B-301B Catch Tank. The 241-B-301B Catch Tank is located approximately 9 m (30 ft) south of the 241-B-252 Diversion Box. The tank collects waste spilled in the 241-B-151, 241-B-152, 241-B-153, and 241-B-252 Diversion Boxes during transfers. It was in service from 1945 until 1984. Its contents are unknown and it was isolated in 1985 (Hanlon 1992).

2.3.2.2 241-B-302B Catch Tank/UPR-200-E-77. The 241-B-302B Catch Tank is located on the northeast corner of Baltimore Avenue and 7th Street. It is located approximately 12 m (40 ft) north of the 241-B-154 Diversion Box. The tank collects waste spilled in the diversion box during transfers. It was in service from 1945 until 1985. In 1985, the diversion box was isolated and stabilized by application of a weather-proofing plasticizer (WHC 1991a).

Unplanned release UPR-200-E-77 was caused by metal waste solution from the 221-B Building with fission products measuring approximately 1 Ci contaminating the ground around the 241-B-154 Diversion Box (and consequently the 241-B-302B Catch Tank) in 1946 during work associated with the repair of a leaky jumper in the box. The unplanned release site was covered with 0.3 m (1 ft) of soil after the incident. It is probable that cover blocks were open during the repairs; therefore, the contamination may be mainly surface.

2.3.2.3 241-BX-302A Catch Tank. The 241-BX-302A Catch Tank is associated with the 241-BR-152, 241-BX-153, 241-BXR-152, and 241-BYR-152 Diversion Boxes and the 241-BX Tank Farm. It is located approximately 9 m (30 ft) east of the 241-BX-153 Diversion Box and collects waste spilled during transfers between these diversion boxes and the 241-BX Tank Farm. The catch tank was in service from 1948 until its isolation in July 1985. The tank is associated with the 241-BX Tank Farm where leak detection and air monitoring are performed continuously.

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2.3.2.4 241-BX-302B Catch Tank. The 241-BX-302B Catch Tank is located adjacent to and below the 241-BX-154 Diversion Box. The tank collects waste spilled in the diversion box during transfers (Hanlon 1992). It was in service from 1948 until 1985. The catch tank has been isolated and stabilized by application of a weather proofing plasticizer (Hanlon 1992).

2.3.2.5 241-BX-302C Catch Tank/UPR-200-E-78. The 241-BX-302C Catch Tank is located approximately 9 m (30 ft) east of the 241-BX-155 Diversion Box. The tank collects waste spilled in the diversion box during transfers. It was in service from 1948 until 1985. This inactive waste management unit is located about 260 m (850 ft) northeast of the 221-B Building between Atlanta and Baltimore Avenues.

Unplanned release UPR-200-E-78 occurred when salt waste containing about 10 Ci of mixed fission products leaked from the 241-BX-151 Diversion Box during pressure testing of lines and jumpers, contaminating about 20 m² (200 ft²) of the surrounding soil. The area was then covered with clean soil. Because the pressure test may have been conducted when the cover blocks were off (to allow observation), the contamination may be mainly surface.

2.3.2.6 241-ER-311 Catch Tank/UPR-200-E-84. The 241-ER-311 Catch Tank is located 300 m (900 ft) southwest of the 221-B Building and is not associated with a tank farm. The catch tank is located adjacent to and at a lower elevation than the 241-ER-151 Diversion Box. The catch tank receives cross-site process and decontamination waste from the 241-UX-154 Diversion Box via the 241-EW-151 Vent Station. Waste is also received from the 241-B, -BX, and -BY Tank Farms via the 244-BX DCRT (WHC 1991a). The catch tank collects waste spilled in the diversion box during transfers (WHC 1991a). The catch tank and diversion box are located approximately 55 m (180 ft) southeast of the 224-B Concentration Facility. The tank is located approximately 7 m (22 ft) south of the 241-ER-151 Diversion Box. The waste management unit was activated in 1945 and transfers various types of waste solutions from processing and decontamination operations (WHC 1991a).

Unplanned release UPR-200-E-84 occurred in March 1953 when the catch tank leaked about 6,500 L (1,700 gal) of acid contaminated with approximately 10 Ci of fission products to the ground (Stenner et al. 1988). At the time of release, no ground surface contamination was detected. This is a low activity unplanned release site. Historical records do not indicate whether the tank was repaired or if the tank "leak" was caused by overfilling. There is no mention of any cleanup of the site.

2.3.2.7 241-B-361 Settling Tank. This inactive waste management unit is located 183 m (600 ft) northeast of the 221-B Building on the east side of Baltimore Avenue. The settling tank was in operation from April 1945 to September 1947 receiving low salt alkaline radioactive waste from cell washings collected in the 5-6 Cell in the 221-B Building and additional waste from the 224-B Concentration Facility. Overflow from this tank was

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injected to the 216-B-5 Reverse Well. An estimated 121,000 L (32,000 gal) of sludge, consisting primarily of bismuth phosphate, with about 2.46 kg (1.12 lb) of plutonium is contained in the tank (DOE/RL 1991a).

Although this waste management unit was interim stabilized in 1985, the release potential for radiological hazard rates are high in comparison to other 200 Area waste management units (DOE/RL 1991a).

2.3.2.8 270-E Condensate Neutralization Tank. The 270-E Condensate Neutralization Tank is located west of the 221-B Building. The unit is approximately 3 m (9 ft) in diameter and height, with the bottom at approximately 4 m (12 ft) below grade. A 8-cm (3-in.) stainless pipe enters at the bottom, and a 15-cm (6-in.) vitreous clay pipe exits near the top.

Unplanned release UN-200-E-64 resulted from ants burrowing into and distributing soil that was possibly contaminated by leakage from this tank. The coordinates in WIDS give a location approximately 31 m (100 ft) east of the tank. This unplanned release is described more fully in Section 2.3.8.3.

The 270-E Condensate Neutralization Tank was used from 1952 until 1970. Very little information is known about the use and function of this tank. Old drawings show that this tank was constructed as part of a neutralization facility in 1952. A 8-cm (3-in.) schedule 40 stainless steel line from the 221-B Building entered at the bottom of the tank. A 15-cm (6-in.) vitreous clay pipe exited from top of the tank and went to the 216-B-12 Crib. This arrangement suggests that one of the functions of the tank was to remove solids from the fluid passing through the tank so that only a decanted supernatant liquid flowed to the crib. The tank contained a 102-cm (40-in.) diameter riser that extended from the top of the tank below grade up to a wooden platform constructed above the tank. The relatively large size of this riser suggests that access to the tank contents was required, probably to add neutralization agents to the tank contents. A 270-E wooden building was constructed next to the wooden platform above the tank, which may have been used to store neutralization solids. The neutralization material used was probably limestone as one reference lists the 216-B-12 Crib as a "limestone-neutralized" crib during the time period that the tank was operational (Tabasinske 1958). The tank was operational during the time period when the 221-B Building was being decommissioned and placed in "layaway" status. It appears possible that this tank may have been used to neutralize condensate produced by the evaporation of waste produced during acid cleaning of process equipment during decommissioning activities at the 221-B Building. The present status of the tank is unknown. Drawings show that the neutralization building was removed and the tank was capped and abandoned in place by 1970. The tank was apparently not used when the 216-B-12 Crib became operational again in 1967 in support of the cesium and strontium recovery mission for B Plant. The tank is thought to contain about 14,000 L (3,800 gal) of sludge. The prioritization of this facility for decommissioning classifies the relative radiological hazard as high in comparison with other 200 Area surplus facilities (DOE/RL 1991a).

2.3.2.9 244-BXR Vault. The 244-BXR Vault is an inactive waste management unit located at the southern boundary in the 241-B Tank Farm. The unit was in operation from 1948 until July 1985 transferring waste solutions from processing and decontamination operations. The unit has been isolated and weather covered. The WIDS radionuclide inventories were not available for this waste management unit.

2.3.2.10 244-BX Receiving Tank. The 244-BX Receiving Tank is an active waste management unit located within the 241-BX Tank Farm on the east side. The unit last received waste from the 241-BY-102 and -109 Single-Shell Tanks during the 1991 Stabilization campaign.

2.3.3 Cribs and Drains

Cribs and tile fields and drains were all designed to percolate wastewater into the ground without exposing it to the open air. Various types of cribs were built in the B Plant Aggregate Area: 4 x 4 m (12 x 12 ft) open-bottom wooden boxes; vertical concrete pipes, either alone or parallel to nearby pipes; horizontal perforated pipes; dispersion structures made of cinder blocks resting on wood. Tile fields are semihorizontal perforated pipes set out in a chevron pattern. Where wooden cribs and tile fields are associated, the main feed pipe of the tile field exits the crib near the top, on the side opposite of the crib inlet pipe. Figures 2-20 through 2-24 show several types of cribs. Drains are vertical, shallow, gravel-filled concrete pipes.

The cribs and drains received low-level waste for disposal. Most cribs, drains, and trenches were designed to receive liquid until the unit's specific retention or radionuclide capacity was met. The term "specific retention" is defined as that volume of waste liquid that may be disposed to the soil and be held against the force of gravity by the molecular attraction between sand grains and the surface tension of the water, when expressed as a percent of the packed soil volume (Bierschenk 1959). Experimental work performed by Bierschenk (1959) indicated that due to the time varying nature of the specific retention capacity of the soil a potential exists for long-term gravity drainage to the groundwater. Radionuclide capacity refers to a specific number of curies of radioactivity the waste management units were allowed to receive until they were shut down (Fecht et al. 1977). The locations of all cribs, drains, and reverse wells are shown on Figure 2-4. The following sections describes each crib and drain in the B Plant Aggregate Area.

2.3.3.1 216-B-7A and 216-B-7B Cribs. The 216-B-7A and 216-B-7B Cribs (also known as the 224-B Waste Crib, 201-B Tank Crib [Brown and Ruppert 1950] or the 241-B-1 and 241-B-2 Cribs) are inactive waste management units located about 30 m (100 ft) north of 241-B Tank Farm. The two cribs are located approximately 6 m (20 ft) apart and are in line with a 8 cm (3 in.) steel inlet pipe that supplied waste to both cribs simultaneously. Each crib is a 4 x 4 x 1.2 m (12 x 12 x 4 ft) wooden structure made of 15 x 15 cm (6 x 6 in.) timbers, placed in a 4.2 x 4.2 x 4.2 m (14 x 14 x 14 ft) deep excavation. The cribs operated

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from September 1946 to May 1967 and received a total volume of 43,600,000 L (11,500,000 gal) of wastewater (Maxfield 1979). Each crib is a hollow structure, i.e., not gravel filled. Both units are classified as having cave-in potential.

From October 1946 to August 1948 these cribs received overflow from Single-Shell Tank (settling tank) 241-B-201. This waste included 221-B waste, 224-B waste, and cell drainage and other liquid waste (low salt, alkaline, radioactive liquid) via Tank 5-6 in the 221-B Building. Tank 241-B-201 was taken out of service in October 1948 because it was nearly filled with sludge from the 221-B Building and 224-B Concentration Facility wastes. Single-Shell Tanks (settling tanks) 241-B-202 through 241-B-204 were connected in series, and began flowing into the crib in December 1948. After August 1948 liquid waste from the 224-B Concentration Facility was disposed of directly to the cribs until October 1961. From December 1954 to October 1961 the unit received Cell 5-6 drainage and equipment cleanout waste from the 224-B Concentration Facility. From October 1961 to May 1967 material disposed of in these cribs consisted of decontamination construction waste from the 221-B Building. The cribs became inactive in 1967 (Brown and Ruppert 1950, WHC 1991a).

Radionuclides contained within the waste streams include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, uranium, and TRU fission products (Brown et al. 1990). The 22,300,000 L (5,890,000 gal) of waste jetted to the 241-B-201 through 241-B-204 Single-Shell Tanks (used as settling tanks) between 1947 and 1950 contained 2,180 g of plutonium and 4,000 Ci of fission products. Only 10 g of plutonium and 20 curies of fission products were estimated jetted from the 241-B-201 and -202 Single-Shell Tanks to the cribs (Brown and Ruppert 1950). By deducting the volume of the four single-shell tanks it is estimated that 96% of this volume, 21,470,000 L (5,670,000 gal), ultimately reached the 216-B-7A and 216-B-7B Cribs. An additional 22,100,000 L (5,800,000 gal) of wastewater was discharged to the cribs after 1950 until they were taken out of service in 1967.

2.3.3.2 216-B-8TF Crib and Tile Field. The 216-B-8TF Crib and Tile Field (also known as the 2nd Cycle Crib, Tile Field and Shaft [Brown and Ruppert 1950]), is an inactive waste management unit located about 107 m (350 ft) north of 241-B Tank Farm. The crib is a 4 x 4 m (12 x 12 ft) wooden structure in a 4.2 x 4.2 x 6.9 m (14 x 14 x 22.5 ft) deep excavation. The hollow structure is not gravel filled and has cave-in potential. The tile field is 91 m (300 ft) long, 30 m (100 ft) wide, and fed by a 30 cm (12 in.) VCP trunk with eight, 21 m (70 ft) pipes branching at 45 degrees (DOE/RL 1991a). The unit was connected to the 241-B-110, -111, and -112 Single-Shell Tanks of the 241-B Tank Farm and received about 27,200,000 L (7,190,000 gal) of waste between April 1945 and December 1951. Waste types included second-cycle waste supernatant from the 221-B Building until July 1951, cell drainage and other liquid waste from Tank 5-6 in the 221-B Building in addition to second-cycle supernatant from July 1951 until December 1951, and decontamination and cleanup waste generated during the shutdown of the 224-B Concentration Facility from December 1951 to December 1952 (Stenner et al. 1988; Brown et al. 1990). According to Anderson (1990), the single-shell tanks received first-cycle waste and fission products prior to 1968, thus it is likely that the crib also received these wastes.

According to Maxfield (1979) a total of 27,200,000 L (7,186,300 gal) of wastes containing approximately 30 g of plutonium, 45 kg of uranium, and 116 curies of fission products were discharged to the unit between April 1945 and December 1950. The 216-B-8TF Crib system was tied directly to the waste lines, bypassing the 241-B-361 Settling Tank, and sludge accumulated in the crib, decreasing its capacity. Unknown amounts of citric and hydrochloric acid were added to the crib in an attempt to clear the sludge, but results were not significantly successful. The tile field was therefore put into service receiving the overflow of waste liquids from the crib (Brown and Ruppert 1950). The volume of sludge in the crib is unknown.

A facility unique to the Hanford site is found adjacent to and within the bounds of the 216-B-8 Crib and Tile Field. A shaft, eight foot in inside diameter and 55 feet deep was constructed within eleven feet of the wooden crib structure in the late 1940s. The primary purpose of the facility was to provide sampling access to the soil column beneath the crib. Perforated pipe laterals were extended under the crib at depths approximately 9 ft and 19 ft beneath the crib's centerline at a decline 10 degrees below horizontal. Water and sludge samples were taken using a special sampling device. Also, soil sampling ports were constructed through the 9 in. thick concrete culvert segments. Sampling from the shaft was conducted for at least several years and was halted sometime after the reported sampling ended December 31, 1949. Brown and Ruppert (1950) present the only known results of the sampling effort which are discussed below.

Some of the sludge recovered in sample cups in the adjacent shaft 6 m (20 ft) below ground surface showed plutonium activity was 990 $\mu\text{g}/\text{kg}$ (approximately 1,000 times higher than in the supernatant). The fission product activity in the sludge was roughly 5,000 times higher than in the supernatant (Brown and Ruppert 1950). Highly permeable sediments conducted radioactive contaminants that leached from the sludge downward and laterally beneath the crib. However, very little plutonium penetrated greater than 3 m (10 ft) below the crib, except where transported by sludge (Brown and Ruppert 1950).

The shaft was supplied with water, electrical power and lighting, air fan inlet and outlet ducts, dewatering pump, and ladder access to the two grating platforms constructed for access to the laterals. The shaft quickly became contaminated in the first 22 months of use. At some point in the late 1950's the facility was used to test repaired, contaminated B-, BX-, and BY-Tank Farms pumps, and later, sluicing pumps. Water was probably added to the shaft to support the pump tests. This use continued intermittently through the early-mid 1970's and the facility has not been used since. Currently, there is an estimated 5.5 ft of contaminated water in the bottom of the shaft. There is no known analysis of the water. Ownership of the facility is not established at this time. The shaft site has been covered with two feet of soil following recent stabilization efforts at a nearby facility.

2.3.3.3 216-B-9TF Crib and Tile Field. The 216-B-9TF Crib and Tile Field (5-6 Crib and Tile Field [Brown and Ruppert 1950]) is an inactive waste management unit located along Baltimore Avenue approximately 380 m (1,250 ft) south of the 241-B Tank Farm. It consists of a wooden box, 4.2 x 4.2 x 2.4 m (14 x 14 x 8 ft) with a tile field to the north. The

hollow structure is not gravel filled and has cave-in potential. The tile field is 55 x 26 m (180 x 84 ft) consists of a 15 cm (6 in.) clay tile pipe main set at 1% slope with six laterals at 45 degrees (DOE/RL 1991a). The tile pipes have 46 cm (18 in.) of gravel above and below, and are covered with roofing felt. The trenches for the pipe are 1.2 m (4 ft) wide at the bottom and the side slopes are 1:1.5. The tile pipes are 4 m (12 ft) below grade at the head and 2 m (6 ft) at the end (DOE/RL 1991a).

Between August 1948 and July 1951 the unit received about 36,000,000 L (9,500,000 gal) of cell drainage and Tank 5-6 liquid wastes from the 221-B Building. In August 1948 the 216-B-9TF Crib and Tile Field were connected to the waste line from the 221-B Building when the 216-B-5 Reverse Well was deactivated. The 241-B-361 Settling Tank was bypassed, since it was nearly filled with sludge from the operations with the 216-B-5 Reverse Well (Brown and Ruppert 1950). Consequently, suspended solids with significantly higher radionuclide concentrations settled out as sludge in the wooden crib, significantly decreasing its volume. Overflow into the tile field began in November 1948, after about 4,000,000 L (1,000,000 gal) had flowed into the crib and filled it with sludge. Acid was added to dissolve the sludge to extend the life of the crib (Brown and Ruppert 1950).

The WIDS Hazardous Chemical Inventory lists only 1,000 kg (2,000 lb) of nitrate contained within the waste stream. Radionuclides include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, uranium, and TRU elements. The waste management unit was deactivated by disconnecting the supply line from the 241-B-154 Diversion Box when the calculated specific retention of the underlying soil column was achieved (Maxfield 1979; Brown et al. 1990).

2.3.3.4 216-B-10A and 216-B-10B Cribs. The 216-B-10A and 216-B-10B Cribs are located about 50 m (160 ft) south of the west end of the 222-B Building and are inactive. The waste management units consist of a roughly 4 x 4 x 1.1 m (12 x 12 x 3.5 ft) wooden box, in an excavation with 4.2 x 4.2 m (14 x 14 ft) bottom area and 1:1 side slopes (DOE/RL 1991a). The bottom of the excavation is 6 m (20 ft) below grade. The structure is not gravel filled and has cave-in potential.

The 216-B-10A Crib was used from December 1949 to January 1952 and received decontamination sink and sample slurper waste from the 222-B Building and floor drainage from the 292-B Building (Stenner et al. 1988; WHC 1991a). During this time the crib received acidic liquid waste that contained TRU and fission products. Nitric acid and sodium dichromate were some of the inorganics also disposed of at the cribs. Radionuclides contained in the waste stream include ^{137}Cs , ^{106}Ru , ^{90}Sr , and plutonium (Stenner et al. 1988; Brown et al. 1990).

The 216-B-10B Crib received cascaded waste from the 216-B-10A Crib when it was in service. Decontamination sink and shower waste from the 221-B Building was sent directly to the 216-B-10B Crib from June 1969 through October 1973. Similar inorganic and radionuclide wastes were disposed of in both cribs; however, the volume in the 216-B-10B Crib was approximately 1/30 that of the 216-B-10A Crib.

Both cribs were deactivated by disconnecting the pipeline to the units. The earth has subsided about 1 m (3 ft) over the top of both of the units indicating deterioration of the structures (WHC 1991a).

2.3.3.5 216-B-12 Crib. The 216-B-12 Crib is located 300 m (1,000 ft) northwest of 221-B Building. The crib operated from November 1952 through December 1957 and from May 1967 through November 1973 and is now inactive. The unit consists of a series of three cascading, 5 x 5 x 3 m (16 x 16 x 10 ft) high wooden boxes in a 9 m (30 ft) deep excavation. The bottom 4 m (12 ft) contains 1.3 cm (0.5 in.) gravel backfill, 1.2 m (4 ft) of which underlie the cribs. The excavation has side slopes of 1:1 (DOE/RL 1991b). The bottom dimensions are 49 x 15 m (160 x 50 ft) (Maxfield 1979). It is unclear if the gravel backfill merely surrounds the boxes or also fills them; however, the unit is considered to have cave-in potential.

The crib was inactive between December 1957 through May 1967. Radiation Occurrence Report 73-82 suggests the 216-B-12 Crib was abandoned on November 1973 when the ground above the crib started to subside resulting in flow restrictions. It was backfilled in 1973 and the fill line was capped in March 1974 (Maxfield 1979). Cave-in potential is still of concern.

During its service history, the crib received process condensate from the waste evaporators in the 221-U Building and 224-U Concentration Facility until December 1957; construction waste from the 221-B Building from May 1967 to November 1967; and process condensate from the 221-B Building after November 1967. The waste is low salt and neutral/basic. Inorganics disposed of at this crib include ammonium nitrate (Stenner et al. 1988). Radionuclides present in the monitoring wells associated with the structure include ^{137}Cs , ^{106}Ru , ^{90}Sr , ^3H , ^{60}Co , and ^{239}Pu (Brown et al. 1990). The crib has a collapse potential because of its wooden construction.

2.3.3.6 216-B-14 Crib. Cribs 216-B-14 through -19 are located in the BC Controlled Area, south of the 200-E Area. Cross sections of these cribs are shown on Figure 2-22. The 216-B-14 Crib is an inactive waste management unit located in the BC Crib area west of Baltimore Avenue on 1st Street. An unmarked gravel road leads to the BC Crib-Trench units, which lay outside of the 200 East security area. The crib is a 3 x 3 x 1 m (10 x 10 x 3 ft) structure made of wood, concrete blocks, and steel. It is built over a 1.5 m (5 ft) thick gravel bed and was fed by a 36 cm (14 in.) steel pipe 2 m (6 ft) below grade (Figure 2-22) (Maxfield 1979; Stenner et al. 1988). The wood base of the crib is considered a collapse hazard (Ortiz 1974). The bottom of the excavation is 12 x 12 m (40 x 40 ft) (DOE/RL 1991a).

The 216-B-14 Crib received 8,710,000 L (2,301,000 gal) of scavenged tributyl phosphate waste from the 221-U Building from January to February 1956. The waste is high salt and neutral/basic. The waste contained inorganic compounds such as ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides in the waste stream deposited in these cribs contained ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (WHC 1991a;

9 1 1 2 3 4 5 6 7 7 5

Fecht et al. 1977; Brown et al. 1990). The crib was deactivated by disconnecting the pipeline to the unit when the calculated specific retention of the underlying soil column was achieved (Lundgren 1970).

Stabilization of the entire crib was completed in August 1981. Prior to stabilization the vent filter boxes, 20 cm (8 in.) vent risers, liquid level risers, 5 cm (2 in.) vent risers, and valve handle extensions were removed at or below existing grade and disposed of in the 218-E-12B Burial Ground. As the vent filters and risers were removed, expanding rubber plugs were installed in each opening. The eight vadose monitoring well casings were extended to accommodate the addition of clean soil cover. One m (2.5 ft) of topsoil treated with the herbicides and 2,4-D amine plus a polymer, and a rodent deterrent consisting of sucrose octa-acetate were added as cover material then seeded with wintergraze, thickspike, crested, and Siberian wheatgrasses.

About 30 m (100 ft) south of the BC Cribs is a 9 x 30 m (30 x 100 ft) area delineated with metal posts and underground contamination signs. This area is devoid of any vegetation. It is not reflected on any of the drawings and is reported to be a radionuclide migration study area. Evidence of wildlife (rabbit droppings, paw and hoof prints) is seen throughout the BC Cribs.

2.3.3.7 216-B-15 Crib. The 216-B-15 Crib is located northwest of the 216-B-14 Crib. It is inactive. This crib is a 3 x 3 x 1 m (10 x 10 x 3 ft) structure made of wood, concrete blocks, and steel, placed over a 1.5 m (5 ft) thick gravel bed and was fed by a 36 cm (14 in.) steel pipe 2 m (6 ft) below grade (Maxfield 1979; Stenner et al. 1988). The wood base of the crib is considered a collapse hazard (Ortiz 1974). The bottom of the excavation is 12 x 12 m (40 x 40 ft) (DOE/RL 1991a).

This crib received 6,320,000 L (1,670,00 gal) of scavenged tributyl phosphate waste from the 221-U Building from April 1956 until December 1957. The waste is high salt and neutral/basic. The waste contained inorganic compounds such as ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides in the waste stream deposited in these cribs contained ¹³⁷Cs, ¹⁰⁶Ru, ⁹⁰Sr, plutonium, and uranium (WHC 1991a; Fecht et al. 1977; Brown et al. 1990). The crib was deactivated by blanking the feed pipe to the unit when the calculated specific retention of the underlying soil column was achieved (Maxfield 1979).

2.3.3.8 216-B-16 Crib. The 216-B-16 Crib is inactive and located southwest of the 216-B-14 Crib. This crib is a 3 x 3 x 1 m (10 x 10 x 3 ft) structure made of wood, concrete blocks, and steel, placed over a 1.5 m (5 ft) thick gravel bed and is fed by a 36 cm (14 in.) steel pipe 2 m (6 ft) below grade (Maxfield 1979; Stenner et al. 1988). The wood base of the crib is considered a collapse hazard (Ortiz 1974). The bottom of the excavation is 12 x 12 m (40 x 40 ft) (DOE/RL 1991a).

This crib received 5,600,000 L (1,500,000 gal) of scavenged tributyl phosphate waste from the 221-U Building between April and August 1956. The waste is high salt and neutral/basic. The waste contained inorganic compounds such as ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides in the waste stream deposited in these cribs contained ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (WHC 1991a; Fecht et al. 1977; Brown et al. 1990). The crib was deactivated by valving out the feed pipe to the crib when the calculated specific retention of the underlying soil column was achieved (Maxfield 1979).

2.3.3.9 216-B-17 Crib. The 216-B-17 Crib is located northwest of the 216-B-16 Crib. It is inactive. This crib is a 3 x 3 x 1 m (10 x 10 x 3 ft) structure made of wood, concrete blocks, and steel, placed over a 1.5 m (5 ft) thick gravel bed and fed by a 36 cm (14 in.) steel pipe 2 m (6 ft) below grade (Maxfield 1979; Stenner et al. 1988). Because the base of the crib is wood there is a small potential for collapse (Ortiz 1974). The bottom of the excavation is 12 x 12 m (40 x 40 ft) (DOE/RL 1991a).

In January 1956 this crib received 3,410,000 L (901,000 gal) of scavenged tributyl phosphate waste from the 221-U Building. The waste is high salt and neutral/basic. The waste contained inorganic compounds such as ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides in the waste stream deposited in these cribs contained ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (WHC 1991a; Fecht et al. 1977; Brown et al. 1990). The crib was deactivated by valving out the feed pipe to the to the crib when the calculated specific retention of the underlying soil column was achieved (Maxfield 1979).

2.3.3.10 216-B-18 Crib. The 216-B-18 Crib is an inactive waste management unit located southwest of the 216-B-16 Crib. This crib is a 3 x 3 x 1 m (10 x 10 x 3 ft) structure made of wood, concrete blocks, and steel, placed over a 1.5 m (5 ft) thick gravel bed and are fed by a 36 cm (14 in.) steel pipe 2 m (6 ft) below grade (Maxfield 1979; Stenner et al. 1988). The wood base of the crib is considered a collapse hazard (Ortiz 1974). The bottom of the excavation is 12 x 12 m (40 x 40 ft) (DOE/RL 1991a).

This crib received 8,520,000 L (2,251,000 gal) of scavenged tributyl phosphate waste from the 221-U Building in March and April 1956. The waste is high salt and neutral/basic. The waste contained inorganic compounds such as ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides in the waste stream deposited in these cribs contained ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (WHC 1991a; Fecht et al. 1977; Brown et al. 1990). The crib was deactivated by valving out the feed pipe to the crib when the calculated specific retention of the underlying soil column was achieved (Maxfield 1979).

The soil overlying the 216-B-18 Crib was discovered to have collapsed approximately 1.0 m (3 ft), with no exposure of the crib to the air during a field inspection in February 1974 (Ortiz 1974). The collapse was filled with gravel (Maxfield 1979). Since the wooden cribs should have a service life of about 25 years, all of the cribs in this area, as well as the wood-covered trenches described below, are considered to be potential collapse hazards.

2.3.3.11 216-B-19 Crib. The 216-B-19 Crib is located southwest of the 216-B-16 Crib. It is an inactive waste management unit. This crib is a 3 x 3 x 1 m (10 x 10 x 3 ft) structure made of wood, concrete blocks, and steel, placed over a 1.5 m (5 ft) thick gravel bed and is fed by a 36 cm (14 in.) steel pipe 2 m (6 ft) below grade (Maxfield 1979; DOE 1988; Stenner et al. 1988). The wood base of the crib is considered a collapse hazard (Ortiz 1974). The bottom of the excavation is 12 x 12 m (40 x 40 ft) (DOE/RL 1991a).

This crib received 6,400,000 L (1,700,000 gal) tributyl phosphate waste from the 221-U Building from February 1957 until October 1957. The waste is high salt and neutral/basic. The waste contained inorganic compounds such as ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides in the waste stream deposited in these cribs contained ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (WHC 1991a; Fecht et al. 1977; Brown et al. 1990). The crib was deactivated by valving out the feed pipe to the crib when the calculated specific retention of the underlying soil column was achieved (Maxfield 1979).

2.3.3.12 216-B-43 Crib. The 216-B-43 through 216-B-50 Cribs are inactive waste management units located adjacent to the northern boundary of the 241-BY Tank Farm (200-BP-1 Operable Unit). Each crib received scavenged tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. 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 ft) long, placed 2 m (7 ft) below grade, and 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 (30 x 30 x 15 ft) deep excavation (DOE/RL 1991a). A cross section and plan view of the 216-B-43 through -50 Cribs can be found on Figure 2-23.

The 216-B-43 Crib received 2,100,000 L (554,000 gal) of waste in November 1954. Maxfield (1979) reports that the crib was taken out of service when the specific retention capacity of the soil under the crib was reached. The *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that all of the cribs in this series except the 216-B-43 Crib received volumes beyond their specific retention capacity. Dates of operation and radiological and chemical inventories are presented in Tables 2-1, 2-3, and 2-4.

Tributyl phosphate acid waste from the 221-U Building was made alkaline for transport, and sent to the 241-BY Tank Farm, where it was treated with potassium ferrocyanide as a cesium scavenger. The supernatant from the tanks was allowed to cascade, to allow precipitation of cesium, and was then discharged to the 216-B-43 through 216-B-49 Cribs (DOE/RL 1990a; Jungfleisch 1984). The eight cribs in this group are arranged in two, north trending lines of four cribs each; two lines run north from the 201-B Flush Tank, and individual feed pipes extend out, perpendicular to the central lines to the individual cribs.

Inorganic compound in the liquids disposed to these cribs include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990)

Stabilization of the crib area began in 1975 and was completed in November 1977. Stabilization activities included removal of radioactive vegetation, removal and blanking of all crib vent risers below grade, removal of a buried radioactive spill adjacent to the 216-B-43 Crib, extension of all monitoring well casings above grade, grading of crib site surface, placement of two 3 x 30 m (10 x 100 ft) test strips treated with lithium chloride (to determine effectiveness of root barrier), addition of 15 cm (6 in.) of sand over a 10 mil plastic root barrier, and addition of at least 30 cm (12 in.) of topsoil seeded with cheatgrass and Siberian wheatgrass treated with the herbicide urea borate (Maxfield 1979).

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.

2.3.3.13 216-B-44 Crib. The 216-B-44 Crib is located north of the 216-B-43 Crib, and received 5,600,000 L (1,500,000 gal) of tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. The crib, currently inactive, consists 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 ft) long, placed 2 m (7 ft) below grade, and set on a 1.5 m (5 ft) 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). It received waste from November 1954 until March 1955. Maxfield (1979) reports that the feed pipe to the crib was valved out when the specific retention capacity of the soil under the crib was reached, but the *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that the crib received volumes beyond its specific retention capacity.

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to the crib include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990)

2.3.3.14 216-B-45 Crib. This crib is located north of the 216-B-44 Crib, and received 4,900,000 L (1,300,000 gal) of tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. The crib, currently inactive, consists 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) diameter and 1.2 m (4 ft) long, placed 2 m (7 ft) below grade, and 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). It was active from April until June 1955. Maxfield (1979) reports that the feed pipe to the crib was valved out when the specific retention capacity of the soil under the crib was reached, but the *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that the crib received volumes beyond its specific retention capacity.

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; Brown et al. 1990)

2.3.3.15 216-B-46 Crib. The 216-B-46 Crib is located north of the 216-B-45 Crib, and received 6,700,000 L (1,800,000 gal) of tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. The crib, currently inactive, consists 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 ft) long, placed 2 m (7 ft) below grade, and 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). It received waste from September until December 1955. Maxfield (1979) reports that the feed pipe to the crib was valved out when the specific retention capacity of the soil under the crib was reached, but the *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that the crib received volumes beyond its specific retention capacity.

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990)

2.3.3.16 216-B-47 Crib. The 216-B-47 Crib is located west of the 216-B-43 Crib, and received 3,700,000 L (980,000 gal) of tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. The crib, currently inactive, consists 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 ft) long, they 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). It was active only in September 1955. Maxfield (1979) reports that the feed pipe to the crib was valved out when the specific retention capacity of the soil under the crib was reached, but the *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that the crib received volumes beyond its specific retention capacity.

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990).

2.3.3.17 216-B-48 Crib. The 216-B-48 Crib is located west of the 216-B-44 Crib, and north of the 216-B-47 Crib. It received 4,100,000 L (1,100,000 gal) of tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. The crib, currently inactive, consists 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 ft) long, placed 2 m (7 ft) below grade and 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 4.6 x 4.6 x 9 m (15 x 15 x 30 ft) deep excavation (DOE/RL 1991a). The unit received waste in November 1955. Maxfield (1979) reports that the feed pipe to the crib was valved out when the specific retention capacity of the soil under the crib was reached, but the *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that the crib received volumes beyond its specific retention capacity.

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990)

2.3.3.18 216-B-49 Crib. The 216-B-49 Crib is located west of the 216-B-45 Crib, and north of the 216-B-48 Crib. It received 6,700,00 L (1,800,000 gal) of tributyl phosphate supernatant waste from the 221-U Building and 241-BY tanks. The crib, currently inactive, consists 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 (4 ft) in diameter and 1.2 (4 ft) long, placed 2 m (7 ft) below grade, and 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 m x 4.6 m x 9 m (15 x 15 x 30 ft) deep excavation (DOE/RL 1991a). The crib was active in November and December 1955. Maxfield (1979) reports that the feed pipe to the crib was valved out when the specific retention capacity of the soil under the crib was reached, but the *RI/FS Work Plan for the 200-BP-1 Operable Unit* (DOE/RL 1990a) states that the crib received volumes beyond its specific retention capacity.

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ^{137}Cs , ^{90}Sr , ^{106}Ru , plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990)

2.3.3.19 216-B-50 Crib. The 216-B-50 Crib is located west of the 216-B-46 Crib, and north of the 216-B-49 Crib. It received 54,800,000 L (14,500,000 gal) of waste storage tank

condensate from the ITS-1 unit in the 241-BY Tank Farm (Maxfield 1979). The crib, currently inactive, consists 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 ft) long, placed 2 m (7 m) below grade, and 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). The feed pipe was valved out when the specific retention capacity of the soil was reached (Maxfield 1979).

Inorganic compounds in the liquids disposed to the crib include ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained within the waste stream sent to these cribs include ¹³⁷Cs, ⁹⁰Sr, ¹⁰⁶Ru, plutonium, and uranium (Maxfield 1979; WHC 1991a; Brown et al. 1990)

The 216-B-50 Crib did not receive waste until January 1965 due to elevated ⁶⁰Co and ¹³⁷Cs levels in groundwater. In 1956, a nearby monitoring well had ⁶⁰Co levels over 300 times the Hanford Atomic Products Operation (HAPO) limit. The decision to use the 216-B-50 Crib for ITS system condensate was made following 8 to 9 years of observations when it was shown that the groundwater activity levels were definitely decreasing.

From January 1965 until January 1974 the 216-B-50 Crib received 54,800,000 L (14,500,000 gal) of waste storage tank condensate from the ITS-1 unit in the 241-BY Tank Farm. Discharge to the crib was about 19 to 23 L/min (5 to 6 gal/min) of condensate. Around 1968 the capacity of ITS-1 was doubled (Project ICE-618). The quantity of waste generated (about 45 L/min, 12 gal/min) was now greater than the designed disposal rate (19 to 23 L/min, 5 to 6 gal/min) of the 216-B-50 Crib. This created concern that an increase in water level could drive the condensate through the highly contaminated zone under the other seven cribs. Chemical data obtained from monitoring wells showed condensate sent to the 216-B-50 Crib tended to migrate beneath the highly contaminated cribs. The 216-B-50 Crib was to be taken out of operation when the calculated specific retention capacity of the underlying soil column was achieved, but may have been retired prematurely due to "size" limitations and because of its close proximity to the highly contaminated the 216-B-43 through 216-B-49 Cribs used for scavenged tributyl phosphate waste.

2.3.3.20 216-B-55 Crib. The 216-B-55 Crib is an active 230 m (750 ft) long waste disposal unit located approximately 200 m (600 ft) west of the 221-B Building. It is 230 m (750 ft) long, 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 1 m (3 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). It was designed to receive low-level liquid wastes (steam condensate) from the 221-B Building. Radioisotopes

present within the waste stream include ^{211}Am , ^{137}Cs , ^{131}Pu , ^{106}Ru , ^{90}Sr , and ^3H (Brown et al. 1990; WHC 1991a). Although still active, this unit has not received any effluent for the last 3 to 4 years (see Section 2.4.3).

2.3.3.21 216-B-56 Crib. The 216-B-56 Crib, located approximately 150 m (500 ft) north of 7th Street near the center of the operable unit, was designed to receive organic wastes from the 221-B Building but the pipeline to the unit was not installed when disposal practices were changed and discharge of organic wastes to the ground was prohibited (Lundgren 1979; Maxfield 1979). The unit is 21 m (70 ft) long and 3 m (10 ft) wide. It is a gravel filled crib and is, presumably, similar in construction to cribs 216-B-55 and 216-B-57. The crib was surveyed and downposted due to cross-contamination from surrounding sites.

2.3.3.22 216-B-57 Crib. The 216-B-57 Crib is an inactive waste management unit located adjacent to the northwest corner of the 241-BY Tank Farm. It is 60 m (200 ft) long, 4.6 m (15 ft) wide, and 3 m (10 ft) deep, and is composed of a perforated, 30 cm (12 in.) diameter pipe that runs the length of the unit, 1 m (3 ft) above the bottom. The site is filled with gravel to 1.2 m (4 ft) above the bottom. From February 1968 to June 1973 84,400,000 L (22,300,000 gal) of waste storage tank condensate from the ITS-2 unit of the 241-BY Tank Farm were disposed at this crib. Inorganic liquid waste was also deposited to this trench and consisted primarily of aluminum carbonate. Radionuclides contained in the waste stream include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (WHC 1991a; Brown et al. 1990).

In 1991 surface contamination in the areas around the 216-B-43 through 216-B-50 and 216-B-57 Cribs was interim stabilized to achieve environmental compliance in preparation for the RI/FS work activities currently underway. The areas were then re-posted with underground radioactive material warning signs (prior to remedial activities, the crib areas were posted with surface contamination signs). Recent drilling activities at the crib areas required that the units be re-posted with surface contamination warning signs.

Currently, the area is about 1 m (2 ft) above grade and covered with gravel. A 15 cm (6 in.) steel vent pipe is located at each end. The north vent extends about 91 cm (36 in.) above grade and has a 39 x 39 x 39 cm² (6 x 6 x 6 in.²) filter box.

2.3.3.23 216-B-60 Crib. The 216-B-60 Crib consists of two steel vertical cascading caissons positioned side by side. The two caissons are 2.4 m (8 ft) in diameter, 5 m (16 ft) long and bottom at 12 m (40 ft) depth. They are covered by 46 cm (18 in.) thick concrete tops. They are located 1.2 m (4 ft) west of the 221-B Building. In 1975, an extension to the 221-B Building was added covering the crib. The cribs are currently under the northeast corner of the 225-B Encapsulation Facility (Maxfield 1979; Stenner et al. 1988). This waste management unit is inactive.

The crib was specifically built for solid and liquid wastes generated from the clean-out of the 221-B Building cell drain header that took place November 1967. The calculated total plutonium and fission product discharged to the site is 715.5 kg (1,577.4 lb) of uranium, 0.08 g of plutonium, 777 Ci of ^{144}Ce , 8 Ci of ^{137}Cs , and 5 Ci of ^{154}Eu (WHC 1991a).

After the drain header clean-out was completed, the caissons were plugged with 46 cm (18 in.) of concrete to seal the waste. The area was backfilled to grade and in 1975 the 225-B Encapsulation Facility was built over the crib (Stenner et al. 1988).

2.3.3.24 216-B-61 Crib. 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 and is located about 150 m (500 ft) northwest of the tank farm. This crib was designed to replace the 216-B-50 Crib, which could not handle the increased capacity from the ITS No. 1 unit when it was modified in 1968. Although this crib was built, it was never used (WHC 1991a). It is known that this crib is gravel filled and covers 163 m² (1,750 ft²); however, individual dimensions could not be determined. Its design is presumed to be similar to the 216-B-57 Crib. It is listed in the WIDS database as containing nonhazardous nonradioactive material.

The 216-B-61 Crib is enclosed in a light weight chain barricade with a placard indicating a crib. A concrete identification post stands at the head of the crib and two risers appear above the ground surface near the west end of the crib.

2.3.3.25 216-B-62 Crib. The 216-B-62 Crib is active and located 460 m (1,500 ft) northwest of the 221-B Building and has received 282,000,000 L (74,505,000 gal) of low-level process condensate from the 221-B Building Separations Facilities. Although active, the unit has not received effluent in the last 3 to 4 years (see Section 2.4.3). The crib is 150 m (500 ft) long, 3 m (10 ft) wide (Maxfield 1979), and consists of a perforated 15 cm (6 in.) diameter fiberglass reinforced epoxy distributor pipe that runs the length of the crib, approximately 3 m (10 ft) below grade. It is a gravel filled crib. Americium-241, ¹³⁷Cs, ¹⁰⁶Ru, ⁹⁰Sr, and ²³⁹Pu are radionuclides present within the waste stream (Brown et al. 1990; WHC 1991a).

2.3.3.26 Chemical Tile Field North of 2703-E Hazardous Waste Staging Area. The chemical tile field is an active waste management unit 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 the tile field received is not known.

2.3.3.27 216-B-13 French Drain. The 216-B-13 French Drain is located 100 m (300 ft) south of the 221-B Building and 8 m (25 ft) northeast of the 291-B-1 Stack. The unit consists of two 1.2 m (4 ft) by 1.5 m (5 ft) tall tile pipe sections stacked vertically and filled with 2,270 kg (2.5 tons) of crushed limestone. A piece of plywood covers the top of the drain 2.4 m (8 ft) below grade. Site dimensions are 1.2 m (4 ft) diameter by 5.5 m (18 ft) deep. It is inactive. The french drain received 21,000 L (7,400 gal) of 291-B-1 Stack drainage. The mixed liquid waste was low in salt and neutral/basic, and contained an unknown amount of plutonium. The unit operated from August 1947 through June 1976. Prior to August 1947, 291-B Stack drainage was disposed in the 216-B-4 Reverse Well. In June 1976, the stack drainage was rerouted into a cell drainage sample tank. The WIDS lists only 2,000 kg (5,000 lb) of nitrate contained within the waste stream disposed by this unit (WHC 1991a).

The top of the structure is buried 2.4 m (8 ft) below grade. It is marked by a yellow concrete post. A depression in the soil 2.4 m (8 ft) from the marker could be due to the collapse of the plywood which covered the drain.

2.3.3.28 216-B-51 French Drain. This is an inactive waste management unit located about 230 m (750 ft) north of the 241-B Tank Farm. It received waste from January 1956 until January 1958. The unit consists of vertically stacked sections of 1.5 m (5 ft) diameter concrete pipe filled with gravel. The bottom of the unit is 4.3 m (14 ft) below grade and the top is 0.3 m (1 ft) below grade with a treated wood cover. The unit dimensions are 1.5 m (5 ft) in diameter by 4.3 m (14 ft) in depth.

The drain received about 1,000 L (260 gal) of flush drainage from the BC Crib pipeline. The pipeline carried high salt neutral to basic scavenged tributyl phosphate waste from the 221-U Building to the BC Crib area. The french drain contains less than 10 Ci of total beta activity (Stenner et al. 1988). The unit has a plywood cover (WHC 1991a) and may represent a collapse potential.

2.3.4 Reverse Wells

Reverse wells are injection wells drilled to a depth slightly above the water table. In the early years of the Hanford operation, they were used to dispose of liquid waste. Sources of waste disposed to these wells is shown in Table 2-1. The locations of these reverse wells are shown on Figure 2-4. A reverse well disposal system is shown in Figure 2-25.

2.3.4.1 216-B-4 Reverse Well. The 216-B-4 Reverse Well is located about 250 m (800 ft) southeast of the 221-B Building and west of the 292-B Building. It is 20 cm (8 in.) in diameter, and 33.5 m (110 ft) deep. The structure received 10,000 L (2,700 gal) of low salt, neutral/basic, TRU fission waste during its operational lifetime of April 1945 through December 1949. Until August 1947, the reverse well received 291-B Stack drainage. After August 1947, the reverse well received floor drainage from the 292-B Building. The WIDS hazardous chemical inventory lists only 1,000 kg (2,000 lb) of nitric acid contained in the waste stream. A radionuclide inventory was not available. However, it is estimated that the waste contained less than 1 Ci total beta (Maxfield 1979). The pipeline to the unit has been disconnected (Stenner et al. 1988).

2.3.4.2 216-B-5 Reverse Well. The 216-B-5 Reverse Well is an inactive, 92 m (302 ft) deep, 20 cm (8 in.) diameter (Brown and Ruppert 1950), waste management unit located about 300 m (1,000 ft) northeast of the 221-B Building and east of Baltimore road. It received overflow waste from the 241-B-361 Settling Tank, which received waste from the 224-B Concentration Facility and from Tank 5-6 in the 221-B Building from April 1945 until September 1946. Between September 1946 and October 1947 cell drainage and other liquid waste from Tank 5-6 was injected into the well (WHC 1991a; Brown et al. 1990). Approximately 31,000,000 L (8,100,000 gal) of liquid were discharged to the

216-B-361 Settling Tank from the 224-B Concentration Facility and the 221-B Building, containing an estimated 4,275 g of plutonium and 3,800 Ci of beta-gamma activity (Brown and Ruppert 1950).

In 1947 the elevation of the water table in Well E33-18 demonstrated that the reverse well penetrated about 3 m (10 ft) into the groundwater and that radioactive waste had been discharged into the groundwater. The 216-B-5 Reverse Well was deactivated and the Tank 5-6 wastes were rerouted to the 216-B-7A and -7B Cribs (Maxfield 1979). Figure 2-25 shows the general arrangement of the 216-B-5 Reverse Well.

2.3.4.3 216-B-6 Reverse Well. The 216-B-6 Reverse Well is located 4 m (12 ft) west and 1 m (3 ft) north of the northwest corner of the 222-B Building and is marked by a 1.2 m (4 ft) concrete identification post. It was constructed of 15-cm (6-in) diameter stainless steel pipe at a 23-m (75-ft) depth. The lower 8 m (25 ft) are perforated at every 0.3 m (1 ft) with 1-cm (0.5-in) holes.

Six million liters (2,000,000 gal) of mixed liquid waste was received by the reverse well from April 1945 through December 1949. The waste was acidic (containing nitric and sulfuric acid) and radioactive (containing TRU fission products) and came from decontamination and sample slurper waste from the 222-B Building. Use of this well was terminated when it was determined that the radionuclide capacity had been reached (Maxfield 1979). The 216-B-6 Reverse Well contains less than 10 Ci of total beta.

2.3.4.4 216-B-11A and 216-B-11B Reverse Wells. The 216-B-11A and 216-B-11B Reverse Wells are inactive waste management units located approximately 76 m (250 ft) north of the 241-B Tank Farm. These two wells are placed about 18 m (60 ft) apart in line with a 7.6 cm (3 in.) steel inlet pipe. The wells are pipe-encased, have a 1.2 m (4 ft) diameter and are 12.2 m (40 ft) deep.

From December 1951 to December 1954 approximately 29,600,000 L (7,820,000 gal) of low salt, neutral to basic process condensate from the 242-B Evaporator were disposed of at these units. Radionuclides contained in the waste stream at the time of discharge included 50 Ci of ^{137}Cs , 5 Ci of ^{90}Sr , 50 Ci of ^{106}Ru , 0.4 g of plutonium, and 14 kg of uranium (Maxfield 1979). These contaminants were distributed between the two reverse wells. The majority of it is probably in the 216-B-11A Reverse Well (Maxfield 1979).

The reverse wells were deactivated when it became evident that cribs and trenches were more effective means of disposal. The supply lines were blanked and capped. The most recent radiological survey of these units identified a collapse potential, apparently created by wooden covers on the top of the wells.

2.3.5 Ponds, Ditches, and Trenches

The ponds and trenches in the B Plant Aggregate Area were designed to percolate waste liquid into the ground. The ponds in the B Plant Aggregate Area include the 216-A-25 Pond (Gable Mountain Pond), 216-N-8 (West Lake), and the 216-B-3 Pond System, which consists of a main pond and three interconnected expansion lobes. The expansion lobes are referred to as the 216-B-3A, 216-B-3B, and 216-B-3C Ponds. Several ditches designed to convey cooling water are also associated with the pond systems. Trenches were excavations that were opened for discrete time intervals for subsurface disposal of liquid waste, then backfilled. In "specific retention" trenches, a specified volume of liquid was discharged to the trench and would be held by capillary action in the soil column. Table 4-14 compares the volume of waste discharged to a unit with its calculated soil column pore volume. The B Plant Aggregate Area trenches were excavated to absorb scavenged tributyl phosphate waste (waste from tributyl phosphate solvent extraction process in the U Plant Aggregate Area where uranium, cesium, and strontium was recovered from aqueous B Plant Aggregate Area bismuth phosphate waste) and waste from the Plutonium Recycle Test Reactor in the 300 Area (Maxfield 1979). The locations of the ponds, ditches, and trenches are shown on Figures 2-5, 2-6, and 2-7.

2.3.5.1 216-B-3 Pond/UN-200-E-14. The 216-B-3 Pond is approximately 1,100 m (3,500 ft) east of the 200 East Area perimeter fence and about 1,500 m (5,000 ft) northeast of the 202-A Building. It is roughly rectangular, currently covers a surface area of about 35 acres, and is between 0.6 to 6 m (2 to 20 ft) deep. Historical records indicate that throughout its operational lifetime, the 216-B-3 Pond has varied in size from approximately 19 to 46 acres. The east end of the pond is formed by a dike 420 m (1,380 ft) long, 12.8 m (42 ft) wide, and 10.6 m (35 ft) high. The dike extends approximately 1.5 m (5 ft) above the water level. An area of approximately 4.1 acres immediately west of the 216-B-3 Pond was diked during the 1970's to provide an overflow area for the 216-B-3 Pond. This overflow area was decommissioned and backfilled in 1985.

The 216-B-3 Pond, a RCRA facility, has been operational since April 1945 (Maxfield 1979). A Closure/Postclosure plan (DOE/RL 1990b) has been prepared for the pond system, but has not yet been approved by the Department of Ecology. During its lifetime, the 216-B-3 Pond has received mixed waste via the 216-A-29 Ditch and the PUREX Cooling Water Line in the PUREX Aggregate Area. From the B Plant Aggregate Area, the pond has received waste from the 216-B-2-1, 216-B-2-2, and 216-B-2-3 Ditches, the 216-B-3-1, 216-B-3-2, and 216-B-3-3 Ditches, and the current 216-B-2-3 pipeline. A pipeline connects the B-2 ditches (and current 216-B-2-3 pipeline) to the past and present B-3 Ditches. This pipeline falls within the PUREX Plant Aggregate Area 200-PO-6 Operable Unit.

Currently, effluent streams reach the 216-B-3 Pond System through two means of conveyance, the 216-B-2-3 Pipeline from the 207-B Retention Basin at B Plant, which carries effluents from B Plant and runs along the route of the 216-B-2-3 Ditch, and a pipeline from the PUREX Plant Aggregate Area called the PUREX Cooling Water Line. Both of these

pipelines discharge into the western end of the 216-B-3-3 Ditch which drains into the 216-B-3 Pond. Plates 1 and 4, and Figure 2-6 show the location of these facilities. Effluent streams which reach the 216-B-3 Pond System through the pipeline from B Plant include B Plant Cooling Water (CBC) and, since February 1992, the B Plant Chemical Sewer (BCE). Effluents which reach the pond through the PUREX Cooling Water Line include 284-E and 283-E effluent, PUREX Cooling Water (CWL), PUREX Chemical Sewer (CSL) effluent, and cooling water effluents from the 244-AR Vault, the 241-A Ventilation System Complex, and the 242-A Evaporator. The effluents which are conveyed by the PUREX Cooling Water Line are described in the PUREX Aggregate Area Management Study Report with the exception of the 284-E and 283-E effluents which are described in Section 2.3.1.1.8 and 2.3.1.1.9. The 216-B-63 Trench serves as an emergency backup discharge point for the streams which pass through the B Plant pipeline. The 216-B-3 Pond System received an estimated total waste volume of 240,000,000,000 L (63,408,000,000 gal) between 1945 and 1991 (WHC 1991a).

The steam condensate and cooling water that reaches the pond is primarily river water with little potential for chemical or radioactive contamination, and comprise the bulk of the water used in the 200 East Area. Releases into this stream have occurred but represent a small fraction of the waste volume discharged to the pond. Other liquid wastes that have been discharged in low volume to the pond may contain potentially hazardous substances (Luttrell et al. 1989).

Several hazardous, nonradioactive discharges have reached the 216-B-3 Pond through the 216-A-29 Ditch. Compounds in these CERCLA-reportable releases include: demineralizer regenerant, aqueous makeup tank heels and off-specification batches; N cell prestart testing (oxalic acid, nitric acid, hydrogen peroxide, calcium nitrate); potassium permanganate; sodium carbonate solution; hydrazine HN solution; potassium hydroxide; sodium nitrate; nitric acid; sodium hydroxide; cadmium nitrate; hydrazine; and sodium nitrite. The demineralizer regenerant, aqueous makeup tank heels, and off-specification batches and compounds were released from 1955 to 1987. Other compounds were released in discrete events from the early to late 1980's (Luttrell et al. 1989).

There is one known unplanned release directly associated with this pond: UN-200-E-14. Unplanned release UN-200-E-14 occurred in 1958 when a dike on the east side of the 216-B-3 Pond ruptured and released contaminated water into a ravine east of the pond. The contaminated area was covered with clean soil and was removed from radiation zone status in December 1970.

In addition to the one unplanned release directly associated with the 216-B-3 Pond, there have been four other unplanned releases which have released contamination into the ditches and ultimately reached the 216-B-3 Pond. These unplanned releases, UPR-200-E-32, UPR-200-E-34, UPR-200-E-51, and UPR-200-E-138, are described in Sections 2.3.5.9, 2.3.5.12, 2.3.5.14, and 2.3.5.10.

2.3.5.2 216-B-3A Pond. The 216-B-3A and -3B Ponds were built in 1983 to handle the increased discharge flowrate resulting from the restart of the 202-A Building operations. In January 1984 the dike separating the 216-B-3A and -3B Ponds was breached at the dike spillway and pond use was halted. The failure was attributed to erosion of sediments (channeling) around and underneath the concrete-lined channel connecting the two lobes. A slide gate, a duplicate of the 216-B-352 slide gate on the 216-B-3 Pond, was built and the ponds were reopened for use.

The 216-B-3A Pond is an active waste management unit covering about 10 acres and appears to be shallow, about 1 m (2 to 3 ft) deep. It receives water from the 216-B-3 Pond via the 216-B-352 overflow structure. The surface elevation of this pond is approximately 6 m (18 ft) lower than the 216-B-3 Pond. It has two outflow structures at its eastern end. One of these structures can release water to the 216-B-3B Pond and one can release water to the 216-B-3C Pond. The pond has a very low infiltration rate. This could be due to siltation, algae growth, and wind-blown sedimentation. Migration of bentonite from the 216-B-3 Pond is another possibility, even though there was a 13 year gap between the last known use of bentonite in the 216-B-3 Pond and the startup of the 216-B-3A lobe.

Following the dike break, a north-south trending ditch, 1.8 m (6 ft) deep, 6 m (20 ft) wide, and approximately 244 m (800 ft) long, was excavated into the bottom of the 216-B-3A lobe to improve percolation.

2.3.5.3 216-B-3B Pond. This pond was returned to service in June 1984, after the dike repair. It is roughly rectangular and is currently dry. It has been unused since 1985, and was dredged in 1986. Up to 2 m (7 ft) of material was removed in the dredging process to level the bottom of the pond. The removed material was placed along the north shore of the 216-B-3 Pond. It is listed as an active waste management unit (WHC 1991a).

The 216-B-3B lobe is surrounded by "Danger" warning signs. However, these are due to Ecology requirements and there is no indication of actual contamination. The whole pond is surrounded by a light chain barricade and there is a second light chain barricade surrounding the inlet ditch. It is posted with surface radiation contamination warning signs.

2.3.5.4 216-B-3C Pond. This pond has been active since its construction in 1985. It was built to handle increased discharge to the 216-B-3 Pond system arising from the decommissioning of the Gable Mountain Pond. Unlike the other ponds which were formed by blocking off a topographic low with an embankment, this lobe was completely excavated into the ground so that there was no possible chance of embankment failure. The excavation was done in a coarse gravel layer to increase the infiltration rate. Within the roughly rectangular depression of the pond, there are a series of distribution channels running the length of the pond bottom. This is the lowest elevation pond in the 216-B-3 Pond series. Eventually, the 216-B-3C Pond will become the main disposal pond in the 216-B-3 Pond system although under low flow conditions, most of the inflow percolates through the 216-B-3 and -3A Ponds.

2.3.5.5 216-E-28 Contingency Pond. The 216-E-28 Contingency Pond is approximately 30 acres in size and is divided into three lobes. It was built to receive effluents and is being held in reserve for any future embankment failures. It was built in 1986 and has never been used. Along with the pond, a pipeline approximately 915 m (3,000 ft) long was built to connect the contingency pond to the various suppliers to the 216-B-3 Pond system. From this pipeline, an extension has been added so that there is now a pipeline connection around the 216-B-3 Pond's main lobe. Effluent will be diverted into the 216-B-3A Lobe when the 216-B-3 Pond's Closure/Postclosure Plan is implemented. Bypass pipelines around the 216-B-3A Lobe to the 216-B-3B and 216-B-3C Lobes are in the design phase.

2.3.5.6 216-A-25 Gable Mountain Pond. The 216-A-25 Gable Mountain Pond was a 71 acre natural depression located 1.6 km (1 mi.) south of the west end of Gable Mountain. It was the largest seepage disposal facility of the several Hanford ponds. In 1957 it was commissioned for service to receive cooling water from the 202-A Building. Gable Mountain Pond routinely received low level liquid wastewater from the 202-A Building, the 242-A Evaporator, the 244-AR Vault, 200 East Area Powerhouse, and the 241-A Tank Farm (WHC 1991a). Waste reached Gable Mountain Pond through the PUREX Cooling Water line. This pipeline, made of corrugated metal, was broken and capped when the Gable Mountain Pond was decommissioned in 1987. Between its commissioning in 1957 and its decommissioning in 1987, the pond received approximately 307,000,000,000 L (8,110,000,000 gal) of liquid mixed waste (Coony and Thomas 1989). The radionuclides contained in the waste streams disposed at this site include ²⁴¹Am, ³H, ¹⁰⁶Ru, ¹³⁷Cs, ¹⁴⁷Pm, ⁹⁰Sr, and plutonium (Brown et al. 1990; WHC 1991a).

Although the pond has received low levels of chemically and radioactively contaminated wastes since its startup, a single unplanned release (UPR-200-E-34) on June 11, 1964 resulted in relatively large quantities of short and long-lived mixed fission products to 216-B-3 Pond, Gable Mountain Pond, and the ditch associated with 216-B-3 Pond (216-B-3-1 Ditch). Bentonite clay was introduced to the pond bottom as an attempt to tie-up radionuclides in the upper sediment layers after the release (Maxfield 1979). Copper sulfate was added on two occasions to eliminate the algae and invertebrate life, thus breaking the important links in the food chain of the migratory water fowl. The desired water concentration was 3 ppm (Maxfield 1979).

Clean-up actions were started in July 1984. The stabilization was completed in December 1988. The unit was backfilled with clean pit run soil and cobbles to a minimum of 1 m (2 ft) above the original shoreline (Hayward 1989). The pond was re-vegetated after a 0.3 m (1 ft) layer of topsoil was spread over the entire backfilled area. Wells 699-53-47, 699-55-50C, and 699-52-52 monitor the groundwater beneath the site of the backfilled pond (WHC 1991a).

2.3.5.7 216-N-8 Pond. Also known as "West Pond" or "West Lake", the 77,800 m² 216-N-8 Pond serves as a natural basin for a large watershed area. It is located 1.2 km (75 mi) northwest of Gable Mountain Pond.

Prior to the development of the crib, trench, and pond systems (Separations Area) in the 200 East Area, the 216-N-8 Pond was an intermittent natural pond that appeared in the winter and spring when the water table was elevated. The pond was used as a disposal site for sewage sludge from the early Hanford construction camp. Consequently, high levels of alkalinity and phosphate have been measured in the pond, as well as elevated pH values, which may be attributed to the sewage disposal. With the cribs, trenches, and surface ponds receiving effluents, the water table rose, making the 216-N-8 Pond a permanent feature. (Strait and Moore 1981)

Although the 216-N-8 Pond was not directly used as a waste disposal unit, vegetation and sediment samples show relatively high concentrations of radionuclides. The actual source of the contamination is unknown.

2.3.5.8 2101-M Pond. Located in the 200-SS-1 Operable Unit near the 200-E Steam Plant, the 2101-M Pond became operational in 1953 and receives small volumes of steam condensate and overflow drain wastewater from the 2101-M Building heating and air conditioning system. In addition, the pond has received barium chloride laboratory waste solutions estimated at less than 2,000 L/yr (500 gal/yr), and 1 to 10 kg/yr (2 to 22 lb) of nitric and hydrochloric acid. The pond is a RCRA waste management unit and an application for closure has been submitted. The closure plan has been prepared, sampling has been completed, and closure is awaiting regulatory approval. The pond is encompassed by a light-weight chain barricade with "RCRA WASTE SITE DO NOT DISTURB," and "DRY ROT" warning signs. The pond is covered with heavy vegetation and a few small trees. Two berms of soil, trending east-west, lie on either side of the pond.

2.3.5.9 216-B-2-1 Ditch/UPR-200-E-32. The 216-B-2-1 Ditch is the northernmost of the three ditches (216-B-2-1, 216-B-2-2, and 216-B-2-3). It was an open ditch 4.6 m (15 ft) wide at ground level, 1.8 m (6 ft) deep, and approximately 1,067 m (3,500 ft) long. Operational from April 1945 to November 1963, the ditch conveyed steam condensate, process cooling water, and chemical sewer from the 221-B Building and water from the 284-E Powerhouse to the 216-B-3 Pond via the 216-B-3-1 Ditch (Maxfield 1979). From March 1952 until its closing, it also conveyed 241-CR Vault cooling water (DOE/RL 1991a).

The 216-B-2-1 Ditch was closed after the unplanned release UPR-200-E-32 occurred. In November 1963, a coil leak developed in the 221-B Building 6-1 Tank, which stored the cesium-rare earth fraction of the fission product stream. The leak caused gross contamination of the 207-B Water Retention Basin and the head end of this ditch. After damming the 216-B-2-1 Ditch 300 m (1,000 ft) from its head, the contaminated basin water was flushed into the ditch. The total volume of liquid to be discharged to the ditch during this incident was estimated to be 4,900,000 L (1,300,000 gal) 4,200,000 L (1,100,000 gal) of which were low activity level cooling water. A sample was taken and analyzed to estimate the amount of activity released. The ^{141}Cs content was determined insignificant. Only ^{144}Cs (30 Ci) and ^{90}Sr (0.05 Ci) were considered pertinent (Maxfield 1979). Another source estimated that less than half a liter of highly contaminated waste from the 221-B Building 6-1 tank contents was discharged to the retention basin (Maxfield 1979).

2.3.5.10 216-B-2-2 Ditch/UPR-200-E-138. The 216-B-2-2 Ditch was built to replace the 216-B-2-1 Ditch, and was active from November 1963 to May 1970. It was an open ditch approximately 4.6 m (15 ft) wide at ground level, 1.8 to 2.4 m (6 to 8 ft) deep at the upper end, and 1,067 m (3,500 ft) long. Until January 1965, it transported and percolated the 284-E Powerhouse waste, 241-CR Vault cooling water, 221-B Building cooling water and steam condensate, and chemical sewer to the 216-B-3 Pond. From January 1965 until November 1967, it also carried the 241-BY ITS Unit cooling water. Until February 1968, it transported 241-CR Vault cooling water and the 221-B Building cooling water without the 284-E Powerhouse waste and the steam condensate. Until April 1970, the site received cleanup waste from 207-B Retention Basin.

Unplanned release UPR-200-E-138 occurred on March 22, 1970. An estimated 1,000 Ci ^{90}Sr release occurred while attempting to measure the liquid level of product storage tank 8-1. The waste was sprayed with several small water hoses down the 221-B Building floor drain and chemical sewer, that led to the 216-B-2-2 Ditch and the 216-B-3 Pond (Maxfield 1979). The 207-B Retention Basin was bypassed and was not contaminated as a result of this unplanned release. On March 23, 1970, earthen dams were built to keep as much contamination out of the 216-B-3 Pond as possible. Radiation levels of 500 R/h 7.6 cm (3 in.) from the pipe gallery existed. Water samples from the 216-B-3 Pond reached a maximum ^{90}Sr concentration of $1.7 \times 10^{+6}$ pCi/L (1.7×10^{-3} $\mu\text{Ci/ml}$) (Maxfield 1979).

After this release, the piping from the 221-B Building was flushed to the 216-B-2-2 Ditch. It was then backfilled and a new ditch, the 216-B-2-3 Ditch, was excavated parallel and south of the entire length of the old ditch. Cooling water was then routed through the new ditch.

2.3.5.11 216-B-2-3 Ditch. The 216-B-2-3 Ditch replaced the 216-B-2-2 Ditch after the ^{90}Sr leak in 1970 (Maxfield 1979). It was an open ditch approximately 6 m (20 ft) wide at ground level, 1.8 to 2.4 m (6 to 8 ft) deep and the upper end, and 1,219 m (4,000 ft) long. Until 1973, it carried and percolated 241-CR Vault cooling water, 221-B Building cooling water, and condenser cooling water from the 241-BY Tank Farm ITS-1 and ITS-2 units. After 1973, the ditch no longer carried the condenser cooling water from the 241-BY Tank Farm ITS-1 and ITS-2 units. It was backfilled and replaced with a parallel polyethylene pipeline west of the 218-E-12A Burial Ground in 1987 (WHC 1991a). A corrugated metal pipeline located at the east end of the 216-B-2 Ditches has been in place since 1945 to carry the waste stream from the 216-B-2 Ditches to the 216-B-3 Ditches. This underground pipeline is approximately 550 m (1,800 ft) long. The area is posted as an underground radioactive material zone.

2.3.5.12 216-B-3-1 Ditch/UPR-200-E-34. The 216-B-3-1 Ditch was in service from April 1945 to July 1964 (Stenner et al. 1988). It was 975 m (3,200 ft) long, 1.8 m (6 ft) wide, and approximately 1.8 m (6 ft) deep. It carried mixed waste (Maxfield 1979) from the 216-B-2-1 Ditch to the 216-B-3 Pond, although much of the waste infiltrated through the ditch bottom (Stenner et al. 1988). The head of the ditch is about 1,980 m (6,500 ft) northeast of the 221-B Building.

Waste streams include 221-B Building steam condensate, process cooling water and chemical sewer waste; 284-E Powerhouse water; 241-CR Vault cooling water; 242-A Evaporator cooling water; 202-A Building process waste; condenser condensate; air sampling vacuum pump seal cooling water, and chemical sewer and acid fractionator condensate; and 241-BY Tank Farm condenser cooling water (Stenner et al. 1988).

Unplanned Release UPR-200-E-34 affected this ditch. It occurred in June 1964 when a coil leak from the F-15 PUREX Tank released an estimated 10,000 Ci of short- and long-lived fission products (Meinhardt and Frostenson 1979). An estimated 2500 Ci of the contamination went through the 216-B-3-1 Ditch to the 216-B-3 Pond. (The other 7500 Ci went to the Gable Mountain Pond.) Remedial action was taken to kill the algae and precipitate the fission products. The 216-B-3-1 Ditch was backfilled and replaced by the 216-B-3-2 Ditch.

In 1971, 10-mil plastic sheets were placed over a new 10-cm (4-in.) layer of sand. The sheets were overlapped 1 m (2 ft) to provide an effective root barrier. The sheeting was then covered with 46 cm (18 in.) of sand and topped with 10 cm (4 in.) of gravel to prevent erosion by the wind. The entire ditch was treated in this fashion, except for the 30 m (100 ft) nearest the head of the ditch located at the western boundary of operable unit 200-BP-11. At the eastern end of the ditch, the treated area is about 30 m (100 ft) wide. This is where the 216-A-29 Ditch had intersected this ditch. This area experienced swampy conditions when both ditches were operational. The plastic barrier has been effective in limiting radioactive contaminated weed growth (Maxfield 1979). The stabilization work also covered the 216-B-3-2 Ditch location.

2.3.5.13 216-B-3-2 Ditch. The 216-B-3-2 Ditch is located south of, and replaced, the 216-B-3-1 Ditch. It is 1,128 m (3,700 ft) long, 4.6 m (15 ft) wide at ground level, and 1.2 to 2.4 m (4 to 8 ft) deep. Operational use of this ditch began in July 1964 and was terminated in September 1970 after it became contaminated with ⁹⁰Sr (UPR-200-E-138) in March 1970 (Maxfield 1979). Maximum dose rates at the head of the ditch, following the unplanned release measured 450 mR/h. The ditch was backfilled following the unplanned release (WHC 1991a).

The ditch carried the following waste to the 216-B-3 Pond system: 221-B Building steam condensate and process cooling water; 284-E Powerhouse water; 241-CR Vault cooling water; 242-A Evaporator cooling water; 202-A Building process waste; condenser water; air sampling vacuum pumps seal cooling water; chemical sewer waste; acid fractionator condensate; 241-BY Tank Farm condenser cooling water; and WESF cooling water (Stenner et al. 1988).

2.3.5.14 216-B-3-3 Ditch/UPR-200-E-51. The 216-B-3-3 Ditch began service in September 1970 and is currently active. The wastes carried by the ditch are provided in Figure 2-18. It trends south of, and sub-parallel to the ditches that it replaced. The ditch is 1,128 m (3,700 ft) long, 6 m (20 ft) wide at ground level, and 1.8 m (6 ft) deep. One unplanned release (UPR-200-E-51) is associated with this ditch. It occurred in May 1977

when 15 kg of cadmium nitrate was released from tank TK-324 in the 202-A Building in the PUREX Plant Aggregate Area. The contamination passed through the 216-B-3-3 Ditch and a portion of it reached the 216-B-3 Pond. Currently, the ditch is on an annual survey schedule.

2.3.5.15 216-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. The 216-B-20 through 216-B-34 Trenches, as well as the 216-B-52, -53A, -53B, -54, and -58 Trenches are located in the BC Controlled Area, south of the southern entrance to the 200 East Area.

The 216-B-20 through 216-B-22 Trenches are parallel and trend northeast. The 216-B-20 Trench is 150 m (500 ft) long, 3 m (10 ft) wide, has a design depth of 4 m (12 ft), and was divided into 19 m (62.5 ft) sections by 1.2 m (4 ft) high earth dams. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

During August 1956, the 216-B-20 Trench received 4,680,000 L (1,240,000 gal) of scavenged tributyl phosphate waste, which is high salt and neutral/basic. The liquids disposed to this trench contained ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 4.4 Ci of ^{60}Co , 1,500 Ci of ^{137}Cs , 790 Ci of ^{90}Sr , 10,000 Ci of ^{106}Ru , 1.3 g of plutonium and 350 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden frame supporting several layers of sisalkraft paper approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting each trench to the permanent underground line (see Figure 2-9). After the piping was removed, it was disposed in a shallow, 1 to 1.2 m (3 to 4 ft), trench located between cribs 216-B-29 and 216-B-53A. The deactivated trench was then backfilled with excavated material which was stored adjacent to it. In 1969, the trenches were covered with 15 cm (6 in.) of gravel (DOE/RL 1991a).

2.3.5.16 216-B-21 Trench. The 216-B-21 Trench is located on the west side of the 216-B-20 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, has a design depth of 4 m (12 ft), and was divided into 19 m (62.5 ft) sections by 1.2 m (4 ft) high earth dams. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between September and October 1956, the 216-B-21 Trench received 4,670,000 L (1,230,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained in the waste

9 3 1 2 8 9 6 7 9 4

stream at the time of discharge included 6.5 Ci of ^{60}Co , 370 Ci of ^{137}Cs , 740 Ci of ^{90}Sr , 15,000 Ci of ^{106}Ru , 10 g of plutonium, and 680 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.17 216-B-22 Trench. The 216-B-22 Trench is located on the west side of the 216-B-21 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, has a design depth of 4 m (12 ft), and was divided into 19 m (62.5 ft) sections by 1.2 m (4 ft) high earth dams. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

During October 1956, the 216-B-22 Trench received 4,740,000 L (1,250,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 13 Ci of ^{60}Co , 45 Ci of ^{137}Cs , 410 Ci of ^{90}Sr , 30,000 Ci of ^{106}Ru , 2.6 g of plutonium, and 420 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.18 216-B-23 Trench. The 216-B-23 through 216-B-28 Trenches are in a east-west trending group south of the 216-B-20 through 216-B-22 group. The 216-B-23 Trench is 150 m (500 ft) long, 3 m (10 ft) wide, approximately 3 m (10 ft) deep, and divided into 19 m (62.5 ft) long sections by 1.2 m (4 ft) high earth dams (DOE/RL 1991a). Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit. The side slopes are 1.5:1.

During October 1956, the 216-B-23 Trench received 4,520,000 L (1,190,000 gal) of scavenged tributyl phosphate waste. Radionuclides contained in the waste stream at the time of discharge included 6.7 Ci of ^{60}Co , 110 Ci of ^{137}Cs , 150 Ci of ^{90}Sr , 15,000 Ci of ^{106}Ru , 1.8 g of plutonium, and 160 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting each trench to the permanent underground line (see Figure 2-9). After the piping was removed, it was disposed in a shallow, 1 to 1.2 m (3 to 4 ft), trench located between cribs 216-B-29 and 216-B-53A. The deactivated trench was then backfilled with excavated material which was stored adjacent to it. In 1969, the trenches were covered with 15 cm (6 in.) of gravel (DOE/RL 1991a).

9 3 1 2 9 9 5 7 9 5

2.3.5.19 216-B-24 Trench. The 216-B-24 Trench is immediately south of the 216-B-23 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, approximately 3 m (10 ft) deep (Maxfield 1979), and divided into 19 m (62.5 ft) long sections by 1.2 m (4 ft) high earth dams (DOE/RL 1991a). The side slopes are 1.5:1. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between October and November 1956, the 216-B-24 Trench received 4,700,000 L (1,200,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 10 Ci of ^{60}Co , 130 Ci of ^{137}Cs , 180 Ci of ^{90}Sr , 23,000 Ci of ^{106}Ru , 7.7 g of plutonium, and 250 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The collapse potential appears to be small because the weakness of the cover design probably caused most of it to collapse during backfilling.

2.3.5.20 216-B-25 Trench. The 216-B-25 Trench is immediately south of the 216-B-24 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, approximately 3 m (10 ft) deep, and divided into 19 m (62.5 ft) long sections by 1.2 m (4 ft) high earth dams (DOE/RL 1991a). The side slopes are 1.5:1. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between November and December 1956, the 216-B-25 Trench it received 3,760,000 L (990,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 6.9 Ci of ^{60}Co , 56 Ci of ^{137}Cs , 210 Ci of ^{90}Sr , 16,000 Ci of ^{106}Ru , 2 g of plutonium, and 150 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.21 216-B-26 Trench. The 216-B-26 Trench is immediately south of the 216-B-25 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, approximately 3 m (10 ft) deep, and divided into 19 m (62.5 ft) long sections by 1.2 m (4 ft) high earth dams (DOE/RL 1991a). The side slopes are 1.5:1. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between December 1956 and February 1957, the 216-B-26 Trench received 5,880,000 L (1,550,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 11 Ci of ^{60}Co , 950 Ci of ^{137}Cs , 1,100 Ci of ^{90}Sr , 24,000 Ci of ^{106}Ru , 2.5 g of plutonium, and 590 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom.

A survey identified collapse potential for this trench (Ortiz 1974). The collapse potential appears to be small because the weakness of the cover design probably caused most of it to collapse during backfilling.

2.3.5.22 216-B-27 Trench. The 216-B-27 Trench is immediately south of the 216-B-26 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, approximately 3 m (10 ft) deep, and divided into 19 m (62.5 ft) long sections by 1.2 m (4 ft) high earth dams (DOE/RL 1991a). The side slopes are 1.5:1. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between February and April 1957, the 216-B-27 Trench received 4,420,000 L (1,170,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 7.6 Ci of ^{60}Co , 34 Ci of ^{137}Cs , 600 Ci of ^{90}Sr , 17,000 Ci of ^{106}Ru , 0.7 g of plutonium, and 340 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.23 216-B-28 Trench/UN-200-E-83. The 216-B-28 Trench is immediately south of the 216-B-27 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, approximately 3 m (10 ft) deep, and divided into 19 m (62.5 ft) long sections by 1.2 m (4 ft) high earth dams (DOE/RL 1991a). The side slopes are 1.5:1. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between April and June 1957, the 216-B-28 Trench received 5,050,000 L (1,330,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 2.3 Ci of ^{60}Co , 23 Ci of ^{137}Cs , 110 Ci of ^{90}Sr , 5,200 Ci of ^{106}Ru , 5.6 g of plutonium, and 300 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The collapse potential appears to be small because the weakness of the cover design probably caused most of it to collapse during backfilling.

In May 1958, radioactive rabbit and coyote feces were found scattered over the ground surface of the desert as far as 2.5 miles south, east, and west of the BC Cribs and Trenches. It is supposed that a badger or some other animal burrowed into the 216-B-28 Trench and exposed a radioactive salt layer. Rabbits and coyotes ingested the contaminated salts and defecated over an approximately 4 square mile area of undisturbed land covered by sagebrush and cheat grass. Surface contamination is spread throughout. This contaminated area, known as the BC Controlled Area, was given the unplanned release number UN-200-E-83.

2.3.5.24 216-B-29 Trench. The 216-B-29 through 216-B-34 Trenches were constructed in an east-west trending group northwest of the 216-B-23 through 216-B-28 group. The 216-B-29 Trench is 150 m (500 ft) long, 3 m (10 ft) wide, 3 m (10 ft) deep, and divided into two sections by a 1.5 m (5 ft) high and 1.5 m (5 ft) wide earthen dam at the center. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit. These trenches also have wooden covers, and are considered a collapse hazard (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

The 216-B-29 Trench, the northernmost of the group, received 4,840,000 L (1,280,000 gal) of waste containing ferrocyanide, nitrate, phosphate, sodium, and sulfate based compounds during June and July 1957. Radionuclides contained in the waste stream at the time of discharge included 7.1 Ci of ^{60}Co , 59 Ci of ^{137}Cs , 190 Ci of ^{90}Sr , 16,000 Ci of ^{106}Ru , 1.1 g of plutonium, and 340 kg of uranium (Maxfield 1979).

2.3.5.25 216-B-30 Trench. The 216-B-30 Trench is south of the 216-B-29 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, 3 m (10 ft) deep, and divided into two sections by a 1.5 m (5 ft) high and 1.5 m (5 ft) wide earthen dam at the center. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

During July 1957, the 216-B-30 Trench received 4,780,000 L (1,260,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 1.7 Ci of ^{60}Co , 3,400 Ci of ^{137}Cs , 600 Ci of ^{90}Sr , 3,900 Ci of ^{106}Ru , 2.1 g of plutonium, and 88 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.26 216-B-31 Trench. The 216-B-31 Trench is south of the 216-B-30 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, 3 m (10 ft) deep, and divided into two sections by a 1.5 m (5 ft) high and 1.5 m (5 ft) wide earthen dam at the center. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between July and August 1957, the 216-B-31 Trench received 4,740,000 L (1,250,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 2.7 Ci of ^{60}Co , 28 Ci of ^{137}Cs , 210 Ci of ^{90}Sr , 6,100 Ci of ^{106}Ru , 5.2 g of plutonium, and 120 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.27 216-B-32 Trench. The 216-B-32 Trench is south of the 216-B-31 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, 5 m (10 ft) deep, and divided into two sections by a 1.5 m (5 ft) high and 1.5 m (5 ft) wide earthen dam at the center. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between August and September 1957, the 216-B-32 Trench received 4,770,000 L (1,260,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 1.7 Ci of ^{60}Co , 130 Ci of ^{137}Cs , 260 Ci of ^{90}Sr , 3,800 Ci of ^{106}Ru , 2.6 g of plutonium, and 11 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.28 216-B-33 Trench. The 216-B-33 Trench is south of the 216-B-32 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, 3 m (10 ft) deep, and divided into two sections by a 1.5 m (5 ft) high and 1.5 m (5 ft) wide earthen dam at the center. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

Between September and October 1957, the 216-B-33 Trench received 4,740,000 L (1,250,000 gal) of scavenged tributyl phosphate waste, containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides disposed to the trench include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium. Radionuclides contained in the waste stream at the time of discharge included 1.4 Ci of ^{60}Co , 270 Ci of ^{137}Cs , 41 Ci of ^{90}Sr , 3,200 Ci of ^{106}Ru , 12 g of plutonium, and 20 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

2.3.5.29 216-B-34 Trench. The 216-B-34 Trench is south of the 216-B-33 Trench. It is 150 m (500 ft) long, 3 m (10 ft) wide, 3 m (10 ft) deep, and divided into two sections by a 1.5 m (5 ft) high and 1.5 m (5 ft) wide earthen dam at the center. Eight sections of dispersion pipe were placed along the side slope to the bottom of the unit.

During October 1957, the 216-B-34 Trench received 4,870,000 L (1,290,000 gal) of scavenged tributyl phosphate waste containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 0.6 Ci of ^{60}Co , 17 Ci of ^{137}Cs , 41 Ci of ^{90}Sr , 1,400 Ci of ^{106}Ru , 5.7 g of plutonium, and 85 kg of uranium (Maxfield 1979). This trench was constructed with a weak wooden cover approximately 0.6 m (2 ft) above the trench bottom. A survey identified collapse potential for this trench (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

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2.3.5.30 216-B-35 Trench. The 216-B-35 through 216-B-42 Trenches are inactive waste management units located about 60 m (200 ft) due west of the 241-BX Tank Farm. They are 77 m (252 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979). These trenches received first-cycle high salt, neutral/basic supernatant waste from the 221-B Building (Maxfield 1979).

The 216-B-35 Trench is the southernmost of the group. Between February and March 1954, it received 1,060,000 L (280,000 gal) of first-cycle supernatant waste containing fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 430 Ci of ^{137}Cs , 240 Ci of ^{90}Sr , 230 Ci of ^{106}Ru , 1.2 g of plutonium, and 17 kg of uranium (Maxfield 1979).

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting it to the permanent underground line (see Figure 2-9). The deactivated trench was then backfilled to grade. Stabilization of the trench site was completed on October 19, 1982, and consisted of the addition of 1 m (2 ft) of topsoil treated with 2,4-d amine and seeded with thickspike, crested, and Siberian wheatgrasses (WHC 1991a).

2.3.5.31 216-B-36 Trench. The 216-B-36 Trench is north of the 216-B-35 Trench. It is 77 m (252 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979). The unit was deactivated by removing the aboveground piping when specific retention was reached (Maxfield 1979).

The trench, active from March to April 1954, received 1,940,000 L (510,000 gal) of high salt, neutral/basic first-cycle supernatant waste from the 221-B (Maxfield 1979). Compounds in the liquid disposed to this site fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 770 Ci of ^{137}Cs , 490 Ci of ^{90}Sr , 470 Ci of ^{106}Ru , 0.8 g of plutonium, and 16 kg of uranium (Maxfield 1979).

2.3.5.32 216-B-37 Trench. The 216-B-37 Trench is north of the 216-B-36 Trench. It received first-cycle bottoms from the 242-B Waste Evaporator (Maxfield 1979). The unit was deactivated by removing the aboveground piping when specific retention was reached (Maxfield 1979).

The trench, active during August 1954, received 4,320,000 L (1,140,000 gal) of first-cycle bottoms waste from the 242-B Waste Evaporator (Maxfield 1979). The waste is high salt and neutral/basic. Compounds in the liquid disposed to this site include fluoride, nitrate, nitrite, phosphate, sodium, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 1 Ci of ^{60}Co , 3,100 Ci of ^{137}Cs , 16 Ci of ^{90}Sr , 500 Ci of ^{106}Ru , 2 g of plutonium, and 3.6 kg of uranium (Maxfield 1979).

2.3.5.33 216-B-38 Trench. The 216-B-38 Trench is north of the 216-B-37 Trench. It is 77 m (252 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979). The unit was deactivated by removing the aboveground piping when specific retention was reached (Maxfield 1979).

The trench, active during July 1954, received 1,430,000 L (380,000 gal) of high salt, neutral/basic first-cycle supernatant waste from the 221-B Building (Maxfield 1979). Compounds in the liquid disposed to this site fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 510 Ci of ^{137}Cs , 1,900 Ci of ^{90}Sr , 560 Ci of ^{106}Ru , 1.2 g of plutonium, and 42 kg of uranium (Maxfield 1979).

2.3.5.34 216-B-39 Trench. The 216-B-39 Trench is north of the 216-B-38 Trench. It is 77 m (252 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979). The unit was deactivated by removing the aboveground piping when specific retention was reached (Maxfield 1979).

The trench, active from December 1953 to November 1954, received 1,470,000 L (390,000 gal) of high salt, neutral/basic first-cycle supernatant waste from the 221-B Building (Maxfield 1979). Compounds in the liquid disposed to this site fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 450 Ci of ^{137}Cs , 23 Ci of ^{90}Sr , 65 Ci of ^{106}Ru , 1.5 g of plutonium, and 5.8 kg of uranium (Maxfield 1979).

2.3.5.35 216-B-40 Trench. The 216-B-40 Trench is north of the 216-B-39 Trench. It is 77 m (252 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979). The unit was deactivated by removing the aboveground piping when specific retention was reached (Maxfield 1979).

The trench, active from April to July 1954, received 1,640,000 L (430,000 gal) of high salt, neutral/basic first-cycle supernatant waste from the 221-B Building (Maxfield 1979). Compounds in the liquid disposed to this site include fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 350 Ci of ^{137}Cs , 280 Ci of ^{90}Sr , 240 Ci of ^{106}Ru , 1 g of plutonium, and 35 kg of uranium (Maxfield 1979).

2.3.5.36 216-B-41 Trench. The 216-B-41 Trench is north of the 216-B-39 Trench. It is 77 m (252 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep (Maxfield 1979). The unit was deactivated by removing the aboveground piping when specific retention was reached (Maxfield 1979).

The trench, active during November 1954, received 1,440,000 L (380,000 gal) of high salt, neutral/basic first-cycle supernatant waste from the 221-B Building (Maxfield 1979).

Compounds in the liquid disposed to this site include fluoride, nitrate, nitrite, phosphate, sodium aluminate, sodium hydroxide, sodium silicate, and sulfate based compounds. Radionuclides contained in the waste stream at the time of discharge included 890 Ci of ^{137}Cs , 47 Ci of ^{90}Sr , 130 Ci of ^{106}Ru , 0.3 g of plutonium, and 7.5 kg of uranium (Maxfield 1979).

2.3.5.37 216-B-42 Trench. The 216-B-42 Trench is west of the 216-B-35 Trench. The 216-B-42 Trench is 76 m (252 feet) long, 3 m (10 feet) wide, and 3 m (10 feet) deep. The sides of the excavation have a slope of 1.5:1.

The trench, active from January to February 1955, received 1,500,000 L (396,200 gal) of scavenged tributyl phosphate supernatant waste from the 221-U Building. The waste contains a high salt content and is neutral to basic in pH. Compounds contained in the waste include ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 10 Ci of ^{60}Co , 96 Ci of ^{137}Cs , 1,100 Ci of ^{90}Sr , 1,500 Ci of ^{106}Ru , 10 g of plutonium, and 680 kg of uranium (Maxfield 1979).

2.3.5.38 216-B-52 Trench. The 216-B-52 Trench is parallel to and immediately north of the 216-B-23 through -28 group of trenches in the BC Controlled area. It is 180 m (580 ft) long, 3 m (10 ft) wide, 2.4 m (8 ft) deep, and divided in half by earthen dams and has a wood cover. The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

The trench, active from December 1957 to January 1958, received 8,530,000 L (2,250,000 gal) of scavenged tributyl phosphate waste from the tributyl phosphate recovery process in the 221-U Building (Maxfield 1979), containing ferrocyanide, nitrate, phosphate, sodium, and sulfate. Radionuclides contained in the waste stream at the time of discharge included 4.5 Ci of ^{60}Co , 340 Ci of ^{137}Cs , 11 Ci of ^{90}Sr , 8,600 Ci of ^{106}Ru , 19 g of plutonium, and 30 kg of uranium (Maxfield 1979).

2.3.5.39 216-B-53A Trench. The 216-B-53A, -53B, -54, and -58 Trenches were operated in the mid 1960's. They are located in the BC Controlled Area. The 216-B-53A Trench is 18 m (60 ft) long, 3 m (10 ft) wide, and 3 m (10 ft) deep. It is divided in half by an earthen dam across the center of the trench. A "sisalkraft" cover (a wooden frame consisting of 1 x 2's and 2 x 4's covered with sisalkraft tar paper) was placed over each trench while in operation. The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

The 216-B-53A Trench received 549,000 L (145,000 gal) of liquid waste from the Plutonium Recycle Test Reactor in the 300 Area between October and November 1965. The Hazardous Chemical Inventory in the WIDS database only indicates 1 kg (2 lb) of nitrates

were contained in the waste streams disposed to this trench. Radionuclides contained in the waste stream at the time of discharge included 5 Ci of ^{106}Ru , 100 g of plutonium, and 23 kg of uranium (Maxfield 1979).

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting it to the permanent underground line (see Figure 2-9). The deactivated trench was then backfilled to grade and stabilized by adding 0.6 m (2 ft) of topsoil which was seeded with thickspike, Siberian, and crested wheatgrass.

2.3.5.40 216-B-53B Trench. The 216-B-53B Trench is located in the BC Controlled area, south of the 216-B-53A Trench. It trends northeast, and is very close to the southeast corner of the 216-B-53A Trench. The 216-B-53B Trench is 45 m (150 ft) long, 2.4 m (8 ft) wide, and 3 m (10 ft) deep. It is divided in half by an earthen dam across the center of the trench. A "sisalkraft" cover (a wooden frame consisting of 1 x 2's and 2 x 4's covered with sisalkraft roofing paper) was placed over each trench while in operation. The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

The 216-B-53B Trench received 15,100 L (3,990 gal) of liquid waste from the Plutonium Recycle Test Reactor in the 300 Area between September 1962 and March 1963. The Hazardous Chemical Inventory in the WIDS database does not show a list of inorganics, but it is presumed that the waste stream was similar to that which entered 216-B-53A. Radionuclides contained in the waste stream at the time of discharge included 1 Ci of ^{60}Co , 7 Ci of ^{137}Cs , 10 Ci of ^{90}Sr , 4 Ci of ^{106}Ru , 5 g of plutonium, and 9.1 kg of uranium (Maxfield 1979).

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting it to the permanent underground line (see Figure 2-9). The deactivated trench was then backfilled to grade and stabilized by adding 0.6 m (2 ft) of topsoil which was seeded with thickspike, Siberian, and crested wheatgrass.

2.3.5.41 216-B-54 Trench. The 216-B-54 Trench is located in the BC Controlled area, south of the 216-B-53A and -53B Trenches. It trends east-west. The 216-B-54 Trench is 60 m (200 ft) long, 3 m (10 ft) wide, and 2.4 m (8 ft) deep (Maxfield 1979). It is divided in half by an earthen dam across the center of the trench. A "sisalkraft" cover (a wooden frame consisting of 1 x 2's and 2 x 4's covered with sisalkraft roofing paper) was placed over each trench while in operation. The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

The 216-B-54 Trench received 999,000 L (264,000 gal) of liquid waste from the Plutonium Recycle Test Reactor in the 300 Area between March 1963 and October 1965. The Hazardous Chemical Inventory in the WIDS database indicates that only 100 kg (220 lb)

of nitrates were contained in the waste stream disposed to this trench. Radionuclides contained in the waste stream at the time of discharge included 10 Ci of ^{106}Ru , 5 g of plutonium, and 9.1 kg of uranium (Maxfield 1979).

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting it to the permanent underground line (see Figure 2-9). The deactivated trench was then backfilled to grade and stabilized by adding 0.6 m (2 ft) of topsoil which was seeded with thickspike, Siberian, and crested wheatgrass.

2.3.5.42 216-B-58 Trench. The 216-B-58 Trench is located in the BC Controlled area, south of the 216-B-54 and -53B Trenches. It trends east-west. The 216-B-58 Trench is 60 m (200 ft) long, 3 m (10 ft) wide, and 2.4 m (8 ft) deep (Maxfield 1979). Earthen dams divide the 216-B-58 Trench into 8-m (25-ft) sections, each of which was covered by a "sisalkraft" cover (a wooden frame consisting of 1 x 2's and 2 x 4's covered with sisalkraft roofing paper) while in operation. A corrugated 122 cm (48 in.) STL pipe is placed along the bottom. The trench also contains a wooden cover that creates a collapse potential (Ortiz 1974). The low height of the structure, the small size of the wood used, and the age, combined with its probable collapse during backfilling, suggests that the current collapse potential is minimal.

The 216-B-58 Trench received 999,000 L (264,000 gal) of liquid waste from the Plutonium Recycle Test Reactor in the 300 Area between March 1963 and October 1965. The Hazardous Chemical Inventory in the WIDS database indicates that only 100 kg (220 lb) of nitrates were contained in the waste stream disposed to this trench. Radionuclides contained in the waste stream at the time of discharge included 2.4 Ci of ^{60}Co , 7.7 Ci of ^{137}Cs , 10 Ci of ^{90}Sr , 7 Ci of ^{106}Ru , 6.7 g of plutonium, and 9.1 kg of uranium (Maxfield 1979).

When the specific retention capacity of the trench was reached, it was deactivated by disconnecting the short section of above ground piping connecting it to the permanent underground line (see Figure 2-9). The deactivated trench was then backfilled to grade and stabilized by adding 0.6 m (2 ft) of topsoil which was seeded with thickspike, Siberian, and crested wheatgrass.

2.3.5.43 216-B-63 Trench/Ditch. The 216-B-63 Trench, a RCRA facility, is located northeast of the 221-B Building and originates approximately 366 m (1,200 ft) east of Baltimore Avenue. It is an open, unlined earthen trench, approximately 1.2 m (4 ft) wide at the bottom, 427 m (1,400 ft) long, and 3 m (10 ft) deep. The trench, closed at one end, did not convey effluent to other facilities. The side slope is 1.5:1. There is a 5.1 cm (2 in.) rockfill for the first 3.1 m (10 ft) of the trench and there is a 40.6 cm (16 in.) CSTL SCH 10 inlet pipe about 1.5 m (5 ft) long that enters the trench 1 m (3 ft) below grade.

The 216-B-63 Trench received effluents from floor drains and chemical sewers in the 221-B, 225-B, and 271-B Buildings via the 207-B Retention Basin (WHC 1991a). It was also to be used as an emergency discharge point for B Plant cooling water, but has never received that stream. Average discharge into the 216-B-63 Trench ranged from 378 to 1,408,000 L/day (100,000 to 400,000 gal/day) during normal operations. Routine discharge to the trench was discontinued in February 1992.

The only documented hazardous effluent discharged to the trench consisted of demineralizer recharge effluent and compressor cooling water from the 221-B Building. From 1970 to 1985, the demineralizer recharge effluent contained aqueous H_2SO_4 and NaOH solutions; after 1985, the cation column effluent was treated with sodium carbonate and the anion column effluent was treated with monosodium phosphate to maintain a combined pH between 4 and 10. As of 1987, the waste discharged to 216-B-63 was no longer considered to be "Dangerous Waste" under WAC 173-303. According to a study done by Meinhardt and Frostensen (1979), radiological discharges to the trench were relatively low with a total beta discharge of 8.7 Ci, and approximately 7.6 kg (16.7 lb) of uranium.

In August 1970, the 216-B-63 Trench was dredged (after UPR-200-E-138). The dredgings, reading approximately 3,000 ct/min of beta/gamma activity, were buried in the 218-E-12B Burial Ground.

2.3.6 Septic Tanks and Associated Drain Fields

Septic tanks and associated drain fields are designed to accept sanitary sewer effluent from the buildings in the B Plant Aggregate Area. The locations of the septic tanks and drain fields are shown on Figure 2-8.

2.3.6.1 2607-EB Septic Tank and Tile Field. The 2607-EB Septic Tank and Tile Field was activated in 1951 and is currently generating about 0.02 m^3 of sanitary wastewater and sewage per day. The waste management unit is listed as nonhazardous and nonradioactive. Adjacent to the septic tank is a drain field composed of vitrified clay pipe, concrete pipe, or drain tile forming the main line and laterals from the tank.

2.3.6.2 2607-EH Septic Tank and Drain Field. Data in the WIDS files show the 2607-EH Septic Tank was built in 1983 and remains in use today. The unit includes a drain field receiving about 1.36 m^3 of sanitary wastewater and sewage per day. It is believed to be located on the west side of Baltimore Avenue adjacent to the east side of the 2101-M Building.

2.3.6.3 2607-EK Septic Tank and Drain Field. The 2607-EK Septic Tank and drain field are located about 60 m (200 ft) east of Baltimore Avenue and 200 m (700 ft) south of the 2607-E8 Septic Tank. The tank and drain field were constructed in 1980. The tank receives

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about 24,200 L (6,395 gal) (64% of capacity) of waste per day. The septic tank is believed to have a 57,000 to 72,000 L (15,000 to 19,000 gal) capacity. The drain field is about 2,200 ft² and is operating at about 387% of its design capacity.

2.3.6.4 2607-EM Septic Tank and Drain Field. The 2607-EM Septic Tank and drain field are located southeast of the Akron Avenue and 4th Street intersection. The system was built in 1984 and receives waste from the 2721-E Building. The septic tank receives approximately 6,380 L (1,685 gal) of waste per day which is estimated to be 50% of the design capacity. The tank has a maximum capacity of 20,000 L (5,000 gal). The associated drain field is 1,320 ft² and is operating at about 170% of its design capacity.

2.3.6.5 2607-EN Septic Tank and Drain Field. The 2607-EN Septic Tank is not identified in the Tri-Party Agreement. It was put into service sometime prior to 1980. The tank is situated about 30 m (100 ft) south of the 2727-E Building. The 2607-EN Septic Tank has a 9,500 L (2,500 gal) capacity and receives an estimated 2,060 L/day (545 gal/day). The waste drains to a 360 ft² drain field. The tank, at this input level, is at 32% capacity, while the drain field is running at 200% of capacity.

2.3.6.6 2607-EO Septic Tank and Drain Field. The 2607-EO Septic Tank is located about 46 m (150 ft) west of the 2711-E Building. This tank is not included in the Tri-Party Agreement. The tank holds 9,500 L (2,500 gal) and has 2,120 L (560 gal) of daily input. It discharges to a 780 ft² drain field. The tank is operating at 33% of capacity and the drain field is running at 95% capacity.

2.3.6.7 2607-EP Septic Tank and Drain Field. The 2607-EP Septic Tank and Drain Field were constructed in 1984. The septic tank is adjacent to the northeast corner of building 2721-EA. The tank receives about 1,875 L (495 gal) of waste per day, approximately 49% of its designed capacity. The drain field is operating at about 131% of its capacity.

2.3.6.8 2607-EQ Septic Tank and Drain Field. The 2607-EQ Septic Tank is located approximately 46 m (150 ft) southeast of the Ames Avenue and 2nd Street intersection. This system was built in 1985 and consists of a 40,000 L (10,000 gal) septic tank and a 4,644 ft² drain field. Approximately 10,500 L (2,770 gal) of waste are discharged to the tank per day, about 41% of its design capacity. The drain field is operating at an estimated 79% capacity.

2.3.6.9 2607-ER Septic Tank. Data contained in the WIDS database lists the 2607-ER Septic Tank's location as 150 m (500 ft) southeast of the Akron Avenue and 4th Street intersection between the 2607-EP and 2607-EM Septic Tanks. The septic tank is actually located southwest of the Akron Avenue and the 4th Street intersection where Baltimore Avenue is intersected by railroad tracks. The 2607-ER Septic Tank has an estimated 4,000 L (1,000 gal) capacity. Information pertaining to the system's design capacity and daily waste estimates were not contained in the WIDS files.

2.3.6.10 2607-E1 Septic Tank and Drain Field. The 2607-E1 Septic Tank is currently active. The drain field entered operation in 1970 (WHC 1991a). The 2607-E1 Septic Tank is located about 60 m (200 ft) northeast of the intersection of Baltimore Avenue and 4th Street and the drain field is north of the tank. The tank is constructed of reinforced concrete with 25-cm (10-in.) walls and floor and dimensions of 8 x 3.2 x 4 m (25 x 10.5 x 13 ft) deep. It is designed to serve 400 people with an average retention period of 24 hours (WHC 1991a). Estimated waste inflow is 21,555 L/day (5,695 gal/day) (42% of capacity), but it is expected that the input will increase to 29,837 L/day (7,883 gal/day).

The drain field is constructed of 10-cm (4-in.) diameter vitrified clay pipe, concrete pipe, or drain tile with a minimum of 8 linear feet per capita. The laterals are spaced 2.4 m (8 ft) apart and are open jointed (WHC 1991a). The drain field covers 8,376 ft² and is currently operating at 90% capacity.

2.3.6.11 2607-E2 Septic Tank and Drain Field. The 2607-E2 Septic Tank is not in the Tri-Party Agreement, but is located in the 200-SS-1 Operable Unit. It is about 60 m (200 ft) northeast of the intersection of Baltimore Avenue and 1st Street. It has a volume of 25,000 L (6,620 gal) and has a daily input of 2,380 L (630 gal). There are two drain fields associated with this tank, the original field having an area of 913 m² (9,831 ft²) and a new drain field of 2,300 m² (25,000 ft²). There is no indication in the literature as to whether they are both active or not.

2.3.6.12 2607-E3 Septic Tank and Tile Field. The 2607-E3 Septic Tank is an active waste management unit located about 100 m (400 ft) north of the 221-B Building. The septic tank became operational in 1944 having a 292 person capacity and receiving about 14,400 L (3800 gal) of sanitary wastewater and sewage per day from the B Plant Aggregate Area facilities. The septic tank is 4.15 m (13.6) deep and is constructed of reinforced concrete. The tile field is comprised of 10 cm (4 in.) vitrified clay pipe and drain tile. The laterals are open jointed and are spaced 2.4 m (8 ft) apart. The septic tank and tile field are not known to contain radionuclides or hazardous chemicals and are listed in the nonhazardous/nonradioactive waste category (WHC 1991a). A WIDS General Summary Report indicates that mixed waste may have been introduced to the tile field. Information in the general summary report is sketchy and incomplete. The tile field associated with this septic tank is believed to be the same tile field south of the 218-E-4 Burial Ground.

2.3.6.13 2607-E4 Septic Tank and Tile Field. The 2607-E4 Septic Tank and Tile Field is an active waste management unit located 60 m (200 ft) northeast of the 221-B Building. The unit became operational in 1944 and currently receives about 0.24 m³ of sanitary wastewater and sewage per day. The septic tank and tile field are not known to contain radionuclides or hazardous chemicals and are listed in the nonhazardous/nonradioactive waste category (WHC 1991a). However, the septic tank and tile field are marked with underground radiation warning signs.

2.3.6.14 2607-E7B Septic Tank. The active 2607-E7B Septic Tank has a 900-L (240-gal) capacity and is located immediately northwest of the intersection of Baltimore Avenue and 4th Street (Figure 2-8) (WHC 1991a).

2.3.6.15 2607-E8 Septic Tank and Drain Field. The 2607-E8 Septic Tank was built in 1978 and is presently operational. The tank includes a drain field and is located on the east side of Baltimore Avenue across from the 2101-M Pond, immediately north of the 2607-EK Septic Tank. Waste inflow is approximately 7,400 L/day (1,960 gal/day). The drain field consists of four lateral sets of tiles arranged in a herringbone pattern. The drain field covers 800 m² (9,000 ft²) and is operating at about 29% of capacity.

2.3.6.16 2607-E9 Septic Tank and Drain Field. The 2607-E9 Septic Tank and Drain Field is located adjacent to the 207-B Retention Basin. Liquid wastes received by the unit are nonhazardous and nonradioactive. The 242-B Building is the waste source for the 2607-E9 Septic Tank. The area east of the 242-B Building, where the 2607-E9 Septic Tank and Drain Field are located, is barricaded with a light chain and surface contamination warning signs. Contaminated particulate releases from the 241-B Tank Farm are the most likely source for the surface contamination.

2.3.6.17 2607-E11 Septic Tank and Drain Field. This 2607-E11 Septic Tank is located 30 m (100 ft) southeast of the Dry Materials Receiving and Handling Facility. It is a 8,500 L (2,250 gal) tank that receives about 3,160 L/day (835 gal/day) of sanitary wastewater and sewage. There is a 118 m² (1,275 ft²) drain field included in this site. The volume handled by this system is 55% of the tank's operational capacity and 87% of the drain field's capacity.

2.3.6.18 2607-GF Septic Tank. The 2607-GF Septic Tank is north of the Dry Materials Receiving and Handling Facility and across the railroad tracks that run on the north of that facility. The tank is listed as active (WHC 1991a).

2.3.6.19 Unnumbered Septic Tanks. There are two new septic tanks located in the 200-SS-1 Operable Unit. One is adjacent to the 281-E-3 Burial Ground and one is about 215 m (700 ft) northwest of the intersection of Ames Avenue and 1st Street. Kaiser Engineering Hanford is responsible for their construction and maintenance. No information on their volume or discharge was found in the literature.

2.3.7 Transfer Facilities, Diversion Boxes, and Pipelines

Transfer facilities connect the major processing facilities with each other and with the various waste disposal and storage facilities. Diversion boxes are concrete boxes with transfer lines leading into both sides. Jumpers in the box allow different lines to be connected to change the routing of wastes. Pipelines connect the waste generating facilities with the waste management units. The lines are mainly 7.6 cm (3 in.) diameter stainless

steel pipes with welded joints and may either be enclosed in below grade, steel-reinforced concrete, or encased within a larger diameter steel pipe. Locations of the transfer facilities, diversion boxes, and pipelines are shown on Figure 2-9.

Transfer lines to liquid effluent disposal facilities (e.g., cribs or ponds) were constructed of a variety of materials including vitreous clay and galvanized metal. A leak in a pipeline may be due to the segmented nature of its fabrication. Pipelines such as the Purex Cooling Water Line and the segment connecting the 216-B-2 Ditches to the 216-B-3 Ditches are likely candidates for leaking and would be more likely to warrant test pit examination than would others. For the purposes of the AAMS, these transfer lines are considered part of the waste management unit in to which they discharged and will be investigated as a part of their respective units.

2.3.7.1 241-B-151 Diversion Box/UPR-200-E-4, UPR-200-E-73. The 241-B-151 Diversion Box is an underground structure located approximately 70 m (225 ft) south of the 241-B Tank Farm. It is made of reinforced concrete and is 6 m (20 ft) long, 3 m (9 ft) wide, and 4.6 m (15 ft) high. It interconnects the 241-B-152 and 241-B-153 Diversion Boxes and the 241-B and 241-BX Tank Farms. It transferred waste solutions from processing and decontamination operations to the 241-B and 241-BX Tank Farms.

It was in service from 1945 to 1984, and is now isolated and weather covered. Radionuclide inventories are not available; however, historical records indicate that the concrete structure is potentially contaminated with high levels of alpha, beta, and gamma emitters.

Approximately 10 Ci of fission products were transported to the soil surrounding the 241-B-153 Diversion Box as the result of leakage from the unit in the fall of 1951. Most of the contaminated soil was removed and transported to a burial ground. The remaining contamination was covered with about 0.3 m (1 ft) of clean soil (WHC 1991a). This unplanned release is designated UPR-200-E-4.

Between late 1951 and 1952, leaks and spills from work on the 241-B-151 Diversion Box contaminated soil surrounding the unit with approximately 10 Ci of fission products. Most of the contaminated soil was removed and the remaining contaminated areas are covered with about 0.3 m (1 ft) of clean soil. This unplanned release is documented as UPR-200-E-73.

2.3.7.2 241-B-152 Diversion Box/UPR-200-E-38, UPR-200-E-74. The 241-B-152 Diversion Box is an underground structure located approximately 60 m (200 ft) south of the 241-B Tank Farm and 12 m (40 ft) west of the 241-B-151 Diversion Box. It is made of reinforced concrete and is 8.5 m (28 ft) long, 3 m (9 ft) wide, and 4.6 m (15 ft) high. It interconnects the 241-B-151, 241-BX-153, and 241-B-154 Diversion Boxes and the 241-B Tank Farms. It transferred waste solutions from processing and decontamination operations to the 241-B and 241-BX Tank Farms.

It was in service from 1945 to 1984, and is now isolated and weather covered. Radionuclide inventories are not available; however, historical records indicate that the concrete structure is potentially contaminated with high levels of alpha, beta, and gamma emitters.

Unplanned release UPR-200-E-38 occurred on January 4, 1968 when a waste line leading to the 241-B-152 Diversion Box leaked 221-B Building cell drain waste that caused a small cave-in at the northeast corner of the box. The hole was backfilled, which reduced dose rates from 5 R/h to 20 mrem/h. A small area of the southern portion of the 241-B Tank Farm affected by aerially deposited contaminants was also covered with clean soil (Maxfield 1979).

Unplanned release UPR-200-E-74 occurred in the Spring of 1954 when work on the 241-B-152 Diversion Box contaminated about 5 m² (50 ft²) of surface soil with approximately 1 Ci of mixed fission products. The contamination was removed and buried. Several inches of clean fill were placed on the contaminated area, rope barriers and radiation zone signs were installed (WHC 1991a).

2.3.7.3 241-B-153 Diversion Box/UPR-200-E-75, UPR-200-E-6. The 241-B-151 Diversion Box is an underground structure located approximately 25 m (75 ft) south of the 241-B Tank Farm and is almost directly north of the 241-B-151 Diversion Box. It is made of reinforced concrete and is 10 m (34 ft) long, 3 m (9 ft) wide, and 10 m (34 ft) high. It interconnects the 241-B-151 and 241-B-152 Diversion Boxes and the 241-B Tank Farm. It transferred waste solutions from processing and decontamination operations to the 241-B and 241-BX Tank Farms.

It was in service from 1945 to 1984, and is now isolated and weather covered. Radionuclide inventories are not available; however, records indicate that the concrete structure is potentially contaminated with high levels of alpha, beta, and gamma emitters.

In 1954 an unplanned release (UPR-200-E-6) resulted when waste containing about 1 Ci of fission products leaked from the 241-B-153 Diversion Box and contaminated the soil in the immediate vicinity. No decontamination information is available.

From 1954 to 1955 work on the 241-B-153 Diversion Box caused a general buildup to contamination around the unit. The contaminants contained about 1 Ci of fission products. The site was categorized as low-activity, covered with clean gravel, posted as a radiation zone, and documented as unplanned release UPR-200-E-75 (WHC 1991a).

2.3.7.4 241-B-154 Diversion Box. The 241-B-154 Diversion Box is located on the northeast corner of Baltimore Avenue and 7th Street. The diversion box, in service from 1945 to June 1984, was used to transfer various types of waste solutions from processing and decontamination operations to disposal sites. The 241-B-154 Diversion Box interconnects 241-B-151 and 241-B-152 Diversion Boxes and 221-B Building (WHC 1991a). It is 11 m

(36 ft) long, 3 m (9 ft) wide and 5 m (17 ft) deep, and is made of 1 m (2 ft) thick concrete walls. Alpha, beta, and gamma contamination is estimated to be high (WHC 1991a).

2.3.7.5 241-B-252 Diversion Box. The unit transferred waste solutions from processing and decontamination operations between 1945 and June 1984. The unit is connected to the 241-BX-154 AND 241-B-152 diversion boxes and the 241-B and 241-BY Tank Farms (WHC 1991a).

2.3.7.6 241-BR-152 Diversion Box. The 241-BR-152 Diversion Box is located 8 m (25 ft) south of the 241-BX Tank Farm. The unit transferred waste solutions from processing and decontamination operations between 1948 and June 1984 and is associated with the 241-BX Tank Farm. It adjoins the 241-BXR-152 Diversion Box on the east. Encasements connect these diversion boxes with the 241-BXR and 241-BYR Diversion Boxes (WHC 1991a).

2.3.7.7 241-BX-153 Diversion Box. The 241-BX-153 Diversion Box is an inactive waste management unit located at the southern boundary in the 241-BX Tank Farm. The diversion box was in service from 1948 until June 1983 transferring waste solutions from processing and decontamination operations. Located adjacent to and below the diversion box is the 241-BX-302A Catch Tank that collects waste spilled in the box during transfers (WHC 1991a). Both units have been isolated and weather covered (Hanlon 1992). The 241-BX-153 Diversion Box interconnects the 241-B-152 and 241-B-155 Diversion Boxes and the 241-BX and 241-BY Tank Farms.

2.3.7.8 241-BX-154 Diversion Box. The 241-BX-154 Diversion Box is an inactive waste management unit located about 9 m (30 ft) south of the 221-B Building. The unit was in service from 1948 until July 1984. The diversion box interconnects the 241-B-252 and 241-BX-155 Diversion Boxes and the 221-B Building (WHC 1991a). Located adjacent to and below the diversion box is the 241-BX-302-B Catch Tank that collects waste spilled in the diversion box during transfers (Hanlon 1992). The 241-BX-154 Diversion Box has been isolated and stabilized by application of a weather proofing plasticizer (Hanlon 1992).

2.3.7.9 241-BX-155 Diversion Box/UPR 200-E-78. The 241-BX-155 Diversion Box is an inactive waste management unit and is located about 260 m (850 ft) northeast of B Plant between Atlanta and Baltimore Avenues. The unit was in service from 1948 until June 1984 transferring various types of waste solutions from processing and decontamination operations. The 241-BX-155 Diversion Box interconnects the 241-BX-154 Diversion box, 241-BX Tank Farm, and 221-B Building (WHC 1991a). Located adjacent to and below the diversion box is the 241-BX-302C Catch Tank that collects waste spilled in the diversion box during transfers (WHC 1991a).

Unplanned release UPR-200-E-78 occurred when salt waste containing about 10 Ci of mixed fission products leaked from the diversion box during pressure testing of lines and

jumpers contaminating about 200 ft² of the surrounding soil. The area was then covered with clean soil. The unplanned release site has been isolated and stabilized by application of a weather proofing plasticizer (Hanlon 1992).

2.3.7.10 241-BXR-151 Diversion Box. The 241-BXR-151 Diversion Box is an inactive waste management unit. The diversion box is located at the southern boundary in the 241-BX Tank Farm. The unit was in service from 1948 until June 1984 transferring waste solutions from processing and decontamination operations. The 241-BXR-151 Diversion Box is associated with the 241-BX Tank Farm where leak detection and air monitoring are performed continuously. The unit has been isolated and weather coated (WHC 1991a).

2.3.7.11 241-BXR-152 Diversion Box. The 241-BXR-152 Diversion Box is an inactive waste management unit. The diversion box is located at the southern boundary in the 241-BX Tank Farm. The unit was in service from 1948 until June 1984 transferring waste solutions from processing and decontamination operations. The 241-BXR-152 Diversion Box is associated with the 241-BX Tank Farm where leak detection and air monitoring are performed continuously. The unit has been isolated and weather coated (WHC 1991a).

2.3.7.12 241-BXR-153 Diversion Box. The 241-BXR-153 Diversion Box is an inactive waste management unit. The diversion box is located at the southern boundary in the 241-BX Tank Farm. The unit was in service from 1948 until June 1984 transferring waste solutions from processing and decontamination operations. The 241-BXR-153 Diversion Box is associated with the 241-BX Tank Farm where leak detection and air monitoring are performed continuously. The diversion box interconnected the 241-B-152 and 241-B-155 diversion boxes and the 241-BX and 241-BY Tank Farms. The unit has been isolated and weather coated (WHC 1991a).

2.3.7.13 241-BYR-152 Diversion Box. The 241-BYR-152 Diversion Box is located at the southern boundary within the 241-BX Tank Farm. The 241-BYR-152 Diversion Box is an inactive waste management unit that operated from 1950 until June 1984 transferring waste solutions from processing and decontamination operations. Leak detection and air monitoring are performed continuously within the tank farm in which it is located. The unit has been isolated and weather covered (WHC 1991a).

2.3.7.14 241-BYR-153 Diversion Box. The 241-BYR-153 Diversion Box is an inactive waste management unit associated with the 241-BY Tank Farm. The diversion box is located at the southern boundary in the 241-BX Tank Farm. The unit was in operation from 1950 until June 1984 transferring waste solutions from processing and decontamination operations. The unit has been isolated and weather covered. Leak detection and air monitoring are performed continuously within the 241-BX Tank Farm (WHC 1991a).

2.3.7.15 241-BYR-154 Diversion Box. The 241-BYR-154 Diversion Box is an inactive waste management unit associated with the 241-BY Tank Farm. The diversion box is located at the southern boundary in the 241-BX Tank Farm. The unit was in operation from 1950

until June 1984 transferring waste solutions from processing and decontamination operations. The box has been isolated and weather covered. Leak detection and air monitoring are performed continuously within the 241-BX Tank Farm (WHC 1991a).

2.3.7.16 241-ER-151 Diversion Box. The active 241-ER-151 Diversion Box is located 275 m (900 ft) southwest of the 221-B Building and is not associated with any tank farm. The diversion box receives cross-site process and decontamination waste from the 241-UX-154 Diversion Box via the 241-EW-151 Vent Station. Waste is also received from the 241-B Tank Farm via the 244-BX DCRT. The unit is a reinforced concrete structure with an attached enclosure for pipe housing. The main section is 14.3 m (43 ft) long by 3 m (10 ft) wide and 5.6 m (16.7 ft) deep. The pipe housing structure extends 10.5 m (31.5 ft) on the north side. The 241-ER-151 Diversion Box is associated with the 214-ER-311 Catch Tank. The area around the diversion box is surrounded by a 1.8 m (6 ft) high chain link fence.

2.3.7.17 241-ER-152 Diversion Box. The 241-ER-152 Diversion Box is an active waste management unit and is located approximately 55 m (180 ft) southeast of the 224-B Building. The diversion box was activated in 1945 and transfers various types of waste solutions from processing and decontamination operations (WHC 1991a). The walls are 0.3 m (1 ft) thick, and 5 m (15 ft) deep. Located adjacent to and at a lower elevation than the diversion box is the 241-ER-311 Catch Tank that collects waste spilled in the diversion box during transfers (Hanlon 1990).

2.3.7.18 242-B-151 Diversion Box. Located at the southern boundary of the 241-B Tank Farm, the 242-B-151 Diversion Box is an inactive waste management unit that operated from 1945 until June 1984 transferring waste solutions from processing and decontamination operations.

2.3.7.19 242-B Evaporator Building to 207-B Retention Basin Waste Line. Unplanned release UN-200-E-79 occurred when five leaks were detected in this line in June 1953. Up to 2,500 ct/min were detected at points of emission.

The line connecting the 242-B Evaporator Building and the 207-B Retention Basin is a 10-cm (4-in.) cast iron pipe. It exits the 242-B Evaporator Building on its west side, runs due south to a point approximately 20 m (70 ft) north of the retention basin, then cuts to the southwest and enters the basin on the west side.

2.3.7.20 221-B Building to 241-B-361 Settling Tank Waste Line. Unplanned release UN-200-E-7 occurred on November 30, 1954, when a leak developed in the waste line that connects the 221-B Building and 216-B-361 Settling Tank. The leak released cell wash water with 1.7 rem/h contamination (WHC 1991a).

The WIDS database states that the leak occurred in the line connecting the 216-B-361 Settling Tank, but occurred near the 216-B-9 Crib, which is northeast of the settling tank. The coordinates in WIDS correspond to a location on the waste line near the

216-B-9 Crib. The settling tank was deactivated in 1947 (WHC 1991a) and the waste line to it was rerouted to 216-B-9, so the release is more correctly associated with the crib.

The line in question is V204, which emerges with seven other lines from the 241-B-154 Diversion box. Line V204 diverges from the unencased group north of the 216-B-361 Settling tank and runs northeast to the 216-B-9 Crib. The other lines continue north to 10th Street and then branch out to various diversion boxes. Line V204 is 9 cm (3.5 in.) diameter stainless steel, unencased, and enters the 216-B-9 Crib at invert elevation 205 m (671.7 ft), approximately 2 m (7 ft) below grade (WHC 1991a). Monitoring Well 299-E28-54 is very close to the coordinates of the leak.

2.3.7.21 221-B Building to 241-BX-154 Diversion Box Process Line. Two unplanned releases, in 1951 (UN-200-E-3) and 1972 (UN-200-E-85), are associated with this line. The pipe was not repaired after the 1951 leak because readings of 120 rem/h were detected with 46 cm (18 in.) of soil remaining over it and further excavation was deemed to be unwise (WHC 1991a).

The 241-BX-154 Diversion Box is approximately 6 m (20 ft) south of the 221-B Building, and is connected to it by two unencased lines V335 and V336. These lines are approximately 1.1 m (3.5 ft) below grade.

2.3.7.22 221-B Building to 241-B-110 Single-Shell Tank Pipeline. In January 1968, a leak developed in the line connecting Tank 9-2 in the 221-B Building and the 241-B-110 Tank. The coordinates correspond to a location along the three waste lines connecting the 241-B-152 and -153 Diversion Boxes.

2.3.7.23 BCS Crib Line. Two unplanned releases, in March and August 1972 are associated with the "BCS Crib Line." The line was sealed with a filter after the March leak (UN-200-E-103), and since the August leak (UN-200-E-44) occurred at the same coordinates, it probably resulted from failure of the repairs made after the March incident.

The line that produced these leaks is referred to as the "BCS Crib line", and the coordinates for these leaks give a location southeast of the 221-B Building, near 10th Street. The BCS Crib Line carried steam condensate from the B Plant Concentrator to the BCS Crib (216-B-55).

Lines V200 and V334 are located at the coordinates of the leak. These lines emerge from sections 10 and 9 of the 221-B Building, respectively, and end at the 241-B-154 Diversion Box. They enter the box at elevation 209 m (685.4 ft), approximately 4 m (12 ft) below grade. They connect to 8 cm (3 in.) diameter Hanford style nozzles at the box, and thus would be 9 cm (3.5 in.) stainless steel.

2.3.7.24 221-B Building Cooling Water Line. Unplanned releases UN-200-E-80 and UN-200-E-1 occurred in June 1946 and 1966, respectively. Metal waste leaked from the line

in 1946 and contaminated the surrounding soil with approximately 10 Ci of fission products. The 1966 leak was approximately 24 m (80 ft) from the 1946 leak and apparently leaked a similar waste liquid as the 221-B Building was being restarted.

The line is 2904-E-1, a 61 cm (24 in.) diameter cast iron process sewer pipe. It begins on the south side of B Plant and runs east to the 241-B-154 Diversion Box, then turns north and proceeds to the 207-B Retention Basin. Approximately 15 m (50 ft) east of Baltimore Avenue it is converted to 61 cm (24 in.) VC pipe.

2.3.7.25 221-B Building to 224-B Concentration Facility Process Line. Unplanned release UN-200-E-87 occurred between 1945 and 1953. Subsurface plutonium contamination was found near buried process lines.

A 61 cm (24 in.) VCP encasement runs from the drain pit on the southwest corner of the 221-B Building to the southwest corner of the 224-B Concentration Facility. Thirteen lines run north from the encasement where it runs south of the 224-B Concentration Facility. The two easternmost of these lines bracket the location of the unplanned release, and are probably responsible for the seepage. Given the elevation of the bottom of the drain pit from which the encasement emerges, the lines are probably approximately 1 m (3 ft) below grade.

2.3.8 Basins

Retention basins are concrete-lined settling ponds that receive liquids before they overflow into ditches. Three basins are present in the B Plant Aggregate Area and their locations are shown on Figure 2-10.

2.3.8.1 207-B Retention Basin. Currently, the 207-B Retention Basin is an active retention basin for B Plant cooling water and chemical sewer effluent enroute to the 216-B-3 Pond. The 216-B-2 series ditches, which are parallel to the 216-B-63 Ditch, were initially used to convey liquid waste from the retention basin. The basin is located 600 m (2,000 ft) north east of the 221-B Building, immediately south of the 241-B Tank Farm.

The basin is concrete-lined, has a capacity of 3,800 m³ (1,000,000 gal), and has dimensions of 75 m (246 ft) length, 37.5 m (123 ft) width, and 2 m (6.5 ft) depth. It is divided into two equal-sized sections. The structure was designed to take only low-level liquid wastes. The concrete walls of the unit have been contaminated over the years by a number of incidents involving radioactive water releases. In 1953, the walls were covered with a coat of tar to seal the residue contamination (Maxfield 1979).

On November 7, 1963, Unplanned Release UPR-200-E-32 contaminated the 207-B Retention Basin and 216-B-2-1 Ditch. The release is described in Section 2.3.5.10. Immediate clean-up actions were taken. Three hundred meters (1,000 ft) of the 216-B-2-1 Ditch was backfilled and replaced with a new ditch, presumably the 216-B-2-2 Ditch based on its start-up date. The retention basin walls were decontaminated

by washing them down repeatedly with fire hoses, and then they were coated with an asphalt-oil emulsion. Fresh dirt was spread over the backfilled ditch and around the contaminated soils adjacent to the retention basin. Some tumbleweeds that had collected in the 207-B Retention Basin at the time of the unplanned release, were contaminated and removed for disposal. A 2.4-m (8-ft) chain link fence was erected around the basin later that same month to prevent tumbleweeds from getting into the basin (Maxfield 1979).

The 207-B Retention Basin is currently active and in use. Some spots with levels of contamination from 200 to 600 ct/min have been detected on the north side of the basin. Except for these spots perimeter surveys of the basin indicate only normal background levels of radiation (WHC 1991a).

2.3.8.2 216-B-59/59B Trench/Retention Basin. Centered approximately 230 m (750 ft) north of 7th Street the 216-B-59 Trench was designed to receive 221-B Building cooling water with radionuclide concentrations above those allowed for the existing ponds. The site was activated in December 1967 and only received a single delivery of approximately 477,000 L (126,000 gal) of waste. The trench was upgraded to a retention basin adding a hypalon liner and changing the identification number to 216-B-59B. The retention basin held diverted cooling water for subsequent reprocessing. It was later upgraded by replacing the hypalon liner with a concrete liner and cover. In addition, minor pumping and piping modifications were made. The retention basin is currently active and receives diverted wastes for reprocessing (WHC 1991a).

The retention basin is surrounded by a 2 m (6 ft) high chain link fence. Yellow contamination flags are adjacent to the western boundary. The concrete retention basin is about 9 m (30 ft) wide, 40 m (120 ft) long, and 3 m (10 ft) deep, and is situated in a 30 x 60 x 4.6 m (100 x 200 x 15 ft) deep excavation. The excavation has a gravel sub-base beneath the retention basin and the top of the basin is about 1.5 m (5 ft) below grade.

2.3.8.3 216-B-64 Retention Basin/UN-200-E-64. The 216-B-64 Retention Basin located 75 m (250 ft) west of the 221-B Building was constructed but has not been used with the exception of an initial test. It may, however, be used in future B Plant Processes. Built in 1974, the purpose of the basin was to receive steam condensate from the 221-B Building that exceeded release limits. The structure is surrounded by an 2.4 m (8 ft) chain link fence with surface contamination warnings. Surface contamination was discovered in October 1984 and was given the unplanned release number UN-200-E-64.

UN-200-E-64 was discovered on October 12, 1984, and is located on the west side of 216-B-64 Retention Basin. It predominantly consists of ^{137}Cs and ^{90}Sr contamination up to 100,000 ct/min. The original source of the release has not been determined, but an uncapped riser on a nearby pipeline encasement and activities at the nearby 270-E Condensate Neutralization Tank have been considered. The contamination has been spread by burrowing ants so that the zone is approximately 2 acres in size. Pesticides and stabilization methods are being investigated to control the spread (Schmidt et al. 1991).

2.3.8.4 Liquid Effluent Retention Facility. The Liquid Effluent Retention Facility (LERF) is a temporary effluent-storage area that is currently under construction immediately east of the 200 East Area and northwest of the 216-B-3 Pond. It will be used for the temporary storage of effluent prior to its treatment and disposal to a state approved disposal facility (Olascoaga 1991). The LERF will consist of four basins, each with two impermeable liners, and capable of containing up to approximately 24,600,000 L (6,500,000 gal) for a total capacity of 98,400,000 L (26,000,000 gal).

In addition, northeast of the LERF, two 3,785,000 L (1,000,000 gal) tanks constructed of 80 to 100 mil HDPE have been constructed to store and evaporate monitoring well purge water.

2.3.9 Burial Sites

Several solid waste burial sites are present in the B Plant Aggregate Area. These generally consisted of trenches that received contaminated material, then were backfilled and stabilized.

The locations of all the burial sites in the B Plant Aggregate are shown on Figure 2-11. A partial inventory of radionuclides disposed to the burial sites is summarized on Table 2-5.

2.3.9.1 200-E Powerhouse Ash Pit. The 200-E Powerhouse Ash Pit is an active waste management unit. The pit is located about 60 m (200 ft) south of 4th Street across from the entrance to the Dry Materials Receiving and Handling Facility. The ash pit received ash from the 200 East Area Powerhouse at a rate of about 9,480 yd³/yr. The ash pit became active in 1943 and currently contains about 81,000 yd³ of ash. The ash has been analyzed for EP Toxicity and no hazardous materials were found (WHC 1991a).

2.3.9.2 218-E-2 Burial Ground. The 218-E-2 Burial Ground is located around the railroad spur north of the 221-B Building. The burial ground consists of nine industrial waste trenches. The bottom widths are 3.3 m (11 ft), and the lengths range from 30 to 140 m (90 to 465 ft). The trenches received 0.0031 m³ of mixed MFP/TRU dry wastes, which were backfilled. Radionuclides released to the trench include ¹³⁷Cs, ¹⁰⁶Ru, ⁹⁰Sr, plutonium, and uranium. This burial ground is also the location of the 218-E-9 Burial Ground, the above-ground storage site for fission product equipment.

An inspection on February 21, 1978 disclosed some degree of subsidence associated with each trench, and ground surface contamination on a number of tumbleweeds near the north end of the 218-E-9 Burial Ground. Extensive research was done in 1979 to determine the location of all burial trenches within the bounds of the 218-E-2, -5, -5A, and -9 Burial Ground radiation zone. The work included viewing aerial photographs and construction prints, analyzing plant growth patterns, and load testing the ground surface with a 40-ton

vehicle. As a direct result of the research, four previously unrecorded trenches within the burial grounds were identified: 218-E-2A, 218-E-5, 218-E-5A, and 218-E-9 (Maxfield 1979; WHC 1991a).

The entire burial ground has been stabilized. Burial grounds 218-E-2, -5, -5A, and -9 were stabilized together as one large field. Burial grounds 218-E-2A and 218-E-4 were stabilized independently. Contaminated equipment previously stored above ground in these burial grounds was removed and transported to the 218-E-10 Burial Ground for further storage or burial. A minimum 0.3 m (1 ft) layer of soil and sand depth was distributed over the trenches.

The soil was fertilized and a mixture of perennial grasses was planted in October and November 1980 (WHC 1991a). The re-vegetation efforts were hampered by poor weather conditions in the late fall.

2.3.9.3 218-E-2A Burial Ground. The 218-E-2A Burial Ground was active from 1945 to 1955 and contains one trench (WHC 1991a). No records or burial inventories are available to indicate that the 218-B-2A site was ever used as a burial ground. It was used, however, as an above-ground storage site for regulated equipment (Maxfield 1979).

An inspection of the burial site performed in February 1978 disclosed a number of sink holes along the center line of the trench, indicating that it had been used for dry waste burials (Maxfield 1979). In 1979, soil was placed over the burial site to bring the surface of the depressions to ground level.

2.3.9.4 218-E-3 Burial Ground. The 218-E-3 Burial Ground was located in the extreme southwestern corner of the 200-SS-1 Operable Unit, and was active only in 1954. The burial ground received construction scrap including metal slip forms, barrels, and timbers from the 202-A Building construction work that had been contaminated with ^{106}Ru released from the REDOX Stack. In 1971, the pit was uncovered and surveys found that no measurable alpha, beta, or gamma activity remained in the soil or on the equipment. The burial ground was exhumed and removed from radiation zone status.

2.3.9.5 218-E-4 Burial Ground. The 218-E-4 Burial Ground was thought to have consisted of two trenches; however, load testing during stabilization failed to identify clearly defined trenches. Maxfield (1979) reports that construction and repair wastes were buried here, and indicates that the number of trenches is unknown. Some contaminated equipment that was stored here was removed. Radionuclides believed to have been disposed to the trenches include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium. The burial ground was stabilized with the others around it.

2.3.9.6 218-E-5 Burial Ground. The 218-E-5 Burial Ground consists of two trenches. Trench 1 is 100 m (325 ft) long and 3.3 m (11 ft) wide at the bottom. Trench 2 is 100 m (325 ft) long and 40 m (125 ft) wide at the bottom. The burial ground received failed equipment, industrial dry waste, and small boxes. The north end contains railroad boxcars

contaminated with uranyl-nitrate-hexhydrate. Radionuclides released to the trench include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium. The burial ground was stabilized with the others around it.

2.3.9.7 218-E-5A Burial Ground. The 218-E-5A Burial Ground is west of the 218-E-5 Burial Ground, and consists of several backfilled trenches with a surface area of 220,000 ft². In 1956, the 218-E-5 Burial Ground received waste from L Cell, known as the 202-A Building Burial Package, in the form of four large boxes containing failed equipment and industrial wastes. One of the boxes was damaged while unloading, and the contents were pushed into the trench. The D-2 Column from the 202-A Building K Cell was buried in this site as well (Maxfield 1979). Radionuclides released to the trench include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium. The area was stabilized with the other trenches around it.

2.3.9.8 218-E-6 Burial Ground. In the fall of 1955 a shack and other wooden items were collected from the 291-B Stack area and placed in the 218-E-6 Burial Ground. The burial ground is a 1.2 m (4 ft) deep trench. The collected material was burned and the ashes covered. Later the burial ground was exhumed and stabilized by seeding with wintergraze, crested, Siberian, and thickspike wheatgrasses. The burial ground has since been released from radiation zone status.

2.3.9.9 218-E-7 Burial Ground. The 218-E-7 Burial Ground is located about 30 m (100 ft) south of the 222-B Building. It consists of three underground vaults containing about 170 m³ of mixed fission products and TRU solid mixed waste deposited from 1947 until 1952. Two of the vaults are 0.9 m² (10 ft²) by 4 m (12 ft) deep constructed of 5 x 5 cm (2 x 2 in.) wooden planking. The top of each vault is 1.5 m (5 ft) below grade and both have open bottoms. The third vault is an 2.4 m (8 ft) diameter concrete culvert pipe 8 m (25 ft) deep. The pipe has a 22 cm (9 in.) thick concrete cover and a 30 cm (12 in.) thick concrete floor. Radionuclides contained within the waste include ^{137}Cs , ^{106}Ru , ^{90}Sr , plutonium, and uranium (Anderson et al. 1991). The wooden vaults create a collapse potential.

Currently, the burial ground is approximately 4.6 m (15 ft) wide by 9 m (30 ft) long and is delimited by a light-weight chain barricade with surface contamination and potential cave-in hazard warning signs. The southern edge of the burial ground is adjacent to a small outdoor Kaiser Engineers storage site. Non-native grass and Russian thistle cover approximately 70% of the delimited surface.

2.3.9.10 218-E-9 Burial Ground. The 218-E-9 Burial Ground is located with the 218-E-2, -2A, -4, -5, and -5A group. This burial ground was an above-ground storage site for fission product equipment that became contaminated in the uranium recovery program at the tank farm. It never appears to have been a burial ground (Maxfield 1979).

2.3.9.11 218-E-10 Burial Ground. The 218-E-10 Burial Ground is the current, active burial ground for the B Plant facility. It is located in the 200-BP-10 Operable Unit in the

northwest corner of the B Plant Aggregate Area. It is about 610 m (2,000 ft) northwest of the B Plant separations building. The burial ground became active in February 1960, and is also known as 200 East Industrial Waste No. 10.

This waste management unit will consist of 17 north-south running trenches and one east-west running trench. The east-west trench has bottom dimensions of 30.5 m (100 ft) by 4.6 m (15 ft). North-south trench 1 is 400 m (1,300 ft) by 4.6 m (15 ft) and is 7.3 m (24 ft) deep. North-south trenches 2 through 8 are 250 m (805 ft) to 350 m (1145 ft) long by 4.9 m (16 ft) and are 4.6 m (15 ft) deep. North-south trenches 9 through 17 are empty at this time.

The 218-E-10 Burial Ground has received 21,764 m³ of solid, mixed waste consisting of mixed industrial wastes, failed PUREX equipment, 69 PUREX cover blocks, and 4 PUREX centrifuge blocks. The burial ground is partially stabilized.

2.3.9.12 200-East Area Construction Pit. From 1945 through 1955, the 200-East Area Construction Pit, located west of the 200 East Area fence was used as a nonhazardous solid waste pit for broken blocks of concrete foundation and other structures (WHC 1991a). There have been no known chemicals dumped into this unit (Stenner et al. 1988). The large gravel pit has been abandoned. Native vegetation now grows in and around the pit excavation.

2.3.9.13 200-E8 Borrow Pit Demolition Site. The 200-E8 Borrow Pit, an active thermal treatment (detonation) pit, became operational in August 1984. It is a RCRA facility located southwest of the 218-E-10 Burial Ground, west of the 200 East Area fence, and just north of the 200-East Area Construction Pit. The 200-E8 Borrow Pit had the following detonations in 1984: Isopropyl Ether 8 L, 1,4-Dioxane 1,250 mL, 2-Butoxyethanol 19 L, Methyl Ethyl Ketone 177 mL, Hydrogen Peroxide 11.36 L, Dioxane 946 mL, Sodium Azide 473 mL, and Phosphoric Acid 189 L. No detonations took place in 1985 or 1986.

2.3.10 Unplanned Releases

Fifty-nine unplanned releases are included in the B Plant Aggregate Area. Most of the releases have been included in the Tri-Party Agreement or are associated with an existing waste management unit. These unplanned releases and their associated waste management units will be addressed together in this study. Table 2-6 summarizes the known information for each unplanned release and, where applicable, lists the waste management unit to which it is related. (Note that the additional unnumbered release in Table 2-6 will not be evaluated in this AAMSR.) Most of the information available for the unplanned releases is derived from the WIDS sheets. The locations of all the unplanned releases in the B Plant Aggregate Area, except the unnumbered one, are shown on Figures 2-12 and 2-13.

2.4 WASTE GENERATING PROCESSES

Several processes have operated in the B Plant Aggregate Area since the construction of the original 221-B Building in 1945.

The 221-B Building (B Plant) was the second fuel reprocessing plant at the Hanford Site to separate plutonium from other fission products. The 221-B Building originally used the bismuth phosphate process to recover plutonium from irradiated uranium fuel pellets and operated from 1945 to 1952. In 1968, the plant was restarted with a new process to recover cesium and strontium from single-shell tank wastes. The plant continued this mission until 1984. The 221-B Building also has a low-level radioactive waste concentration process that reduces the volume of wastes by evaporating water from them. This process has not been utilized since 1986. The 225-B Building, also called the Waste Encapsulation and Storage Facility (WESF), was designed to convert strontium and cesium solutions that were recovered at the 221-B Building, crystallize them, and store them in stainless steel cylinders that are immersed in a cooling water bath. Other waste generating processes at B Plant Aggregate Area include the 242-B Evaporator used to reduce liquid volume in single-shell tanks and two ITS Units (ITS-1 and ITS-2) that directly evaporated water from single-shell tanks. Equipment conversions were made at 221-B Building beginning in 1986 to process neutralized cladding acid waste (NCAW) and a test quantity of 80,000 L (20,000 gal) was processed.

Figure 2-14 shows the historical timelines for the waste generating processes. Table 2-7 summarizes the available information about the waste streams produced within the aggregate area. The chemicals or radionuclides that are known or suspected to be in the B Plant Aggregate Area waste streams are listed in Table 2-8 and Table 2-9 lists radionuclides, organic and inorganic chemicals disposed of at the B Plant Aggregate Area waste management facilities. These lists have been compiled from inventory data, sampling data and process descriptions. Section 2.4.1 through 2.4.11 describe the B Plant Aggregate Area waste generating processes in more detail.

2.4.1 221-B Building Bismuth Phosphate Plutonium Recovery Process

This was the original process for which the 221-B Building was designed and constructed in 1945. This process was designed to separate and concentrate the small amounts of plutonium contained in the irradiated fuel pellets produced in the 100 Area reactors. In the bismuth phosphate process, all of the material contained within the irradiated fuel pellets was discarded as waste except for the recovered plutonium.

The first step in the bismuth phosphate process was to remove the aluminum cladding surrounding the fuel. This was done by dropping the pellets into a tank containing a solution of sodium hydroxide which preferentially dissolved the aluminum surrounding the pellet. Sodium nitrate was added to the solution to prevent the formation of excessive quantities of hydrogen gas during the dissolution of the aluminum metal. The waste solution from the

cladding dissolution step contained sodium aluminate, sodium nitrate, and sodium nitrite as well as small amounts of fission products. This waste solution was combined with the first-cycle decontamination waste and transferred to single-shell tank storage (Waite 1991).

The next step in the process was to dissolve the uranium and extract the plutonium. The decladded uranium slugs were rinsed with water and dissolved in 50 to 60% nitric acid. Excess uranium metal remained in the dissolver as a heel to increase the rate of dissolution. The completion of the dissolving step was determined by specific gravity that was measured with a pair of bubbler tubes immersed in the solution (Ballinger and Hall 1991).

The plutonium was recovered from the dissolved uranium solution by adding sodium nitrate solution to convert the plutonium to the +4 valence state. Next, bismuth nitrate and phosphoric acid were added. Sulfuric acid was also used at this point in the process. The resulting precipitate of bismuth phosphate carried 99% of the plutonium with it. This precipitate was separated from the solution in a solid-bowl centrifuge, and the solution was transferred to single-shell tank storage as the metal waste stream (Ballinger and Hall 1991). The metal waste stream contained the bulk of the uranium and approximately 90% of the long-lived fission products (e.g., ^{137}Cs and ^{90}Sr) (Waite 1991).

Once the plutonium had been extracted in the precipitate, it went through two decontamination cycles to purify it further. In the first decontamination cycle, the precipitate was washed in the centrifuge and dissolved in strong nitric acid. The valence of the plutonium was then adjusted to +6 by the addition of a sodium dichromate solution and a precipitate of bismuth phosphate was again formed using bismuth nitrate, phosphoric acid, and sodium metabismuthate. However, this time the precipitate captured some of the fission products that were not extracted in the first liquid waste stream and the plutonium remained in solution. The precipitate was separated from liquid product stream, dissolved in nitric acid, and transferred as a liquid to be mixed with other liquid wastes from the first decontamination cycle.

Following separation from the waste precipitate, a precipitate containing the plutonium was formed from the product solution using ammonium fluosilicate, ferrous ammonium sulfate, bismuth oxynitrate, and phosphoric acid. The plutonium-containing precipitate was separated from the solution and the solution was transferred to single-shell tank storage along with the other liquid wastes from the first contamination cycle. The plutonium product precipitate was dissolved in nitric acid prior to further processing (Ballinger and Hall 1991). The waste stream from the first decontamination cycle contained almost 10% of the long-lived fission products and was sent to single-shell tank storage (Waite 1991).

The second decontamination cycle was performed on the plutonium solution remaining from the first decontamination cycle to further purify it by removing additional fission products from the plutonium solution. The same process was used for the second decontamination cycle as was used for the first decontamination cycle. The waste stream from the second cycle contained less than 0.1% of the fission products. This was sent to single-shell tanks for storage until 1948. Because of limited tank space, the second-cycle

waste supernatant was discharged directly to cribs and trenches from 1948 until the 221-B Building was shut down in 1952. This included second cycle material that had previously been stored in tanks (Waite 1991).

The product from the bismuth phosphate process was a dilute plutonium nitrate solution. This was transferred to the 224-B Concentration Facility to be purified and reduced in volume. The solution was first oxidized with sodium bismuthate. Next, phosphoric acid was added to precipitate byproduct followed by centrifugation. Product solution was treated with hydrogen fluoride and lanthanum salt to precipitate by-product. Following separation by centrifuge, product solution was treated with oxalic acid, hydrofluoric acid, and lanthanum salt to precipitate plutonium and lanthanum fluoride. These solids were centrifuged from the solution and washed with water. The plutonium fluoride was metathesized to plutonium hydroxide by digestion with hot potassium hydroxide. The solid hydroxides were centrifuged and dissolved in nitric acid to form plutonium nitrate, which was transferred in cans to the Isolation Building (the 231-Z Building in the Z Plant Aggregate Area).

The plutonium nitrate-lanthanum nitrate solution sent to the Isolation Building was treated with ammonium sulfite and sulfate. It was treated with hydrogen peroxide to form plutonium peroxide in two precipitations followed by dissolving in nitric acid. The final plutonium nitrate was concentrated in a still and then concentrated in a sample can by evaporation to a thick paste. The liquid waste stream from the 224-B Concentration Facility concentration processing was initially discharged to the 241-B-361 Settling Tank when processing began in 1945. The overflow from the settling was discharged to the 216-B-5 Reverse Well.

Beginning in 1947, the 224-B Concentration Facility waste was routed to the 241-B-201 through 241-B-204 (208,000 L, 55,000 gal capacity) Single-Shell Tanks for settling before being discharged to cribs. This discharge continued until the bismuth phosphate process was shut down in 1952. The primary concern about the waste streams from the 224-B Concentration Facility was plutonium. The majority of the plutonium remained in the tanks after settling. However, the waste from this facility was the primary contributor of plutonium to the ground from all of the tank waste discharges (Ballinger and Hall 1991). Figure 2-15 schematically shows the fuel separations processing at the 221-B Building between 1945 and 1954.

2.4.2 221-B Building Strontium and Cesium Recovery

In 1963, the 221-B Building began recovering strontium, cerium, and rare-earths using an acid-side, oxalate-precipitation process as part of the Phase I processing for the 221-B Building Waste Fractionization Project. A centrifuge was used to separate the phases. The lead, cerium, and rare-earth fractions were dissolved in nitric acid and stored. The strontium fraction was thermally concentrated and stored. Portions of the strontium and rare earths produced in Phase I were pumped by underground transfer line to the Semiworks for

purification of the ^{90}Sr fraction and separation of the rare-earth fraction in ^{144}Ce and a rare-earth fraction including ^{147}Pm . Phase I processing at the 221-B Building ended in June 1966 to accommodate Phase III construction.

The objective of the Phase I processing was to restore services to the 221-B Building after its extended shutdown and to accumulate an inventory of fission products. The Phase II portion of the project was the installation of facilities necessary to demonstrate a process system for packaging the long-lived fission products as a small volume concentrated waste. The purpose of Phase III was to provide waste fractionization facilities in the 221-B Building for processing high level wastes from PUREX Plant Aggregate Area and the B Plant Aggregate Area tank farms into fractions that could be immobilized and contained more safely.

The Phase III Waste Fractionization processing began at the 221-B Building in 1968. This process separated the long-lived radionuclides, ^{90}Sr and ^{137}Cs , from high-level PUREX and REDOX wastes and stored a concentrated solution of ^{90}Sr and ^{137}Cs at the 221-B Building. Individual tanks at the B Plant Aggregate Area contained up to 35 megacuries of ^{90}Sr or ^{137}Cs at concentrations up to 10,000 Ci/gal. The combined storage capacity of the tanks was estimated to be 85 megacuries of ^{90}Sr and 25 megacuries of ^{137}Cs .

Three processes were used for the waste fractionization. The first process was the feed preparation and solvent extraction of current acid wastes generated by the 202-A Building and stored at PUREX Plant Aggregate Area and REDOX tank farms. The solids in these wastes contained about 55% of the strontium and 70% of the rare earths. The solids, consisting mostly of silicates, phosphates, and sulfates, were treated by a carbonate-hydroxide metathesis solution to convert the sulfates to carbonate-hydroxide solids. These solids were then separated from the solution by centrifuge and dissolved in nitric acid to recover the fission products. The dissolved fission products were combined with original acid waste supernate after it had been treated to form feed for the solvent extraction columns by adding a metal-ion complexing agent, a pH buffer, and a pH adjustment solution (Bixler 1967).

The feed went through a series of solvent extraction columns. The solvent used was a mixture of di(2-ethylhexyl) phosphoric acid extractant and tributyl phosphate modifier in a normal paraffin hydrocarbon diluent. The strontium, cerium, and other rare earths were extracted from the aqueous phase into the solvent. The aqueous fraction contained the cesium and was routed to the 241-A or 241-AX underground tank farms in the PUREX Plant Aggregate Area for temporary storage to allow the decay of short-lived activity (Bixler 1967).

The strontium fraction was stripped from the solvent with dilute nitric acid and thermally concentrated with the Cell 5 concentrator for storage in tanks in the 221-B Building Cells 6-8. The cerium and rare-earth fraction was stripped from its solvent with nitric acid, combined with organic wash wastes, and sent to single-shell tank storage. The solvent was washed and recycled for reuse.

The second process used was a feed preparation and solvent extraction process for processing stored sludge wastes from the 241-A, 241-AX, and 241-SX Tank Farms. The sludge was sluiced with supernate and water and pumped out of the tanks to the 244-AR or 244-SR Vault. At these vaults, the sluicing water was decanted for storage to await treatment for cesium removal. The sludge, containing the bulk of the fission products, was dissolved in nitric acid and transferred to the 221-B Building for treatment.

At the 221-B Building, the rare-earths and strontium were precipitated as sulfates using lead sulfate as a carrier to separate them from iron and aluminum. A sodium hydroxide-sodium carbonate metathesis was performed to convert the sulfates to hydroxides and carbonates and to eliminate the bulk of the lead. The product cake was centrifuged, dissolved with nitric acid, and accumulated for solvent extraction treatment. The solvent extraction was similar to the solvent extraction for the current acid waste, except that the waste aqueous fraction from the initial solvent extraction containing the rare-earths and the solvent wash wastes were thermally concentrated at the 221-B Building using the Cell 20 concentrator and transferred to immobilization processing (in-tank solidification).

The third waste fractionation process was the ion exchange of stored cesium supernates and sluicing solutions. High-level tank farm supernates and sluicing water containing ^{137}Cs was passed through an ion-exchange column at the 221-B Building. The cesium and a small fraction of sodium were adsorbed on a synthetic alumino-silicate zeolite. About 97% of the adsorbed sodium and 0.5% of the loaded cesium were designed to be removed from the column with a dilute ammonium and carbonate-ammonium hydroxide scrub solution (Bixler 1967). Following this, the remaining cesium was removed with a concentrated mixture of ammonium carbonate and ammonium hydroxide. The cesium was thermally concentrated in the Cell 20 concentrator and stored in tanks in 221-B Building Cells 14 and 17. The waste from the adsorption step was routed directly to in-tank solidification. The column wash wastes and scrubs were thermally concentrated in the Cell 23 concentrator prior to transfer to in-tank solidification. In 1974, the 221-B Building began using Cell 38 to perform final purification of the cesium prior to processing at the WESF. The WESF is described in Section 2.4.4. The strontium solvent extraction process operated until 1978. Cesium final purification was ended in 1983 and strontium purification was ended in 1984.

Wastewater continues to be generated from the 221-B Building from heating, ventilation, and air conditioning (HVAC) systems, floor drains, and steam condensate drains. This stream is known as the B Plant Chemical Sewer Stream and was disposed of to the 216-B-2-2 Ditch and the B Ponds until UN-200-E-138 forced the closure of that ditch. From 1970 until February 1992, it was disposed of to the 216-B-63 Ditch. In February 1992, the effluent piping was revised to allow the chemical sewer stream to be discharged to the B Plant Cooling Water Stream which ultimately reaches the 216-B-3 Pond. This waste stream is not specific to any process, and would have been generated throughout B Plant operations.

2.4.3 221-B Building Waste Concentration Process

The waste fractionation process described in Section 2.4.2 included a thermal evaporation concentrator in Cell 23 to concentrate process wastewaters prior to disposal. This system was used to concentrate low-level radioactive waste after the cesium and strontium waste fractionation process was shut down in 1984. Double-shell tank waste was received at the 221-B Building to be processed through the low-level waste concentrator until 1986. The 221-B Building received no double-shell tank wastes after April 1986 and processing of these wastes was complete by late 1986. Other sources of the low-level waste included miscellaneous sumps and drains in the WESF, which diverted decontamination waste solutions generated in the WESF process cells. Another contributor was a liquid collection system located beneath the 40 cells in the 221-B Building that collected cell drainage from decontamination work and water washdowns in the processing section of the 221-B Building. The concentrator also processed wastes produced by the cleanout of various process vessels at the 221-B Building and WESF through 1986 (Peterson 1990a).

The concentrator process consisted of a vertical, single-pass, shell-and-tube thermal-recirculated and steam-heated evaporator. The evaporator had two bundles of tubes that contained low-pressure steam to heat the process feed. The tube bundles heated the feed to the boiling point and vaporized it. The evaporated liquid passed through a high-efficiency deentrainer to remove entrained liquid droplets and was condensed as process condensate (Peterson 1990a). The process condensate was disposed of in the 216-B-12 Crib beginning in May 1967 when disposal to the 216-B-12 Crib began again. In November 1973, the process condensate was diverted to the 216-B-62 Crib. Disposal continued to this crib until the concentrator was shut down (RHO 1986). The process condensate is known as the B Plant Process Condensate Stream. It was not generated before the waste concentration process.

The steam that was used to heat the feed was condensed by the heating process and was collected as steam condensate. The steam condensate was disposed of to 216-B-3 Pond until September 1967. In 1967, it was diverted to the 216-B-55 Crib (Peterson 1990b). The steam condensate is known as the B Plant Steam Condensate Stream. Prior to the waste concentration process, steam would have been used in other processes and condensate would have been disposed of to cribs or ponds.

The liquid remaining in the evaporator was reduced in volume by the removal of water through evaporation. The concentrated liquid waste was transferred to tank farm storage. The concentrator was shut down in January 1987 for repairs to its deentrainment system (Peterson 1990b). The concentrator was restarted in April 1988 and over 2,000,000 L (500,000 gal) of flush water were processed through the concentrator to ensure that residuals from past processing were removed. The flush water was disposed of in double-shell tank underground storage (Peterson 1990a). At the present time, the low-level waste from B Plant is disposed of to double-shell tank storage.

2.4.4 225-B Building Waste Encapsulation and Storage Facility

Four processes were undertaken at the WESF in the 225-B Building located west of, and attached to, the 221-B Building. Three processes have been discontinued and one process, capsule storage, is still in operation. The first process was to convert purified cesium carbonate to cesium chloride. The cesium carbonate was converted to cesium chloride by the addition of 12 M hydrochloric acid. Carbon dioxide and heat were released during the reaction. The cesium chloride solution was cooled with a cooling coil and air sparging through mixing. The offgas from the acidification process was vented through a deentrainer, condenser, and a scrubber which neutralized the hydrochloric acid. The cesium chloride solution was transferred to an electrically heated melter crucible which boiled the liquid away and then melted the cesium chloride salt. The molten cesium chloride was poured into capsules.

The second process was the process used to convert strontium nitrate to strontium fluoride. The strontium nitrate was transferred to a precipitation tank and powdered sodium fluoride was added to precipitate the strontium as a slurry of strontium fluoride. The slurry was filtered to produce a cake that was allowed to dry and self-heat. The cake was loaded into a furnace boat which was placed into a furnace at a sintering temperature of 800 °C (1,472 °F) to remove water and nitrate volatiles. The sintered strontium fluoride was dumped or air chiseled out of the furnace boat and loaded into a capsule and compacted.

The third process was the encapsulation of the strontium and cesium. Two capsules were used to encapsulate the material, an inner capsule which contained the cesium or strontium, and an outer capsule which enclosed the inner capsule. The capsules arrived at the WESF with one end welded on. Ultrasonic inspection was performed by the manufacturer to verify weld penetration. At the WESF, the capsules were first degreased with acetone and weighed. After the inner capsule was filled it was purged with helium and sealed by welding a cap on the open end. Weld inspection was done visually and by a helium leak detection process in a vacuum chamber. A final check was done using a bubble test.

Following testing, the capsules were decontaminated by placing them in a capsule scrubber and an electropolisher. After decontamination, the capsule was placed into an outer capsule and a cap was welded onto the open end of the outer capsule. The outer capsules were subjected to additional inspections using ultrasonic scanning followed by calorimetry to determine curie levels. The finished capsule was weighed and the known weights of the inner and outer capsules subtracted. The net weight of the capsule content was divided into the curie content to give the curie output per gram. Capsules that did not pass testing were disassembled and reworked. The contents were removed from the defective capsule and the process was repeated. The rejected capsule was discarded as solid waste.

The final process conducted at the WESF is capsule storage. The finished capsules were smear sampled for loose residual contamination and decontamination if necessary. A surface contamination of less than 200 ct/min was required before the capsule could be

stored in the capsule storage area. The completed capsule transferred to one of 8 capsule storage pools using pool cell tongs. The capsule was transferred through a transfer aisle filled to a depth of 3 m (9 ft) with demineralized water and placed in one of the storage pools that was filled to a depth of 3.3 to 4 m (11 to 13 ft) of water. The water provides both radiation shielding and a means of removing heat generated by the radioactive decay of the capsule contents. Each storage pool contains a vertical turbine pump that circulates the pool water continuously. The recirculated water passes through the tube side of a heat exchanger and is returned to the bottom of the pool cell. Raw water passes through the shell side of the heat exchanger to cool the pool water. If pool water becomes contaminated, it is diverted to the 221-B Building low-level waste header (see Section 2.4.3). The time-averaged flowrate of pool cell water diverted to the low-level waste header is .07 liters/min (.02 gpm). This flowrate also includes water from additional WESF sources such as cell drains and floor drains (WHC 1992b). The raw water that is used for cooling passes through the heat exchanger and is discharged through the 216-B-2-3 Ditch to the 216-B-3 Pond. Provisions exist to divert the cooling water to the 216-B-63 Crib in an emergency. The flowrate of cooling water used for WESF capsule storage cooling is about 5.7 m³/min (1,500 gal/min) (Peterson 1990c). The cooling water is known as the B Plant Cooling Water Stream, cooling water has been generated in other processes at B Plant and related facilities.

Processing began at the WESF in 1974. The strontium, cesium, and encapsulation processes were ended in 1984. The capsule storage process continues to operate to maintain the inventory of capsules in storage at the WESF.

2.4.5 242-B Evaporator System

In December 1951, the 242-B thermal evaporation system was placed into operation at a location south of the 241-B Tank Farm. The evaporator was installed to evaporate cladding/first cycle waste and reduce the waste volume (Waite 1991). The evaporator was a steam-heated pot evaporator that operated at atmospheric pressure (Jungfleisch 1984). The liquors were partially boiled down to produce a more concentrated waste. The water that was evaporated from the waste was discharged as 242-B Evaporator process condensate to the 216-B-11A and 216-B-11B Reverse Wells. The evaporator bottoms were initially placed into single-shell tank storage (Anderson 1990). In 1954, evaporator bottoms from the 242-B Evaporator began being discharged to the 216-B-37 specific retention trench (Maxfield 1979). The 242-B Evaporator was shut down in December 1954 and was never restarted (Anderson 1990).

2.4.6 In-Tank Solidification Process

Two in-tank solidification units were installed in the 241-BY Tank Farm. The objective of the in-tank solidification units was to heat waste liquors while they were inside of a single-shell tank and remove water leaving a solid salt cake behind in the tank. The first unit, ITS-1, began operation in March 1965. It used a hot air sparge into the tank. The air

sparging was done on one individual tank. The hot air caused water in the tank to evaporate and leave the tank with the air while leaving the solids behind (Anderson 1990). The evaporated water was condensed and discharged to the 216-B-50 Crib. The cooling water was discharged to the 216-B-2-2 Ditch.

The second unit, ITS-2 began operation in February 1968. This unit used electrical immersion heaters to heat the tank contents. The heated liquor was then transferred to other tanks. In August 1971, ITS-1 was modified to become a cooler for ITS-2. Both units were shut down in June 1974.

2.4.7 Wastes Generated at the 221-U Building

In 1952, the previously unused 221-U Building began operation with a process using tributyl phosphate in a kerosene (paraffin hydrocarbon) diluent to recover uranium metal from metal waste that was in single-shell tank storage at the 221-B and 221-T Buildings. The aqueous phase waste stream from the solvent extraction process was neutralized with sodium hydroxide and transferred to the B Plant Aggregate Area for storage in single-shell tanks.

In addition to tributyl phosphate wastes, evaporator condensate from the 221-U Building was transferred to the 216-B-12 Crib for disposal between November 1952 and December 1957. Lanthanum fluoride wastes from the 221-U Building were also stored in single-shell tanks in the 241-B Tank Farm.

2.4.8 In-Tank Scavenging

A ferrocyanide scavenging process was begun in 1954 to attempt to reduce the volume of wastes that had to be stored in single-shell tanks. The objective of the scavenging process was to precipitate the soluble long-lived ^{137}Cs from the 221-U Building uranium recovery waste supernatant that had been stored in B Plant Aggregate Area single shell tanks. The other principal long-lived fission product, ^{90}Sr , was already essentially insoluble in the neutralized uranium recovery waste and precipitated without adding scavenging chemicals. However, during the later operational years of the process, calcium nitrate or strontium nitrate were added to enhance the precipitation of the ^{90}Sr .

After precipitation, the waste was allowed to settle in single-shell tank storage and the solid precipitate particles settled to the bottom of the tanks as sludge. Following settling, the supernate was decanted from the sludge, tested for the applicable discharge requirements, and discharged to the ground.

Beginning in 1954, the newly-generated uranium recovery waste was scavenged in the 221-U Building and transferred to the B Plant Aggregate Area for settling in the single-shell tanks. Then it was discharged to the ground either through cribs or specific retention trenches. This scavenging process was ended in June 1957.

Starting in May 1955, scavenging was also done on 221-U Building tributyl phosphate wastes that had previously been stored in single-shell tanks. The wastes were pumped to the 244-CR Vault in the PUREX Plant Aggregate Area where they were scavenged. The waste was then routed back to single-shell tanks for settling and the supernatant subsequently was pumped to the ground. This was referred to as "in-tank farm" scavenging. The scavenging in the 244-CR Vault ended in December 1957 and the last of these wastes was discharged to the ground in January 1958 (Waite 1991). Waste management units that received tributyl phosphate waste are the 216-B-14 through 216-B-19 Cribs, the 216-B-20 through 216-B-34 Trenches, the 216-B-42 Trench, the 216-B-43 through 216-B-49 Cribs, and the 216-B-52 Trench. Figure 2-16 schematically shows the interrelationships between the 221-U Building processing and the in-tank scavenging process.

2.4.9 Wastes Generated at the 202-A Building

The 202-A Building produced coating wastes from the dissolution of the irradiated fuel pellet cladding that were disposed of to single-shell tanks in the 241-B and 241-BY Tank Farms.

2.4.10 Wastes Generated at S Plant

The S Plant operated between 1951 and 1967 and used an methyl isobutyl ketone (MIBK or hexone) solvent extraction process to accomplish the separation of uranium and plutonium from the irradiated fuel pellets. High level wastes were transferred to the 241-B-103 Single-Shell Tank. Waste from ion exchange processing was transferred to the 241-BX-101, 241-BX-103, and 241-BX-106 Single-Shell Tanks storage.

2.4.11 Analytical Laboratory Programs

The 222-B Laboratory supported operations at the 221-B Building complex and other 200 Area facilities with laboratory services. A liquid waste stream was generated from the laboratory facility that included sample disposal waste and hood and hot cell cleanup waste. Sampling and testing equipment, gloves, empty containers, and other materials were buried as solid waste. Laboratory liquid wastes were directed to the 216-B-6 Reverse Well from April 1945 to December 1949 and to the 216-B-10A Crib from December 1949 to January 1952.

2.5 INTERACTIONS WITH OTHER AGGREGATE AREAS OR OPERABLE UNITS

The B Plant Aggregate Area dominates the 200 East Area and is comprised of three non-contiguous segments: the main plant area to the west (200-BP-1 to 10 and 200-SS-1 Operable Units), the B Plant Aggregate Area pond area (200-BP-11 Operable Unit) to the east; and the Gable Mountain Pond (200-IU-6 Operable Unit) to the north. Located between the east and west segments are the PUREX Plant Aggregate Area and the Semiworks Aggregate Area.

- The PUREX ("plutonium-uranium extraction") process (202-A Building) succeeded both the original bismuth phosphate and REDOX processes for fuel separation. The 202-A Building operated from 1956 to 1972 and from 1983 to 1988 and was put on "standby" in 1990. The process utilized tributyl phosphate extraction and reduced overall waste volumes at the expense of increased high-level waste volume.
- The Semiworks Aggregate Area was a plutonium-uranium extraction pilot-plant area where process development and process improvement operations for the REDOX and PUREX processes were performed. Criticality tests were also performed at the Semiworks Area.

From 1952 to 1958, the B Plant Aggregate Area single-shell tank farms supplied the raw material for the uranium recovery mission taking place at the 221-U Building. Metal wastes stored in the single-shell tanks were sluice-mined from the tanks, dissolved with nitric acid, and transferred to the 221-U Building where uranium was recovered by the tributyl phosphate/normal paraffin hydrocarbon (NPH) extraction process.

In 1956 high ^{60}Co concentrations in the groundwater beneath the cribs receiving the uranium recovery wastes from the U Plant Aggregate Area necessitated the transfer of the process supernatant back to the B Plant Aggregate Area where it was discharged to 16 specific retention trenches and 6 specific retention cribs located in the 200-BP-2 Operable Unit and the BY cribs located in the 200-BP-1 Operable Unit. This practice continued until the completion of the uranium recovery mission in 1958. The area surrounding the trenches and cribs is a controlled area designated UN-200-E-83.

From 1968 to 1978, during the B Plant Aggregate Area's second mission, waste from the PUREX Plant Aggregate Area waste storage tanks was used to recover ^{90}Sr and ^{137}Cs for space and medical applications. High-level sludge from the twelve self-boiling PUREX Plant Aggregate Area tanks yielded ^{90}Sr ; the supernatant was used to recover ^{137}Cs . The remaining waste was evaporated, with condensate discharge to the ground and concentrate returned to the tanks.

Over the years there have been numerous high-level liquid waste transfers into and out of the B Plant Aggregate Area single-shell tanks involving other aggregate areas. As a

result, the 241-B, 241-BX, and 241-BY Tank Farms contain wastes with a broad background of origin, type, treatment, and age. Inputs have included PUREX coating wastes, PNL waste, REDOX high-level waste, ion exchange waste, double-shell slurry feed from the 241-S and 241-SX Tank Farms, and organic wash waste.

The B Plant Aggregate Area operable unit 200-BP-8 consists primarily of several east-west running ditches whose boundary protrudes well into the 200-PO-6 Operable Unit of the PUREX Plant Aggregate Area. Several unplanned release sites (UPR-200-E-24, UPR-200-E-30, UPR-200-E-50) exist along this protrusion and may have contributed to some inter-area contaminant migration. An underground pipe completes the crossing of the 200-PO-6 Operable Unit and into the 216-B-3 Pond system in the 200-B-11 Operable Unit.

The 216-B-3 Pond, and its three auxiliary overflow ponds 216-B-3A, 216-B-3B, and 216-B-3C received cooling water and low-level liquid waste from the 221-B Building. These ponds also received 202-A Building wastes via the 216-A-29 Ditch. Typical PUREX Plant Aggregate Area wastes included cooling water from 244-AR and 244-CR Vaults and process wastes from the 242-A Evaporator and the 202-A Building. All four ponds are still classified as active units.

The 200 East Area Construction Pit lies just west and outside of the fenceline border of the B Plant Aggregate Area. Located one-half mile west of the pit and also outside the aggregate area is the 241-EW-151 Diversion Box. Near these two locations is the future site of the Hanford Waste Vitrification Plant to be located within the 200-BP-9 Operable Unit.

The 200-IU-6 Operable Unit lies north of the main B Plant Aggregate Area and consists of the 216-A-25 Pond (Gable Mountain Pond) and the 216-N-8 Pond (West Lake). Gable Mountain Pond received cooling water from the PUREX Plant and low-level liquid waste from the 242-A Evaporator, the 244-AR Vault, and the 241-A Tank Farm. It has been filled-in and is no longer functional. West Lake exists but has always been inactive.

2.6 INTERACTION WITH RESOURCE CONSERVATION AND RECOVERY ACT PROGRAM

Appendixes B and C of the Tri-Party Agreement (Ecology et al. 1990) list RCRA TSD facilities on the Hanford Site that have entered interim status and, thus, will require final permitting or closure. Within the geographical extent of the B Plant Aggregate Area there are a number of facilities that fall into this category.

The 216-B-3 Pond system, the 2101-M Pond, the 200-E-8 Borrow Pit, the 216-B-63 Trench, and the 241-B, -BX, and -BY Tank Farms are all to be closed. Operating permits are to be sought for the 244-BX Receiver Tank, the 218-E-10 Burial Ground, and a number of B Plant Aggregate Area facilities including the Waste Concentrator, the Radioactive Organic Waste Solvent Tanks (tanks 1 through 7), the Storage Area, and the Waste Piles in and around the 221-B Building.

The 216-B-3 Pond system includes ponds 216-B-3, 216-B-3A, 216-B-3B, 216-B-3C, and the 216-B-3-3 Ditch. All these facilities are identified as RCRA TSD units because of their long term use for disposal of low-level mixed wastes. The Closure/Postclosure Plan was submitted to Ecology and EPA in March 1990. The current status of the Closure/Postclosure Plan can be obtained from the RCRA Permitting Group. Unplanned releases UN-200-E-14, UN-200-E-32, UPR-200-E-34, UPR-200-E-51, and UPR-200-E-138 are all associated with the 216-B-3 Pond system.

The 200-E-8 Borrow Pit Demolition Site Closure Plan was submitted to Ecology and EPA in November 1992. The current status of the Closure/Postclosure Plan can be obtained from the RCRA Permitting Group. The 216-B-63 Trench is scheduled to have a closure plan submitted to Ecology and EPA in May 1996.

The 40 single-shell tanks of the 241-B, 241-BX, and 241-BY Tank Farms will be closed under RCRA rather than seek a RCRA operating permit. The preferred closure option will be resolved through the preparation and completion of a supplemental environmental impact statement (EIS). A number of unplanned releases are associated with the tanks. In the 241-B Tank Farm these releases include UPR-200-E-108 (tank 241-B-101), UPR-200-E-127 (tank 241-B-107), UPR-200-E-128 (tank 241-B-110), UPR-200-E-129 (tank 241-B-201), and UPR-200-E-130 (tank 241-B-203). In 241-BX Tank Farm the releases are UPR-200-E-5, -131, and -132 (tank 241-BX-102) and UPR-200-E-133 (tank 241-BX-108). In 241-BY Tank Farm the associated releases are UPR-200-E-134 (tank 241-BY-103), UPR-200-E-135 (tank 241-BY-108), and UPR-200-E-116 (tank 241-BY-112). The 244-BXR Vault has been transferred to the Single-Shell Tank Program and will be closed as a part of the 241-BX Tank Farm.

The 218-E-10 Burial Ground is included in a Part B Permit Application for eight burial grounds. The permit application has been submitted to Ecology and is in the third "Notice of Deficiency" cycle.

In October 1995, the Part B permit covering B Plant Aggregate Area facilities is to be submitted to Ecology and EPA with an expected permit issue in 1997. These facilities, located within or adjacent to the 221-B Building include the following:

Waste Concentrator	treatment
Radioactive Organic Waste	storage
Solvent Tanks 1 through 7	
Storage Area	storage
Waste Piles	storage

The four HWSAs, 226-B, 2703-E, 2704-E, and 2715-EA, perform as temporary waste accumulators and, as such, are not required to have a RCRA Part B permit.

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2.7 INTERACTIONS WITH OTHER HANFORD PROGRAMS

In addition to RCRA, there are several other ongoing programs that affect buildings and waste management units in the B Plant Aggregate Area. These programs include: the Hanford Surplus Facilities Program, the Radiation Area Remedial Action Program, the Hanford Site Single-Shell Tank Program, and the Defense Waste Management Program.

The Hanford Surplus Facilities Program is responsible for the safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities at the Hanford Site. There are four B Plant Aggregate Area facilities covered under this program. These facilities are the 224-B Plutonium Concentration Building, the 242-B Evaporator, the 241-B-361 Settling Tank, and the 270-E Condensate Neutralization Tank.

The Radiation Area Remedial Action (RARA) Program is conducted as part of the Surplus Facilities Program. The RARA is responsible for the surveillance, maintenance, decontamination, and/or interim stabilization of inactive burial grounds, cribs, ponds, trenches, and unplanned releases at the Hanford Site. A major concern associated with these requirements is the management and control of surface soil contamination. All of the controlled access surface radiation zones and the cribs with collapse potential in the B Plant Aggregate Area are covered by this program.

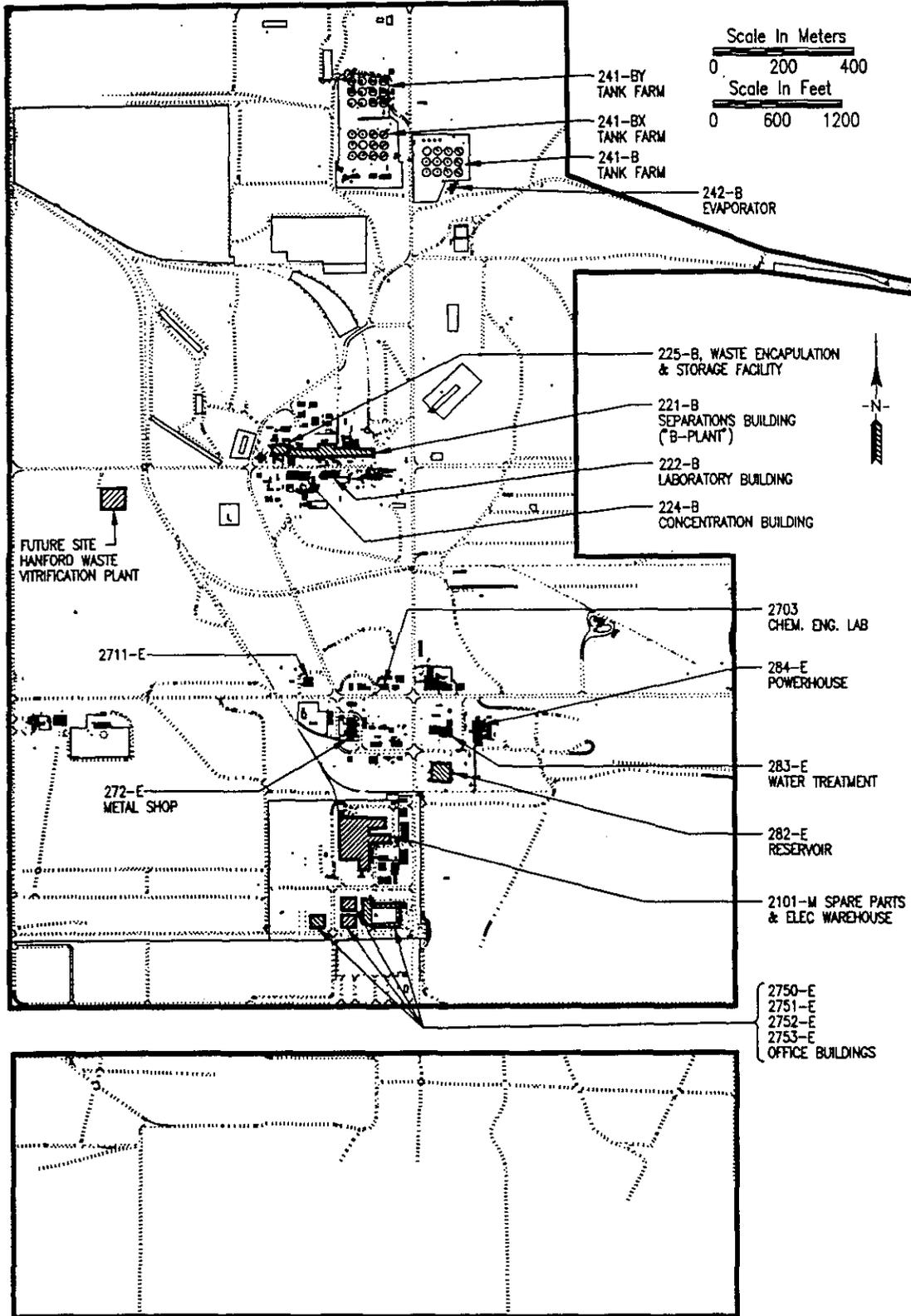
The Hanford Site Single-Shell Tank Program covers near-term waste management activities to ensure safe interim storage of waste in the tanks. It also addresses the environmental restoration activities to close the six single-shell tank operable units, including the 241-B, 241-BX, and 241-BY Tank Farms. The primary regulatory drivers of this program are the Tri-Party Agreement and RCRA.

The Defense Waste Management Program is responsible for all actively operating waste management units in the B Plant Aggregate Area. These facilities include the waste management units listed below and all high-level waste process lines and their associated diversion boxes.

<u>Operable Unit</u>	<u>Waste Management Unit</u>	<u>Type</u>
200-BP-5	216-B-59	retention basin
200-BP-6	226-B HWSA 241-ER-152 2607-E3 2607-E4	staging area diversion box septic tank septic tank
200-BP-7	2607-EB	septic tank

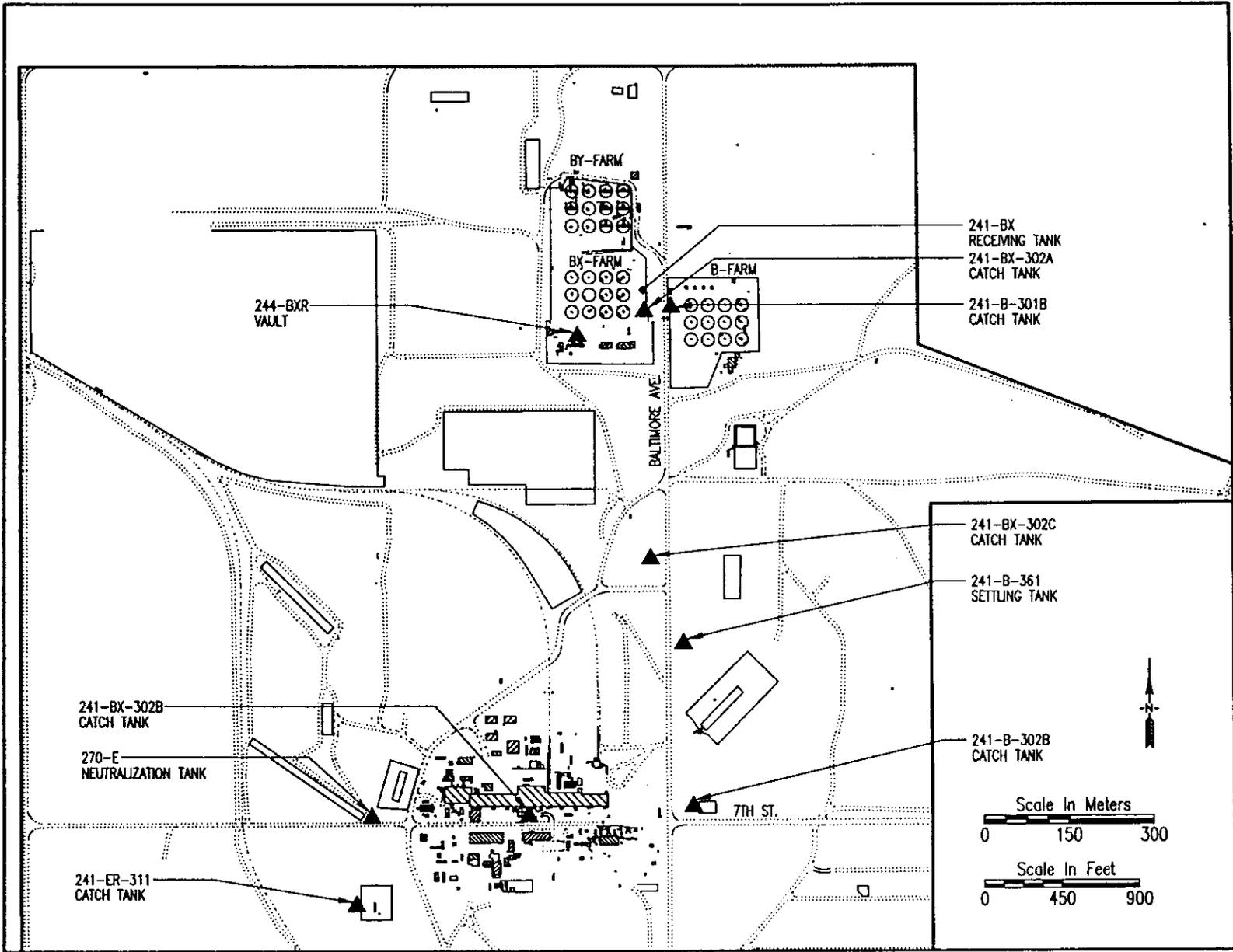
<u>Operable Unit</u>	<u>Waste Management Unit</u>	<u>Type</u>
200-BP-8	207-B 216-B-63 2607-E9	retention basin trench septic tank
200-BP-9	216-B-55 216-B-62 241-ER-151 241-ER-311	crib crib diversion box catch tank
200-BP-10	218-E-10	burial ground
200-BP-11	216-B-3 216-B-3A 216-B-3B 216-B-3C 216-B-3-3	pond pond pond pond ditch
200-SS-1	2703-E HWSA 2704-E HWSA 2715-EA HWSA 2607-E1, -E2, -E8, -E11, -EK, -EM, -EN, -EO, -EP, -EQ, -Er, -GF 200-E Powerhouse Ash Pit	staging area staging area staging area septic tanks

Figure 2-1. Location of Plants, Buildings, and Storage Units.



9 3 1 2 8 9 6 7 9 3 6

Figure 2-2. Location of Tank and Vaults.



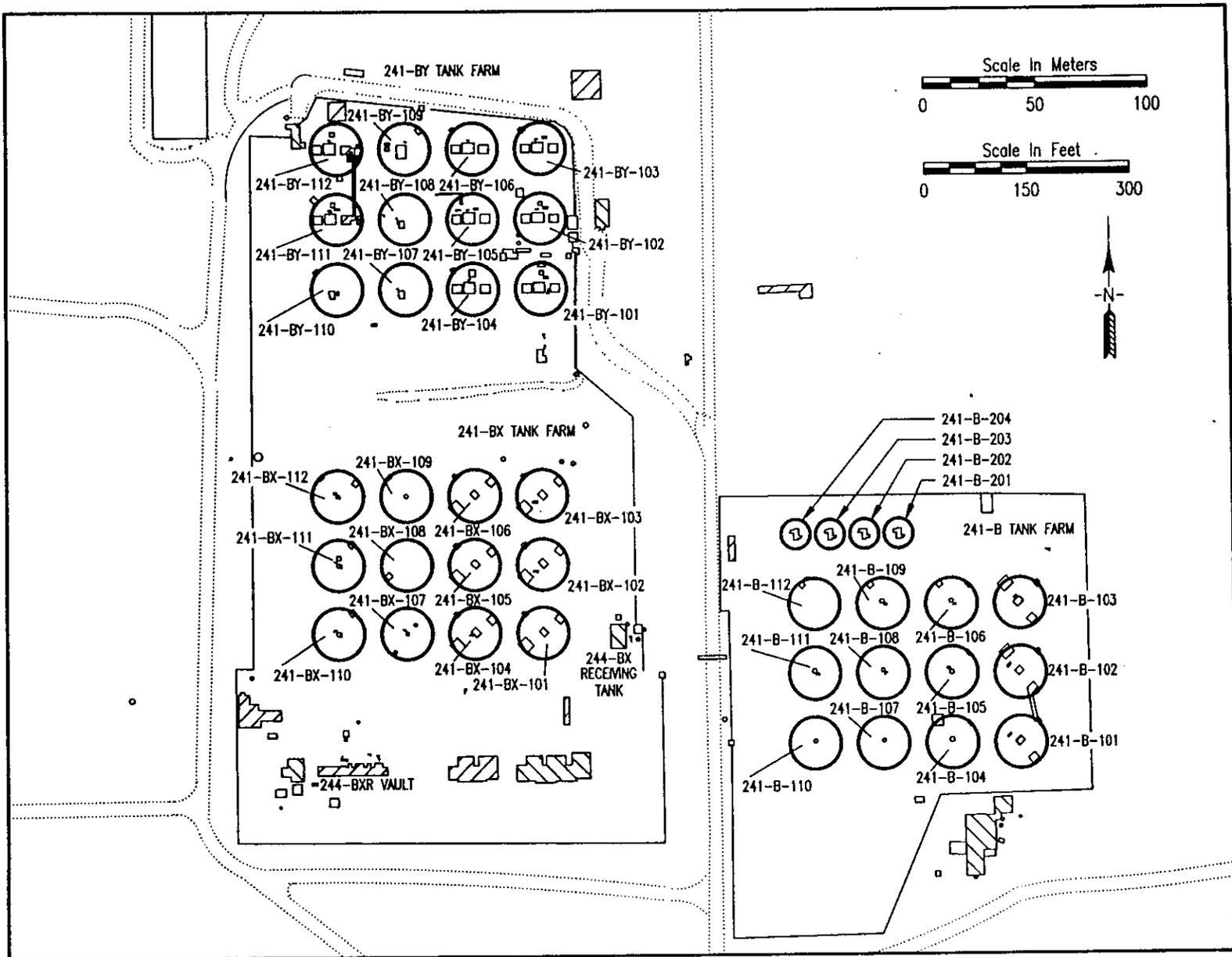
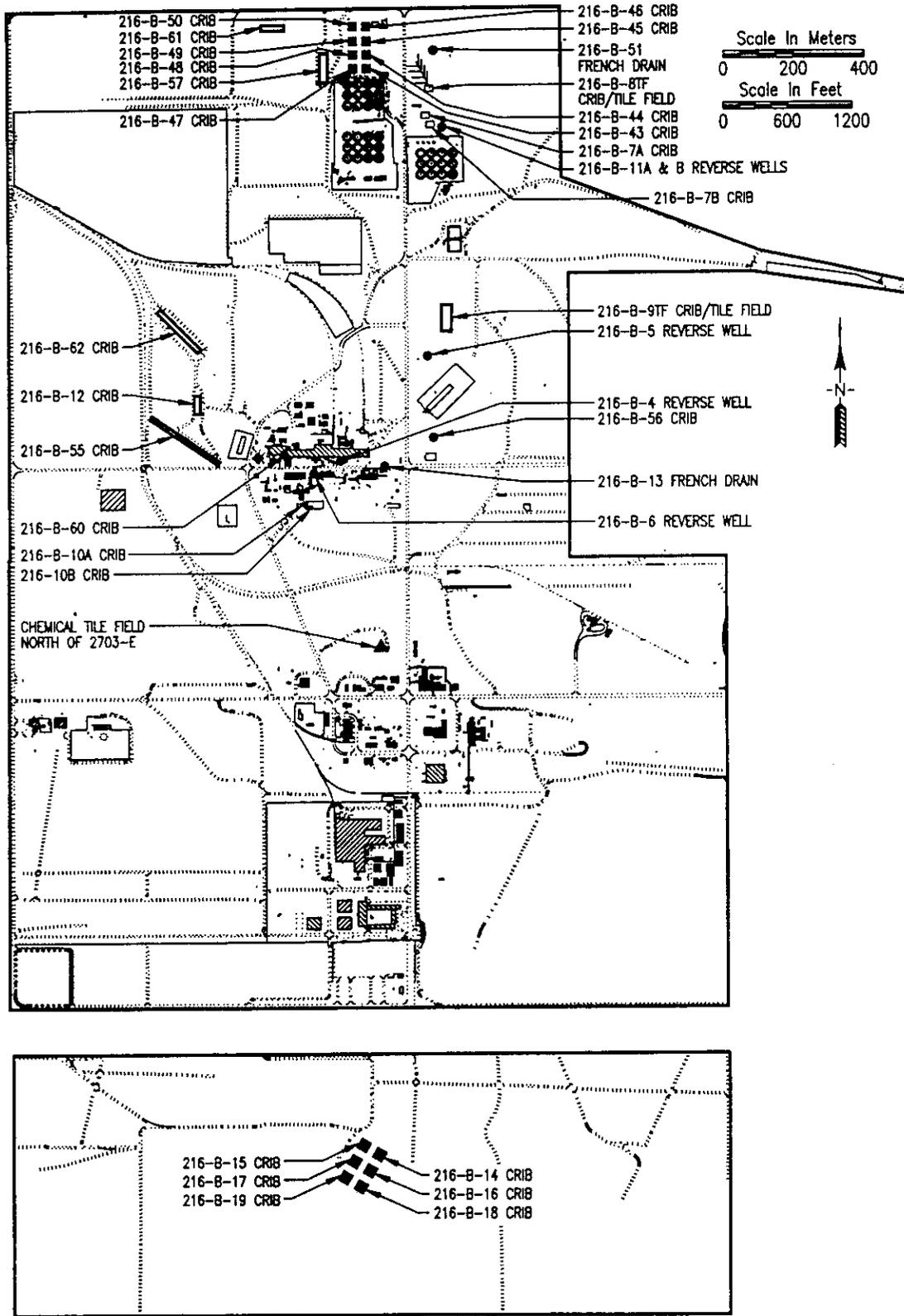


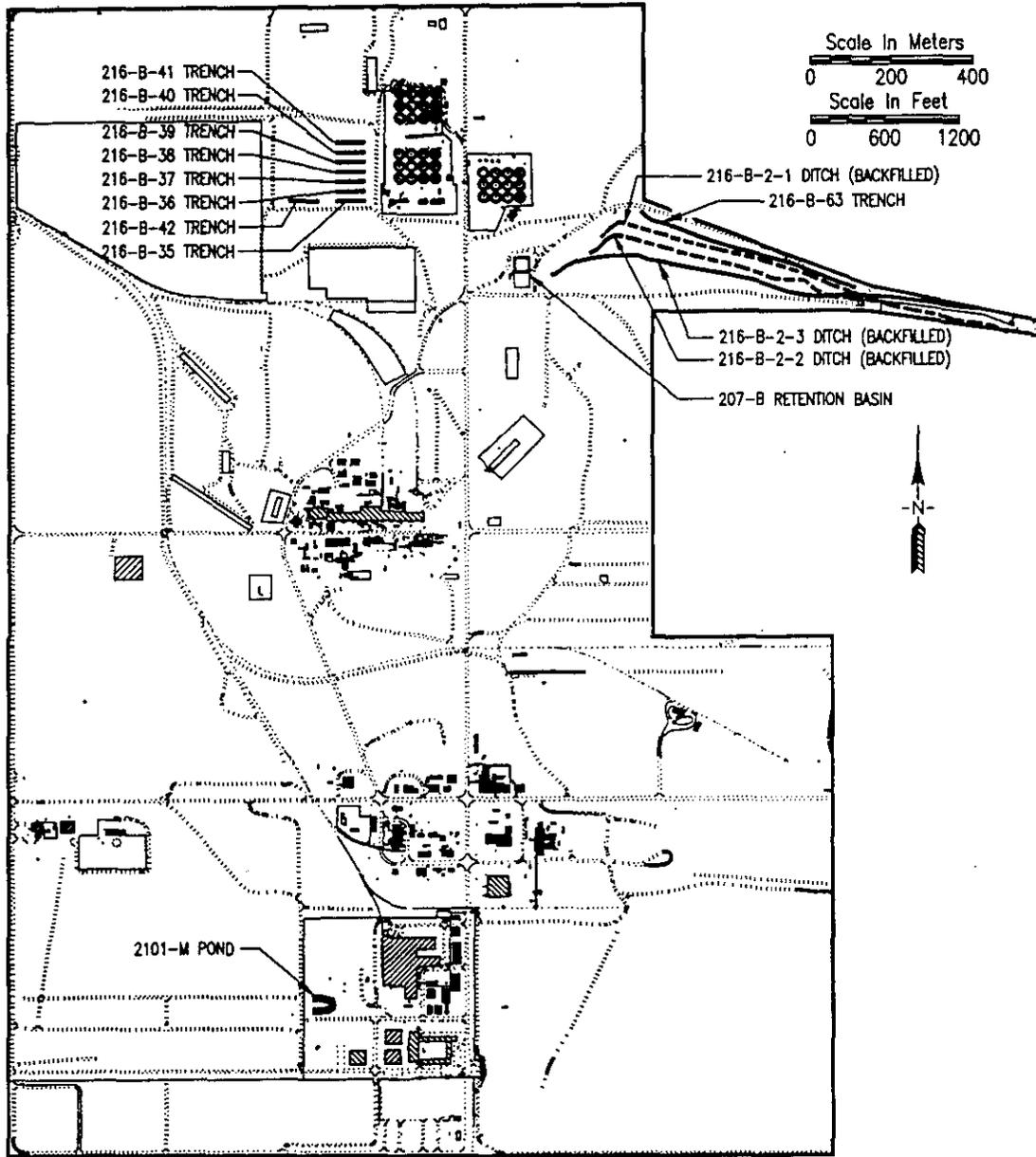
Figure 2-3. Location of Tank and Vaults in the Single-Shell Tank Farms.

Figure 2-4. Location of Cribs, Drains, and Reverse Wells.



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Figure 2-5. Location of Ponds, Ditches, and Trenches: Western Portion Operable Units.



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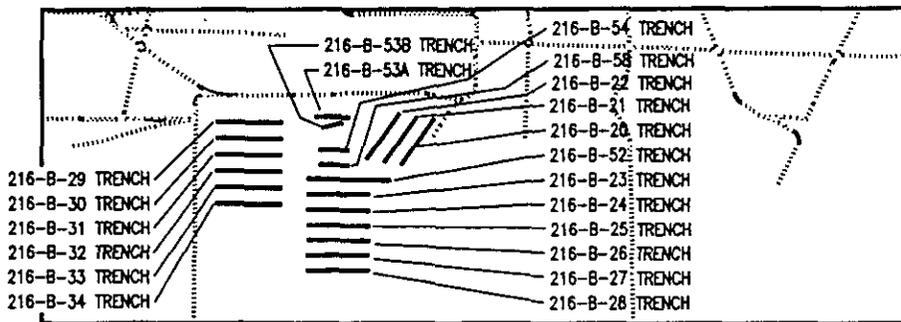
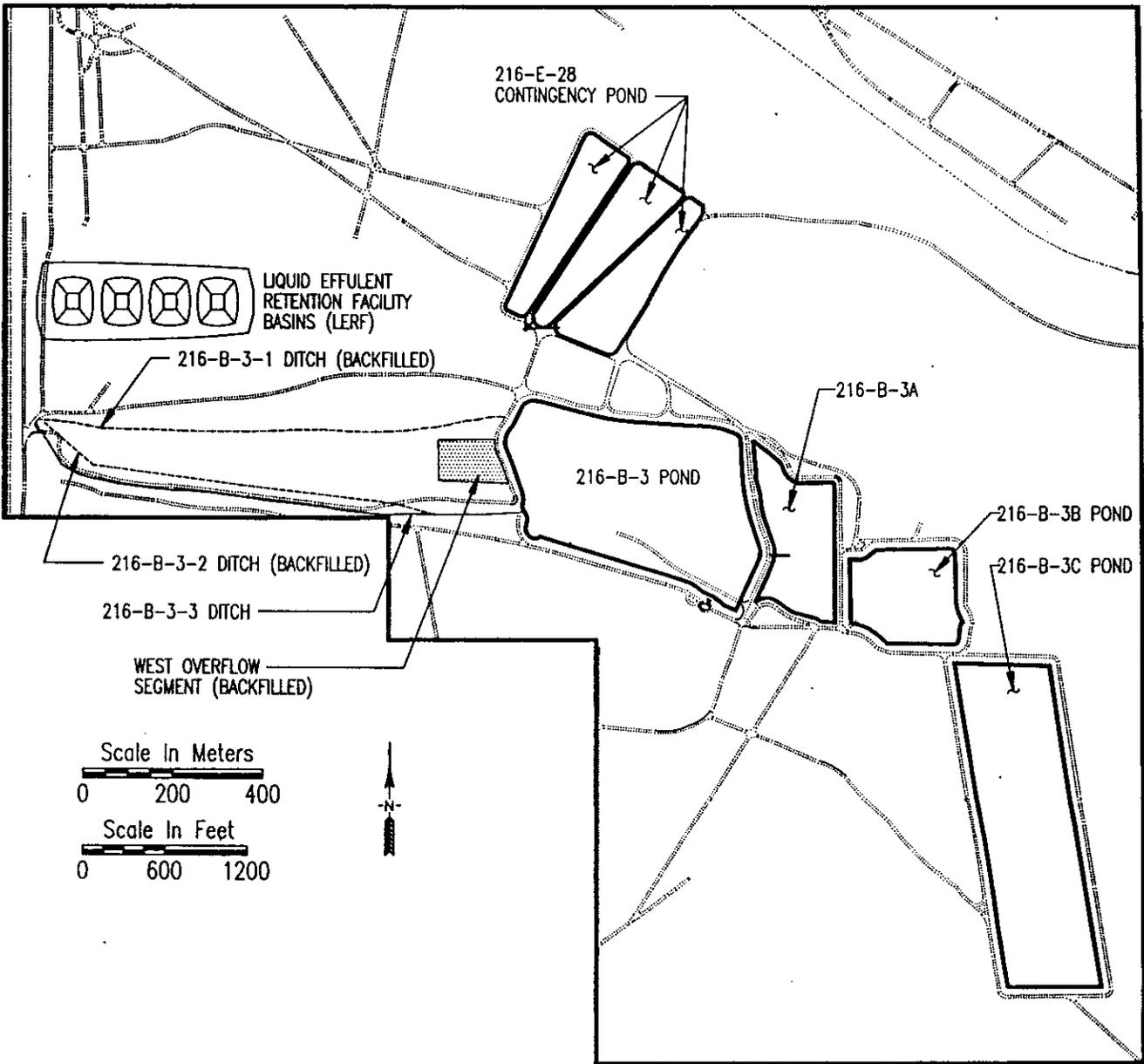


Figure 2-6. Location of Ponds, Ditches, and Trenches: 200-BP-11 Operable Unit.



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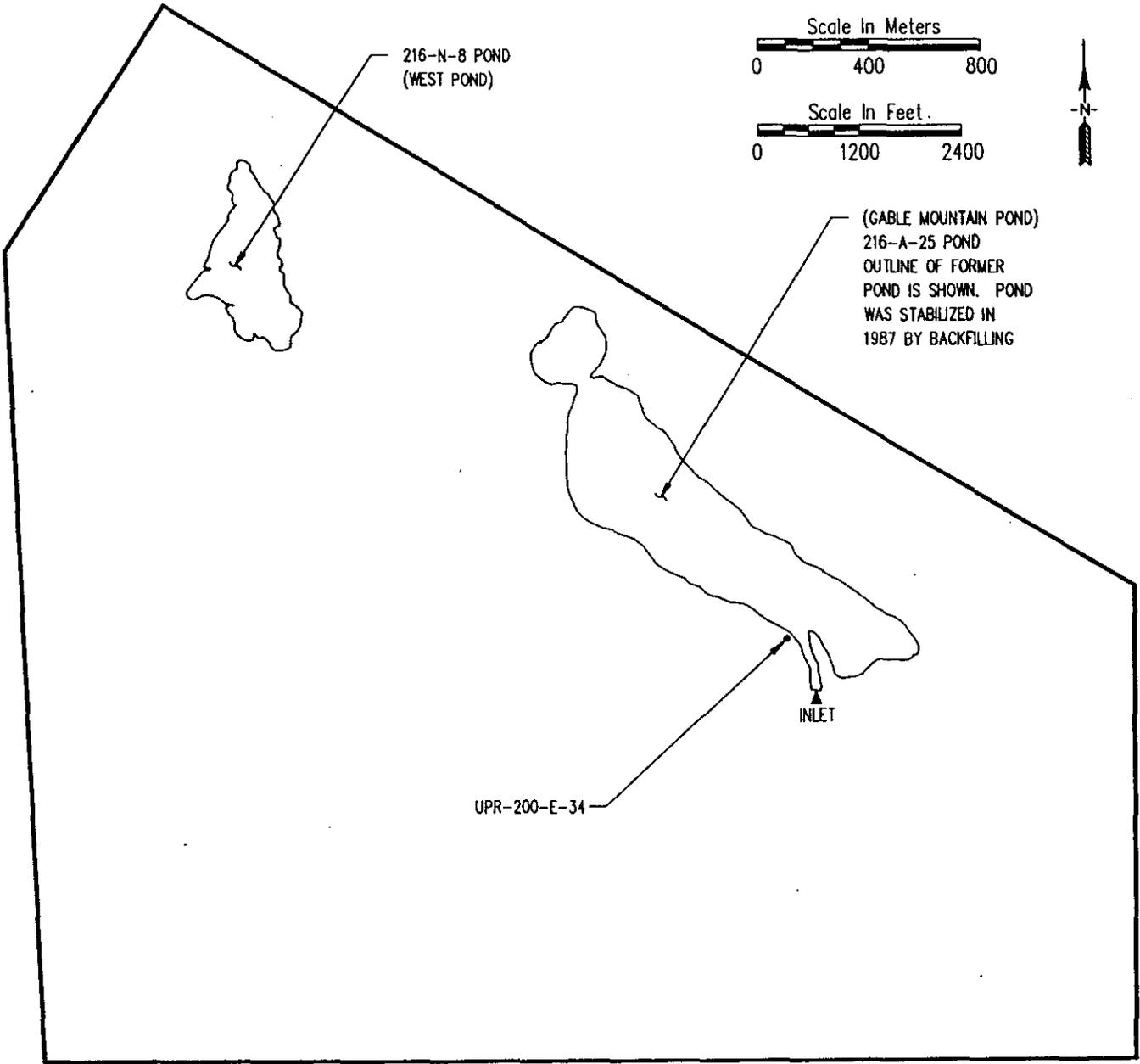


Figure 2-7. Location of Ponds and Unplanned Releases: 200-IP-6 Operable Unit.

Figure 2-8. Location of Septic Tanks and Drain Fields.

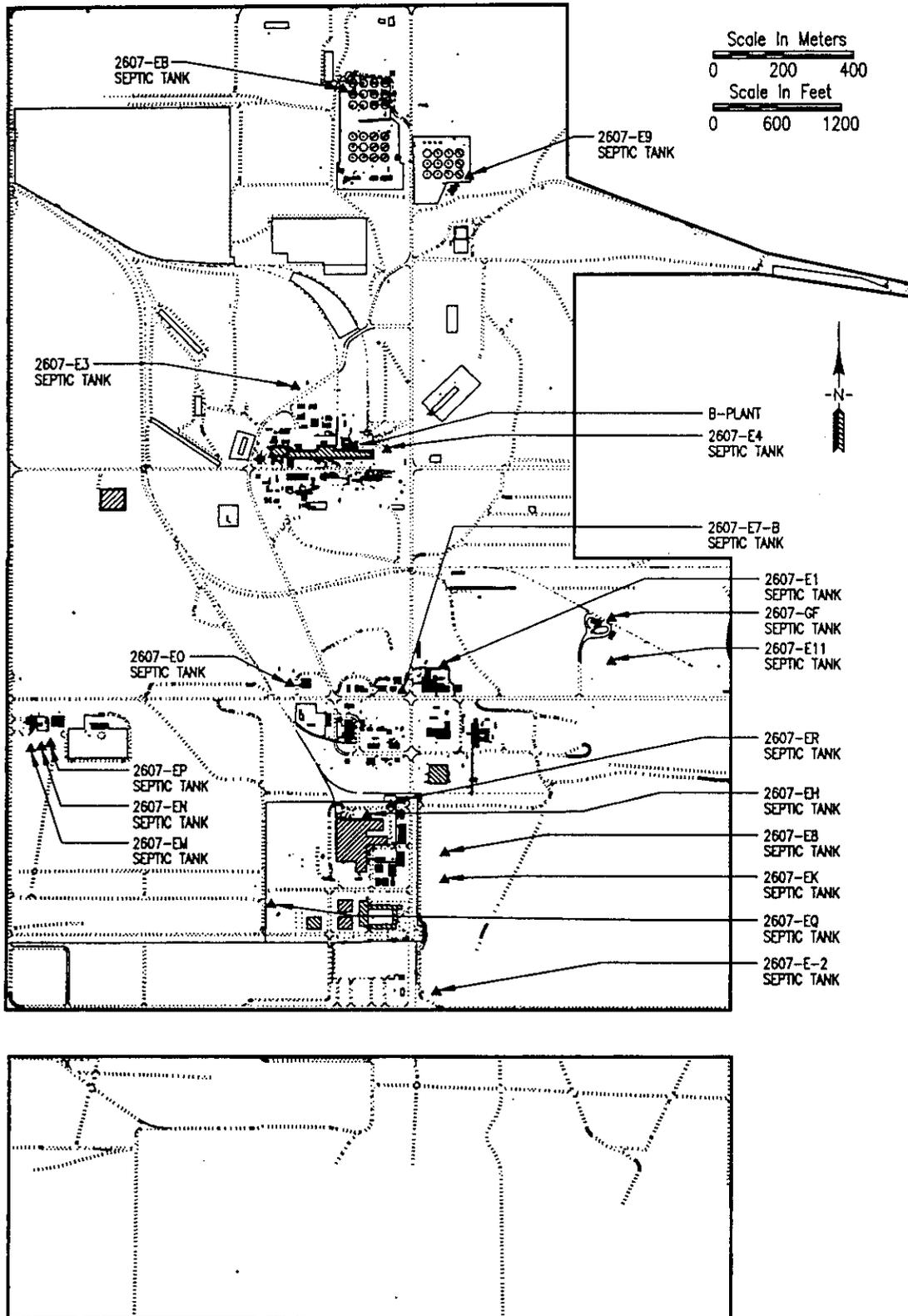
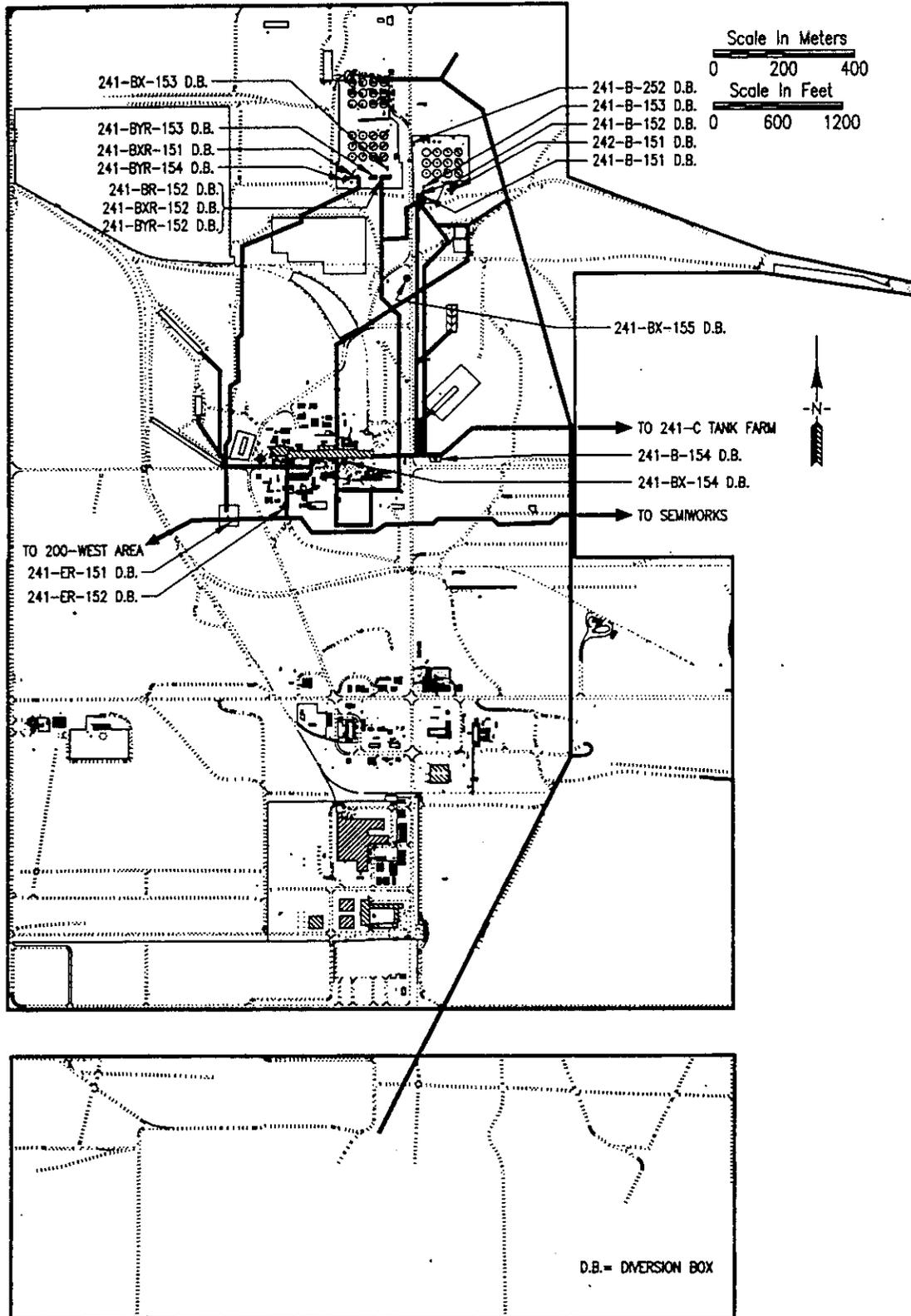


Figure 2-9. Location of Transfer Facilities, Diversion Boxes, and Pipelines: Western Portion Operable Units.



9 5 1 2 8 9 6 0 3 4 4

Figure 2-10. Location of Basins.

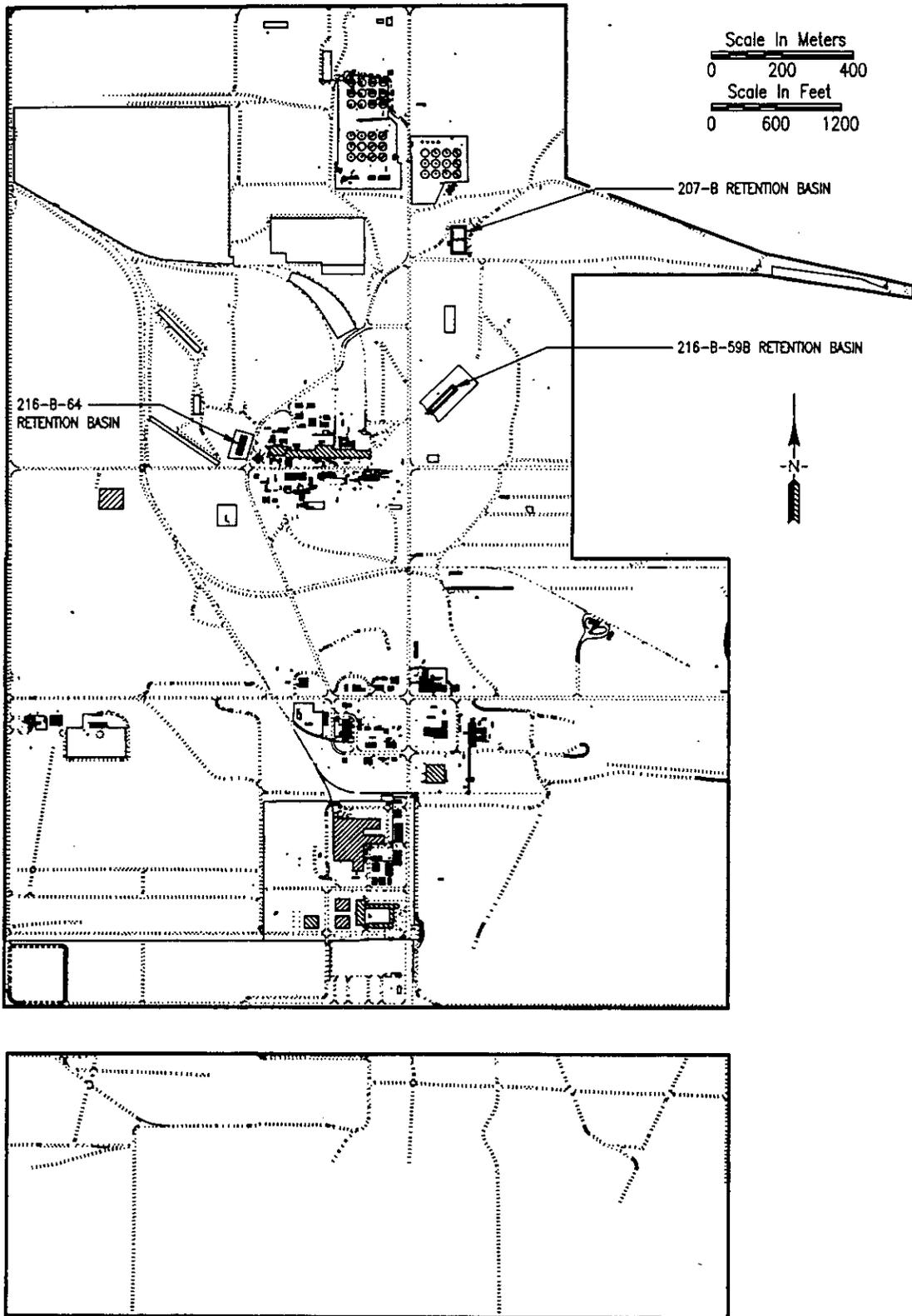


Figure 2-11. Location of Burial Sites.

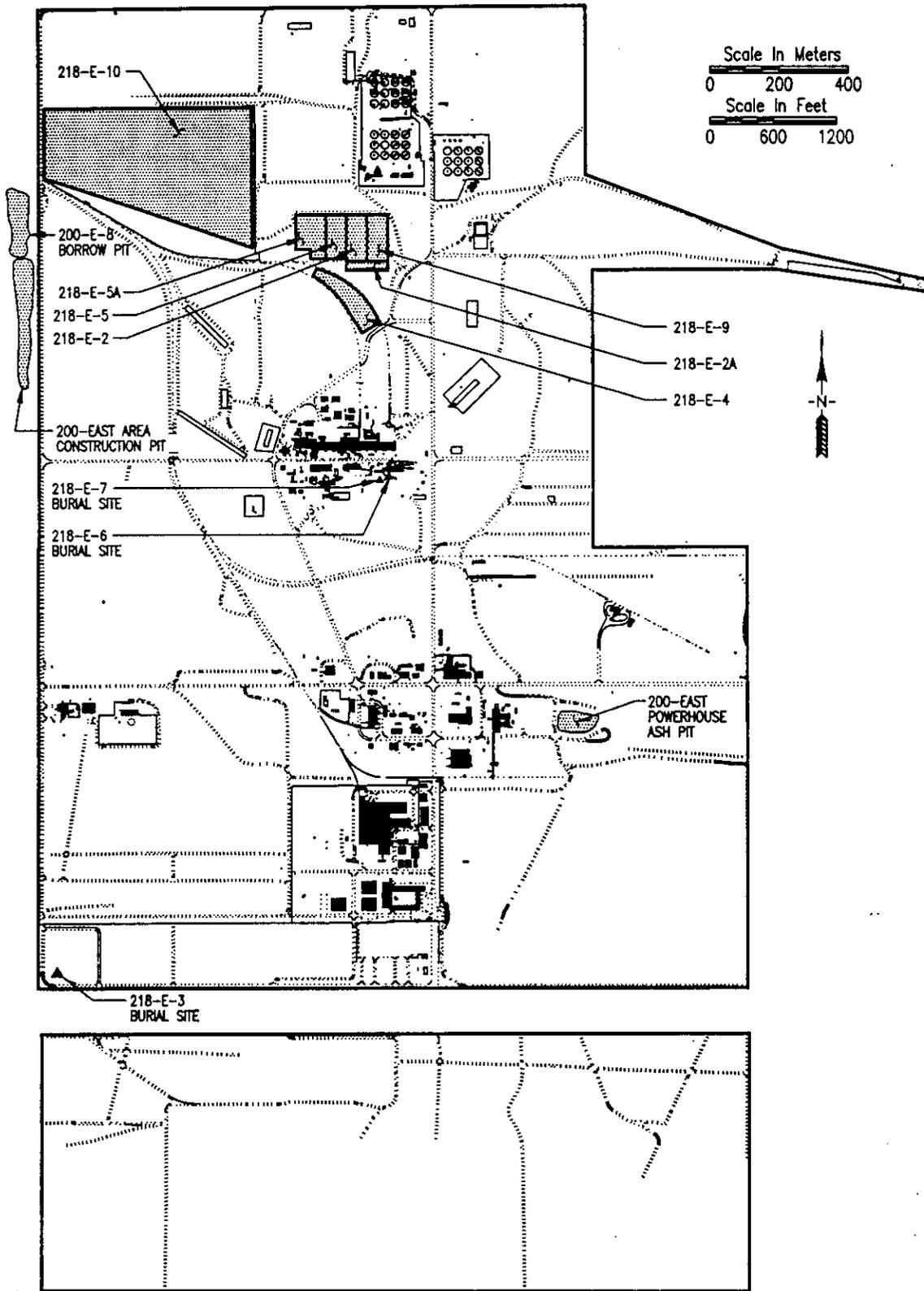
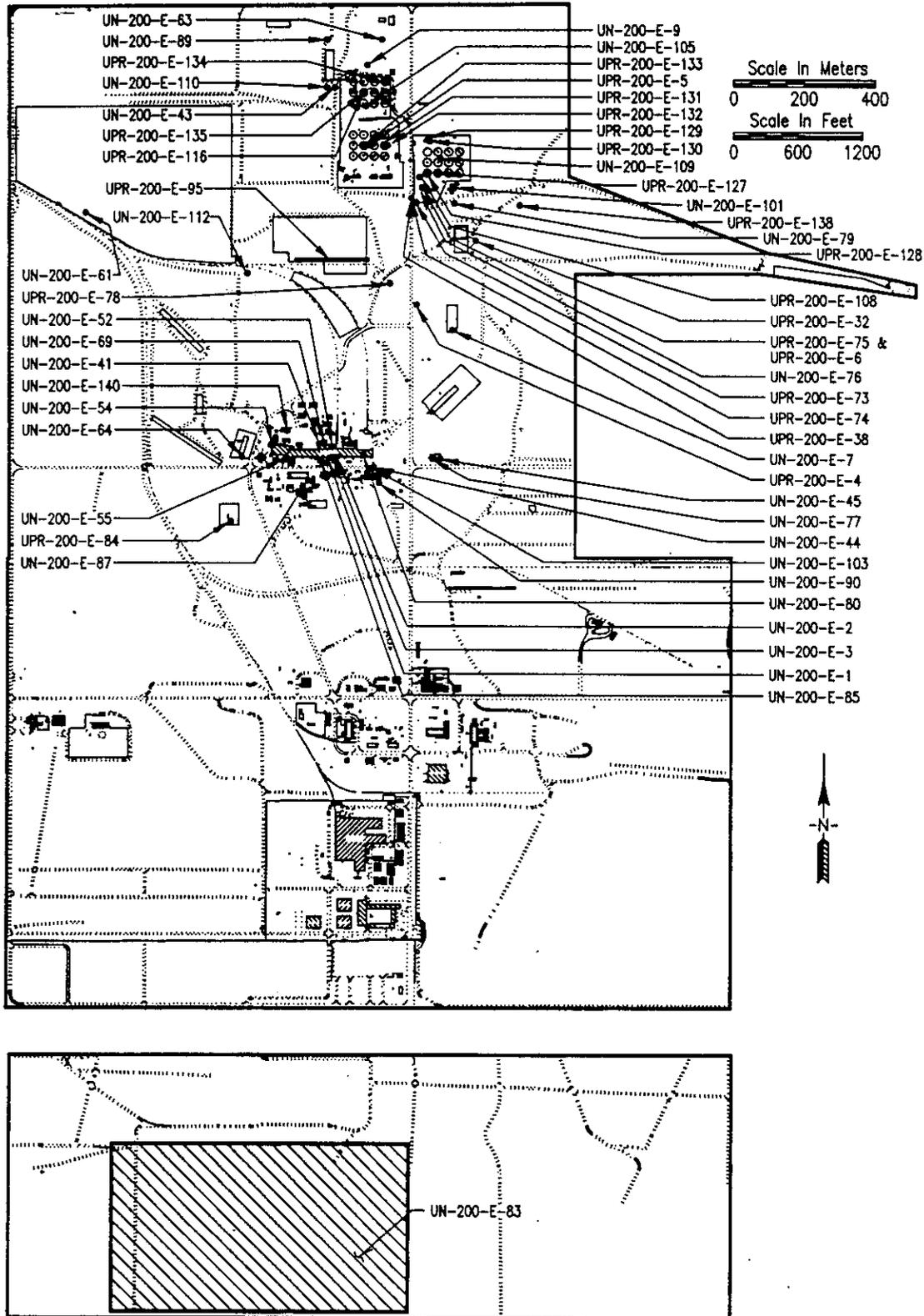
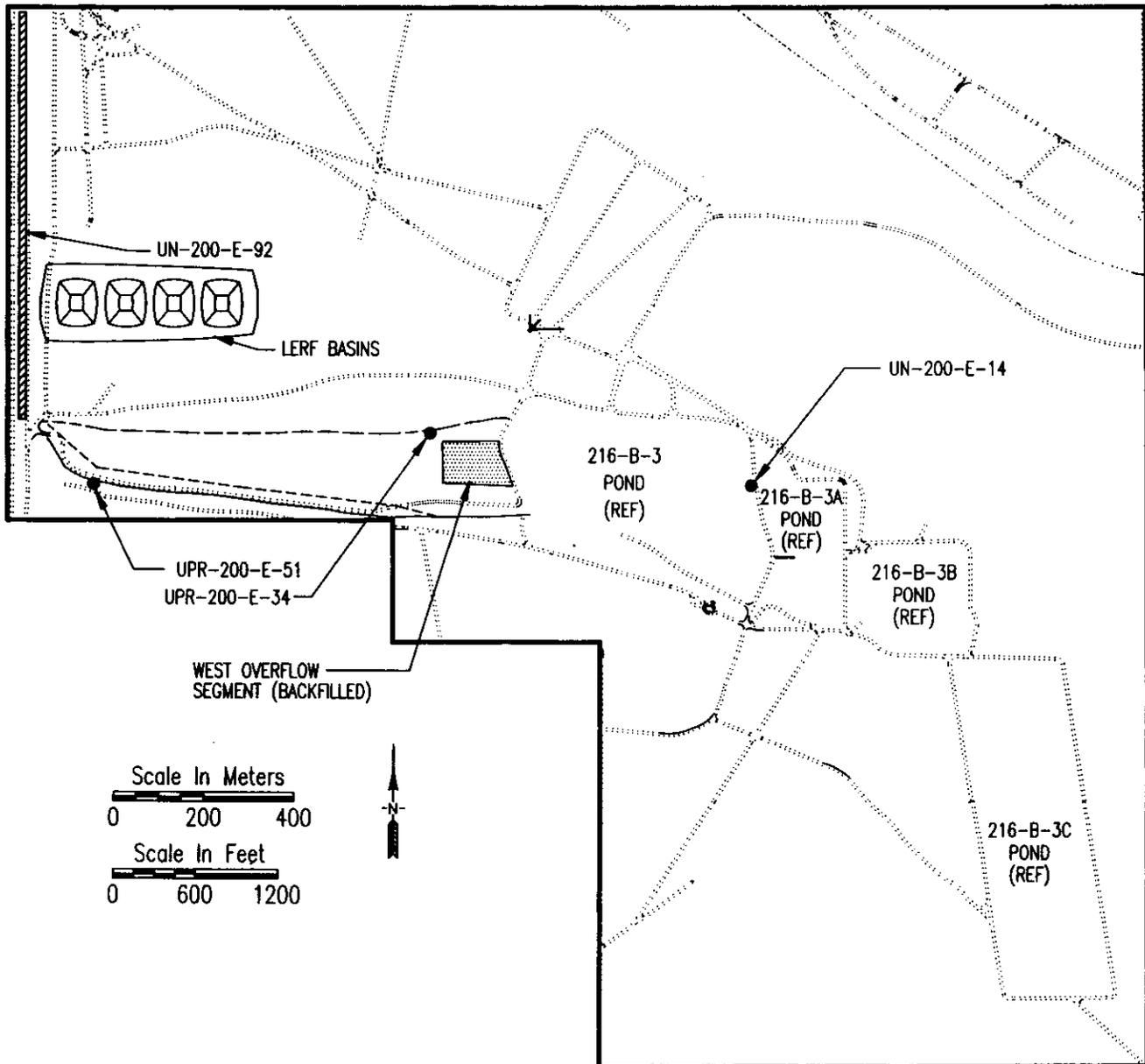


Figure 2-12. Location of Unplanned Releases: Western Portion Operable Units.

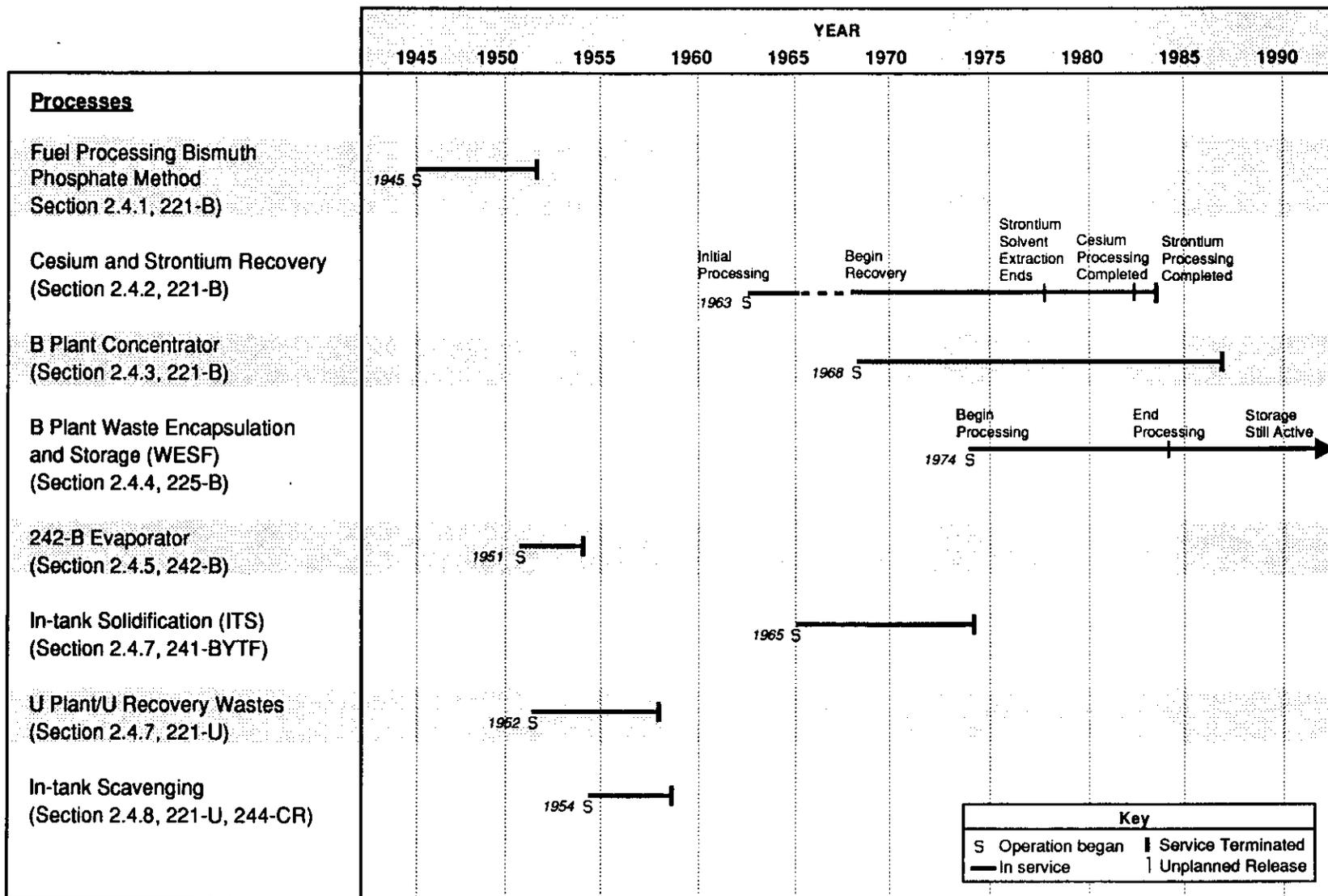


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Figure 2-13. Location of Unplanned Releases: 200-BP-11 Operable Unit.



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Figure 2-14. Process History of B Plant Aggregate Area.

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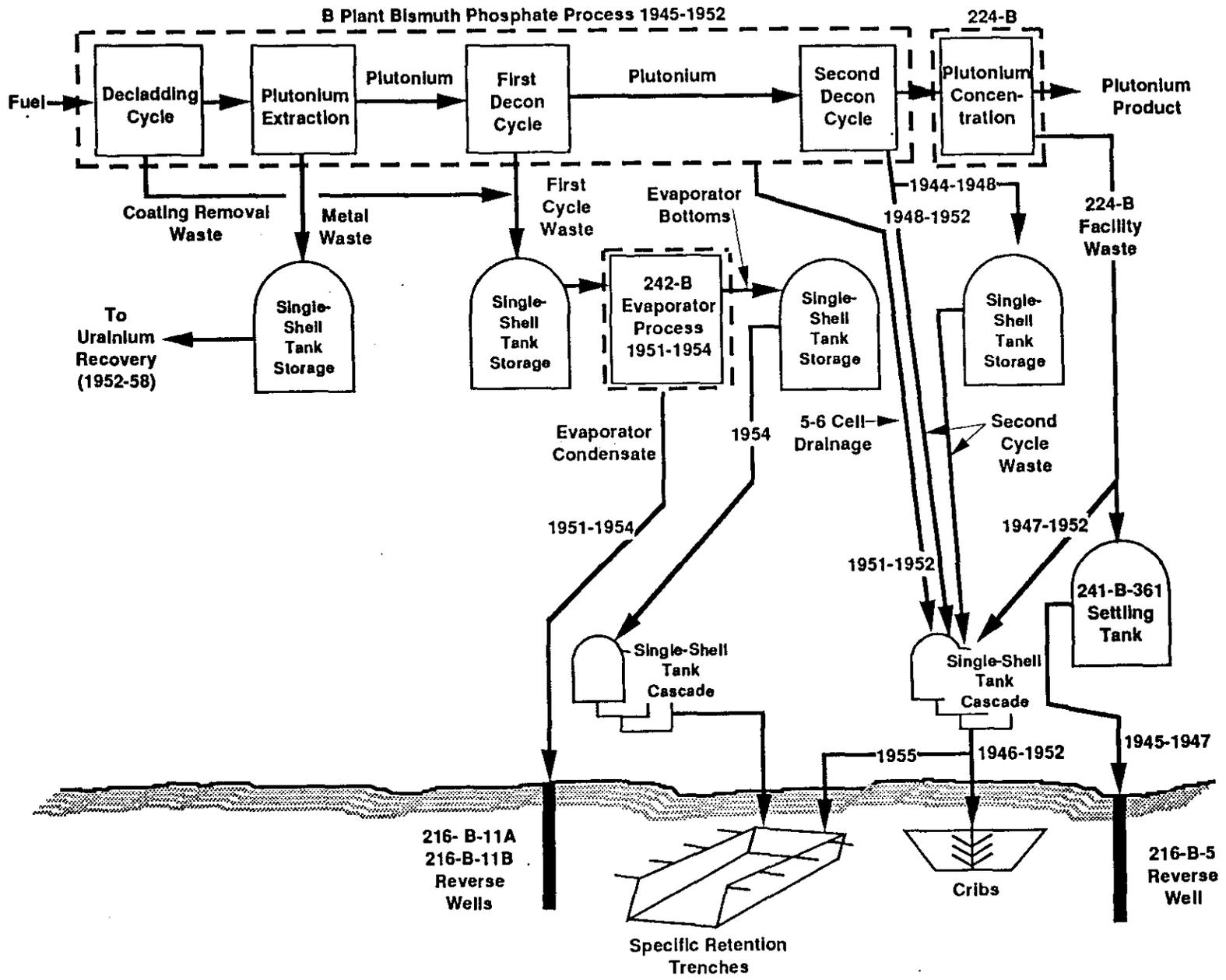


Figure 2-15. Fuel Separations Processing at B Plant (1945-1954).

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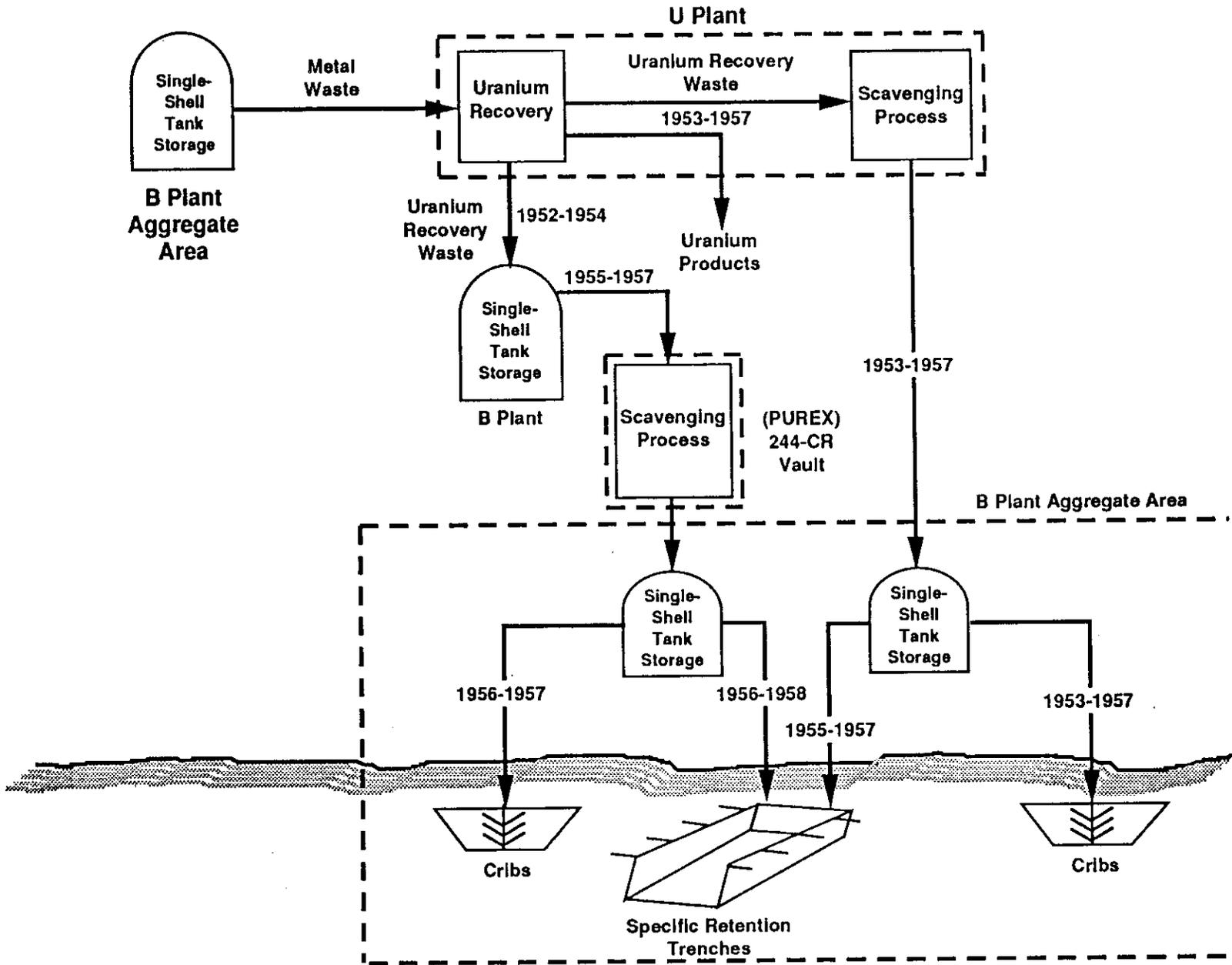
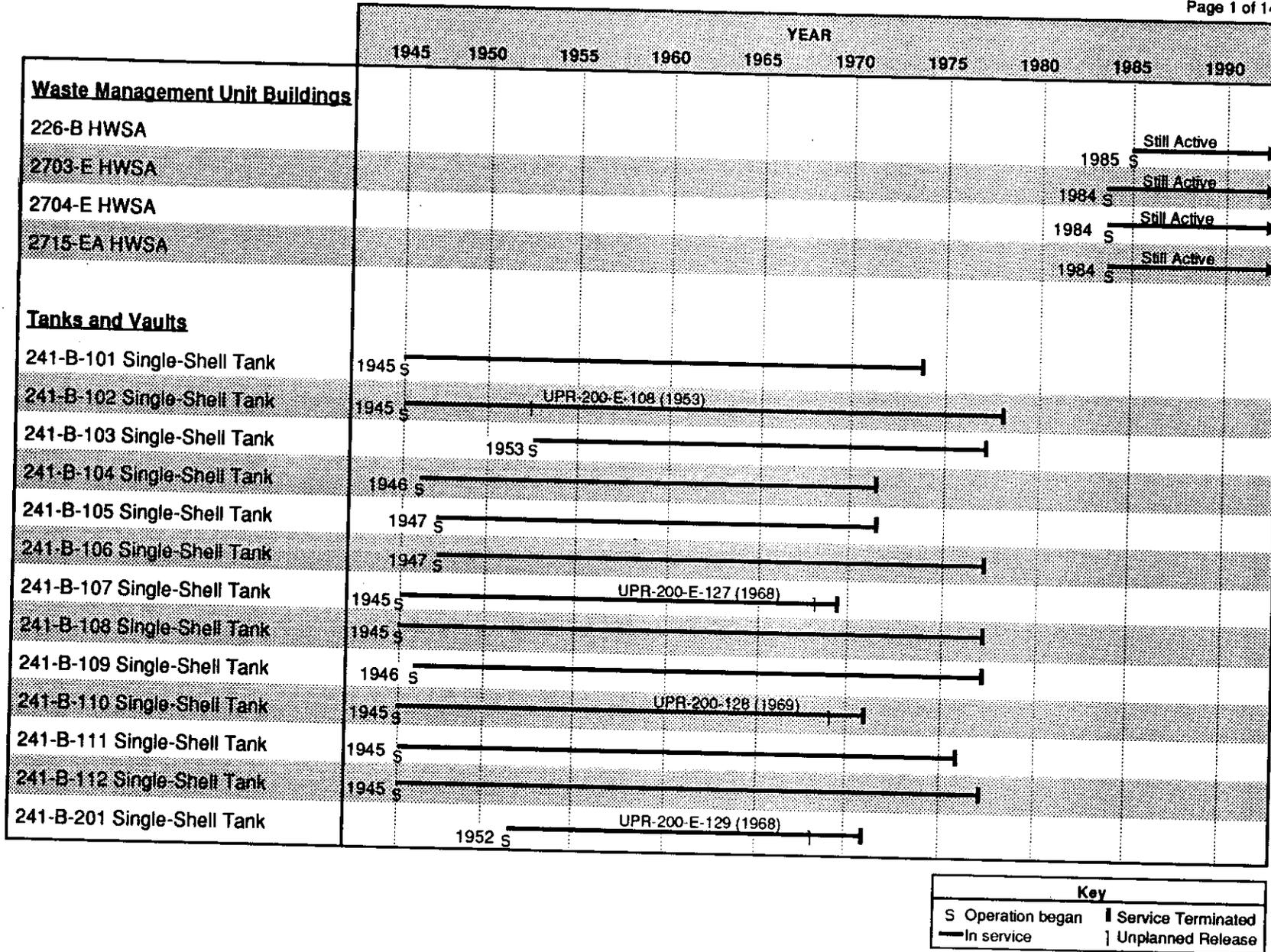


Figure 2-16. B Plant Aggregate Area Uranium Recovery Processing and Tank Scavenging Processes.

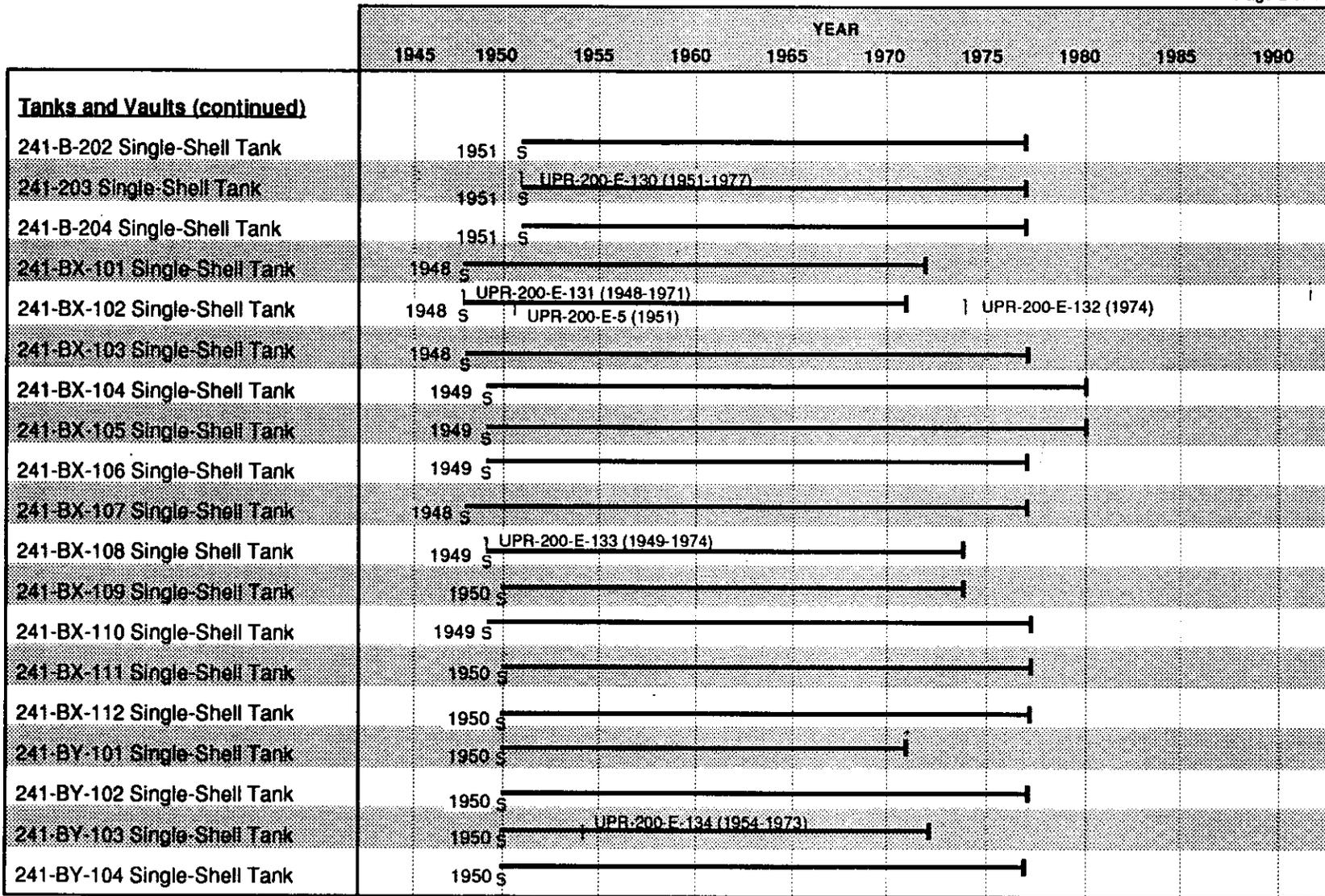
Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



2F-17a

Key	
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—	In service
	Service Terminated
]	Unplanned Release

Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



2F-17b

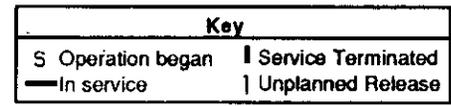


Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.

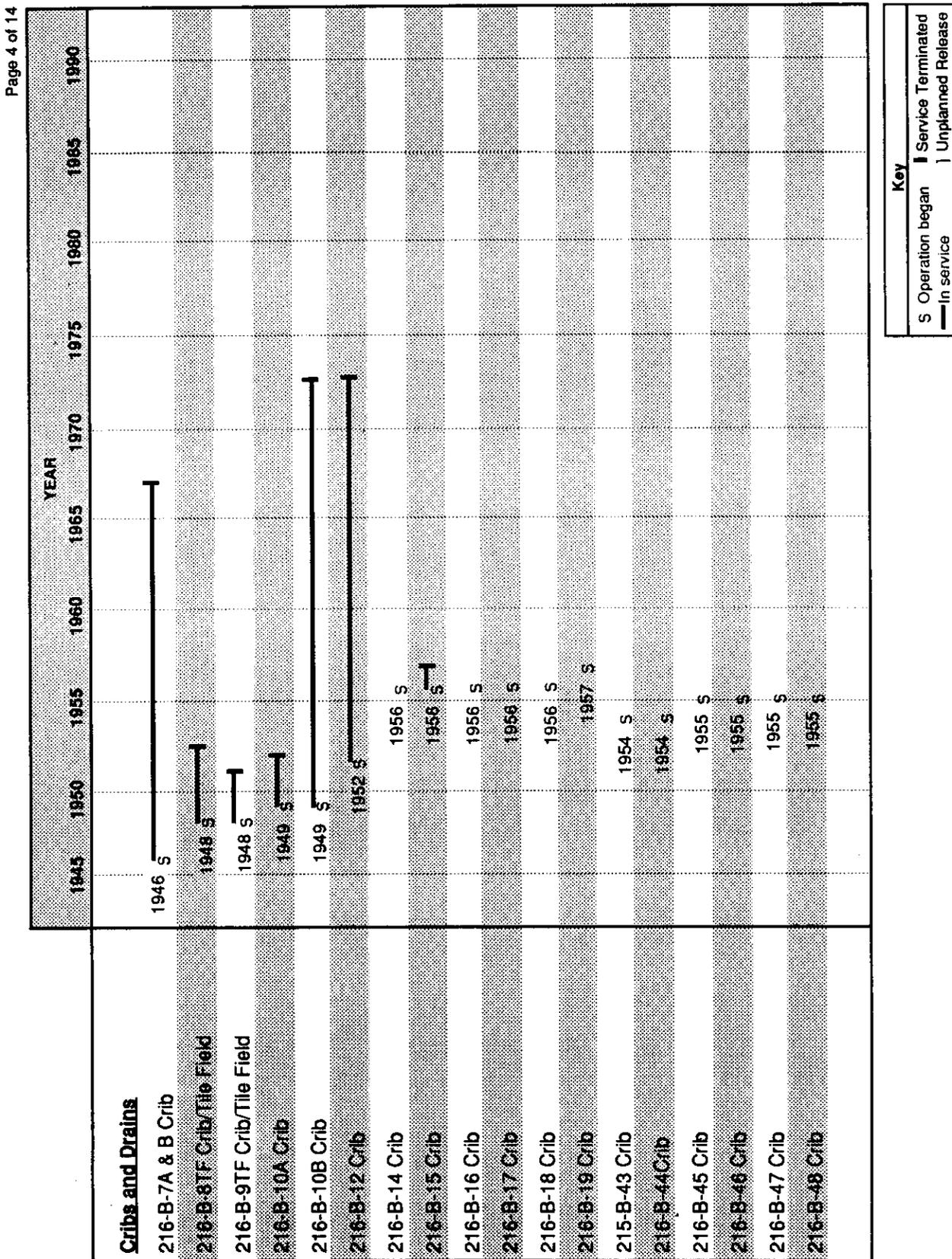
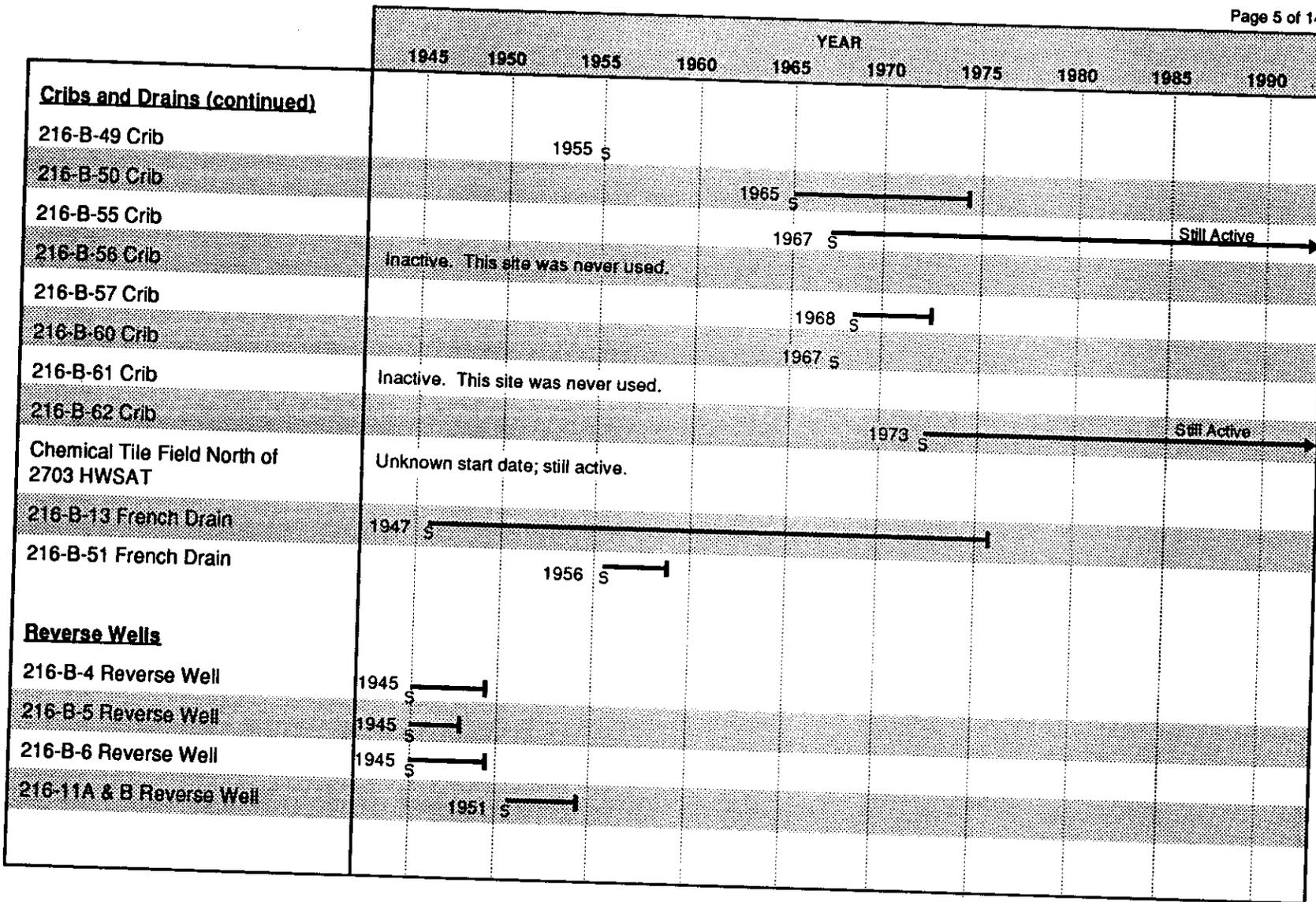


Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



Key			
S	Operation began		Service Terminated
—	In service		Unplanned Release

2F-17e

Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.

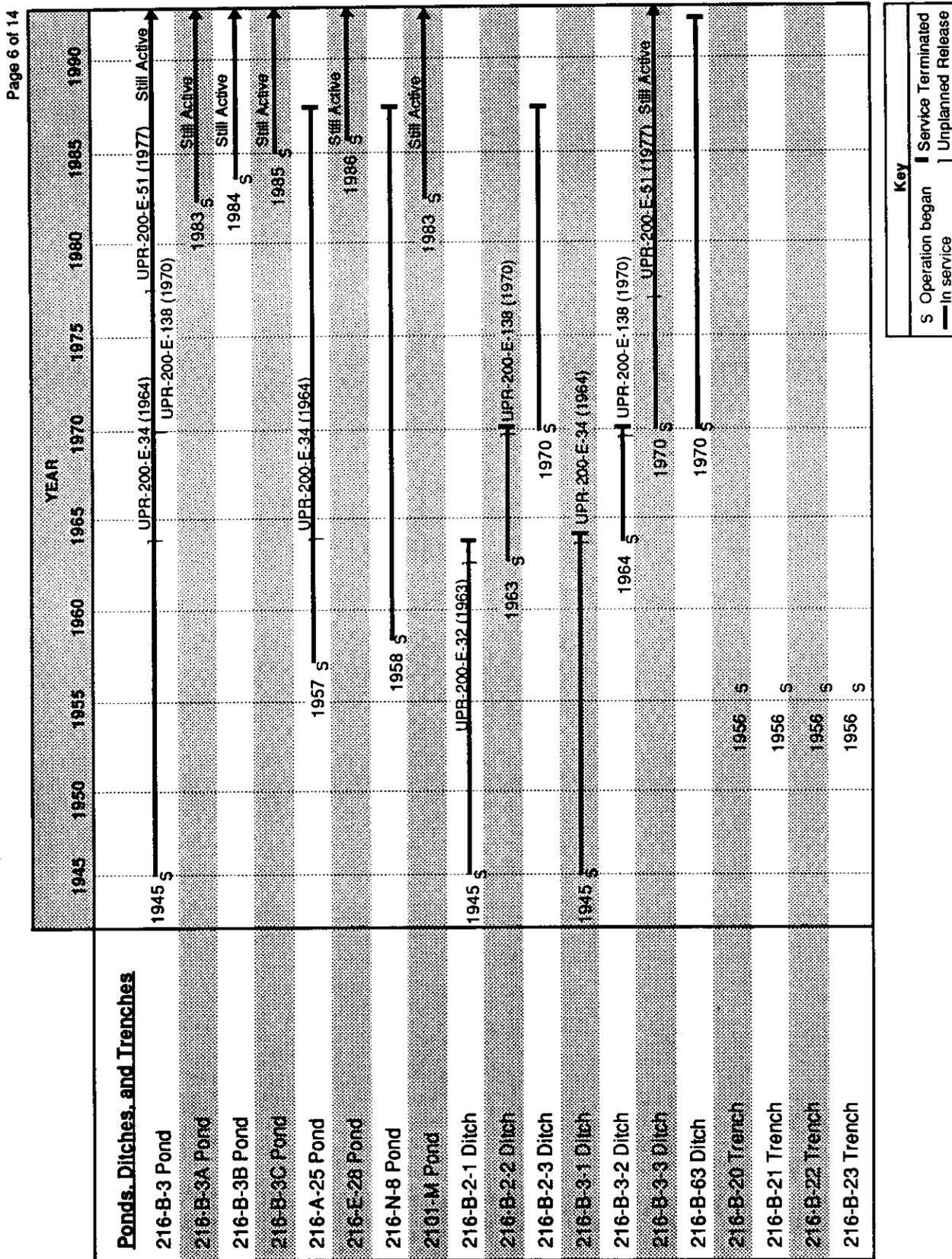


Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.

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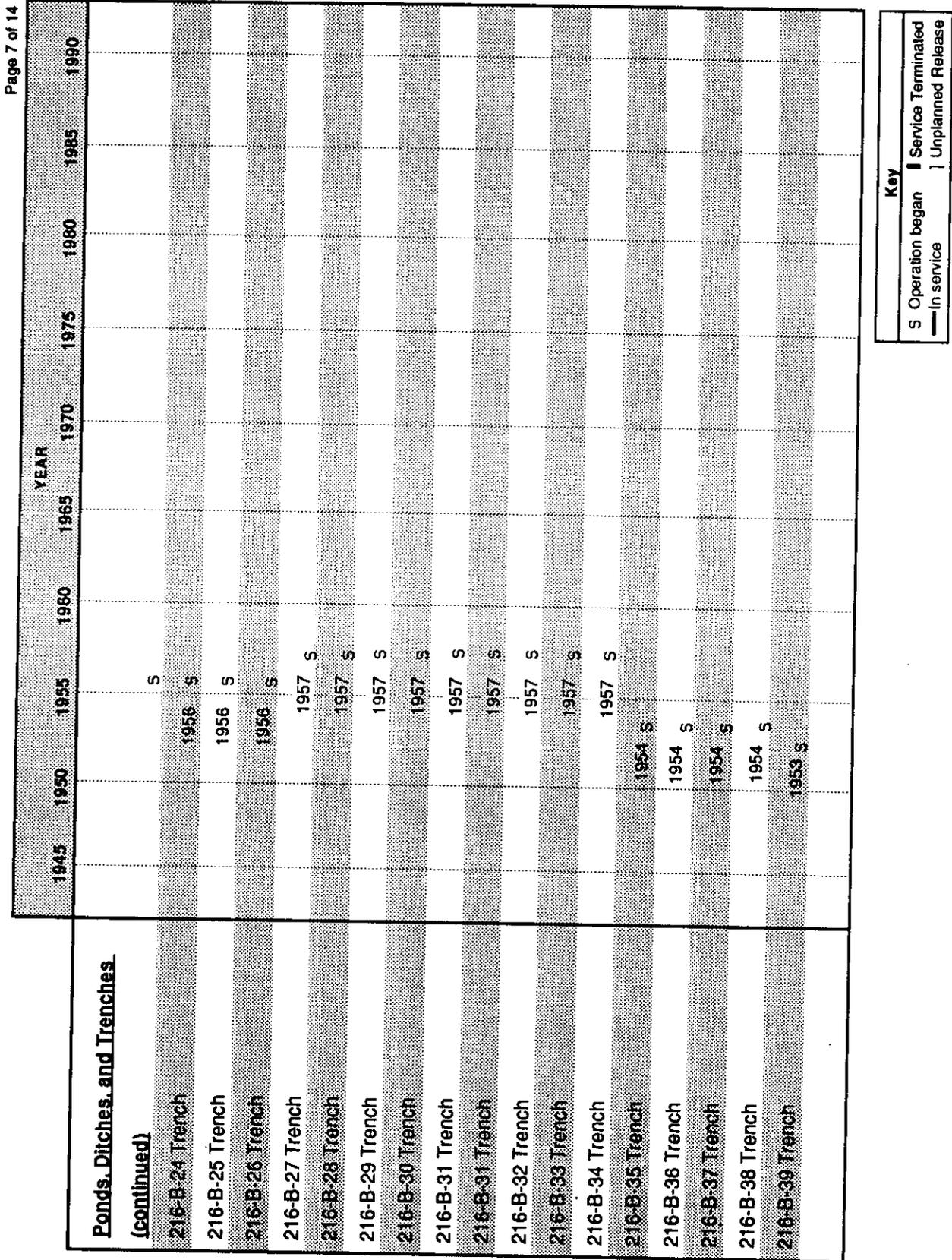
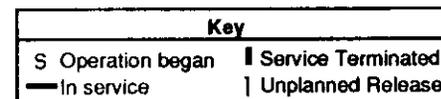
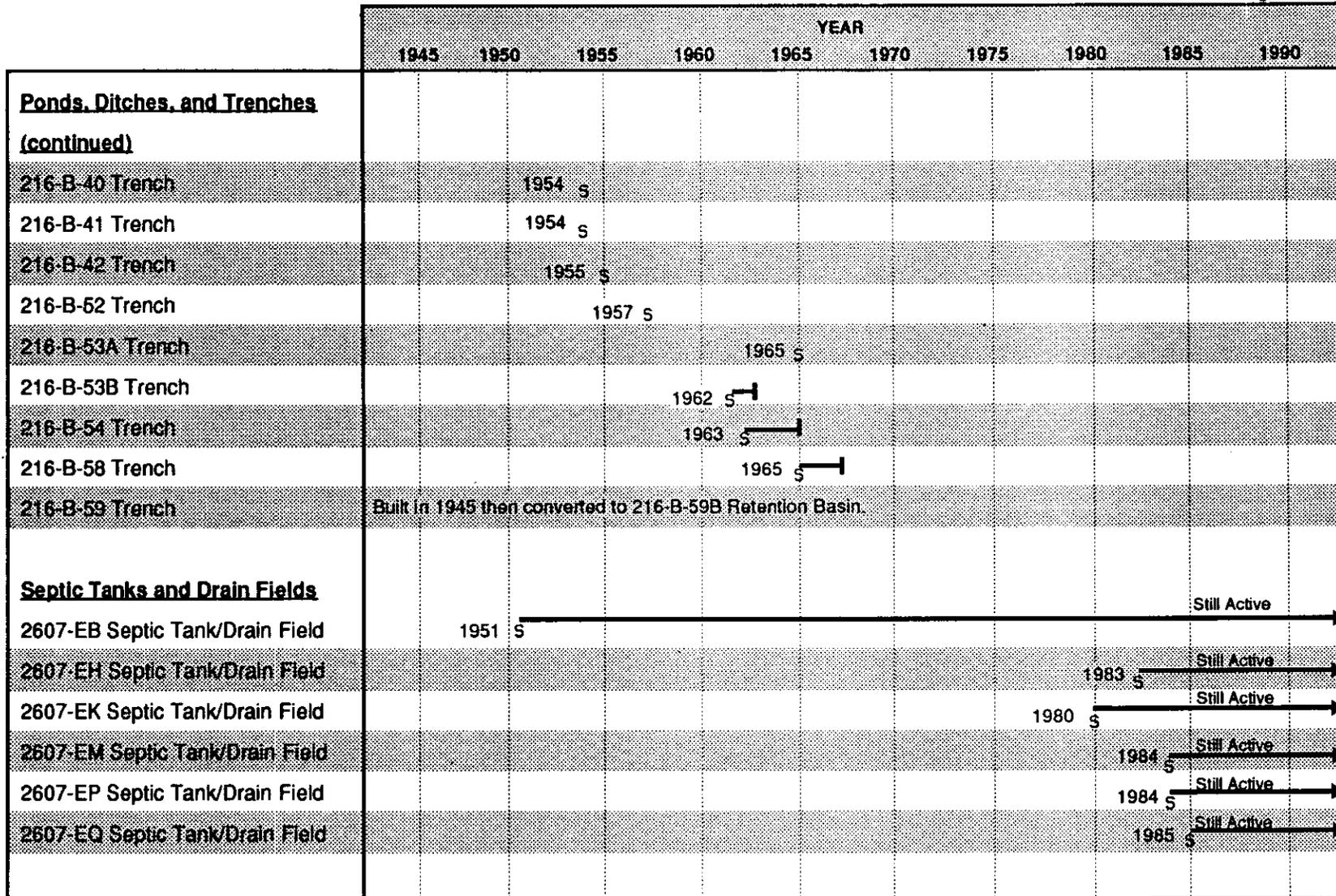
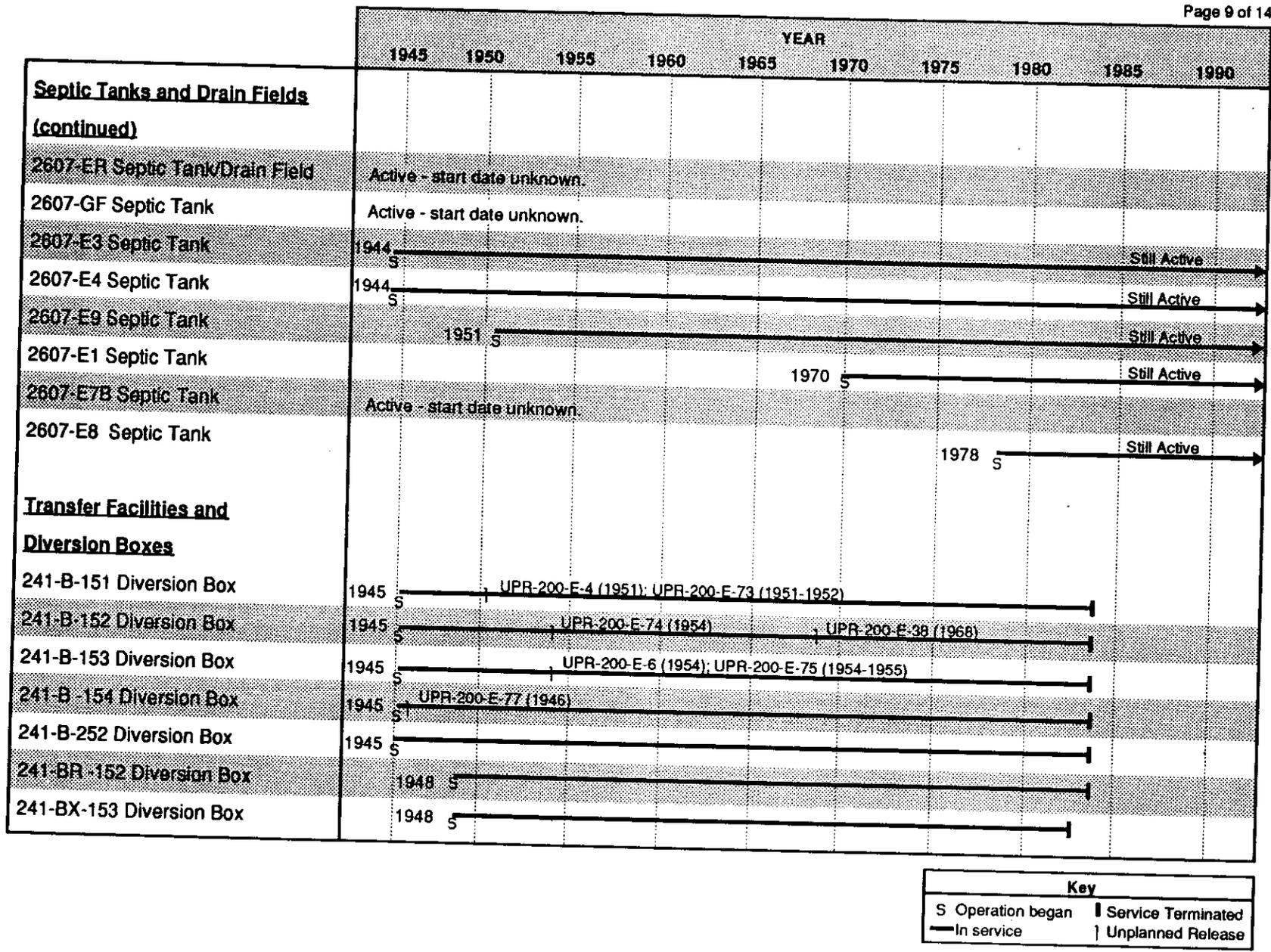


Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



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Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.

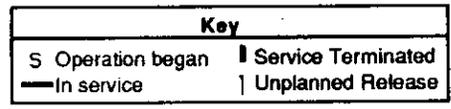
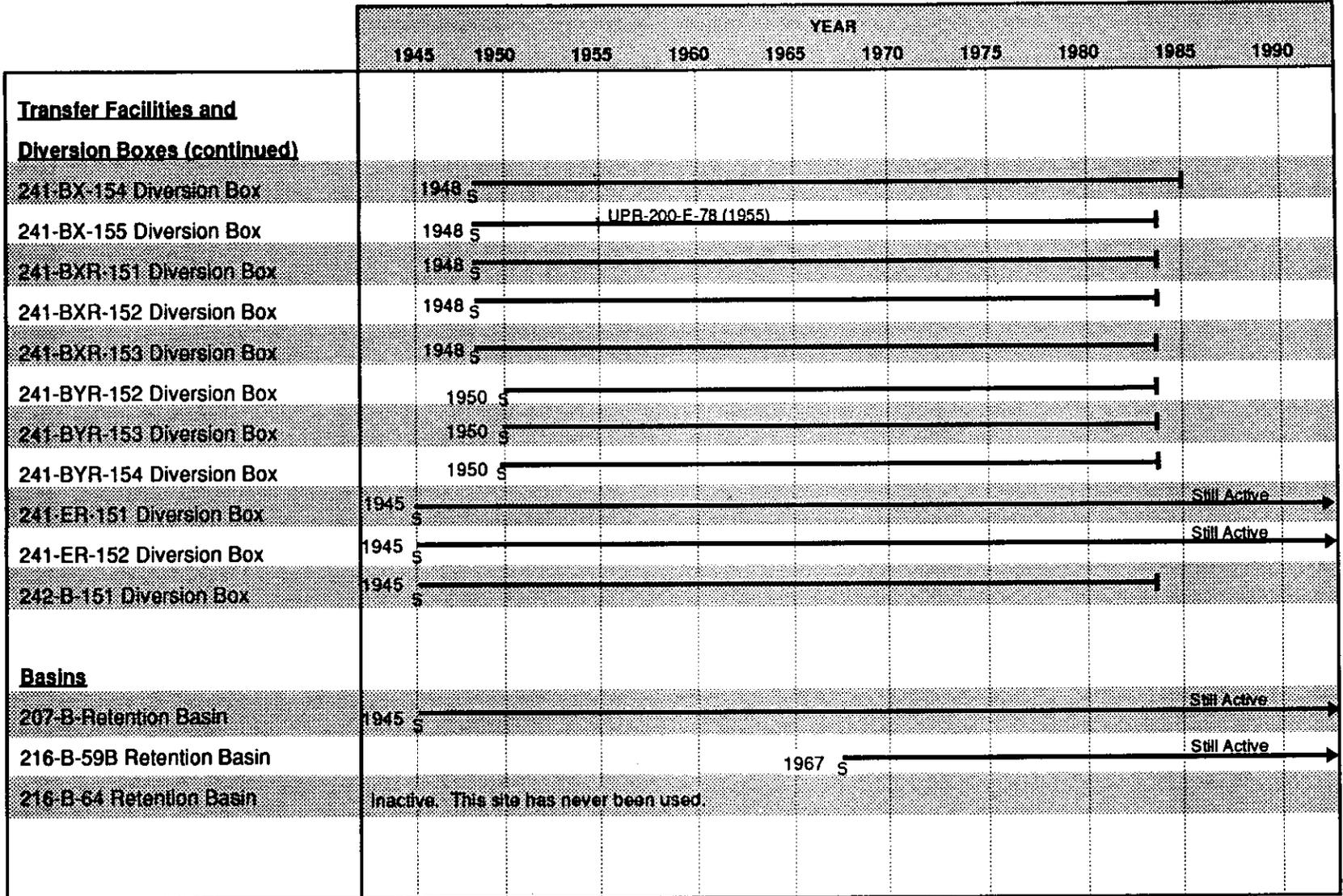


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Key

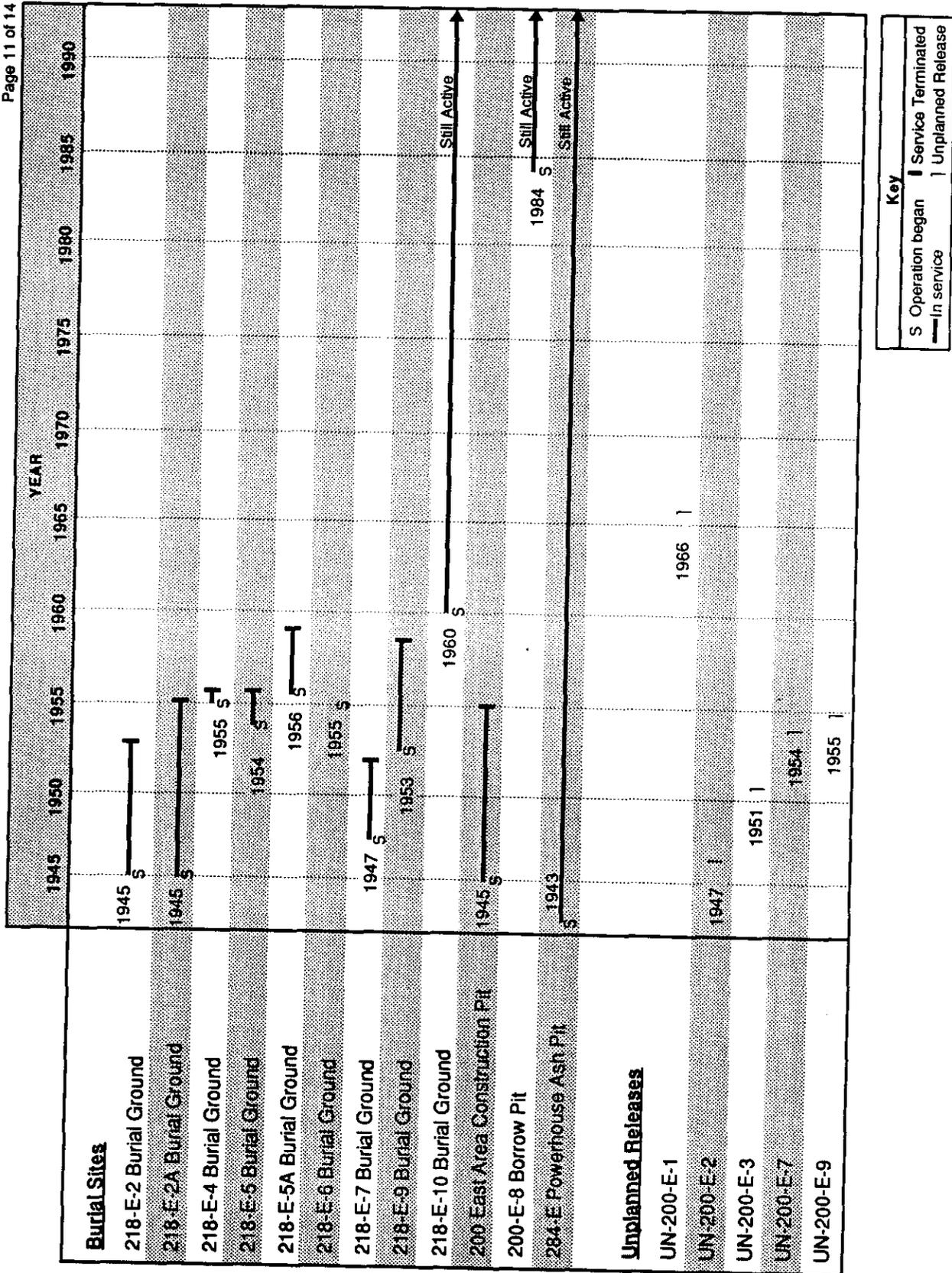
- S Operation began
- In service
- Service Terminated
- | Unplanned Release

Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



2F-17j

Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



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Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.

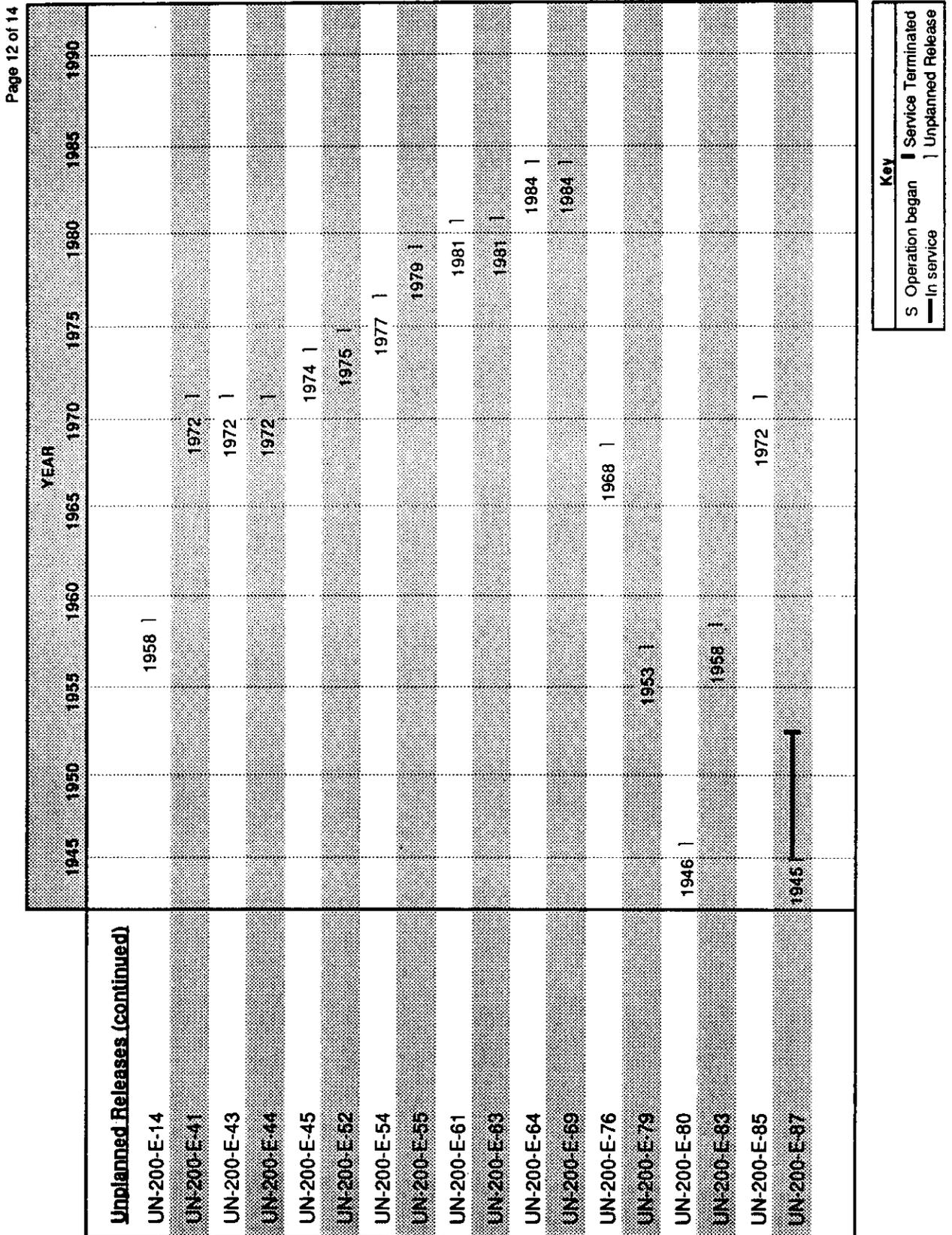
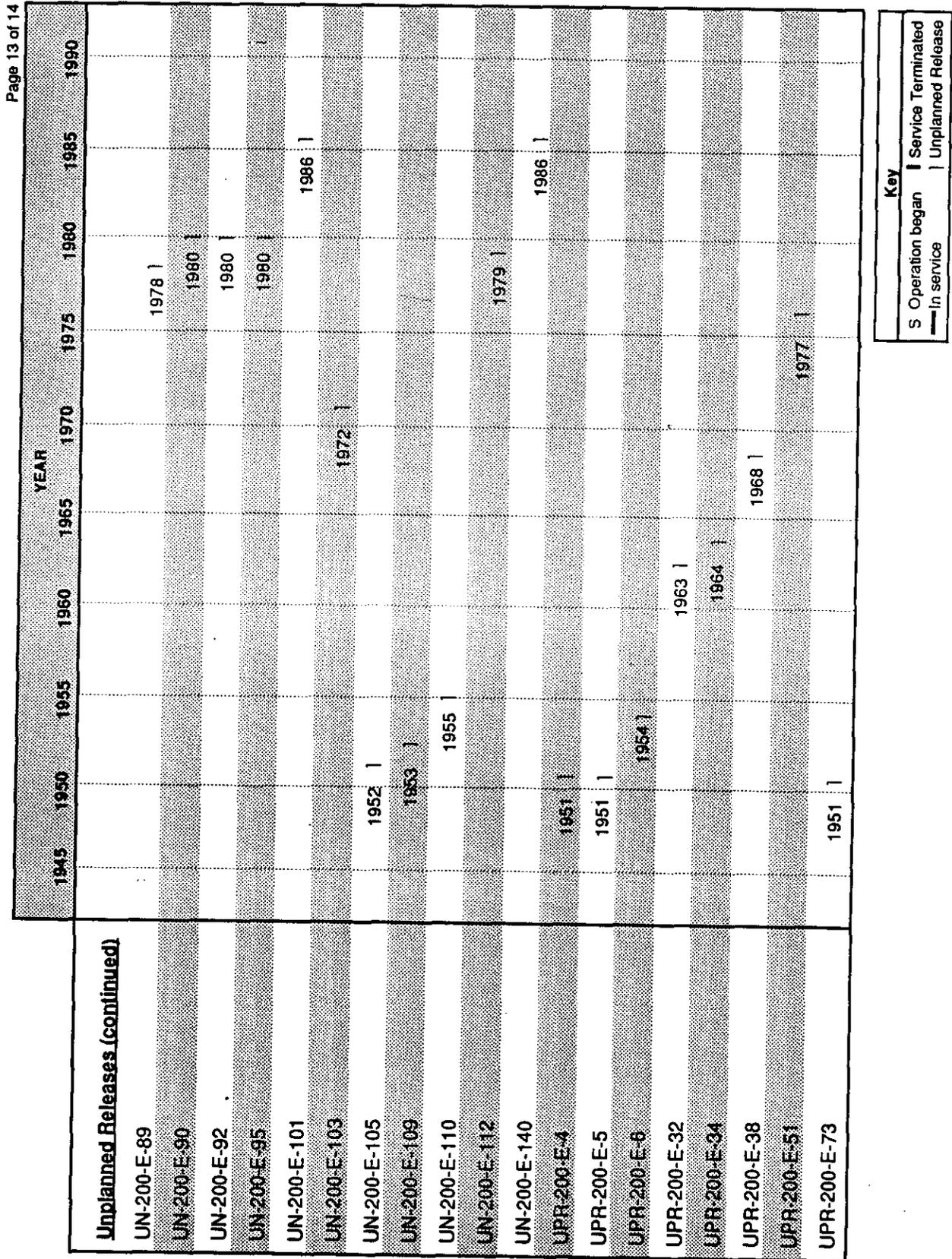
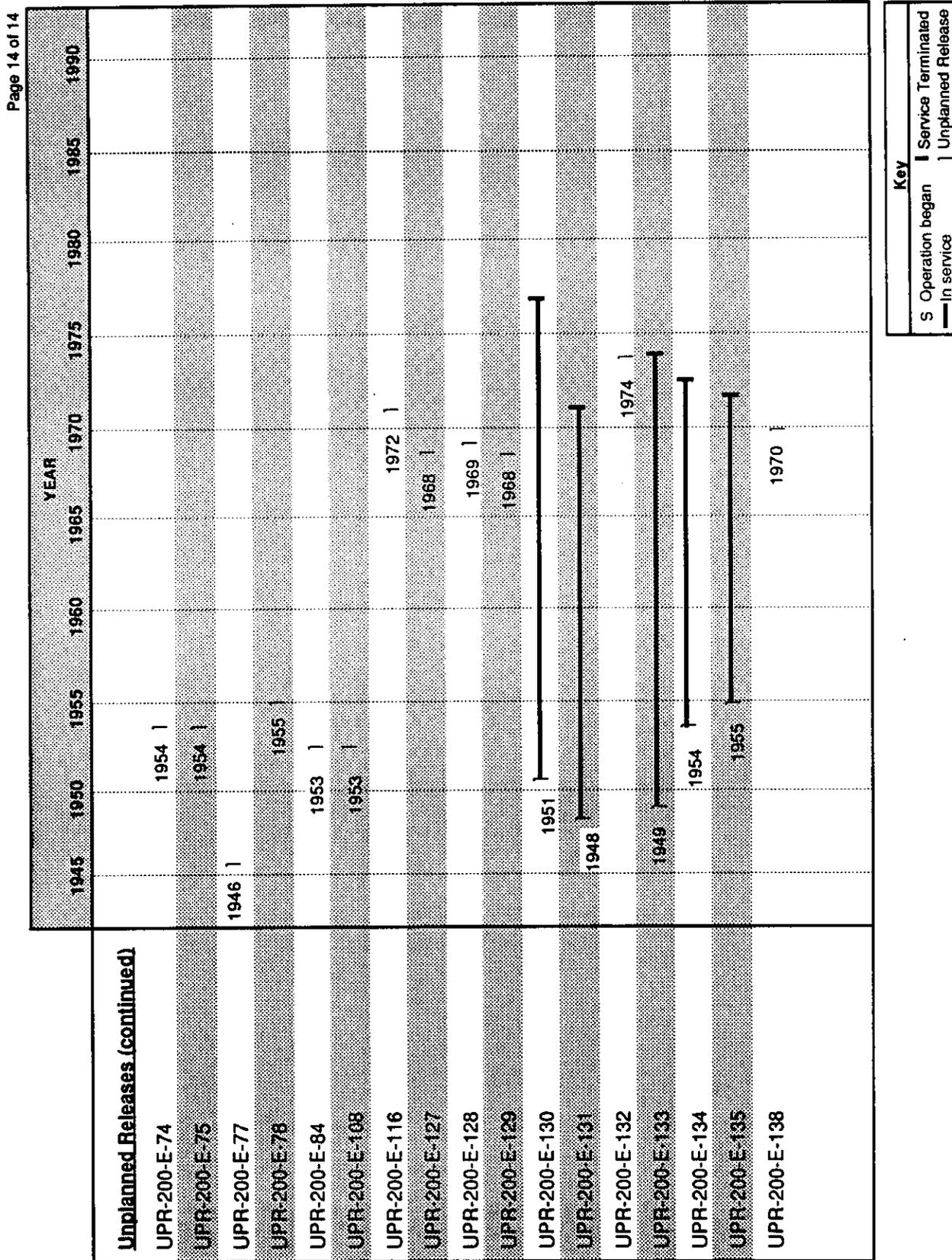


Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



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Figure 2-17. B Plant Aggregate Area Waste Management Unit Operational History.



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Figure 2-18. 216-B-3 Pond System and Associated Waste Management Units Operational History.

Page 1 of 3

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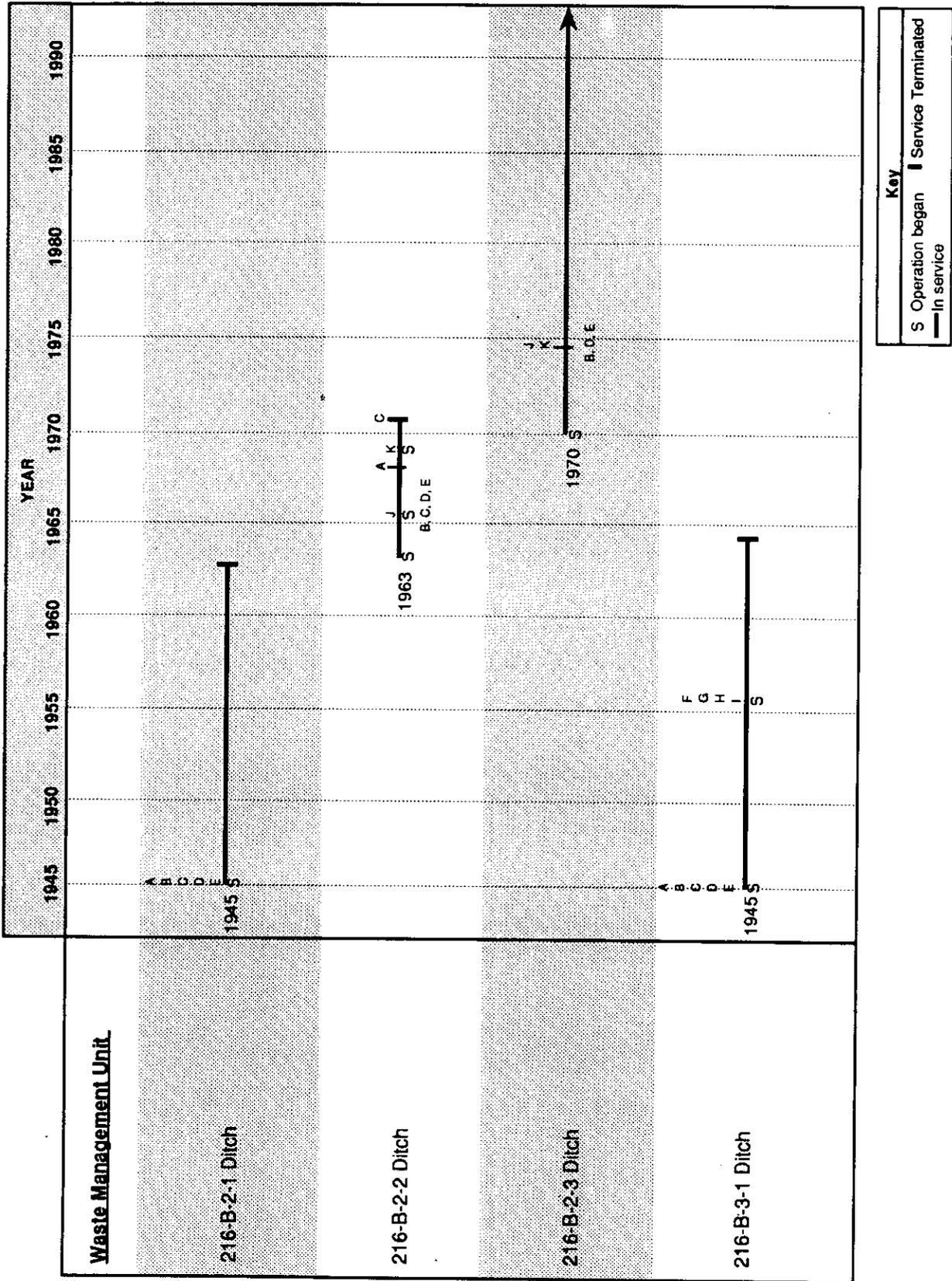


Figure 2-18. 216-B-3 Pond System and Associated Waste Management Units Operational History.

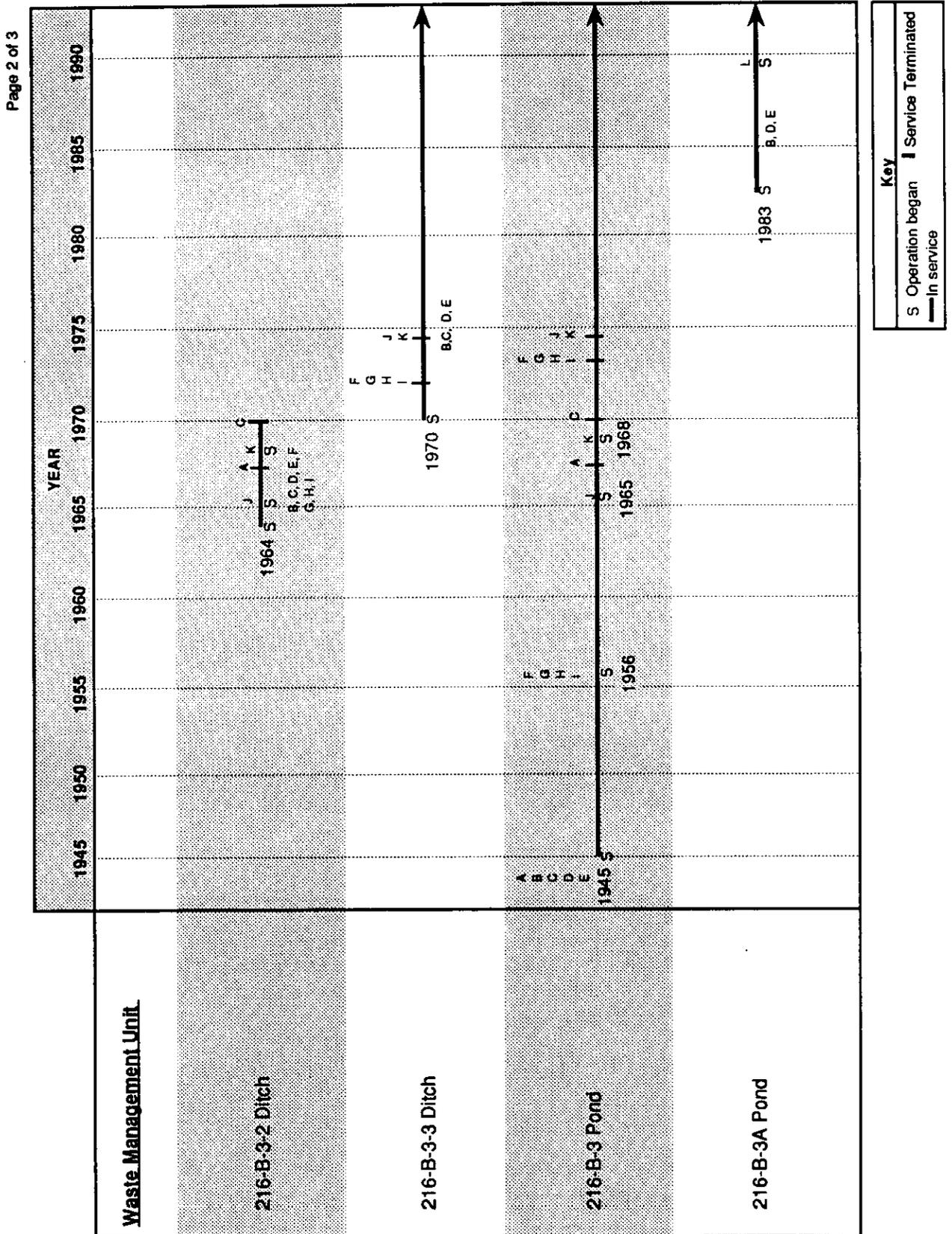
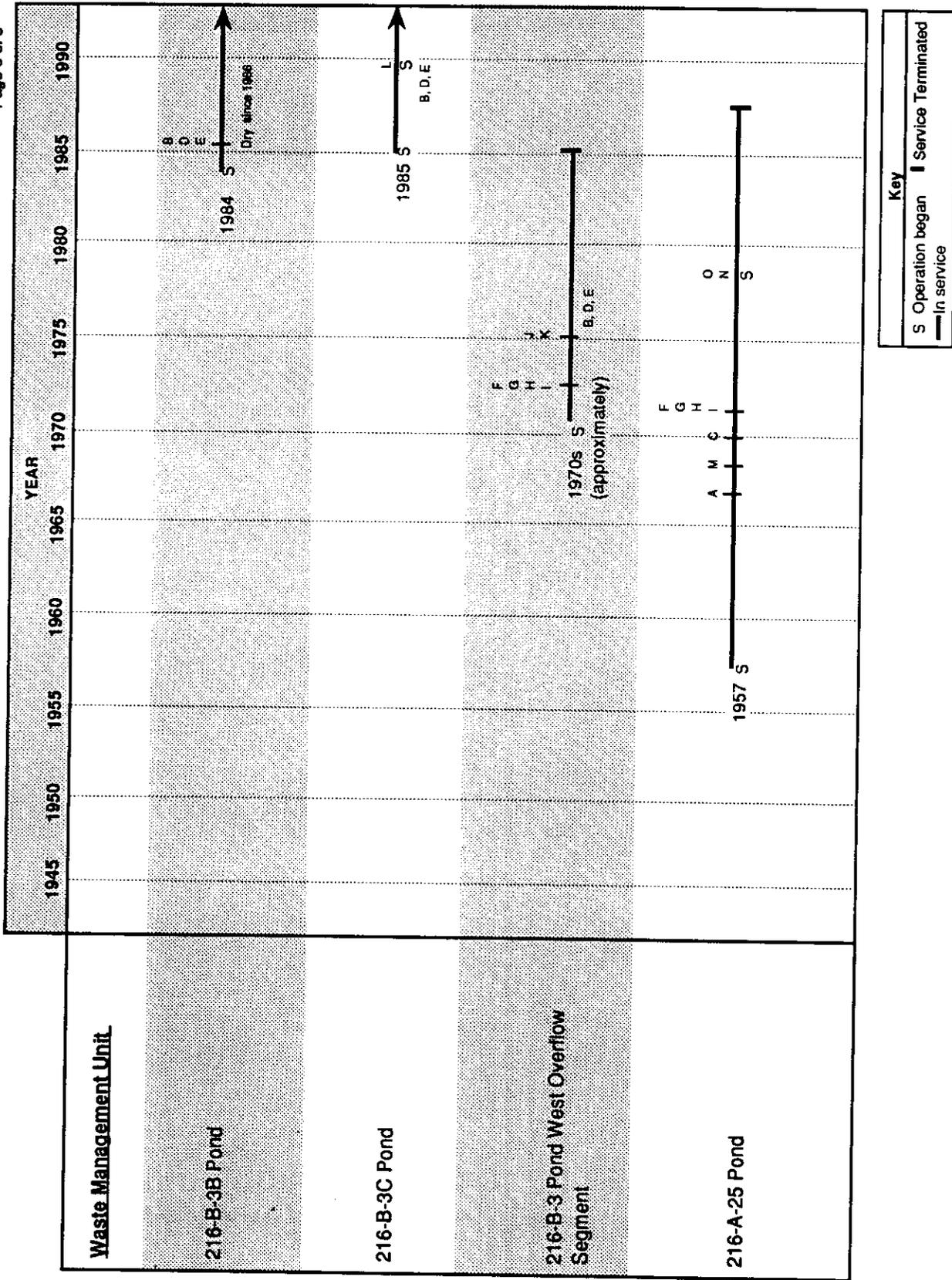


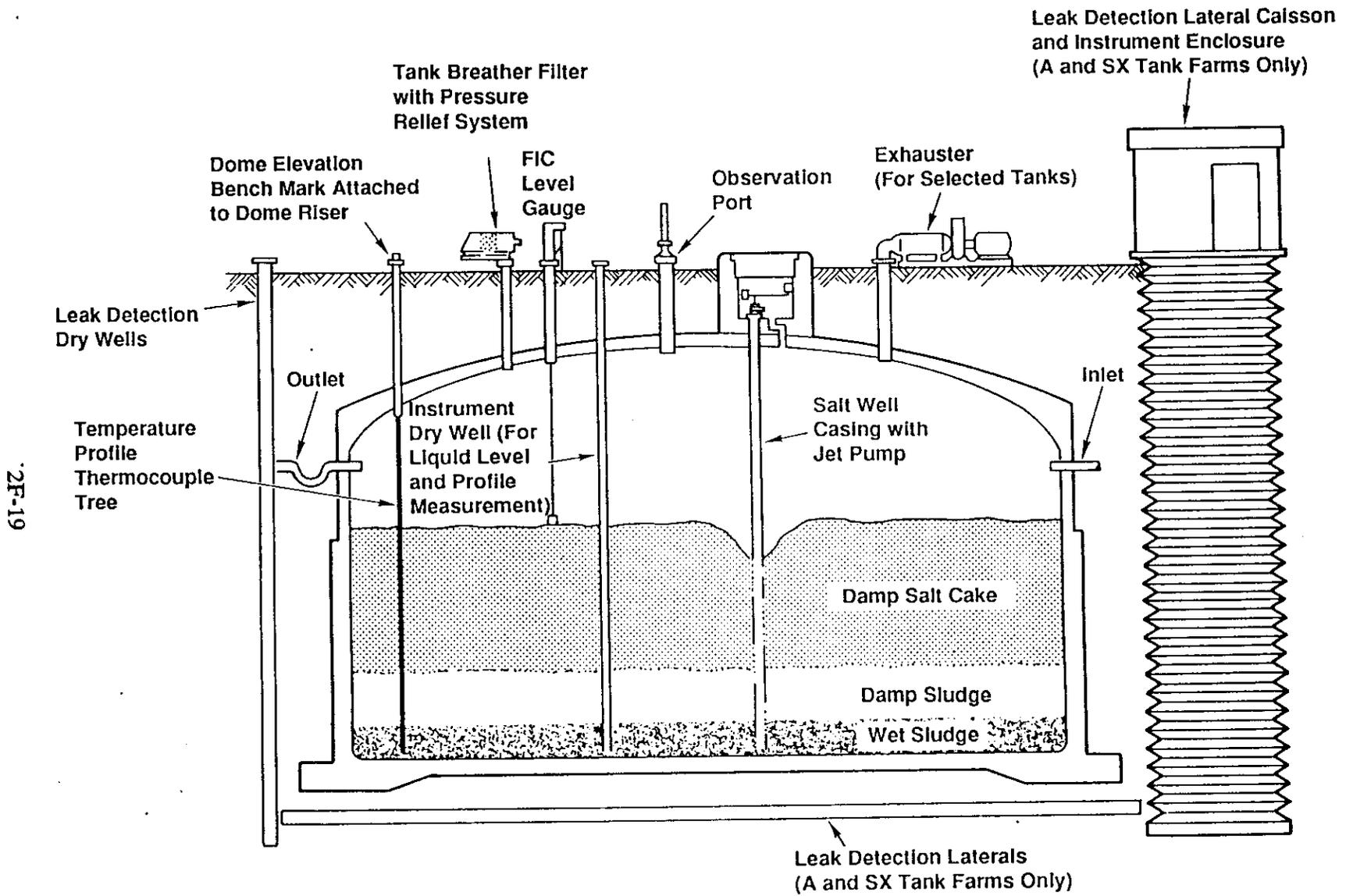
Figure 2-18. 216-B-3 Pond System and Associated Waste Management Units Operational History.

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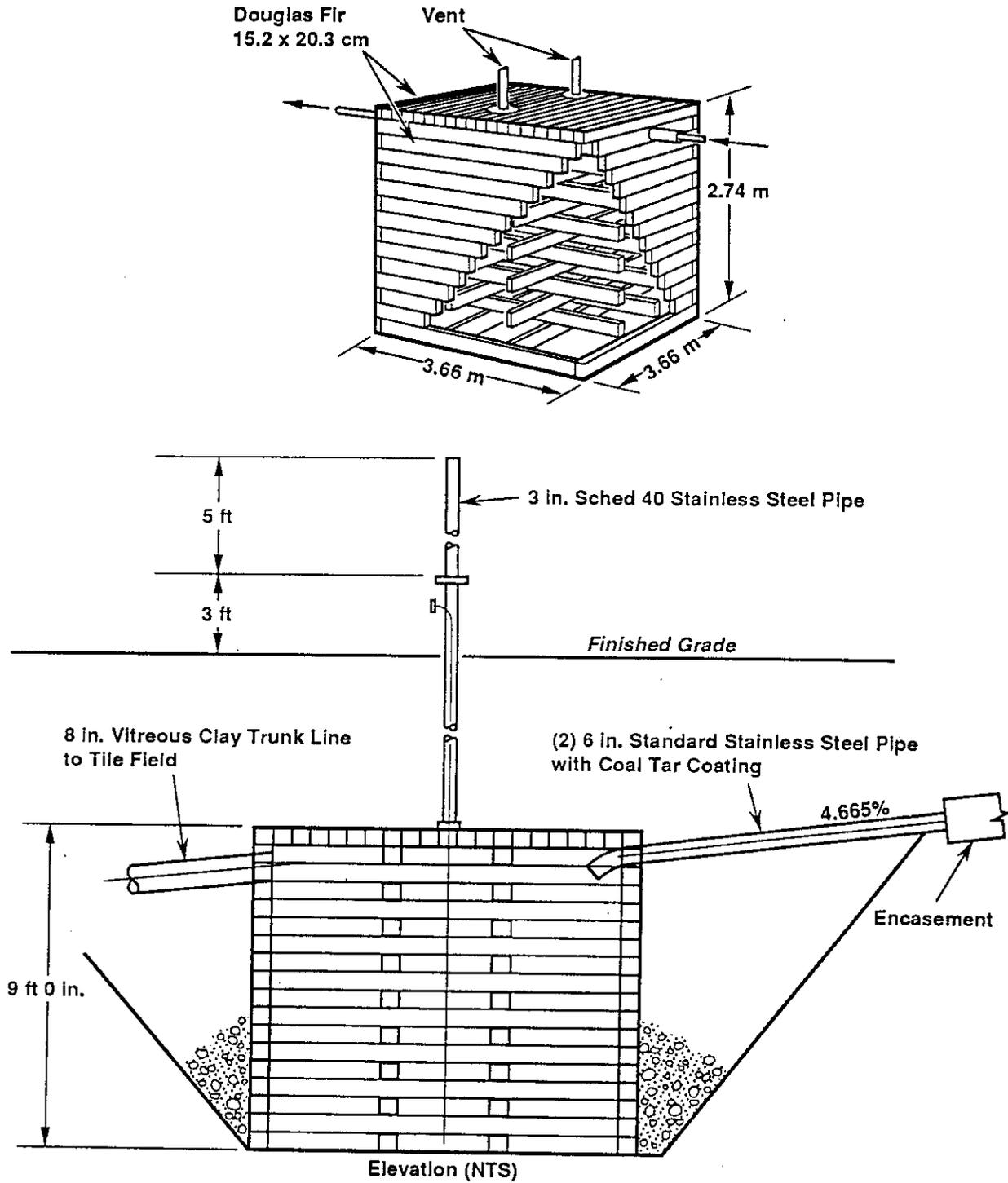
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2F-19

Figure 2-19. Representative Single-shell Tank.

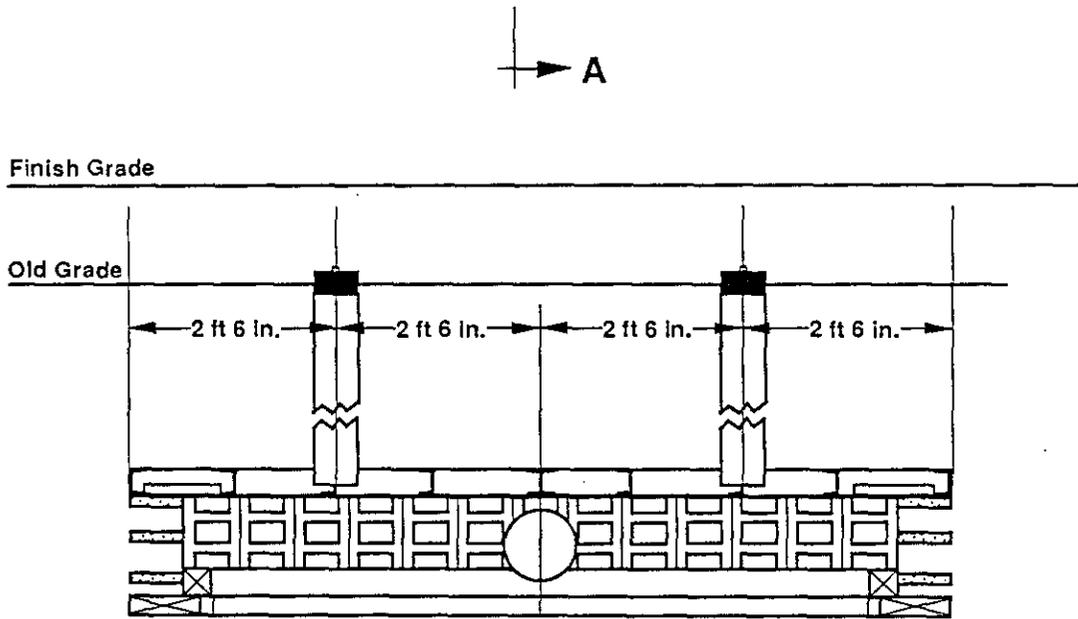
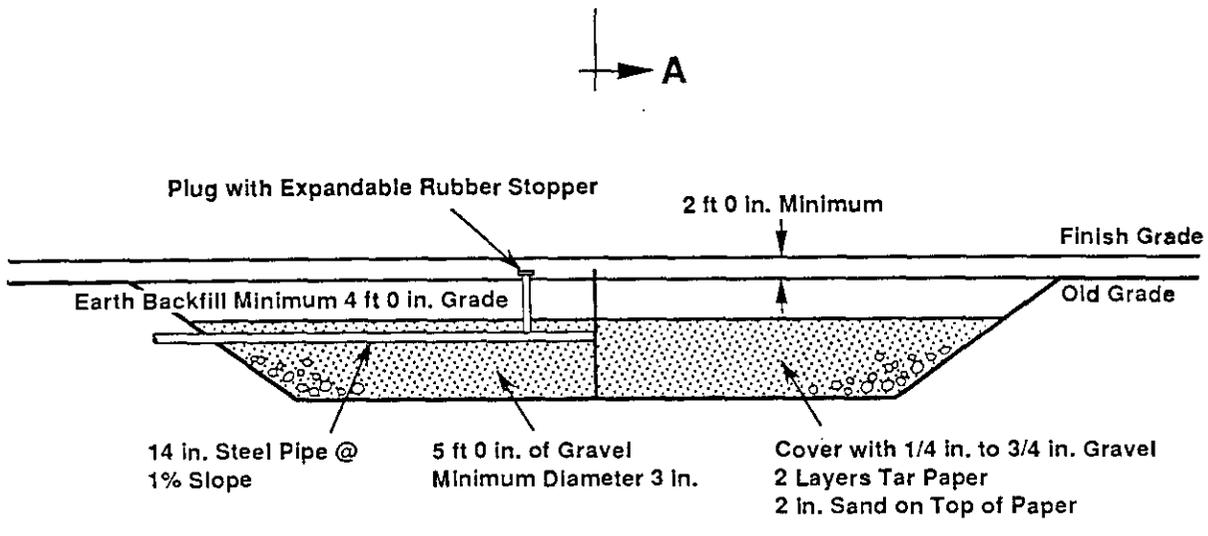
Figure 2-20. Representative Wooden Cribs.



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Figure 2-21. Cross-sections of the 216-B-14 through 216-B-29 Cribs.

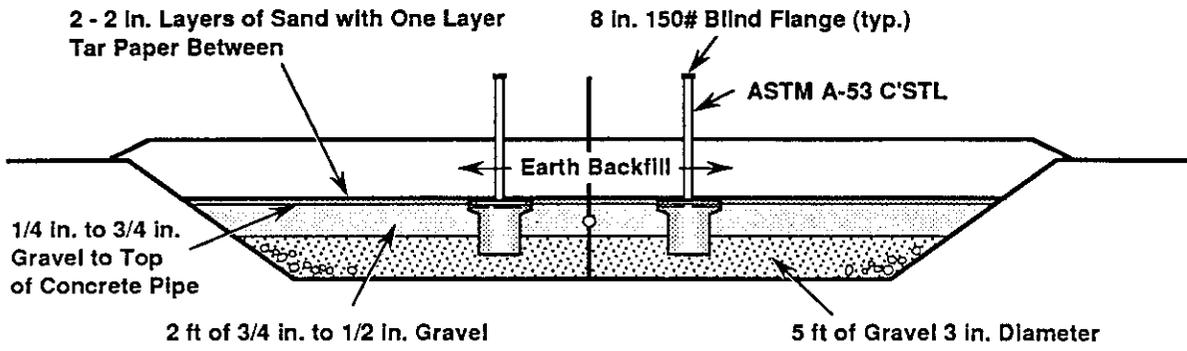


Section A - A

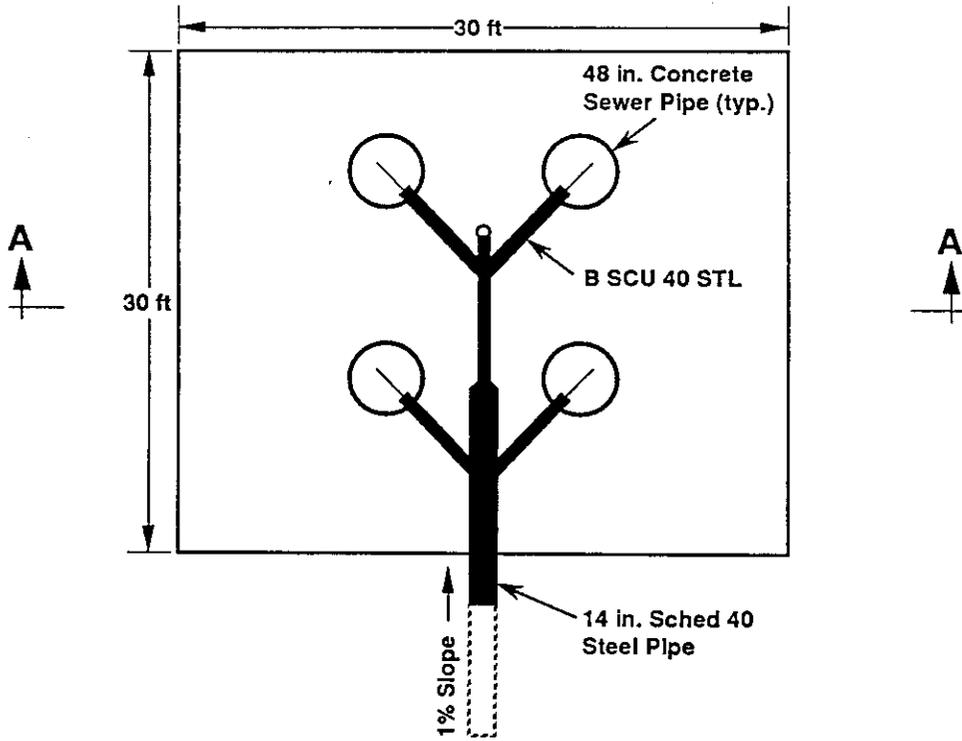
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Figure 2-22. Cross-sections and Plan View of the 216-B-43 through 216-B-50 Cribs.



Section A - A

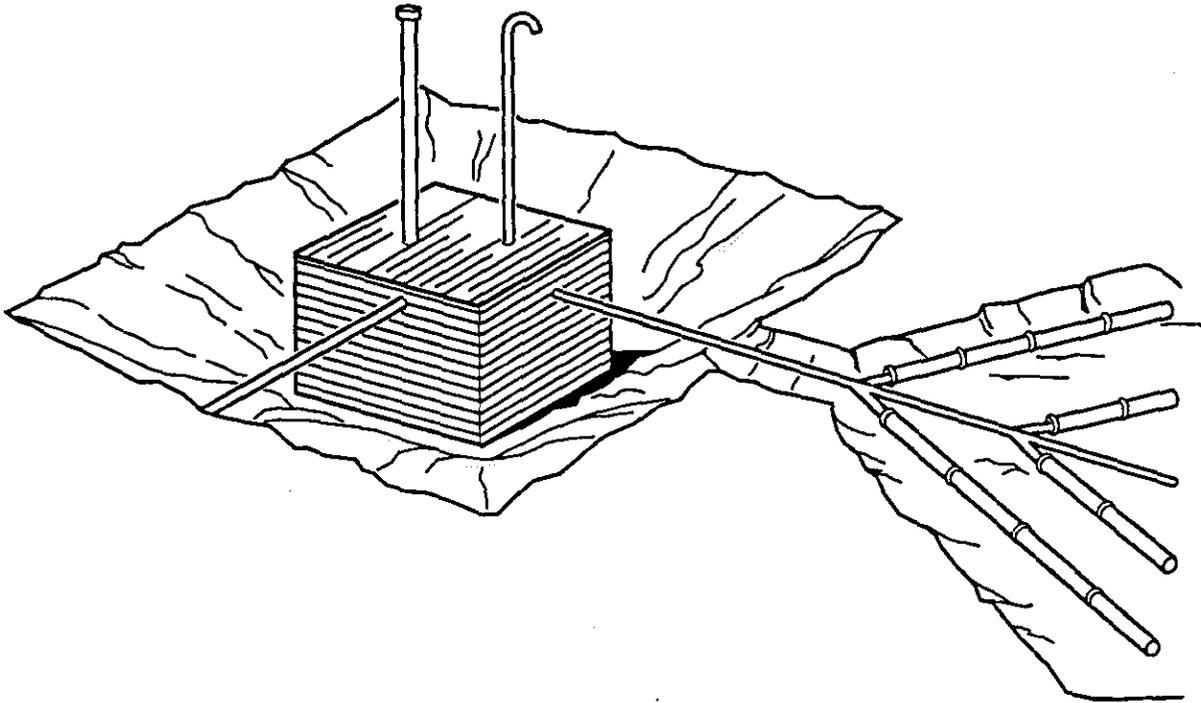


Plan

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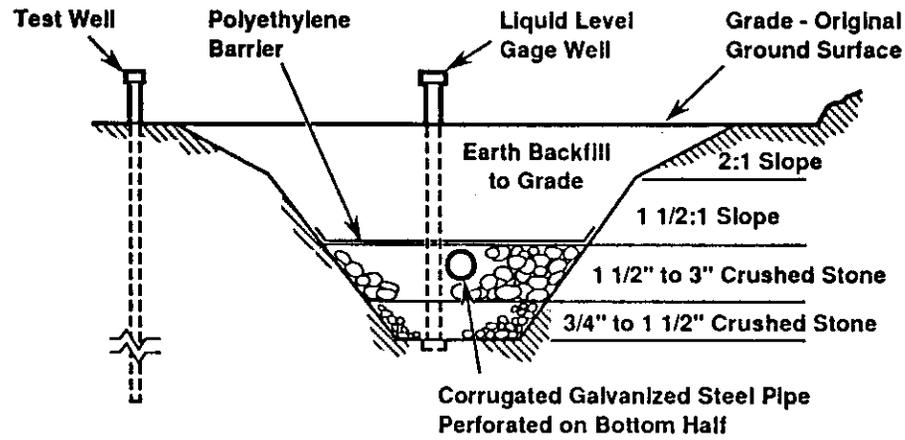
Figure 2-23. Schematic of Wooden Crib and Tile Field.



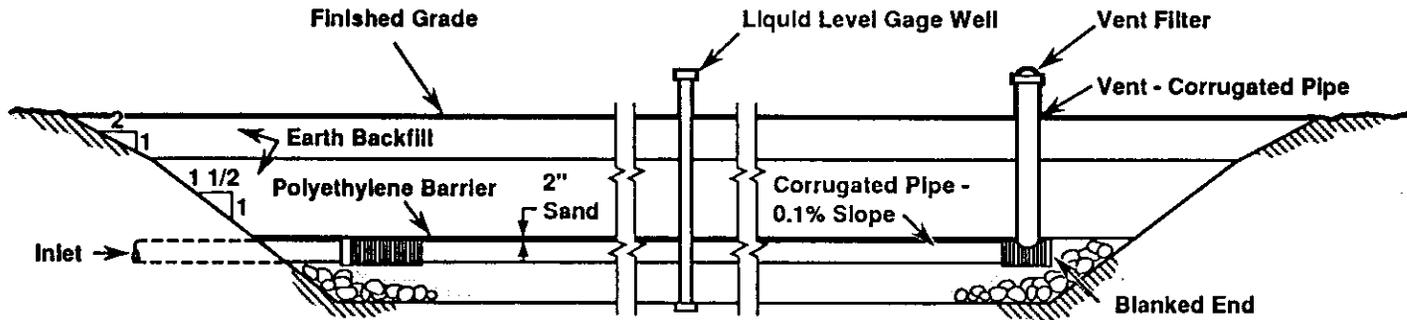
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Typical Crib Cross Section



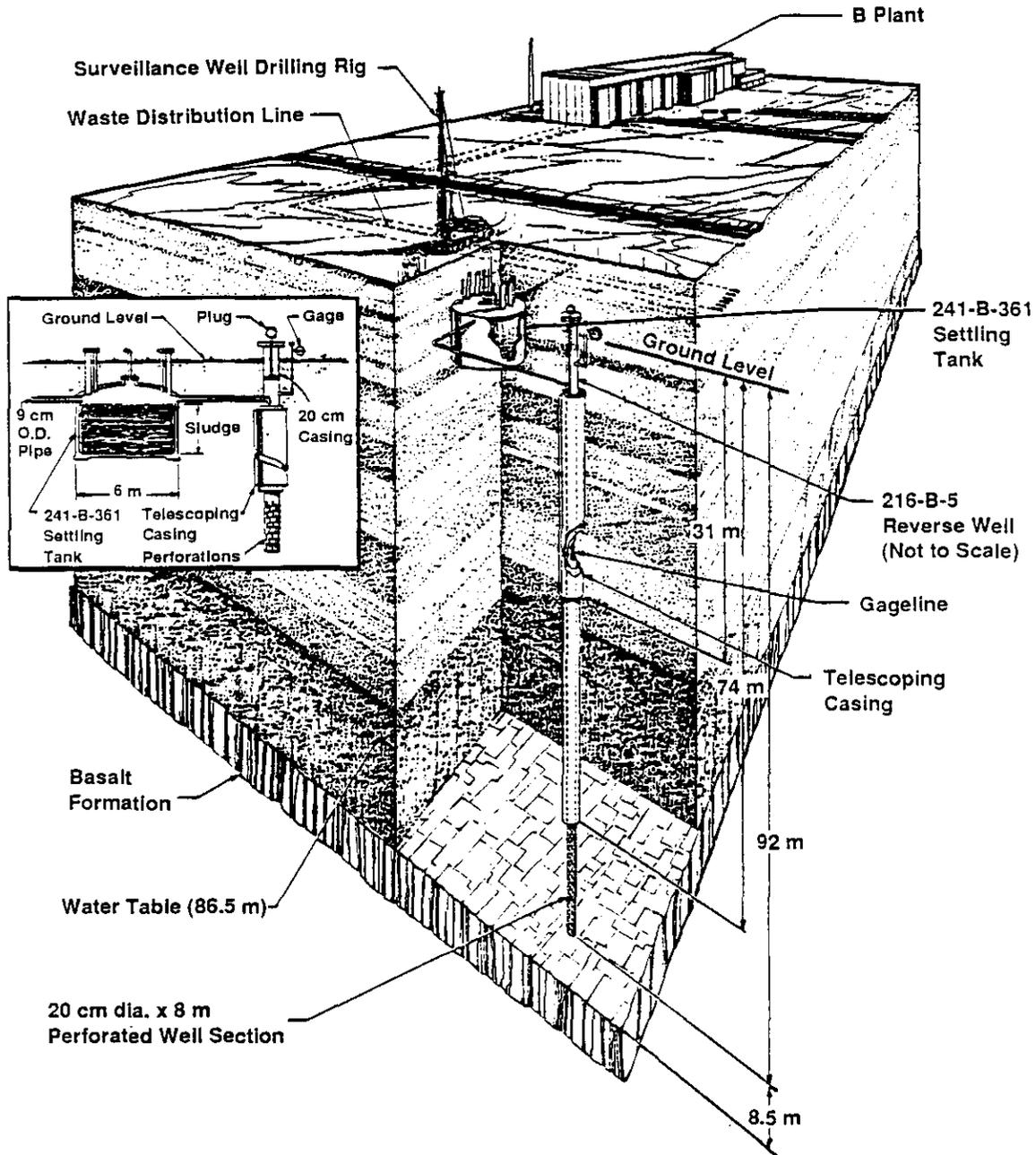
Typical Crib Long Section



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Figure 2-24. Typical Crib Construction for 216-B-55 through 216-B-62 Cribs.

Figure 2-25. 216-B-5 Reverse Well Disposal System.



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Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
Plants, Buildings, and Storage Area				
226-B HWSA	unknown/active	Halogenated hydrocarbons, PCBs, flammable solvents, alkaline liquids, antifreeze, miscellaneous toxic chemicals.	NA	200-B-6
2703-E HWSA	1984-present/active	Temporary storage of hazardous chemicals, such as alkaline liquids, sodium hydroxide, sodium dichromate containing process solutions, waste acids.	NA	200-SS-1
2704-E HWSA	Nov 1984-present/active	Antifreeze, grease, diesel, asphalt.	NA	200-SS-1
2715-EA HWSA	Nov 1984-present/active	Paint and thinning solvents.	NA	200-SS-1
Tanks and Vaults				
241-B-101 Single-Shell Tank	May 1945-1974	Bi(PO) ₄ metal waste; PUREX coating waste; B Plant high-level waste (Cell 23); evaporator bottoms from 241-B tanks.	--	200-BP-7
241-B-102 Single-Shell Tank	Oct 1945-1978	Bi(PO) ₄ metal waste; PUREX coating waste; supernatant containing B Plant low-level, ion exchange, evaporator bottoms.	--	200-BP-7
241-B-103 Single-Shell Tank	Dec 1953-1977	Bi(PO) ₄ metal waste; PUREX coating waste; B Plant low level waste, ion exchange, evaporator bottoms, N Reactor, organic wash, PNL, REDOX high-level waste, coating waste, decon, tributyl phosphate and lab waste.	--	200-BP-7
241-B-104 Single-Shell Tank	Aug 1946-1972	Bi(PO) ₄ 2-C and 1-C; evaporator bottoms from 241-B Tanks.	--	200-BP-7
241-B-105 Single-Shell Tank	Jan 1947-1972	Bi(PO) ₄ 2-C and 1-C; flush water containing evaporator bottoms from 241-B Tanks.	--	200-BP-7

2T-1a

DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
241-B-106 Single-Shell Tank	Sept 1947-1977	Bi(PO) ₄ 2-C and 1-C; Hanford Lab operations, evaporator bottoms, tributyl phosphate waste, 224-U waste, PNL, B Plant low-level, ion exchange.	--	200-BP-7
241-B-107 Single-Shell Tank	May 1945-1969	PUREX coating waste, Bi(PO) ₄ 1-C and 2-C, evaporator bottoms.	--	200-BP-7
241-B-108 Single-Shell Tank	1945-1977	Bi(PO) ₄ 1-C and 2-C, PUREX coating waste, evaporator bottoms, ion exchange from 241-B and -BY Tank Farms.	--	200-BP-7
241-B-109 Single-Shell Tank	Jan 1946-1977	Bi(PO) ₄ 1-C, PUREX coating waste, evaporator bottoms, ion exchange 224-U waste, coating waste from 241-B, -BY, -S Tank Farms.	--	200-BP-7
241-B-110 Single-Shell Tank	May 1945-1971	Bi(PO) ₄ 2-C and 1-C, fission product waste, B Plant high-level waste fractionization, B Plant Cells 5 and 6; B Plant flushes, ion exchange.	--	200-BP-7
241-B-111 Single-Shell Tank	Nov 1945-1976	Bi(PO) ₄ 2-C, fission product waste, ion exchange (waste fractionization), B Plant Cells 5 and 6.	--	200-BP-7
241-B-112 Single-Shell Tank	April 1946-1977	Bi(PO) ₄ 2-C, fission product waste, evaporator bottoms from 241-B and -BX B Plant Cells 5 and 6, ion exchange.	--	200-BP-7
241-B-201 Single-Shell Tank	1946-1948	221-B wastes and 224-B wastes	--	200-BP-7
241-B-202 Single-Shell Tank	1948-1977	224-B wastes, 5-6 Tank waste, and 224-U wastes (lanthanum fluoride), B Plant high-level waste.	--	200-BP-7
241-B-203 Single-Shell Tank	1948-1977	224-B wastes, 5-6 Tank waste, and 224-U wastes (lanthanum fluoride).	--	200-BP-7
241-B-204 Single-Shell Tank	1948-1977	224-B wastes, 5-6 Tank waste, and 224-U wastes (lanthanum fluoride), B Plant flushes.	--	200-BP-7

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DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
241-B-301B Catch Tank	1945-June 1984	Processing and decon wastes.	--	200-BP-7
241-B-302B Catch Tank	1945-July 1985	Processing and decon wastes.	0	200-BP-5
241-B-361 Settling Tank	April 1945-Sep 1947	Low salt, alkaline radioactive from cell washings collected in 5-6W Cell in 221-B and from 224-B. Solids primarily Bi(PO) ₄ .	121	200-BP-5
241-BX-101 Single-Shell Tank	Jan 1948-1972	Bi(PO) ₄ metal waste; B Plant low-level waste, ion exchange (waste fractionization), evaporator bottoms, N Reactor, organic wash, REDOX ion exchange waste, tributyl phosphate and coating waste.	--	200-BP-7
241-BX-102 Single-Shell Tank	June 1948-1971	Bi(PO) ₄ metal waste, diatomaceous earth, tributyl phosphate, metal, and coating waste, B Plant low level, evaporator bottoms.	--	200-BP-7
241-BX-103 Single-Shell Tank	Sept 1948-1977	Bi(PO) ₄ metal waste; PUREX high- and low-level waste and sludge supernatant; exchange, evaporator bottoms, N Reactor, organic wash, PNL, REDOX ion exchange waste, coating waste, decon, tributyl phosphate and lab waste, B Plant low-level.	--	200-BP-7
241-BX-104 Single-Shell Tank	1949-1980	Bi(PO) ₄ metal waste; PUREX coating waste, ion exchange (waste fractionization) evaporator bottoms, REDOX high-level, complexed and noncomplexed waste, double-shell slurry feed, tributyl phosphate and lab waste, B Plant low-level, ion exchange.	--	200-BP-7
241-BX-105 Single-Shell Tank	1949-1980	Bi(PO) ₄ metal waste, tributyl phosphate waste, coating, ion exchange waste; evaporator bottoms, complexed and noncomplexed waste, double-shell slurry feed.	--	200-BP-7

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Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
241-BX-106 Single-Shell Tank	1949-1977	Bi(PO) ₄ metal waste, tributyl phosphate waste, coating, ion exchange waste; evaporator bottoms, B Plant low-level, organic wash, REDOX ion exchange waste from 241-B, -BX, and -BY tanks.	--	200-BP-7
241-BX-107 Single-Shell Tank	Sept 1948-1977	Bi(PO) ₄ 1-C, tributyl phosphate waste, ion exchange waste from the 241-BX Tank Farm.	--	200-BP-7
241-BX-108 Single-Shell Tank	1949-1974	Bi(PO) ₄ 1-C, tributyl phosphate waste, coating, ion exchange waste from the 241-BX and -C Tanks.	--	200-BP-7
241-BX-109 Single-Shell Tank	1950-1974	Bi(PO) ₄ 1-C; ion exchange (waste fractionization), tributyl phosphate waste, tributyl phosphate waste from the 241-BY and -C Tanks.	--	200-BP-7
241-BX-110 Single-Shell Tank	1949-1977	Bi(PO) ₄ 1-C, ion exchange (waste fractionization), tributyl phosphate waste, evaporator bottoms, coating waste, B Plant 1-C from the 241-B and -C Tank Farms. It is an ITS-2 Unit.	--	200-BP-7
241-BX-111 Single-Shell Tank	1950-1977	Bi(PO) ₄ 1-C, ITS-2 bottoms and recycle systems, evaporator bottoms, coating waste, ion exchange waste, 1-C from the 241-BY Tanks.	--	200-BP-7
241-BX-112 Single-Shell Tank	1950-1977	Ion exchange (waste fractionization), evaporator bottoms, coating waste, 1-C from the 241-C Tanks.	--	200-BP-7
241-BX-302A Catch Tank	1948-July 1985	Processing and decon wastes.	--	200-BP-7
241-BX-302B Catch Tank	1948-July 1985	Processing and decon wastes.	--	200-BP-6
241-BX-302C Catch Tank	1948-July 1985	Processing and decon wastes.	--	200-BP-6
241-BY-101 Single-Shell Tank	Jan 1950-1971	Bi(PO) ₄ metal waste, tributyl phosphate waste, evaporator bottoms from the 241-BY and -C Tank Farms. This is an ITS-2 Unit.	--	200-BP-7

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DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
241-BY-102 Single-Shell Tank	1950-1977	Bi(PO) ₄ metal waste, tributyl phosphate and coating waste, evaporator bottoms from the 241-BX, -BY and -C farms. This is an ITS-2 Unit.	--	200-BP-7
241-BY-103 Single-Shell Tank	Nov 1950-May 1973	Bi(PO) ₄ metal waste, PUREX coating waste, evaporator bottoms, coating and tributyl phosphate waste, PUREX high-level and organic wash wastes from 241-BX, -BY, -C, and -B Tanks. This is an ITS-2 Unit.	--	200-BP-7
241-BY-104 Single-Shell Tank	1950-1977	Bi(PO) ₄ metal waste, tributyl phosphate and coating waste, evaporator bottoms from the 241-BX, -BY and -C Tank Farms, and ion exchange waste. This is an ITS-2 Unit.	--	200-BP-7
241-BY-105 Single-Shell Tank	June 1951-1974	tributyl phosphate waste, Bi(PO) ₄ metal waste and coating waste, evaporator bottoms from the 241-BY and -C Tank Farms, concrete. This is an ITS-2 Unit.	--	200-BP-7
241-BY-106 Single-Shell Tank	1953-1977	I-C and Bi(PO) ₄ 1-C waste, tributyl phosphate waste, coating waste, evaporator bottoms from 241-BY and -C Tank Farms. It is an ITS-2 Unit.	--	200-BP-7
241-BY-107 Single-Shell Tank	December 1950-1974	tributyl phosphate waste, Bi(PO) ₄ 1-C waste and coating waste, evaporator bottoms from the 241-BY and -C Tank Farms. This is an ITS-2 Unit.	--	200-BP-7
241-BY-108 Single-Shell Tank	April 1951-1972	Bi(PO) ₄ 1-C waste, evaporator bottoms from the 241-BY and -C Tank Farms. This is an ITS-2 Unit.	--	200-BP-7

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Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
241-BY-109 Single-Shell Tank	1953-1979	Supernatant containing tributyl phosphate waste, PUREX coating waste, Bi(PO) ₄ metal waste, evaporator bottoms, PUREX organic wash waste from the 241-B, -BX, -BY, and -C Tank Farms. This is an ITS-2 Unit.	--	200-BP-7
241-BY-110 Single-Shell Tank	1952-1979	Bi(PO) ₄ 1-C waste, tributyl phosphate waste, evaporator bottoms, coating waste from the 241-BY and -C Tank Farms, and the WR-241 Tank.	--	200-BP-7
241-BY-111 Single-Shell Tank	1952-1977	Bi(PO) ₄ metal waste, tributyl phosphate waste, PUREX coating waste, organic wash waste, evaporator bottoms, coating waste, and organic was waste from the 241-BY and -C Tank Farms. This is an ITS-2 Unit.	--	200-BP-7
241-BY-112 Single-Shell Tank	1951-1976	Bi(PO) ₄ metal waste, tributyl phosphate waste, coating waste, evaporator bottoms from the 241-B, -BX, -BY, and -C Tank Farms. This is an ITS-2 Unit.	--	200-BP-7
244-BX Receiving Tank	1983-present/active	Process and decon wastes.	--	200-BP-7
244-BXR Vault	1948-July 1985	Process and decon wastes.	--	200-BP-7
241-ER-311 Catch Tank	1945-present/active	Process and decon wastes.	--	200-BP-9
270-E Cond. Neutralization Tank	1952-1976	Sludge	14.7	200-BP-6
Cribs and Drains				
216-B-7A & B Crib	Oct 1946-May 1967	224-B via overflow from 201-B Tank, cell drainage from Tank 5-6 in 221-B, equipment cleanout waste from 224-B, decon and construction waste from 221-B.	43,600	200 BP-4

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DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-8TF Crib	April 1948-July 1953	1 and 2-Cycle supernatant from 221-B, cell drainage and other waste from Tank 5-6, decon and cleanup waste generated at shutdown of 224-B, fission products waste.	27,200	200-BP-4
216-B-9TF Crib	Aug 1948-July 1951	Cell drainage and other liquid waste via Tank 5-6 in 221-B.	36,000	200-BP-5
216-B-10A Crib	Dec 1949-Jan 1952	Decon sink and sample slurper waste from 222-B and floor drainage from 292-B.	9,990	200-BP-6
216-B-10B Crib	June 1969-Oct 1973	Decon sink and shower waste from 221-B, overflow from 216-10A.	28	200-BP-6
216-B-12 Crib	Nov 1952-Nov 1973	Process condensate from 221-U and 224-U waste evaporators, construction waste from 221-B and process condensate from 221-B.	520,000	200-BP-9
216-B-14 Crib	Jan 1956-Feb 1956	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	8,710	200-BP-2
216-B-15 Crib	April 1956-Dec 1956	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	6,320	200-BP-2
216-B-16 Crib	April 1956-Aug 1956	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	5,600	200-BP-2
216-B-17 Crib	Jan 1956-Jan 1956	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	3,410	200-BP-2
216-B-18 Crib	March 1956-April 1956	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	8,520	200-BP-2
216-B-19 Crib	Feb 1957-Oct 1957	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	6,400	200-BP-2
216-B-43 Crib	Nov 1954	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	2,120	200-BP-1

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DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-44 Crib	Nov 1954-March 1955	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	5,600	200-BP-1
216-B-45 Crib	April 1955-June 1955	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	4,920	200-BP-1
216-B-46 Crib	Sept 1955-Dec 1955	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	6,700	200-BP-1
216-B-47 Crib	Sept 1955	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	3,710	200-BP-1
216-B-48 Crib	Nov 1955	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	4,090	200-BP-1
216-B-49 Crib	Nov 1955-Dec 1955	Scavenged tributyl phosphate supernatant from 221-U during uranium recovery operations.	6,700	200-BP-1
216-B-50 Crib	Jan 1965-Jan 1974	Waste storage tank condensate from the ITS-1 unit in the 241-BY Tank Farms	54,800	200-BP-1
216-B-55 Crib	Sept 1967-present/active	Steam condensate from 221-B.	1,230,000	200-BP-9
216-B-56 Crib	Not Used	Waste storage tank condensate from the ITS-2 unit in the 241-BY Tank Farm.	0	200-BP-5
216-B-57 Crib	Feb 1968-June 1973	Waste storage tank condensate from the ITS-2 unit in the 241-BY Tank Farm.	84,400	200-BP-1
216-B-60 Crib	Nov 1967	Cell cleanout solid and liquid waste from the 24 in. sewer in 221-B.	18.9	200-BP-6
216-B-61 Crib	Not Used	Not used.	0	200-BP-1
216-B-62 Crib	Nov 1973-present/active	Process condensate from the 221-B Separations Facilities.	282,000	200-BP-9
Chem TF North of 2703-E	Unknown	Mixed Waste.	Unknown	200-SS-1

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DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-13 French Drain	Aug 1947-June 1976	291-B stack drainage.	21	200-BP-6
216-B-51 French Drain	Jan 1956-Jan 1958	Flush drainage from the BC Crib pipeline.	1	200-BP-4
Reverse Wells				
216-B-4 Reverse Well	April 1945-Dec 1949	291-B stack drainage and floor drainage from 292-B.	10	200-BP-6
216-B-5 Reverse Well	April 1945-Oct 1947	Supernatant overflow from the 216-B-361 settling tank waste via Tank 5-6 in 221-B and liquid waste from 224-B. Cell drainage and other liquid waste via Tank 5-6 in 221-B.	30,600	200-BP-5
216-B-6 Reverse Well	April 1945-Dec 1949	Decontamination sink and sample slurper waste from 222-B.	6,000	200-BP-6
216-B-11A & -11B Rev. Well	Dec 1951-Dec 1954	Process condensate from the 242-B Evaporator.	29,600	200-BP-4
Ponds, Ditches, and Trenches				
216-B-3 Pond	April 1945-present/ <i>active</i>	221-B steam condensate and process cooling water, 284-E Powerhouse water, 244-CR, -AR, and 242-A cooling water, 202-A process, condenser, and air sampler vacuum pump cooling water, 202-A chem sewer, fractionator condensate, WESF cooling water	240,000,000	200-BP-11
216-B-3A Pond	Oct 1983-present/ <i>active</i>	221-B steam condensate and process cooling water, 284-E Powerhouse water, 244-CR, -AR, and 242-A cooling water, 202-A process, condenser, and air sampler vacuum pump cooling water, 202-A chem sewer, fractionator condensate, WESF cooling water, via the 216-B-3 Pond.	Not reported	200-BP-11

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Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-3B Pond	June 1984-present/ <i>active</i>	221-B steam condensate and process cooling water, 284-E Powerhouse water, 244-CR, -AR, and 242-A cooling water, 202-A process, condenser, and air sampler vacuum pump cooling water, 202-A chem sewer, fractionator condensate, WESF cooling water, via the 216-B-3A Pond.	Not reported	200-BP-11
216-B-3C Pond	1985-present/ <i>active</i>	221-B steam condensate and process cooling water, 284-E Powerhouse water, 244-CR, -AR, and 242-A cooling water, 202-A process, condenser, and air sampler vacuum pump cooling water, 202-A chem sewer, fractionator condensate, WESF cooling water, via the 216-B-3A Pond.	Not reported	200-BP-11
216-E-28 Contingency Pond	Constructed in 1986; never used	Emergency diversion pond for the 216-B-3 Pond system	0	200-BP-11
216-A-25 Pond	Dec 1957-1987	Process cooling water from 202-A, contact condenser cooling water from 241-A-431, surface condenser cooling water from 241-A-401, 284-E Powerhouse wastewater, cooling water and steam condensate from 244-AR Vault, 242-A steam condensate cooling water and B Plant cooling water.	307,000,000	200-IU-6
216-N-8 Pond	1958-1987	Sewage sludge from Hanford construction camp.	Unknown	200-IU-6
2101-M Pond	1983-present/ <i>active</i>	Swamp-cooler condensate and overflow drain wastewater from the 2101-M air conditioning system. Barium chloride lab waste solution, nitric and hydrochloric acid.	Not reported	200-SS-1
216-B-2-1 Ditch	April 1945-Nov 1963	Steam condensate, process cooling water, chem sewer from 221-B waste, 284-E Powerhouse water, 241-CR vault cooling water.	149,000,000	200-BP-8

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Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-2-2 Ditch	Nov 1963-May 1970	Steam condensate, process cooling water, chem sewer from 221-B waste, 284-E Powerhouse water, 241-CR vault cooling water, ITS-1 and -2 cooling water, cleanup waste from 207-B Retention Basin.	49,700	200-BP-8
216-B-2-3 Ditch	1970-1987	221-B cooling water, 241-CR vault cooling water, condenser cooling water from ITS-1 and -2 cooling water.	Not reported	200-BP-8
216-B-3-1 Ditch	April 1945-July 1964	Steam condensate, process cooling water, chem sewer from 221-B waste, 284-E Powerhouse waste, 241-CR vault cooling water, 242-A process cooling water and chem sewer, 202-A acid fractionator condensate, 202-A air sampler vacuum pumps seal cooling water.	149,000,000	200-BP-11
216-B-3-2 Ditch	July 1964-Sept 1970	Steam condensate, process cooling water, chem sewer from 221-B waste, 284-E Powerhouse waste, 241-CR vault cooling water, 242-A process cooling water and chem sewer, 202-A acid fractionator condensate, 202-A air sampler vacuum pumps seal cooling water, ITS-1 condenser cooling water.	149,000,000	200-BP-11
216-B-3-3 Ditch	Sept 30, 1970 - present/active	221-B cooling water, 202-A chem sewer, ITS-1 and -2 cooling water, 244-CR cooling water.	not reported	200-BP-11
216-B-20 Trench	Aug 1956-Sept 1956	Scavenged tributyl phosphate waste from 221-U.	4,680	200-BP-2
216-B-21 Trench	Sept 1956-Oct 1956	Scavenged tributyl phosphate waste from 221-U.	4,670	200-BP-2
216-B-22 Trench	Oct 1956	Scavenged tributyl phosphate waste from 221-U.	4,740	200-BP-2
216-B-23 Trench	Oct 1956	Scavenged tributyl phosphate waste from 221-U.	4,520	200-BP-2
216-B-24 Trench	Oct 1956-Nov 1956	Scavenged tributyl phosphate waste from 221-U.	4,700	200-BP-2

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Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-25 Trench	Nov 1956-Dec 1956	Scavenged tributyl phosphate waste from 221-U.	3,760	200-BP-2
216-B-26 Trench	Dec 1956-Feb 1957	Scavenged tributyl phosphate waste from 221-U.	5,880	200-BP-2
216-B-27 Trench	Feb 1957-April 1957	Scavenged tributyl phosphate waste from 221-U.	4,420	200-BP-2
216-B-28 Trench	April 1957-June 1957	Scavenged tributyl phosphate waste from 221-U.	5,050	200-BP-2
216-B-29 Trench	June 1957-July 1957	Scavenged tributyl phosphate waste from 221-U.	4,840	200-BP-2
216-B-30 Trench	July 1957	Scavenged tributyl phosphate waste from 221-U.	4,780	200-BP-2
216-B-31 Trench	July 1957-Aug 1957	Scavenged tributyl phosphate waste from 221-U.	4,740	200-BP-2
216-B-32 Trench	Aug 1957-Sept 1957	Scavenged tributyl phosphate waste from 221-U.	4,770	200-BP-2
216-B-33 Trench	Sept 1957-Oct 1957	Scavenged tributyl phosphate waste from 221-U.	4,740	200-BP-2
216-B-34 Trench	Oct 1957	Scavenged tributyl phosphate waste from 221-U.	4,870	200-BP-2
216-B-35 Trench	Feb 1954-March 1954	1-C supernatant from 221-B.	1,060	200-BP-3
216-B-36 Trench	March 1954-April 1954	1-C supernatant from 221-B.	1,940	200-BP-3
216-B-37 Trench	Aug 1954	1-C bottom supernatant waste from the 242-B waste evaporator.	4,320	200-BP-3
216-B-38 Trench	July 1954	1-C supernatant from 221-B.	1,430	200-BP-3
216-B-39 Trench	Dec 1953-Nov 1954	1-C supernatant from 221-B.	1,540	200-BP-3
216-B-40 Trench	April 1954-July 1954	1-C supernatant from 221-B.	1,640	200-BP-3
216-B-41 Trench	Nov 1954	1-C supernatant from 221-B.	1,440	200-BP-3
216-B-42 Trench	Jan 1955-Feb 1955	Scavenged tributyl phosphate waste from 221-U.	1,500	200-BP-3
216-B-52 Trench	Dec 1957-Jan 1958	Scavenged tributyl phosphate waste from 221-U.	8,530	200-BP-2
216-B-53A Trench	Oct 1965-Nov 1965	Waste from the 300 Area Hanford lab operations.	549	200-BP-2

2T-11

DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/ <i>Status</i>	Source Description	Waste Volume Received (m ³)	Operable Unit
216-B-53B Trench	Nov 1962-March 1963	Waste from the 300 Area Hanford lab Operations (321 Building).	15.1	200-BP-2
216-B-54 Trench	March 1963-Oct 1965	Waste from the 300 Area Hanford Laboratories operations.	999	200-BP-2
216-B-58 Trench	Nov 1965-June 1967	PNL waste from the 300 Area.	413	200-BP-2
216-B-63 Trench	March 1970-present/ <i>active</i>	Effluent from 221-B, 225-B, and 271-B floor drains and chem sewer wastes.	7,220,000	200-BP-8
Septic Tanks and Associated Drain Fields				
2607-EB Septic Tank	1951-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-BP-7
2607-EH Septic Tank	1983-unknown	Sanitary wastewater and sewage.	NA	200-SS-1
2607-EK Septic Tank	1980-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-EM Septic Tank	1984-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-EN Septic Tank	Pre 1980-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-EO Septic Tank	Circa 1985-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-EP Septic Tank	1984-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-EQ Septic Tank	1985-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-ER Septic Tank	Unknown-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-GF Septic Tank	Unknown	Sanitary wastewater and sewage.	NA	200-SS-1
2607-E1 Septic Tank	1970-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-E2 Septic Tank	Pre 1980-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-SS-1
2607-E3 Septic Tank	1944-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-BP-6
2607-E4 Septic Tank	1944-present/ <i>active</i>	Sanitary wastewater and sewage.	NA	200-BP-6

2T-1m

DOE/RL-92-05, Rev. 0

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
2607-E7B Septic Tank	Unknown	Sanitary wastewater and sewage.	NA	200-SS-1
2607-E8 Septic Tank	1978-present/active	Sanitary wastewater and sewage.	NA	200-SS-1
2607-E9 Septic Tank	1951-present/active	Sanitary wastewater and sewage.	NA	
2607-E11 Septic Tank	Circa 1985-present/active	Sanitary wastewater and sewage.	NA	200-SS-1
Transfer Facilities, Diversion Boxes, and Pipelines				
241-B-151 Diversion Box	1945-June 1984	Processing and decon wastes.	NA	200-BP-7
241-B-152 Diversion Box	1945-June 1984	Processing and decon wastes.	NA	200-BP-7
241-B-153 Diversion Box	1945-June 1984	Processing and decon wastes.	NA	200-BP-7
241-B-154 Diversion Box	1945-June 1984	Processing and decon wastes.	NA	200-BP-5
241-B-252 Diversion Box	1945-June 1984	Processing and decon wastes.	NA	200-BP-7
241-BR-152 Diversion Box	1948-June 1984	Processing and decon wastes.	NA	200-BP-7
241-BX-153 Diversion Box	1948-June 1983	Processing and decon wastes.	NA	200-BP-7
241-BX-154 Diversion Box	1948-July 1985	Processing and decon wastes.	NA	200-BP-6
241-BX-155 Diversion Box	1948-June 1984	Processing and decon wastes.	NA	200-BP-6
241-BXR-151 Diversion Box	1948-June 1984	Processing and decon wastes.	NA	200-BP-7
241-BXR-152 Diversion Box	1948-June 1984	Processing and decon wastes.	NA	200-BP7
241-BXR-153 Diversion Box	1948-June 1984	Processing and decon wastes.	NA	200-BP-7
241-BYR-152 Diversion Box	1950-June 1984	Processing and decon wastes.	NA	200-BP-7
241-BYR-153 Diversion Box	1950-June 1984	Processing and decon wastes.	NA	200-BP-7
241-BYR-154 Diversion Box	1950-June 1984	Processing and decon wastes.	NA	200-BP-7
241-ER-151 Diversion Box	1945-present/active	Processing and decon wastes.	NA	200-BP-9

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
241-ER-152 Diversion Box	1945-present/ <i>active</i>	Processing and decon wastes.	NA	200-BP-6
242-B-151 Diversion Box	1945-June 1984	Processing and decon wastes.	NA	200-BP-7
242 B-207 Waste Line	NA	Processing and decon wastes.	NA	200-BP-7
221 B-216-B Waste Line	NA	Processing and decon wastes.	NA	200-BP-5
221B-241-BX Waste Line 154	NA	Processing and decon wastes.	NA	200-BP-6
221B-241-B Waste Line	NA	Processing and decon wastes.	NA	200-BP-6
BCSA Crib Line Waste Line	NA	Processing and decon wastes.	NA	200-BP-6
Basins				
207-B Retention Basin	April 1945-present/ <i>active</i>	Process cooling water from equipment jackets in 221-B.	Not reported	200 BP-8
216 B-59/59B Retention Basin	Dec 1967 - present/ <i>active</i>	Diverted cooling water from 221-B.	477	200-BP-5
216-B-64 Retention Basin	Never used	Never used.	0	200-BP-9
Burial Sites				
200-E Powerhouse Ash Pit	1943-present/ <i>active</i>	Ash from the 200 East Powerhouse.	63,000	200-SS-1
218-E-2 Burial Ground	1945-1953	Source unknown; contains MFP/TRU dry wastes.	9,033 ^w 9,056 ^{bw}	200-BP-10
218-E-2A Burial Ground	1945-1955	Source unknown; also used as a storage site.	Unknown	200-BP-10
218-E-3 Burial Ground	1954	Source unknown; site exhumed.	NA	200-SS-1
218-E-4 Burial Ground	Feb 1955-1956	No trenches suspected; contaminated equipment was stored above ground.	1,586 ^w 1,587 ^{bw}	200-BP-10
218-E-5 Burial Ground	1954-1956	Industrial mixed waste and small boxes. North end contains railroad boxcars contaminated with UNH.	3,172 ^w 3,115 ^{bw}	200-BP-10

2T-10

Table 2-1. Summary of B Plant Aggregate Area Waste Management Units.

Waste Management Unit	Years in Service/Status	Source Description	Waste Volume Received (m ³)	Operable Unit
218-E-5A Burial Ground	1956-1959	Waste from L Cell (202-A burial package); four large boxes containing failed equipment and industrial wastes. D-2 Column from PUREX buried.	6,173 ^w 6,230 ^w	200-BP-10
218-E-6 Burial Ground	Fall 1955	Wooden shack and other items from 291-B stack area were placed in a trench and burned.	0	200-BP-6
218-E-7 Burial Ground	1947-1952	Lab and sample waste; mixed MFP/TRU wastes.	170 ^w 170 ^w	200-BP-6
218-E-9 Burial Ground	1953-1958	Storage site for fission product equipment contaminated in U recovery program at the tank farm.	unknown	200-BP-10
218-E-10 Burial Ground	1960-present/active	Failed equipment and mixed industrial waste, PUREX cover and centrifuge blocks.	21,764 ^w 153,000 ^w	200-BP-10
200 East Area Construction Pit	1945-1955	Used as solid waste disposal site for construction debris.	NA	200-BP-9
200-E-8 Borrow Pit	1984-present/active	Site used to carry out thermal detonations for experimental purposes.	NA	200-BP-10

NOTES:

^w Source: WHC 1991a.^w Source: Maxfield 1979.

NA = No data available.

9 3 1 2 0 2 5 1 2 9 3

Table 2-2. Description of B Plant Aggregate Area Single-Shell Tank Farms.

Page 1 of 3

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume (L)	Drainable Waste Volume (L)	High Ferrocyanide Content?
241-B Tank Farm							
241-B-101	Single-Shell	Assumed Leaker	Yes	Interim Isolated	427,676	22,709	No
241-B-102	Single-Shell	Sound	Yes	Interim Isolated	121,300	15,139	No
241-B-103	Single-Shell	Assumed Leaker	Yes	Interim Isolated	223,300	0	No ^a
241-B-104	Single-Shell	Sound	Yes	Interim Isolated	1,404,142	177,883	No
241-B-105	Single-Shell	Assumed Leaker	Yes	Interim Isolated	1,158,134	87,049	No
241-B-106	Single-Shell	Sound	Yes	Interim Isolated	442,816	26,493	No
241-B-107	Single-Shell	Assumed Leaker	Yes	Interim Isolated	624,484	49,202	No
241-B-108	Single-Shell	Sound	Yes	Interim Isolated	355,767	15,139	No
241-B-109	Single-Shell	Sound	Yes	Interim Isolated	480,663	30,278	No
241-B-110	Single-Shell	Assumed Leaker	Yes	Interim Isolated	931,049	87,049	No
241-B-111	Single-Shell	Assumed Leaker	Yes	Interim Isolated	896,986	83,265	No
241-B-112	Single-Shell	Assumed Leaker	Yes	Interim Isolated	124,897	11,354	No
241-B-201	Single-Shell	Assumed Leaker	Yes	Interim Isolated	109,758	15,139	No
241-B-202	Single-Shell	Sound	Yes	Interim Isolated	102,188	11,354	No
241-B-203	Single-Shell	Assumed Leaker	Yes	Interim Isolated	193,022	22,709	No
241-B-204	Single-Shell	Assumed Leaker	Yes	Interim Isolated	189,238	22,709	No
241-BX Tank Farm							
241-BX-101	Single-Shell	Assumed Leaker	Yes	Interim Isolated	162,774	3,785	No
241-BX-102	Single-Shell	Assumed Leaker	Yes	Interim Isolated	363,336	15,139	Yes

2T-2a

DOE/RL-92-05, Rev. 0

Table 2-2. Description of B Plant Aggregate Area Single-Shell Tank Farms.

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume (L)	Drainable Waste Volume (L)	High Ferrocyanide Content?
241-BX-103	Single-Shell	Sound	Yes	Interim Isolated	249,794	15,139	No
241-BX-104	Single-Shell	Sound	Yes	Interim Isolated	374,690	124,897	No
241-BX-105	Single-Shell	Sound	Yes	Interim Isolated	193,022	41,632	No
241-BX-106	Single-Shell	Sound	No	Part. Interim Isolated	174,099	56,771	Yes
241-BX-107	Single-Shell	Sound	Yes	Part. Interim Isolated	1,305,739	113,543	No
241-BX-108	Single-Shell	Assumed Leaker	Yes	Interim Isolated	98,404	3,785	No
241-BX-109	Single-Shell	Sound	Yes	Part. Interim Isolated	730,457	49,202	No
241-BX-110	Single-Shell	Assumed Leaker	Yes	Part. Interim Isolated	753,165	79,480	Yes
241-BX-111	Single-Shell	Assumed Leaker	No	Part. Interim Isolated	870,492	261,148	Yes
241-BX-112	Single-Shell	Sound	Yes	Part. Interim Isolated	624,484	30,278	No
241-BY-Tank Farm							
241-BY-101	Single-Shell	Sound	Yes	Interim Isolated	1,464,689	18,924	Yes
241-BY-102	Single-Shell	Sound	No	Part. Interim Isolated	1,290,560	162,700	No
241-BY-103	Single-Shell	Assumed Leaker	No	Part. Interim Isolated	1,513,900	606,400	Yes
241-BY-104	Single-Shell	Sound	Yes	Interim Isolated	1,536,609	68,126	Yes
241-BY-105	Single-Shell	Assumed Leaker	No	Part. Interim Isolated	1,903,729	727,700	Yes
241-BY-106	Single-Shell	Assumed Leaker	No	Part. Interim Isolated	2,429,810	889,416	Yes
241-BY-107	Single-Shell	Assumed Leaker	Yes	Interim Isolated	1,006,744	94,619	Yes
241-BY-108	Single-Shell	Assumed Leaker	Yes	Interim Isolated	862,923	34,063	Yes
241-BY-109	Single-Shell	Sound	No	Part. Interim Isolated	1,600,949	264,600	No

2T-2b

Table 2-2. Description of B Plant Aggregate Area Single-Shell Tank Farms.

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume (L)	Drainable Waste Volume (L)	High Ferrocyanide Content?
241-BY-110	Single-Shell	Sound	Yes	Interim Isolated	1,506,331	34,063	Yes
241-BY-111	Single-Shell	Sound	Yes	Interim Isolated	1,737,200	0	Yes
241-BY-112	Single-Shell	Sound	Yes	Interim Isolated	1,101,362	30,278	Yes

^a Contains concentration of organic salts $\geq 10\%$ (weight) TOC.

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Table 2-3. Radionuclide Waste Inventory Summary.

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^{d/} (NOTE: Sheet 6 starts a new set of radionuclides.)							
	Am-241	Co-60	Sr-90	Cs-137	Pu Total (grams)	Pu-238	Pu-239	Pu-240
200-E Ash Pit	--		--	--	--	--	--	--
207-B ^{b/} Retention Basin	--	--	--	--	--	--	--	--
2101-M Pond	--	--	--	--	--	--	--	--
216-A-25 Pond	5.28E-04	--	2.57E+02	2.04E+02	4.28E+02	--	--	--
216-B-2-1 Ditch ^{b/}	3.96E+00	--	1.01E+02	9.35E+01	2.50E+02	2.60E-03	7.99E-01	--
216-B-2-2 Ditch ^{d/}	--	--	1.47E+02	3.14E-01	4.20E-02	--	2.40E-03 ^{d/}	6.00E-04 ^{d/}
216-B-2-3 Ditch	--	--	4.32E+02	3.14E-01	--	--	--	--
216-B-3 Pond ^{d/}	3.96E+00	--	1.01E+02	9.35E+01	2.50E+02	2.60E-03	7.99E-01	--
216-B-3-1 Ditch ^{b/}	--	--	--	--	--	--	--	--
216-B-3-2 Ditch ^{d/}	--	--	--	--	--	--	--	--
216-B-3-3 Ditch	--	--	--	--	--	--	--	--
216-B-3A Pond	--	--	--	--	--	--	--	--
216-B-3B Pond	--	--	--	--	--	--	--	--
216-B-3C Pond	--	--	--	--	--	--	--	--
216-B-4 Reverse Well ^{f/}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-B-10A Crib	0.00E+00	9.90E-04 ^{d/}	1.89E+00	4.01E-01	9.80E+00	0.00E+00	5.60E-01 ^{d/}	1.51E-01 ^{d/}
216-B-10B Crib	0.00E+00	0.00E+00	2.00E-04	1.00E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-B-11A&B Reverse Wells	0.00E+00	1.43E-03 ^{d/}	2.01E+00	2.13E+01	4.00E+00	0.00E+00	2.28E-01 ^{d/}	6.16E-02 ^{d/}
216-B-12 Crib	0.00E+00	2.32E-01 ^{d/}	7.93E+01	7.16E+02	3.74E+02	0.00E+00	2.14E+01 ^{d/}	5.76E+00 ^{d/}
216-B-13 French Drain	--	--	--	--	--	--	--	--

2T-3a

DOE/RL-92-05, Rev. 0

Table 2-3. Radionuclide Waste Inventory Summary.

Sheet 2 of 10

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^d (NOTE: Sheet 6 starts a new set of radionuclides.)							
	Am-241	Co-60	Sr-90	Cs-137	Pu Total (grams)	Pu-238	Pu-239	Pu-240
216-B-14 Crib	0.00E+00	1.03E-01 ^d	1.72E+02	1.14E+02	2.50E+01	0.00E+00	1.43E+00 ^d	3.85E-01 ^d
216-B-15 Crib	0.00E+00	1.09E-01 ^d	8.73E+01	9.24E+01	5.00E+00	0.00E+00	2.85E-01 ^d	7.70E-02 ^d
216-B-16 Crib	0.00E+00	1.03E-01 ^d	3.02E+02	2.96E+02	1.00E+01	0.00E+00	5.71E-01 ^d	1.54E-01 ^d
216-B-17 Crib	0.00E+00	2.04E-02 ^d	6.89E+01	1.00E+02	1.00E+01	0.00E+00	5.71E-01 ^d	1.54E-01 ^d
216-B-18 Crib	0.00E+00	1.03E-01 ^d	8.18E+01	1.14E+02	1.00E+01	0.00E+00	5.71E-01 ^d	1.54E-01 ^d
216-B-19 Crib	0.00E+00	1.17E-01 ^d	8.83E+01	1.26E+02	1.00E+01	0.00E+00	5.71E-01 ^d	1.54E-01 ^d
216-B-20 Trench	0.00E+00	8.99E-02 ^d	3.40E+02	6.84E+02	1.30E+00	0.00E+00	7.42E-02 ^d	2.00E-02 ^d
216-B-21 Trench	0.00E+00	1.33E-01 ^d	3.18E+02	1.69E+02	1.03E+01	0.00E+00	5.80E-01 ^d	1.36E-01 ^d
216-B-22 Trench	0.00E+00	2.74E-01 ^d	1.76E+02	2.05E+01	2.60E+00	0.00E+00	1.48E-01 ^d	3.42E-02 ^d
216-B-23 Trench	0.00E+00	1.37E-01 ^d	6.25E+01	5.09E+01	1.80E+00	0.00E+00	1.02E-01 ^d	2.77E-02 ^d
216-B-24 Trench	0.00E+00	2.10E-01 ^d	7.80E+01	5.86E+01	7.70E+01	0.00E+00	4.40E-01 ^d	1.19E-01 ^d
216-B-25 Trench	0.00E+00	1.41E-01 ^d	8.83E+01	2.55E+01	2.00E+00	0.00E+00	1.14E-01 ^d	3.08E-01 ^d
216-B-26 Trench	0.00E+00	2.23E-01 ^d	4.75E+02	4.38E+02	2.50E+00	0.00E+00	1.43E-01 ^d	3.85E-01 ^d
216-B-27 Trench	0.00E+00	1.77E-01 ^d	2.63E+02	1.58E+01	7.00E+01	0.00E+00	4.00E-02 ^d	1.08E-02 ^d
216-B-28 Trench	0.00E+00	5.37E-02 ^d	4.95E+01	1.07E+01	5.60E+00	0.00E+00	3.20E-01 ^d	8.62E-02 ^d
216-B-29 Trench	0.00E+00	1.65E-01 ^d	8.48E+01	2.74E+01	1.10E+00	0.00E+00	6.28E-02 ^d	1.69E-02 ^d
216-B-30 Trench	0.00E+00	3.97E-02 ^d	2.65E+02	1.57E+03	2.10E+00	0.00E+00	1.20E-01 ^d	3.23E-02 ^d
216-B-32 Trench	0.00E+00	3.97E-02 ^d	1.13E+02	5.86E+01	2.60E+00	0.00E+00	1.48E-01 ^d	4.00E-02 ^d
216-B-33 Trench	0.00E+00	3.27E-02 ^d	1.81E+01	1.27E+02	1.18E+01	0.00E+00	6.74E-01 ^d	1.82E-01 ^d
216-B-34 Trench	0.00E+00	1.40E-02 ^d	1.81E+01	7.91E+00	5.70E+00	0.00E+00	3.25E-01 ^d	8.78E-02 ^d
216-B-35 Trench	0.00E+00	4.70E-04 ^d	9.64E+01	1.85E+02	1.20E+00	0.00E+00	6.85E-02 ^d	1.85E-02 ^d

2T-3b

DOE/RL-92-05, Rev. 0

Table 2-3. Radionuclide Waste Inventory Summary.

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^d (NOTE: Sheet 6 starts a new set of radionuclides.)							
	Am-241	Co-60	Sr-90	Cs-137	Pu Total (grams)	Pu-238	Pu-239	Pu-240
216-B-36 Trench	0.00E+00	1.10E-03 ^d	1.99E+02	3.36E+02	8.00E-01	0.00E+00	4.57E-02 ^d	1.23E-02 ^d
216-B-37 Trench	0.00E+00	1.57E-02 ^d	6.56E+00	1.35E+03	2.00E+00	0.00E+00	1.14E-01 ^d	3.08E-02 ^d
216-B-38 Trench	0.00E+00	9.40E-04 ^d	7.59E+02	2.21E+02	1.20E+00	0.00E+00	6.85E-02 ^d	1.85E-02 ^d
216-B-39 Trench	0.00E+00	1.48E-02 ^d	9.27E+00	1.92E+02	1.51E+00	0.00E+00	8.26E-02 ^d	2.32E-02 ^d
216-B-40 Trench	0.00E+00	3.10E-04 ^d	1.15E+02	1.53E+02	1.00E+00	0.00E+00	5.71E-02 ^d	1.54E-02 ^d
216-B-41 Trench	0.00E+00	1.60E-04 ^d	1.93E+01	3.86E+02	3.00E-01	0.00E+00	1.71E-02 ^d	4.62E-03 ^d
216-B-42 Trench	0.00E+00	1.79E-01 ^d	4.63E+02	4.27E+01	1.00E+01	0.00E+00	5.71E-02 ^d	1.54E-01 ^d
216-B-43 Crib	0.00E+00	1.57E-02 ^d	5.74E+02	1.30E+02	5.00E-01	0.00E+00	2.85E-02 ^d	7.70E-03 ^d
216-B-44 Crib	0.00E+00	8.48E-02 ^d	1.20E+03	3.09E+02	1.50E+01	0.00E+00	8.56E-01 ^d	2.31E-01 ^d
216-B-45 Crib	0.00E+00	8.99E-02 ^d	1.18E+03	6.66E+02	1.00E+01	0.00E+00	5.71E-01 ^d	1.54E-01 ^d
216-B-46 Crib	0.00E+00	8.99E-02 ^d	6.31E+02	8.89E+01	2.00E+01	0.00E+00	1.01E+03 ^d	3.08E-01 ^d
216-B-47 Crib	0.00E+00	1.79E-02 ^d	2.61E+02	6.66E+01	5.00E+00	0.00E+00	2.85E-01 ^d	7.66E-02 ^d
216-B-48 Crib	0.00E+00	1.79E-02 ^d	5.47E+02	2.00E+02	5.00E+00	0.00E+00	2.85E-01 ^d	7.70E-02 ^d
216-B-49 Crib	0.00E+00	8.99E-02 ^d	1.14E+03	1.82E+02	1.50E+01	0.00E+00	8.56E-01 ^d	2.31E-01 ^d
216-B-5 Reverse Well	0.00E+00	0.00E+00	2.55E+01	2.92E+01	4.27E+03	0.00E+00	2.44E+02 ^d	6.57E+01 ^d
216-B-50 Crib	0.00E+00	2.83E-02 ^d	3.39E+00	5.12E+01	2.39E-01	0.00E+00	1.36E-02 ^d	3.68E-03 ^d
216-B-51 French Drain	--	--	--	--	--	--	--	--
216-B-52 Trench	0.00E+00	1.13E-01 ^d	4.92E+00	1.60E+02	1.90E+01	0.00E+00	1.08E+00 ^d	2.93E-01 ^d
216-B-53A Trench	0.00E+00	3.35E-02 ^d	5.38E-02	5.59E-02	1.00E+02	0.00E+00	5.71E+00 ^d	1.54E+00 ^d
216-B-53B Trench	0.00E+00	4.83E-02 ^d	5.06E+00	3.70E+00	5.00E+00	0.00E+00	2.85E-01 ^d	7.70E-02 ^d
216-B-54 Trench	0.00E+00	5.90E-03 ^d	5.25E-02	5.47E-02	5.00E+00	0.00E+00	2.85E-01 ^d	7.70E-02 ^d

2T-3c

Table 2-3. Radionuclide Waste Inventory Summary.

Sheet 4 of 10

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^a (NOTE: Sheet 6 starts a new set of radionuclides.)							
	Am-241	Co-60	Sr-90	Cs-137	Pu Total (grams)	Pu-238	Pu-239	Pu-240
216-B-55 Crib	3.80E-06	--	7.23E+00	1.37E+01	6.53E-01	0.00E+00	3.80E-06	0.00E+00
216-B-56 Crib	never used	--	--	--	--	--	--	--
216-B-57 Crib	0.00E+00	1.47E-02 ^d	1.83E+00	2.26E+02	1.87E-01	0.00E+00	1.06E-02 ^d	2.87E-03
216-B-58 Trench	0.00E+00	1.98E-01 ^d	5.55E+00	4.40E+00	6.70E+00	0.00E+00	3.93E-01 ^d	1.03E-01 ^d
216-B-59 Basin	--	--	2.89E-02	1.20E-02	--	--	--	--
216-B-6 Reverse Well ^f	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
216-B-60 Crib	--	--	--	--	--	--	--	--
216-B-61 Crib	never used	--	--	--	--	--	--	--
216-B-62 Crib	1.03E-01	--	7.46E+01	1.35E+02	7.55E-01	--	2.30E-03 ^d	--
216-B-63 Trench	3.48E-02	--	2.41E+00	6.25E-01	5.73E-01	--	1.08E-02	--
216-B-64 Basin	never used	--	--	--	--	--	--	--
216-B-7A&B Crib	0.00E+00	1.20E-02 ^d	2.20E+03	4.32E+01	4.30E+03	0.00E+00	2.46E+02 ^d	6.62E+01 ^d
216-B-8TF Crib	0.00E+00	9.00E-03 ^d	5.58E+00	1.98E+01	3.00E+01	0.00E+00	1.70E+00 ^d	4.62E-01 ^d
216-B-9TF Crib	0.00E+00	9.00E-04 ^d	5.52E+00	3.92E+00	1.74E+02	0.00E+00	9.94E+00 ^d	2.68E+00 ^d
216-E-28 Pond	--	--	--	--	--	--	--	--
216-N-8 Pond	--	--	--	--	--	--	--	--
218-E-2 Burial Ground	--	--	1.87E+02	2.13E+02	8.00E+02	--	--	--
218-E-2A Burial Ground	--	--	--	--	--	--	--	--
218-E-4 Burial Ground	--	--	8.33E-02	9.40E+02	1.00E+01	--	--	--
218-E-5 Burial Ground	--	--	6.27E+01	7.07E+01	6.20E+02	--	--	--
218-E-5A Burial Ground	--	--	1.47E+02	1.65E+02	1.38E+03	--	--	--

2T-3d

DOE/RL-92-05, Rev. 0

Table 2-3. Radionuclide Waste Inventory Summary.

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^a (NOTE: Sheet 6 starts a new set of radionuclides.)							
	Am-241	Co-60	Sr-90	Cs-137	Pu Total (grams)	Pu-238	Pu-239	Pu-240
218-E-6 Burial Ground	--	--	--	--	--	--	--	--
218-E-7 Burial Ground	--	--	4.36E+00	4.96E+00	1.00E+00	--	--	--
218-E-9 Burial Ground								
218-E-10 Burial Ground	--	2.47E+03 ^a	7.68E+05 ^a	9.31E+05 ^a	4.90E+03	--	--	--

Table 2-3. Radionuclide Waste Inventory Summary.

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^{a/}								Volume Recorded (L)
	Pu-241	Ru-106	Total U	H-3	Alpha	Beta	U-238	U-235	
207-B Retention Basin ^{b/}	--	--	--	--	--	--	--	--	--
2101-M Pond	--	--	--	--	--	--	--	--	--
216-A-25 Pond	--	1.62E-04	4.24E+00	2.13E+02	2.75E+01	9.39E+02	--	--	3.07E+11
216-B-2-1 Ditch ^{b/}	--	1.42E+00	2.10E+00	7.90E+02	1.62E+01	3.90E+02	--	--	1.49E+11
216-B-2-2 Ditch ^{c/}	0.00E+00	--	1.57E-05	0.00E+00	2.58E-03	2.95E+02	0.00E+00	0.00E+00	4.97E+07
216-B-2-3 Ditch	--	--	--	--	--	8.64E+02	--	--	--
216-B-3 Ditch ^{c/}	--	1.42E+00	2.10E+00	7.90E+02	1.62E+01	3.90E+02	--	--	2.40E+11
216-B-3-1 Ditch ^{b/}	--	--	--	--	--	--	--	--	1.49E+11
216-B-3-2 Ditch ^{c/}	--	--	--	--	--	--	--	--	1.49E+11
216-B-3-3 Ditch	--	--	--	--	--	--	--	--	--
216-B-3A Pond	--	--	--	--	--	--	--	--	--
216-B-3B Pond	--	--	--	--	--	--	--	--	--
216-B-3C Pond	--	--	--	--	--	--	--	--	--
216-B-4 Reverse Well ^{f/}	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00 ^{d/}	0.00E+00	0.00E+00	1.00E+04
216-B-10A Crib	0.00E+00	0.00E+00	3.02E-03	0.00E+00	6.02E-01	4.55E+00	3.04E-03 ^{d/}	0.00E+00	9.99E+06
216-B-10B Crib	0.00E+00	0.00E+00	2.49E-07	0.00E+00	2.91E-06	5.31E-07	0.00E+00	0.00E+00	2.80E+04
216-B-11A&B Reverse Well	0.00E+00	4.25E-01	4.54E-03	0.00E+00	2.46E-01	4.49E+01	4.56E-03 ^{d/}	0.00E+00	2.96E+07
216-B-12 Crib	0.00E+00	1.00E-04	6.96E+00	0.00E+00	2.30E+01	1.54E+03	7.00E+00	0.00E+00	5.20E+08

2T-3f

Table 2-3. Radionuclide Waste Inventory Summary.

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^d								Volume Recorded (L)
	Pu-241	Ru-106	Total U	H-3	Alpha	Beta	U-238	U-235	
216-B-13 French Drain	--	--	--	--	--	--	--	--	2.10E+04
216-B-14 Crib	0.00E+00	0.00E+00	7.26E-02	0.00E+00	1.53E+00	5.67E+02	0.073 ^d	0.00E+00	8.71E+06
216-B-15 Crib	0.00E+00	0.00E+00	3.48E-02	0.00E+00	3.07E-01	3.57E+02	3.48E-02 ^d	0.00E+00	6.32E+06
216-B-16 Crib	0.00E+00	0.00E+00	1.07E-01	4.50E+02 ^d	6.14E-01	1.18E+03	1.08E-01 ^d	0.00E+00	5.60E+06
216-B-17 Crib	0.00E+00	0.00E+00	1.18E-01	0.00E+00	6.14E-01	3.30E+02	1.19E-01 ^d	0.00E+00	3.41E+06
216-B-18 Crib	0.00E+00	0.00E+00	7.86E-02	0.00E+00	6.14E-01	3.85E+02	7.91E-02 ^d	0.00E+00	8.52E+06
216-B-19 Crib	0.00E+00	0.00E+00	6.05E-02	0.00E+00	6.14E-01	4.18E+02	6.06E-02 ^d	0.00E+00	6.40E+06
216-B-20 Trench	0.00E+00	0.00E+00	1.17E-01	0.00E+00	7.98E-02	2.00E+03	1.18E-01 ^d	0.00E+00	4.68E+06
216-B-21 Trench	0.00E+00	0.00E+00	2.25E-01	0.00E+00	6.32E-01	9.65E+02	2.26E-01 ^d	0.00E+00	4.67E+06
216-B-22 Trench	0.00E+00	0.00E+00	1.39E-01	0.00E+00	1.60E-01	3.98E+02	1.40E-01 ^d	0.00E+00	4.74E+06
216-B-23 Trench	0.00E+00	0.00E+00	5.20E-02	0.00E+00	1.11E-01	2.26E+02	5.23E-02 ^d	0.00E+00	4.52E+06
216-B-24 Trench	0.00E+00	0.00E+00	8.20E-02	0.00E+00	4.73E-01	2.74E-01	8.25E-02 ^d	0.00E+00	4.70E+06
216-B-25 Trench	0.00E+00	0.00E+00	0.510E-02	0.00E+00	1.23E-01	2.29E+02	5.13E-01 ^d	0.00E+00	3.76E+06
216-B-26 Trench	0.00E+00	0.00E+00	1.96E-01	0.00E+00	1.53E-02	1.80E+03	1.97E-01 ^d	0.00E+00	5.88E+06
216-B-27 Trench	0.00E+00	0.00E+00	1.14E-01	0.00E+00	4.30E-02	5.60E+02	1.15E-01 ^d	0.00E+00	4.42E+06
216-B-28 Trench	0.00E+00	0.00E+00	1.00E-01	0.00E+00	3.40E-01	1.21E+02	1.01E-01 ^d	0.00E+00	5.05E+06
216-B-29 Trench	0.00E+00	0.00E+00	1.15E-01	0.00E+00	6.75E-02	2.26E+02	1.15E-01 ^d	0.00E+00	4.84E+06
216-B-30 Trench	0.00E+00	0.00E+00	2.93E-02	0.00E+00	1.29E-01	3.54E+03	2.95E-02 ^d	0.00E+00	4.78E+06
216-B-32 Trench	0.00E+00	0.00E+00	3.67E-03	0.00E+00	1.60E-01	3.39E+02	3.68E-03 ^d	0.00E+00	4.77E+06
216-B-33 Trench	0.00E+00	0.00E+00	6.67E-03	0.00E+00	7.24E-01	2.81E+02	6.70E-03 ^d	0.00E+00	4.74E+06

2T-3g

DOE/RL-92-05, Rev. 0

Table 2-3. Radionuclide Waste Inventory Summary.

Sheet 8 of 10

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^{d/}								Volume Recorded (L)
	Pu-241	Ru-106	Total U	H-3	Alpha	Beta	U-238	U-235	
216-B-34 Trench	0.00E+00	0.00E+00	2.83E-02	0.00E+00	3.50E-01	5.17E+01	2.85E-02 ^{d/}	0.00E+00	4.80E+06
216-B-35 Trench	0.00E+00	0.00E+00	5.57E-03	0.00E+00	7.37E-02	5.49E+02	5.59E-03 ^{d/}	0.00E+00	1.06E+06
216-B-36 Trench	0.00E+00	0.00E+00	5.32E-03	0.00E+00	4.91E-02	1.04E+03	5.32E-03 ^{d/}	0.00E+00	1.94E+06
216-B-37 Trench	0.00E+00	0.00E+00	1.21E-03	0.00E+00	1.23E-01	2.60E+03	1.21E-03 ^{d/}	0.00E+00	4.32E+06
216-B-38 Trench	0.00E+00	0.00E+00	1.41E-02	0.00E+00	7.37E-02	1.94E+03	1.42E-02 ^{d/}	0.00E+00	1.43E+06
216-B-39 Trench	0.00E+00	0.00E+00	1.93E-03	0.00E+00	9.27E-02	3.87E+02	1.94E-03 ^{d/}	0.00E+00	1.54E+06
216-B-40 Trench	0.00E+00	0.00E+00	1.70E-02	0.00E+00	6.14E-02	5.23E+02	1.17E-03 ^{d/}	0.00E+00	1.64E+06
216-B-41 Trench	0.00E+00	0.00E+00	2.50E-03	0.00E+00	1.84E-02	7.80E+02	2.51E-03 ^{d/}	0.00E+00	1.44E+06
216-B-42 Trench	0.00E+00	0.00E+00	2.27E-01	0.00E+00	6.14E-01	1.01E+03	2.28E-01 ^{d/}	0.00E+00	1.50E+06
216-B-43 Crib	0.00E+00	0.00E+00	4.54E-03	1.70E+02 ^{d/}	3.07E-02	1.40E+03	4.56E-03 ^{d/}	0.00E+00	2.12E+06
216-B-44 Crib	0.00E+00	0.00E+00	7.56E-04	4.50E+02 ^{d/}	9.21E-01	2.99E+03	7.60E-04 ^{d/}	0.00E+00	5.60E+06
216-B-45 Crib	0.00E+00	0.00E+00	2.27E-03	3.90E+02 ^{d/}	6.14E-01	3.64E+03	2.28E-03 ^{d/}	0.00E+00	4.92E+06
216-B-46 Crib	0.00E+00	0.00E+00	6.35E-02	5.36E+02 ^{d/}	1.23E+00	1.44E+03	6.36E-02	0.00E+00	6.70E+06
216-B-47 Crib	0.00E+00	0.00E+00	2.27E-03	0.00E+00	3.07E-01	6.50E+02	2.28E-03 ^{d/}	0.00E+00	3.71E+06
216-B-48 Crib	0.00E+00	0.00E+00	7.57E-04	3.27E+02 ^{d/}	3.07E-01	1.49E+03	7.60E-04 ^{d/}	0.00E+00	4.09E+06
216-B-49 Crib	0.00E+00	0.00E+00	1.06E-01	5.36E+02 ^{d/}	2.62E+02	2.36E+03	1.06E-01 ^{d/}	0.00E+00	6.70E+06
216-B-5 Reverse Well	0.00E+00	1.03E-11	0.00E+00	0.00E+00	2.62E+02	1.08E+02	0.00E+00	0.00E+00	3.06E+07
216-B-50 Crib	0.00E+00	0.00E+00	9.50E-05	9.00E+01 ^{d/}	1.47E-02	1.05E+02	1.00E-04 ^{d/}	0.00E+00	5.48E+07
216-B-51 French Drain	--	--	--	--	--	--	--	--	1.00E+03

2T-3h

DOE/RL-92-05, Rev. 0

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Table 2-3. Radionuclide Waste Inventory Summary.

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^d								Volume Recorded (L)
	Pu-241	Ru-106	Total U	H-3	Alpha	Beta	U-238	U-235	
216-B-52 Trench	0.00E+00	0.00E+00	9.98E-03	0.00E+00	1.17E+00	3.17E+02	1.00E-02 ^d	0.00E+00	8.53E+06
216-B-53A Trench	0.00E+00	0.00E+00	7.56E-03	0.00E+00	6.14E+00	2.46E-01	7.60E-02 ^d	0.00E+00	5.49E+05
216-B-53B Trench	0.00E+00	0.00E+00	3.02E-03	0.00E+00	3.07E+02	1.72E+01	3.03E-03 ^d	0.00E+00	1.51E+04
216-B-54 Trench	0.00E+00	0.00E+00	3.02E-03	0.00E+00	3.07E-01	9.45E-01	3.03E-3 ^d	0.00E+00	9.99E+05
216-B-55 Crib	0.00E+00	5.01E-05	2.68E-02	2.68E+00	4.23E-02	4.09E+01	--	0.00E+00	1.23E+09
216-B-56 Crib	--	--	--	--	--	--	--	--	4.77E+05
216-B-57 Crib	0.00E+00	0.00E+00	2.97E-04	0.00E+00	1.15E-02	4.37E+02	2.90E-04 ^d	0.00E+00	8.44E+07
216-B-58 Trench	0.00E+00	0.00E+00	3.04E-03	0.00E+00	4.11E-01	1.97E+01	3.05E-03 ^d	0.00E+00	4.13E+05
216-B-59 Basin	--	--	--	--	--	8.32E-02	--	--	4.77E+05
216-B-6 Reverse Well ^e	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+01 ^d	0.00E+00	0.00E+00	6.00E+06
216-B-60 Crib	--	--	--	--	--	--	--	--	1.89E+04
216-B-61 Crib	--	--	--	--	--	--	--	--	0.00E+00
216-B-62 Crib	--	4.90E-03	1.00E-02	1.47E+01	1.05E-01	4.18E+02	--	--	2.82E+08
216-B-63 Trench	--	2.39E-07	1.50E-01	2.12E+00	7.42E-02	6.32E+00	--	--	7.22E+09
216-B-64 Basin	--	--	--	--	--	--	--	--	--
216-B-7A&B Crib	0.00E+00	0.00E+00	6.06E-02	0.00E+00	2.64E+02	4.49E+03	6.10E-02 ^d	0.00E+00	4.36E+07
216-B-8TF Crib	0.00E+00	0.00E+00	1.51E-02	0.00E+00	1.84E+00	4.93E+01	0.00E+00	0.00E+00	2.72E+07
216-B-9TF Crib	0.00E+00	0.00E+00	1.51E-02	0.00E+00	1.07E+01	2.00E+00	1.52E-02 ^d	0.00E+00	3.60E+07
216-E-28 Pond	--	--	--	--	--	--	--	--	--
216-N-8 Pond	--	--	--	--	--	--	--	--	unknown

2T-3i

DOE/RL-92-05, Rev. 0

Table 2-3. Radionuclide Waste Inventory Summary.

Sheet 10 of 10

Waste Management Unit No. and Type	Quantity of Reported Radionuclides (Ci) ^{a/}								Volume Recorded (L)
	Pu-241	Ru-106	Total U	H-3	Alpha	Beta	U-238	U-235	
218-E-2 Burial Ground	--	0.00E+00	--	--	--	--	--	--	9.03E+03
218-E-2A Burial Ground	--	--	--	--	--	--	--	--	unknown
218-E-4 Burial Ground	--	0.00E+00	--	--	--	--	--	--	1.59E+03
218-E-5 Burial Ground	--	0.00E+00	--	--	--	--	--	--	3.17E+03
218-E-5A Burial Ground	--	0.00E+00	--	--	--	--	--	--	6.17E+03
218-E-6 Burial Ground	--	--	--	--	--	--	--	--	--
218-E-7 Burial Ground	--	0.00E+00	--	--	--	--	--	--	1.70E+05
218-E-9 Burial Ground									
218-E-10 Burial Ground	--	7.71E-01 ^{a/}	8.0E+05	--	--	4.3E+05 ^{b/}	--	--	21.7E+06

A dash (--) indicates where no inventory data were available.

^{a/} Values decayed through Dec 31, 1989 unless otherwise noted.

^{b/} WIDS states that inventory is included in the 216-B-3 Pond, but presents these values.

^{c/} Closed after UPR-200-E-138 released 1,000 Ci of Sr-90.

^{d/} Values are decayed through April 1, 1986.

^{e/} Unplanned releases UN-200-E-32, -34, and -138 contained approximately 21,000 Ci of activity.

^{f/} No inventory data is contained in WIDS, however, the presence of TRU fission products is mentioned. HISS shows low beta activity.

^{g/} Values decayed through December 31, 1990.

^{h/} Values as of September 30, 1978.

Table 2-4. Chemical Waste Inventory Estimates.

Sheet 1 of 8

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^w (NOTE: Page 6 starts a new set of chemicals.)							
	AlNO ₃	F	FeCN	H ₂ SO ₄	HNO ₃	K	Na	NaAl
216-B-7A&B Crib	--	240,000	--	--	--	400,000	1,600,000	--
216-B-8TF Crib ^b	--	25,000	--	1,400,000	--	40,000	900,000	--
216-B-9TF Crib	--	--	--	--	--	--	--	--
216-B-10A Crib	--	--	--	--	1,000	--	--	--
216-B-10B Crib	--	--	--	--	2	--	--	--
216-B-12 Crib	--	--	--	--	--	--	--	--
216-B-14 Crib	--	--	5,000	--	--	--	600,000	--
216-B-15 Crib	--	--	3,300	--	--	--	400,000	--
216-B-16 Crib	--	--	3,000	--	--	--	500,000	--
216-B-17 Crib	--	--	1,800	--	--	--	500,000	--
216-B-18 Crib	--	--	5,000	--	--	--	400,000	--
216-B-19 Crib	--	--	3,400	--	--	--	700,000	--
216-B-43 Crib	--	--	1,100	--	--	--	170,000	--
216-B-44 Crib	--	--	3,000	--	--	--	330,000	--
216-B-45 Crib	--	--	2,600	--	--	--	340,000	--
216-B-46 Crib	--	--	4,000	--	--	--	500,000	--
216-B-47 Crib	--	--	2,000	--	--	--	310,000	--
216-B-48 Crib	--	--	2,200	--	--	--	400,000	--
216-B-49 Crib	--	--	4,000	--	--	--	600,000	--
216-B-50 Crib	--	--	--	--	--	--	500	--
216-B-55 Crib	--	--	--	--	--	--	--	--

2T-4a

DOE/RI-92-05, Rev. 0

Table 2-4. Chemical Waste Inventory Estimates.

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^{a/} (NOTE: Page 6 starts a new set of chemicals.)							
	AlNO ₃	F	FeCN	H ₂ SO ₄	HNO ₃	K	Na	NaAl
216-B-56 Crib	--	--	--	--	--	--	--	--
216-B-57 Crib	--	--	--	--	--	--	--	--
216-B-60 Crib	--	--	--	--	--	--	--	--
216-B-61 Crib	--	--	--	--	--	--	--	--
216-B-62 Crib	--	--	--	--	--	--	--	--
Chem TF North of 2703-E	--	--	--	--	--	--	--	--
216-B-13 French Drain	--	--	--	--	--	--	--	--
216-B-51 French Drain	--	--	--	--	--	--	80	--
216-B-4 Reverse Well	--	--	--	--	1,000	--	--	--
216-B-5 Reverse Well	5,000	50,000	--	--	--	80,000	--	--
216-B-6 Reverse Well	--	--	--	10,000	10,000	--	--	--
216-B-11A&B Reverse Well	--	--	--	--	--	--	--	--
216-B-3 Pond	--	--	--	--	--	--	--	--
216-B-3A Pond	--	--	--	--	--	--	--	--
216-B-3B Pond	--	--	--	--	--	--	--	--
216-B-3C Pond	--	--	--	--	--	--	--	--
216-E-28 Contingency Pond	--	--	--	--	--	--	--	--
216-A-25 Pond	--	--	--	--	--	--	--	--

2T-4b

Table 2-4. Chemical Waste Inventory Estimates.

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^{a/} (NOTE: Page 6 starts a new set of chemicals.)							
	AlNO ₃	F	FeCN	H ₂ SO ₄	HNO ₃	K	Na	NaAl
216-N-8 Pond	--	--	--	--	--	--	--	--
2101-M 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	--	--	2,500	--	--	--	500,000	--
216-B-22 Trench	--	--	2,500	--	--	--	400,000	--
216-B-23 Trench	--	--	2,400	--	--	--	400,000	--
216-B-24 Trench	--	--	2,500	--	--	--	280,000	--
216-B-25 Trench	--	--	2,000	--	--	--	220,000	--
216-B-26 Trench	--	--	3,100	--	--	--	350,000	--
216-B-27 Trench	--	--	2,300	--	--	--	260,000	--
216-B-28 Trench	--	--	2,700	--	--	--	400,000	--
216-B-29 Trench	--	--	2,600	--	--	--	280,000	--
216-B-30 Trench	--	--	2,500	--	--	--	500,000	--
216-B-31 Trench	--	--	2,500	--	--	--	500,000	--
216-B-32 Trench	--	--	2,500	--	--	--	500,000	--
216-B-33 Trench	--	--	2,500	--	--	--	700,000	--

2T-4c

Table 2-4. Chemical Waste Inventory Estimates.

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^{a/} (NOTE: Page 6 starts a new set of chemicals.)							
	AlNO ₃	F	FeCN	H ₂ SO ₄	HNO ₃	K	Na	NaAl
216-B-34 Trench	--	--	2,600	--	--	--	800,000	--
216-B-35 Trench	--	2,600	--	--	--	--	60,000	10,000
216-B-36 Trench	--	5,000	--	--	--	--	120,000	24,000
216-B-37 Trench	--	50,000	--	--	--	--	1,300,000	250,000
216-B-38 Trench	--	4,000	--	--	--	--	90,000	18,000
216-B-39 Trench	--	4,000	--	--	--	--	90,000	18,000
216-B-40 Trench	--	4,000	--	--	--	--	100,000	20,000
216-B-41 Trench	--	4,000	--	--	--	--	90,000	18,000
216-B-42 Trench	--	--	800	--	--	--	90,000	--
216-B-52 Trench	--	--	5,000	--	--	--	860,000	--
216-B-53A Trench	--	--	--	--	--	--	--	--
216-B-53B Trench	--	--	--	--	--	--	--	--
216-B-54 Trench	--	--	--	--	--	--	--	--
216-B-58 Trench	--	--	--	--	--	--	--	--
216-B-63 Trench	--	--	--	--	--	--	--	--

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Table 2-4. Chemical Waste Inventory Estimates.

Sheet 5 of 8

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^w							
	NaCr ₂ O ₇	NH ₄ CO ₃	NH ₄ NO ₃	NO ₂	NO ₃	Oxalate	PO ₄	SO ₄
216-B-7A&B Crib	--	--	22,000	--	1,800,000	60,000	130,000	15,000
216-B-8TF Crib ^w	--	--	160,000	--	1,400,000	6,000	500,000	70,000
216-B-9TF Crib	--	--	--	--	1,000	--	--	--
216-B-10A Crib	100	--	--	--	1,000	--	--	1,000
216-B-10B Crib	--	--	--	--	--	--	--	--
216-B-12 Crib	--	--	1,800,000	--	--	--	--	--
216-B-14 Crib	--	--	--	--	1,500,000	--	40,000	50,000
216-B-15 Crib	--	--	--	--	900,000	--	50,000	60,000
216-B-16 Crib	--	--	--	--	1,100,000	--	70,000	110,000
216-B-17 Crib	--	--	--	--	1,100,000	--	60,000	90,000
216-B-18 Crib	--	--	--	--	1,000,000	--	50,000	70,000
216-B-19 Crib	--	--	--	--	1,500,000	--	100,000	90,000
216-B-43 Crib	--	--	--	--	400,000	--	21,000	29,000
216-B-44 Crib	--	--	--	--	800,000	--	40,000	60,000
216-B-45 Crib	--	--	--	--	90,000	--	41,000	60,000
216-B-46 Crib	--	--	--	--	1,200,000	--	70,000	100,000
216-B-47 Crib	--	--	--	--	700,000	--	40,000	60,000
216-B-48 Crib	--	--	--	--	1,000,000	--	60,000	80,000
216-B-49 Crib	--	--	--	--	1,500,000	--	60,000	80,000
216-B-50 Crib	--	9,100	10,000	--	1,500	--	--	--
216-B-55 Crib	--	--	90,000	--	--	--	--	--

2T-4e

DOE/RL-92-05, Rev. 0

Table 2-4. Chemical Waste Inventory Estimates.

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^{a/}							
	NaCr ₂ O ₇	NH ₄ CO ₃	NH ₄ NO ₃	NO ₂	NO ₃	Oxalate	PO ₄	SO ₄
216-B-56 Crib	--	--	--	--	--	--	--	--
216-B-57 Crib	--	12,000	--	--	--	--	--	--
216-B-60 Crib	--	--	--	--	--	--	--	--
216-B-61 Crib	--	--	--	--	--	--	--	--
216-B-62 Crib	--	--	--	--	--	--	--	--
Chem TF North of 2703-E	--	--	--	--	--	--	--	--
216-B-13 French Drain	--	--	--	--	2,000	--	--	--
216-B-51 French Drain	--	--	--	--	190	--	8	11
216-B-4 Reverse Well	--	--	--	--	--	--	--	--
216-B-5 Reverse Well	--	--	--	--	400,000	12,000	29,000	3,300
216-B-6 Reverse Well	100	--	--	--	--	--	--	--
216-B-11A&B Reverse Well	--	--	--	--	--	--	--	--
216-B-3 Pond	--	--	--	--	--	--	--	--
216-B-3A Pond	--	--	--	--	--	--	--	--
216-B-3B Pond	--	--	--	--	--	--	--	--
216-B-3C Pond	--	--	--	--	--	--	--	--
216-E-28 Contingency Pond	--	--	--	--	--	--	--	--
216-A-25 Pond	--	--	--	--	--	--	--	--
216-N-8 Pond	--	--	--	--	--	--	--	--

2T-4f

Table 2-4. Chemical Waste Inventory Estimates.

Sheet 7 of 8

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^{a/}							
	NaCr ₂ O ₇	NH ₄ CO ₃	NH ₄ NO ₃	NO ₂	NO ₃	Oxalate	PO ₄	SO ₄
2101-M 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	--	--	--	--	1,100,000	--	80,000	100,000
216-B-22 Trench	--	--	--	--	900,000	--	40,000	80,000
216-B-23 Trench	--	--	--	--	1,000,000	--	60,000	60,000
216-B-24 Trench	--	--	--	--	600,000	--	34,000	50,000
216-B-25 Trench	--	--	--	--	500,000	--	27,000	40,000
216-B-26 Trench	--	--	--	--	800,000	--	40,000	60,000
216-B-27 Trench	--	--	--	--	600,000	--	32,000	50,000
216-B-28 Trench	--	--	--	--	1,000,000	--	50,000	80,000
216-B-29 Trench	--	--	--	--	700,000	--	35,000	50,000
216-B-30 Trench	--	--	--	--	1,100,000	--	70,000	110,000
216-B-31 Trench	--	--	--	--	1,100,000	--	60,000	90,000
216-B-32 Trench	--	--	--	--	1,000,000	--	60,000	90,000
216-B-33 Trench	--	--	--	--	1,700,000	--	100,000	110,000
216-B-34 Trench	--	--	--	--	1,900,000	--	80,000	90,000

2T-4g

Table 2-4. Chemical Waste Inventory Estimates.

Sheet 8 of 8

Waste Management Unit No. and Type	Quantity of Reported Chemicals (kg) ^{a/}							
	NaCr ₂ O ₇	NH ₄ CO ₃	NH ₄ NO ₃	NO ₂	NO ₃	Oxalate	PO ₄	SO ₄
216-B-35 Trench	--	--	--	10,000	90,000	--	20,000	4,000
216-B-36 Trench	--	--	--	18,000	160,000	--	40,000	8,000
216-B-37 Trench	--	--	--	200,000	1,700,000	--	400,000	90,000
216-B-38 Trench	--	--	--	13,000	120,000	--	27,000	6,000
216-B-39 Trench	--	--	--	14,000	120,000	--	29,000	6,000
216-B-40 Trench	--	--	--	15,000	130,000	--	31,000	7,000
216-B-41 Trench	--	--	--	13,000	120,000	--	27,000	6,000
216-B-42 Trench	--	--	--	--	210,000	--	11,000	150,000
216-B-52 Trench	--	--	--	--	2,100,000	--	80,000	80,000
216-B-53A Trench	--	--	--	--	1	--	--	--
216-B-53B Trench	--	--	--	--	1	--	--	--
216-B-54 Trench	--	--	--	--	100	--	--	--
216-B-58 Trench	--	--	--	--	10	--	--	--
216-B-63 Trench	--	--	--	--	--	--	--	--

^{a/} The reported inventories are derived from the Waste Inventory Data System (WHC 1991a) and the Hanford Inactive Site Survey (DOE 1986). Not all sites have reported inventories, and the inventories do not necessarily list all of the contaminants disposed of at a site. A dash (--) indicates that inventory data is not available.

^{b/} The 216-B-8TF Crib also received an unknown quantity of citric and hydrochloric acid.

Table 2-5. Partial Inventory of Radionuclides Disposed to the 218-E-2, -2A, -3, -4, -5, -5A, -6, -7, -9, and -10 Burial Grounds.

	U Grams	Pu Grams	⁹⁰ Sr Ci	¹⁰⁶ Ru Ci	¹³⁷ Cs Ci
218-E-2 ^a	300,000	800	187.6	2.39E-09	213.1
218-E-2A ^a	NA	NA	NA	NA	NA
218-E-3 ^a	NA	NA	NA	NA	NA
218-E-4 ^a	1,000	10	0.08328	1.5E-11	0.09402
218-E-5 ^a	12,000	620	62.66	9.92E-09	70.72
18-E-5A ^a	120,000	1,380	147	1.4E-07	165.2
218-E-6 ^a	NA	NA	NA	NA	NA
218-E-7 ^a	1,000	1	5.89	1.16E-07	6.58
218-E-9 ^a	NA	NA	NA	NA	NA
218-E-10 ^a	800,000	4,900	7.68E+05	0.771	9.31E+05

^a Source: WHC 1991a. Values decayed through December 31, 1990.

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Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-1	Near 221-B Building 24 m (80 ft) from a June 17, 1946 line failure (UN-200-E-80). Waste line from 221-B Building to 241-BX-154 Diversion Box	Oct. 14, 1966	NA	<ul style="list-style-type: none"> • Soil contamination occurred from a waste line failure. Examination showed line failures in five lines installed in project C-112. Piping showed three areas of electrolytic corrosion. • Piping was removed and new pipe installed in V-shaped troughs with concrete covers. • This release is listed in the Tri-Party Agreement.
UN-200-E-2	Area around B Plant Stack	Nov. 18, 1947	291-B Stack	<ul style="list-style-type: none"> • Radioactive particle matter up to 1/32 inch found around the 291-B Stack. Further examination revealed a larger area of mist-like particles over a larger area. The exhaust fan inlet and outlet ducts were discovered as the reasons. • Stainless steel ducting, fans, CWS filters, and scrubbers installed to alleviate emissions. • HEPA filters installed in mid-1960's further reduced radionuclide concentrations. • Current emissions meet federal regulation limits. • Area around 291-B Stack is delimited by a light-weight chain barricade. • This release is listed in the Tri-Party Agreement.
UN-200-E-3	Waste line from 221-B Building to the 241-BX-154 Diversion Box	Nov. 21, 1951	NA	<ul style="list-style-type: none"> • Line failure contaminated the soil around the pipe to 120 R/h precluding failure investigation. Boreholes indicated the contamination limits. • Area posted with "Underground Radioactive Warning" signs. • PNL Hazard Ranking 1.09.

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-7	Waste line from 221-B Building to the 241-B-361 Settling Tank near the 216-B-9 Crib and Tile Field	Nov. 30, 1954	NA	<ul style="list-style-type: none"> • A leak released approximately 19,000 L (5,000 gal) of cell wash water from 5-9 Tank. The dose rate was observed at 1.7 R/h. • The 216-B-9 Crib delimited with light-weight chain barricade. • PNL Hazard Ranking 1.45.
UN-200-E-9	216-BY-5 Flush Tank	Sept. 15, 1955	261-BY-5 Flush Tank	<ul style="list-style-type: none"> • 42,000 L (11,000 gal) of tributyl phosphate scavenged supernatant overflowed the 216-BY Flush Tank associated with the 216-B-43 Crib. • Contaminated soil excavated and placed in a pit south of the 216-B-43 Crib. • This release is listed in the Tri-Party Agreement.
UN-200-E-14	216-B-3 Pond	1958	216-B-3 Pond	<ul style="list-style-type: none"> • The 216-B-3 Pond dike broke allowing contaminated water to flow into a ravine east of the pond. • This release is listed in the Tri-Party Agreement.
UN-200-E-41	R-13 Stairwell of 271-B Building	July 19, 1972	271-B Building	<ul style="list-style-type: none"> • Line leak in a waste line contaminated the area with an estimated 30 Ci ¹³⁷Cs posting readings of 12.5 R/h. • Approximately 1/2 of the total Cs-137 was removed and buried. • This release is listed in the Tri-Party Agreement.
UN-200-E-43	Roadway from 241-BY Tank Farm to burial ground	Jan. 10, 1972	NA	<ul style="list-style-type: none"> • Liquid contained in 102-BY Pump being transported to burial. Counts of 1,000 to 100,000 ct/min were measured. • Cleanup decontamination began immediately. • PNL Hazard Ranking 1.04.

2T-6b

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-44	BCS Crib line south of R-17 Change House	Aug. 16, 1972	NA	<ul style="list-style-type: none"> Leak in the 15-cm (6-in.) BCS Crib line caused a cave in. The soil was contaminated to 10,000 to 20,000 ct/min. The pipe registered 20 mR/h. No spread of contamination occurred. This release is listed in the Tri-Party Agreement.
UN-200-E-45	241-B-154 Diversion Box	Aug. 26, 1974	241-B-154 Diversion Box	<ul style="list-style-type: none"> Mixed waste at 50,000 ct/min flowed across 7th Avenue covering an area of 100 m (300 ft) long by 30 m (100 ft) wide. The road was washed with water and the contaminated soil removed to a burial trench. PNL Hazard Ranking 1.14.
UN-200-E-52	Soil and building adjacent and below the pressure relief valve from the E-5-2 strontium concentrator in the 221-B Building	Aug. 1, 1975	221-B Building	<ul style="list-style-type: none"> The steam relief valve setting was lower than operating pressure allowing an escape that contaminated the 221-B Building side, the underlying soil, and the adjacent railroad berm. The radiation was measured from 20,000 to 100,000 ct/min. The building side was cleaned, painted, and marked. The contaminated soil was excavated, packaged, and buried. No clean-up action was made to the railroad berm allowing radionuclide to be washed out with natural precipitation. PNL Hazard Ranking 0.98.

2T-6c

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-54	225-B Building	July 20, 1977	225-B Building	<ul style="list-style-type: none"> • 2 L (0.5 gal) of contaminated wash water seeped under a door contaminating the concrete pad and a 1 ft³ of soil to radiation levels of 10,000 to 20,000 ct/min. • The soil was removed to a burial site. Signs were posted at the site. • PNL Hazard Ranking 1.04.
UN-200-E-55	Railway south of K-3 filter and gravel area southeast of 212-B Building	April 27, 1979	NA	<ul style="list-style-type: none"> • A temporary radiation zone established at surface radiation levels of 5,000 to 30,000 ct/min, presumably from wind-blown materials. • The area was cleaned and released from monitoring. • PNL Hazard Ranking 0.84.
UN-200-E-61	Railroad tracks adjacent to 200 East Area Burial Grounds	Oct. 31, 1981	NA	<ul style="list-style-type: none"> • The unloading ramp was identified as a site of an unplanned release with readings of 100,000 ct/min. Radioactive contamination of the ground resulted from burial operations. • The area was decontaminated to background levels. • The area is marked with a light-weight chain barricade.
UN-200-E-63	Contaminated vegetation in gravel pit outside of BY Trench Area	June 4, 1981	NA	<ul style="list-style-type: none"> • Vegetation absorbed radionuclides to 100,000 ct/min from the BY Cribs and then were blown to the gravel pit. • Vegetation was removed and a spraying program initiated to control future growth. • This release is listed in the Tri-Party Agreement.

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-64	West of 216-B-64 Retention Basin	Oct. 12, 1984	216-B-64 Retention Basin	<ul style="list-style-type: none"> • Ants carried contaminated material with readings of 60,000 ct/min to the surface from the retention basin, consisting primarily of ¹³⁷Cs and ⁹⁰Sr. • The area is marked with light-weight chain barricades.
UN-200-E-69	221-B Railway Tunnel	June 19, 1984	221-B Building	<ul style="list-style-type: none"> • Flush water spilled from underneath a burial box being removed from a railcar leaving small spots of beta/gamma contamination up to 20,000 ct/min. • The area is contained behind a chain link fence with warning signs. • This release is listed in the Tri-Party Agreement.
UN-200-E-76	241-B-153 Diversion Box	Jan. 4, 1968	241-B-153 Diversion Box	<ul style="list-style-type: none"> • A line leak in the waste line from 9-2 Tank in the 221-B Building to the 241-B-110 Tank contaminated the soil with about 4,780 Ci of ¹⁴⁴Ce, 360 Ci of ¹⁰⁶Ru and 850 Ci of ⁹⁵Zr and niobium. • The release was covered with clean gravel. • PNL Hazard Ranking 0.98.
UN-200-E-79	Five areas between 242-B Evaporator and 207-B Retention Basin.	June 1953	NA	<ul style="list-style-type: none"> • Five leaks in the waste line allowed contamination of about 10 Ci of mixed fission waste products with radiation levels up to 2,500 ct/min. • It is assumed the area has been stabilized. • PNL Hazard Ranking 1.20.

2T-6e

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-80	Underground waste line south of 221-B Building	June 17, 1946	NA	<ul style="list-style-type: none"> • An unknown amount leaked from an underground line creating a small depression having approximately 10 Ci of fission products. • The contaminated soil removed to a burial site, and was replaced with clean gravel. Approximately 5 Ci contaminants remain. • PNL Hazard Ranking 1.20.
UN-200-E-83	BC Controlled Area	1958 to 1989	10.4 km ² (4 mi ²) area around BC Cribs and Trenches	<ul style="list-style-type: none"> • Contaminants injected into the area were spread by wildlife into the food chain and were exhibited by fecal droppings over a 1.5 km² (4 mi²) area to a level of approximately 18 Ci of ⁹⁰Sr and 14 Ci of ¹³⁷Cs. • A burrow into the 216-B-28 Trench was discovered and asphalt capped. • The inactive trenches were filled with sand and gravel and capped with 15 cm (6 in.) of gravel, except trenches 216-B-20, -21, and -22.
UN-200-E-85	R-13 utility pit adjacent to 221-B Building	July 20, 1972	NA	<ul style="list-style-type: none"> • A suspected leak of the 18-1 waste line allowed 15 Ci of ¹³⁷Cs into the soil. • Cleanup actions were not reported. • PNL Hazard Ranking 1.14.
UN-200-E-87	South side of 221-B Building adjacent to 224-B Building	1945 ~ 1953	221-B Building	<ul style="list-style-type: none"> • Seepage from underground pipe joints into the soil. A 1975 radiological survey showed counts no greater than 200 ct/min. • Lightweight chain barricades surround the area. • PNL Hazard Ranking 1.04.

2T-6f

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-89	Airborne contamination from 241-BX Tank Farm	~ 1978	241-BX Tank Farm, 241-BY Tank Farm	<ul style="list-style-type: none"> An unplanned airborne release from the 241-BX Tank Farm allowed particulate matter to accumulate on the north side of Baltimore Avenue 8 m (25 ft) west of 216-B-57 Crib. The road was overlaid with new asphalt. PNL Hazard Ranking 1.36.
UN-200-E-90	Area surrounding 291-B Stack sand filter	Sept. 1980	291-B Stack	<ul style="list-style-type: none"> High gamma dose rates discovered, presumably from the materials filtered by the systems. Area adjacent to the filtration equipment delimited with light-weight chain barricades and signs. This release is listed in the Tri-Party Agreement.
UN-200-E-92	East perimeter fence	1981	NA	<ul style="list-style-type: none"> Over a period of time, Russian thistle has adsorbed contaminants which accumulated at the fence as a result of the gathered thistle decomposing there. Contaminated sand was removed and clean sand replaced. The contaminated material was placed in a burial site north of the 216-A-24 Crib. This release is listed in the Tri-Party Agreement.
UN-200-E-95	Railroad spur between 218-E-2A and 218-E-5	Sept. 1980	NA	<ul style="list-style-type: none"> A series of small releases over time has accumulated to a higher level. The most recent radiation levels were measured at 200 to 400 ct/min with spots to 4,000 ct/min. This release is listed in the Tri-Party Agreement. PNL Hazard Ranking 0.73.

2T-6g

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-101	Area between 242-B Evaporator and 241-B Tank Farm fence	1986	NA	<ul style="list-style-type: none"> • An unknown amount of radionuclide contamination discovered in the weeds, possibly from airborne particulate emissions from the 241-B Tank Farm. • The contaminated weeds have been removed. • This release is listed in the Tri-Party Agreement.
UN-200-E-103	BCS Crib line south of R-17 change house	Mar. 8, 1972	221-B Building	<ul style="list-style-type: none"> • A line leak contaminated the soil to a surface detection level of up to 1,500 ct/min. • The leak was sealed and the area barricaded with a light-weight chain with posted signs. • This release is listed in the Tri-Party Agreement.
UN-200-E-105	107-BY Manifold Header in the 107-BY Tank Farm	Dec. 15, 1952	107-BY Tank Farm	<ul style="list-style-type: none"> • Approximately 87,000 L (23,000 gal) of first cycle liquid waste escaped from the header. • Area covered with concrete. • This release is listed in the Tri-Party Agreement • PNL Hazard Ranking 1.14.
UN-200-E-109	104-B Tank inside of the 241-B Tank Farm	Nov. 11, 1953	241-B Tank Farm	<ul style="list-style-type: none"> • About 570 L (150 gal) of concentrated tributyl phosphate waste was released from the tank in the 241-B Tank Farm contaminating about 300 ft² of soil with levels of 1 R/h. • The area was asphalt covered. • This release is listed in the Tri-Party Agreement. • PNL Hazard Ranking 1.04.

2T-6h

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-110	241-BY-112 Tank at the 112-BY Pit	Aug. 7, 1955	241-BY-112 Tank	<ul style="list-style-type: none"> • 2,500 ft² of soil contaminated to a level of 22 R/h. • PNL Hazard Ranking 1.14.
UN-200-E-112	B Plant Aggregate Area Railroad Tunnel	Feb. 12, 1979	221-B Building	<ul style="list-style-type: none"> • During a canyon equipment burial transfer, some ion-exchange liquid spilled. The spilled liquid was carried out of the tunnel by the wheels, contaminating the rail from the 221-B Building to the east boundary of the burial ground. • The contamination was cleaned up immediately. • This release is listed in the Tri-Party Agreement. • PNL Hazard Ranking 0.82.
UN-200-E-140	221-B Bulk Storage Area	April 23, 1986	221-B Building	<ul style="list-style-type: none"> • Approximately 7.6 L (28.8 gal) of PCB contaminated oil spilled on the ground. Established as a Hazardous Waste Site. • The contaminated soil was removed and drummed for disposal. • This release is listed in the Tri-Party Agreement.
UPR-200-E-4	241-B-151 Diversion Box	Fall 1951	241-B-151 Diversion Box	<ul style="list-style-type: none"> • Leakage from the 241-B-151 Diversion Box contaminated the soil in the immediate vicinity to approximately 10 Ci. • Most of the contamination was removed and buried. The area was covered with 0.3 m (1 ft) of clean soil. • PNL Hazard Ranking 1.14.

2T-6i

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-5	241-BX-102 Tank	Mar. 20, 1951	241-BX-102 Tank	<ul style="list-style-type: none"> Approximately 22.5 tons of soil was contaminated with depleted uranium from BX-102 Tank due to a plugged cascade outlet. No clean-up action was reported. PNL Hazard Ranking 1.20.
UPR-200-E-6	241-B-153 Diversion Box	1954	241-B-153 Diversion Box	<ul style="list-style-type: none"> Leakage from the 241-B-153 Diversion Box contaminated the soil in the immediate vicinity to approximately 1 Ci. Most of the contamination was removed and buried. The area was covered with 0.3 m (1 ft) of clean soil. PNL Hazard Ranking 1.09.
UPR-200-E-32	207-B Retention Basin and 216-B-2-1 Ditch	Nov. 7, 1963	216-B-2-1 Ditch and 207-B Retention Basin	<ul style="list-style-type: none"> A coil leak in the 221-B Building contaminating the 4,900,000 L (1,300,000 gal) of primarily low-level cooling water discharged through the basin to the ditch. The primary ingredients were ^{144}Ce at 30 Ci and ^{90}Sr at 0.05 Ci. The 216-B-2-1 Ditch was closed, backfilled, and stabilized. The 207-B Retention Basin walls were washed and covered with an asphalt-oil emulsion. Contaminated vegetation was removed and disposed. Live tumbleweeds were found with readings of 2,000 ct/min. PNL Hazard Ranking 1.09.

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-34	216-B-3-1 Ditch	June 1964	216-B-3-1 Ditch 216-A-25 Pond 216-B-3 Pond	<ul style="list-style-type: none"> As a result of a coil leak at the F-15 PUREX Tank, an estimated 10,000 Ci of mixed fission products were released to 216-B-3-1 Ditch, 216-A-25 Pond, and 216-B-33 Pond. The pond algae was killed and efforts were made to precipitate the fission products. The 216-B-3-1 Ditch was backfilled and replaced by the 216-B-3-2 Ditch.
UPR-200-E-38	241-B-152 Diversion Box	Jan. 4, 1968	241-B-152 Diversion Box	<ul style="list-style-type: none"> A fan-shaped area northeast of the 241-B-152 Diversion Box was contaminated. Ground readings of 2,000 to 6,000 ct/min were recorded. Local asphalt readings were 20 to 30 mR/h. No clean-up actions were recorded.
UPR-200-E-51	216-B-3 Pond	May 1977	216-B-3-3 Ditch	<ul style="list-style-type: none"> 15 kg of cadmium nitrate was released from PUREX Tank TK-324 to the 216-B-3 Pond and the 216-B-3-3 Ditch.
UPR-200-E-73	241-B-151 Diversion Box within 241-B Tank Farm	1951 ~ 1952	241-B-151 Diversion Box	<ul style="list-style-type: none"> Leakage and spills contaminated the surrounding soil with approximately 10 Ci of fission products. Most of the contamination was removed. The remaining contaminated soil was covered with 0.3 m (1 ft) of clean soil and the area delimited with a light-weight chain barricade and signs. PNL Hazard Ranking 1.04.

2T-6K

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-74	Area around 241-B-152 Diversion Box	Spring 1954	241-B-152 Diversion Box	<ul style="list-style-type: none"> This is a low activity release containing approximately 1 Ci in a 50 ft² area as contaminated with the diversion box in use. A 1975 radiological survey measured up to 30,000 ct/min. A portion of the contaminated soil was removed and buried. Several inches of clean soil was placed on top. The area was delimited with rope and signs. PNL Hazard Ranking 1.04
UPR-200-E-75	Near 241-B-153 Diversion Box in southwest corner of 241-B Tank Farm	1954 ~ 1955	241-B-153 Diversion Box	<ul style="list-style-type: none"> Work with the diversion box caused a general build-up to approximately 1 Ci of fission products. Area covered with clean gravel and marked as a radiation zone. PNL Hazard Ranking 1.09
UPR-200-E-77	241-B-154 Diversion Box	1946	241-B-154 Diversion Box	<ul style="list-style-type: none"> Metal waste solution from the 221-B-Building with fission products measuring approximately 1 Ci contaminated the ground around the 241-B-154 Diversion Box as a result of a leaky jumper. The site was stabilized, but re-contamination occurred. 0.3 m (1 ft) of clean soil was placed on top. PNL Hazard Ranking 1.09.

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-78	Area covered the 241-B-155 Diversion Box approximately 300 m (900 ft) south of 241-BX Tank Farm	Oct. 1955	241-BX-155 Diversion Box	<ul style="list-style-type: none"> • During pressure testing of lines and jumpers, a spill occurred causing the ground to be contaminated with approximately 10 Ci of mixed fission product salt waste. • The site is classified as a low activity site with general contamination to 150 ct/min and contact readings of 5mR/h on a riser. • The area is covered with clean soil. • PNL Hazard Ranking 1.04.
UPR-200-E-84	241-ER-311 Catch Tank	March 1953	241-ER-311 Catch Tank	<ul style="list-style-type: none"> • The Catch Tank leaked an estimated 6,500 L (1,700 gal) of acid contaminated with approximately 10 Ci of fission products. No surface contamination was detected. • No clean-up action was recorded.
UPR-200-E-108	241-B-102 Heel Pit	Unknown	241-B-102 Single-Shell Tank	<ul style="list-style-type: none"> • Supernatant leak between the 241-B-102 and 241-B-101 Single-Shell Tanks with readings of 10 R/h. • Contaminated area was asphalt covered to reduce migration. • PNL Hazard Ranking 1.14.
UPR-200-E-116	241-BY-112 Pump	Nov. 20, 1972	241-BY-112 Single-Shell Tank	<ul style="list-style-type: none"> • An unknown volume of caustic flush water containing ^{137}Cs, ^{90}Y, ^{90}Sr sprayed from the pump. Radiation levels up to 3 R/h were measured 15 cm (6 in.) above the waste.
UPR-200-E-127	Soil surrounding 241-B-107 Single-Shell Tank	1968	241-B-107 Single-Shell Tank	<ul style="list-style-type: none"> • Approximately 30,000 L (8,000 gal) containing 2,000 Ci of ^{137}Cs leaked from the 241-B-110 Single-Shell Tank.
UPR-200-E-128	Soil surrounding 241-B-110 Single-Shell Tank	1969	241-B-110 Single-Shell Tank	<ul style="list-style-type: none"> • Approximately 31,000 L (8,300 gal) of waste containing 4,300 Ci of ^{137}Cs leaked from the 241-B-110 Single-Shell Tank.

2T-6m

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-129	241-B-201 Single-Shell Tank	1968	241-B-201 Single-Shell Tank	<ul style="list-style-type: none"> Approximately 4,500 L (1,200 gal) of waste containing 420 Ci of ¹³⁷Cs leaked from 241-B-201 Single-Shell Tank to the soil underneath and around the tank. The tank is an assumed leaker.
UPR-200-E-130	241-B-203 Single-Shell Tank	1951 ~ 1977	241-B-203 Single-Shell Tank	<ul style="list-style-type: none"> Approximately 11,000 L (300 gal) of lanthanum fluoride escaped from the 241-B-203 Single-Shell Tank to the soil underneath and around the tank. The tank is an assumed leaker.
UPR-200-E-131	241-BX-102 Single-Shell Tank	1948 ~ 1971	241-BX-102 Single-Shell Tank	<ul style="list-style-type: none"> A leak allowed 51,000 Ci of ¹³⁷Cs in a high-level, non-boiling liquid waste to contaminate approximately 31,000 ft³ of soil to a depth of 40 m (120 ft). Groundwater may have been contaminated due to monitoring well installation at that location.
UPR-200-E-132	241-BX-102 Single-Shell Tank	1974	241-BX-102 Single-Shell Tank	<ul style="list-style-type: none"> A leak in the tank allowed 9,500 L (2,500 gal) to contaminate the soil surrounding the tank with 500 Ci materials. The soil was excavated and backfilled with clean soil.
UPR-200-E-133	241-BX-108 Single-Shell Tank	1949 ~ 1974	241-BX-108 Single-Shell Tank	<ul style="list-style-type: none"> A tank leak allowed about 9,500 L (2,500 gal) of ¹³⁷Cs containing 500 Ci to contaminate the soil surrounding the tank.
UPR-200-E-134	241-BY-103 Single-Shell Tank	1973	241-BY-103 Single-Shell Tank	<ul style="list-style-type: none"> 19,000 L (5,000 gal) of PUREX coating waste leaked from the 241-BY-103 Tank.
UPR-200-E-135	Soil around and under 241-BY-108 Single-Shell Tank	1955 ~ 1972	241-BY-108 Single-Shell Tank	<ul style="list-style-type: none"> 19,000 L (5,000 gal) of tributyl phosphate waste leaked from the 241-BY-108 Tank. A saltwater system has been installed.

2T-6n

DOE/RL-92-05, Rev. 0

Table 2-6. Description of Unplanned Releases.

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-138	216-B-2-2 Ditch	Mar. 22, 1970	216-B-2-2 Ditch and 216-B-3-2 Ditch	<ul style="list-style-type: none"> • An estimated 1,000 Ci ⁹⁰Sr release during an operation with the product storage Tank 801 via a leaking manometer sensing line. The waste was washed to the floor drains which were directed to 216-B-2-2 Ditch bypassing the 207-B Retention Basin. The 216-B-2-2 Ditch received much of the material resulting in radiation levels of 500 R/h at 8 cm (3 in.) from the pipe gallery. • The 216-B-2-2 Ditch was decommissioned and backfilled with surface stabilization. • The 216-B-3-2 was also decontaminated and backfilled as a result of this unplanned release.
No Number	241-BX-103 Single-Shell Tank	1951	241-BX-103 Single-Shell Tank	<ul style="list-style-type: none"> • An estimated 100,000 to 300,000 L (30,000 to 90,000 gal) has overflowed and spilled to the ground between 241-BX-102 and 241-BX-103 Single-Shell Tanks in the vicinity of Dry Wells 21-0303, -05, and -12.

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Table 2-7. Summary of Waste-Producing Processes in the B Plant Aggregate Area.

Process	Waste Generated	Major Chemical Constituents	Ionic Strength	pH	Organic Concentration	Radioactivity
Bismuth Phosphate	Process waste	nitric acid				
	Aqueous process waste	phosphoric acid nitrate solution uranium, plutonium	high	acidic (neutralized)	low	high
Lanthanum Fluoride	Process waste	plutonium sodium bismuthate	NA	NA	NA	high
	Aqueous process waste	phosphoric acid nitric acid hydrogen fluoride lanthanum salts				
Cesium and Strontium Recovery	Process waste	hydrochloric acid nitric acid	high	acidic (neutralized)	low	high
	Aqueous process waste	phosphoric acid normal parafin hydrocarbon ammonium carbonate ammonium hydroxide				
PUREX Wastes	Cladding waste	sodium hydroxide nitric acid	high	acidic (neutralized)	low	high
	Process waste	tributyl phosphate parafin hydrocarbon nitrates	low			low
S Plant Wastes	Process waste	nitric acid sodium aluminate	high	neutral/basic	low	high
	Ion exchange waste	hexone uranium, plutonium				
284-E Powerhouse Wastes	Cooling water Water softener Scaling removal wastewater	sodium chloride EDTA sodium sulfite	high	neutral	low	none

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Table 2-8. Chemicals Used in Separations/
Recovery Processes.

RADIONUCLIDES

Actinium-225
Actinium-227
Americium-241
Americium-242
Americium-242m
Americium-243
Antimony-126
Antimony-126m
Astatine-217
Barium-135m
Barium-137m
Barium-140
Bismuth-210
Bismuth-211
Bismuth-213
Bismuth-214
Carbon-14
Cerium-141
Cerium-144
Cesium-134
Cesium-135
Cesium-137
Cobalt-57
Cobalt-58
Cobalt-60
Curium-242
Curium-244
Curium-245
Europium-152
Europium-154
Europium-155
Francium-221
Francium-223
Iodine-129
Iron-59
Lanthanum-140
Lead-209
Lead-210
Lead-211
Lead-212
Lead-214
Manganese-54
Neptunium-237
Neptunium-239
Nickel-59

Nickel-63
Niobium-93m
Niobium-95
Palladium-107
Plutonium-238
Plutonium-239/240
Plutonium-241
Polonium-210
Polonium-213
Polonium-214
Polonium-215
Polonium-218
Potassium-40
Praseodymium-144
Promethium-147
Protactinium-231
Protactinium-233
Protactinium-234m
Radium
Radium-223
Radium-225
Radium-226
Rhodium-103
Rhodium-106
Ruthenium-103
Ruthenium-106
Samarium-151
Selenium-79
Silver-110m
Sodium-22
Strontium-85
Strontium-89
Strontium-90
Technetium-99
Tellurium-129
Thallium-207
Thorium-227
Thorium-229
Thorium-230
Thorium-231
Thorium-233
Thorium-234
Tin-126
Tritium
Uranium-233
Uranium-234
Uranium-235

Uranium-238
Yttrium-90
Yttrium-91
Zinc-65
Zirconium-93
Zirconium-95

INORGANIC CHEMICALS

Acetic Acid^{af}
Alkaline liquids^{a/b/c/d/}
Aluminum^{a/c/d/}
Aluminum nitrate
(mono basic)^{af}
Aluminum nitrate
nonahydrate^{a/c/}
Ammonia (anhydrous)^{cf}
Ammonium carbonate^{cf}
Ammonium fluoride^{a/c/}
Ammonium hydroxide^{cf}
Ammonium ion^{d/}
Ammonium nitrate^{a/c/d/}
Ammonium oxalate^{af}
Ammonium silicofluoride^{cf}
Ammonium sulfate^{cf}
Antifreeze^{a/b/c/d/}
Arsenic^{d/}
Barium^{c/d/}
Barium nitrate^{af}
Beryllium^{a/c/}
Bismuth^{d/}
Bismuth nitrate^{cf}
Bismuth phosphate^{c/d/}
Boric acid^{a/c/}
Boron^{d/}
Cadmium^{c/d/}
Cadmium nitrate^{af}
Calcium^{c/d/}
Calcium carbonate^{cf}
Calcium chloride^{cf}
Carbon dioxide^{cf}
Carbonate^{c/d/}
Ceric fluoride^{af}
Ceric iodate^{af}
Ceric nitrate^{cf}
Ceric sulfate^{af}
Cerium^{cf}

Table 2-8. Chemicals Used in Separations/
Recovery Processes.

Cesium carbonate^{cf}
Cesium chloride^{cf}
Chloride^{cf}
Chromium^{cf/d}
Chromium nitrate^{cf}
Chromous sulfate^{cf}
INORGANIC CHEMICALS
(Continued)

Copper^{cf/d}
Cyanide^{cf/d}
DOW Anti-Foam B^{cf}
Duolite ARC-359 (IX Resin)
(sulfonated phenolic)^{cf}
Ferric cyanide^{cf/d}
Ferric nitrate^{cf}
Ferrous sulfamate^{cf}
Ferrous sulfate^{cf}
Fluoride^{cf/d}
Hydrobromic Acid^{cf}
Hydrochloric acid^{cf}
Hydrofluoric acid^{cf}
Hydrogen^{cf}
Hydrogen fluoride^{cf}
Hydrogen peroxide^{cf}
Hydroiodic acid^{cf}
Hydroxide^{cf}
Hydroxyacetic acid^{cf}
Hydroxylamine
hydrochloride^{cf}
Iron^{cf/d}
Lanthanum fluoride^{cf}
Lanthanum hydroxide^{cf}
Lanthanum nitrate^{cf}
Lanthanum-neodymium
nitrate^{cf}
Lead^{cf}
Lead nitrate^{cf}
Lithium^{cf}
Magnesium^{cf/d}
Magnesium carbonate^{cf}
Magnesium nitrate^{cf}
Manganese^{cf/d}
Mercuric nitrate^{cf}
Mercury^{cf}
Misc. Toxic Process
Chemicals^{cf}
Nickel^{cf}

Nickel nitrate^{cf}
Niobium^{cf}
Nitrate^{cf/d}
Nitric acid^{cf/d}
Nitrite^{cf/d}
Normal paraffin
hydrocarbon^{cf/d}
Oxalic acid^{cf}
Periodic acid^{cf}
Phosphate^{cf/d}
Phosphoric acid^{cf/d}
Phosphorous pentoxide^{cf}
Phosphotungstic acid^{cf}
Plutonium fluoride^{cf}
Plutonium nitrate^{cf}
Plutonium peroxide^{cf}
Potassium^{cf/d}
Potassium carbonate^{cf}
Potassium ferrocyanide^{cf}
Potassium fluoride^{cf}
Potassium hydroxide^{cf}
Potassium oxalate^{cf}
Potassium permanganate^{cf}
Pu-Lanthanum fluoride^{cf}
Pu-Lanthanum oxide^{cf}
Rubidium^{cf}
Silica^{cf/d}
Silicon^{cf/d}
Silver^{cf/d}
Silver nitrate^{cf}
Sodium^{cf/d}
Sodium aluminate^{cf}
Sodium bismuthate^{cf}
Sodium bisulfate^{cf}
Sodium bromate^{cf}
Sodium carbonate^{cf}
Sodium citrate^{cf}
Sodium dichromate^{cf/d}
Sodium ferrocyanide^{cf}
Sodium fluoride^{cf}
Sodium gluconate^{cf}
Sodium hydroxide^{cf/d}
Sodium nitrate^{cf}
Sodium nitrite^{cf}
Sodium persulfate^{cf}
Sodium phosphate^{cf}
Sodium sulfate^{cf}
Sodium thiosulfate^{cf}

Sodium thiosulfate^{cf}
Strontium carbonate^{cf}
Strontium fluoride^{cf}
Strontium sulfate^{cf}
Sugar^{cf}
Sulfamic acid^{cf/d}
Sulfate^{cf/d}
Sulfuric acid^{cf/d}
Tartaric acid^{cf}
Thorium^{cf}
Tin^{cf}
Titanium^{cf}
Uranium^{cf/d}
Uranium oxide^{cf}
Uranyl nitrate
hexahydrate^{cf}
Various acids^{cf/d}
Yttrium^{cf}
Zeolon^{cf}
Zinc^{cf/d}
Zirconium^{cf}
Zirconyl nitrate^{cf}

ORGANIC CHEMICALS

1-Butanol^{cf}
1-Butanone^{cf}
2-Butanone^{cf}
Acetone^{cf}
Ammonium^{cf}
Bismuth phosphate^{cf}
Butanoic acid^{cf}
Butyl alcohol^{cf/d}
Butylated hydroxy toluene^{cf}
Carbon tetrachloride^{cf}
Cesium phosphotungstic
salts^{cf}
Chloroform^{cf/d}
Chloroplatinic Acid^{cf}
Citric acid^{cf}
Decane^{cf/d}
Di2-Ethyl hexyl phosphoric
acid^{cf}
Dibutyl butyl phosphonate^{cf}
Dibutyl phosphate^{cf/d}
Dichloromethane^{cf}
Diesel fuel^{cf/d}

**Table 2-8. Chemicals Used in Separations/
Recovery Processes.**

Dowex 21 K/Amberlite XE-270 ^{a/}	Sodium acetate ^{c/}
Ethanol ^{a/c/}	Soltrol-170 (C ₁₀ H ₂₂ to C ₁₆ H ₃₄ ; purified kerosene ^{a/}
Ethyl ether ^{a/}	Tartaric acid ^{c/}
Flammable solvents ^{a/b/c/d/}	Tetrasodium ethylene diamine tetra-acetate (EDTA) ^{c/}
Formaldehyde (Solution) ^{a/}	Thenoyltrifluoroacetone ^{a/}
Grease ^{a/b/c/d/}	Toluene ^{c/e/}
Halogenated hydrocar- bons ^{a/b/c/d/}	Tri-n-dodecylamine ^{a/}
ORGANIC CHEMICALS (Continued)	Tributyl phosphate ^{a/c/d/}
	Trichloroethane ^{a/c/d/}
	Trichloromethane ^{c/}
	Trisodium hydroxyethyl Ethylene-diamine triacetate (HEDTA) ^{c/}
Hydroxy acetic acid- Trisodium hydroxy ethylene- Diamine-triaetic acid (THEDTA) ^{c/}	Waste Paint and Thinners ^{a/b/c/d/}
Hydroxylamine nitrate ^{a/}	Zeolite AW-500 (IX Resin) ^{c/}
Ionac A-580/Permutit SK ^{a/}	
Isopropyl alcohol ^{a/}	
Kerosene ^{c/d/}	
Methyl ethyl ketone ^{a/b/c/d/}	
Methylene chloride ^{c/e/}	
Misc. Toxic Process Chemicals ^{a/b/c/d/}	
Molybdate-citrate reagent ^{a/}	
Monobutyl phosphate ^{c/d/}	
Normal paraffin hydrocarbon ^{a/c/}	
Paraffin hydrocarbons ^{c/d/}	
PCBs ^{c/}	
Propanol ^{c/}	
Shell E-2342 (naphthalene and paraffin) ^{a/}	

Note: Not all analytes are reported in waste inventories. This list contains those chemicals know, or based on their association with B Plant processes, are suspected to have been disposed of to B Plant Aggregate Area waste management units.

^{a/} Chemicals used in PUREX processes.

^{b/} Stored in Hazardous Waste Staging Areas.

^{c/} Chemicals used in B Plant processes.

^{d/} Chemicals used in U Plant processes.

^{e/} Detected in 2101-M Pond sediment; thought to be cross-contamination sample in analyzing lab.

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Table 2-9. Radionuclides and Chemicals Disposed of to B Plant Waste Management Units.

RADIONUCLIDES

Actinium-225
Actinium-227
Americium-241
Americium-242
Americium-242m
Americium-243
Antimony-126
Antimony-126m
Astitine-217
Barium-135m
Barium-137m
Barium-140
Bismuth-210
Bismuth-211
Bismuth-213
Bismuth-214
Carbon-14
Cerium-141
Cerium-144
Cesium-134
Cesium-135
Cesium-137
Cobalt-57
Cobalt-58
Cobalt-60
Curium-242
Curium-244
Curium-245
Europium-152
Europium-154
Europium-155
Francium-221
Francium-223
Iodine-129
Iron-59
Lanthanum-140
Lead-209
Lead-210
Lead-211
Lead-212
Lead-214
Manganese-54
Neptunium-237
Neptunium-239
Nickel-59
Nickel-63

Niobium-93m
Niobium-95
Palladium-107
Plutonium-238
Plutonium-239/240
Plutonium-241
Polonium-210
Polonium-213
Polonium-214
Polonium-215
Polonium-218
Potassium-40
Praeseodymium-144
Promethium-147
Protactinium-231
Protactinium-233
Protactinium-234m
Radium
Radium-223
Radium-225
Radium-226
Rhodium-103
Rhodium-106
Ruthenium-103
Ruthenium-106
Samarium-151
Selenium-79
Silver-110m
Sodium-22
Strontium-85
Strontium-89
Strontium-90
Technetium-99
Tellurium-129
Thallium-207
Thorium-227
Thorium-229
Thorium-230
Thorium-231
Thorium-233
Thorium-234
Tin-126
Tritium
Uranium-233
Uranium-234
Uranium-235
Uranium-238
Yttrium-90

Yttrium-91
Zinc-65
Zirconium-93
Zirconium-95

INORGANIC CHEMICALS

Acetic Acid^{af}
Alkaline liquids^{af/b/c/d/}
Aluminum^{af/c/d/}
Aluminum nitrate
(mono basic)^{af}
Aluminum nitrate
nonahydrate^{af/c/}
Ammonia (anhydrous)^{cf}
Ammonium carbonate^{cf}
Ammonium fluoride^{af/c/}
Ammonium hydroxide^{cf}
Ammonium ion^{d/}
Ammonium nitrate^{af/c/d/}
Ammonium oxalate^{af}
Ammonium silicofluoride^{cf}
Ammonium sulfate^{cf}
Arsenic^{d/}
Barium^{cf/d/}
Barium nitrate^{af}
Beryllium^{af/c/}
Bismuth^{d/}
Bismuth nitrate^{cf}
Bismuth phosphate^{cf/d/}
Boric acid^{af/c/}
Boron^{d/}
Cadmium^{cf/d/}
Cadmium nitrate^{af}
Calcium^{cf/d/}
Calcium carbonate^{cf}
Calcium chloride^{cf}
Carbon dioxide^{cf}
Carbonate^{cf/d/}
Ceric fluoroide^{af}
Ceric iodate^{af}
Ceric nitrate^{cf}
Ceric sulfate^{af}
Cerium^{cf}
Cesium carbonate^{cf}
Cesium chloride^{cf}
Chloride^{cf}
Chromium^{cf/d/}

9 3 1 2 3 9 6 7 9 3 4

Table 2-9. Radionuclides and Chemicals Disposed of to B Plant Waste Management Units.

Chromium nitrate^{ci}
 Chromous sulfate^{ai}
 Copper^{ci/di}
 INORGANIC CHEMICALS
 (Continued)

Cyanide^{ci/di}
 Ferric cyanide^{ci/di}
 Ferric nitrate^{ai/ci}
 Ferrous sulfamate^{ai}
 Ferrous sulfate^{ai/ci}
 Fluoride^{ci/di}
 Hydrochloric acid^{ai/ci}
 Hydrofluoric acid^{ai}
 Hydrogen^{ci}
 Hydrogen fluoride^{ci}
 Hydrogen peroxide^{ai/ci}
 Hydroiodic acid^{ai}
 Hydroxide^{ai}
 Hydroxyacetic acid^{ai/ci}
 Hydroxylamine
 hydrochloride^{ai}
 Iron^{ai/ci/di}
 Lanthanum fluoride^{ai}
 Lanthanum hydroxide^{ai}
 Lanthanum nitrate^{ai/ci}
 Lanthanum-neodymium
 nitrate^{ci}
 Lead^{di}
 Lead nitrate^{ai/ci}
 Lithium^{di}
 Magnesium^{ai/ci/di}
 Magnesium carbonate^{ci}
 Magnesium nitrate^{ci}
 Manganese^{ci/di}
 Mercuric nitrate^{ai}
 Mercury^{ci}
 Misc. Toxic Process
 Chemicals^{ai}
 Nickel^{ci}
 Nickel nitrate^{ai/ci}
 Niobium^{ci}
 Nitrate^{ci/di}
 Nitric acid^{ai/ci/di}
 Nitrite^{ci/di}
 Normal paraffin
 hydrocarbon^{ai/ci/di}
 Oxalic acid^{ai/ci}

Periodic acid^{ai}
 Phosphate^{ci/di}
 Phosphoric acid^{ai/ci/di}
 Phosphorous pentoxide^{ai}
 Phosphotungstic acid^{ci}
 Plutonium fluoride^{ci}
 Plutonium nitrate^{ci}
 Plutonium peroxide^{ci}
 Potassium^{ci/di}
 Potassium carbonate^{ai}
 Potassium ferrocyanide^{ci}
 Potassium fluoride^{ai}
 Potassium hydroxide^{ai/ci}
 Potassium oxalate^{ai}
 Potassium permanganate^{ai/ci}
 Pu-Lanthanum fluoride^{ci}
 Pu-Lanthanum oxide^{ci}
 Rubidium^{ci}
 Silica^{ci/di}
 Silicon^{ai/ci/di}
 Silver^{ci/di}
 Silver nitrate^{ai/ci}
 Sodium^{ci/di}
 Sodium aluminate^{ci}
 Sodium bismuthate^{ci}
 Sodium bisulfate^{ai/ai}
 Sodium bromate^{ai}
 Sodium carbonate^{ai/ci}
 Sodium chloride^{ci}
 Sodium citrate^{ci}
 Sodium dichromate^{ai/bi/ci/di}
 Sodium ferrocyanide^{ai}
 Sodium fluoride^{ai/ci}
 Sodium gluconate^{ci}
 Sodium hydroxide^{ai/bi/ci/di}
 Sodium nitrate^{ai/ci}
 Sodium nitrite^{ai/ci}
 Sodium persulfate^{ci}
 Sodium phosphate^{ci}
 Sodium sulfate^{ai/ci}
 Sodium sulfite^{ci}
 Sodium thiosulfate^{ai}
 Sodium thiosulfate^{ai}
 Strontium carbonate^{ci}
 Strontium fluoride^{ci}
 Strontium sulfate^{ci}
 Sugar^{ai/ci}
 Sulfamic acid^{ai/di}

Sulfate^{ci/di}
 Sulfuric acid^{ai/ci/di}
 Tartaric acid^{ai}
 Thorium^{di}
 Tin^{di}
 Titanium^{di}
 Uranium^{ci/di}
 Uranium oxide^{di}
 Uranyl nitrate
 hexahydrate^{di}
 Various acids^{ai/bi/ci/di}
 Yttrium^{ci}
 Zeolon^{ci}
 Zinc^{ci/di}
 Zirconium^{ai/ci}
 Zirconyl nitrate^{ci}

ORGANIC CHEMICALS

1-Butanol^{ci}
 1-Butanone^{ci}
 2-Butanone^{ci}
 Acetone^{ai/ci}
 Ammonium^{di}
 Bismuth phosphate^{di}
 Butanoic acid^{ci}
 Butyl alcohol^{ci/di}
 Butylated hydroxy toluene^{ci}
 Carbon tetrachloride^{ai}
 Cesium phosphotungstic
 salts^{ci}
 Chloroform^{ci/di}
 Citric acid^{ci}
 Decane^{ci/di}
 Di2-Ethyl hexyl phosphoric
 acid^{ci}
 Dibutyl phosphate^{ci/di}
 Dichloromethane^{ci}
 Ethanol^{ai/ci}
 Ethylene diamine tetra acetic
 acid^{ci}
 Halogenated hydrocar-
 bons^{ai/bi/ci/di}
 Hydroxy acetic acid-
 Trisodium hydroxy ethylene-
 Diamine-triaetic acid
 (THEDTA)^{ci}
 Kerosene^{ci/di}

Table 2-9. Radionuclides and Chemicals Disposed of to B Plant Waste Management Units.

Methyl ethyl ketone^{a/b/c/d/}
 Methylene chloride^{c/e/}
 Molybdate-citrate reagent^{a/}
 Monobutyl phosphate^{c/d/}
 Normal paraffin
 hydrocarbon^{a/e/}
 ORGANIC CHEMICALS
 (Continued)

Paraffin hydrocarbons^{c/d/}
 Propanol^{f/}
 Shell E-2342 (naphthalene
 and paraffin)^{a/}
 Sodium acetate^{c/}
 Soltrol-170 (C₁₀H₂₂ to
 C₁₆H₃₄; purified
 kerosene^{a/}
 Tartaric acid^{c/}
 Tetrasodium ethylene diamine
 tetra-acetate (EDTA)^{c/}
 Thenoyltrifluoroacetone^{a/}
 Toluene^{c/e/}
 Tributyl phosphate^{a/c/d/}
 Trichloroethane^{a/c/d/}
 Trichloromethane^{c/}
 Trisodium hydroxyethyl
 Ethylene-diamine triacetate
 (HEDTA)^{c/}

Note: Not all analytes are reported in waste inventories. This list contains those chemicals known, or based on their association with B Plant processes, are suspected to have been disposed of to B Plant Aggregate Area waste management units.

- ^{a/} Chemicals used in PUREX processes.
^{b/} Stored in Hazardous Waste Staging Areas.
^{c/} Chemicals used in B Plant processes.
^{d/} Chemicals used in U Plant processes.
^{e/} Detected in 2101-M Pond sediment; thought to be cross-contamination sample in analyzing lab.
^{f/} From the 284-E Powerhouse water softening process.

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Table 2-10. General 200 East Single-Shell Tank Information Reference Locator.

Desired Single-Shell Tank Information	Reference Document
Watch List Tanks: Identification per Public Law 101-510, Section 3137, "Safety Measures for Waste Tanks at Hanford Nuclear Reservation." (Wyden Bill Amendment)	WHC-EP-0182, <i>Tank Farm Surveillance and Waste Status Summary Report</i> , Table 1
Definitions: Definitions include Interim Stabilized (IS), Partial Interim Isolated (PI), Interim Isolated (II), Tank Integrity (Sound or Assumed Leaker), Intrusion, Drywells, Laterals, Surface Levels, Automatic FIC, Liquid Observation Well (LOW), Thermocouple (TC), Sludge, and Salt Cake.	WHC-EP-0182, Appendix A
Tank Schematic: Quick reference for tank capacities and relative dimensions.	WHC-EP-0182, Figure B-1
Tank Information: Tank waste material, tank integrity ("sound" or "assumed leaker" stabilization/isolation status, total waste, supernatant waste, drainable interstitial, sludge volume, salt cake volume, last in-tank photo date.	WHC-EP-0182, Table C-5
Single-Shell Tank Leak Volume Estimates	WHC-EP-0182, Table H-1
Leak Detection Equipment: Type and description of leak detection devices for each tank, and detection criteria.	WHC-SD-WM-TI-357, <i>Waste Storage Tank Status and Leak Detection Criteria</i>
East Area Waste Storage Tank Criteria: Criteria is discussed by tank farm and includes leak detection drywells (type of probe used, radiation criteria, well location, well depths and monitoring frequency), surface level measurement (decrease/increase criteria, monitoring frequency).	WHC-SD-WM-TI-357, Section 2.0
Tank Farms Facility Interim Stabilization Evaluation: Provides the stabilization criteria for single-shell tanks and auxiliary tanks.	WHC-CM-5-7 Section 1.11
Single-Shell Tank Operating Specifications: Information includes structural limitations (tank content composition, dome loading, waste temperatures, vapor space pressures), radiological containment requirements, cross-connection requirements, and leak detection control.	OSD-T-151-00013

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3.0 SITE CONDITIONS

The following sections describe the physical nature and setting of the Hanford Site, the 200 East Area, and the B Plant Aggregate Area. The site conditions are presented in the following sections:

- Physiography and Topography (Section 3.1)
- Meteorology (Section 3.2)
- Surface Hydrology (Section 3.3)
- Geology (Section 3.4)
- Hydrogeology (Section 3.5)
- Environmental Resources (Section 3.6)
- Human Resources (Section 3.7).

Sections describing topography, geology, and hydrogeology have been taken from standardized texts provided by Westinghouse Hanford (Delaney et al. 1991 and Lindsey et al. 1992) for that purpose.

3.1 PHYSIOGRAPHY AND TOPOGRAPHY

The Hanford Site (Figure 3-1) is situated within the Pasco Basin of southcentral Washington. The Pasco Basin is one of a number of topographic depressions located within the Columbia Basin Subprovince of the Columbia Intermontane Province (Figure 3-2), a broad basin located between the Cascade Range and the Rocky Mountains. The Columbia Intermontane Province is the product of Miocene continental flood basalt volcanism and regional deformation that occurred over the past 17 million years. The Pasco Basin is bounded on the north by the Saddle Mountains, on the west by Umtanum Ridge, Yakima Ridge, and the Rattlesnake Hills, on the south by Rattlesnake Mountain and the Rattlesnake Hills, and on the east by the "Palouse" slope (Figure 3-1).

The physiography of the Hanford Site is dominated by the low-relief plains of the Central Plains physiographic region and anticlinal ridges of the Yakima Folds physiographic region (Figure 3-3). Surface topography seen at the Hanford Site is the result of (1) uplift of anticlinal ridges, (2) Pleistocene cataclysmic flooding, and (3) Holocene eolian activity (DOE 1988b). Uplift of the ridges began in the Miocene epoch and continues to the present. Cataclysmic flooding occurred when ice dams in western Montana and northern Idaho were breached, allowing large volumes of water to spill across eastern and central Washington. The last major flood occurred about 13,000 years ago, during the late Pleistocene Epoch. Anastomosing flood channels, giant current ripples, bergmounds, and giant flood bars are among the landforms created by the floods. Since the end of the Pleistocene Epoch, winds have locally reworked the flood sediments, depositing dune sands in the lower elevations and

loess (windblown silt) around the margins of the Pasco Basin. Generally, sand dunes have been stabilized by anchoring vegetation except where they have been reactivated where vegetation is disturbed (Figure 3-4).

A series of numbered areas have been delineated at the Hanford Site. The 100 Areas are situated in the northern part of the Site adjacent to the Columbia River in an area commonly called the "Horn." The elevation of the "Horn" is between 119 and 143 m (390 and 470 ft) above mean sea level (msl) with a slight increase in elevation away from the river. The 200 Areas are situated on a broad flat area called the 200 Areas Plateau. The 200 Areas Plateau is near the center of the Hanford Site at an elevation of approximately 198 to 229 m (650 to 750 ft) above msl. The plateau decreases in elevation to the north, northwest, and east toward the Columbia River, and plateau escarpments have elevation changes of between 15 to 30 m (50 to 100 ft).

The 200 East Area is situated on the 200 Areas Plateau on a relatively flat prominent terrace (Cold Creek Bar) formed during the late Pleistocene flooding (Figure 3-5). Cold Creek Bar trends generally east to west and is bisected by a flood channel that trends north to south. This terrace drops off rather steeply to the north and northwest with elevation changes between 15 and 30 m (50 to 100 ft).

The topography of the 200 East Area is generally flat (Figure 3-1). The elevation in the vicinity of the B Plant Aggregate Area ranges from approximately 225 m (740 ft) in the southern part of the unit to about 133 m (435 ft) above msl in the northern part. A detailed topographic map of the area is provided as Plate 2. There are no natural surface drainage channels within the area.

3.2 METEOROLOGY

The following sections provide information on Hanford Site meteorology including precipitation (Section 3.2.1), wind conditions (Section 3.2.2), and temperature variability (Section 3.2.3).

The Hanford Site lies east of the Cascade Mountains and has a semiarid climate because of the rainshadow effect of the mountains. The weather is monitored at the Hanford Meteorology Station, located between the 200 East and 200 West Areas, and at other points situated through the reservation. The following sections summarize the Hanford Site meteorology.

3.2.1 Precipitation

The Hanford Site receives an annual average of 16 cm (6.3 in.) of precipitation. Precipitation falls mainly in the winter, with about half of the annual precipitation occurring

between November and February. Average winter snowfall ranges from 13 cm (5.3 in.) in January to 0.8 cm (0.31 in.) in March. The record snowfall of 62 cm (24.4 in.) occurred in February 1916 (Stone et al. 1983). December through February snowfall accounts for about 38% of all precipitation in those months.

The average yearly relative humidity at the Hanford Site for 1946 to 1980 was 54.4%. Humidity is higher in winter than in summer. The monthly averages for the same period range from 32.2% for July to 80% in December. Atmospheric pressure averages are higher in the winter months and record absolute highs and lows also occur in the winter.

3.2.2 Winds

The Cascade Mountains have considerable effect on the wind regime at the Hanford Site by serving as a source of cold air drainage. This gravity drainage results in a northwest to west-northwest prevailing wind direction. The average mean monthly speed for 1945 to 1980 is 3.4 m/s (7.7 mph). Peak gust speeds range from 28 to 36 m/s (63 to 80 mph) and are generally southwest or west-southwest winds (Stone et al. 1983).

Figure 3-6 shows wind roses for the Hanford Telemetry Network (Stone et al. 1983). The gravity drainage from the Cascades produces a prevailing west-northwest wind in the 200 East Area. In July, hourly average wind speeds range from a low of 2.3 m/s (5.2 mph) from 9 to 10 a.m. to a high of 6 m/s (13.0 mph) from 9 to 10 p.m.

3.2.3 Temperature

Based on data from 1914 to 1980, minimum winter temperatures vary from -33 to -6 °C (-27 to +22 °F) and maximum summer temperatures vary from 38 to 46 °C (100 to 115 °F). Between 1914 and 1980, a total of 16 days with temperatures -29 °C (-20 °F) or below are recorded. There are 10 days of record when the maximum temperature failed to go above -18 °C (0 °F). Prior to 1980 there were three summers on record when the temperatures were 38 °C (100 °F) or above for 11 consecutive days (Stone et al. 1983).

3.3 SURFACE HYDROLOGY

The following subsections provide information on regional (Section 3.3.1), Hanford Site (Section 3.3.2), and B Plant Aggregate Area (Section 3.3.3) surface hydrology including surface water features and their relationship to Hanford areas.

3.3.1 Regional Surface Hydrology

Surface drainage enters the Pasco Basin from several other basins, which include the Yakima River Basin, Walla Walla River Basin, "Palouse"/Snake Basin, and Big Bend Basin (Figure 3-7). Within the Pasco Basin, the Columbia River is joined by major tributaries including the Yakima, Snake, and Walla Walla Rivers. No perennial streams originate within the Pasco Basin. Columbia River inflow to the Pasco Basin is recorded at the United States Geological Survey gage below Priest Rapids Dam and outflow is recorded below McNary Dam. Average annual flow at these recording stations is approximately $1.1 \times 10^{11} \text{ m}^3$ (8.7×10^7 acre-ft) at the United States Geological Survey gage and $1.6 \times 10^{11} \text{ m}^3$ (1.3×10^8 acre-ft) at the McNary Dam gage (DOE 1988b).

Total estimated precipitation over the basin averages less than 15.8 cm/yr (6.2 in./yr). Mean annual runoff from the basin is estimated to be less than $3.1 \times 10^7 \text{ m}^3/\text{yr}$ (2.5×10^4 acre-ft/yr), or approximately 3% of the total precipitation. The remaining precipitation is assumed to be lost through evapotranspiration with a small component (perhaps less than 1%) recharging the groundwater system (DOE 1988b).

3.3.2 Surface Hydrology of the Hanford Site

Primary surface water features associated with the Hanford Site, located near the center of the Pasco Basin, are the Columbia and Yakima Rivers and their major tributaries, the Snake and Walla Walla Rivers. West Lake, about 4 hectares (10 acres) in size and less than 0.9 m (3 ft) deep, is the only natural lake within the Hanford Site (DOE 1988b). Wastewater ponds, cribs, and ditches associated with nuclear fuel reprocessing and waste disposal activities are also present on the Hanford Site.

The Columbia River flows through the northern part and along the eastern border of the Hanford Site. This section of the river, the Hanford Reach, extends from Priest Rapids Dam to the headwaters of Lake Wallula (the reservoir behind McNary Dam). Flow along the Hanford Reach is controlled by Priest Rapids Dam. Several drains and intakes are also present along this reach, including irrigation outfalls from the Columbia Basin Irrigation Project, the Washington Public Power Supply System Nuclear Project 2, and Hanford Site intakes for onsite water use. Much of the northern and eastern parts of the Hanford Site are drained by the Columbia River.

Routine water quality monitoring of the Columbia River is conducted by the U.S. Department of Energy (DOE) for both radiological and nonradiological parameters and has been reported by Pacific Northwest Laboratory (PNL) since 1973. Washington State Department of Ecology (Ecology) has issued a Class A (excellent) quality designation for Columbia River water along the Hanford Reach from Grand Coulee Dam, through the Pasco Basin, to McNary Dam. This designation requires that all industrial uses of this water be

compatible with other uses including drinking, wildlife habitat, and recreation. In general, the Columbia River water is characterized by a very low suspended load, a low nutrient content, and an absence of microbial contaminants (DOE 1988b).

Approximately one-third of the Hanford Site is drained by the Yakima River system. Cold Creek and its tributary, Dry Creek, are ephemeral streams on the Hanford Site that are within the Yakima River drainage system. Both streams drain areas along the western part of the Hanford Site and cross the southwestern part of the Hanford Site toward the Yakima River. Surface flow, which may occur during spring runoff or after heavier-than-normal precipitation, infiltrates and disappears into the surface sediments. Rattlesnake Springs, located on the western part of the Hanford Site, forms a small surface stream that flows for about 2.9 km (1.8 mi) before infiltrating into the ground.

3.3.3 B Plant Aggregate Area Surface Hydrology

One natural surface water body exists in the B Plant Aggregate Area. The 216-N-8 Pond (West Pond), located 1.2 km (0.75 mi) northeast of 216-A-25 (Gable Mountain Pond), is the only naturally occurring body of water found on the Hanford Site. The location of the ponds are shown on Figure 2-7. Prior to the filling of Gable Mountain Pond, 216-N-8 Pond was an intermittent seasonal pond located in a natural basin at the base of Gable Mountain. After the introduction of large quantities of water to Gable Mountain Pond, the water table in the area was raised sufficiently to provide year-round water to 216-N-8 Pond.

The existing manmade surface water bodies in the B Plant Aggregate Area are the 2101-M Pond, 216-B-3 Pond, 216-B-3A Pond, 216-B-3C Pond, 216-B-3-3 Ditch, and the 207-B Retention Basin. Figures 2-5, 2-6, and 2-10 show the locations of these waste management units. The 2101-M Pond, located near the 200 East Area Powerhouse, receives small quantities of wastewater and generally contains less than 15 cm (6 in.) of standing water. Water dispersion takes place by evaporation and infiltration to the soil.

The 216-B-3 Pond (B Pond) is part of a cascading pond system that receives water from the 216-B-3-3 Ditch. This pond system consists of the 216-B-3 Pond, the 216-B-3A Pond, the 216-B-3B Pond (Lobe)(currently inactive), and the 216-B-3C Pond (Lobe). The normal cascading flow for the system is from the 216-B-3 Pond to the 216-B-3A Pond, and finally to the 216-B-3C Lobe. Under abnormal circumstances, water can also be diverted to the 216-B-3B Lobe. The 216-B-3 Pond system is located 1,066 m (3,500 ft) east of the 200 East perimeter fence. Ongoing 216-B-3 Pond monitoring is discussed in Section 4.1.2.

The potential for flooding caused by overflow of the 216-B-3 Pond system to the surrounding area is minor because of the dike system surrounding the ponds, and also

9 3 1 0 3 0 5 7 9 4 2

because water can be discharged from the 216-B-3A Pond to either the 216-B-3B or the 216-B-3C Lobes. If necessary, water can also be diverted to the 216-E-28 Contingency Pond located north of the 216-B-3 Pond system.

The 216-B-3A Pond, located south of the 216-B-3 Pond, receives water from the 216-B-3 Pond via the 216-B-352 overflow structure, and is separated from the other ponds in the system by a dike. The 216-B-3A Pond presents no threat of flooding due to the fact that water can be discharged to the 216-B-3B Pond (inactive) or to the 216-B-3C Pond via two water overflow structures. The last pond in the cascading series, the 216-B-3C Pond, receives overflow water from the 216-B-3A Pond. The Hanford soils, such as those beneath the 216-B-3C Pond, have historically demonstrated a high water infiltration rate. The 216-B-3C Pond is excavated into the surrounding soils so there is no possibility of an embankment failure. The high soil infiltration rate and the absence of embankment failure potential result in a low flooding potential.

The 216-B-3-3 Ditch, which originates just east of the 200 East Area perimeter fence, is fed by the 216-B-2-3 Pipeline and PUREX Cooling Water Line, and discharges to the 216-B-3 Pond system. The 216-B-3-3 Ditch is an open ditch that is posted as an area of surface contamination. Ongoing monitoring of the 216-B-3-3 Ditch is discussed in Section 4.1.2. The open portions of this ditch represent minor, if any, flooding potential due to the high bermed sides of the ditch and the nature of the soil, which allows for high infiltration of surface water.

The 207-B Retention Basin, located 610 m (2,000 ft) northeast of the 221-B Building, is a concrete-lined retention basin that receives cooling water from the 221-B Building and discharges to the 216-B-2-3 Pipeline. Possible flooding of the 207-B Retention Basin would be caused by plugging the 216-B-2-3 Pipeline resulting in the overflow of the basin. However, this scenario is unlikely, therefore, the flooding potential is low.

The 200 East Area, and specifically the B Plant Aggregate Area, is not in a designated floodplain. Calculations of probable maximum floods for the Columbia River and the Cold Creek Watershed indicate that the 200 East Area is not expected to be inundated under maximum flood conditions (DOE/RL 1991a).

3.4 GEOLOGY

The following sections provide information pertaining to geologic characteristics of southcentral Washington, the Hanford Site, the 200 East Area, and the PUREX Plant Aggregate Area. Topics included are the regional tectonic framework (Section 3.4.1), regional stratigraphy (Section 3.4.2), and 200 East Area and PUREX Plant Aggregate Area geology (Section 3.4.3).

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The geologic characterization of the Hanford Site, including the 200 East Area and PUREX Plant Aggregate Area is the result of many previous site investigation activities at Hanford. These activities include the siting of nuclear reactors, characterization activities for the Basalt Waste Isolation Project (BWIP), waste management activities, and related geologic studies supporting these efforts. Geologic investigations have included regional and Hanford Site surface mapping, borehole/well sediment logging, field and laboratory sediment classification, borehole geophysical studies (including gamma radiation logging), and in situ and laboratory hydrogeologic properties testing.

3.4.1 Regional Tectonic Framework

The following sections provide information on regional (southcentral Washington) geologic structure, structural geology of the Pasco Basin and the Hanford Site, and regional and Hanford Site seismology.

3.4.1.1 Regional Geologic Structure. The Columbia Plateau is a part of the North American continental plate and lies in a back-arc setting east of the Cascade Range. It is bounded on the north by the Okanogan Highlands, on the east by the Northern Rocky Mountains and Idaho Batholith, and on the south by the High Lava Plains and Snake River Plain (Figure 3-8).

The Columbia Plateau can be divided into three informal structural subprovinces (Figure 3-9): Blue Mountains, Palouse, and Yakima Fold Belt (Tolan and Reidel 1989). These structural subprovinces are delineated on the basis of their structural fabric, unlike the physiographic provinces that are defined on the basis of landforms. The Hanford Site is located in the Yakima Fold Belt Subprovince near its junction with the Palouse Subprovince.

The principal characteristics of the Yakima Fold Belt (Figure 3-10) are a series of segmented, narrow, asymmetric anticlines that have wavelengths between 5 and 32 km (3 and 19 mi) and amplitudes commonly less than 1 km (0.6 mi) (Reidel 1984; Reidel et al. 1989a). The northern limbs of the anticlines generally dip steeply to the north, are vertical, or even overturned. The southern limbs generally dip at relatively shallow angles to the south. Thrust or high-angle reverse faults with fault planes that strike parallel or subparallel to the axial trends are principally found on the north sides of these anticlines. The amount of vertical stratigraphic offset associated with these faults varies but commonly exceeds hundreds of meters. These anticlinal ridges are separated by broad synclines or basins that, in many cases, contain thick accumulations of Tertiary- to Quaternary-age sediments. The Pasco Basin is one of the larger structural basins in the Yakima Fold Belt Subprovince.

Deformation of the Yakima folds occurred under a north-south compression and was contemporaneous with the eruption of the basalt flows (Reidel 1984; Reidel et al. 1989a).

Deformation occurred during the eruption of the Columbia River Basalt Group and continued through the Pliocene Epoch, into the Pleistocene Epoch, and perhaps to the present.

3.4.1.2 Pasco Basin and Hanford Site Structural Geology. The Pasco Basin, in which the Hanford Site is located, is a structural depression bounded on the north by the Saddle Mountains anticline, on the east by the Palouse Slope, on the west by the Umtanum Ridge, Yakima Ridge, and Rattlesnake Hills anticlines, and on the south by the Rattlesnake Mountain anticline (Figure 3-11). The Pasco Basin is divided by the Gable Mountain anticline, the easternmost extension of the Umtanum Ridge anticline, into the Wahluke syncline in the north, and Cold Creek syncline in the south. Both the Cold Creek and Wahluke synclines are asymmetric and relatively flat-bottomed structures. The north limbs of both synclines dip gently (approximately 5°) to the south and the south limbs dip steeply to the north. The deepest parts of the Cold Creek syncline, the Wye Barricade depression, and the Cold Creek depression are approximately 12 km (7.5 mi) southeast of the Hanford Site 200 Areas, and to the west-southwest of the 200 East Area, respectively. The deepest part of the Wahluke syncline lies just north of Gable Gap.

The 200 East Area is situated on the generally southward dipping north limb of the Cold Creek syncline 1 to 5 km (0.6 to 3 mi) north of the syncline axis. The Gable Mountain-Gable Butte segment of the Umtanum Ridge anticline lies approximately 4 km (2.5 mi) north of the 200 West Area. The axes of the anticline and syncline are separated by a distance of 9 to 10 km (5.6 to 6.2 mi) and the crest of the anticline (as now exposed) is over 200 m (656 ft) higher than the uppermost basalt layer in the syncline axis. As a result, the basalts and overlying sediments dip to the south and southwest beneath the 200 East Area.

3.4.1.3 Regional and Hanford Site Seismology. Eastern Washington, especially the Columbia Plateau region, is a seismically inactive area when compared to the rest of the western United States (DOE 1988b). The historic seismic record for eastern Washington began in approximately 1850, and no earthquakes large enough to be felt had epicenters on the Hanford Site. The closest regions of historic moderate-to-large earthquake generation are in western Washington and Oregon and western Montana and eastern Idaho. The most significant event relative to the Hanford Site is the 1936 Milton-Freewater, Oregon, earthquake that had a magnitude of 5.75 and that occurred more than 90 km (54 mi) away. The largest Modified Mercalli Intensity for this event was felt about 105 km (63 mi) from the Hanford site at Walla Walla, Washington, and was VII.

Geologic evidence of past moderate or possibly large earthquake activity is shown by the anticlinal folds and faulting associated with Rattlesnake Mountain, Saddle Mountain, and Gable Mountain. The currently recorded seismic activity related to these structures consists of micro-size earthquakes. The suggested recurrence rates of moderate and larger-size earthquakes on and near the Hanford Site are measured in geologic time (tens of thousands of years).

3.4.2 Regional Stratigraphy

The following sections summarize regional stratigraphic characteristics of the Columbia River Basalt and suprabasalt sediments. Specific references to the Hanford Site and 200 East Area are made where applicable to describe the general occurrence of these units within the Pasco Basin.

The principal geologic units within the Pasco Basin include the Miocene age basalt of the Columbia River Basalt Group, and overlying late Miocene to Pleistocene suprabasalt sediments (Figure 3-12). Older Cenozoic sedimentary and volcanoclastic rocks underlying the basalts are not exposed at the surface near the Hanford Site. The basalts and sediments thicken into the Pasco Basin and generally reach maximum thicknesses in the Cold Creek syncline. The suprabasalt sedimentary sequence at the Hanford Site pinches out against the anticlinal structures of Saddle Mountains, Gable Mountain/Umtanum Ridge, Yakima Ridge, and Rattlesnake Hills.

The suprabasalt sediment sequence is up to approximately 230 m (750 ft) thick and dominated by laterally extensive deposits assigned to the late Miocene- to Pliocene-age Ringold Formation and the Pleistocene-age Hanford formation (Figure 3-13). Locally occurring strata informally referred to as the pre-Missoula gravels, the Plio-Pleistocene unit, and the early "Palouse" soil comprise the remainder of the sedimentary sequence. The pre-Missoula gravels underlie the Hanford formation in the east-central Cold Creek syncline and at the east end of Gable Mountain anticline east and south of the 200 Areas. The pre-Missoula gravels have not been identified in the 200 East Area. The nature of the contact between the pre-Missoula gravels and the overlying Hanford formation has not been completely delineated. In addition, it is unclear whether the pre-Missoula gravels overlie or interfinger with the early "Palouse" soil and Plio-Pleistocene unit. Magnetic polarity data indicate the unit is no younger than early Pleistocene in age (> 1 Ma [million years before present]) as reported in Baker et al. (1991).

Relatively thin surficial deposits of eolian sand, loess, alluvium, and colluvium discontinuously overlie the Hanford formation.

3.4.2.1 Columbia River Basalt Group. The Columbia River Basalt Group (Figure 3-12) comprises an assemblage of tholeiitic, continental flood basalts of Miocene age. These flows cover an area of more 163,700 km² (63,000 mi²) in Washington, Oregon, and Idaho and have an estimated volume of about 174,356 km³ (40,800 mi³) (Tolan et al. 1989). Isotopic age determinations indicate that basalt flows were erupted approximately 17 to 6 Ma with more than 98% by volume being erupted in a 2.5 million year period (17 to 14.5 Ma) (Reidel et al. 1989b).

Columbia River basalt flows were erupted from north-northwest-trending fissures of linear vent systems in north-central and northeastern Oregon, eastern Washington, and western Idaho (Swanson et al. 1979). The Columbia River Basalt Group is formally divided

into five formations (from oldest to youngest): Imnaha Basalt, Picture Gorge Basalt, Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt. Of these, only the Picture Gorge Basalt is not known to be present in the Pasco Basin. The Saddle Mountains Basalt, divided into the Ice Harbor, Elephant Mountain, Pomona, Esquatzel, Asotin, Wilbur Creek and Umatilla Members (Figure 3-12), forms the uppermost basalt unit throughout most of the Pasco Basin. The Elephant Mountain Member is the uppermost unit beneath most of the Hanford Site except near the 300 Area where the Ice Harbor Member is found and north of the 200 Areas where the Saddle Mountains Basalt has been eroded down to the Umatilla Member locally. On anticlinal ridges bounding the Pasco Basin, the Saddle Mountains Basalt is locally absent, exposing the Wanapum and Grande Ronde Basalts.

3.4.2.2 Ellensburg Formation. The Ellensburg Formation consists of all sedimentary units that occur between the basalt flows of the Columbia River Basalt Group in the central Columbia Basin. The Ellensburg Formation generally displays two main lithologies: volcanoclastics (Reidel and Fecht 1981; Smith et al. 1989), and siliciclastics (DOE 1988b). The volcanoclastics consist mainly of primary pyroclastic air fall deposits and reworked epiclastics derived from volcanic terrains west of the Columbia Plateau. Siliciclastic strata in the Ellensburg Formation consists of reworked clastic, plutonic, and metamorphic detritus derived from the Rocky Mountain terrain. These two lithologies occur as both distinct and mixed in the Pasco Basin. A detailed discussion of the Ellensburg Formation in the Hanford Site is given by Reidel and Fecht (1981). Smith et al. (1989) provides a discussion of age equivalent units adjacent to the Columbia Plateau.

The stratigraphic names for individual units of the Ellensburg Formation are given in Figure 3-12. The nomenclature for these units is based on the upper- and lower-bounding basalt flows and thus the names are valid only for those areas where the bounding basalt flows occur. Because the Pasco Basin is an area where most bounding flows occur, the names given in Figure 3-12 are applicable to the Hanford Site. At the Hanford Site the three uppermost units of the Ellensburg Formation are the Selah interbed, the Rattlesnake Ridge interbed, and the Levey interbed.

3.4.2.2.1 Selah Interbed. The Selah interbed is bounded on the top by the Pomona Member and on the bottom by the Esquatzel Member. The interbed is a variable mixture of silty to sandy vitric tuff, arkosic sands, tuffaceous clays, and locally thin stringers of predominantly basaltic gravels. The Selah interbed is found beneath most of the Hanford Site.

3.4.2.2.2 Rattlesnake Ridge Interbed. The Rattlesnake Ridge interbed is bounded on the top by the Elephant Mountain Member and on the bottom by the Pomona Member. The interbed is up to 33 m (108 ft) thick and dominated by three facies at the Hanford Site: (1) a lower clay or tuffaceous sandstone, (2) a middle, micaceous-arkosic and/or tuffaceous sandstone, and (3) an upper, tuffaceous siltstone to sandstone. The unit is found beneath most of the Hanford Site.

3.4.2.2.3 Levey Interbed. The Levey interbed is the uppermost unit of the Ellensburg Formation and occurs between the Ice Harbor Member and the Elephant Mountain Member. It is confined to the vicinity of the 300 Area. The Levey interbed is a tuffaceous sandstone along its northern edge and a fine-grained tuffaceous siltstone to sandstone along its western and southern margins.

3.4.2.3 Ringold Formation. The Ringold Formation at the Hanford Site is up to 185 m (607 ft) thick in the deepest part of the Cold Creek syncline south of the 200 West Area and 170 m (558 ft) thick in the western Wahluke syncline near the 100-B Area. The Ringold Formation pinches out against the Gabie Mountain, Yakima Ridge, Saddle Mountains, and Rattlesnake Mountain anticlines. It is largely absent in the northern and northeastern parts of the 200 East Area and adjacent areas to the north in the vicinity of West Lake. The Ringold Formation is assigned a late Miocene to Pliocene age (Fecht 1987; DOE 1988b) and was deposited in alluvial and lacustrine environments (Bjornstad 1985; Fecht et al. 1987; Lindsey 1991).

Recent studies of the Ringold Formation (Lindsey and Gaylord 1989; Lindsey et al. 1992) indicate that it is best described and divided on the basis of sediment facies associations and their distribution. Facies associations in the Ringold Formation (defined on the basis of lithology, petrology, stratification, and pedogenic alteration) include fluvial gravel, fluvial sand, overbank deposits, lacustrine deposits, and alluvial fan. The facies associations are summarized as follows:

- Fluvial gravel--Clast-supported granule to cobble gravel with a sandy matrix dominates the association. Intercalated sands and muds also are found. Clast composition is variable, with common types being basalt, quartzite, porphyritic volcanics, and greenstones. Silicic plutonic rocks, gneisses, and volcanic breccias also are found. Sands in this association are generally quartzo-feldspathic, with basalt contents generally in the range of 5 to 25%. Low angle to planar stratification, massive bedding, wide, shallow channels, and large-scale cross-bedding are found in outcrops. The association was deposited in a gravelly fluvial system characterized by wide, shallow shifting channels.
- Fluvial sand--Quartzo-feldspathic sands displaying cross-bedding and cross-lamination in outcrop dominate this association. These sands usually contain less than 15% basalt lithic fragments, although basalt contents as high as 50% may be encountered. Intercalated strata consist of lenticular silty sands and clays up to 3 m (10 ft) thick and thin (<0.5 m, 1.6 ft) gravels. Fining upwards sequences less than 1 m (3.3 ft) to several meters thick are common in the association. Strata comprising the association were deposited in wide, shallow channels.
- Overbank deposits--This association dominantly consists of laminated to massive silt, silty fine-grained sand, and paleosols containing variable amounts of pedogenic calcium carbonate. Overbank deposits occur as thin lenticular

interbeds (<0.5 m to 2 m, <1.6 ft to 6 ft) in the fluvial gravel and fluvial sand associations and as thick (up to 10 m, 33 ft) laterally continuous sequences. These sediments record deposition in a floodplain under proximal levee to more distal floodplain conditions.

- **Lacustrine deposits**--Plane laminated to massive clay with thin silt and silty sand interbeds displaying some soft-sediment deformation characterize this association. Coarsening upwards packages less than 1 m (3.3 ft) to 10 m (33 ft) thick are common in the association. Strata comprising the association were deposited in a lake under standing water to deltaic conditions.
- **Alluvial fan**--Massive to crudely stratified, weathered to unweathered basaltic detritus dominates this association. These basaltic deposits generally are found around the periphery of the basin. This association was deposited largely by debris flows in alluvial fan settings.

The lower half of the Ringold Formation contains five separate stratigraphic intervals dominated by fluvial gravels. These gravels, designated units, A, B, C, D, and E (also called FSA, FSB, FSC, FSD and FSE [Lindsey and Gaylord 1989; Lindsey et al. 1991]) (Figure 3-13), are separated by intervals containing deposits typical of the overbank and lacustrine facies associations. The lowermost of the fine-grained sequences, overlying unit A, is designated the lower mud sequence. The uppermost gravel unit, unit E, grades upwards into interbedded fluvial sand and overbank deposits. These sands and overbank deposits are overlain by lacustrine-dominated strata.

Fluvial gravel units A and E correspond to the lower basal and middle Ringold units respectively as defined by DOE (1988b). Gravel units B, C, and D do not correlate to any previously defined units (Lindsey et al. 1991). The lower mud sequence corresponds to the upper basal and lower units as defined by DOE (1988b). The upper basal and lower units are not differentiated. The sequence of fluvial sands, overbank deposits, and lacustrine sediments overlying unit E corresponds to the upper unit as seen along the White Bluffs in the eastern Pasco Basin. This essentially is the same usage as originally proposed by Newcomb (1958) and Myers et al. (1979).

3.4.2.4 Plio-Pleistocene Unit. Unconformably overlying the Ringold Formation in the western Cold Creek syncline in the vicinity of 200 West Area (Figures 3-11, 3-12, and 3-13) is the laterally discontinuous Plio-Pleistocene unit (DOE 1988b). The unit is up to 25 m (82 ft) thick and divided into two facies: (1) sidestream alluvium and (2) calcic paleosol (Stage III and Stage IV) (DOE 1988b). The calcic paleosol facies consists of massive calcium carbonate-cemented silt, sand, and gravel (caliche), to interbedded caliche-rich and caliche-poor silts and sands. The basaltic detritus facies consists of weathered and unweathered basaltic gravels deposited as locally derived slope wash, colluvium, and sidestream alluvium. Where the unit occurs, it unconformably overlies the Ringold Formation. The Plio-Pleistocene unit appears to be correlative to other sidestream alluvial

and pedogenic deposits found near the base of the ridges bounding the Pasco Basin on the north, west, and south. These sidestream alluvial and pedogenic deposits are inferred to have a late Pliocene to early Pleistocene age on the basis of stratigraphic position and magnetic polarity of interfingering loess units.

3.4.2.5 Pre-Missoula Gravels. Quartzose to gneissic clast-supported pebble to cobble gravel with a quartzo-feldspathic sand matrix underlies the Hanford formation in the east-central Cold Creek syncline and at the east end of Gable Mountain anticline east and south of the 200 East Area (Figures 3-11, 3-12, and 3-13). These gravels, called the pre-Missoula gravels (PSPL 1982), are up to 25 m (82 ft) thick, contain less basalt than underlying Ringold gravels and overlying Hanford deposits, have a distinctive white or bleached color, and sharply truncate underlying strata. The nature of the contact between the pre-Missoula gravels and the overlying Hanford formation is not clear. In addition, it is unclear whether the pre-Missoula gravels overlie or interfinger with the early "Palouse" soil and Plio-Pleistocene unit. Magnetic polarity data indicates the unit is no younger than early Pleistocene in age (> 1 Ma) (Baker et al. 1991).

3.4.2.6 Early "Palouse" Soil. The early "Palouse" soil consists of up to 20 m (66 ft) of massive, brown yellow, and compact, loess-like silt and minor fine-grained sand (Tallman et al. 1979, 1981; DOE 1988b). These deposits overlie the Plio-Pleistocene unit in the western Cold Creek syncline around the 200 West Area (Figures 3-11, 3-12, and 3-13). The unit is differentiated from overlying graded rhythmites (Hanford formation) by greater calcium carbonate content, massive structure in core, and high natural gamma response in geophysical logs (DOE 1988b). This natural gamma response is due to the inherent stratigraphic properties of the unit, rather than from the effects of radionuclide contamination. The upper contact of the unit is poorly defined, and it may grade up-section into the lower part of the Hanford formation. Based on a predominantly reversed polarity the unit is inferred to be early Pleistocene in age (Baker et al. 1991).

3.4.2.7 Hanford Formation. The Hanford formation consists of pebble to boulder gravel, fine- to coarse-grained sand, and silt (Baker et al. 1991). These deposits are divided into three facies: (1) gravel-dominated, (2) sand-dominated, and (3) silt-dominated. These facies are referred to as coarse-grained deposits, plane-laminated sand facies, and rhythmite facies, respectively, in Baker et al. (1991). The silt-dominated deposits also are referred to as the "Touchet Beds" or slackwater deposits, while the gravel-dominated facies are generally referred to as the Pasco Gravels. The Hanford formation is thickest in the Cold Creek bar in the vicinity of 200 West and 200 East Areas where it is up to 107 m (350 ft) thick (Figures 3-11, 3-12, 3-13, and 3-31). The Hanford formation was deposited by cataclysmic flood waters that drained out of glacial Lake Missoula (Fecht et al. 1987; DOE 1988b; and Baker et al. 1991). Hanford deposits are absent on ridges above approximately 385 m (1,263 ft) above sea level. The following sections describe the three Hanford formation facies.

In addition to the three Hanford formation facies, clastic dikes (Black 1980) also are commonly found in the Hanford formation. These dikes, while common in the Hanford formation, also are found locally in other sedimentary units in the Pasco Basin. Clastic dikes, whether in the Hanford formation or other sedimentary units, are structures that generally cross-cut bedding, although they do locally parallel bedding. The dikes generally consist of alternating vertical to subvertical layers (millimeters to centimeters thick) of silt, sand, and granules. Where the dikes intersect the ground surface, a feature known as patterned ground can be observed (Lindsey et al. 1992).

3.4.2.7.1 Pasco Gravels. The Pasco Gravels consist of two facies, a gravel-dominated and sand-dominated facies. The gravel-dominated facies is dominated by coarse-grained basaltic sand and granule to boulder gravel. These deposits display massive bedding, plane to low-angle bedding, and large-scale planar cross-bedding in outcrop, while the gravels generally are matrix-poor and display an open-framework texture. Lenticular sand and silt beds are intercalated throughout the facies. Gravel clasts in the facies generally are dominated by basalt (50 to 80%). Other clast types include Ringold and Plio-Pleistocene rip-ups, granite, quartzite, and gneiss. The relative proportion of gneissic and granitic clasts in Hanford gravels versus Ringold gravels generally is higher (up to 20% as compared to less than 5%). Sands in this facies usually are very basaltic (up to 90%), especially in the granule size range. Locally Ringold and Plio-Pleistocene rip-up clasts dominate the facies comprising up to 75% of the deposit. The gravel facies dominates the Hanford formation in the 100 Areas north of Gable Mountain, the northern part of 200 East Area, and the eastern part of the Hanford Site including the 300 Area. The gravel-dominated facies was deposited by high-energy flood waters in or immediately adjacent to the main cataclysmic flood channelways.

The sand-dominated facies consists of fine-grained to coarse-grained sand and granular sand displaying plane lamination and bedding and less commonly plane cross-bedding in outcrop. These sands may contain small pebbles and rip-up clasts in addition to pebble-gravel interbeds and silty interbeds less than 1 m (3.3 ft) thick. The silt content of these sands is variable, but where it is low, an open framework texture is common. These sands are typically very basaltic, commonly being referred to as black, gray, or salt and pepper sands. This facies is most common in the central Cold Creek syncline, in the central to southern parts of the 200 East and 200 West Areas, and in the vicinity of the WPPSS facilities. The sand-dominated facies was deposited in channelways as flow power waned and adjacent to main flood channelways as water in the channelways spilled out of them, losing their competence. The facies is transitional between gravel-dominated facies and silt-dominated facies.

3.4.2.7.2 Touchet Beds. The Touchet Beds consists of a silt-dominated facies. The silt-dominated facies consists of thinly bedded, plane-laminated and ripple cross-laminated silt and fine- to coarse-grained sand that commonly display normally graded rhythmites similar to Bouma sequences, a few centimeters to several tens of centimeters thick in outcrop (Myers et al. 1979; DOE 1988b; Baker et al. 1991). The facies dominates the Hanford

formation throughout the central, southern, and western Cold Creek syncline within and south of 200 East and West Areas. These sediments were deposited under slackwater conditions and in backflooded areas (DOE 1988b).

3.4.2.8 Surficial Deposits. Surficial deposits consist of silt, sand, and gravel that form a thin (<10 m, 33 ft) veneer across much of the Hanford Site. These sediments were deposited by a mix of eolian and alluvial processes.

3.4.3 200 East Area and B Plant Aggregate Area Geology

The following sections describe the occurrence of the uppermost basalt unit and the suprabasalt sediments in the 200 East Area. The subsection discusses notable stratigraphic characteristics, thickness variations, and the geometric relationships of the sediments. Stratigraphic variations pertinent to the B Plant Aggregate Area are presented in the overall context of stratigraphic trends throughout the 200 East Area.

Geologic cross-sections depicting the distribution of basalt and sedimentary units within and near the B Plant Aggregate Area are presented on Figures 3-14 through 3-18. Figure 3-14 illustrates the cross-sections locations. A legend for symbols used on the cross-sections is provided on Figure 3-15. The cross-sections are based on geologic information from wells shown on the figures, as interpreted in Lindsey et al. (1992). To develop these stratigraphic interpretations, logs for all the wells in the B Plant Aggregate Area were reviewed and a selection was made of the most relevant to the B Plant Aggregate Area. The cross-sections depict subsurface geology in the B Plant Aggregate Area. For each cross-section, locations of B Plant Aggregate Area waste management units are identified for reference. Figures 3-19 through 3-32 present structure maps of the top of the sedimentary units, and isopach maps illustrating the thickness of each unit in the 200 East Area and B Plant Aggregate Area. The structure and isopach maps are included from Lindsey et al. (1992). Figures 2-1 through 2-13 and Plates 1, 4, and 7 identify the location of the B Plant Aggregate Area buildings and waste management units.

3.4.3.1 Elephant Mountain Basalt. The uppermost basalt unit beneath most of the 200 East Aggregate Area is the Elephant Mountain Member of the Saddle Mountains Basalt. At one location north of the 200 East Area, the Elephant Mountain Member is absent and the uppermost basalt encountered is the Pomona Member (Figure 3-12). Where the Elephant Mountain Member is absent the Rattlesnake Ridge Interbed, the sedimentary unit that commonly separates the Elephant Mountain and Pomona Members, is encountered above the first basalt unit (Figure 3-16).

3.4.3.2 Ellensburg Formation. The Rattlesnake Ridge Interbed of the Ellensburg Formation is found beneath the entire 200 East Area (Reidel and Fecht 1981). Mapping on Gable Mountain indicates it is absent at many localities on this structural high (Fecht 1978). Three units comprise the Rattlesnake Ridge interbed; (1) a lower clay or tuffaceous

sandstone, (2) a middle, micaceous-arkosic and/or tuffaceous sandstone, and (3) an upper, tuffaceous siltstone or sandstone. In the 200 Area East, the unit thickens from 6 m (20 ft) in the north to approximately 26 m (80 ft) in the south (Lindsey 1992). The upper contact of the interbed with the overlying Elephant Mountain Member generally is baked from contact with the Elephant Mountain Basalt (Fecht 1978).

3.4.3.3 Ringold Formation. Within the 200 East Area, the Ringold Formation includes the fluvial gravels of unit A, the paleosol and lacustrine muds of the lower mud sequence, the fluvial gravels of unit E, and the sand and minor muds of the upper unit (Figure 3-13). Ringold units B, C, and D are not found in the immediate vicinity of the 200 East Area. The other Ringold strata are found throughout the southern two-thirds of the 200 East Area.

The lowest Ringold unit in the 200 East Area, the fluvial gravels of unit A, thicken and dip to the south and southwest towards the axis of the Cold Creek syncline. Unit A generally pinches out in the central part of the area against structural highs in the underlying basalt. Thin, lenticular occurrences of unit A are found locally in the area between the northeast 200 East Area and Gable Mountain. Most of the Ringold gravels encountered in the central part of the 200 East Area probably belong to unit A (Lindsey et al. 1992). The top of the unit is a relatively flat surface that dips to the south into the Cold Creek syncline. Intercalated lenticular sand and silt of the fluvial sand overbank facies associations are found locally in the middle part of the unit in the southeastern part of the area. In the B Plant Aggregate Area, the Ringold unit A is present throughout the area except in the northern portion north of the 218-E-5 Burial Ground (Figures 3-20 and 3-21).

The overbank and lacustrine deposits of the lower mud sequence thicken and dip to the south and southwest in a manner similar to the Ringold unit A gravels. However, unlike unit A, the line along which the lower mud sequences pinches out is very irregular. In the area between the 200 East Area and Gable Mountain the lower mud sequence can be found directly overlying the Elephant Mountain basalt at a number of locations where unit A is absent. Within the central part of the 200 East Area the lower mud sequence is largely absent. The nature of the pinchout of the lower mud sequence varies from location to location. At some locations it pinches out against uplifted basalt while at other locations the sequence is truncated by overlying deposits (either Ringold gravel unit E or Hanford gravels). In the area between Gable Mountain and the 200 East Area and in the vicinity of the 216-B-3 Pond complex, the lower mud sequence forms the uppermost part of the Ringold Formation and is overlain by the Hanford formation. Throughout the rest of the 200 East Area the lower mud sequence is overlain by the gravels of Ringold unit E. In regard to the B Plant Aggregate Area, the lower mud sequence is thickest in the 200-BP-2 Operable Unit where the sequence reaches a thickness of approximately 18.6 m (61 ft). The lower mud sequence is absent just north of the southern boundary of the 200-BP-9 Operable Unit (Figures 3-22 and 3-23).

Ringold unit E thickens to the south and southwest in the 200 East Area. Like the lower mud sequence, the line along which unit E pinches out is very irregular. In the

200 East Area, unit E is largely restricted to the southwest corner of the area and the GTF. It is absent in the B Pond area, the central and northern part of the area, and from the area between 200 East and Gable Mountain. Based on the stratigraphic relationships shown in Figure 3-13, most of the Ringold gravels encountered beneath the central part of the 200 East Area are part of gravel unit A and not gravel unit E. Ringold unit E dominantly consists of fluvial gravels. Strata typical of the fluvial sand and overbank facies associations may be encountered locally. However, predicting where intercalated lithologies will occur is very difficult. In the B Plant Aggregate Area, the Ringold unit E is not present north of the 200-SS-1 Operable Unit. The Ringold unit E is found only in the southern part of the B Plant Aggregate Area and is thickest (37 m, 121 ft) near the 200-BP-2 Operable Unit (Figure 3-24).

3.4.3.4 Plio-Pleistocene Unit and Early "Palouse" Soil. The Plio-Pleistocene unit and early "Palouse" soil are not found within or near the 200 East Area or the B Plant Aggregate Area. They are encountered only near the eastern boundary of the 200 West Area approximately 5 km (3 mi) from the 200 East Area.

3.4.3.5 Hanford Formation. As discussed in the regional geology section, the cataclysmic flood deposits of the Hanford formation are divided into three facies: (1) gravel-dominated, (2) sand-dominated, and (3) the silt-dominated facies. Typical lithologic successions consist of fining upwards packages, major fine-grained intervals, and laterally persistent coarse-grained sequences. Mineralogic and geochemical data were not used in differentiating units because of the lack of a comprehensive mineralogic and geochemical data set. Studying the distribution of these facies types and identifying similarities in lithologic succession from borehole to borehole across the 200 East Area indicates the Hanford formation can be divided into three stratigraphic sequences. These sequences are designated: (1) lower gravel, (2) sand, and (3) upper gravel. However, because of the variability of Hanford deposits, contacts between the sequences can be difficult to identify.

The sequences are composed mostly of the gravel-dominated and sand-dominated facies. The silt-dominated facies are relatively rare except in the southern part of the 200 East Area. Two of the sequences are dominated by deposits typical of the gravel-dominated facies and they are designated the upper and lower gravel sequences. The third sequence consists of deposits of the sand-dominated facies with lesser intercalated occurrences from both the gravel-dominated and silt-dominated facies. This sequence, designated the sandy sequence, generally is situated between the upper and lower gravel sequences.

The lower gravel sequence is dominated by deposits typical of the gravel-dominated facies. Local intercalated intervals of the sand-dominated facies are also found. The lower gravel sequence ranges from 0 to 44 m (0 to 135 ft) thick and is found throughout most of the 200 East Area. The sequence probably is present in these areas, but because of the absence of the fine sequence that separates the lower from the upper coarse sequences it is impossible to determine the true extent of the lower coarse sequence. The contact between

the lower coarse sequence and the overlying sandy sequence is arbitrarily placed at the top of the first thick (>6 m, >20 ft) gravel interval encountered below the sand-dominated strata of the sandy sequence. In the B Plant Aggregate Area the lower gravel sequence is thickest near the western border of the 200-BP-11 Operable Unit, the lower gravel sequence is absent throughout most of the 200-BP-5 Operable Unit as well as the northeast corner of the 200-SS-1 Operable Unit (Figures 3-27 and 3-28).

The sandy sequence consists of a heterogenous mix of sands typical of the sand-dominated facies. Deposits of the silt-dominated facies are present, but less abundant. The sandy sequence ranges from 0 to 92 m (0 to 280 ft) thick. This sequence is dominated by the sand-dominated facies in the north, and the slackwater facies towards the south. Gravels, occurring both singly and as interbeds are common in the sandy sequence, especially towards the north. Thin intervals typical of the gravel facies also are encountered. The sandy sequence probably contains the greatest concentration of clastic dikes and it is laterally equivalent with lower fine sequence in the 200 West Area (Lindsey et al. 1991). Where the sandy sequence pinches out it commonly interfingers with gravels of the overlying and underlying gravel sequences. Where this occurs the contact separating the sandy sequence from the other intervals is arbitrary. The sandy sequence is differentiated from the gravelly strata of the upper and lower gravel sequences on the basis of sand content. The base of the sandy sequence is placed at the top of the highest gravelly interval and underlies sand-dominated strata. The top of the sequence is placed at the top of the highest thick, sand-dominated interval. In the B Plant Aggregate Area, the thickness of the sequence ranges from 0 m (0 ft) near the B and C Lobes of the 216-B-3 Ponds to 61 m (200 ft) near the 200-BP-10 Operable Unit (Figures 3-29 and 3-30).

The third Hanford formation stratigraphic sequence consists of gravel-dominated strata referred to as the upper gravel sequence. This sequence is dominated by deposits typical of the gravel-dominated facies. Lesser occurrences of the sand-dominated facies are encountered locally. The sequence thins from as much as 60 m (182 ft) in the north to zero near the southern border of the 200 East Area. In addition, at one location, northwest of the 200 East Area, the sequence thins more than surrounding localities and at another location, in the central part of the 200 East Area, the unit is completely absent. Where the upper gravel sequence is thickest, in the north, it is found to form an elongated northwest to southeast oriented body. The upper coarse and lower coarse sequences are not differentiated in this area where the intervening sandy sequence is absent. In the B Plant Aggregate Area the thickness of the upper gravel sequence is absent near the 216-B-3C Lobe of B Pond, and absent in all of the 200-BP-2 Operable Unit. The maximum thickness of the upper gravel in the B Plant operable unit is 33.2 m (109 ft) near Gable Mountain Pond (Figures 3-31 and 3-32).

3.4.3.6 Holocene Surficial Deposits. Holocene-age surficial deposits in the 200 East Area are dominated by very fine- to medium-grained to occasionally silty eolian sands. These deposits have been removed from much of the area by construction activities. Where the eolian sands are found, they tend to consist of thin (<3 m, 10 ft) sheets that cover the

ground. Dunes are not generally well developed within the 200 East Area. The Holocene surficial deposits are not differentiated on cross-sections and maps because they are relatively thin and because of the lack of definition on so many of the borehole geologic logs available for the 200 East Area and the B Plant Aggregate Area.

3.5 HYDROGEOLOGY

The following sections present discussions of regional hydrogeology (Section 3.5.1), Hanford Site hydrogeology (3.5.2), and B Plant Aggregate Area hydrogeology (Section 3.5.3). Sections 3.5.2 and 3.5.3 also discuss Hanford Site and B Plant Aggregate Area vadose zone characteristics.

3.5.1 Regional Hydrogeology

The hydrogeology of the Pasco Basin is characterized by a multiaquifer system that consists of four hydrogeological units that correspond to the upper three formations of the Columbia River Basalt Group (Grande Ronde Basalt, Wanapum Basalt, and Saddle Mountains Basalt) and the suprabasalt sediments. The basalt aquifers consist of the tholeiitic flood basalts of the Columbia River Basalt Group and relatively minor amounts of intercalated fluvial and volcanoclastic sediments of the Ellensburg Formation. Confined zones in the basalt aquifers are present in the sedimentary interbeds and/or interflow zones that occur between dense basalt flows. The main water-bearing portions of the interflow zones are networks of interconnecting vesicles and fractures of the flow tops and flow bottoms (DOE 1988b). The suprabasalt sediment or uppermost aquifer system consists of fluvial, lacustrine, and glaciofluvial sediments. This aquifer is regionally unconfined and is contained largely within the Ringold Formation and Hanford formation. The position of the water table in the southwest Pasco Basin is generally within the Ringold fluvial gravels of unit E. In the northern and eastern Pasco Basin the water table is generally within the Hanford formation. Table 3-1 presents hydraulic parameters for various water-bearing geologic units at the Hanford Site.

Local recharge to the shallow basalt aquifers results from infiltration of precipitation and runoff along the margins of the Pasco Basin, and in areas of artificial recharge where a downward gradient from the unconfined aquifer systems to the uppermost confined basalt aquifer may occur. Regional recharge of the deep basalt aquifers is inferred to result from interbasin groundwater movement originating northeast and northwest of the Pasco Basin in areas where the Wanapum and Grande Ronde Basalts crop out extensively (DOE 1988b). Groundwater discharge from shallow basalt aquifers is probably to the overlying aquifers and to the Columbia River. The discharge area(s) for the deeper groundwater system is uncertain, but flow is inferred to be generally southeastward with discharge thought to be south of the Hanford Site (DOE 1988b).

Erosional "windows" through dense basalt flow interiors allow direct interconnection between the uppermost aquifer systems and underlying confined basalt aquifers.

Graham et al. (1984) reported that some contamination was present in the uppermost confined aquifer (Rattlesnake Ridge interbed) south and east of Gable Mountain Pond.

Graham et al. (1984) evaluated the hydrologic relationships between the Rattlesnake Ridge Interbed aquifer and the unconfined aquifer in this area and delineated a potential area of intercommunication beneath the northeast portion of the 200 East Area.

The base of the uppermost aquifer system is defined as the top of the uppermost basalt flow. However, fine-grained overbank and lacustrine deposits in the Ringold Formation locally form confining layers for Ringold fluvial gravels underlying unit E. The uppermost aquifer system is bounded laterally by anticlinal basalt ridges and is approximately 152 m (500 ft) thick near the center of the Pasco Basin.

Sources of natural recharge to the uppermost aquifer system are rainfall and runoff from the higher bordering elevations, water infiltrating from small ephemeral streams, and river water along influent reaches of the Yakima and Columbia Rivers. The movement of precipitation through the unsaturated (vadose) zone has been studied at several locations on the Hanford Site (Gee 1987; Routson and Johnson 1990; Rockhold et al. 1990). Conclusions from these studies vary. Gee (1987) and Routson and Johnson (1990) conclude that no downward percolation of precipitation occurs on the 200 Areas Plateau where the sediments are layered and vary in texture, and that all moisture penetrating the soil is removed by evapotranspiration. These two studies analyzed data collected over a period of 12 and 14 years, respectively, and do not specifically address short-term seasonal fluctuations. Rockhold et al. (1990) suggest that downward water movement below the root zone is common in the 300 Area, where soils are coarse-textured and precipitation is above normal.

3.5.2 Hanford Site Hydrogeology

This section describes the hydrogeology of the Hanford Site with specific reference to the 200 Areas.

3.5.2.1 Hydrostratigraphy. The hydrostratigraphic units of concern in the 200 Areas are (1) the Rattlesnake Ridge interbed (confined water-bearing zone), (2) the Elephant Mountain Basalt member (confining horizon), (3) the Ringold Formation (unconfined and confined water-bearing zones and lower part of the vadose zone), (4) the Plio-Pleistocene unit and early "Palouse" soil (primary vadose zone perching horizons and/or perched groundwater zones), and (5) the Hanford formation (vadose zone) (Figure 3-33). The Plio-Pleistocene unit and early "Palouse" soil are only encountered in the 200 West Area. Strata below the Rattlesnake Ridge interbed are not discussed because the more significant water-bearing intervals, relating to environmental issues, are primarily closer to ground surface. The hydrogeologic designations for the 200 Areas were determined by examination of borehole logs and integration of these data with stratigraphic correlations from existing reports.

3.5.2.1.1 Vadose Zone. The vadose zone beneath the 200 Areas ranges from approximately 55 m (180 ft) beneath the former U Pond to approximately 104 m (340 ft) in the west of the 200 East Area (Last et al. 1989). Sediments in the vadose zone consist of the (1) fluvial gravel of Ringold unit E, (2) the upper unit of the Ringold Formation, (3) Plio-Pleistocene unit, (4) early "Palouse" soil, and (5) Hanford formation. Only the Hanford formation is continuous throughout the vadose zone in the 200 Areas. The upper unit of the Ringold Formation, the Plio-Pleistocene unit, and the early "Palouse" soil only occur in the 200 West Area. In the 200 East Area, the Plio-Pleistocene and early "Palouse" soil are absent. The unconfined aquifer water table (discussed in Section 3.5.2.1.3) lies within the Ringold unit E.

The transport of water through the vadose zone depends in complex ways on several factors, including most significantly the moisture content of the soils and their hydraulic properties. Darcy's law, although originally conceived for saturated flow only, was extended by Richards to unsaturated flow, with the provisions that the soil hydraulic conductivity becomes a function of the water content of the soil and the driving force is predominantly differences in moisture level. The moisture flux, q , in cm/s in one direction is then described by a modified form of Darcy's law commonly referred to as Richards' Equation (Hillel 1971) as follows:

$$q = K(\theta) \times \frac{\partial \varphi}{\partial \theta} \times \frac{\partial \theta}{\partial x} \text{ (Richards' Equation)}$$

where

- $K(\theta)$ is the water-content-dependent unsaturated hydraulic conductivity in cm/s
- $\frac{\partial \varphi}{\partial \theta}$ is the slope of the soil-moisture retention curve $\varphi(\theta)$ at a particular volumetric moisture content θ (a soil-moisture retention curve plots volumetric moisture content observed in the field or laboratory against suction values for a particular soil, see Figure 3-34 from Gee and Heller (1985) for an example)
- $\frac{\partial \theta}{\partial x}$ is the water content gradient in the x direction.

More complicated forms of this equation are also available to account for the effects of more than one dimensional flow and the effects of other driving forces such as gravity.

The usefulness of Richards' Equation is that knowing the moisture content distribution in soil, having measured or estimated values for the unsaturated hydraulic conductivity corresponding to these moisture contents, and having developed a moisture retention curve for this soil, one can calculate a steady state moisture flux. With appropriate algebraic manipulation or numerical methods, one could also calculate the moisture flux under transient conditions.

In practice, applying Richards' Equation is quite difficult because the various parameters involved are difficult to measure and because soil properties vary depending on whether the soil is wetting or drying. As a result, soil heterogeneities affect unsaturated flow even more than saturated flow. Several investigators at the Hanford Site have measured the vadose zone moisture flux directly using lysimeters (e.g., Rockhold et al. 1990; Routson and Johnson 1990). These direct measurements are discussed in Section 3.5.2.2 under the heading of natural groundwater recharge.

An alternative to direct measurement of unsaturated hydraulic conductivity is to use theoretical methods that predict the conductivity from measured soil moisture retention data (Van Genuchten 1991).

Thirty-five soil samples from the 200 West Area have had moisture retention data measured. These samples were collected from Wells 299-W18-21, 299-W15-16, 299-W15-2, 299-W10-13, 299-W7-9, and 299-W7-2. Eleven of these samples were reported by Bjornstad (1990). The remaining 24 were analyzed as part of an ongoing performance assessment of the low-level burial grounds (Connelly et al. 1992). For each of these samples saturated hydraulic conductivity was measured in the laboratory. Van Genuchten's computer program RETC was then used to develop wetting and drying curves for the Hanford, early "Palouse," Plio-Pleistocene, upper Ringold, and Ringold Gravel lithologic units. An example of the wetting and drying curves, and corresponding grain size distributions, is provided on Figure 3-34.

The unsaturated hydraulic conductivities may vary by orders of magnitude with varying moisture contents and among differing lithologies with significantly different soil textures and hydraulic conductivities. Therefore, choosing a moisture retention curve should be made according to the particle size analyses of the samples and the relative density of the material.

Once the relationship between unsaturated hydraulic conductivity and moisture content is known for a particular lithologic unit, travel time can also be estimated for a steady-state flux passing through each layer by assuming a unit hydraulic gradient. Under the unit gradient condition, only the force of gravity is acting on water and all other forces are considered negligible. These assumptions may be met for flows due to natural recharge since moisture differences become smoothed out after sufficient time. Travel time for each lithologic unit of a set thickness and calculated for any given recharge rate and the total travel time is equivalent to the sum of the travel times for each individual lithologic unit. To calculate the travel time for any particular waste management unit the detailed layering of the lithologic units should be considered. For waste management units with artificial recharge (e.g., cribs and trenches) more complicated analyses would be required to account for the effects of saturation.

Several other investigators have measured vadose zone soil hydraulic conductivities and moisture retention characteristics at the Hanford Site both in situ (i.e., in lysimeters) and in specially prepared laboratory test columns. Table 3-2 summarizes data identified for this

study by stratigraphic unit. Rockhold et al. (1988) presents a number of moisture retention characteristic curves and plots of hydraulic conductivity versus moisture content for various Hanford soils. For the Hanford formation, vadose zone hydraulic conductivity values at saturation range from 10^{-4} to 10^{-2} cm/s. These saturated hydraulic conductivity values were measured at volumetric water contents of 40 to 50%. Hydraulic conductivity values corresponding to volumetric water contents, ranging from 2 to 10%, ranged from 2×10^{-11} to 7×10^{-7} cm/s.

An example of the potential use of this vadose zone hydraulic parameter information is presented by Smoot et al. (1989) in which precipitation infiltration and subsequent contaminant plume movement near a prototype single-shell tank was evaluated using a numerical computer code. Smoot et al. (1989) used the UNSAT-H one-dimensional finite-difference unsaturated zone water flow computer code to predict the precipitation infiltration for several different soil horizon combinations and characteristics. The researchers used statistically generated precipitation values that were based on actual daily precipitation values recorded at the Hanford Site between 1947 and 1989 to simulate precipitation infiltration from January 1947 to December 2020. The same authors also used the PORFLO-3 computer code to simulate ^{106}Ru and ^{137}Cs movement through the unsaturated zone.

Smoot et al. (1989) concluded that 68 to 86% of the annual precipitation infiltrated into a gravel-capped soil column while less than 1% of the annual precipitation infiltrated into a silt loam-capped soil column. For the gravel-capped soil column, the simulations showed the ^{106}Ru plume approaching the water table after 10 years of simulated precipitation infiltration. The simulated ^{137}Cs plume migrated a substantially shorter distance due to greater adsorption on soil particles. In both cases, the simulated plume migration scenarios are considered to be conservative due to the relatively soil absorption coefficients used.

Graham et al. (1981) estimated that historical artificial recharge from liquid waste disposal in the 200 (Separations) Areas exceeded all natural recharge by a factor of ten. In the absence of ongoing artificial recharge, i.e., liquid waste disposal to the soil column, natural recharge could potentially be a driving force for mobilizing contaminants in the subsurface. Natural sources of recharge to the vadose zone and the underlying water table aquifer are discussed in Section 3.5.2.2. Additional discussion of the potential for natural and artificial recharge to mobilize subsurface contaminants is presented in Section 4.2.

Another facet of moisture migration in the vadose zone is moisture retention above the water table. Largely because of capillary forces, some portion of the moisture percolating down from the ground surface to the unconfined aquifer will be held against gravity in soil pore space. Finer-grained soils retain more water (against the force of gravity) on a volumetric basis than coarse-grained soils (Hillel 1971). Because unsaturated hydraulic conductivity increases with increasing moisture content, finer-grained soils may be more permeable than coarse-grained soils at the same water content. Also, because the moisture retention curve for coarse-grained soils is generally quite steep (Smoot et al. 1989), the permeability contrast between fine-grained and coarse-grained soils at the same water content

can be substantial. The occurrence of interbedded fine-grained and coarse-grained soils may result in the formation of "capillary barriers" and can in turn lead to the formation of perched water zones. General conditions leading to the formation of perched water zones at the Hanford Site are discussed in Section 3.5.2.1.2. The potential for perched water zones in the B Plant Aggregate Area is discussed in Section 3.5.3.1.2.

3.5.2.1.2 Perched Water Zones. Moisture moving downward through the vadose zone may accumulate on top of highly cemented horizons and may accumulate above the contact between a fine-grained horizon and an underlying coarse-grained horizon as a result of the "capillary barrier" effect. If sufficient moisture accumulates, the soil pore space in these perching zones may become saturated. In this case, the capillary pressure within the horizon may locally exceed atmospheric pressure, i.e., a water table condition may develop. Additional input of downward percolating moisture to this horizon may lead to a hydraulic head buildup above the top of the horizon. Consequently, a monitoring well screened within or above this horizon would be observed to contain free water.

The lateral extent and composition of the Plio-Pleistocene and early "Palouse" soil units may provide conditions amenable to the formation of perched water zones in the vadose zone above the unconfined aquifer. The calcrete facies of the Plio-Pleistocene unit, consisting of calcium-carbonate-cemented silt, sand, and gravel, is a potential perching horizon due to its likely low hydraulic conductivity. However, the Plio-Pleistocene unit is typically fractured and may have erosional scours in some areas, potentially allowing deeper infiltration of groundwater, a factor which may limit the lateral extent of accumulated perched groundwater. The early "Palouse" soil horizon, consisting of compact, loess-like silt and minor fine-grained sand, is also a likely candidate for accumulating moisture percolating downward through the sand and gravel-dominated Hanford formation. As discussed earlier, the Plio-Pleistocene unit and the early "Palouse" soil do not occur in the 200 East Area. Therefore, the potential for perched water occurring in the B Plant Aggregate Area is low.

3.5.2.1.3 Unconfined Aquifer. The uppermost aquifer system in the 200 Areas occurs primarily within the sediments of the Ringold Formation and Hanford formation. In the 200 West Area, the upper aquifer is contained within the Ringold Formation and displays unconfined to locally confined or semiconfined conditions. In the 200 East Area, the upper aquifer occurs in the Ringold Formation and Hanford formation. The depth to groundwater in the upper aquifer underlying the 200 Areas ranges from approximately 60 m (197 ft) beneath the former 216-U-10 Pond in the 200 West Area to approximately 105 m (340 ft) west of the 200 East Area to approximately 103 m (313 ft) near the 202-A Building in the 200 East Area. The saturated thickness of the unconfined aquifer ranges from approximately 67 to 112 m (220 to 368 ft) in the 200 West Area and approximately 61 m (200 ft) in the southern 200 East Area to nearly absent in the northeastern 200 East Area where the aquifer thins out and terminates against the basalt located above the water table in that area.

The upper part of the uppermost aquifer in the 200 East Area consists of generally unconfined groundwater within the Ringold unit E. In the northern part of the B Plant

Aggregate Area the Ringold Formation has been eroded and the groundwater is found within the Hanford formation. The lower part of the uppermost aquifer consists of confined to semi-confined groundwater within the gravelly sediments of Ringold unit A. The Ringold unit A is generally confined by fine-grained sediments of the lower mud sequence.

Because of its importance with respect to contaminant transport, the unconfined aquifer is generally the most characterized hydrologic unit beneath the Hanford Site. A number of observation wells have been installed and monitored in the unconfined aquifer. Additionally, in situ aquifer tests have been conducted in a number of the unconfined aquifer monitoring wells. Results of these in situ tests vary greatly depending on the following:

- Horizontal position/location between areas across the Hanford Site and even smaller areas (such as across portions of the 200 Areas)
- Depth, even within a single hydrostratigraphic unit
- Analytical methods for estimating hydraulic conductivity.

Details regarding this aquifer system will be discussed in the 200 East Groundwater Aggregate Area Management Study Report (AAMSR).

3.5.2.2 Natural Groundwater Recharge. Sources of natural recharge to groundwater at the Hanford Site include precipitation infiltration, runoff from higher bordering elevations and subsequent infiltration within the Hanford Site boundaries, water infiltrating from small ephemeral streams, and river water infiltrating along influent reaches of the Yakima and Columbia Rivers (Graham et al. 1981). The principal source of natural recharge is believed to be precipitation and runoff infiltration along the periphery of the Pasco Basin. Small streams such as Cold Creek and Dry Creek also lose water to the ground as they spread out on the valley plain. Considerable debate exists as to whether any recharge to groundwater occurs from precipitation falling on broad areas of the 200 Areas Plateau.

Natural precipitation infiltration at or near waste management units or unplanned releases may provide a driving force for the mobilization of contaminants previously introduced to surface or subsurface soils. For this reason, determination of precipitation recharge rates at the Hanford Site has been the focus of many previous investigations. Previous field programs have been designed to assess precipitation, infiltration, water storage changes, and evaporation to evaluate the natural water balance during the recharge process. Precipitation recharge values ranging from 0 to 10 cm/yr have been estimated from various studies.

The primary factors affecting precipitation recharge appear to be surface soil type, vegetation type, topography, and year-to-year variations in seasonal precipitation. A modeling analysis (Smoot et al. 1989) indicated that 68 to 86% of the precipitation falling

on a gravel-covered site might infiltrate to a depth greater than 2 m (6 ft). As discussed below, various field studies suggest that less than 25% of the precipitation falling on typical Hanford Site soils actually infiltrates to any depth.

Examples of precipitation recharge studies include:

- A study by Gee and Heller (1985) described various models used to estimate natural recharge rates. Many of the models use a water retention relationship for the soil. This relates the suction required to remove (or move) water to its dryness (saturation or volumetric moisture content). Two of these have been developed by Gee and Heller (1985) for soils in lysimeters on the Hanford Site. As an example of available data, the particle size distribution and the water retention curves of these two soils are shown in Figure 3-35. Additional data and information about possible models for unsaturated flow may be found in Brownell et al. (1975), and Rockhold et al. (1990).
- Moisture contents have been obtained from a number of core-barrel samples in the 200 Areas (East and West) and varied from 1 to 18%, with most in the range of 2 to 6% (Last et al. 1989). The data appear to indicate zones of increased moisture content that could be interpreted as signs of moisture transport.
- A lysimeter study reported by Routson and Johnson (1990) was conducted at a location 1.6 km south of the 200 East Area. During much of the lysimeters' 13-year study period between 1972 and 1985, the surface of the lysimeters were maintained unvegetated with herbicides. No information regarding the soil types in the lysimeters was found. To a precision of +/- 0.2 cm, no downward moisture movement was observed in the instruments during periodic neutron-moisture measurements or as a conclusion of a final soil sample collection and moisture content analysis episode.
- An assessment of precipitation recharge involving the redistribution of ^{137}Cs in vadose zone soil also reported by Routson and Johnson (1990). In this study, split-spoon soil samples were collected beneath a solid waste burial trench in the T Plant Aggregate Area. The trench, located just south and west of the 218-W-3AE Burial Ground, approximately 6 km (3.7 mi) west of the 200 East Area, received soil containing ^{137}Cs from an unspecified spill. Cesium-137 was not detected below the bottom of the burial trench. However, increased ^{137}Cs activity was observed above the top of the waste fill which Routson and Johnson concluded indicated that net negative recharge (loss of soil moisture to evapotranspiration) had occurred during the 10-year burial period.

Sparse Russian thistle was observed at the burial trench area in 1980.

Rockhold et al. (1990) noted that ^{137}Cs appears to strongly sorb to Hanford Site

soils indicating that the absence of the radionuclide at depth below the burial trench may not support the conclusion that no downward moisture movement occurred.

- A weighing lysimeter study reported by Rockhold et al. (1990) was conducted at a grassy plot approximately 5 km (3 mi) northwest of the 300 Area. The grass test site was located in a broad, shallow topographic depression approximately 900 m (2,953 ft) wide, several hundred meters long, trending southwest. The area is covered with annual grasses (cheatgrass and bluegrass). The upper 3.5 m (11.5 ft) of the soil profile consists of slightly silty to silty sand (sandy loam) with an estimated saturated hydraulic conductivity of 9×10^{-3} cm/s. Rockhold et al. (1990) estimated that approximately 0.8 cm (0.3 in.) of downward moisture movement occurred between July 1987 and June 1988. This represents approximately 7% of the total precipitation recorded in that area during that time period.
- A gravel-covered lysimeter study discussed by Rockhold et al. (1990) was conducted at the 200 East Area lysimeter site, approximately 1 km (1.6 mi) south of the 200 East Area. Water contents below the 4.88 m (16 ft) depth in the closed-bottom lysimeter have not changed reasonably between 1972 and 1988, implying that significant recharge has not occurred. Data are insufficient to conclude whether the presence of a plant community on the lysimeter is the reason for the lack of water increase.

The drainage (downward moisture movement) observed in these studies may represent potential recharge to deeper vadose zone soils and/or the underlying water table.

3.5.2.3 Groundwater Flow. Groundwater flow north of Gable Mountain currently trends in a northeasterly direction as a result of mounding near reactors and flow through Gable Gap. South of Gable Mountain, flow is interrupted locally by the groundwater mounds in the 200 Areas. There is also a component of groundwater flow to the north between Gable Mountain and Gable Butte from the 200 Areas. In the 200 East Area, groundwater elevations in June 1990 for the unconfined aquifer showed little variation and were generally around 133 m (405 ft) (Kasza et al. 1990).

Temporary reversal of groundwater flow entering the Columbia River may occur during transient, high-river stages. This occurrence is known as bank storage. Correlations were made between groundwater level and river-stage fluctuations along a 81 km (50 mi) reach of the Columbia River adjacent to the Hanford Site by Newcomb and Brown (1961). They concluded that a 260 km² (100 mi²) area within the Hanford Site was affected by bank storage. During a 45 day rise in river stage, it was estimated that water infiltrated at an average rate of 4,500,000 m³/day (3,700 acre-ft/day) versus 1,233,000 m³/day

(1,000 acre-ft/day) during the 165 day recession period. Since this study was conducted, dam control on the Columbia River has reduced the magnitude of bank storage on the groundwater system.

Natural groundwater inflow to the unconfined aquifer primarily occurs along the western boundary of the Hanford Site. Currently, manmade recharge occurs in several active waste management units (e.g., the 216-U-14 Ditch, 216-U-17 Crib, and the 216-Z-20 Crib) located within the U Plant Aggregate Area in the 200 West Area. Historically, much greater recharge occurred from a number of waste management units in the 200 Areas. Manmade recharge probably substantially exceeds natural precipitation recharge in these areas. The unconfined aquifer ultimately discharges to the Columbia River, either near the 100 Areas, north of the 200 Areas through Gable Gap, or between the 100 Areas and the 300 Area, east of the 200 Areas. The precise path is strongly dependent on the hydrologic conditions in the 200 East Area (Delaney et al. 1991). If recharge in the 200 East Area is large, more of the recharge from the 200 West Area is diverted north through Gable Gap toward the 100 Areas. Generally, however, the easterly route appears to be more likely for recharge from the 200 West Area.

3.5.2.4 Historical Effects of Operations. Historical effluent disposal at the Hanford Site altered previously prevailing groundwater hydraulic gradients and flow directions. Before operations at the Hanford Site began in 1944, groundwater flow was generally toward the east, and the groundwater hydraulic gradient in the 200 East Area was on the order of 0.0003 (Delaney et al. 1991). Prior to disposing liquid waste to the soil column in the 200 (Separations) Areas, groundwater elevations in the 200 East Area may have been as much as 18 m (55 ft) lower in 1944 than at present. As seen in Figure 3-36, a distinct groundwater mound is still apparent east of the 200 East Area near the 216-B-3 Pond. The 216-B-3 Pond has caused the groundwater flow direction to change to a northwest-southeast flow pattern.

3.5.3 B Plant Aggregate Area Hydrogeology

This section presents additional hydrogeologic information identified with specific application to the B Plant Aggregate Area.

3.5.3.1 Hydrostratigraphy. As shown on Figure 3-37, the hydrostratigraphic units of concern beneath the B Plant Aggregate Area are (1) the Rattlesnake Ridge interbed, (2) the Elephant Mountain Basalt member, (3) the Ringold Formation units A and E, and (4) the Hanford formation. The hydrogeologic designations for the B Plant Aggregate Area were determined by examination of borehole logs from Lindsey et al. (1992) and Chamness et al. (1992) and integration of these data with stratigraphic correlations from existing reports. For the purposes of the B Plant AAMSR, this discussion will be limited to the vadose zone and possible perching horizons with the vadose zone underlying the aggregate area. Additional information on the aquifer systems will be discussed in the 200 East Groundwater AAMSR.

3.5.3.1.1 Vadose Zone. The vadose zone beneath the B Plant Aggregate Area ranges in thickness from about 104 m (341 ft) along the southern part of the western aggregate area boundary to 37 m (123 ft) in the vicinity of the 216-B-3C Pond based on June 1990 groundwater elevation data (Kasza et al. 1990). The observed variation in vadose zone thickness is the result of variable surface topography and the variable elevation of the water table in the underlying unconfined aquifer.

During the 1985 Grout Treatment Facility (GTF) baseline and site characterization study, several groundwater monitor wells were drilled (Swanson et al. 1988). The data collected from the drilling of these wells (299-E25-25, 299-E25-26, 299-E25-27 and 299-E25-28) provided information pertaining to the vadose zone east of the B Plant Aggregate Area. Similar data were collected, to the west from groundwater monitor wells adjacent to the 216-U-12 Crib and at the southwest border of the U Plant Aggregate Area (Goodwin 1990). Because of the similar stratigraphy between the areas east (GTF) and west (U Plant) of the B Plant Aggregate Area, it is probable that the B Plant Aggregate Area vadose zone is similar and it can be assumed that the collected data are correct for this study area. Analysis of the borehole samples collected from the GTF and U Plant indicate that soil moisture is normally between < 1% to 27% by weight. Of 105 samples analyzed for moisture content from the U Plant Aggregate Area, 86% were between 1% and 10% by weight. At the GTF, 126 samples were collected for soil moisture and 89% were between 1% and 10% by weight. It should be noted however, that both investigations are in the vicinity of previously active cribs and/or ditches, and that there is some impact by the disposal of liquid waste on these moisture contents.

3.5.3.1.2 Perched Water Zones. Unlike the 200 West Area, the likelihood of perched water occurring in the 200 East Area is low. In the 200 West Area perched water is found predominantly in the Plio-Pleistocene and the early "Palouse" soil. Those stratigraphic units are not present in the 200 East Area. However, perched water zones are still possible because of the large quantity of liquid waste disposed, provided that the proper soil grain size and intercalated lenses exist.

Perched water has been found in the 200 East Area near the B Pond system. The main aquifer in this area is within the fluvial gravel Unit A of the Ringold Formation. In two boreholes drilled in the "C" lobe of B Pond, perched water was found above the clayey lower mud sequence of the Ringold Formation. The lower mud sequence is also found below the "A" lobe of the B Pond and beneath the main portion of the B Pond, though perched water has not been detected in these locales. Where the perched water has been found, it is moving down-dip (southeast) and into the main aquifer of the Unit A fluvial gravels.

3.5.3.2 Natural Groundwater Recharge. As discussed in Section 3.3.3, only one natural surface water body exists within the B Plant Aggregate Area near Gable Mountain. Other than in this one location, the potential for natural groundwater recharge within the B Plant Aggregate Area is limited to precipitation infiltration. No precipitation infiltration data were

identified with specific reference to the B Plant Aggregate Area. However, the amount of precipitation infiltration is likely comparable to the range of values identified for various Hanford test sites, i.e., 0 to 10 cm/yr.

As suggested in Section 3.5.2.2, precipitation infiltration rates probably vary with respect to location within the B Plant Aggregate Area. Higher infiltration rates are expected in unvegetated areas or areas with shallow rooting plants. Higher infiltration rates are also expected in areas with gravelly soils exposed at the surface.

3.5.3.3 Groundwater Flow Beneath the B Plant Aggregate Area. Within the B Plant Aggregate Area, groundwater flow is generally toward the west, based on December 1990 Hanford wells groundwater elevation data (DOE/RL 1991b) (Figure 3-36). Flow is generally away from the groundwater mound located below the 216-B-3 Pond just east of the B Plant Aggregate Area. A review of groundwater maps of the unconfined aquifer (Kasza et al. 1990) indicates relatively steep decreases in groundwater elevations directly west of the mound and a very gradual elevation decrease to the west across the B Plant Aggregate Area. A detailed evaluation of the groundwater flow beneath the B Plant Aggregate Area will be discussed in the 200 East Groundwater Aggregate Area Management study.

3.5.3.4 Historical Effects of Operations. Artificial recharge from waste management facilities within the 200 East Area has caused significant changes to the water levels of the unconfined aquifer since operations began in 1943. Historically, the majority (greater than 90%) of wastewater discharged from the 200 East Area has been routed to the B or Gable Mountain Ponds (Zimmerman et al. 1986). Between 1943 and 1980, approximately 3.433×10^{11} L of wastewater had been discharged to these ponds. The B Pond received greater than 90% of the wastewater discharged from the 200 East Area between 1945 and 1955. In 1957 the Gable Mountain Pond began receiving wastewater. From 1956 to 1980, these ponds received over 90% of the wastewater generated from the 200 East Area. This discharging has created elevated groundwater levels, or mounding of the groundwater, in the vicinity of the B and Gable Mountain Ponds.

Between 1950 and 1955, small groundwater elevation increases occurred south of Gable Mountain in response to wastewater discharges from the B Plant. Groundwater mounding in the vicinity of the B Pond continued in response to the startup of the PUREX Plant in 1956 and new discharges to the Gable Mountain Pond. During this time, the artificial recharge caused elevations to reach approximately 10 m (32 ft) above the natural groundwater elevations.

During the 1960's, the groundwater mound grew at a much slower rate and reached near equilibrium conditions during the 1970's. During the 1980's, three expansion ponds were created near the B Pond to receive wastewater redirected from the Gable Mountain Pond and the PUREX Plant which resumed production in 1983. This increased discharge amount has elevated groundwater levels in the vicinity of the B Pond approximately 1.5 m

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(5 ft) between December 1979 and December 1989. Groundwater elevations in the vicinity of the Gable Mountain Pond have decreased approximately 1 m (3 ft) during this same time.

3.6 ENVIRONMENTAL RESOURCES

The Hanford Site is characterized as a cool desert or a shrub-steppe and supports a biological community typical of this environment.

3.6.1 Flora and Fauna

The 200 Areas Plateau is represented by a number of plant, mammal, bird, reptile, amphibian, and insect species as discussed below.

3.6.1.1 Vegetation of the 200 Areas Plateau. The vegetation of the 200 Areas Plateau is characterized by native shrub steppe interspersed with large areas of disturbed ground with a dominant annual grass component. The native stands are classified as an *Artemisia tridentata*/*Poa sandbergii* - *Bromus tectorum* community (Rogers and Rickard 1977) meaning that the dominant shrub is big sagebrush (*Artemisia tridentata*) and the understory is dominated by the native Sandberg's bluegrass (*Poa sandbergii*) and the introduced annual cheatgrass (*Bromus tectorum*). Other shrubs that are typically present include gray rabbitbrush (*Chrysothamnus nauseosus*), green rabbitbrush (*C. viscidiflorus*), spiny hopsage (*Grayia spinosa*), and occasionally antelope bitterbrush (*Pursia tridentata*). Other native bunchgrasses that are typically present include bottlebrush squirreltail (*Sitanion hystrix*), Indian ricegrass (*Oryzopsis hymenoides*), needle-and-thread (*Stipa comata*), and prairie junegrass (*Koeleria cristata*). Common and important herbaceous species include turpentine cymopterus (*Cymopterus terebinthinus*), globemallow (*Spherocarya munroana*), balsamroot (*Basamorhiza careyana*), several milk vetch species (*Astragalus caricinus*, *A. sclerocarpus*, *A. succumbens*), long-leaf phlox (*Phlox longifolia*), the common yarrow (*Achillea millifolium*), pale evening-primrose (*Oenothera pallida*), thread-leaf phacelia (*Phacelia linearis*), and several daisy/fleabane species (*Erigeron poliospermus*, *E. filifolius*, and *E. pumilus*). In all, well over 100 plant species have been documented to occur in native stands on the 200 Areas Plateau.

Disturbed communities on the 200 Areas Plateau are primarily the result of either mechanical disturbance or range fires. Mechanical disturbance, including construction activities, soil borrow areas, road clearings, and fire breaks, results in drastic changes to the plant community. This type of disturbance usually entails a complete loss of soil structure and total disruption of nutrient cycling. The principle colonizers of mechanically disturbed areas are the annual weeds Russian thistle (*Salsola kali*), Jim Hill mustard (*Sisymbrium*

altissimum), and bur-ragweed (*Ambrosia acanthicarpa*). If no further disturbance occurs, the areas will eventually become dominated by cheatgrass. All of these annual weeds are occasionally found in native stands, but only at relatively low frequencies.

Range fires also have dramatic effects on the overall ecosystem, the most obvious being the complete removal of sagebrush from the community, and the rapid increase in cheatgrass coverage. Unlike the native grasses, the other important shrubs, and many of the perennial herbaceous species, sagebrush is unable to resprout from rootstocks after being burned. Therefore, there is no dominant shrub component in burned areas until sagebrush is able to become re-established from seed. Burning also opens the community to the invasion by cheatgrass, which is capable of quickly utilizing the nutrients that are released through burning. The extensive cover of cheatgrass may then prevent the re-establishment of many of the native species, including sagebrush. The species richness in formerly burned areas is usually much lower than in native stands, often consisting of only cheatgrass, Sandberg's bluegrass, Russian thistle, and Jim Hill mustard, with very few other species.

The vegetation in and around the ponds and ditches on the 200 Areas Plateau is significantly different from that of the surrounding dryland areas. Several tree species are present, especially cottonwood (*Populus trichocarpa*) and willows (*Salix* spp.). A number of wetland species are also present including several sedges (*Carex* spp.), bulrushes (*Scirpus* spp.), cattails (*Typha latifolia* and *T. angustifolia*), and pond-weeds (*Potamogeton* spp.).

3.6.1.2 Plant Species of Concern. The Washington State Department of Natural Resources, Natural Heritage Program classifies rare plants in the State of Washington in three different categories, depending on the overall distribution of the taxon and the state of its natural habitat. These categories are: *Endangered*, which is a "vascular plant taxon in danger of becoming extinct or extirpated in Washington within the near future if factors contributing to its decline continue. Populations of these taxa are at critically low levels or their habitats have been degraded or depleted to a significant degree"; *Threatened*, which is a "vascular plant taxon likely to become endangered within the near future in Washington if factors contributing to its population decline or habitat degradation or loss continue"; and *Sensitive*, which is a taxon that is "vulnerable or declining, and could become endangered or threatened in the state without active management or removal of threats" (definitions taken from the Natural Heritage Program [1990]). Of concern to the Hanford Site, there are two Endangered taxa, two Threatened taxa, and at least eleven Sensitive taxa; these are listed in Table 3-3. All four of the Threatened and Endangered taxa are presently candidates for the Federal Endangered Species List.

Of the two Endangered taxa, persistent-sepal yellowcress is well documented along the banks of the Columbia River throughout the 100 Areas, it is unlikely to occur in the 200 Areas. The northern wormwood is known in the state of Washington by only two populations, one across from The Dalles, Oregon, and the other near Beverly, Washington, just north of the Hanford Site. This taxon has not been found on the Hanford Site, but

would probably occur only on rocky areas immediately adjacent to the Columbia River if it were present. Neither of the Threatened taxa listed in Table 3-2 has been observed on the Hanford Site. The Columbia milk vetch is known to be relatively common on the Yakima Firing Range, and has been documented to occur within 1.6 to 3.2 km (1 to 2 mi) to the west of the Hanford Site on both sides of Umptanum Ridge. This species could occur on the 200 Areas Plateau. Hoover's Desert Parsley inhabits the steep talus slopes near Priest Rapids Dam. Potentially, it could be found on similar slopes on Gable Mountain and Gable Butte, but has yet to be documented in these areas.

Of the Sensitive species, five are inhabitants of aquatic or moist habitats and the other six are inhabitants of dry upland habitats. Dense sedge, shining flatsedge, southern mudwort, and false pimpinell are all known to occur in the 100 Areas, especially near the B-C Area, in or near the Columbia River. Some of these species could be present in or near ponds and ditches in the 200 Areas. The few-flowered collinsia may also occur in these habitats. The gray cryptantha occurs on open dunes throughout the Hanford Site. Piper's daisy is fairly common on Umptanum Ridge and Rattlesnake Ridge, but has also been documented in the vicinity of B Pond, the 216-A-24 Crib, and 100-H Area. Bristly cryptantha and dwarf evening-primrose have been found at the south end of the White Bluffs, approximately 3.2 km (2 mi) upstream from the 300 Area. The "Palouse" milk vetch and coyote tobacco are not as well documented but are known to inhabit dry sandy areas such as the 200 Areas Plateau.

In addition to the three classifications for species of concern listed above, the Natural Heritage Program also maintains a "Monitor" list, which is divided into three groups. Group 1 consists of taxa in need of further field work before a formal status can be assigned. The tooth-sepal dodder (*Cuscuta denticulata*), which has been found in the state of Washington only on the Hanford Site is the only taxon in this group that is of concern to Hanford operations. This parasitic species has been found in the area west of McGee Ranch. Group 2 of the Monitor list includes species with unresolved taxonomic questions. Thompson's sandwort (*Arenaria franklinii* var. *thompsonii*) is of concern to Hanford operations. However, the representatives of this species in the state of Washington are now believed to all be variety *franklinii* which is not considered particularly rare. Group 3 of the Monitor list includes taxa that are either more abundant or less threatened than previously believed. There are approximately 15 taxa on the Hanford Site that are included on this list.

3.6.1.3 Fauna of the 200 Areas Plateau. The mammals, birds, reptiles, and amphibians inhabiting the 200 Areas Plateau are discussed below.

3.6.1.3.1 Mammals. The largest mammal occurring on the 200 Area Plateau is the mule deer (*Odocoileus hemionus*). Although mule deer are much more common to riparian sites along the Columbia River, they are frequently observed foraging throughout the 200 Areas. Elk (*Cervus elaphus*) also occur at Hanford but they have only been observed at the Arid Lands Ecology Reserve. Other mammal species common to the 200 Areas include

badgers (*Taxidea taxus*), coyotes (*Canis latrans*), blacktail jackrabbits (*Lepus californicus*), Townsend ground squirrels (*Spermophilus townsendii*), Great Basin pocket mice (*Perognathus parvus*), pocket gophers (*Thomomys talpoides*), and deer mice (*Peromyscus maniculatus*). Badgers are known for their digging capability and have been implicated several times for encroaching into inactive burial grounds throughout the 200 Areas. The majority of the badger excavations in the 200 Areas are a result of badgers searching for prey (mice and ground squirrels). Coyotes are the principal predators, consuming such prey as rodents, insects, rabbits, birds, snakes, and lizards. The Great Basin pocket mouse is the most abundant small mammal, which thrives in sandy soils and lives entirely on seeds from native and revegetated plant species. Townsend ground squirrels are not abundant in the 200 Areas but they have been seen at several different sites. Other small mammals that occur in low numbers include the Western harvest mouse (*Reithrodontomys megalotis*) and the grasshopper mouse (*Onychomys leucogaster*). Mammals associated more closely with buildings and facilities include Nuttall's cottontails (*Sylvilagus nuttallii*), house mice (*Mus musculus*), Norway rats (*Rattus norvegicus*), and some bat species. Bats probably play a minor role in the 200 Areas' ecosystem but no documentation is available on bat populations at Hanford. Mammals such as skunks (*Mephitis mephitis*), raccoons (*Procyon lotor*), weasels (*Mustela* spp.), porcupines (*Erethizon dorsatum*), and bobcats (*Lynx rufus*) have only been observed on very few occasions.

3.6.1.3.2 Birds. Over 235 species of birds have been documented to occur at the Hanford Site (Landeem et al. 1991). At least 100 of these species have been observed in the 200 Areas. The most common passerine birds include starlings (*Sturnus vulgaris*), horned larks (*Ermophila alpestris*), meadowlarks (*Sturnella neglecta*), western kingbirds (*Tyrannus verticalis*), rock doves (*Columba livia*), barn swallows (*Hirundo rustica*), cliff swallows (*Hirundo pyrrhonota*), black-billed magpies (*Pica pica*) and ravens (*Corvus corax*). Common raptors include the Northern harrier (*Circus cyaneus*), American kestrel (*Falco sparverius*), and Red tailed hawk (*Buteo jamaicensis*). Swainson's hawks (*Buteo swainsoni*) sometimes nest in the trees located at some of the army bunker sites that were used in the 1940's. Golden eagles (*Aquila chrysaetos*) are observed infrequently. Burrowing owls (*Athene cunicularia*) nest at several locations throughout the 200 Areas. The most common upland game birds found in the 200 Areas are California quail (*Callipepla californica*) and Chukar partridge (*Alectoris chukar*), however, ring-necked pheasants (*Phasianus colchicus*) and gray partridge (*Pertx perdix*) may be found in limited numbers. The only native game bird common to the 200 Areas Plateau is the mourning dove (*Zenaida macrora*) which migrates south each fall. Other species of note which nest in undisturbed sagebrush habitats in the 200 Areas include sage sparrows (*Amphispiza belli*), and loggerhead shrikes (*Lanius ludovicianus*). Long-billed curlews (*Numenius americanus*) also use the sagebrush areas and revegetated burial grounds for nesting and foraging.

Waterfowl and aquatic birds inhabit 216-B-3 Pond and other areas where there is running or standing water. However, many of these areas such as 216-A-29 Ditch are becoming more scarce due to stabilization and remedial action cleanup activities. Aquatic

birds and waterfowl common to 216-B-3 Pond on a seasonal basis include Canada geese (*Branta canadensis*), American coot (*Fulica americana*), mallard (*Anas platyrhynchos*), ruddy duck (*Oxyura jamaicensis*), redhead (*Aythya americana*), bufflehead (*Bucephala albeola*) and great blue heron (*Ardea herodias*).

3.6.1.3.3 Reptiles and Amphibians. Common reptiles include gopher snakes (*Pituophis melanoleucus*) and sideblotched lizards (*Uta stansburiana*). Other reptiles and amphibians that are infrequently observed include sagebrush lizards (*Sceloporus graciosus*), horned toads (*Phrynosoma douglassi*), western spadefoot toads (*Scaphiopus intermontana*), yellow-bellied racer (*Coluber constrictor*), Pacific rattlesnake (*Crotalus viridis*), and striped whipsnake (*Masticophis taeniatus*). Both lizards and snakes are prey items of mammalian and avian predators.

3.6.1.3.4 Insects. There are hundreds of insect species which inhabit the 200 Areas. Two of the most common groups of insects include several species of darkling beetles and grasshoppers. Harvester ants are also common and have been implicated in the uptake of radionuclides from some of the burial grounds in the 200 East Area. Harvester ants have the ability to excavate and bring up material from as far down as 4.6 to 6.1 m (15 to 20 ft). Other major groups of insects include bees, butterflies and scarab beetles. Insects impact the surrounding plant community as well as serving as the prey base for many species of birds, reptiles and mammals.

3.6.1.4 Wildlife Species of Concern. Some animals that inhabit the Hanford Site have been given special status designations by the state and federal government. Some of these designations include state and federal threatened and endangered species, federal candidate, state monitor, state sensitive, and state candidate species. Species listed in Table 3-3 as state and/or federal threatened and endangered such as the bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), American white pelican (*Pelecanus erythrorhynchos*), ferruginous hawk (*Buteo regalis*), and sandhill crane (*Grus canadensis*) do not inhabit the 200 Areas. The bald eagle and American white pelican utilize the Columbia River and associated habitats for roosting and feeding. Peregrine falcons and sandhill cranes fly over the Hanford Site during migration. Ferruginous hawks nest on the Hanford Site but nesting has not been documented for this species on the 200 Areas Plateau. Other species listed in Table 3-4 as state and/or federal candidates and state monitor species such as burrowing owls, Great Blue Herons, Prairie falcons (*Falco mexicanus*), Sage sparrows, and Loggerhead shrikes are not uncommon to the 200 Areas Plateau.

3.6.2 Land Use

The B Plant Aggregate Area is the location of the 221-B Building and its attendant facilities and structures. Past activities at the 221-B Building and related facilities were the extraction of plutonium from fuel rods, and later the extraction of cesium and strontium,

much of which is still stored in the 225-B Building. Other buildings within the aggregate area served mainly as storage or office space. Waste management units that remain active are noted in Figure 2-1, Operational and Waste-Related History.

3.6.3 Water Use

There is no consumptive use of groundwater within the B Plant Aggregate Area. Two wells, for emergency cooling water supply, are located at the 282-B and -BA Pumphouses (Peterson 1990c). Water for drinking and emergency use, and facilities process water is drawn from the Columbia River, treated, and imported to the 200 East Area. The nearest wells used to supply drinking water are located at the Yakima Barricade (Well 699-40-100-C) about 7 km (4 mi) west of the 200 East Area; at the Hanford Safety Patrol Training Academy (Well 699-528-E0) about 40 km (24 mi) to the southeast; at the PNL Observatory (Well 6652-C); and near the Fast Flux Test Facility in the 400 Area (Well 699-S1-8J) about 32 km (19 mi) to the southeast. The nearest water supply wells located offsite are about 15 km (9.4 mi) to the northwest (upgradient). These wells obtain their water from the basalt and the basalt interbeds (the Berkshire Well and Chateau Ste. Michelle No. 1 and No. 2). The latter wells are reportedly used for irrigation although they may also be used to supply drinking water.

3.7 HUMAN RESOURCES

The environmental conditions at the B Plant Aggregate Area must be evaluated in relationship to the surrounding population centers and other human resources. A very brief summary of demography, archaeology, historical resources, and community involvement is given below.

3.7.1 Demography

There are no residences on the Hanford Site. The nearest inhabited residences are farm homes on land located 21 km (13 mi) north of the B Plant Aggregate Area. There are approximately 411,000 (1990 census) people living within a 80 km (50 mi) radius of the 200 Areas Plateau. The primary population centers are the cities of Richland, Kennewick, and Pasco, located southeast of the Hanford Site, Prosser to the south, Sunnyside to the southwest, and Benton City to the southeast.

3.7.2 Archaeology

An archaeological survey has been conducted of undeveloped portions of the 200 East Area by the Hanford Cultural Resources Laboratory. Isolated artifacts and sites of interest

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were identified in the 200 West Area but not within the B Plant Aggregate Area. The closest site of interest is the remains of the White Bluffs Road, located approximately 15 km (9 mi) northwest of the aggregate area, which was previously an Indian trail. More information is available in Rice (1980) and Chatters (1989).

3.7.3 Historical Resources

The only historic site in 200 East Area is the old White Bluffs freight road which crosses diagonally through the vicinity. This site is not considered to be eligible for the National Register.

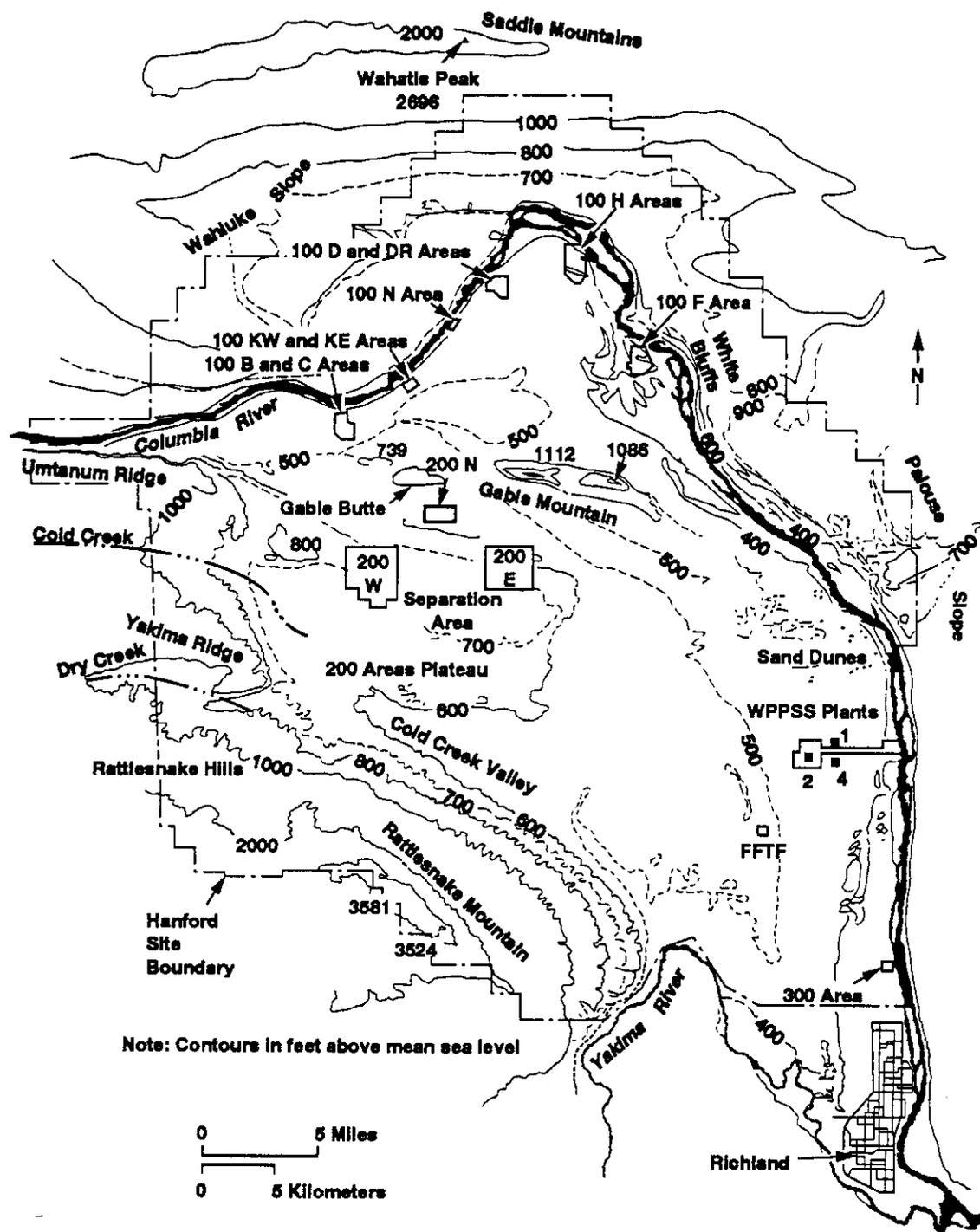
3.7.4 Community Involvement

A Community Relations Plan (Ecology et al. 1989) has been developed for the Hanford Site Environmental Restoration Program that includes any potentially affected community with respect to the B Plant AAMSR. The Community Relations Plan includes a discussion on analysis of key community concerns and perceptions regarding the project, along with a list of all interested parties.

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Figure 3-1. Topography and Location Map for the Hanford Site.



Note: Contours in feet above mean sea level

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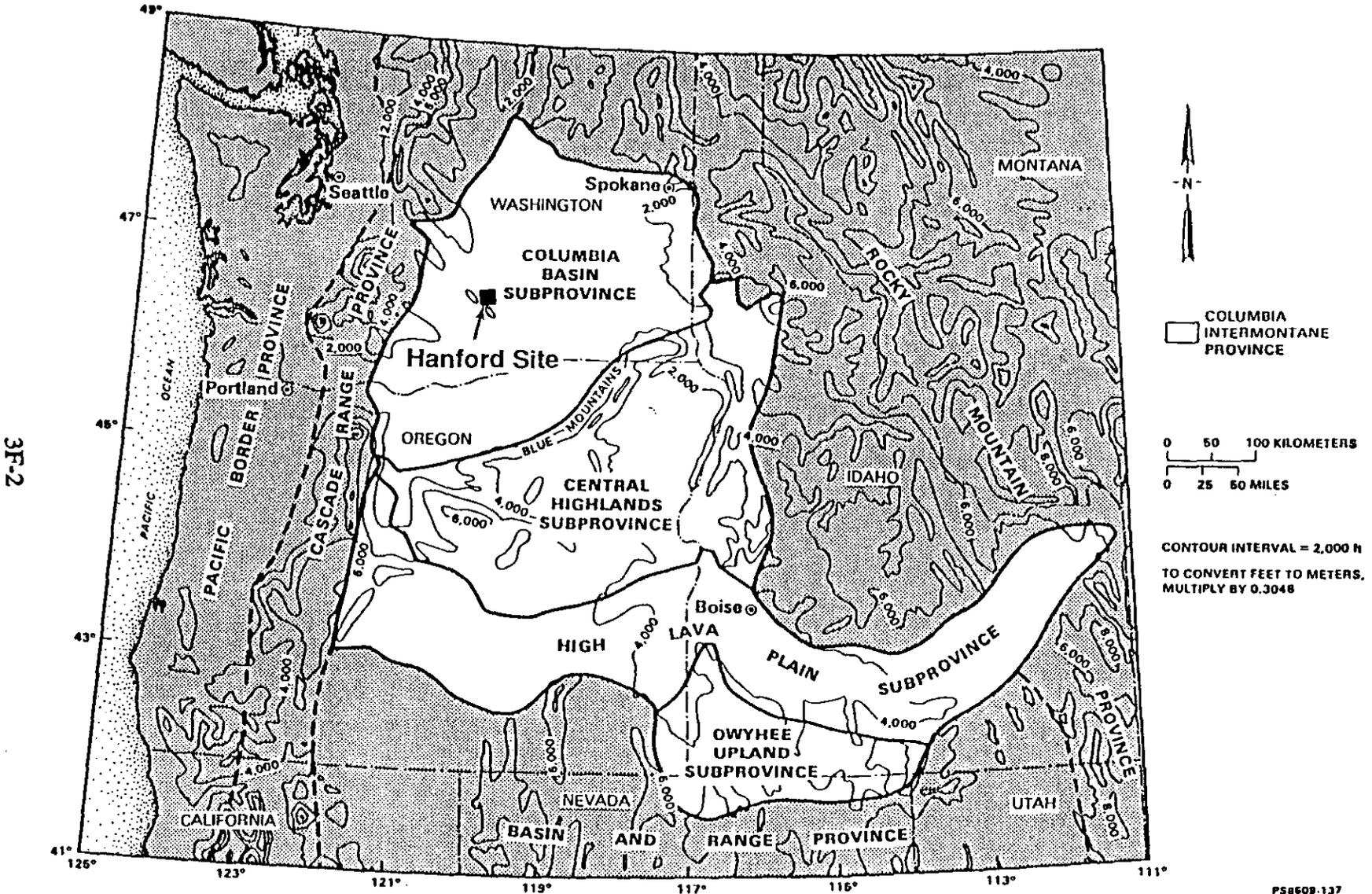


Figure 3-2. Divisions of the Columbia Intermontane Province and Adjacent Snake River Planes Province.

Figure 3-3. Geomorphic Units Within the Central Highlands and Columbia Basin Subprovinces that Contain the Columbia River Basalt Group.



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43° 44° 45° 46° 47° 48°

0 50 100
KILOMETERS

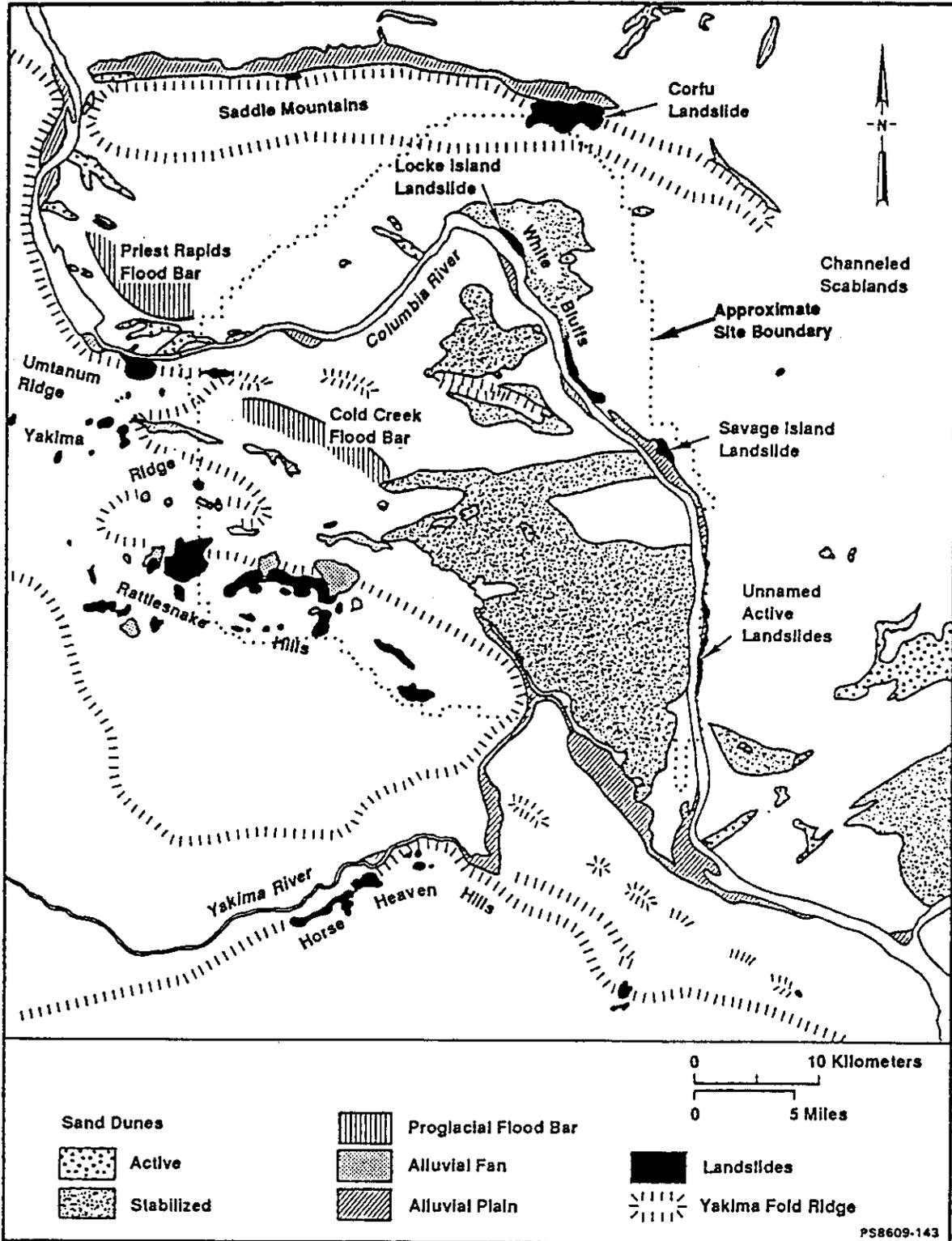
0 25 50
MILES

CONTOUR INTERVAL = 500 m
TO CONVERT METERS TO FEET,
MULTIPLY BY 3.28.

CENTRAL HIGHLANDS SUBPROVINCE
 (A) BLUE MOUNTAINS SECTION
 (B) WALLOWA-SEVEN DEVILS SECTION
 (C) TRI-STATE UPLAND SECTION

COLUMBIA BASIN SUBPROVINCE
 (D) PALOUSE HILLS SECTION
 (E) CHANNIELED SCABLAND SECTION
 (F) WATERVILLE PLATEAU SECTION
 (G) YAKIMA FOLDS SECTION
 (H) NORTH-CENTRAL OREGON PLATEAU SECTION
 (I) CENTRAL PLAINS SECTION

Figure 3-4. Landforms of the Pasco Basin and the Hanford Site.



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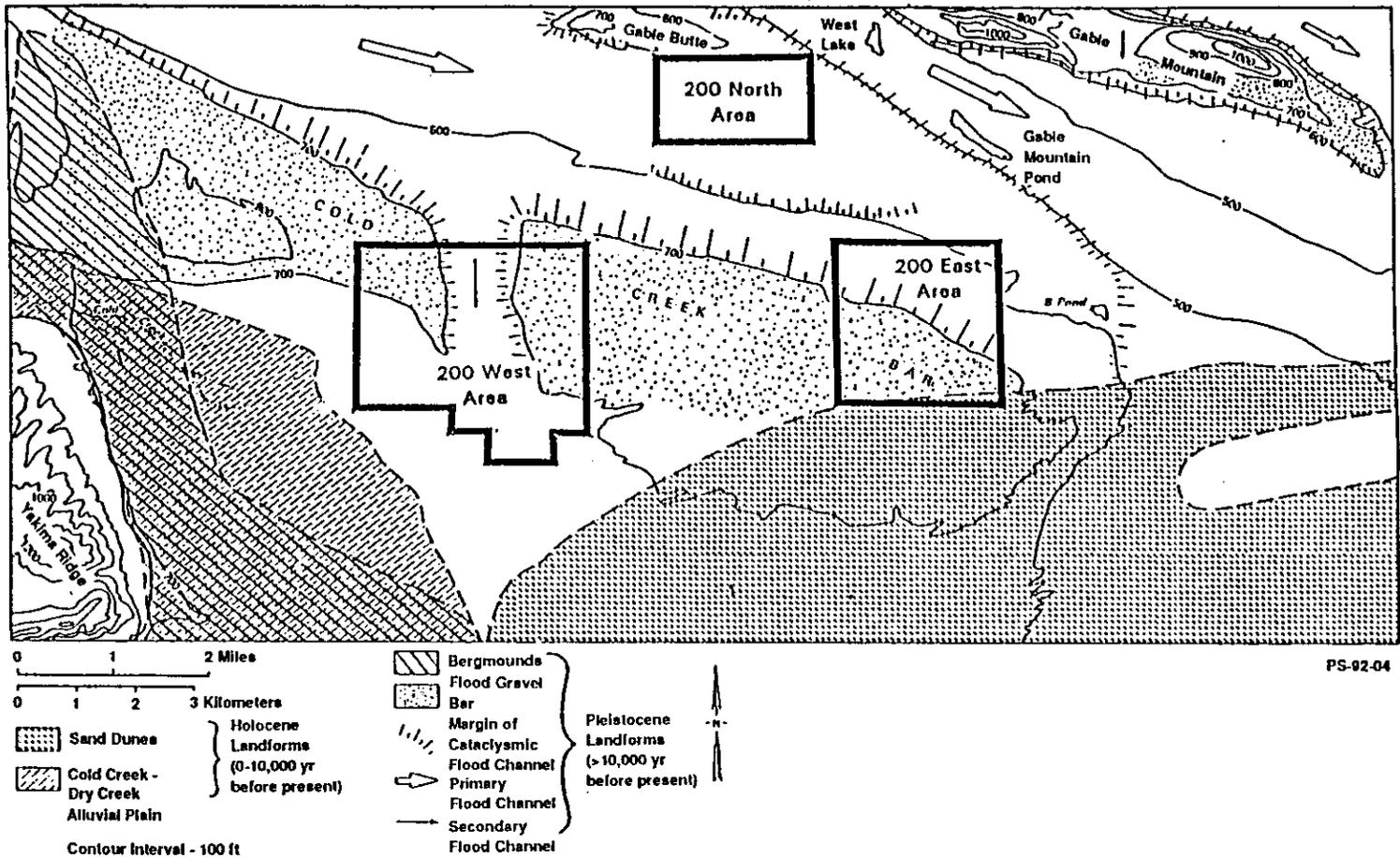
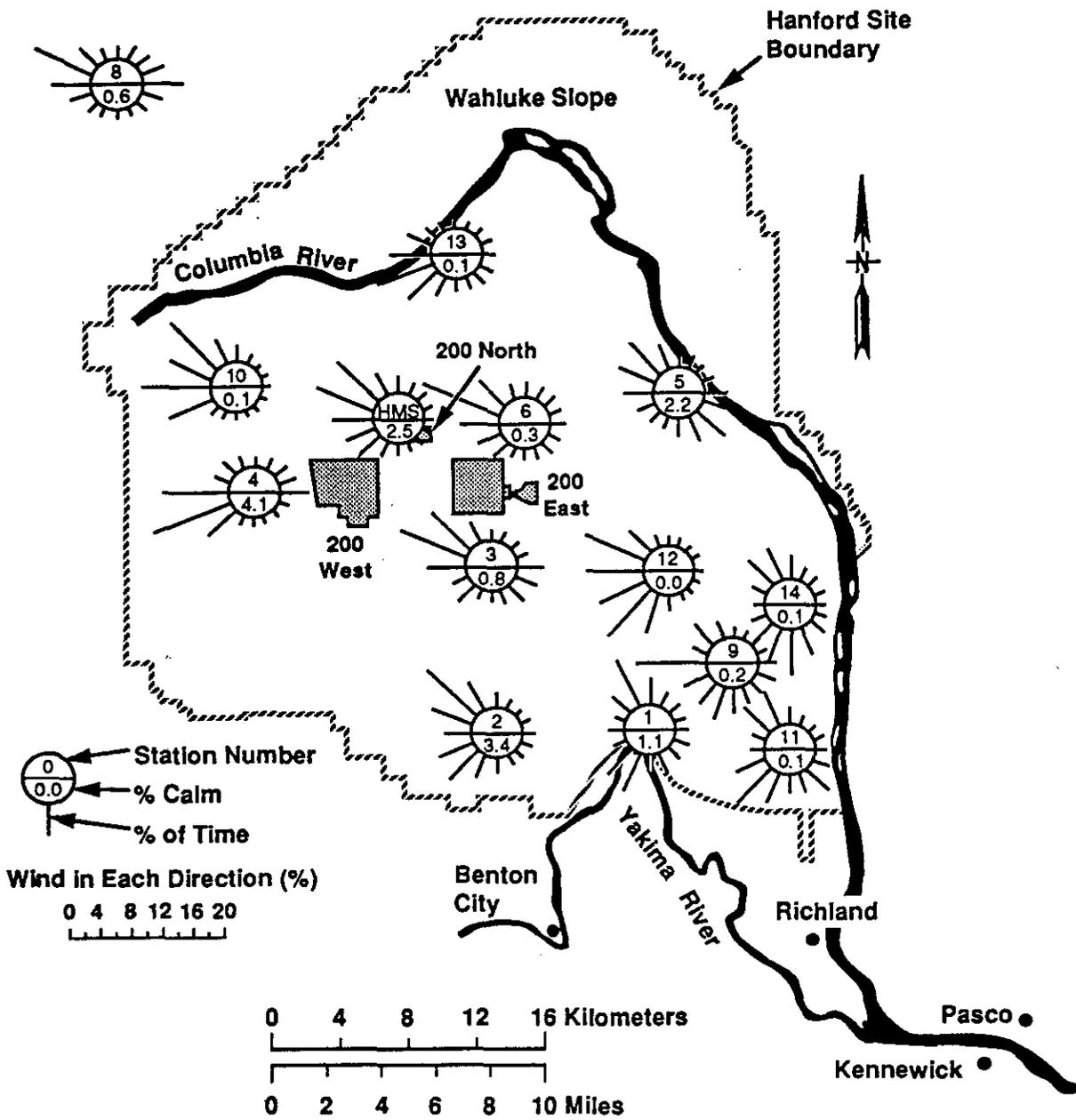


Figure 3-5. Geomorphic Features Surrounding the 200 Areas.

* Keyed features are specifically selected and do not encompass all features.

Figure 3-6. Hanford Site Wind Roses 1979 through 1982.

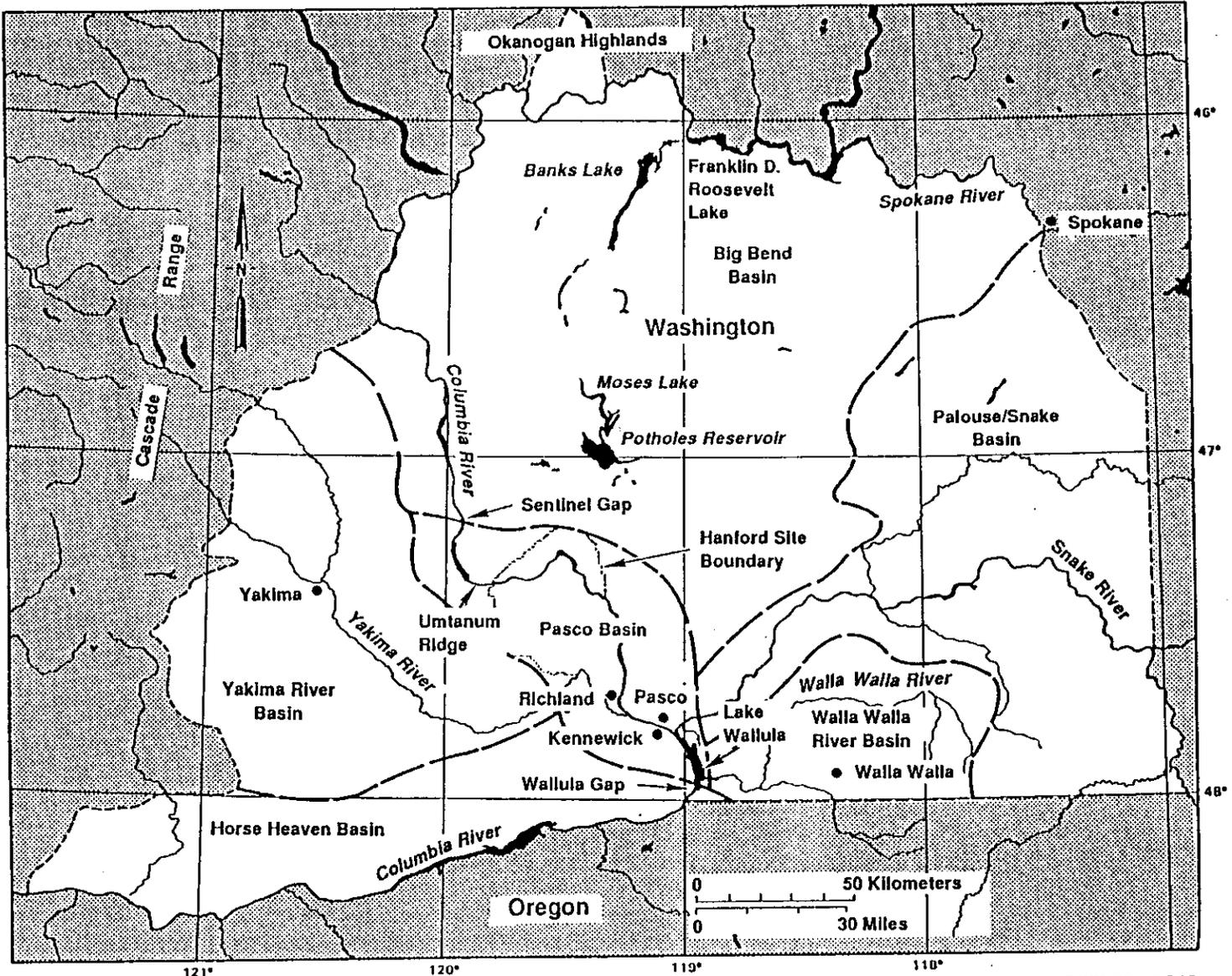
9 3 1 2 2 9 6 7 9 8 0



HMS = Hanford Meteorological Station

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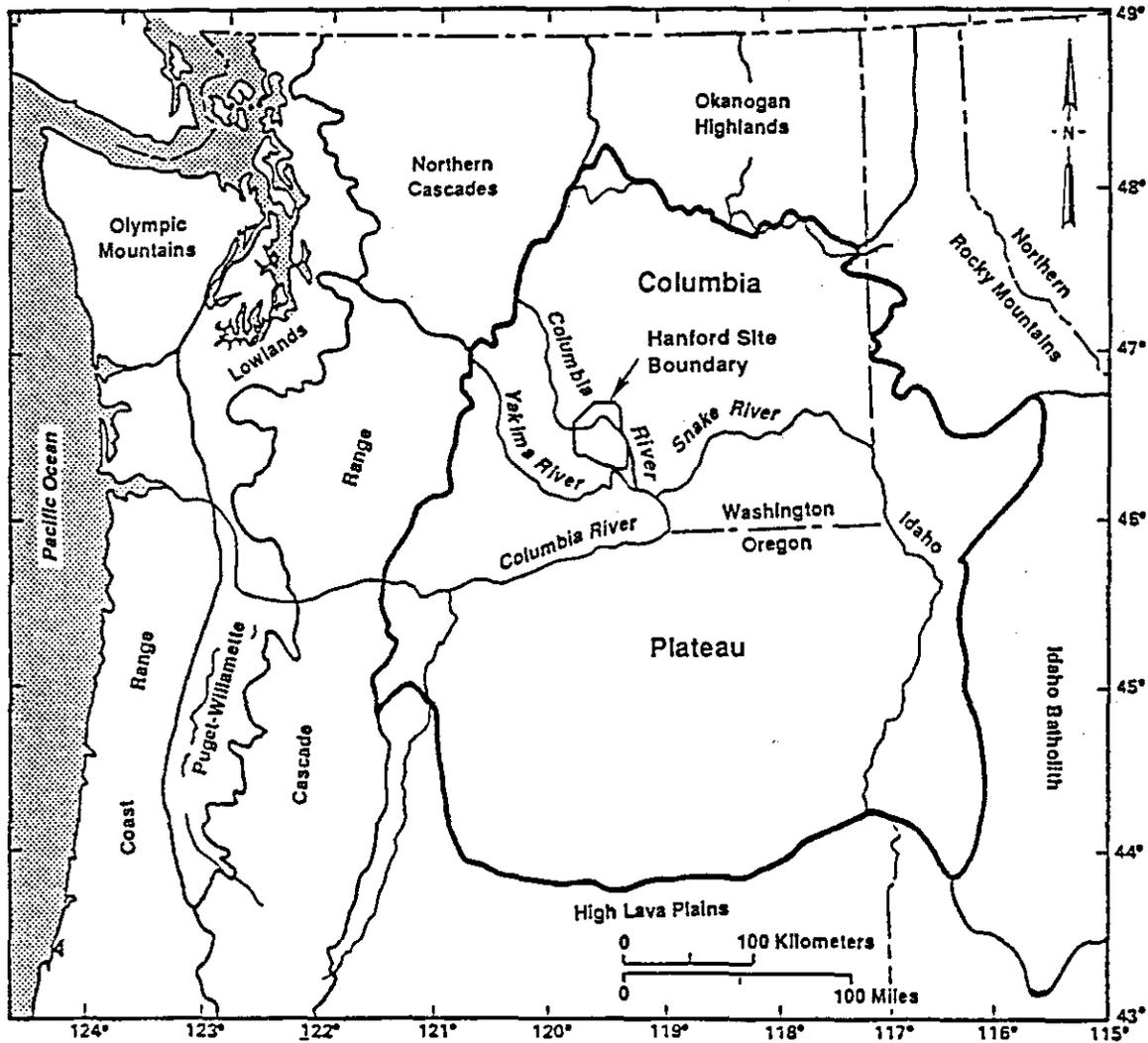
Figure 3-7. Hydrologic Basins Designated for the Washington State Portion of the Columbia Plateau.



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Figure 3-8. Columbia Plateau and Surrounding Structural Provinces.



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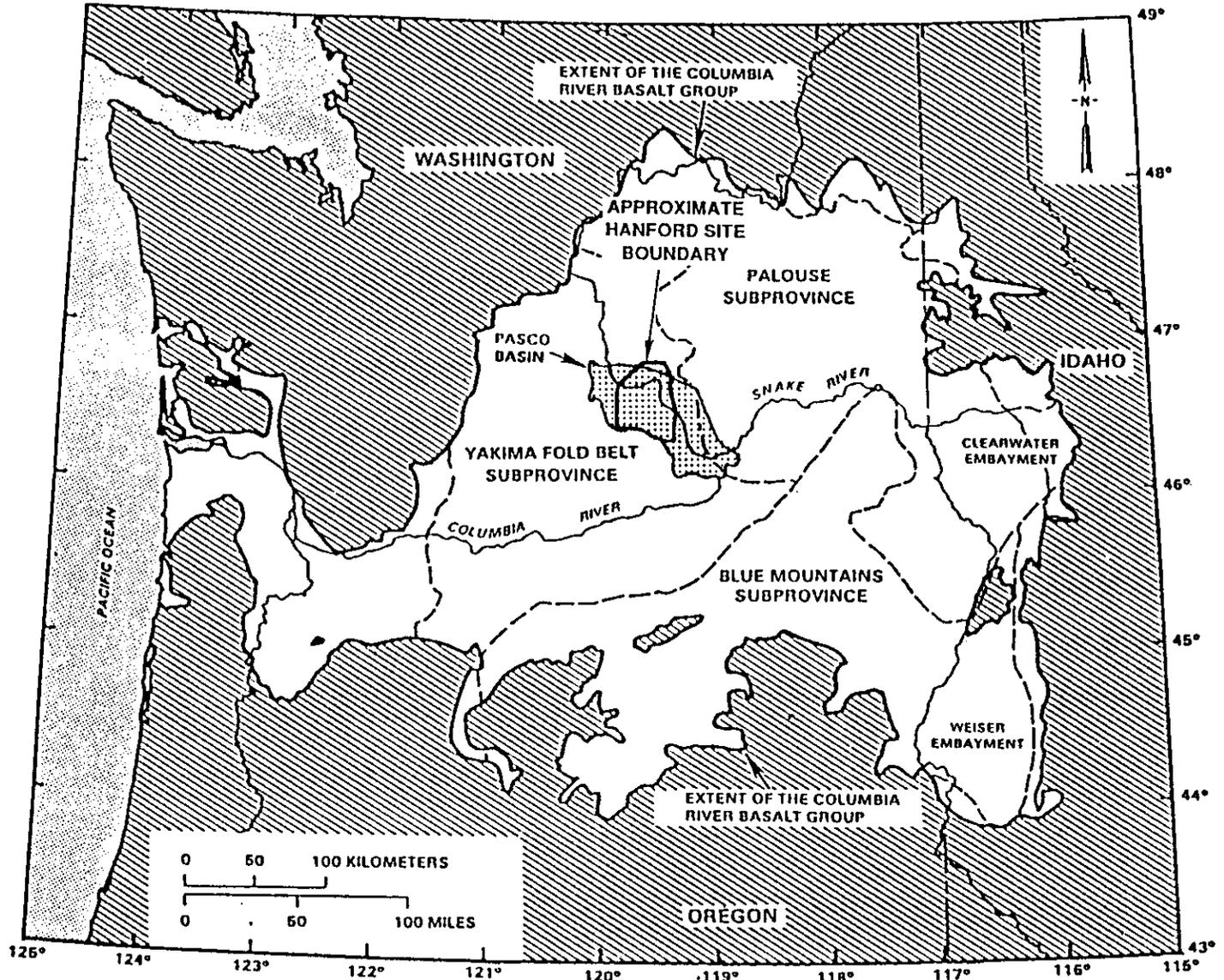


Figure 3-9. Structural Subprovinces of the Columbia Plateau.

Figure 3-10. Structural Elements of the Yakima Fold Belt Subprovince.

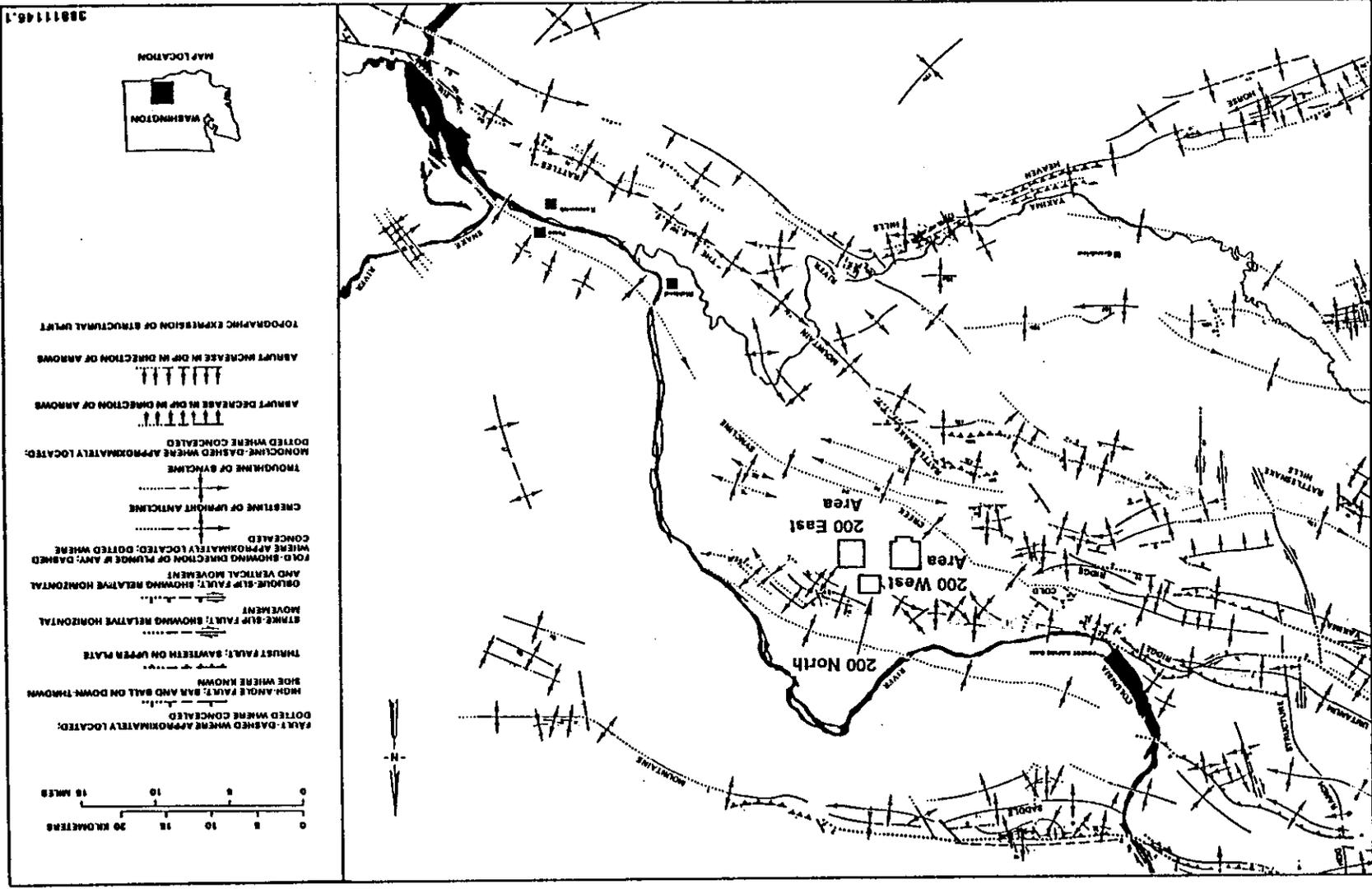
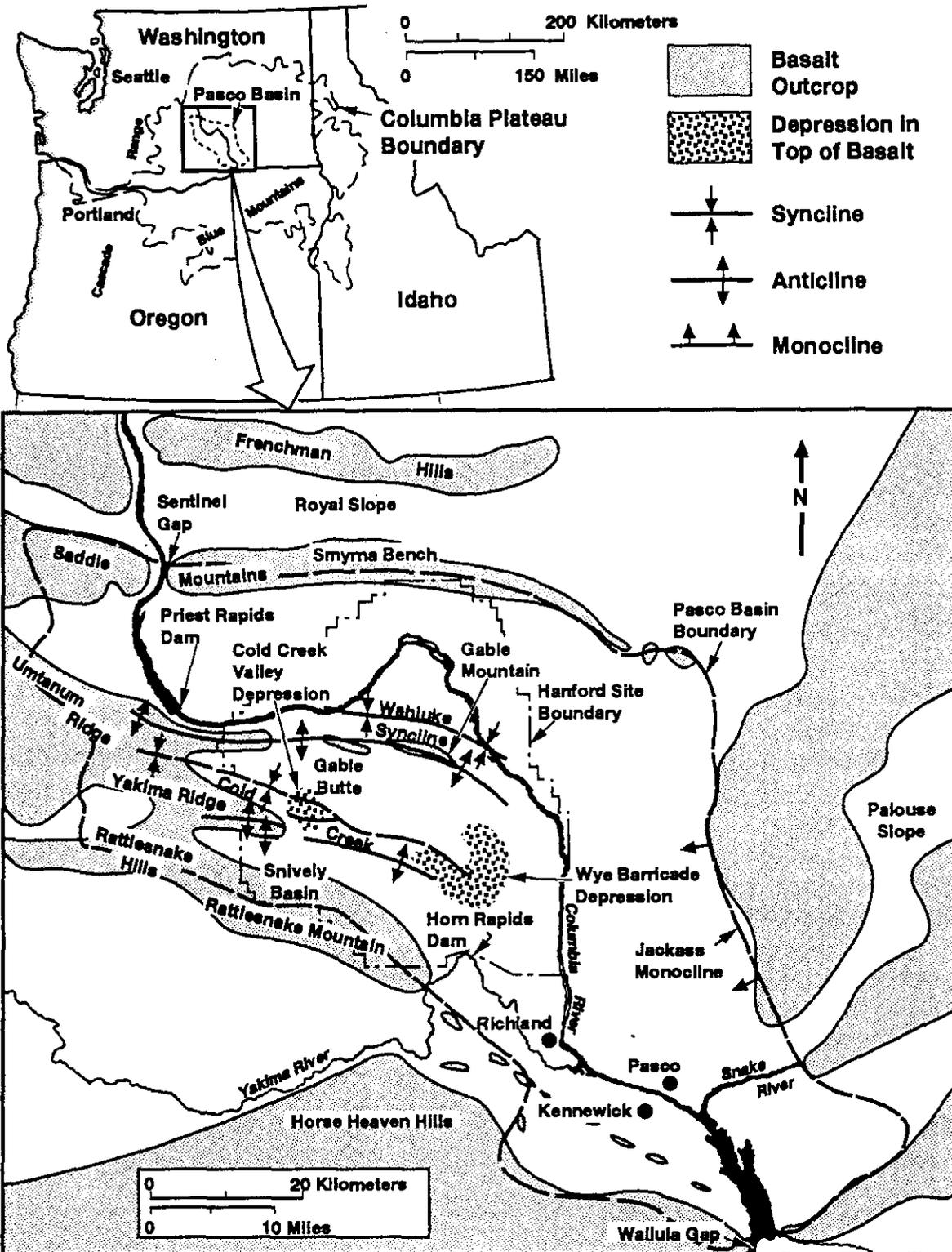


Figure 3-11. Geologic Structures of the Pasco Basin and the Hanford Site.



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Figure 3-12. Generalized Stratigraphy of the Hanford Site.

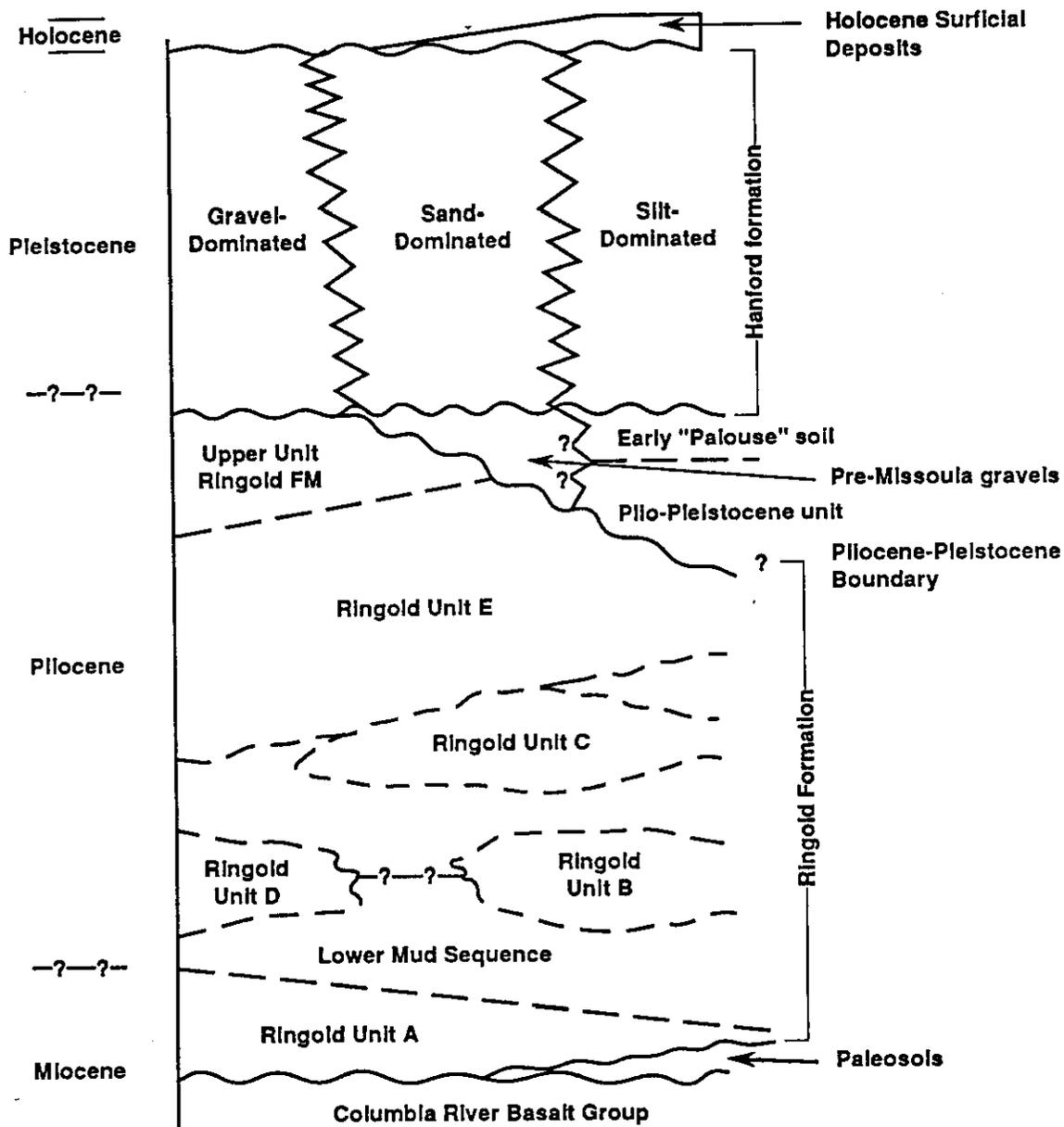
Period	Epoch	Group	Formation	Isotopic Age Dates Years x 10 ⁶	Member (Formal and Informal)	Sediment Stratigraphy or Basalt Flows		
QUATERNARY	Pleistocene	Hanford	Hanford		Surficial Units	Loose Sand Dunes Alluvium and Alluvial Fans Land Slides Talus Colluvium		
					Touchet beds Pasco gravels		Plio-Pleistocene unit	
TERTIARY	Pliocene	Columbia River Basalt Group	Ringold Formation		Ringold Formation			
					Saddle Mountains Basalt	8.5	Ice Harbor Member	basalt of Goose Island basalt of Martindale basalt of Basin City Levey Interbed basalt of Ward Gap
						10.5	Elephant Mountain Member	basalt of Elephant Mountain Rattlesnake Ridge Interbed basalt of Pomona
						12.0	Pomona Member	Selah Interbed basalt of Gable Mountain Cold Creek Interbed
							Esquatzel Member	basalt of Huntzinger basalt of Lapwai
						13.5	Asotin Member	basalt of Wahluke basalt of Sillust basalt of Umatilla
							Wilbur Creek Member	Mabton Interbed basalt of Lolo basalt of Rosalia
						14.5	Umatilla Member	Quincy Interbed basalt of Roza Squaw Creek Interbed basalt of Lyons Ferry basalt of Sentinel Gap basalt of Sand Hollow basalt of Silver Falls basalt of Ginkgo basalt of Palouse Falls
							Priest Rapids Member	Vantage Interbed basalt of Museum basalt of Rocky Coulee basalt of Levering basalt of Cohasset basalt of Birkett basalt of McCoy Canyon basalt of Umtanum
							Roza Member	basalt of Benson Ranch
							Frenchman Springs Member	
					Grande Ronde Basalt	15.6	Sentinel Bluffs Unit	
						N ₂		
16.5								
R ₂								
17.5	R ₁							
Imnaha								

*The Grande Ronde Basalt consists of at least 120 major basalt flows. Only a few flows have been named. N₂, R₂, N₁ and R₁ are magnetostratigraphic units.

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9 3 1 2 0 0 6 7 9 8 6

Figure 3-13. Generalized Stratigraphy of the Suprabasalt Sediments Beneath the Hanford Site.



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3F-14

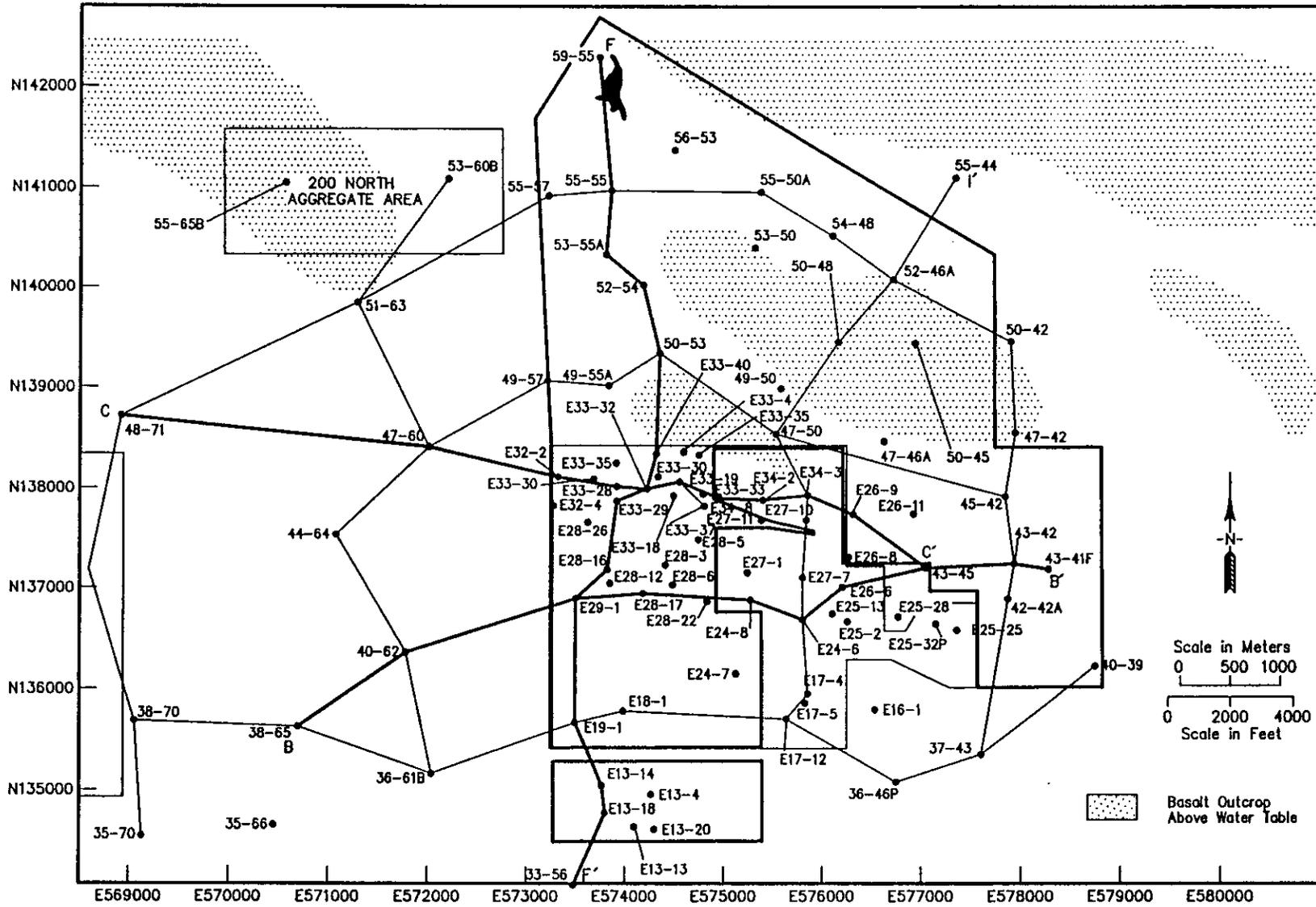


Figure 3-14. Location of Geologic Cross-sections.

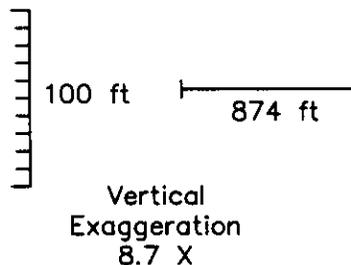
Figure 3-15. Legend for Cross-sections.

Explanation

Additional Lithologic Symbols,
Includes Subordinate Lithologies

- Clay rich
- ~ Silt rich
- Sandy
- ⋯ Pebbly to cobbly
- ⋯ Bouldery
- ⇄ Calcium carbonate present
- × Paleosol
- ⋈ Basalt
- ⋈ Cemented

Scales



Other Symbols

- ? — ? — Formational contact, ? where inferred
- - - - ? - - - ? - - - Unit or sequence contact, ? where inferred
- - - - - Major facies contact
- × Interval absent

Stratigraphic Abbreviations

- Eo - Eolian (Holocene) deposits
- Hun - Undifferentiated Hanford formation
- Hug - Upper gravel sequence, Hanford formation
- Hs - Sandy Sequence, Hanford formation
- Hlg - Lower gravel sequence, Hanford formation
- H/R - Hanford/Ringold contact
- EP - Early "Palouse" soil
- PP - Plio-Pleistocene unit
- UP - Upper unit, Ringold Formation
- E - Gravel Unit E, Ringold Formation
- C - Gravel unit C, Ringold Formation
- LM - Lower mud sequence, Ringold Formation
- A - Gravel unit A, Ringold Formation
- EM - Elephant Mountain Basalt Member, Saddle Mountains Basalt
- RR1 - Rattlesnake Ridge interbed, Ellensburg Formation
- P - Pomona Basalt, Saddle Mountains Basalt

9 3 1 8 3 7 5 0 9 3 9

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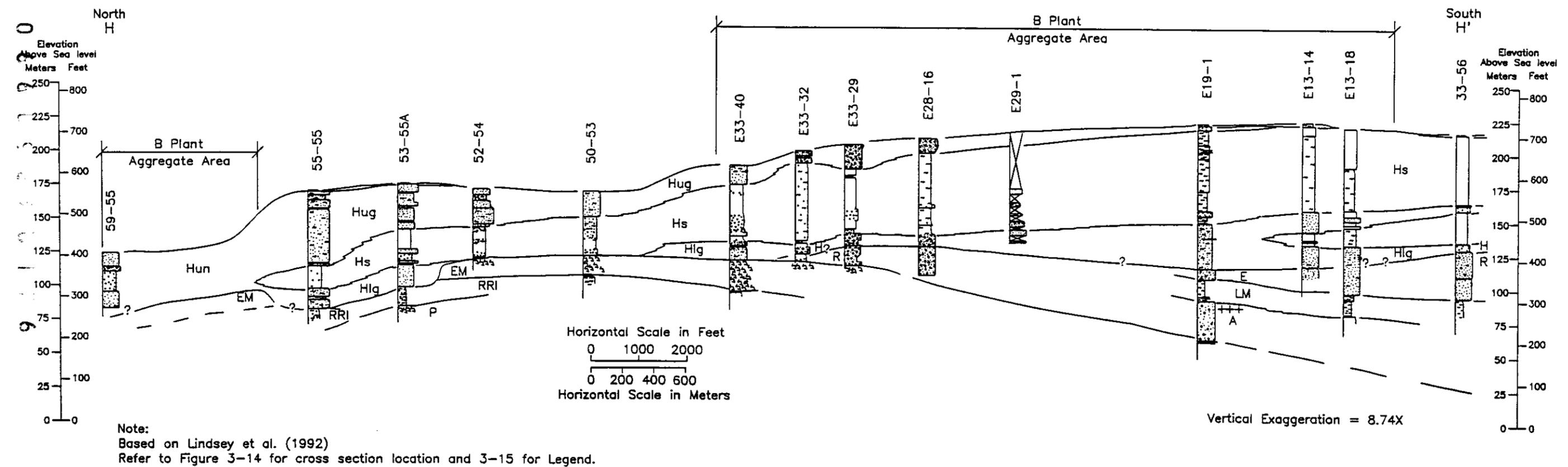


Figure 3-16. Geologic Cross-section - H-H'.

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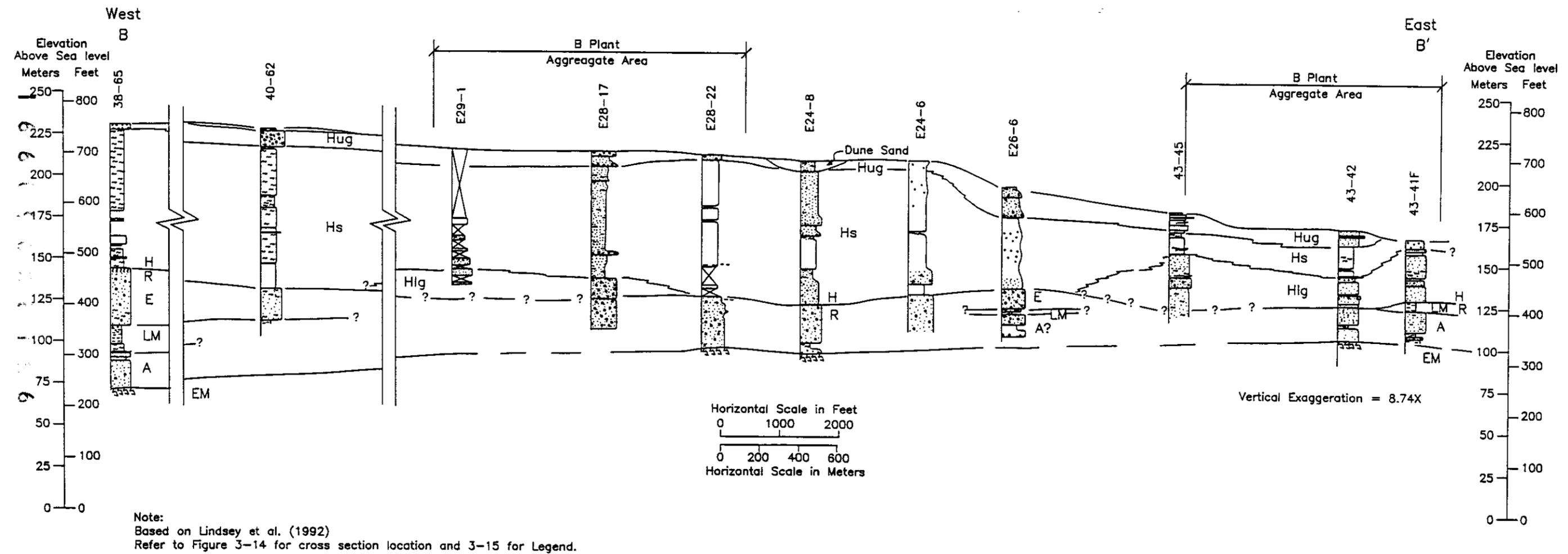
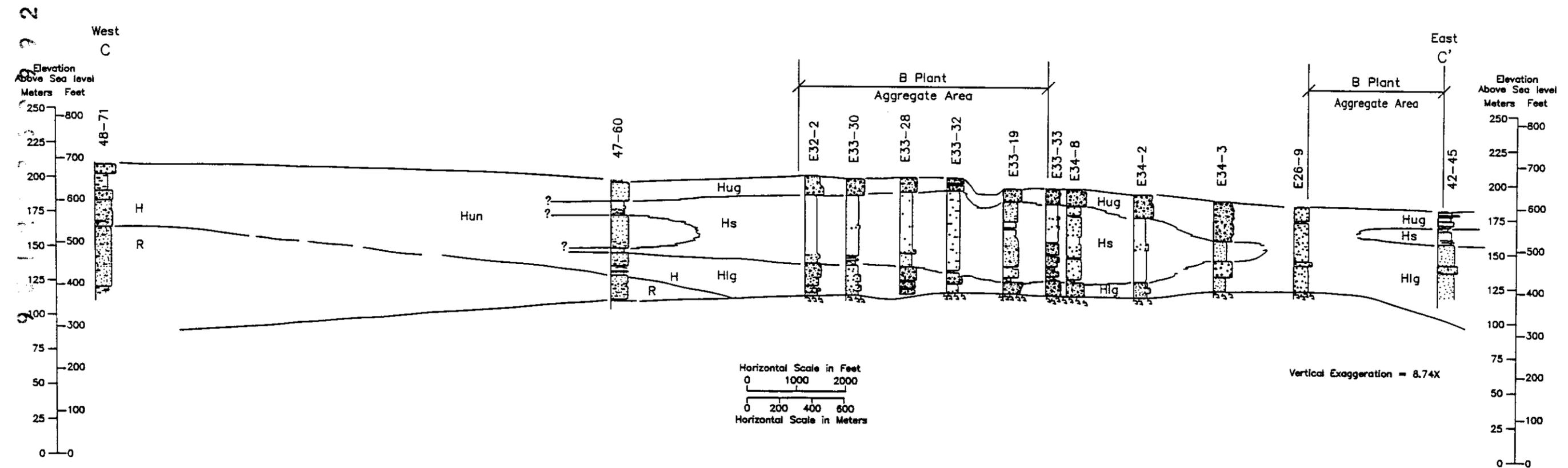


Figure 3-17. Geologic Cross-section - B-B'.

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Note:
 Based on Lindsey et al. (1992)
 Refer to Figure 3-14 for cross section location and 3-15 for Legend.

Figure 3-18. Geologic Cross-section - C-C'.

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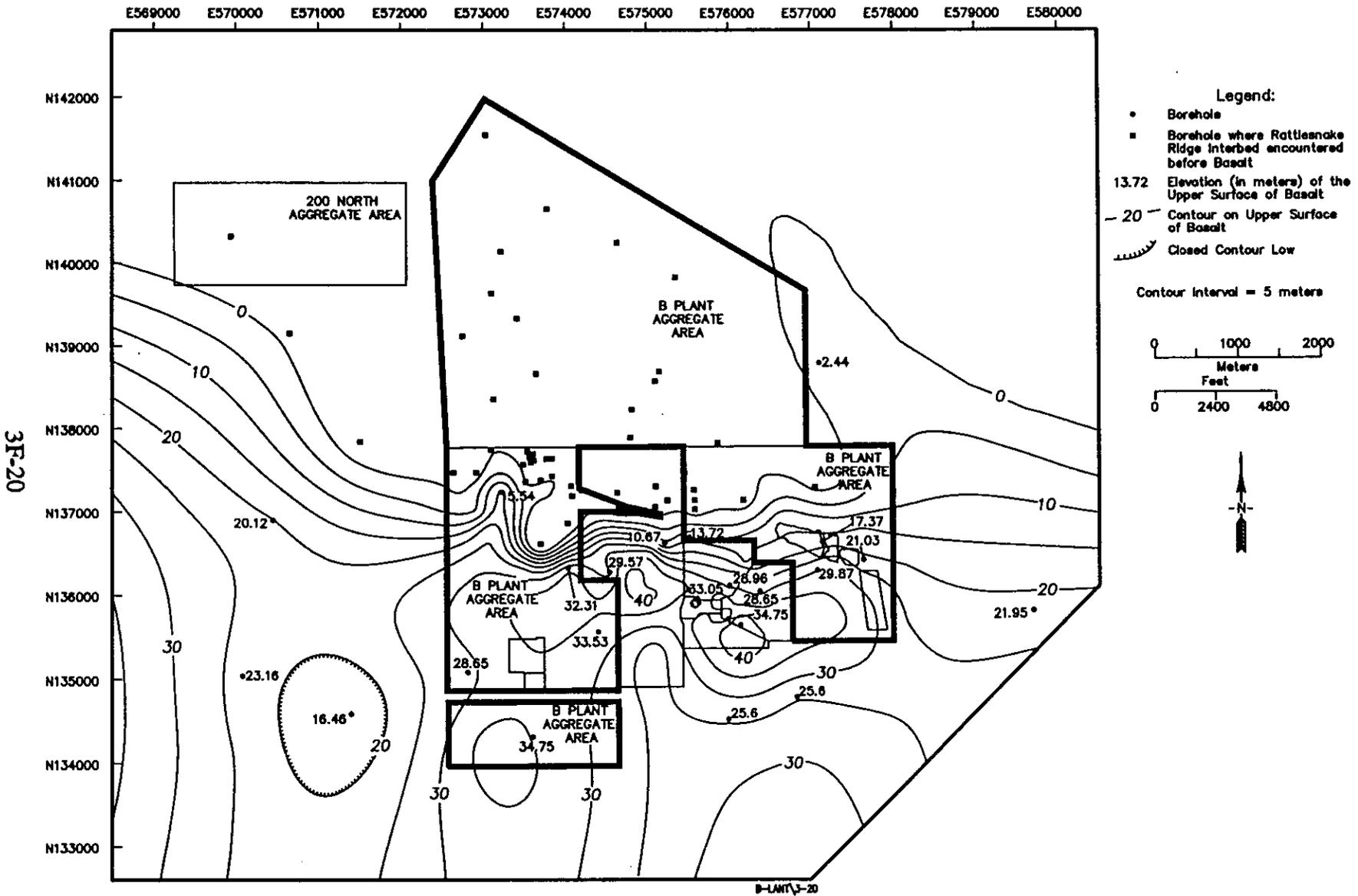
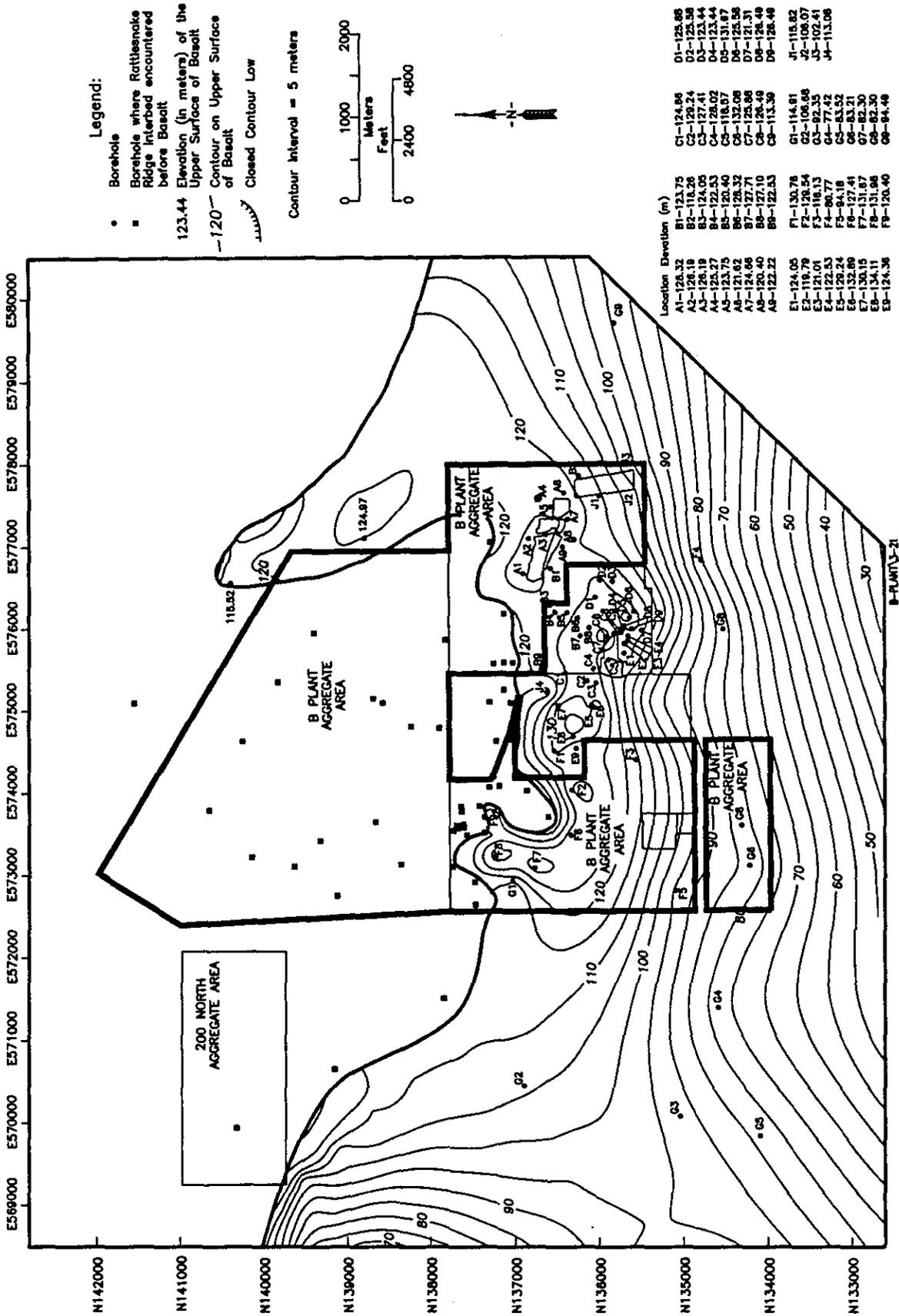


Figure 3-20. Isopach Map of the Ringold Gravel Unit A.

Figure 3-21. Structure Map of the Ringold Gravel Unit A Formation Top.



9 3 1 2 0 9 6 7 9 9 5

9 3 1 2 3 9 6 7 9 9 6

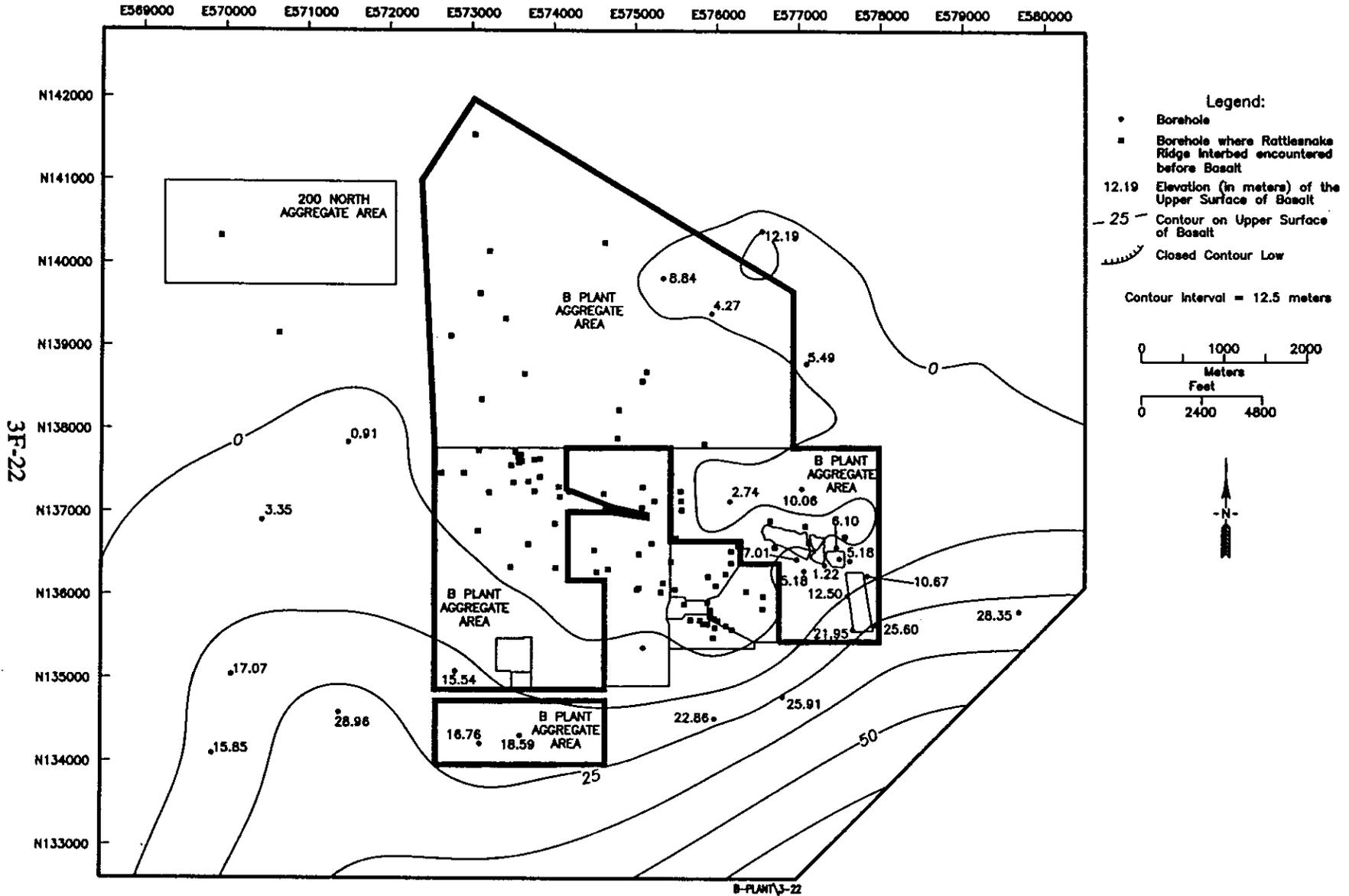


Figure 3-22. Isopach Map of the Top of the Ringold Lower Mud Sequence, Ringold Formation.

9 3 1 2 8 7 6 7 9 9 7

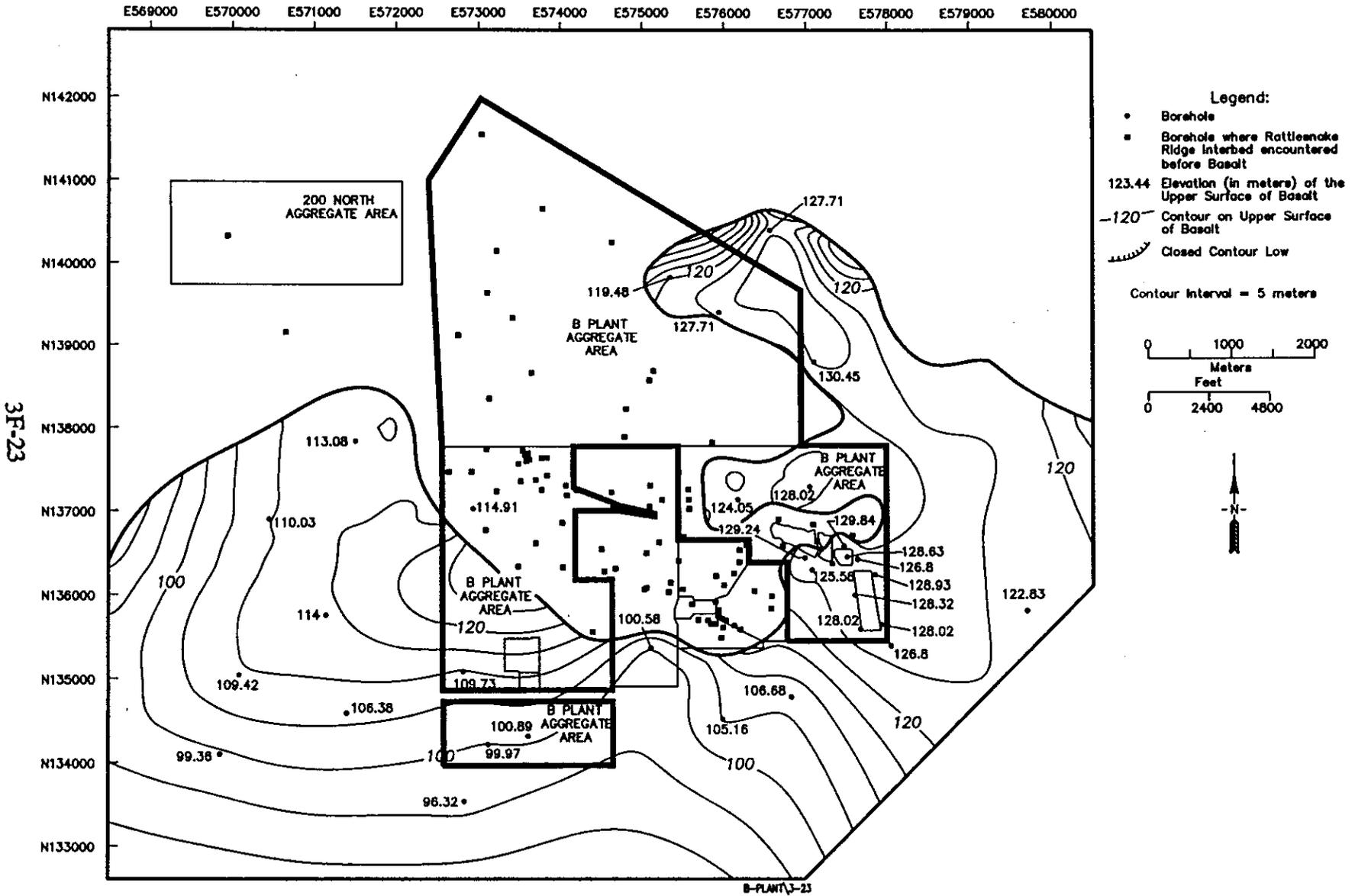


Figure 3-23. Structure Map of the Ringold Lower Mud Sequence, Ringold Formation.

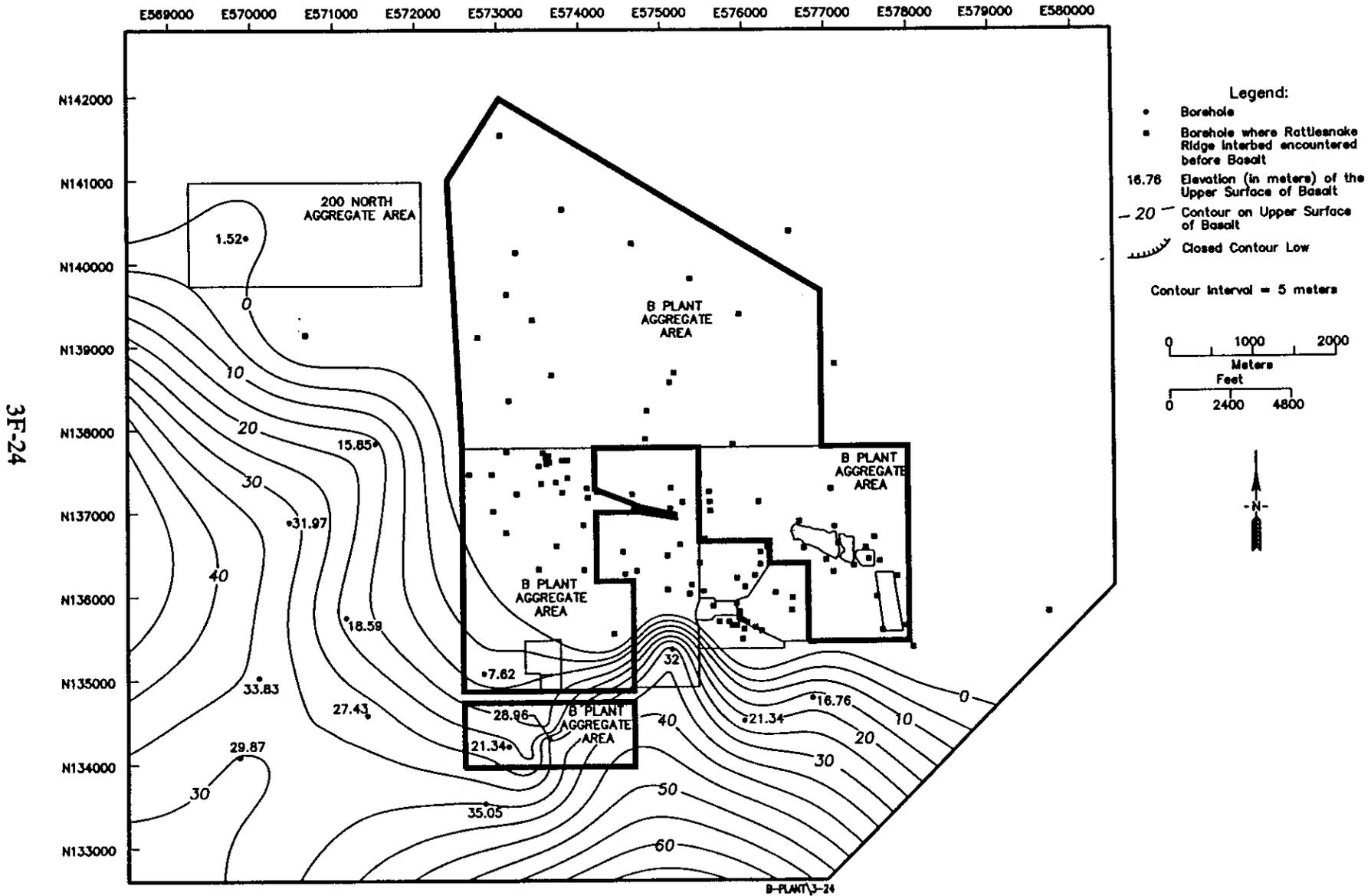


Figure 3-24. Isopach Map of the Ringold Gravel Unit E.

9 3 1 2 0 9 5 7 9 9 9

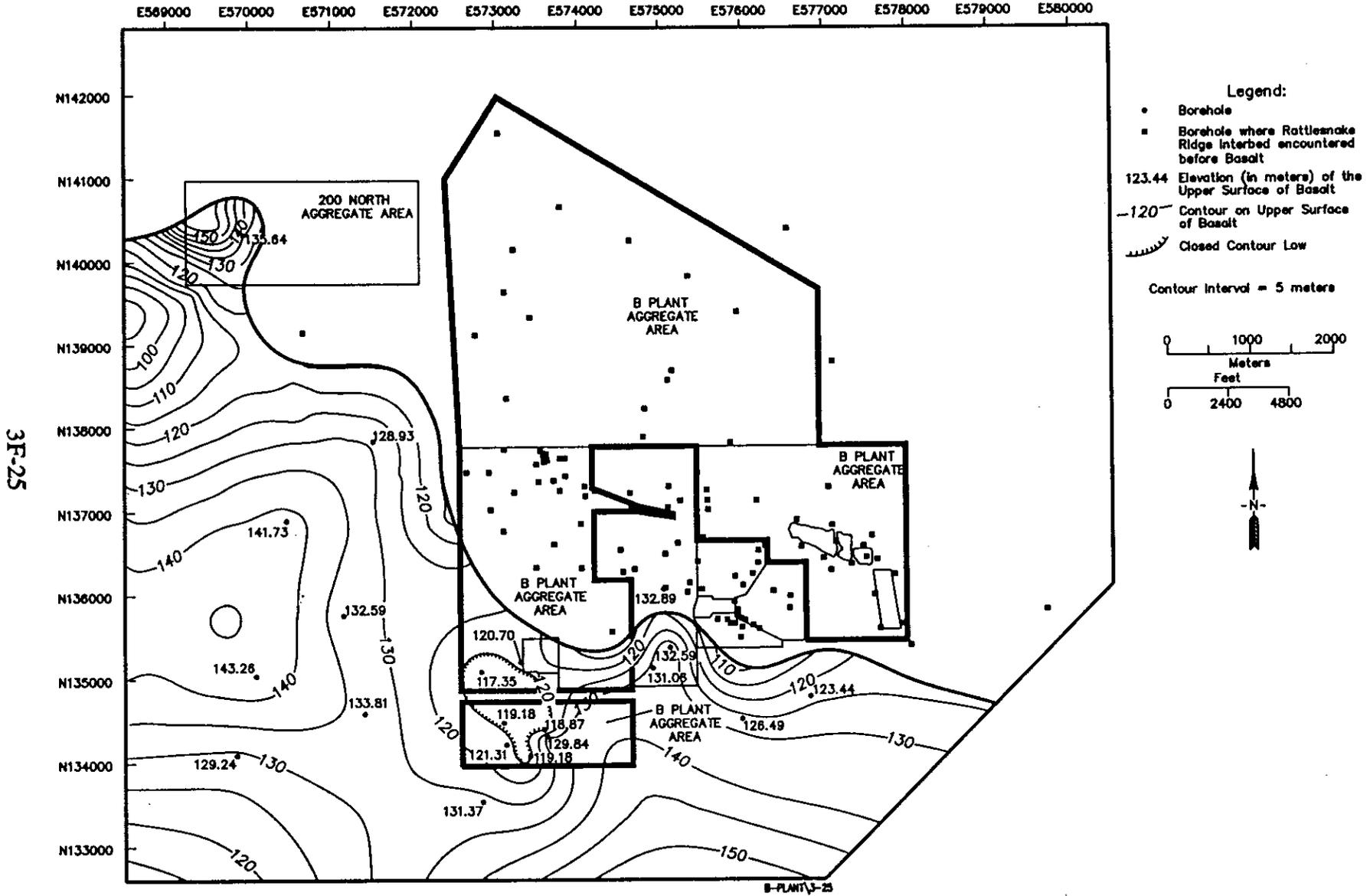


Figure 3-25. Structure Map of the Ringold Gravel Unit E.

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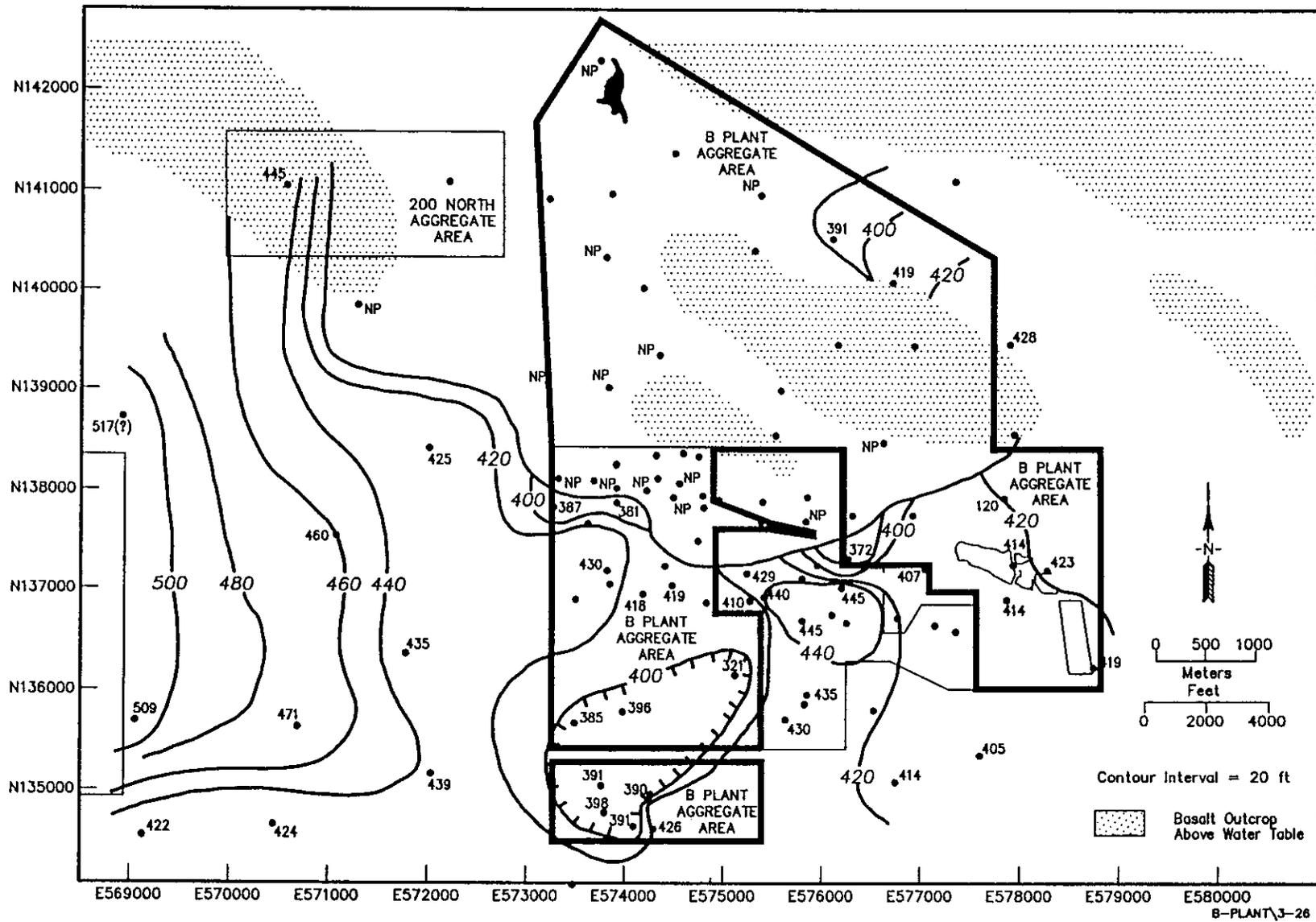
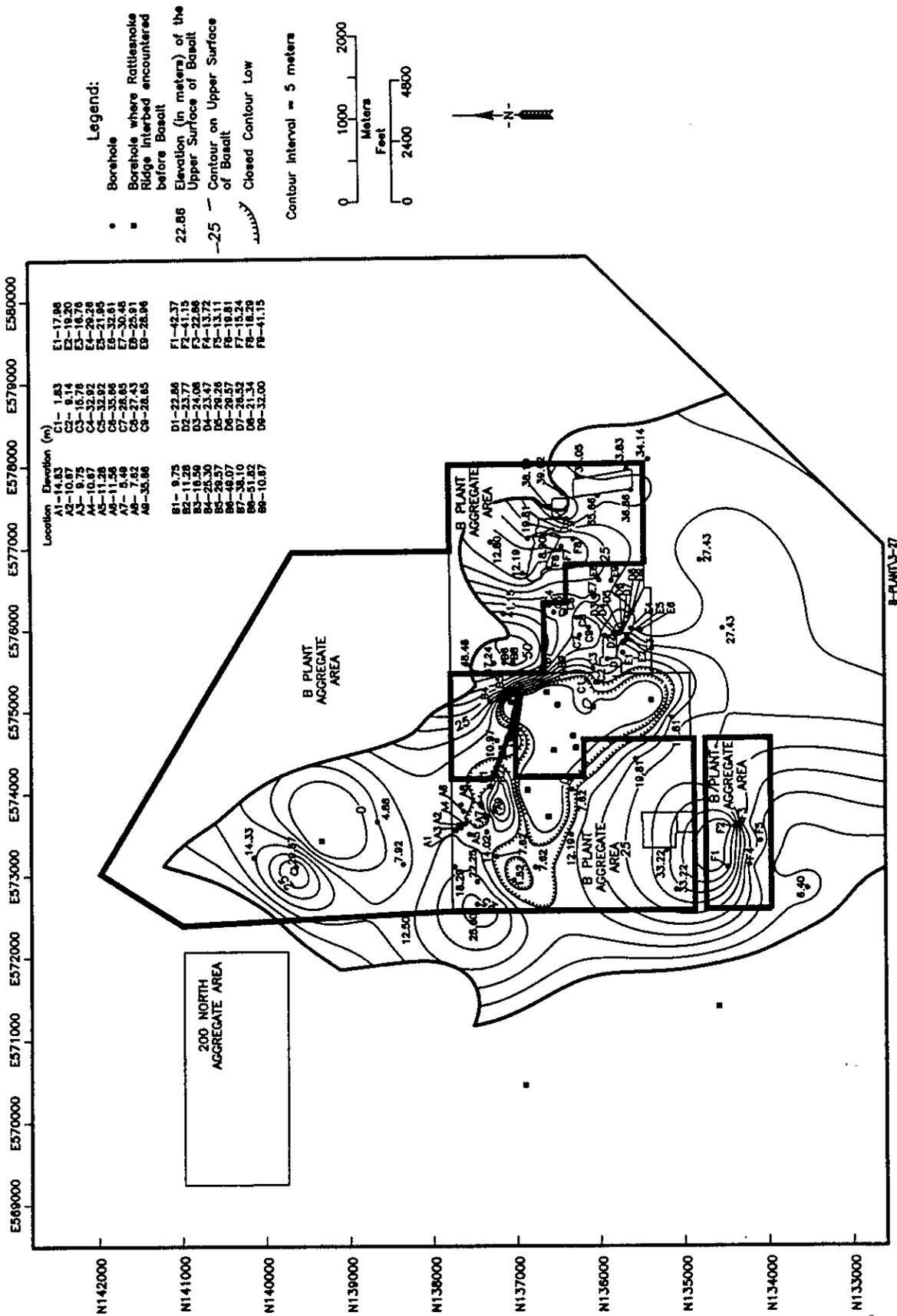


Figure 3-26. Structure Map of the Top of the Ringold Formation.

Figure 3-27. Isopach Map of the Lower Gravel Sequence, Hanford Formation.



9 3 1 2 8 9 6 1 0 0 1

Figure 3-28. Structure Map of the Top of the Lower Gravel Sequence, Hanford Formation.

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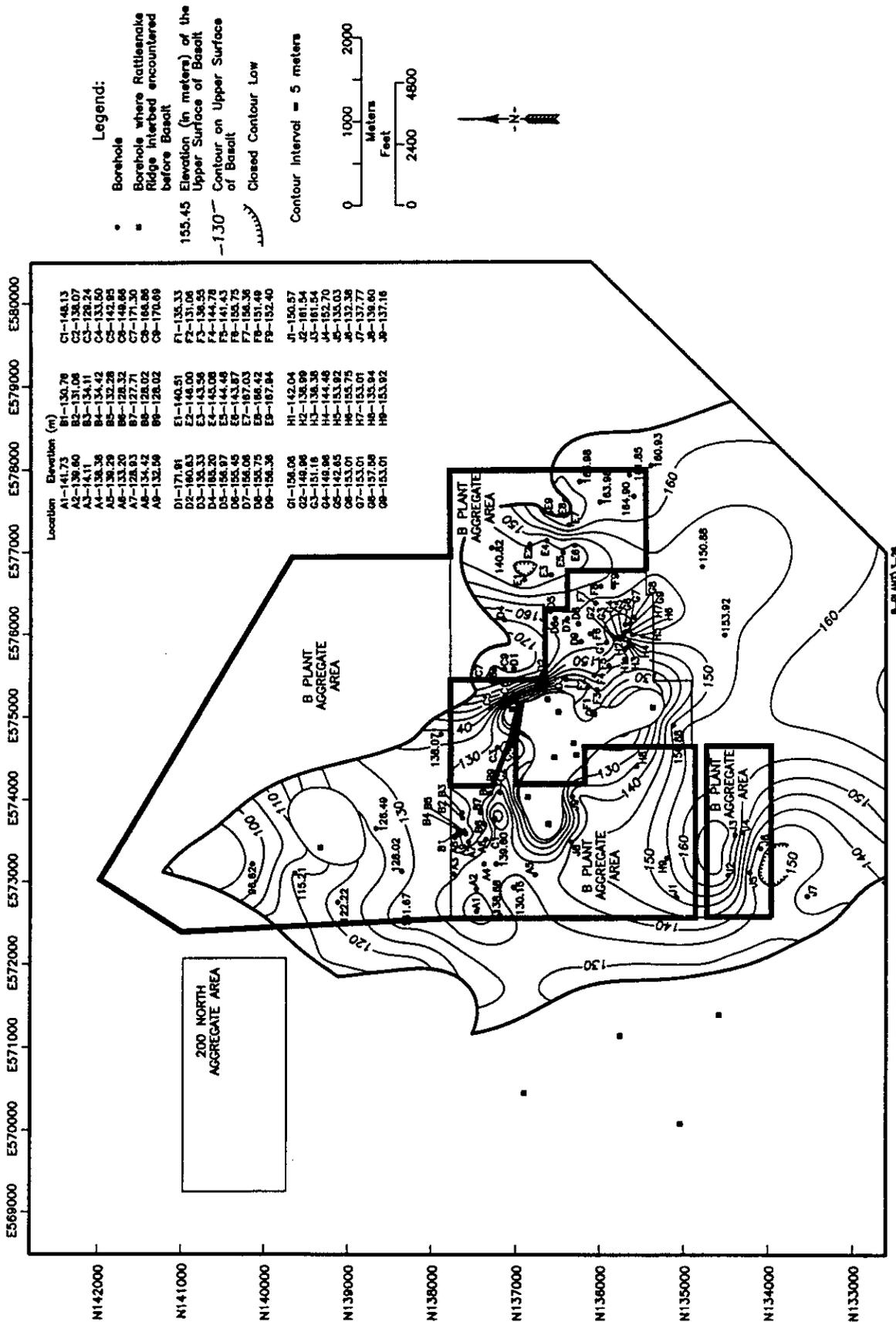
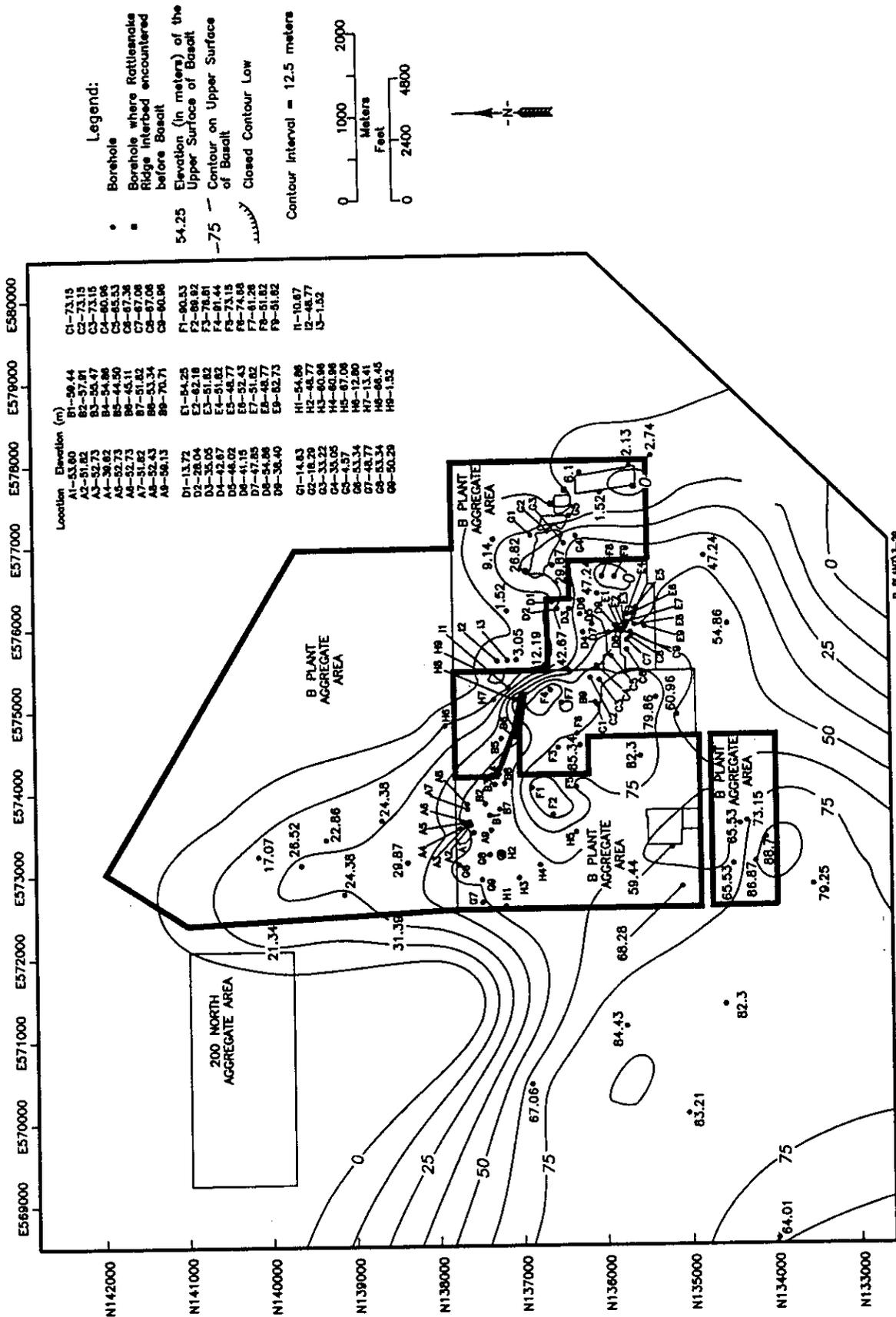


Figure 3-29. Isopach Map of the Sandy Sequence, Hanford Formation.



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Figure 3-30. Structure Map of the Top of the Sandy Sequence, Hanford Formation.

93120951004

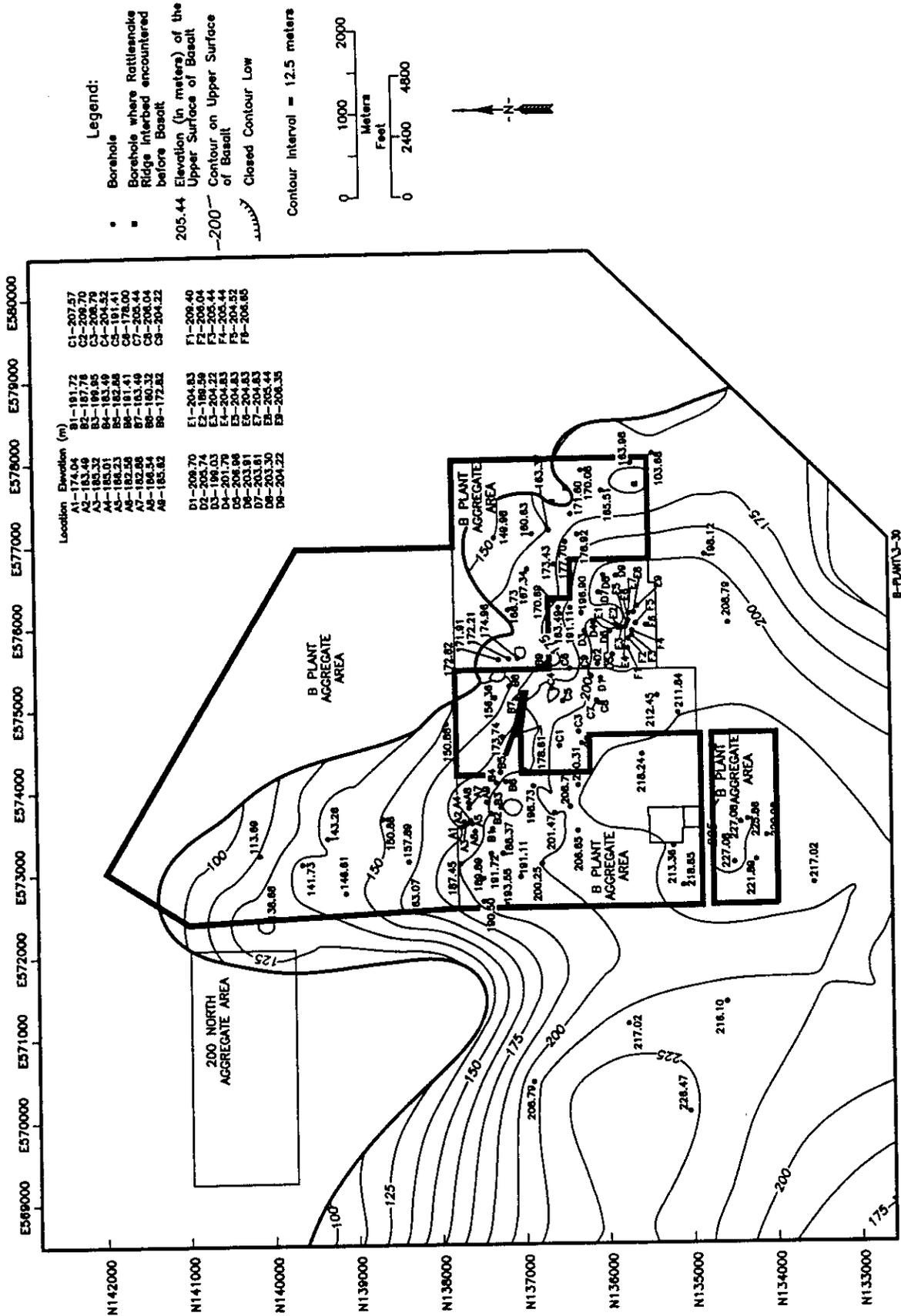
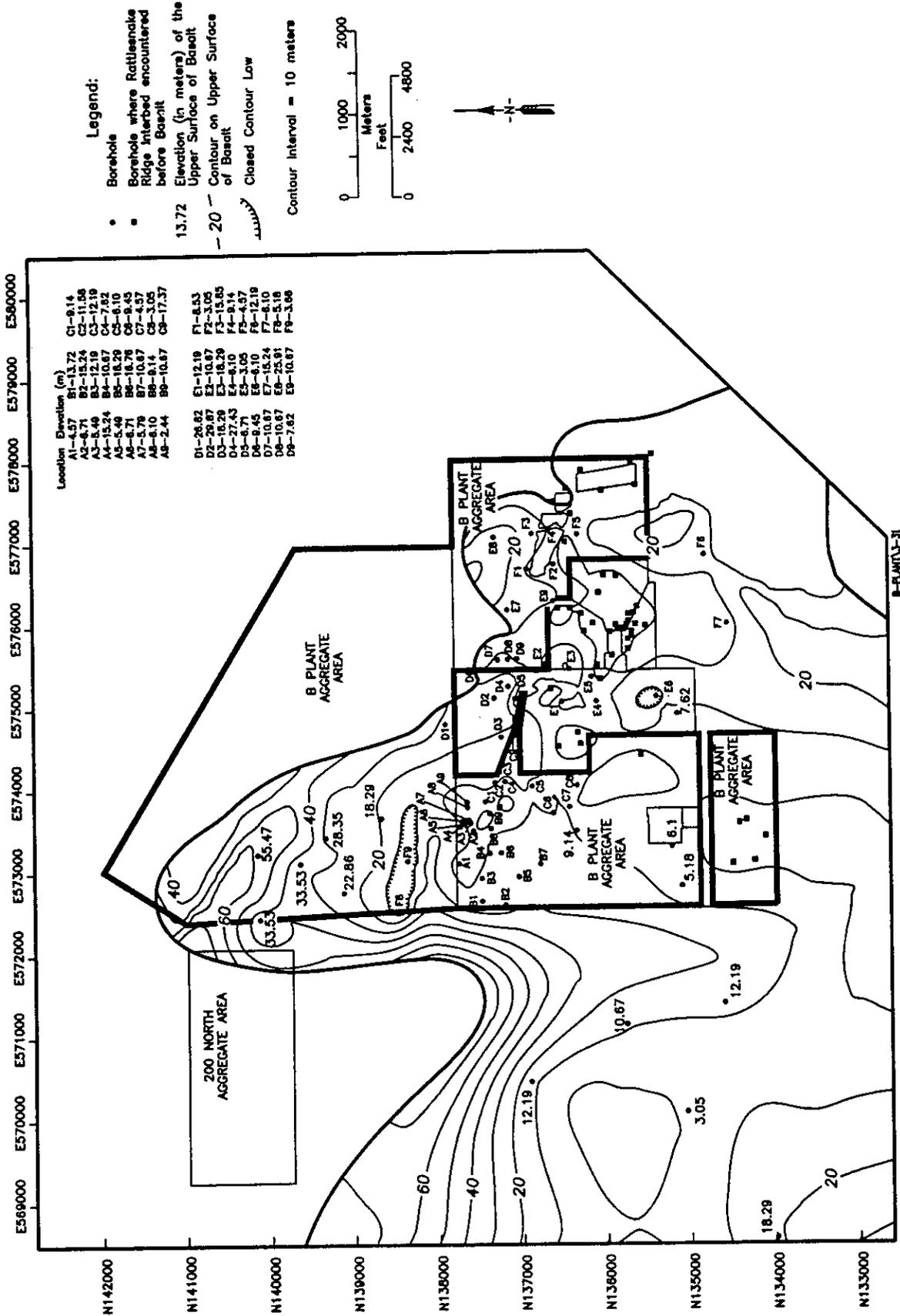
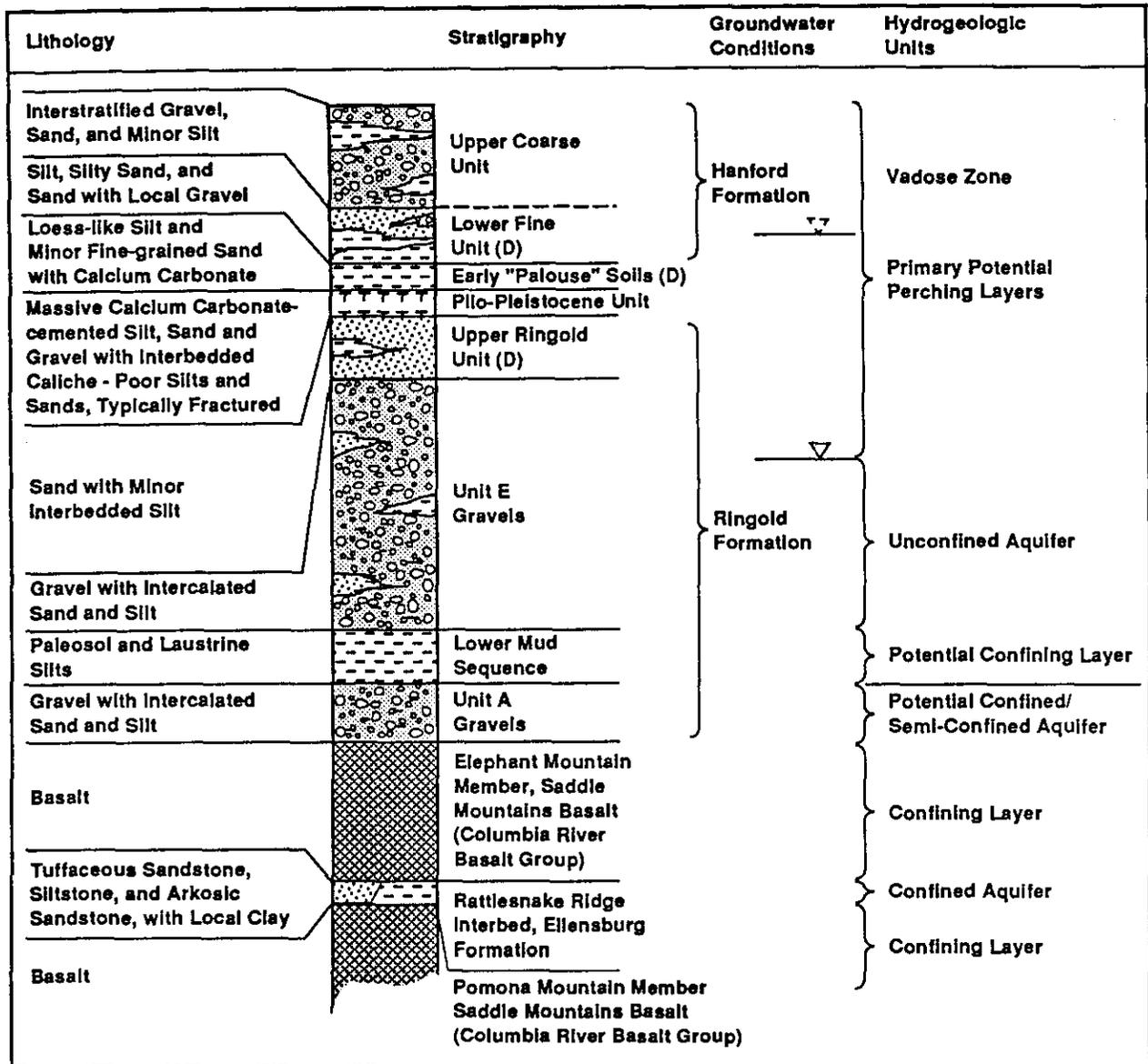


Figure 3-31. Isopach Map of the Upper Coarse Gravel Sequence, Hanford Formation.



9 3 1 2 0 9 6 1 0 0 5

Figure 3-33. Conceptual Hydrogeologic Column for the Hanford Site.



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-  Basalt
-  Sand
-  Silt
-  Gravel
-  Cemented Calcium Carbonate (Caliche)

-  Groundwater Table
-  Potential Perching Layers (localized, potential perched groundwater may also be associated with fine-grained sediments of Hanford formation and Upper Ringold Unit)

(D) Unit Not Continuous Over Z Plant Aggregate Area

Lithology, stratigraphy, and groundwater conditions based on data from Lindsey et al. (1991), and Delaney et al. (1991).

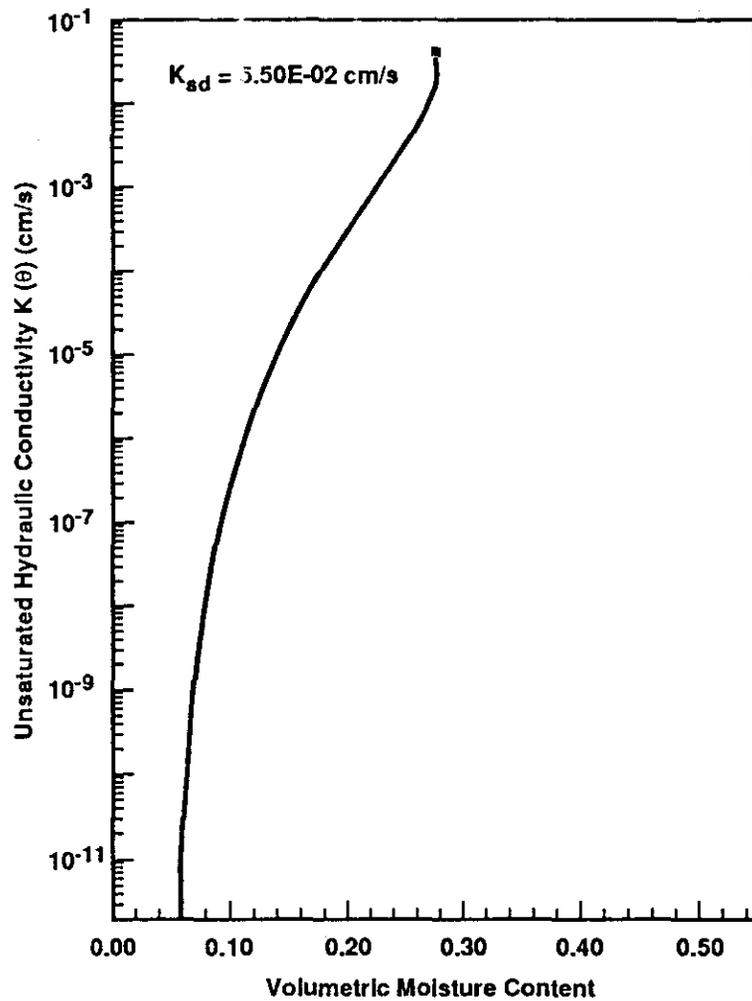
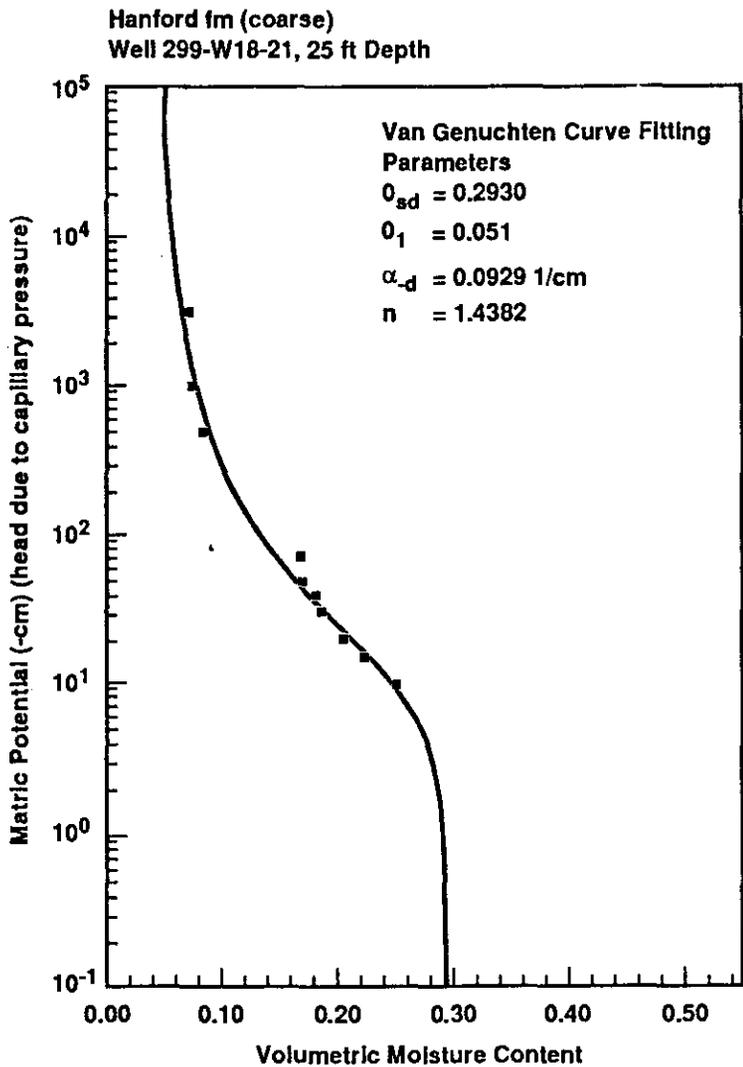
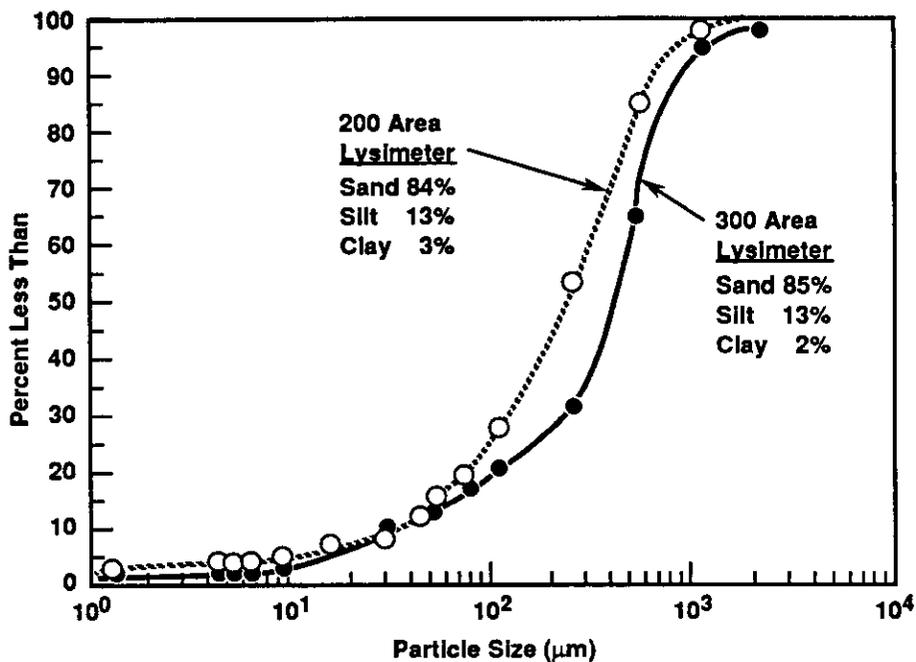
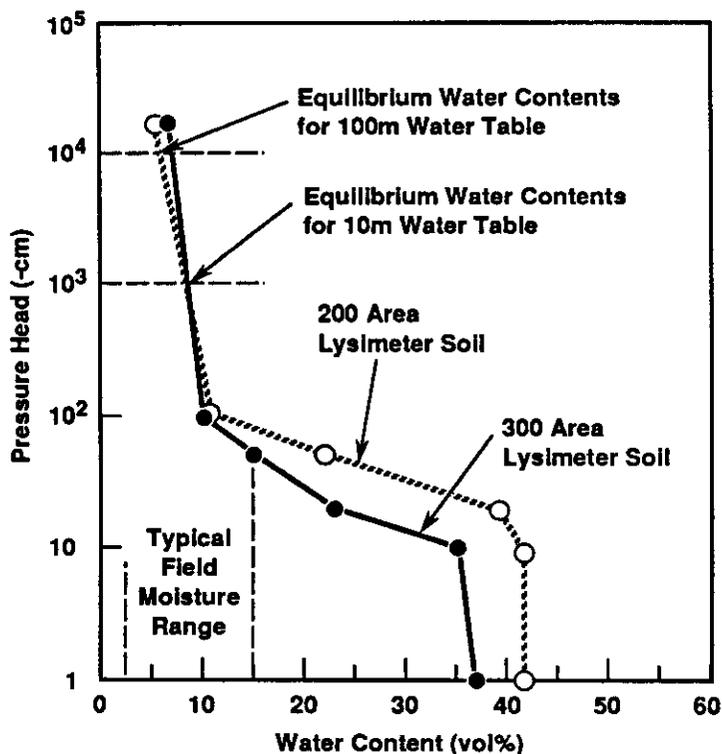


Figure 3-34. Wetting and Drying Curves for Well 299-W18-21.

Figure 3-35. Particle-Size Distribution and Water Retention Characteristics of Soil from Hanford Site Lysimeters.



a. Particle Size Distribution



b. Water Retention Characteristics

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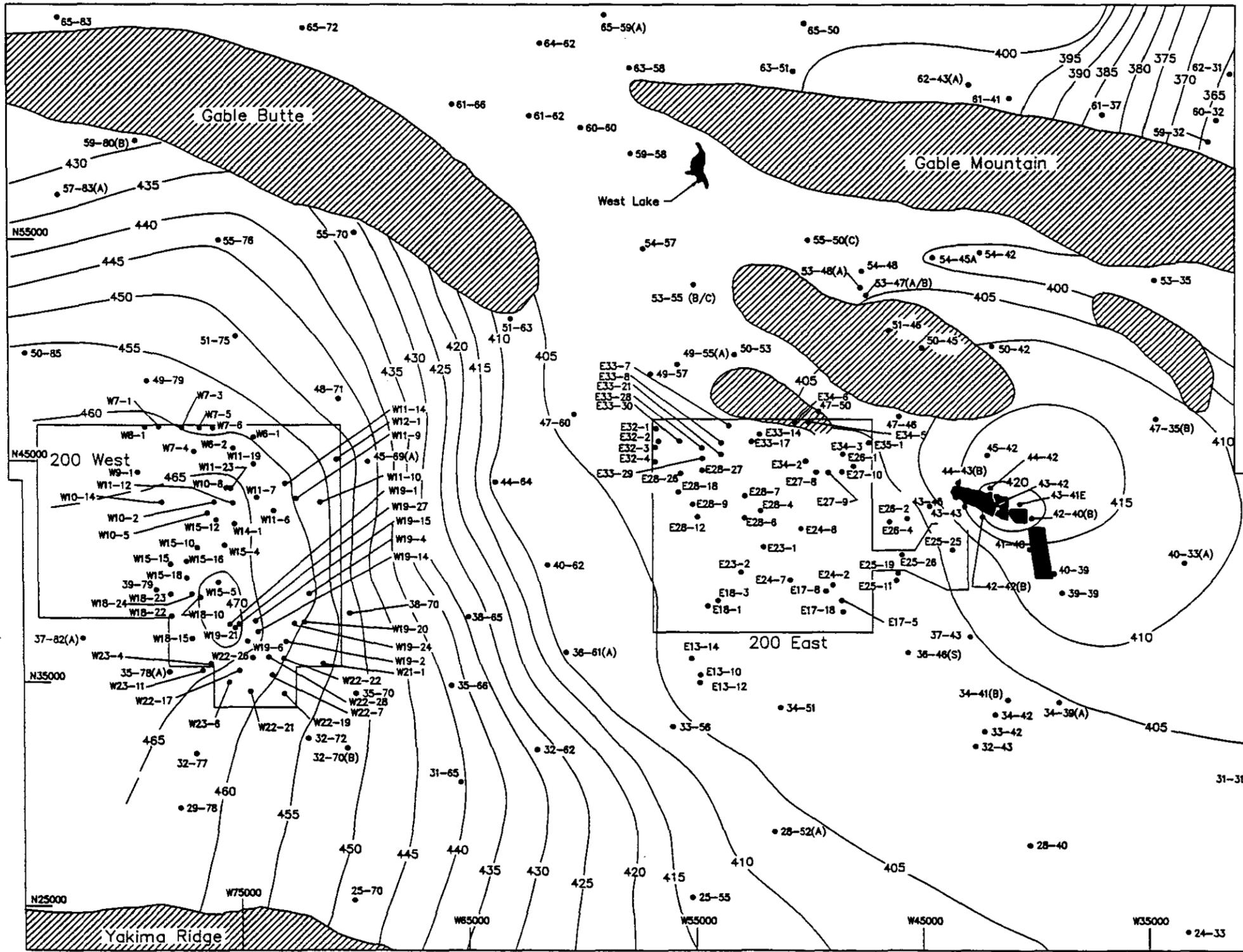
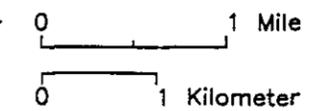
Figure 3-36.

200 Areas Water Table Map June 1990

- Water table contours in feet above mean sea level
- W22-26 Data points used to prepare map
- ▬ Ponds
- ▨ Areas where the basalt surface is generally above the water table

The 200 Areas water table map has been prepared by the Geosciences Group, Environmental Division, of Westinghouse Hanford Company.

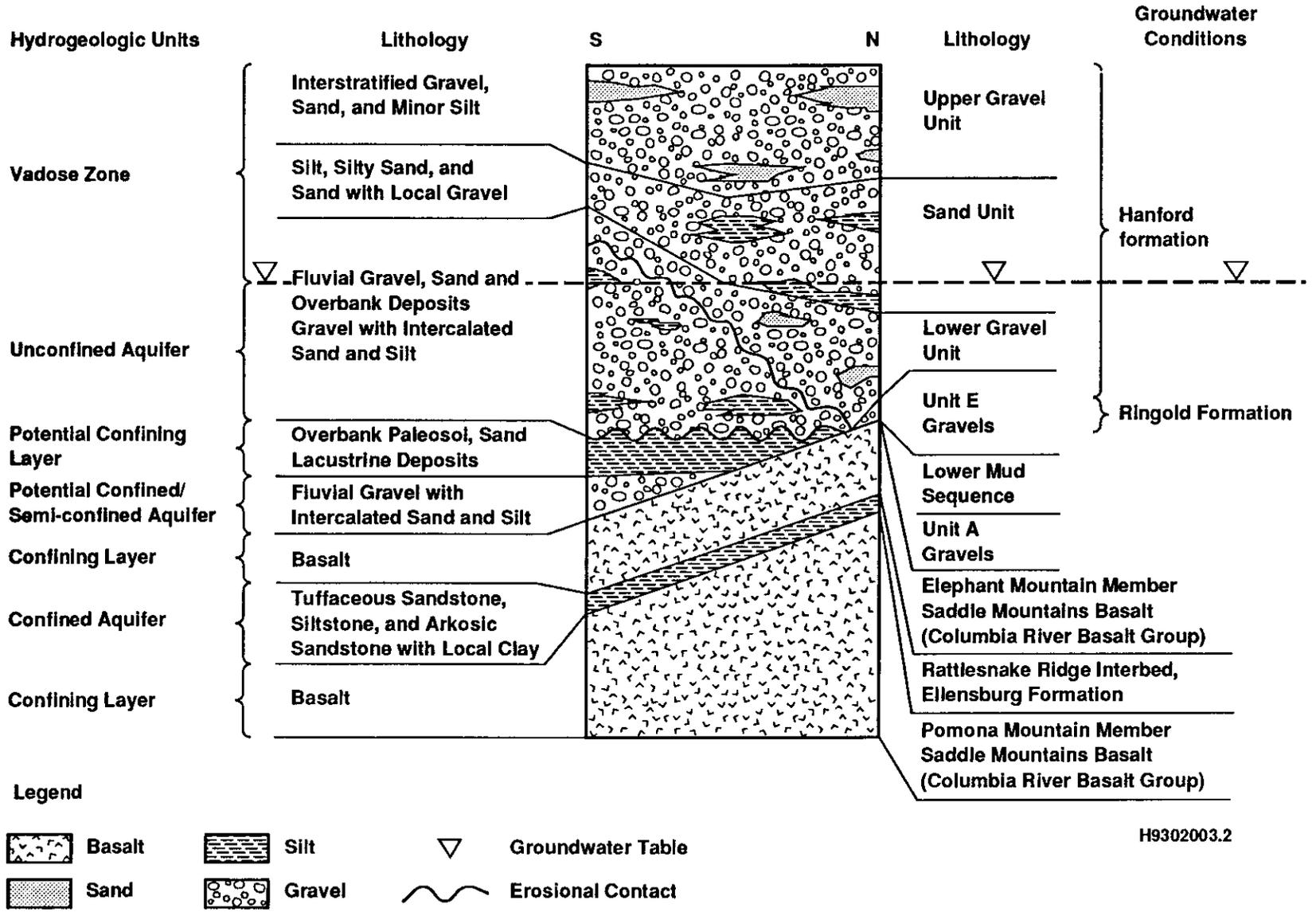
Note: To convert to metric, multiply elevation (ft) by 0.3048 to obtain elevation (m).



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Figure 3-37. Conceptual Hydrogeologic Column for the B Plant Aggregate Area.

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Table 3-1. Hydraulic Parameters for Various Areas and Geologic Units at the Hanford Site.

Location	Interval Tested	Hydraulic Conductivity (ft/d)	Transmissivity (ft ² /d)	Effective Porosity
Pasco Basin	Hanford Formation	500 - 20,300	--	--
	Ringold Formation	20 - 600	--	--
	Unit E			
	Ringold Formation	0.1 - 10	--	--
	Unit A			
100 Area	Ringold Formation	29 - 1,297	5,750 - 26,700	--
	Unit E			
200 Areas	Hanford Formation	2,000 - 10,000	--	--
	Ringold Formation	9 - 230	--	--
	Unit E			
	Ringold Formation	1 - 12	--	--
	Unit A			
200 West Area	Ringold Formation	0.06 - 200	--	--
	Unit E			
	Ringold Formation	1.7 - 4	--	--
	Unit A			
	Lower Ringold	3 x 10 ⁻⁵ - 8 x 10 ⁻⁵	--	--
	laboratory			
Slug Tests at U-12 Crib	Upper Ringold	8 - 44	--	--
300 Area	Hanford Formation	11,000 - 50,000	--	--
300 Area	Ringold Formation	1.9 - 10,000	--	--
1100 Area	Ringold Formation	3 X 10 ⁻¹ - 5	--	--
	Units C/B			
1100 Area	Ringold Formation	8 X 10 ⁻⁴ -	--	--
	Overbank Deposits	1 X 10 ⁻¹	--	--

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Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments.

Page 1 of 2

Reported Hydraulic Conductivity Value or Range of Values in cm/s	Water Content Volume Percent	Reported Geologic Unit or Sediment Type	Test Area or Sampling Location	Measurement Method or Basis for Reported Value
6.7 x 10 ⁻⁷	10	Sand	200 Area	Lysimeter Soil Experiments
1.7 x 10 ⁻⁸	7	--	--	--
1.7 x 10 ⁻⁹	5.5	--	--	--
1.7 x 10 ⁻¹⁰	5	--	--	--
1.3 x 10 ⁻¹¹	4.3	--	--	--
2.6 x 10 ⁻³	31	Sandy soil reported as "typical or many surface materials at the Hanford Site."	--	Unsaturated column studies.
5.7 x 10 ⁻⁴ (sat)	56		--	
6.3 x 10 ⁻¹¹	2.9	Near-surface soils	2-km south of 200 East Area	K estimates by Gee 1987 using water retention curve data from Figure 7 in Hsieh, et al., 1973.
2.2 x 10 ⁻¹¹	2.8	--		
5.40 x 10 ⁻⁸	8.3	Sandy fill excavated from near-surface soil (Hanford formation) with 1.27-cm particle size fraction screened out.	Buried Waste Test Facility (BWTF): 300 North Area Burial Grounds	Laboratory steady-state flux measurements.
9.78 x 10 ⁻³ (sat)	42.2			
8.4 x 10 ⁻³ (sat, arithmetic mean of four measurements)	na			
8 x 10 ⁻⁸	11	NA	BWTF: Southeast Caisson, and North Caisson	Unsteady drainage-flux field measurements.
4 x 10 ⁻³ (Southeast Caisson)	26	NA		
1 x 10 ⁻⁸	10	NA		
1 x 10 ⁻² (North Caisson)	29	NA		
4.5 x 10 ⁻³ (arithmetic mean of 15 measurements)	Field Saturation	NA	BWTF North Caisson and area north of caisson	Guelph permeameter field measurements

Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments.

Page 2 of 2

Reported Hydraulic Conductivity Value or Range of Values in cm/s	Water Content Volume Percent	Reported Geologic Unit or Sediment Type	Test Area or Sampling Location	Measurement Method or Basis for Reported Value
1 x 10 ⁻³ (Upper Soil, arithmetic mean of 7 measurements)	Field Saturation	Loam sand over sand Eolian Surficial deposits	Grass Site; 3 km of BWTF	Guelph permeameter field measurements
9.2 x 10 ⁻³ (Lower Soil, arithmetic mean of 4 measurements)	Field Saturation	NA		
8 x 10 ⁻⁷	16	Loam to sandy loam Hanford formation	McGee Ranch: NW of 200 West Area on State Rt. 240	Unsteady drainage-flux field measurements.
9 x 10 ⁻⁴	40			
9 x 10 ⁻⁴ (arithmetic mean of 9 measurements)	Field Saturation	NA	--	Guelph permeameter field measurements.
5 x 10 ⁻³ (sat)	50	Sand, Gravel	Sediment types are idealized to represent stratigraphic layers commonly encountered below 200 Areas liquid disposal sites.	K _{sat} values derived from idealized moisture content curves on Figure B-1.
1 x 10 ⁻³ (sat)	50	Coarse Sand		
5 x 10 ⁻⁴ (sat)	40	Fine Sand		
1 x 10 ⁻⁴ (sat)	40	Sand, Silt		
5 x 10 ⁻⁵ (sat)	40	Caliche		
1.2 x 10 ⁻⁵ (sat)	19.6 to 18.9	Hanford formation	Well 299-W7-9, 218-W-5 Burial Ground	van Genuchten equation fitted to moisture characteristic curves for Well 299-W7-9 soil samples
6.7 x 10 ⁻⁶ to 2.8 x 10 ⁻¹ (sat)	37.6 to 41.4	Early "Palouse" Soils		
1.10 x 10 ⁻³ (sat)	18.3 to 21	Upper Ringold	--	
1.80 x 10 ⁻⁴ to 3.00 x 10 ⁻⁴ (sat)	24 to 25	Middle Ringold	--	

NOTES:

NA = Not identified in source.

sat - Value for saturated soil.

field saturation - Equilibrium water content after several days of gravity drainage.

Table 3-3. Endangered, Threatened, and Sensitive Plant Species Reported On or Near the Hanford Site.

Scientific Name	Common Name	Family	Washington State Status
<i>Rorippa columbiae</i> ^a Suksd. ex Howell	Persistent-sepal Yellowcress	Brassicaceae	Endangered
<i>Artemisia campestris</i> L ssp. <i>borealis</i> (Pall.) Hall & Clem. var. <i>wormskioldii</i> ^a (Bess.) Cronq.	Northern Wormwood	Asteraceae	Endangered
<i>Astragalus columbianus</i> ^a Barneby	Columbia Milk Vetch	Fabaceae	Threatened
<i>Lomatium tuberosum</i> ^a Hoover	Hoover's Desert- Parsley	Apiaceae	Threatened
<i>Astragalus arrectus</i> Gray	Palouse Milk Vetch	Fabaceae	Sensitive
<i>Collinsia sparsiflora</i> Fisch. & Mey. var. <i>bruciae</i> (Jones) Newsom	Few-Flowered Collinsia	Scrophulariaceae	Sensitive
<i>Cryptantha interrupta</i> (Greene) Pays.	Bristly Cryptantha	Boraginaceae	Sensitive
<i>Cryptantha leucophaea</i> Dougl. Pays	Gray Cryptantha	Boraginaceae	Sensitive
<i>Erigeron piperianus</i> Cronq.	Piper's Daisy	Asteraceae	Sensitive
<i>Carex densa</i> L.H. Bailey	Dense Sedge	Cyperaceae	Sensitive
<i>Cyperus rivularis</i> Kunth	Shining Flatsedge	Cyperaceae	Sensitive
<i>Limosella acaulis</i> Ses. & Moc.	Southern Mudwort	Scrophulariaceae	Sensitive
<i>Lindernia anagallidea</i> (Michx.) Pennell	False-pimpernel	Scrophulariaceae	Sensitive
<i>Nicotiana attenuata</i> Torr.	Coyote Tobacco	Solanaceae	Sensitive
<i>Oenothera pygmaea</i> Dougl.	Dwarf Evening- Primrose	Onagraceae	Sensitive

^aIndicates candidates on the 1991 Federal Register, Notice of Review.

Table 3-4. Federal and State Classifications of Animals That Could Occur on the 200 Areas Plateau.

Name	Status Federal	State
Peregrine Falcon (<i>Falco peregrinus</i>)	FE	SE
Sandhill Crane (<i>Grus canadensis</i>)		SE
Bald Eagle (<i>Haliaeetus leucocephalus</i>)	FT	ST
Ferruginous Hawk (<i>Buteo regalis</i>)	FC2	ST
Swainson's Hawk (<i>Buteo swainsoni</i>)	FC2	SC
Golden Eagle (<i>Aquila chrysaetos</i>)		SC
Burrowing Owl (<i>Athene cunicularia</i>)		SC
Loggerhead Shrike (<i>Lanius ludovicianus</i>)		SC
Sage Sparrow (<i>Amphispiza belli</i>)		SC
Great Blue Heron (<i>Casmerodius albus</i>)		SM
Merlin (<i>Falco columbarius</i>)		SM
Prairie Falcon (<i>Falco mexicanus</i>)		SM
Striped Whipsnake (<i>Masticophis taeniatus</i>)		SC

Source: WHC (1992).

FE = Federal Endangered.

FT = Federal Threatened.

FC2 = Federal Candidate.

SE = State Endangered.

ST = State Threatened.

SC = State Candidate.

SM = State Monitor.

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