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SECTION 1 OF 2

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PUREX Source Aggregate Area Management Study Report

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PUREX PLANT SOURCE AAMS EXECUTIVE SUMMARY

This report presents the results of an aggregate area management study (AAMS) for the PUREX 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.

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 PUREX Plant Aggregate Area are provided in the report. Work plans 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 DQOs. 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 km^2 (560 mi^2) 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 PUREX Plant Aggregate Area is located within the 200 East Area, near the middle of the Hanford Site. There are six operable units within the PUREX Plant Aggregate Area.

The 202-A Building (PUREX Plant) was constructed for the purpose of extracting plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from the Hanford Site reactors. The PUREX chemical separation processes are based on dissolving the decladded fuel rods in nitric acid and conducting multiple purification operations on the resultant aqueous nitrate solution. The process steps involve fuel-element decladding, uranium metal dissolution, solvent extraction, ion exchange and product load-out. Some effluents from the 202-A Building are routed through the 242-A Evaporator where they are concentrated prior to disposal to various waste management units.

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

- 6 (No. of waste management units) Plants, Buildings, and Storage Areas
- 60 Tanks and Vaults
- 40 Cribs and Drains
- 1 Reverse Well
- 6 Ponds, Ditches, and Trenches
- 7 Septic Tanks and Associated Drain Fields
- 30 Transfer Facilities, Diversion Boxes, and Pipelines
- 2 Basins
- 6 Burial Sites
- 63 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 PUREX 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 and eighteen units (primarily single-shell tanks, double-shell tanks and associated transfer facilities) 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 sixteen waste management units will be partially addressed by an ongoing program in addition to the actions recommended in the PUREX Plant AAMSR.

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 200 East 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 PUREX 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 PUREX 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 PUREX 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 PUREX 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 PUREX Plant Aggregate Area are developed in Section 9.1. As a result of the data evaluation process, no waste management units were recommended for ERA, 25 units were recommended for IRMs, 25 units were recommended for LFIs which could lead to IRMs, one unit was recommended for risk assessment and 63 units were recommended for final remedy selection. 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 are the interactions with RCRA required to disposition the 216-A-29, 216-A-10, 216-A-36B and 218-E-12B RCRA TSD facilities. 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.

Table ES-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area. (sheet 1 of 5)

Waste Management Unit	Operable Unit	Site Type	ERA	IRM	LFI	RA	RI	OPS	Remarks
Cribs and Drains									
216-A-1	200-P0-5	Crib	--	X	X	--	--	--	--
216-A-2	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-3	200-P0-1	Crib	--	X	X	--	--	--	--
216-A-4	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-5	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-6	200-P0-4	Crib	--	X	X	--	--	--	--
216-A-7	200-P0-5	Crib	--	X	X	--	--	--	--
216-A-8	200-P0-5	Crib	--	X	X	--	--	--	--
216-A-9	200-P0-1	Crib	--	X	X	--	--	--	--
216-A-10	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-21	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-24	200-P0-5	Crib	--	X	X	--	--	--	--
216-A-27	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-30	200-P0-4	Crib	--	X	X	--	--	--	--
216-A-31	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-32	200-P0-1	Crib	--	X	X	--	--	--	--
216-A-36A	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-36B	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-37-1	200-P0-4	Crib	--	X	X	--	--	--	--
216-A-37-2	200-P0-4	Crib	--	X	X	--	--	--	--
216-A-38-1	200-P0-2	Crib	--	--	--	X	--	--	

Table ES-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area. (sheet 2 of 5)

Waste Management Unit	Operable Unit	Site Type	ERA	IRM	LFI	RA	RI	OPS	Remarks
216-A-41	200-P0-1	Crib	--	X	X	--	--	--	--
216-A-45	200-P0-2	Crib	--	X	X	--	--	--	--
216-A-11	200-P0-1	French Drain	--	--	--	--	X	--	--
216-A-12	200-P0-1	French Drain	--	--	--	--	X	--	--
216-A-13	200-P0-1	French Drain	--	--	--	--	X	--	--
216-A-14	200-P0-1	French Drain	--	X	X	--	--	X	RARA - Surface Contamination
216-A-15	200-P0-2	French Drain	--	--	--	--	X	--	--
216-A-22	200-P0-5	French Drain	--	--	--	--	X	--	--
216-A-26	200-P0-5	French Drain	--	--	--	--	X	--	--
216-A-26A	200-P0-1	French Drain	--	--	--	--	X	--	--
216-A-28	200-P0-1	French Drain	--	X	X	--	--	X	RARA - Surface Contamination
216-A-33	200-P0-1	French Drain	--	--	--	--	X	--	--
216-A-35	200-P0-1	French Drain	--	--	--	--	X	--	--
Reverse Wells									
299-E24-111	200-P0-2	Injection Well	--	--	--	--	X	--	--
Ponds, Ditches, and Trenches									
216-A-29	200-P0-5	Ditch	--	--	--	--	X	--	--
216-A-34	200-P0-5	Ditch	--	--	--	--	X	--	--
216-A-18	200-P0-5	Trench	--	--	--	--	X	--	--
216-A-19	200-P0-5	Trench	--	--	--	--	X	--	--
216-A-20	200-P0-5	Trench	--	--	--	--	X	--	
216-A-40	200-P0-1	Trench	--	--	--	--	X	--	

Table ES-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area. (sheet 3 of 5)

Waste Management Unit	Operable Unit	Site Type	ERA	IRM	LFI	RA	RI	OPS	Remarks
Septic Tanks and Associated Drain Fields									
2607-EA	200-P0-1	Septic Tank/Drain Field	--	--	--	--	X	--	--
2607-EC	200-P0-5	Septic Tank/Drain Field	--	--	--	--	X	--	--
2607-ED	200-P0-3	Septic Tank/Drain Field	--	--	--	--	X	--	--
2607-EG	200-P0-3	Septic Tank	--	--	--	--	X	--	--
2607-EJ	200-P0-3	Septic Tank	--	--	--	--	X	--	--
2607-EL	200-P0-4	Septic Tank	--	--	--	--	X	--	--
2607-E6	200-P0-1	Septic Tank/Drain Field	--	--	--	--	X	--	--
Transfer Facilities, Diversion Boxes, and Pipelines									
216-A-524	200-P0-5	Control Structure		X	X				
Basins									
207-A	200-P0-5	Retention Basin	--	--	--	--	X	--	--
216-A-42	200-P0-4	Retention Basin	--	--	--	--	X	X	RARA - Surface Contamination
Burial Sites									
218-E-1	200-P0-1	Burial Ground	--	--	--	--	X	--	--
218-E-8	200-P0-6	Burial Ground	--	--	--	--	X	--	--
218-E-12A	200-P0-6	Burial Ground	--	--	--	--	X	--	--
218-E-13	200-P0-1	Burial Ground	--	--	--	--	X	--	--
Unplanned Releases									
UN-200-E-10	200-P0-1	Unplanned Release	--	--	--	--	X	--	--

Table ES-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area. (sheet 4 of 5)

Waste Management Unit	Operable Unit	Site Type	ERA	IRM	LFI	RA	RI	OPS	Remarks
UN-200-E-11	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-12	200-P0-1	Unplanned Release	--	--	--	--	X	--	
UN-200-E-13	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-15	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-19	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-20	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-22	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-25	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-26	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-28	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-31	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-33	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-35	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-39	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-40	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-42	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-49	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-56	200-P0-5	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-58	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-60	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-62	200-P0-6	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-65	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-67	200-P0-5	Unplanned Release	--	--	--	--	X	--	
UN-200-E-68	200-P0-3	Unplanned Release	--	--	--	--	X	--	--

Table ES-1. Summary of the Results of Data Evaluation Assessment for PUREX Plant Aggregate Area. (sheet 5 of 5)

Waste Management Unit	Operable Unit	Site Type	ERA	IRM	LFI	RA	RI	OPS	Remarks
UN-200-E-72	200-P0-3	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-88	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-94	200-P0-3	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-96	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-97	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-99	200-P0-3	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-100	200-P0-3	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-114	200-P0-1	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-117	200-P0-2	Unplanned Release	--	--	--	--	X	--	--
UN-200-E-142	200-P0-1	Unplanned Release	--	--	--	--	X	--	--

ERA = Expected Response Action.
RI = Remedial Investigation/Feasibility Study.
LFI = Limited Field Investigations.
RA = Risk Assessment.
IRM = Interim Remedial Measure.
OPS = Operational Program.

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Table ES-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix. (sheet 1 of 5)

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Tech-nology Avail-ability?	Adverse Conse-quences?	Oper-ational Programs?	High Priority?	Data Adequate?	No Adverse Conse-quences?	Collect Data?	Data Adequate?
Cribs and Drains													
216-A-1 Crib	Y	Y	N	Y	N	--	--	--	N[a]	N	--	Y	--
216-A-2 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	--
216-A-3 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	--
216-A-4 Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-5 Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-6 Crib	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
216-A-7 Crib	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
216-A-8 Crib	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
216-A-9 Crib	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
216-A-10 Crib	Y	Y	N	--	--	--	--	--	Y	--	--	--	N
216-A-21 Crib	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
216-A-24 Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-27 Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-30 Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-31 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	--
216-A-32 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	--
216-A-36A Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-36B Crib	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
216-A-37-1 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	--
216-A-37-2 Crib	Y	Y	Y	Y	N	--	--	--	Y	N	--	Y	--
216-A-38-1 Crib	N	--	--	--	--	--	--	--	N	--	--	--	Y
216-A-41 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	N
216-A-45 Crib	Y	Y	N	--	--	--	--	--	N[a]	N	--	Y	N

Table ES-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix. (sheet 2 of 5)

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Tech-nology Avail-ability?	Adverse Conse-quences?	Oper-ational Programs?	High Priority?	Data Adequate?	No Adverse Conse-quences?	Collect Data?	Data Adequate?
216-A-11 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-12 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-13 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-14 French Drain	Y	Y	Y	Y	Y	Y	N	Y	Y	N	--	Y	--
216-A-15 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-22 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-26 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-26A French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-28 French Drain	Y	Y	Y	Y	Y	Y	N	Y	Y	N	--	Y	--
216-A-33 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-35 French Drain	Y	Y	N	--	--	--	--	--	N	--	--	--	N
Reverse Wells													
299-E34-111 Injection Well	Y	Y	N	--	--	--	--	--	N	--	--	--	N
Ponds, Ditches, and Trenches													
216-A-29 Ditch	Y	Y	N	--	--	--	--	--	Y	N	--	N	N
216-A-34 Ditch	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-18 Trench	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-19 Trench	Y	Y	N	--	--	--	--	--	N	--	--	--	N

Table ES-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix. (sheet 3 of 5)

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Tech-nology Avail-ability?	Adverse Conse-quences?	Oper-ational Programs?	High Priority?	Data Adequate?	No Adverse Conse-quences?	Collect Data?	Data Adequate?
216-A-20 Trench	Y	Y	N	--	--	--	--	--	N	--	--	--	N
216-A-40 Trench	Y	Y	Y	Y	N	--	--	--	Y	N	--	N	N
Septic Tanks and Associated Drain Fields													
2607-E6 Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
2607-EA Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
2607-EC Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
2607-ED Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
2607-EG Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
2607-EJ Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
2607-EL Septic Tank	N	--	--	--	--	--	--	--	N	--	--	--	N
Transfer Facilities, Diversion Boxes, and Pipelines													
216-A-524	Y	Y	N	--	--	--	--	--	Y	N	--	Y	--
Basins													
207-A Retention Basins	Y	Y	N	--	--	--	--	--	Y	N	--	N	N
216-A-42 Retention Basin	Y	Y	Y	Y	Y	Y	N	Y	Y	N	--	N	N
Burial Sites													
218-E-1 Burial Ground	Y	Y	Y	Y	N	--	--	--	Y	N	--	N	N
218-E-8 Burial Ground	Y	Y	N	--	--	--	--	--	N	--	--	--	N
218-E-12A Burial Ground	Y	Y	Y	Y	N	--	--	--	Y	N	--	N	N

Table ES-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix. (sheet 4 of 5)

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Tech-nology Avail-ability?	Adverse Conse-quences?	Oper-ational Programs?	High Priority?	Data Adequate?	No Adverse Conse-quences?	Collect Data?	Data Adequate?
218-E-13 Burial Ground	Y	Y	N	--	--	--	--	--	N	--	--	--	N
Unplanned Releases													
UN-200-E-10	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-11	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-12	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-13	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-15	Y	Y	N	--	--	--	--	--	N	--	--	--	N
UN-200-E-19	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-20	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-22	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-25	Y	Y	N	--	--	--	--	--	N	--	--	--	N
UN-200-E-26	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-28	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-31	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-33	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-35	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-39	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-40	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-42	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-49	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-56	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-58	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-60	N	--	--	--	--	--	--	--	N	--	--	--	N

Table ES-2. PUREX Plant Aggregate Area Data Evaluation Decision Matrix. (sheet 5 of 5)

Waste Management Unit	ERA Evaluation Path								IRM Evaluation Path			LFI Path	Final Remedy
	Is an ERA Justified?	Release?	Path-way?	Quan-tity?	Concen-tration?	Tech-nology Avail-ability?	Adverse Conse-quences?	Oper-ational Programs?	High Priority?	Data Adequate?	No Adverse Conse-quences?	Collect Data?	Data Adequate?
UN-200-E-62	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-65	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-67	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-68	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-72	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-88	Y	Y	Y	Y	N	--	--	--	Y	N	--	N	N
UN-200-E-94	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-96	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-97	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-99	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-100	N	--	--	--	--	--	--	--	Y	N	--	N	N
UN-200-E-114	N	--	--	--	--	--	--	--	N	--	--	--	N
UN-200-E-117	Y	Y	N	--	--	--	--	--	N	--	--	--	N
UN-200-E-142	N	--	--	--	--	--	--	--	N	--	--	--	N

(a) Site was low priority but assessed as IRM candidate because of similarities with other high priority units.
Dashes indicate decision point not reached on pathway. Evaluation branched to lower path.
Y = Yes.
N = No.

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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
ARARs	applicable or relevant and appropriate requirements
ASIL	acceptable source impact level
BAT	best available technology
BDAT	best demonstrated available treatment technologies
BWIP	Basalt Waste Isolation Project
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
CMS	Corrective Measures Studies
DCG	Derived Concentration Guide
DOE	U.S. Department of Energy
DOE/RL	U.S. Department of Energy, Richland Operations Office
DQO	data quality objective
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
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
GTF	Grout Treatment Facility
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

ACRONYMS AND ABBREVIATIONS (cont.)

HRS	Hazard Ranking System
HVAC	heating, ventilating, and air conditioning
HWOP	Hazardous Waste Operations Permit
HWSA	Hazardous Waste Staging Area
ICRP	International Commission on Radiological Protection
IMO	Information Management Overview
IRM	interim remedial measure
JSA	Job Safety Analysis
LDR	land disposal restriction
LERF	Liquid Effluent Retention Facility
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
msl	mean sea level
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
NSPS	New Source Performance Standards
OSHA	Occupational Safety and Health Administration
OSM	Office of Sample Management
PARCC	precision, accuracy, representativeness, completeness, comparability
PA	preliminary assessment
PNL	Pacific Northwest Laboratory
PUREX	plutonium uranium extraction
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RA	risk assessment
RAO	remedial action objective

ACRONYMS AND ABBREVIATIONS (cont.)

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 Investigation
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
T-BACT	toxic best available control technology
TBC	to-be-considered material
TCLP	toxicity characteristic leaching procedure
TGE	Transportable Grout Treatment Equipment
TLD	thermoluminescent dosimeter
TOC	total organic carbon
TRAC	Tracks Radioactive Components
Tri-Party Agreement	Hanford Federal Facility Agreement and Consent Order
TRU	transuranic
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
WESF	Waste Encapsulation Storage Facility
WIDS	Waste Information Data System
WIPP	Waste Isolation Pilot Plant
WISHA	Washington Industrial Safety and Health Act
WPCA	Washington State Water Pollution Control Act
WPPSS	Washington Public Power Supply System

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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 (CERCLA) of 1980. 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 PUREX 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, so 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 (Washington Administrative Code [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, 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 (FFS), if needed, to select a remedy

- Limited field investigation (LFI) path, where minimum site data are needed to support IRM or other decisions, and are 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.

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 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 affected 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, to 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 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 North 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 characterization 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 remain 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 units.

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.

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 DQOs and set data priorities
- Provide recommendations for ERA, IRM, LFI, or other actions
- Redefine and prioritize, if necessary, 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 presented in Sections 2.0 and 4.0 of selected AAMSRs. 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 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 AAMSR. 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 the *USEPA Contract Laboratory Program Satement 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.

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

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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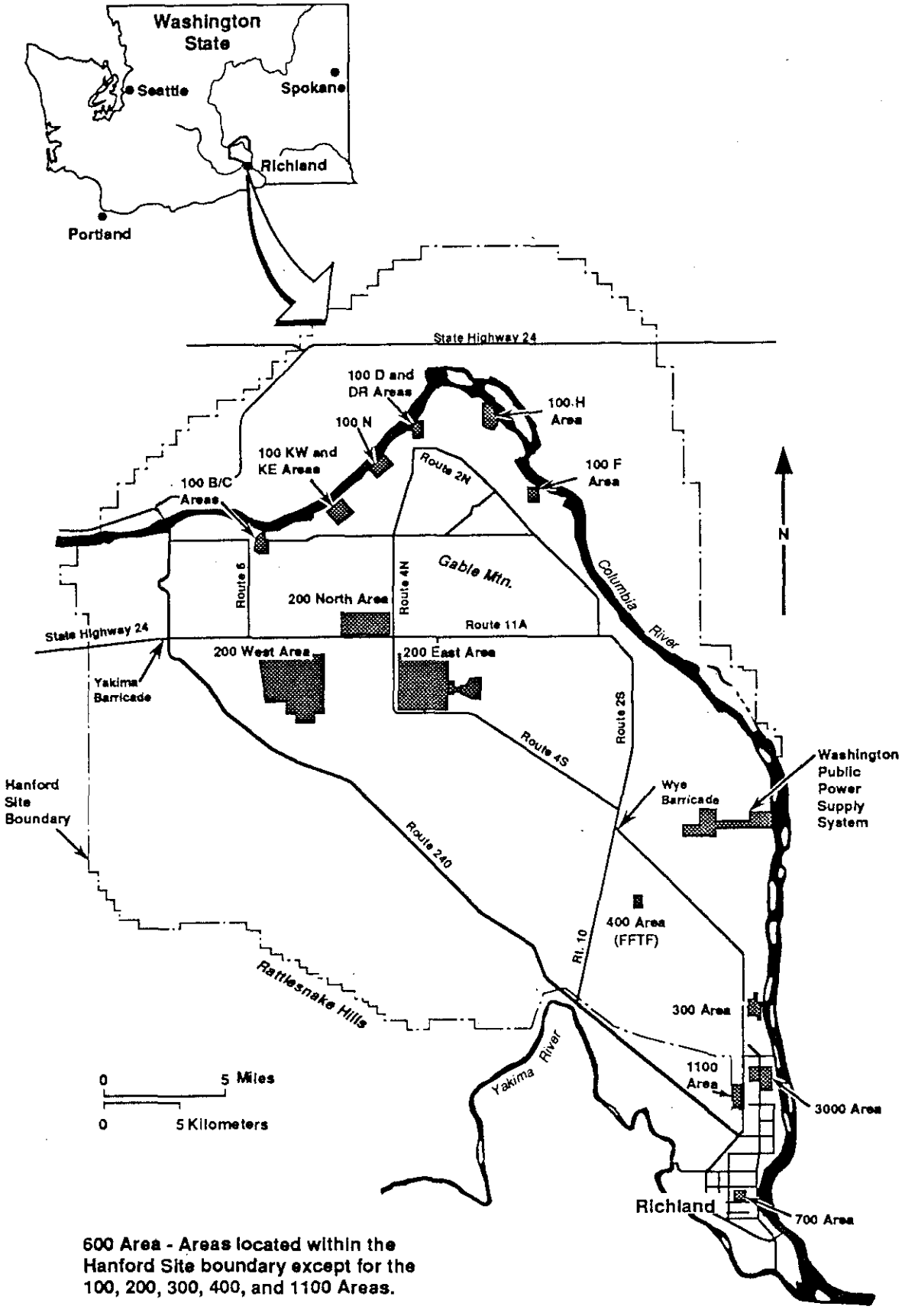
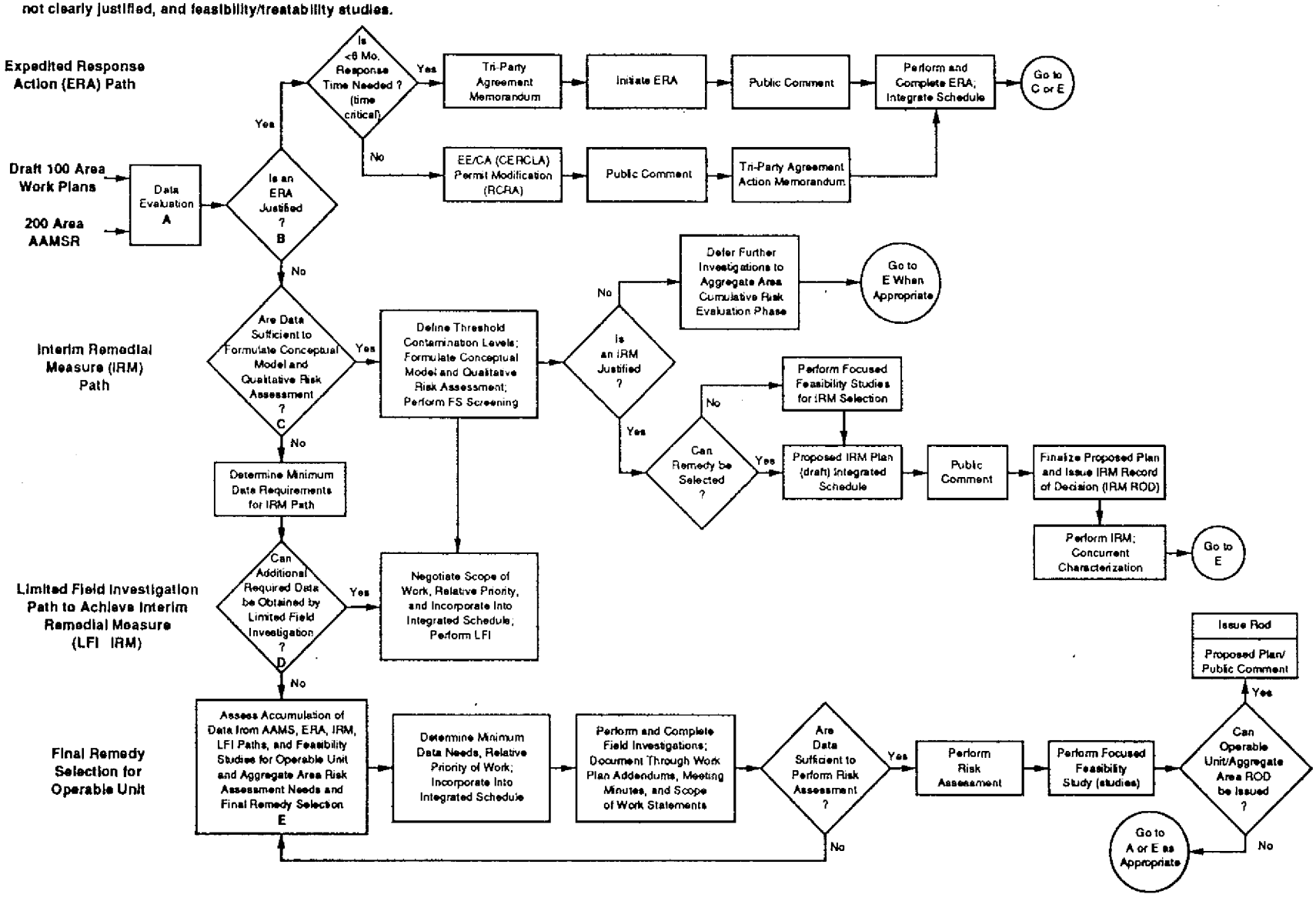
Figure 1-1. Hanford Site Map.



600 Area - Areas located within the Hanford Site boundary except for the 100, 200, 300, 400, and 1100 Areas.

FIG. 1-1

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



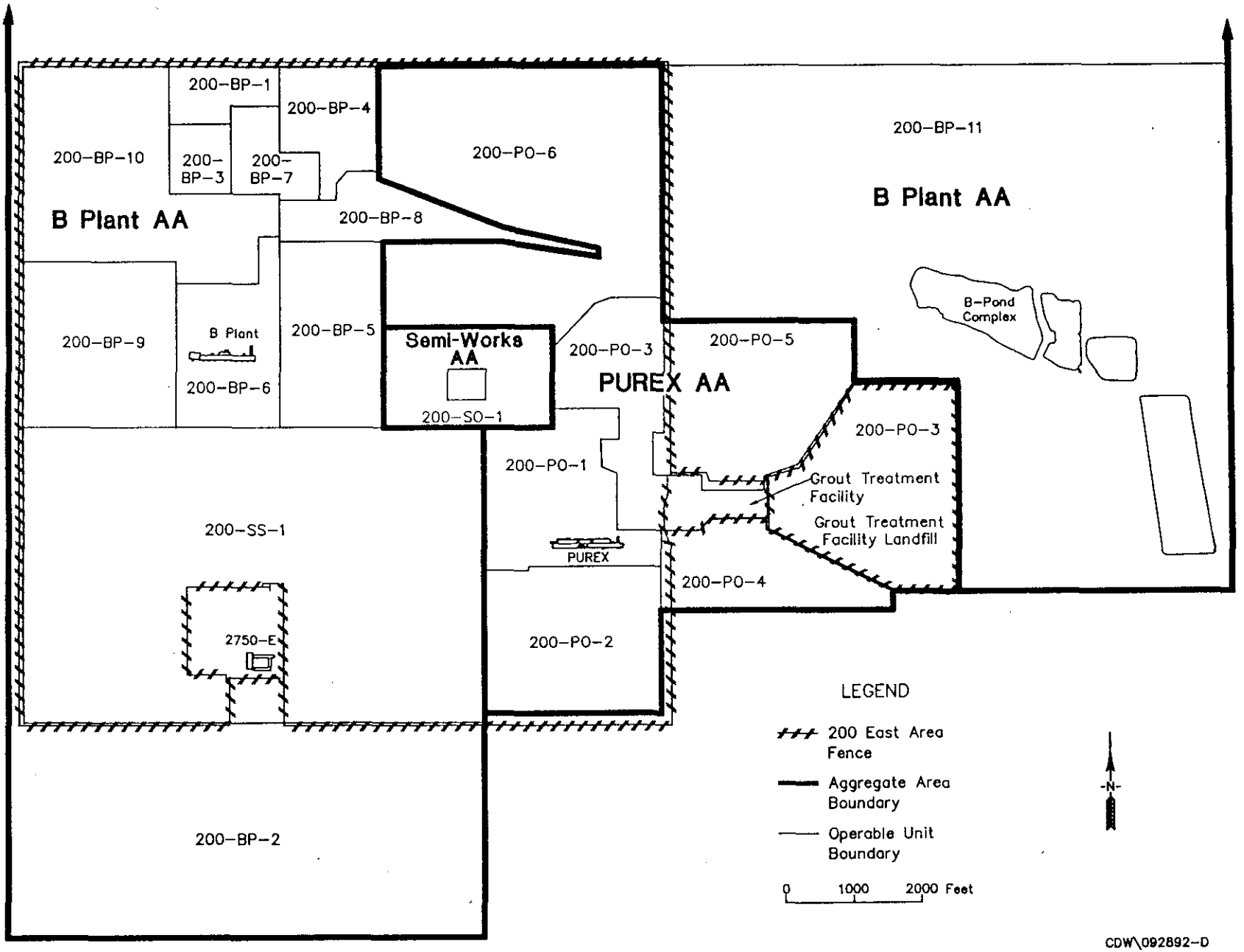


Figure 1-3. 200 East Aggregate Areas.

Figure 1-4. 200 West Aggregate Areas.

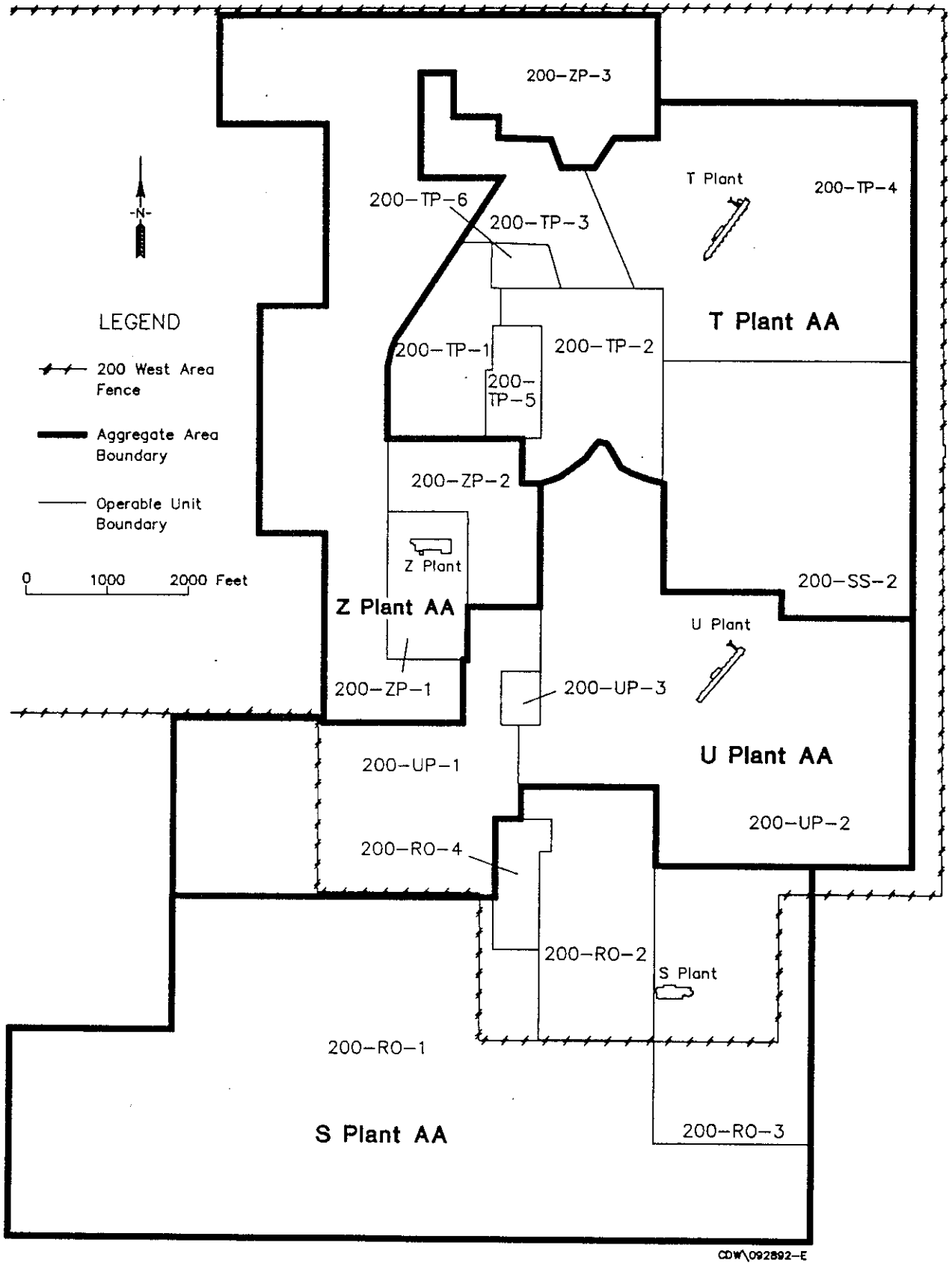
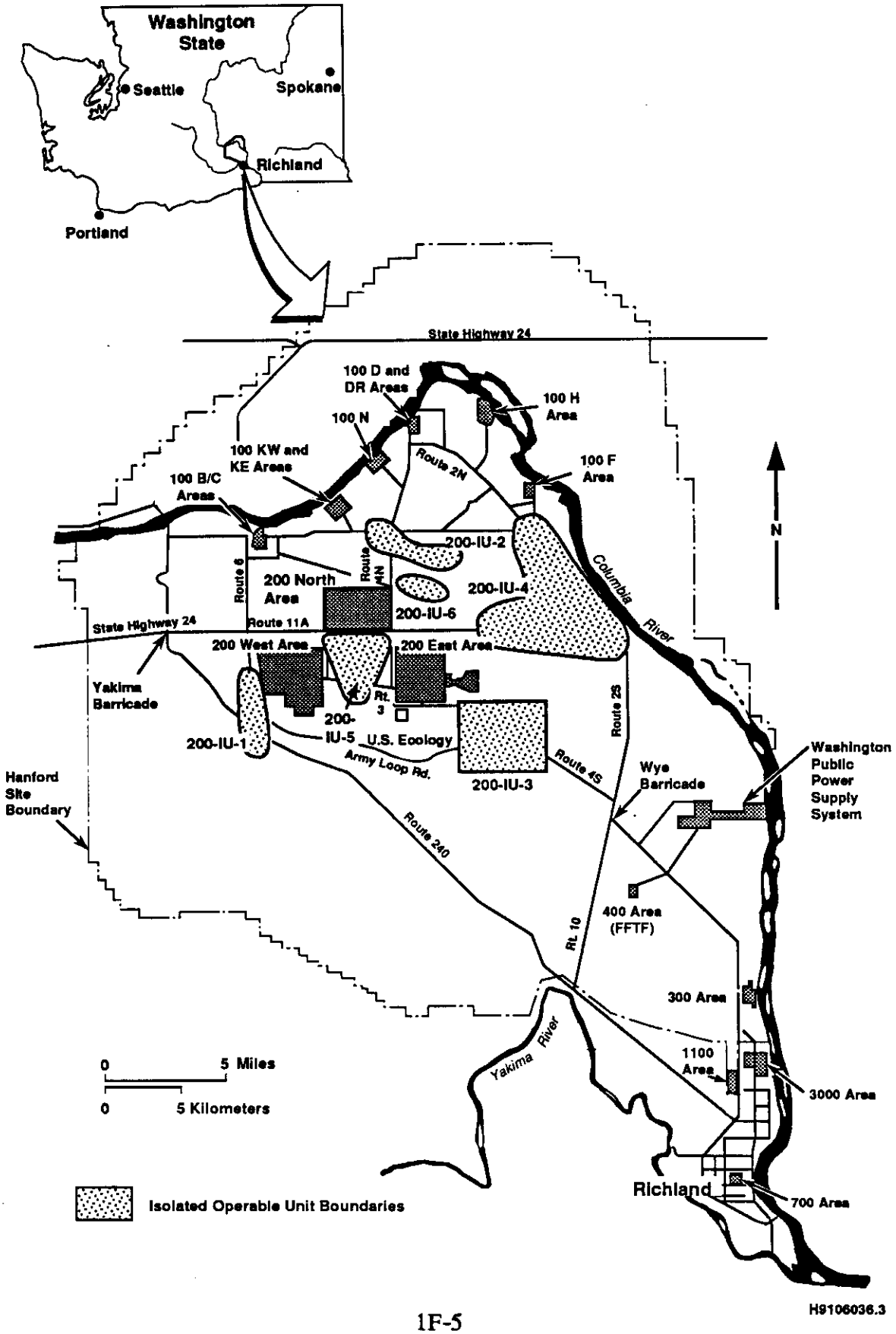


Figure 1-5. 200 NPL Site Isolated Operable Units.



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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 PUREX 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 waste management unit in Section 4.0. Data from these three sections are used to identify contaminants 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 PUREX Plant Aggregate Area (Section 2.1), summarizes the history of operations (Section 2.2), describes the facilities, buildings, and structures of the PUREX Plant Aggregate Area (Section 2.3), and describes PUREX Plant Aggregate Area waste generating processes (Section 2.4). Section 2.5 discusses interactions with other aggregate areas or operable units. Sections 2.6 and 2.7 discuss interactions with the Resource Conservation and Recovery Act (RCRA) and other Hanford programs.

2.1 LOCATION

The Hanford Site, operated by the U.S. Department of Energy (DOE), occupies about 1,450 km^2 (560 mi^2) 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 km^2 (6 mi^2) 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 1-3). The PUREX Plant Aggregate Area (consisting of operable units 200-PO-1, 200-PO-2, 200-PO-3, 200-PO-4, 200-PO-5, and 200-PO-6) lies in the eastern portion of the 200 East Area (Figure 1-3). The locations of the buildings and waste management units are shown on Plate 1. Plate 2 shows the topography of the PUREX Plant Aggregate Area. The media sampling locations are depicted on Plate 3.

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, C, 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 (West and East) are mainly related to separation of special nuclear materials from spent nuclear fuel. Spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation. The 200 East Area consists of two main processing facilities (Figure 1-3):

- 202-A Building (PUREX Plant), where recovery of uranium and plutonium from N Reactor fuels took place

- 221-B Building (B Plant), where plutonium was separated from uranium and the bulk of the fission product separation took place.

The 200 Areas also contain nonradioactive support facilities, including transportation maintenance buildings, service stations, and 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 conducted at PUREX Plant Aggregate Area have been involved with uranium and plutonium recovery. A PUREX Plant Aggregate Area timeline is schematically illustrated in Figure 2-1.

The 202-A Building (PUREX Plant) is one of the primary PUREX Plant Aggregate Area facilities. The PUREX process is an advanced solvent extraction process that uses tributyl phosphate in normal paraffin hydrocarbon solvent for recovering uranium and plutonium from nitric acid solutions of irradiated uranium. This process was utilized between 1955 and 1972. After 11 years in standby, the building resumed operations in November 1983. The 202-A Building ceased operating in 1990 and a decision to shut down the facility was announced in December 1992.

The 241-A Tank Farm contains six single-shell tanks constructed in the mid-1950's. These tanks received mixed waste from the plutonium/uranium extraction (PUREX) process.

The 241-AX Tank Farm contains four single-shell tanks constructed in the mid-1960's and retired in the early 1980's. These tanks received mixed waste from the 202-A Building and the 221-B Building.

The 241-C Tank Farm contains 16 single-shell tanks constructed during the mid-1940's and retired in the late 1970's. These tanks primarily received high-level waste from the bismuth phosphate process used in the 221-B Building. The tanks in the 241-C Tank Farm also received waste from the 201-C Building (Semiworks) and laboratory waste from the 209-E Building (Critical Mass Laboratory). A detailed description of the interim stabilization process for the tank farms is discussed in Section 2.3.2.

The 241-AN Tank Farm contains seven double-shell tanks constructed during the early-1980's. These tanks primarily receive dilute non-complexed waste and double-shell slurry feed. Waste from these tanks is processed in the 242-A Evaporator.

The 241-AP Tank Farm contains eight double-shell tanks constructed during the mid-1980's. These tanks primarily receive ammonia scrubber feed and dilute non-complexed customer waste. Customer waste is material that is not associated with processing plant activities. The tanks in the 241-AP Tank Farm also receive double-shell slurry feed and cladding removal waste.

The 241-AW Tank Farm contains six double-shell tanks constructed during the late-1970's. These tanks receive double-shell slurry feed, dilute non-complexed waste, decladding supernate, and transuranic (TRU) sludge.

The 241-AY Tank Farm contains two double-shell tanks constructed during the late-1960's. These tanks receive strontium- and cesium-depleted, neutralized high-level waste from B Plant, double-shell slurry feed, dilute non-complexed waste, and dilute complexed waste. Neutralized high-level waste is process waste from the first cycle processing of fuel rods which have been treated for disposal to underground storage tanks.

The 241-AZ Tank Farm contains two double-shell tanks constructed during the mid-1970's. These tanks primarily receive dilute high-strontium waste from B Plant, double-shell slurry feed, and non-complexed waste.

2.3 FACILITIES, BUILDINGS, AND STRUCTURES

The PUREX Plant Aggregate Area contains a variety of facilities that were involved in waste generation, transfer, treatment, storage, or disposal. Radiologically contaminated processing wastes were discharged to the soil column through cribs, trenches, and other facilities. Wastes which were not normally contaminated, but have the potential to contain

radionuclides, such as cooling water and condensate water, were allowed to infiltrate into the ground through ponds and open ditches. Radiologically contaminated waste types are defined in DOE Order 5820.2A (DOE 1988a):

- High-Level Waste is defined as: highly radioactive waste 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 TRU waste and fission products in concentrations as to require permanent isolation.

- TRU waste is defined as: without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g. 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: radioactive waste, not classified as high-level waste, TRU waste, spent nuclear fuel, or IIe(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 waste 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 RCRA 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 RCRA. (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 PUREX 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).

Table 2-1 presents a list of the waste management units within the PUREX Plant Aggregate Area. In addition, the aggregate area contains several unplanned release sites. The locations of the waste management units are shown on separate figures for each waste management group and on Plate 1. Figure 2-1 summarizes the operational history of each of the waste management units (WHC 1991a; DOE/RL 1991a). Tables 2-2 and 2-3 summarize data available regarding the quantity and types of wastes disposed of to the waste management units. These data have been compiled from the Waste Information Data System (WIDS) inventory sheets (WHC 1991a) and from the Hanford Inactive Site Survey (HISS) database (DOE 1986). These inventories include all of the contaminants reported in the databases, but do not necessarily include all of the contaminants disposed of at each waste management unit. In the following sections, each waste management unit is described within the context of one of the waste management unit types.

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 Program. Section 2.7 details interaction of the Hanford programs. Because several of the PUREX Plant Aggregate Area plants or buildings were the primary generators of waste disposed within the PUREX Plant Aggregate Area, a description of these is provided in Section 2.3.1.1. The PUREX Plant Aggregate Area plants and buildings that are also waste management units are addressed in Section 2.3.1.2. Some plants and buildings are or contain RCRA treatment, storage, or disposal (TSD) facilities. A description of such facilities is provided in Section 2.6. The locations of plants and buildings in the aggregate area are shown in Figure 2-2.

The 202-A Building, the 241-A-431 Building (Condenser Building), and the 293-A Building (offgas treatment and acid recovery) were the primary generators of waste within the aggregate area. These plants, and the buildings associated with them, will be described in the following sections.

Other buildings and structures located within the aggregate area are not addressed in this study and will be closed through a separate decontamination and decommissioning process. These structures include:

- 241-A-401 Condenser House (coolant building)
- 291-A Building (fan control house and 291-A Stack)
- 241-AX-801-B Building
- 203-A Building (acid pumphouse)
- 218-E-14 PUREX Tunnel
- 218-E-15 PUREX Tunnel
- 242-A Evaporator.

2.3.1.1 Process Facilities

2.3.1.1.1 202-A Building. The 202-A Building was one of the primary sources of waste in the PUREX Plant Aggregate Area and it is the dominant physical structure within the area.

The 202-A Building was constructed between 1953 and 1955 as a chemical separation facility and then operated until 1972. The building began operation again in November 1983 and was finally terminated in December 1992. It was the last of five Hanford Site canyon buildings to be built. The term "canyon" comes from the large size and the canyon-like appearance of the upper galleries. The main purpose for this facility was to extract plutonium, uranium, and neptunium contained in irradiated uranium fuel rods discharged from Hanford Site reactors.

The 202-A Building is a reinforced concrete structure 306 m (1,005 ft) long, 36 m (119 ft) wide at its maximum, and 30 m (100 ft) high. The structure has about 12.2 m (40 ft) below grade. The building consists of three main structural components: (1) a thick-walled, concrete canyon in which the equipment for radioactive processing is contained (in cells below grade); (2) the pipe and operating, sample, and storage galleries; and (3) a steel-and-transite annex that houses offices, process control rooms, laboratories, and the building services. The portion of the canyon below grade is subdivided into a row of process

equipment cells paralleled by a ventilation air tunnel and a pipe tunnel through which intercell solution transfers are made. The air tunnel exhausts the ventilation air from the cells to the ventilation filters and stack. Running nearly the full length of the canyon building, above the cells and pipe trench, is a craneway for three gantry-type maintenance cranes. These cranes are used to handle cell cover blocks, remotely remove and replace process cell equipment, and charge irradiated fuel into the dissolvers. The galleries contain service piping to the cells, samplers for obtaining process samples, and electrical switchgear. The service section, next to the galleries, consists of two separate annexes. The larger annex contains the maintenance shops, offices, lunchroom, locker room, radiation zone entry lobby [special work permit lobby], blower room, a switchgear room, compressor room, central control room, and the aqueous makeup unit. The smaller annex contains the analytical laboratory, the headend control room, and a switchgear room.

The PUREX chemical separation processes are based on dissolving the decladded fuel rods in nitric acid and conducting multiple purification operations on the resultant aqueous nitrate solution. The process steps involve fuel-element decladding, uranium metal dissolution, solvent extraction, ion exchange, and product load-out.

Several unplanned release locations are in the vicinity of the 202-A Building. These are UN-200-E-13, UN-200-E-19, UN-200-E-25, UN-200-E-26, UN-200-E-28, UN-200-E-31, UN-200-E-35, UN-200-E-58, UN-200-E-65, UN-200-E-96, UN-200-E-97, UN-200-E-114, and UN-200-E-142. These unplanned releases range from contaminated tumbleweeds to leaks in a diversion box.

Three units within the 202-A Building have a current RCRA operating permit. The units included are the E-F11 Concentrator, PUREX Waste Piles, and the E-5, G-7, F-15, F-16, F-18, U3, and U4 Neutralization Tanks.

2.3.1.1.2 293-A Building. The 293-A Building (Offgas Treatment Facility) removes nitrogen oxides from the dissolver offgas stream then converts the nitrogen oxides to nitric acid. The nitric acid is then recycled into the PUREX process via the 206-A Building. This process does not operate during standby conditions.

No unplanned releases are associated with this unit.

2.3.1.2 Waste Management Unit Buildings

2.3.1.2.1 241-A-431 Building. The 241-A-431 Building (Tank Farm Ventilation Building) was in operation from 1955 to 1969. It is located in the southeastern corner of the 241-A Tank Farm. This building is also known as a condenser building. This building provided offgas de-entrainment for the 241-A Tank Farm and also received the 296-A-11 Stack drainage.

The 241-A-431 Building is a concrete structure, 8 m (25 ft) high, with the lower 4.9 m (16 ft) below grade. The walls are 20 cm (8 in.) thick and the unit is divided into two sections. One section is 3 x 5 x 3 m (10 x 16 x 10 ft) high and houses the ventilation equipment. The other section is 3 x 5 x 8 m (10 x 16 x 25 ft) high and houses the de-entrainment equipment.

No unplanned releases are associated with this unit.

2.3.1.2.2 204-AR Waste Unloading Station. The 204-AR Waste Unloading Station is a two-story, structural steel, reinforced-concrete building located 91 m (300 ft) west of the 241-A Tank Farm. The facility started operating in 1982 and is still active. The waste unloading station is designed to receive various wastes via rail cars and to pump the wastes to the double-shell tank farms. The 204-AR facility provides agitation, neutralization, nitrite addition, and sampling of the tank car liquid wastes as well as hydraulic sluicing of the tank cars to remove residual solids (Bixler et al. 1981).

The facility receives wastes generated from decontamination and regeneration operations in the 100 Areas; from recovery fabrication, and laboratory operations in the 300 Area; and from decontamination operations in the 400 Area. The waste is chemically adjusted in-line during pumpout to the double-shell tanks to meet corrosion specifications. A catch tank is located beneath the facility and currently contains 1,966 L (520 gal) of waste.

No unplanned releases are associated with this unit.

2.3.1.2.3 Grout Treatment Facility. The Grout Treatment Facility (GTF) is located on the eastern edge of the PUREX Plant Aggregate Area and occupies 1 km^2 (0.4 mi^2). The GTF was developed for the handling, immobilization, and disposal of waste. This provides an alternative for traditional disposal of low-level tank waste to waste management units (i.e., cribs, french drains, etc.). The Transportable Grout Treatment Equipment (TGE) consists of a dry-blended solids feed and lag storage system and mixing and pumping equipment. The dry solids are stored and blended at the Dry Materials Receiving and Handling Facility. The 241-AP-102 and 241-AP-104 Double-Shell Tanks are used as the liquid waste feed tanks. Waste materials are transferred from the waste tanks to the TGE via underground and shielded aboveground pipes. The TGE then prepares grout slurries adjacent to the near-surface disposal sites. The grout is produced by mixing the liquid waste feed stream with the dry-blend solids formulated for a specific waste stream. Following mixing, the TGE pumps the grout to a designated disposal vault. Each vault is a concrete structure 38 x 16 x 10 m (124 x 51 x 34 ft). The vaults are lined with a geomembrane liner to prevent dewatering of the grout to the environment. In addition, a leachate collection system is installed in each vault. Each vault has a capacity of approximately 5,000 m^3 (176,600 ft^3) of grouted waste. Grouted waste in a vault solidifies or cures in about 28 days.

No unplanned releases are associated with this unit.

2.3.1.2.4 241-C-801 Support Facility. The 241-C-801 Cesium Loadout Facility is located within the 241-C Tank Farm. This support facility started operating in 1962 and stopped operating in 1976. The building is 10 x 8 x 8 m (32 x 26 x 28 ft). The bottom 3m (10 ft) of the building is constructed of concrete while the remainder of the building is standard 22 gage prefabricated metal 4 m (12 ft) high. Trucks equipped with ion exchange casks were backed into the building and supernate was pumped from the 241-C-105 single-shell tank to recover cesium. The casks were then sent offsite to Oak Ridge, Tennessee. The building consists of a loadout room, an operations room, and a valve pit.

No unplanned releases are associated with this unit.

2.3.1.2.5 242-A Evaporator. The 242-A Evaporator/Crystallizer is located just north of the 241-AW Double-Shell Tank Farm. The 242-A Evaporator contains the evaporator vessel, supporting process equipment, and the principal process components of the evaporator-crystallizer system. Section 2.4.2 discusses the 242-A Evaporator waste volume reduction process in greater detail.

No unplanned releases are associated with this unit.

2.3.2 Tanks and Vaults

Tanks and vaults were constructed on the Hanford Site to handle and store high-level liquid wastes generated by uranium and plutonium processing activities. Several types of tanks are present in the PUREX Plant Aggregate Area including 5 catch tanks, 26 single-shell tanks, 25 double-shell tanks, 2 vaults, and 1 lift station. The catch tanks are generally associated with diversion boxes and other transfer units, and were designed to accept overflow and spills. The vaults are concrete structures that house several smaller tanks that serve a variety of functions. Single-shell tanks were used to collect and store large quantities of mixed wastes. Double-shell tanks are active tanks that are currently used to collect and store large quantities of mixed wastes. The catch tanks, vaults, and lift station will be discussed individually in this section. The septic tanks are discussed in Section 2.3.6. The single-shell and double-shell tanks will be addressed below.

All single-shell tanks will be evaluated under the Single-Shell Tank Closure Program and the double-shell tanks will be evaluated under the Waste Management Program as discussed in Section 9.0. Therefore, detailed discussions need not be addressed 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 and Waste Management Programs as applicable. Tables 2-1 and 2-4 list single-shell and double-shell tank information that is of importance to this report, including source description, tank integrity, waste volume remaining, and drainable waste volume. The operational history is presented in Figure 2-1 and a reference list for additional single-shell and double-shell tank information is provided in Table 2-5.

There are three single-shell tank facilities considered within the scope of this PUREX Plant AAMS: the 241-A Tank Farm, the 241-AX Tank Farm, and the 241-C Tank Farm. The 241-A Tank Farm consists of six single-shell tanks with capacities of 3,785,000 L (1,000,000 gal), the 241-AX Tank Farm consists of four single-shell tanks with capacities of 3,785,000 L (1,000,000 gal), and the 241-C Tank Farm consists of sixteen single-shell tanks, twelve with capacities of 2,017,000 L (533,000 gal) and four with capacities of 208,000 L (55,000 gal). The 241-A, 241-AX, and 241-C Tank Farms were built in the mid-1950's, mid-1960's, and mid-1940's, respectively. The locations of the tanks and vaults are shown on Figures 2-3, 2-4, and 2-5. Figure 2-6 depicts a typical 2,017,000 L (533,000 gal) tank. Table 2-4 shows tank status in the PUREX Plant Aggregate Area Tank Farms. More details concerning the individual tank farms are discussed in the following sections.

There are five double-shell tank facilities considered within the scope of this PUREX Plant AAMS: the 241-AN Tank Farm, the 241-AP Tank Farm, the 241-AW Tank Farm, the 241-AY Tank Farm, and the 241-AZ Tank Farm. The 241-AN Tank Farm consists of seven double-shell tanks with capacities of 4,309,200 L (1,140,000 gal), the 241-AP Tank Farm consists of eight double-shell tanks with capacities of 4,309,200 L (1,140,000 gal), the 241-AW Tank Farm consists of six double-shell tanks with capacities of 4,309,200 L (1,140,000 gal), and the 241-AY and 241-AZ Tank Farms consists of 2 double-shell tanks per farm with capacities of 3,704,400 L (980,000 gal). The 241-AN, 241-AP, 241-AW, 241-AY, and 241-AZ Tank Farms were placed in service in 1981, 1986, 1980, 1971, and 1976, respectively. The locations of the tanks and vaults are shown on Figures 2-3, 2-4, and 2-5. Figure 2-7 depicts a typical double-shell tank. Table 2-4 shows tank status in the PUREX Plant Aggregate Area Tank Farms.

The waste contained in the tanks can occur in three forms: sludge, salt cake, or liquid. Sludge is composed primarily of insoluble metal hydroxides and hydrated oxides that precipitated from neutralized high-level waste solutions. Salt cake is composed primarily of crystallized nitrate salts (particularly sodium nitrate), the majority being produced by waste concentration operations. The liquid wastes are aqueous solutions rich in sodium hydroxide and sodium aluminate, as well as sodium nitrate. Liquid waste can be present as supernatant or interstitial fluid.

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) and is defined as the removal of as much liquid as possible through the use of a salt well and a jet pump. A salt well is a slotted riser pipe inserted into the salt cake of a tank and into which a pump is placed. Generally, a 100 series tank (a tank with a volume greater than 1,895,500 L [500,793 gal]) is considered interim stabilized 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). Interim isolation is an administrative designation reflecting the completion of the physical effort required to minimize the unplanned addition of liquids into a tank. It is the sealing of all accesses to the tank that are not required for long-term surveillance, so as

to prevent inadvertent additions of liquid. Partially interim isolated 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 single-shell tanks to varying degrees as listed in Table 2-4. Double-shell tanks are active facilities, thus, they are not considered for stabilization or isolation.

All single-shell and double-shell tanks are classified as either "sound" or as an "assumed leaker", as listed in Table 2-4. 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).

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. Double-shell tanks still actively receive waste. The current status of single-shell and double-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 single-shell and double-shell tank information can be found in these two documents, and others, as listed in Table 2-5.

2.3.2.1 241-A-302A Catch Tank. The 241-A-302A Catch Tank is located near the 241-A-151 Diversion Box, immediately south of the 202-A Building.

The 241-A-302A Catch Tank started operating in 1956 and is still active. It is designed to contain leaks from transfers and drainage from operation within the 241-A-151 Diversion Box. It currently contains 13,645 L (3,605 gal) of waste.

No unplanned releases are associated with this unit.

2.3.2.2 241-A-302B Catch Tank. The 241-A-302B Catch Tank is located in the 241-A Tank Farm, which is approximately 487 m (1,600 ft) northeast of the 202-A Building and directly south of the 241-AX and 241-AY Tank Farms. It is located on the berm on the east side of the tank farm fence.

Constructed in 1956 and deactivated in 1980, the 241-A-302B Catch Tank is an inactive waste management unit. A fill pipe and a liquid level measurement station are present. The unit is associated with the 241-A Tank Farm and the 241-A-152 Diversion Box. This unit was used for the transfer of waste solutions from processing and decontamination procedures. It currently contains 12,306 L (3,240 gal) of waste.

No unplanned releases are associated with this unit.

2.3.2.3 241-A-350 Catch Tank. The 241-A-350 Catch Tank is located at the south end of the 241-A Tank Farm.

Constructed in 1956, the 241-A-350 Catch Tank is an active waste management unit with a 2,950 liter (775 gallon) capacity. A fill pipe and a liquid level measurement station are present. The unit is associated with the 241-A Tank Farm and the 241-A-A and 241-A-B Diversion Boxes. This unit was used for the transfer of waste solutions from processing and decontamination procedures. The quantity and nature of the liquid in the tank is unknown.

No unplanned releases are associated with this unit.

2.3.2.4 241-A-417 Catch Tank. The 241-A-417 Catch Tank is located just west of the 241-A-401 Condenser Building and south of the 241-AX Tank Farm.

Constructed in 1956, the 241-A-417 Catch Tank is an active waste management unit. This unit was used to collect condensate from the 241-A-401 Condenser House. It currently holds 120,600 L (31,900 gal) of the 207-A Retention Basin condensate.

No unplanned releases are associated with this unit.

2.3.2.5 241-C-301C Catch Tank. The 241-C-301C Catch Tank is located of the 241-C-252 Diversion Box and west of the 241-C-204 Single-Shell Tank. The unit is near the north corner of the fence of the 241-C Tank Farm.

Constructed in 1946, the 241-C-301C Catch Tank is an inactive waste management unit. The unit was isolated at the surface in 1985 and is marked at the surface by two sets of 10 cm (4 in.) diameter, stubbed pipes, less than 1 m (2 ft) high.

The unit is associated with the 241-C-151, 241-C-152, 241-C-153, and 241-C-252 Diversion Boxes and the 241-C Tank Farm. This unit was used for the transfer of waste solution from processing and decontamination operations. It currently holds 120,600 L (31,900 gal) of the 207-A Retention Basin condensate.

No unplanned releases are associated with this unit.

2.3.2.6 244-A Lift Station. The 244-A Lift Station is located approximately 396 m (1,300 ft) north of the 202-A Building. The unit began operating in 1975 and is still active. The lift station is 6 m (19 ft) long and 5 m (15 ft) in diameter. The 244-A Lift Station contains a carbon steel tank having a capacity of 61,538 L (16,280 gal) which sits vertically inside a larger reinforced concrete, steel-lined vault with 0.3 m (1 ft) thick walls and a 1 m (4 ft) thick base. The bottom of the vault is 15 m (49 ft) below grade. The unit receives waste from several tank farms and currently contains 13,955 L (3,692 gal) of waste.

One unplanned release (UPR-200-E-70) is associated with this unit.

2.3.2.7 244-AR Vault. The 244-AR Vault is located approximately 61 m (200 ft) west of 241-A Tank Farm. The vault began operating in 1968 and is in standby mode (WHC 1990b); however, it is considered still active. The facility comprises the following: a canyon building; wind reduction building; instrument building; closed-loop cooling equipment building; control room; crane control room; and a changehouse. There are four steel tanks in the facility; two with a capacity of 177,000 liter (46,800 gal) and two with a capacity of 21,200 liter (5,075 gal).

The 244-AR Vault was originally used to process radioactive waste that was being removed ("sluiced") from storage tanks. The waste was eventually transferred to B Plant for removal of cesium and strontium (WHC 1990b). The facility also was the focal point for reprocessing and routing of PUREX-generated waste between tank farms and the B Plant facilities in the late 1960's and between the tank farms and the Waste Encapsulation Storage Facility (WESF) in the late 1970's (Pines 1985). In 1984, a decision was made to upgrade the 244-AR Vault for use as a waste transfer facility. The extensive upgrading effort provided improved features for the safe and efficient transferring of PUREX-generated waste between the tanks farms and B Plant. These wastes consist of cladding removal waste enroute to B Plant and TRU waste from B Plant/WESF to the tank farms.

One unplanned release (UPR-200-E-59) is associated with the 244-AR Vault.

2.3.2.8 244-CR Vault. The 244-CR Vault is located in the 241-C Tank Farm just south of the 241-C Tanks and southeast of the 241-CR-151 Diversion Box. The vault started operating in 1946 and ceased operating in 1988. The vault is a reinforced concrete building 31 m (102 ft) long by 8 m (26 ft) wide and 17 m (55 ft) deep. It is a two-level, multi-cell structure constructed below grade. The lower cell contains the process vessels and the upper cells contain the attendant piping and equipment. The facility's roof cover blocks allow access to the upper cells when removed. The lower cells contain four process vessels: TK-CR-001 and TK-CR-011 have diameters of 6 m (20 ft) and are 6 m (19 ft) tall; and TK-CR-002 and TK-CR-003 have diameters of 4 m (14 ft) and are approximately 4 m (12 ft) tall. The larger tanks have a volume of 177,150 liters (40,000 gallons) and the smaller tanks have a volume of 56,800 liters (15,000 gallons). The 244-CR Vault was used in the transfer of waste solutions from processing and decontamination operations.

Three unplanned releases (UN-200-E-27, UN-200-E-99, and UN-200-E-107) are associated with this unit.

2.3.3 Cribs and Drains

The cribs and drains were designed to percolate wastewater into the ground without exposing it to the atmosphere. The locations of cribs and drains in the aggregate area are shown on Figure 2-8. Cribs are shallow excavations that are either backfilled with medium to coarse gravel material or held open by wooden structures. Both types of cribs are covered with an impermeable vapor barrier made of either sisalkraft paper (a natural fiber media) or polyethylene which is then covered with soil to grade. Water flows directly into the backfilled material or covered open space and percolates into the vadose zone soils. A typical crib is illustrated in Figure 2-9. French drains are generally constructed of steel or concrete pipe and may be either open or filled with gravel. A typical french drain is illustrated in Figure 2-10. The PUREX Plant Aggregate Area contains 24 cribs and 16 french drains.

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 liquids 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 the percent of 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 following sections describe each crib and drain in the PUREX Plant Aggregate Area.

2.3.3.1 216-A-1 Crib. The 216-A-1 Crib is located inside the 200 East Area perimeter fence extension, 60 m (200 ft) east of the 241-A Tank Farm, along Canton Avenue. The bottom of the crib is 9 x 9 m (30 x 30) and 5 m (15 ft) deep. The crib has two layers of sisalkraft paper separating the gravel fill from the backfill. The side slope from the surface to 2 m (7 ft) deep is 1:1.5 (V:H), and from 2.1 m (7 ft) to 5 m (15 ft) deep is 1:2. The crib is composed of three 15 cm (6 in.) perforated pipes, 9 m (30 ft) long, running horizontally at 3 m (9 ft) below grade in an H pattern. The bottom 1.8 m (6 ft) of the excavation is filled with 300 m^3 (11,000 ft^3) of coarse rock. Effluent entered the crib from overground piping. The crib also has an inlet pipe entering at the cross bar of the H-pattern distribution piping; a strainer rising vertically from the center; and, a concrete pad to support the strainer. This waste management unit is surrounded by a light chain barricade with surface contamination warning signs. Ancillary equipment includes the 216-A-1 Sampler Pit No. 3.

This crib was only active from November to December of 1955. During this time the unit received the depleted uranium waste from the cold startup run in the 202-A Building. It received a total of 98,400 L (26,000 gal). The unit was deactivated by removing the overground piping and backfilling when it reached specific retention capacity.

No unplanned releases are associated with this unit.

2.3.3.2 216-A-2 Crib. The 216-A-2 Crib is located 80 m (260 ft) south of the 202-A Building, 300 m (900 ft) west of Canton Avenue, and southwest of the 291-A-1 Stack. The bottom crib dimensions are 6 x 6 m (20 x 20 ft) and 8 m (27 ft) deep. The waste management unit consists of 15 cm (6 in.) perforated lines, two 6 m (20 ft) lengths forming a cross pattern horizontally 6.4 m (21 ft) below grade. It has approximately 2 m (6 ft) (140 m^3 [5,000 ft^3]) of coarse rock and is backfilled with clean fill to grade. The side slope from grade to 6.4 m (21 ft) deep is 1:1.5, and from 6.4 m (21 ft) to 8.2 m (27 ft) deep it is 2:1. The crib also has two 10 cm (4 in.) inlet pipes 5 m (15 ft) long, and a 15 cm (6 in.) strainer 4.1 m (13.5 ft) long, rising vertically from the bottom to a vent structure. There are two concrete pads to support the strainer and the vent, and a sisalkraft paper to separate the gravel fill from the backfill. The crib is marked by a light chain barrier and a stubbed green pipe.

This unit was active from January 1956 through January 1963. During this time it received 230,000 L (61,000 gal) of organic wastes, containing normal paraffin hydrocarbons and tributyl phosphate, from the 202-A Building. The unit was deactivated by removing a section of effluent piping when the specific retention capacity was reached.

No unplanned releases are associated with this unit.

2.3.3.3 216-A-3 Crib. The 216-A-3 Crib is located directly south of the 275-EA Building, approximately 365 m (1,200 ft) west of Canton Avenue and 180 m (600 ft) north of the 202-A Building. The crib dimensions are 6 m (20 ft) in length and width with a depth of 5 m (15 ft). The waste management unit has three perforated pipes 2.4 m (8 ft) below grade placed horizontally forming an H pattern. The unit has about 2.4 m (8 ft) (280 m^3 [10,000 ft^3]) of gravel backfilled into the crib. The side slope from grade to 2 m (7 ft) deep is 1.5:1, and from 2 m (7 ft) to the bottom is 2:1.

The 216-A-3 Crib was in operation from January 1956 to April 1981. From the beginning of operation until November 1967, the waste management unit received wastes from silica-gel regeneration in the 203-A Building, the uranyl nitrate hexahydrate storage pit drainage, and the liquid waste from the 203-A Pump House. From November 1967 to April 1981, the crib received uranyl nitrate hexahydrate storage pit drainage, liquid drainage, liquid waste from the 203-A Building enclosure sumps, and the heating coil condensate from the P1 through P4 uranyl nitrate hexahydrate tanks. The above wastes were reworked

through the uranium cycle and any resulting wastes with low radioactivity were sent to 216-A-29 Ditch. This crib received over 3,000,000 L (800,000 gal) of waste (WHC 1991a).

No unplanned releases are associated with this unit.

2.3.3.4 216-A-4 Crib. The location of the 216-A-4 Crib is 80 m (260 ft) south of the 202-A Building and 230 m (760 ft) west of Canton Avenue, and 46 m (150 ft) east of the 216-A-2 Crib. The crib dimensions are 6 x 6 m (20 x 20 ft) and 8 m (26 ft) deep, with a side slope from the surface to 5.5 m (18 ft) deep of 1:1.5, and from 5.5 m (18 ft) to 8 m (26 ft) deep, with a slope of 1:2. The excavation has 5.5 m (18 ft) (280 m^3 [10,000 ft^3]) of coarse rock fill and has been backfilled to grade. The waste management unit consists of two 6 m (20 ft) lengths of 15 cm (6 in.) perforated pipe forming a cross pattern horizontally 5.5 m (18 ft) below grade. Additional structures to the crib consist of three 10 cm (4 in.) inlet pipes 5 m (15 ft) long, a 15 cm (6 in.) strainer 4.1 m (13.5 ft) long, a vent structure, a vent box and concrete pad, and two layers of sisalkraft paper separating the gravel from the backfill. Ancillary equipment include the 216-A-4 Sample Pit, the 216-A-Tank No. 1, and 216-A-Tank No. 2.

This waste management unit was active from December 1955 through December 1958. During this time the crib received 6,210,000 L (1,640,000 gal) of laboratory cell drainage from the 202-A Building and the 291-A-1 Stack drainage. The waste management unit was deactivated by blanking the effluent piping when the unit reached its specific retention capacity. The unit is surrounded by a light chain barricade in addition to the 202-A Building contamination zone barricade.

Two unplanned releases (UN-200-E-13 and UN-200-E-15) are associated with this unit.

2.3.3.5 216-A-5 Crib. The 216-A-5 Crib is located 140 m (450 ft) south of the 202-A Building and 430 m (1,400 ft) west of Canton Avenue between the inner and outer 202-A Building exclusion area fences. The crib excavation dimensions are 10.6 x 10.6 m (35 x 35 ft) and 9.8 m (32 ft) deep, with a side slope from the surface to 7.3 m (24 ft) deep of 1:1.5, and from 7.3 to 9.8 m (24 to 32 ft) deep of 2:1. The excavation is backfilled with about 2.4 m (8 ft) (600 m^3 [21,000 ft^3]) of coarse rock. The waste management unit consists of three 20 cm (8 in.) pipes placed horizontally 7.3 m (24 ft) below grade in an H pattern, an inlet pipe, a strainer and vent, two layers of sisalkraft paper, and a concrete pad to support the strainer. Ancillary equipment include a proportional sampling pit and the 216-A-5 Neutralization Tank.

This crib was active from December 1955 to October 1966. From December 1955 to November 1961, the waste management unit received the process condensate from the 202-A Building. From November 1961 to October 1966, the unit was active but received no waste (backup for the 216-A-10 Crib). In October 1966, the unit received the process condensate from the 202-A Building. While active, the crib received approximately

1,630,000,000 L (431,000,000 gal) of acidic waste. The crib was deactivated by closing the value to the effluent piping to the unit and then rerouting the waste to the 216-A-10 Crib.

No unplanned releases are associated with this unit.

2.3.3.6 216-A-6 Crib. The 216-A-6 Crib is located outside the 200 East Area perimeter fence, 300 m (1,000 ft) east of the 202-A Building and 76 m (250 ft) east of Canton Avenue. The bottom dimension of the crib is 30 x 30 m (100 x 100 ft) and 6 m (19 ft) deep with a side slope from the surface to 2 m (7 ft) of 1:1, and from 2 to 6 m (7 to 19 ft) of 2:1. The waste management unit contains a 38 cm (15 in.) pipe placed horizontally 4 m (12 ft) below grade the length of the unit. Five 30 m (100 ft) lengths of perforated pipe are placed perpendicularly to the first pipe at 6 m (20 ft) intervals. The unit contains 2 m (7 ft) (2,600 m^3 [91,000 ft^3]) of coarse gravel fill and then backfilled to grade. This crib also has an inlet pipe, five strainers, two layers of sisalkraft paper, and five concrete pads to support the strainers.

The crib started operating in 1955 and ceased operating in 1970. From November 1955 to January 1961, this waste management unit received the steam condensate, the equipment disposal tunnel floor drainage, the water-filled door drainage and the slug storage basin overflow waste from the 202-A Building. From January 1961 to March 1966, the unit was inactive. After March 1966, the waste management unit received the previously mentioned effluents again until 1970. Overall, the total volume of waste received by this crib was 3,400,000,000 L (900,000,000 gal). In August 1974, the unit was deactivated by blanking the effluent pipeline to the unit in Diversion Box No. 1. The radiation zone denoting this unit was enlarged to include the contaminated ground surface northeast of the unit.

Two unplanned releases (UPR-200-E-21 and UPR-200-E-29) are associated with this unit.

2.3.3.7 216-A-7 Crib. The 216-A-7 Crib is located inside of the 200 East Area perimeter fence extension, 300 m (1,000 ft) east of the 241-A Tank Farm across from Canton Avenue. The bottom of the crib is 3 x 3 m (10 x 10 ft) and 4.6 m (15 ft) deep. The side slope from the surface to 3 m (10 ft) is 1:1 and from 3 m (10 ft) to the bottom is 2:1 (H:V). Two 15 cm (6 in.) perforated pipes are placed horizontally 3 m (10 ft) below grade with a 3 m (10 ft) length perpendicular to each other forming a cross pattern. The excavation is filled with 2.1 m (7 ft) (100 m^3 [3,500 ft^3]) of coarse rock. The crib is also made up of a riser supported by a concrete pad, two layers of sisalkraft paper for a barrier, and a 15 cm (6 in.) perforated inlet pipe. The 216-A-7 Crib received effluent via the 241-A-302B Catch Tank.

From November 1955 to July 1959 the crib received the catch tank overflow waste, the sump waste, and the pump pit drainage from the 241-A-152 Diversion Box. From July 1959 to November 1966, the waste management unit received the catch tank overflow waste and the pump pit drainage from the 241-A-152 Diversion Box. In November 1966, the unit

received the tributyl phosphate-kerosene organic inventory from the 202-A Building. The unit was deactivated in November 1966, by blanking off the effluent pipeline from the 241-A-152 Diversion Box. While active the crib received a total of 326,000 L (86,129 gal) of low salt and neutral/basic waste.

No unplanned releases are associated with the unit.

2.3.3.8 216-A-8 Crib. The 216-A-8 Crib is located east of the 200 East Area perimeter fence, about 200 m (650 ft) northeast of the 241-A Tank Farm. The bottom of the crib is 259 m (850 ft) long, 6 m (20 ft) wide, and 4.3 m (14 ft) deep with a 1:2 side slope. The crib has a 61 cm (24-in.) perforated distribution pipe placed horizontally 2 m (7 ft) below grade. The waste management unit contains 2 m (7 ft) (6,000 m^3 [206,000 ft^3]) of gravel fill and has been backfilled. The unit also contains four test risers, a vent riser, and two layers of sisalkraft paper for a barrier. A control box (216-A-508) is used to divert effluent to either the 216-A-8 Crib or the 216-A-24 Crib. Ancillary equipment include Sampler Pit No. 2.

An overflow line at the east end of the 216-A-8 Crib ran north to a 66 x 66 m (200 x 200 ft) pond. The overflow line had its own vent riser that was held up by an 8 to 10 ft high mound of soil. The overflow line and soil mound were removed in 1988 when the crib surface was stabilized with a 72 cm (24 in.) layer of clean fill to prevent the spread of contamination. The overflow pond was filled in with clean material taken from a barrow pit between the 216-A-8 and 216-A-24 Crib. Prior to stabilization, 216-A-8 Crib had a considerable amount of surface contamination around the vented risers and from deep-rooted vegetation reaching the crib.

From November 1955 to December 1957, the crib received condensate from the waste storage tanks in the 241-A and 241-AX Tank Farms. From December 1957 to May 1958, the crib received the above effluents and contact cooling water from the contact condenser in the 241-A-431 Building. From May 1958 to January 1966, the waste management unit was inactive; it had approached radionuclide capacity and was valved out. The condensate was rerouted to the 216-A-24 Crib and the cooling water rerouted to the 216-A-25 Pond. From January 1966 to April 1976, the unit was reactivated to receive the condensate from 241-A and 241-AX Tank Farms. From May 1976 to January 1978, the unit did not receive waste. From January 1978 to April 1978, the crib received 241-A, 241-AX and 241-AY Tank Farm condensate. From May 1978 to October 1983, the unit was inactive. In October 1983, the unit was reactivated to receive the 241-AY and 241-AZ Tank Farm condensate. From late-October 1983 to March 1984, the unit was inactive; flow was diverted to 241-A-417 Catch Tank due to high radiation alarms. In March 1984, the unit was reactivated for the same effluent as in October 1983. According to the 1990 survey this crib has thus far received 1,150,000,000 L (304,000,000 gal). The crib received approximately 70% of its total effluent in its first 30 months of operation.

According to Tri-Party Agreement milestone M-17-28, all discharge to the 216-A-8 Crib ceased in September 1991. There shall be no further soil column discharge to this unit until best available technology/all known, available, and reasonable technologies (BAT/AKART) are implemented. In the interim, effluent will be routed to double-shell tanks. Following implementation of BAT/AKART and approval of the sampling and analysis plan, discharge to the crib may resume if supported by the environmental impact assessment agreed to by the Washington State Department of Ecology (Ecology), DOE, and Environmental Protection Agency (EPA) (Ecology et al. 1992).

No unplanned releases are associated with this unit.

2.3.3.9 216-A-9 Crib. The 216-A-9 Crib is located 150 m (500 ft) west of the 241-A Tank Farm and 270 m (900 ft) north of 275-EA Building along 4th Street and the PUREX Plant Aggregate Area railway spur. The crib dimensions are 128 m (420 ft) in length, 6.1 m (20 ft) wide, and 4 m (13 ft) deep. The waste management unit contains a 10 cm (4 in.) perforated pipe placed horizontally 2.3 m (9 ft) below grade. The unit has 1.5 m (5 ft) of gravel backfilled into the crib. The side slope for the entire crib depth is 2:1. Ancillary equipment include a distribution box.

The 216-A-9 Crib operated from March 1956 to August 1969. Between March 1956 and February 1958 the unit received the acid fractionator condensate and the condenser cooling water from the 202-A Building. From February 1958 to April 1966, the waste management unit was inactive because the condenser flow had surpassed the capacity of the crib. From April to October of 1966, the unit received N Reactor decontamination waste via a manhole at the site. From October 1966 to August 1969, the unit was inactive. In August 1969, the unit received the acid fractionator condensate from the 202-A Building. The crib was deactivated by blanking the effluent pipeline to the unit after replacing 33 m (100 ft) of the pipeline that had failed. The effluents were then rerouted to the 216-A-29 Ditch via the 202-A Building chemical sewer. The unit received 981,000,000 L (259,000,000 gal) of waste throughout the years of operation.

One unplanned release (UN-200-E-33) is associated with this unit.

2.3.3.10 216-A-10 Crib. The 216-A-10 Crib is located approximately 120 m (390 ft) south of the 202-A Building. The crib excavation dimensions are 83.8 x 13.7 m (275 x 45 ft) and 13.7 m (45 ft) deep. The excavation is a wedge-shaped cross section with a side slope of 1:1.5 and has 4.6 m (15 ft) (12,000 m^3 [414,000 ft^3]) of rock fill. The unit has a 20 cm (8 in.) pipe placed horizontally 9 m (30 ft) below grade, 8.2 m (27 ft) east of the centerline. It also has the original distribution pipe, two layers of vinyl plastic separating the gravel from the backfill, two vent structures, a vent box on a concrete pad, and three 15 cm (6 in.) risers extending from the bottom to the vent structure. Ancillary equipment include a proportional sampling pit and the 216-A-5 Neutralization Tank.

During 1956, the waste management unit was used only for testing purposes using nonradioactive water. From 1956 to November 1961, the site was inactive. From November 1961 to January 1978, the unit received process condensate from the 202-A Building. From January 1978 to October 1981, the unit was again inactive. From October 1981 to 1986, the unit received the process condensate from the 202-A Building. After the 216-A-10 Crib was closed in March 1987, the waste was rerouted to the 216-A-45 Crib. The crib received a total of 3,210,000,000 L (848,000,000 gal) of waste. The 216-A-10 Crib is a RCRA TSD facility.

No unplanned releases are associated with this unit.

2.3.3.11 216-A-21 Crib. Crib 216-A-21 is located 200 m (600 ft) south of the 202-A Building and 230 m (750 ft) west of Canton Avenue. The bottom dimensions are 18.3 x 5 m (60 x 16 ft) and 6 m (19 ft) deep. The excavation is V-shaped in cross-section with a side slope of 1:1.5. The excavation has about 1.8 m (6 ft) (100 m^3 [2,700 ft^3]) of gravel fill and is backfilled to grade. The waste management unit has a new 10 cm (4 in.) distribution line running horizontally through the length of the crib 1.5 m (5 ft) above the bottom of the excavation. Branching horizontally from this distribution line are four 1.2 m (4 ft) sections of 10 cm (4 in.) tubing. Branching vertically at the same locations are four 2.4 m (8 ft) sections of 10 cm (4 in.) perforated pipe running to the bottom of the excavation. The unit also consists of a failed 15 cm (6 in.) distribution pipe placed 4 m (13 ft) below grade the length of the unit; two layers of sisalkraft paper to separate the gravel from the backfill; two 10 cm (4 in.) test risers which extend to flanges 0.9 m (3 ft) above grade; and concrete blocks at the bottom to support the risers.

The unit started operation in 1957 and was taken out of service in June of 1958 when a 15 cm (6 in.) vitrified clay distribution pipe failed. A new distribution system was installed, the unit was brought back to service in December 1958 and ceased operating in 1965. Until June 1958, the waste management unit received sump waste from the 293-A Building. From June 1958 to December 1958, the unit was inactive. From December 1958 to June 1965, the unit received the above effluent, laboratory cell drainage from the 202-A Building, and the 291-A-1 Stack drainage. Throughout this time the crib received a total of 77,900,000 L (20,000,000 gal) of waste. The unit was deactivated when the effluent flow rate exceeded the infiltration capacity by blanking the effluent pipeline to the unit. The effluents were rerouted to the 216-A-27 Crib.

No unplanned releases are associated with this unit.

2.3.3.12 216-A-24 Crib. This crib is located outside the 200 East Area, about 229 m (750 ft) northeast of the 241-AX Tank Farm along Canton Avenue. The bottom of the crib is 488 x 6 m (1,600 x 20 ft) at a depth of 4.6 m (15 ft) with a 1.5:1 side slope. A 38-cm (15-in.) diameter (perforated bottom half) galvanized corrugated pipe is placed horizontally 3 m (10 ft) below grade. The excavation has 1.2 m (4 ft) (4,100 m^3 [146,000 ft^3]) of gravel fill and is backfilled to grade. The crib is broken into four 107 m (350 ft) segments by 15 m

(50 ft) wide earth barriers. The segments are connected together with 38-cm (15-in) corrugated distribution pipes. The segments are arranged in a cascading fashion. The waste management unit also has eight gage wells resting on concrete pads, four corrugated risers, four filter box assemblies located on top of the risers, and a polyethylene barrier between the gravel and the backfill. The 216-A-524 Diversion Box is located at the west end of the crib.

Beginning in May 1958, the waste management unit received 820,000,000 L (200,000,000 gal) of condensate from the waste storage tanks in the 241-A and 241-AX Tank Farms. The waste was low salt and neutral/basic. The crib was believed to have been deactivated by shutting the valve in January 1966. However, it was still open in 1979. The valve has since been closed. This unit was deactivated and the waste was routed to the 216-A-8 Crib. In September 1988 the surface of the unit was stabilized by covering the crib surface with 2 ft of clean soil. It is currently about 1 m (2 ft) above grade and there are numerous concrete marking posts around the unit.

One unplanned release (UN-200-E-56) is associated with this unit.

2.3.3.13 216-A-27 Crib. The 216-A-27 Crib is located about 213.4 m (700 ft) south of the 202-A Building and 244 m (800 ft) west of Canton Avenue, partly within the PUREX Plant Aggregate Area exclusion area. The bottom dimensions are 60 x 3 x 4.3 m (200 x 10 x 14 ft) deep with a side slope of 1:1.5. The excavation is filled with gravel to 1.8 m (6 ft) (700 m^3 [24,000 ft^3]), and then backfilled to grade. A 15 cm (6 in.) perforated pipe is placed horizontally the length of the unit approximately 3 m (10 ft) below grade. The crib also has a 20 cm (8 in.) diameter well extending from a concrete pad, a 20 cm (8 in.) vent riser with filter, a 41 cm (16 in.) pipe for a recorder, a 3.8 cm (1.5 in.) sensing bulb well, and a polyethylene barrier.

This crib was active from June 1965 to July 1970. During this time the crib received 23,200,000 L (6,130,000 gal) of waste. The waste was the sump waste from the 293-A Building, the lab cell drainage from the 202-A Building and the 291-A-1 Stack Drainage. The waste is low salt and neutral/basic.

No unplanned releases are associated with this unit.

2.3.3.14 216-A-30 Crib. The 216-A-30 Crib is located outside the 200 East Area perimeter fence, about 500 m (1,600 ft) east of the 202-A Building. The dimensions of the bottom of the crib are 427 x 3 m (1,400 x 10 ft) and 37 m (12 ft) deep with a 1:1.5 side slope. The 216-A-30 Crib has one 38 cm (15 in.) corrugated perforated distribution pipe running 2.1 m (7 ft) below grade, for the first 220 m (700 ft) of crib. Another 41 cm (16 in.) steel distribution pipe parallels the first perforated pipe, 2.1 m (7 ft) below grade, then angles to the centerline and changes to a 38 cm (15 in.) corrugated perforated pipe running 2.1 to 2.4 m (7 to 8 ft) below grade until it reaches the end of the crib. The intent of this crib design is to maximize the distribution of liquid throughout the crib area. The crib is filled with 1.5 m (5 ft) (3,500 m^3 [123,000 ft^3]) of gravel and then backfilled to grade. The crib

has one 38 cm (15 in.) diameter vent riser extending from the distribution pipe 1 m (3 ft) above grade, and two 20 cm (8 in.) carbon steel gage wells extending from the bottom of the crib to 1 m (3 ft) above grade. The crib also has a polyethylene barrier and concrete pads to support the gage wells. A control box (Diversion Box No. 2) on the 216-A-30 Crib was used to divert one-third of the effluent to the 216-A-37-2 Crib.

The 216-A-30 Crib started operating in 1961 and ceased operating in 1991. From January 1961 to November 1965, the waste management unit received the steam condensate, equipment disposal tunnel floor and water-filled door drainage, and the slug storage basin overflow waste from the 202-A Building. From November 1965 to January 1970, this unit was to be deactivated because the effluent flowrate had exceeded the infiltration capacity; therefore, requiring the 216-A-6 Crib to be restored to service to receive some of the above effluents. The 216-A-30 Crib was reactivated in 1970 to receive the above effluent because the 216-A-6 Crib was deactivated. The unit has received over 7,000,000,000 L (2,000,000,000 gal) of waste.

Currently the crib has an irregular surface, varying between 0.6 m (2 ft) above to slightly below grade in height. The northwest corner of the site is below grade and mud cracks were readily apparent suggesting that some ponding of surface water occurs. During the winter of 1971, an alkaline deposit was observed to be forming over the ground surface of the entire length of the crib. It appeared to be salt residue condensing out from vapors being emitted through the porous ground surface of the crib.

According to Tri-Party Agreement M-17-24A, discharge of the PUREX Plant steam condensate to the 216-A-30 Crib was shut down in February 1992 ahead of the June 1992 milestone date.

No unplanned releases are associated with this unit.

2.3.3.15 216-A-31 Crib. The 216-A-31 Crib is located about 150 m (500 ft) south of the 202-A Building. The bottom dimensions are 21.3 x 3 m (70 x 10 ft) and 7.3 m (24 ft) deep. The excavation has 1.8 m (6 ft) (250 m^3 [9,000 ft^3]) of gravel fill and was backfilled with clean material. The waste management unit consists of a 8 cm (3 in.) perforated pipe placed horizontally 6.4 m (21 ft) below grade; a 30 cm (12 in.) vent riser extending from the bottom to 0.9 m (3 ft) above grade; a 20 cm (8 in.) gage well extending from the bottom to a cap 0.9 m (3 ft) above grade; a polyethylene barrier; and a concrete pad to support the gage well.

This unit operated from July 1964 to November 1966. During this time the crib received over 10,000 L (3,000 gal) of neutral/basic organic waste from the 202-A Building. The unit was deactivated by blanking the 202-A Building L Cell nozzles to the 241-A-151 Diversion Box, which routed effluents to the unit.

No unplanned releases are associated with this unit.

2.3.3.16 216-A-32 Crib. The 216-A-32 Crib is located approximately 90 m (300 ft) northeast of the 202-A Building and about 200 m (700 ft) west of Canton Avenue. The bottom dimensions are 21.3 x 2.4 m (70 x 8 ft) and 3.7 m (12 ft) deep. The waste management unit contains 24 m (77.5 ft) of 15 cm (6 in.) perforated vitrified clay pipe placed horizontally 15 m (5 ft) below grade. The excavation has a side slope of 1:1.5 which is filled to 1.5 m (5 ft) depth with 200 m^3 (6,000 ft^3) of gravel fill.

Approximately 4,000 L (1,000 gal) of waste was received by this unit between January 1959 and 1972. The crib received the 202-A Building crane maintenance facility floor, sink, and shower drainage (WHC 1991a). There was intent to dispose of 246,025 L (65,000 gal) of 50% kerosene diluent in this crib. To date, this proposed disposal has not been confirmed as having taken place. The crib is inactive.

No unplanned releases are associated with this unit.

2.3.3.17 216-A-36A Crib. The 600 ft x 11 ft 216-A-36 Crib's original purpose was to receive the low salt neutral/basic ammonia scrubber distillate from the 202-A Building. Between crib start-up in September 1965 through March 1966, 1,070,000 L of radioactive ammonia scrubber waste, containing over 147,000 Ci of mostly short-lived beta emitters, contaminated the first 15 m (50 ft) of the crib, which necessitated discontinuing further use of the contaminated portion. This portion was isolated by constructing a concrete barrier thus effectively separating the two parts and creating two separate cribs. The then-abandoned contaminated segment was renamed the 216-A-36A Crib and the remaining less contaminated active segment was renamed the 216-A-36B Crib.

The 216-A-36A Crib is located 190 m (600 ft) south of the 202-A Building and 350 m (1,150 ft) west of Canton Avenue. Dimensions of the crib bottom are 30 x 3.4 m (100 x 11 ft) and 6.7 m (22 ft) deep with a side slope of 1:1.5. The excavation contains a 1 m (3 ft) thick layer of gravel fill containing 130 m^3 (4,500 ft^3) of material. A plastic barrier separates the gravel from the overlying earth backfill. A 15 cm (6 in.) perforated pipe lies horizontally 6.4 m (21 ft) below grade. The crib also contains a 20 cm (8 in.) gage well extending from crib bottom to above grade, the concrete barrier, and two 5 cm (2 in.) grout wells.

As part of the isolation process, a 30 m (100 ft) length of 10 cm (4 in.) diameter unperforated pipe was grouted into the original 15 cm (6 in.) perforated pipe. The 10 cm (4 in.) line also was extended along the remaining 152 m (500 ft) of the 216-A-36B Crib as perforated pipe, thus permitting wastes to enter the soil column.

No unplanned releases are associated with the 216-A-36A Crib.

2.3.3.18 216-A-36B Crib. The 216-A-36B Crib is located 220 m (700 ft) south of the 202-A Building. Bottom dimensions of the crib are 152 x 3.4 m (500 x 11 ft) and 8 m (25 ft) deep with a side slope of 1:1.5. The 1 m (3 ft) thickness of gravel fill contains

620 m^3 (22,000 ft^3) in volume. The remainder of the excavation was backfilled with excavated soil. It is a gravel structure with a 10 cm (4 in.) perforated pipe placed horizontally 7 m (23 ft) below grade inside a 15 cm (6 in.) pipe from the 216-A-36A segment. The crib is also made up of a 20-cm (8-in.) gage well, a plastic barrier between gravel and backfill, and an 20 cm (8 in.) vent with a 5 cm (2 in.) drain. This crib is a RCRA TSD facility.

Beginning in March 1966, the crib received the ammonia scrubber waste from the 202-A Building. In October 1972 the unit was retired. In November 1982, the site was reactivated to receive the above wastes when 202-A Building operation restarted and then was deactivated again on September 6, 1987. During this period the unit received a total 317,000,000 L (84,000,000 gal) of waste.

According to Tri-Party Agreement Milestone M-17-21A all discharges to the 216-A-36B Crib were prohibited as of September 1991 (Ecology et al. 1992).

Two unplanned releases (UN-200-E-39 and UN-200-E-40) are associated with this unit.

2.3.3.19 216-A-37-1 Crib. The 216-A-37-1 Crib is located outside of the 200 East Area perimeter fence, 610 m (2,000 ft) east of the 202-A Building. The bottom dimensions are 213 x 3 m (700 x 10 ft) and 3.4 m (11 ft) deep with a 1:1 side slope. The waste management unit is a gravel structure with a 25 cm (10 in.) corrugated galvanized, perforated pipe located horizontally 2 m (7 ft) below grade. The excavation contains 1.5 m (5 ft) (150 m^3 [5,300 ft^3]) of gravel. The unit also has a vent riser with a concrete base, two gage wells with a concrete pad for support, and a membrane barrier between the gravel and backfill. A valve station is at the east end of the crib and a vent is located at the west end. The valve station is inside the crib perimeter fence and has surface radiation warning signs and a light chain barricade. Hanford Site diagrams indicate a connection between the 216-A-30 Crib and the 216-A-37-1 Crib. The connection was never used due to the fact that the 216-A-37-1 Crib use for evaporator process condensate started in 1977. The pipe was removed prior to PUREX restart in 1983.

This unit began operating in March 1977 and is currently inactive. It received process condensate from the 242-A Evaporator. The unit received 377,000,000 L (100,000,000 gal) of waste. In April 1989, the crib was shut down permanently after it was determined that land disposal restricted wastes (i.e., acetone, butanol) were discharged to the unit.

According to Tri-Party Agreement milestone M-17-29A, all discharges to the 216-A-37-1 Crib were to cease as of September 1991. No soil column disposal of 242-A Evaporator process condensate is to occur until BAT/AKART is implemented as part of "242-A Evaporator/PUREX Plant Condensate Treatment Facility" (Project C-018H). When the 242-A Evaporator restarts in 1992, process condensate will be routed to the Liquid Effluent Retention Facility (LERF) basins for storage and eventual processing (Ecology et al. 1992).

No unplanned releases are associated with this unit.

2.3.3.20 216-A-37-2 Crib. The 216-A-37-2 Crib is located outside the 200 East Area perimeter fence, east of the 216-A-37-1 Crib on the same centerline, directly north of the 216-A-30 Crib. The bottom of the crib is 427 x 3 m (1,400 ft x 10 ft) and 4.6 m (15 ft) deep. A 15 cm (6 in.) flow meter is located in a shallow caisson at the crib's head end. The 216-A-37-2 Crib has one 38 cm (15 in.) corrugated perforated distribution pipe running 2.1 m (7 ft) below grade for the first 700 ft of the crib. 41 cm (16 in.) solid steel distribution pipe parallels the perforated pipe, 2.1 m (7 ft) below grade, then angles to the center of the crib and changes to a 38 cm (15 in.) corrugated perforated pipe running 2.1 to 2.4 m (7 to 8 ft) below grade until it reaches the end of the crib. Two vents are located at the center and at the east end. Two liquid-level gage wells are located 106.7 m (350 ft) from the ends of the unit. The intent of this crib design is to maximize the distribution of liquid throughout the crib area. A 1.7 m (5.5 ft) bed of gravel on the bottom has been covered with a 20-mil polyvinyl chloride barrier cover and then the entire area has been backfilled over with earth. The central portion of the crib's surface has subsided.

The waste management unit was activated in 1983 and, along with the 216-A-30 Crib, has been receiving steam condensate from the 202-A Building. The site received 1,090,000,000 L (290,000,000 gal) of waste, one-third of all steam condensate sent to the diversion box number 2 and the 216-A-30 Crib.

According to Tri-Party Agreement milestone M-17-22A, discharge of the PUREX Plant steam condensate to the 216-A-37-2 Crib was prohibited after June 1992 (Ecology et al. 1992).

No unplanned releases are associated with this unit.

2.3.3.21 216-A-38-1 Crib. The 216-A-38-1 Crib is located approximately 180 m (600 ft) southwest of the 202-A Building and 460 m (1,500 ft) north of 1st Street. The bottom dimensions are 158 x 4.6 m (520 ft x 15 ft) and 11 m (37 ft) deep with a 1:1 side slope. There is 1.5 m (5 ft) (1,400 m^3 [50,000 ft^3]) of gravel in the excavation and backfilled to grade. The waste management unit contains a 15 cm (6 in.) perforated steel pipe narrowing to 10 cm (4 in.) placed horizontally 10 cm (33 ft) below grade. The unit also has a 20 cm (8 in.) diameter inlet pipe, two 8 cm (3 in.) vent risers and filters, two 20 cm (8 in.) gage wells, a membrane barrier, and a 20 cm (8 in.) bypass line paralleling the distribution line in the southern half of the unit. Ancillary equipment include a proportional sampling pit and the 216-A-5 Neutralization Tank.

The crib was not activated when plans for modifying the PUREX headend process were begun. The planned addition would have been constructed immediately adjacent to the crib and it was thus never used. It was intended to receive the 202-A process condensate waste discharged to the 216-A-10 Crib.

2.3.3.22 216-A-39 Crib. The 216-A-39 Crib is located directly north of 241-AX Tank Farm, and immediately south of the 241-AZ Tank Farm, along Canton Avenue. It was constructed to receive 20 L (5.3 gal) of high-level waste spilled when a pressurized line was opened during a valve changeout in the 241-AX-801-B building. The crib is made up of a 0.9 m (3 ft) deep trench from the door of the 241-AX-801-B Building to the brow of the north hill, then over the hill to the flat ground below where it extended eastward approximately 27 m (90 ft). A hole was cut through the back side of the 241-AX-801-B Building, where a fire hose was inserted to wash the contamination into the trench. A second trench was also made paralleling the first one. Each trench contains a 5 cm (2 in.) diameter pipe 1.8 m (6 ft) long, a 16.7 m^2 (180 ft^2) plastic sheet, a 5 cm (2 in.) diameter line 27 m (90 ft) long and 26 m^3 (900 ft^3) of gravel fill.

This waste management unit was only active for one month, June 1966. During that time the unit received an unknown quantity of liquid including the 20 L (5.3 gal) of tank waste from the 241-AX-801-B Building. Currently, the unit is a level gravel-paved area with no markers or indications of a surface spill.

No other unplanned releases are associated with this unit.

2.3.3.23 216-A-41 Crib. The 216-A-41 Crib is located about 180 m (600 ft) west of the 241-AX Tank Farm and 180 m (600 ft) south of 7th Avenue. The dimensions are 3 x 3 m (10 x 10 ft) and 1.8 m (6 ft) deep. The crib contains six 20 x 20 x 41 cm (8 x 8 x 16 in.) bond beam concrete blocks placed end to end to form the dispersion structure 1.2 m (4 ft) below grade. The excavation has 0.6 m (2 ft) (8.2 m^3 [290 ft^3]) of gravel fill and the crib has been backfilled with a side slope of 1:1. The crib also has an inlet pipe from the 296-A-13 Stack and a 20-mil polyethylene barrier separating the gravel from the backfill.

From January 1968 to 1974 the crib received approximately 10,000 L (2,600 gal) of drainage from the 296-A-13 Stack at the 244-AR vault. The waste is slightly acidic and expected to contain less than 1 Ci total beta activity. This inactive waste management unit was deactivated by removing the stack drainage piping from the 296-A-13 Stack and then rerouting the drainage to the vessel vent seal pot system of the 244-AR Vault. The exact location of this unit has not been confirmed; several temporary buildings are located in the vicinity of the crib at the present time (WHC 1991a).

No unplanned releases are associated with this unit.

2.3.3.24 216-A-45 Crib. The 216-A-45 Crib is located approximately 230 m (750 ft) southwest of the 216-A-10 Crib, which is about 120 m (390 ft) south of the 202-A Building. The bottom dimensions are 94 x 18.3 m (310 x 60 ft) and 11.4 m (37.5 ft) deep. The waste management unit has an associated drain field consisting of five 10 cm (4 in.) diameter perforated, fiberglass-reinforced pipes evenly spaced across the width of the crib. The

bottom of the crib excavation has 1.8 m (6 ft) of clean 8 to 13 cm (3 to 5 in.) diameter rock, a 15 cm (6 in.) layer of 2 cm (0.75 in.) gravel, a sheet of 10-mil polyethylene, and a 10 cm (4 in.) layer of sand.

This waste management unit was activated on March 4, 1987 and was shut down and isolated in October 1989. According to the 1990 survey this unit has received a total of 103,000,000 L (27,000,000 gal) of process condensate from the 202-A Building. This unit replaced the 216-A-10 Crib. A neutralization system was placed into operation to preclude the discharge of process condensate that is acidic (pH less than 2.0) or basic (pH greater than 12.5).

According to Tri-Party Agreement milestone M-17-20A, all discharge to the 216-A-45 Crib was prohibited as of September 1991.

No unplanned releases are associated with this unit.

2.3.3.25 216-A-11 French Drain. The 216-A-11 French Drain is located at the southeast corner of the 202-A Building. The drain extends 9 m (30 ft) deep into the ground and is 0.8 m (2.5 ft) in diameter. It is constructed of two concrete pipes placed vertically end to end, placed in a 3 m (10 ft) diameter excavation, which extends 1.5 m (5 ft) below the bottom of the pipe.

The 216-A-11 French Drain was in operation from January 1956 to 1972. The waste management unit received the Trap Pit No. 1 drainage from the 202-A Building. The total volume of waste received by the unit was 100,000 L (30,000 gal) of low-salt neutral drainage. An identification marker post was the only visible surface manifestation of this site.

No unplanned releases are associated with this unit.

2.3.3.26 216-A-12 French Drain. The 216-A-12 French Drain is located at the center of the south side of the 202-A Building, about 20 m (75 ft) from the building. The french drain is 10 m (33 ft) deep and 0.8 m (2.5 ft) in diameter. The unit is composed of two reinforced concrete tile pipes placed vertically end to end in a 3 m (10 ft) diameter excavation extending 1.5 m (5 ft) below the bottom. Both the drain and the excavation are filled with gravel to the top of the unit. The drain has a side slope of 1:1.

The 216-A-12 French Drain started operating in 1955 and ceased operating in 1972. This waste management unit received a total of 100,000 L (30,000 gal) of low-salt neutral drainage waste from the Steam Trap Pit No. 3 in the 202-A Building.

No unplanned releases are associated with this unit.

2.3.3.27 216-A-13 French Drain. The 216-A-13 French Drain is located at the west end of the 202-A Building. The drain is constructed of two lengths of 1 m (3 ft) diameter concrete pipe placed vertically end to end to a depth of 5.5 m (18 ft). The waste management unit is filled to a depth of 1 m (3 ft) with 5 to 8 cm (2 to 3 in.) diameter gravel. The base of the drain was over-excavated by at least 0.3 m (1 ft) in all directions and was filled with a bed of gravel.

The unit was in operation from January 1956 to December 1962. The unit received 100,000 L (30,000 gal) of seal water (low-salt neutral waste) from the air sampler vacuum pumps in the 202-A Building. However, the base of the drain is within the same radiation zone as the 216-A-35 French Drain. The unit was deactivated when the effluent flow rate exceeded the infiltration capacity. There is no identification post at this unit.

No unplanned releases are associated with this unit.

2.3.3.28 216-A-14 French Drain. The 216-A-14 French Drain is located on the south side of the center of the 202-A Building, about 20 m (75 ft) west of the 216-A-12 French Drain. The unit is composed of two 0.8 (2.5 ft) diameter reinforced concrete pipes placed vertically end to end in a 3 m (10 ft) diameter excavation. The pipes are placed to a depth of 8.8 m (29 ft) and the excavation extends below the bottom of the pipe 1.5 m (5 ft) Both the drain and the excavation are filled with 8 cm (3 in.) gravel to the top.

The drain was in operation from January 1956 to 1972. During this time it received 1,000 L (300 gal) low-salt neutral drainage waste from the vacuum cleaner filter and blower pit from the 202-A Building.

No unplanned releases are associated with this unit.

2.3.3.29 216-A-15 French Drain. The 216-A-15 French Drain is located approximately 80 m (270 ft) south of the center of the 202-A Building. The unit is also a registered underground injection well. The bottom dimensions are 1.2 m (4 ft) in diameter by 13 m (44 ft) deep, and is assumed to have a 1:1 side slope. The waste management unit is composed of two lengths of bell-end, reinforced concrete sewer pipe placed vertically end to end. It is filled with 1.8 m (6 ft) of stone and has a 1.3 cm (0.5 in.) carbon steel cover. The unit also includes a 10 cm (4 in.) diameter, 1.2 m (4 ft) long, steel inlet pipe entering at 10 m (33 ft) below grade; a 5 cm (2 in.) riser extending 1.2 m (4 ft) above grade; and a 1.6 m (5.2 ft) diameter concrete pad.

This site was in operation from December 1955 to 1972. During this time the french drain received a total of 10,000,000 L (3,000,000 gal) of drainage from the 216-A-10 Process Condensate Sampler Pit.

No unplanned releases are associated with this unit.

2.3.3.30 216-A-16 French Drain. This drain is located within the southeast corner of the 241-A Tank Farm. Both this drain and the 216-A-17 French Drain are northeast of the 241-A-431 Ventilation Building. The drain is 5 m (17 ft) deep and 1.1 m (3.5 ft) in diameter, and is assumed to have a 1:1 side slope. The waste management unit is composed of a bell-end concrete pipe 1.8 m (6 ft) long, placed vertically 3.4 m (11 ft) below grade. The unit is rock-filled with a 2 cm (0.75 in.) carbon steel cover. Other parts of the drain are a steel vent riser extending from the top to 0.9 m (3 ft) above grade, and an inlet pipe 1 m (2 ft) long coming from the 216-A-17 French Drain.

This waste management was active from January 1956 to March 1969. The unit received the floor drainage and the 296-A-11 Stack drainage from the 241-A-431 Building. The unit also received the overflow from the 216-A-17 French Drain. The piping was water sealed when the 296-A-11 Stack exhaust system was deactivated. This unit received 122,000 L (32,000 gal) of low salt and neutral/basic waste. Currently there is no piping, or other surface feature, to indicate the location of this drain.

No unplanned releases are associated with this unit.

2.3.3.31 216-A-17 French Drain. The 216-A-17 French Drain is located within the southeast corner of the 241-A Tank Farm. It is constructed approximately 3.4 m (11 ft) below grade with no surface manifestations of the drain. The french drain is 5.1 m (17 ft) deep with a 1.1 m (3.5 ft) diameter and a 1:1 side slope. The waste management unit is composed of bell-end concrete pipe 1.8 m (6 ft) long, placed vertically 3.4 m (11 ft) below grade. The unit is rock-filled with a 2 cm (0.75 in.) carbon steel cover. The unit also has a 10 cm (4 in.) inlet pipe 0.6 m (2 ft) long, and an overflow pipe leading to the 216-A-16 French Drain.

The 216-A-17 French Drain was active from January 1956 to March 1969. The unit received the floor drainage and the 296-A-11 Stack drainage from the 241-A-431 Building. This unit also overflows to the 216-A-16 French Drain. The unit received 60,000 L (16,000 gal) of waste.

No unplanned releases are associated with this unit.

2.3.3.32 216-A-22 French Drain. The 216-A-22 French Drain is located approximately 122 m (400 ft) north of the center of the 202-A Building, near the 216-A-28 French Drain. The french drain is made up of two 10 cm (4 in.) effluent pipes; one is vertical, the other enters horizontally 2.4 m (8 ft) below grade. The excavation is 5 m (16 ft) in diameter at grade and 6.8 m (6 ft) in diameter at the bottom with a side slope of 2:1. Approximately 3 m (10 ft) (45 m^3 [1,600 ft^3]) of gravel fills the bottom of the excavation. Access to the drain was by two subsurface feeder pipes.

This french drain was in operation from March 1956 to December 1958. During its operation it received 10,000 L (3,000 gal) of drainage from the 203-A Building truck loadout

apron, the sump waste from the 204-A Building enclosure, and the heating coil condensate from the P-1 through P-4 uranyl nitrate hexahydrate tanks. The waste management unit was deactivated by closing the valve to the drain. There are no surface indications of this drain.

One unplanned release (UPR-200-E-17) is associated with this unit.

2.3.3.33 216-A-23A French Drain. The 216-A-23A French Drain is located within the southeast corner of the 241-A Tank Farm, near the southwest corner of the 241-A-431 Ventilation Building. The french drain is constructed to a depth of 4 m (13 ft) and a 1.1 m (3.5 ft) diameter. The waste management unit is made of a bell-end concrete pipe placed vertically 2 m (7 ft) below grade. The unit is filled with 1 m (3 ft) of rock and has a 2 cm (0.75 in.) carbon steel cover. The unit also has a carbon steel vent riser extending from the top to 1 m (3 ft) above grade, and an inlet pipe entering at 3 (9 ft) below grade. Only a single yellow gooseneck pipe was observed to mark the surface location.

The 216-A-23A French Drain was activated in September 1957 and deactivated in March 1969. The unit received 6,000 L (1,600 gal) of de-entrainer tank condensate and back flush waste from the 241-A-431 Building. The unit was deactivated by sealing the pipe.

No unplanned releases are associated with this unit.

2.3.3.34 216-A-23B French Drain. The 216-A-23B French Drain is located within the southeast corner of the 241-A Tank Farm, near the southeast corner of the 241-A-431 Ventilation Building. The french drain is a bell-end concrete pipe 2 m (7 ft) long by 1.1 m (3.5 ft) in diameter set vertically into the ground 2 m (6.5 ft) below grade. The unit is filled with 1 m (3 ft) of rock and has a 2 cm (0.75 in.) carbon steel cover. The unit also contains an inlet pipe entering at 3 m (9 ft) below grade.

From September 1957 to March 1969 this french drain received the de-entrainer tank condensate and the backflush waste from the 241-A-431 Building. The unit received 6,000 L (1,600 gal) of low salt and neutral/basic waste. The unit was deactivated by sealing the pipe.

No unplanned releases are associated with this unit.

2.3.3.35 216-A-26 French Drain. The 216-A-26 French Drain, also known as the 216-A-26B French Drain, is located about 35 m (115 ft) south of the center of the 202-A Building, and about 4.5 m (15 ft) south of 216-A-26A French Drain. This drain is constructed of three 1.5 x 1.2 m (5 x 4 ft) diameter clay pipes placed end to end and filled with gravel. The drain is accessed by a subsurface feeder pipe.

The 216-A-26 French Drain began operation in July 1965 to replace the 216-A-26A French Drain and is no longer active. The unit was shut down in 1991. The waste management unit received low salt neutral floor drainage from the 291-A Fan Control House.

No unplanned releases are associated with this unit.

2.3.3.36 216-A-26A French Drain. The 216-A-26A French Drain is located approximately 30 m (100 ft) south of the center of the 291-A Building. The construction design of this waste management unit is identical to the 216-A-26 French Drain except that the diameter is only 1 m (3 ft).

This french drain operated from March 1959 through July 1965. During that time the drain received a total of 1,000 L (300 gal) of low-salt neutral waste. The waste was the floor drainage from the 291-A Fan control room. The unit was deactivated by removing the encasement and rerouting the effluent to the new 216-A-26 French Drain encasement. This unit cannot be distinguished from the 216-A-26 French Drain from indications in the field.

No unplanned releases are associated with this unit.

2.3.3.37 216-A-28 French Drain. The 216-A-28 French Drain is located approximately 150 m (500 ft) north of the 202-A Building and about 380 m (1,250 ft) west of Canton Avenue. The drain is constructed in a truncated cone shape; at grade the diameter is 6 m (20 ft) and at a depth of 3 m (11 ft), the diameter is 3 m (10 ft). The excavation has about 3 m (31 m^3 [1,100 ft^3]) of gravel fill and is backfilled to grade. The waste management unit also contains a 10 cm (4 in.) perforated pipe 5.2 m (17 ft) long extending horizontally 1.2 m (4 ft) below grade.

This drain was in operation from December 1958 to November 1967. During this time the unit received 30,000 L (8,000 gal) of low-salt neutral waste from the 203-A Building enclosure sumps and the heating coil condensate from the P1 through P4 uranyl nitrate hexahydrate tanks. The unit was deactivated by blanking the effluent pipeline to the unit when the effluent flow rate exceeded the infiltration capacity. The effluent was rerouted to the 216-A-3 Crib.

In 1981, the center of the unit was excavated and disposed of prior to installation of a PUREX Plant Aggregate Area security system. The security system is comprised of two parallel fences that surround the 202-A Building. After the security system was installed and the unit backfilled to grade, no posting or identification marker was placed at the unit. Currently, the drain is inside a posted surface contamination area immediately north of the uranyl nitrate hexahydrate tanks and south of the security fence.

No unplanned releases are associated with this unit.

2.3.3.38 216-A-33 French Drain. The 216-A-33 French Drain is located about 90 m (300 ft) south of the 202-A Building, and 340 m (1,100 ft) west of Canton Avenue, near the southwest corner of the 291-A Building. This french drain is 1.8 m (6 ft) in diameter and has a depth of 3.7 m (12 ft). At 1.5 m (5 ft) below grade there is a 5 cm (2 in.) inlet pipe entering the unit.

This waste management unit was active from November 1955 through July 1964. It was designed to receive bearing cooling waste from the 291-A-1 Stack electrical exhaust fans; however, no coolant was ever used. Therefore, no waste was discharged to this unit. The unit was deactivated by capping the effluent pipeline to the unit on the south side of the 291-A Fan plenum.

No unplanned releases are associated with this unit.

2.3.3.39 216-A-35 French Drain. The 216-A-35 French Drain is constructed at the west end of the 202-A Building. It is 1.8 m (6 ft) in diameter to a depth of 5 m (16 ft). There is an inlet pipe located 3.2 m (10.5 ft) below grade.

From December 1963 to January 1966 this site received 10,000 L (3,000 gal) of low salt and neutral/basic waste. The waste received by this french drain was the seal cooling water from the air sampler vacuum pumps in the 202-A Building. The drain was deactivated by capping the effluent pipeline to the unit and rerouting the effluent to the 216-B-3 Pond via the 202-A Building cooling water liquid effluent stream. This waste management unit was a replacement for the 216-A-13 French Drain. The drain is marked by a large diameter yellow concrete pipe with a "confined space" warning posted; however, there are no identification posts. It is assumed to be in the same radiological unit as the 216-A-13 French Drain.

No unplanned releases are associated with this unit.

2.3.3.40 216-C-8 French Drain. The 216-C-8 French Drain is located about 25 m (75 ft) southeast of the 241-C Tank Farm southeast perimeter fence and 75 (250 ft) east-northeast of the 244-CR Vault. The waste management unit is composed of a 1.8 m (6 ft) diameter by 2.4 m (8 ft) long concrete culvert placed vertically 1.2 m (4 ft) below grade. The culvert is filled with gravel and rests in a 2.4 m (8 ft) diameter by 4.9 m (16 ft) deep excavation with a slope of 5.5:1. The excavation is partially filled with gravel and backfilled to grade. The drain also has a 8 cm (3 in). diameter inlet pipe 4 m (13 ft) long from the 271-CR Control House; a 5 cm (2 in.) plank top on the culvert, covered with two layers of tar paper; and a 5 cm (2 in.) carbon steel vent pipe extending from the bottom to 1 m (3 ft) above grade. Currently, the drain is marked by a gooseneck pipe in a 3 x 3 m (10 x 10 ft) area stabilized with sand.

This unit was active from June 1962 to June 1965. During this time the french drain received an unknown volume of ion exchange regenerant waste from the 271-CR Control House.

No unplanned releases are associated with this unit.

2.3.4 Reverse Wells

A reverse well is a buried or covered, encased, drilled hole with a perforated or open lower end of the pipe to allow seepage of liquid to the ground. Reverse wells were used in various areas on the Hanford Site. There is one reverse well in the PUREX Plant Aggregate Area.

2.3.4.1 299-E24-111 Injection Well. The 299-E24-111 Injection Well is located southwest of the 202-A-Building, and west of the 216-A-38-1 Crib. The waste management unit consists of a 4.6 m x 1.2 cm (15 ft x 1 in.) diameter pipe inside 4.6 m (15 ft) of casing, welded together at the lower end. This assembly is cemented inside a 4.6 m (15 ft) deep, 15 cm (6 in.) diameter steel well. The injection well also has 32 19.8 m (65 ft) deep observation wells constructed from 15 cm (6 in.) diameter steel casing, and an above ground 5,700 L (1,500 gal) mixing tank.

The injection well is located southwest of the 202-A Building outside of the fence enclosing the 202-A Building. The well was surveyed in February 1991 and found free of contamination and is currently under consideration for a change of posting to "Underground Radioactive Material."

The injection well was in operation from September 22, 1980 through February 2, 1981. The unit received eleven 3,780 L (1,000 gal) injections of uniform solutions of calcium chloride, calcium nitrate and selected tracers composed of ^{134}Cs and ^{90}Sr. The unit was part of an experimental test site constructed to obtain radionuclide migration data for model forecasting. Although it is called an injection well, this unit never received any waste.

No unplanned releases are associated with this unit.

2.3.5 Ponds, Ditches, and Trenches

The ditches and trenches in the PUREX Plant Aggregate Area were designed to percolate wastewater into the ground. Generally, low-level liquid waste was disposed of into the ponds and no attempt was made to isolate the wastewater from the open air. The locations of the ditches and trenches are shown on Figure 2-11. A ditch is a long, open, unlined excavation used to transfer low-level liquid wastes from process facilities to ponds or trenches. Ditches are also used as soil column disposal sites for low-level waste streams. Trenches are unlined temporary (typically 1-3 months lifespan) excavations used for disposing material from the process facilities by infiltration into the subsurface. Quantities are usually limited as compared to cribs or ponds. Many of Hanford's trenches are designated "specific retention" trenches as defined in Section 2.3.3. Generally, for soil column disposal, a target of 6% of the specific retention capacity of the unit was utilized

after 1958 in an effort to ensure that liquid did not reach groundwater (Haney and Honstead 1958). There are two ditches and four trenches in the PUREX Plant Aggregate Area.

There are no ponds located within the PUREX Plant Aggregate Area; however, the 216-A-25 Pond and the 216-B-3 Pond, located within the B Plant Aggregate Area, did receive low-level PUREX cooling water from the 202-A Building. These units are discussed in detail in the B Plant AAMS. The following sections describe the ditches and trenches present in the PUREX Plant Aggregate Area.

2.3.5.1 216-A-29 Ditch. The 216-A-29 Ditch is located outside the 200 East Area perimeter fence, 160 m (525 ft) southeast of the southeast corner of the 241-A Tank Farm. The ditch emptied into the 216-B-3-3 Ditch that terminates at the 216-B-3 Pond. This is a RCRA TSD facility.

This waste management unit began operation in November 1955 and was shut down in July 1991. The unit is a man-made, uncovered earthen ditch that was approximately 1.8 m (6 ft) wide and 1,980 m (6,500 ft) long. The banks varied from about 1 m (2 to 3 ft) high at the head end to 4.6 m (15 ft) at the lower end of the trench. All discharge to the ditch occurred within the 200 East Area perimeter fencing. Discharge from the PUREX chemical sewer line is at the northeast corner of the 241-AP Tank Farm. The chemical sewer line feeds through the 216-A-42E Diversion Box in a 38 cm (15 in.) vitrified-clay pipe, into a 7.6 m (25 ft) section of 91 cm (36 in.) corrugated pipe, and into the ditch. The ditch contained two small dam structures with valves for flow control. The first 3 m (10 ft) from the point of influent was a concrete spillway designed to control erosion.

The ditch received wastes from the 202-A Building chemical sewer and cooling water liquid effluent streams that flowed to 216-B-3 Pond. Until December 1957, the waste management unit received chemical sewer liquid effluent and cooling water from the 202-A Building. From December 1957 until February 1958, the unit received the chemical sewer liquid effluent from the 202-A Building (the cooling water liquid effluent was rerouted to the 216-A-25 Pond). From February 1958 until December 1962, the 216-A-29 Ditch received the chemical sewer liquid effluent from the 202-A Building, which included acid fractionator condensate from the 202-A Building. From December 1962 until December 1963, the ditch also received seal cooling water from air-sampler vacuum pumps in the 202-A Building. From December 1963 through January 1986, the vacuum pump cooling water was rerouted to the 216-A-35 French Drain.

The 216-A-29 Ditch was stabilized during July-October 1991. Inside the GTF perimeter fence the ditch has been filled to grade, surrounded with a light chain barricade, and posted with underground contamination placards. Outside the perimeter fence the ditch has been completely covered with backfill and stabilized.

No unplanned releases are associated with this unit.

2.3.5.2 216-A-34 Ditch. The 216-A-34 Ditch is located outside the 200 East perimeter fence 90 m (300 ft) east of Canton Avenue and 270 m (900 ft) northeast of the 241-A Tank Farm on the north side of 216-A-8 Crib.

This waste management unit operated from November 1955 until December 1957 and is inactive. The ditch is 9.1 m (30 ft) wide at the east end, 3 m (10 ft) wide at the west end, and 85.3 m (280 ft) long. The side slope is 1:2. A 38 cm (15 in.) inlet pipe is placed 1 m (3 ft) below grade.

The trench received the cooling water from the contact condenser in the 241-A-431 Building enroute to the 216-A-19 and 216-A-20 Trenches. The 216-A-34 Ditch was deactivated by blanking the effluent pipeline to the unit. The ditch was backfilled and posted with underground contamination warning signs. The waste was rerouted to the 216-A-8 Crib (Lundgren 1970).

No unplanned releases are associated with this unit.

2.3.5.3 216-A-18 Trench. The 216-A-18 Trench is located outside the 200 East Area perimeter fence, 150 m (500 ft) east of the 241-AX Tank Farm, along Canton Avenue.

This waste management unit operated from November 1955 until January 1956 and is inactive. The trench is 24.4 m (80 ft) wide, 24.4 m (80 ft) long, and 4.6 m (15 ft) deep. The side slope is 1:2.

The trench received the depleted uranium waste from the cold start-up run at 202-A Building. The trench was deactivated by removing the aboveground piping and backfilling the excavation after the specific retention capacity was reached (Lundgren 1970).

No unplanned releases are associated with this unit.

2.3.5.4 216-A-19 Trench. The 216-A-19 Trench is located outside the 200 East Area perimeter fence, 230 m (750 ft) east of the 241-AX Tank Farm, and 150 m (500 ft) east of Canton Avenue.

This waste management unit operated from November 1955 until January 1956 and is inactive. The trench is 8 m (25 ft) wide, 8 m (25 ft) long, and 4.6 m (15 ft) deep.

The trench received the 241-A-431 Building contact condenser cooling water via the 216-A-34 Ditch and the depleted uranium waste from the cold start-up run at 202-A Building. The 216-A-19 Trench was deactivated by removal of surface piping and backfilling of the excavation (Lundgren 1970).

No unplanned releases are associated with this unit.

2.3.5.5 216-A-20 Trench. The 216-A-20 Trench is located outside the 200 East Area perimeter fence, 240 m (800 ft) east of the 241-AX Tank Farm, and 180 m (600 ft) east of Canton Avenue.

This waste management unit operated from November 1955 until January 1956 and is inactive. The trench is 8 m (25 ft) wide, 8 m (25 ft) long, and 4.6 m (15 ft) deep.

The trench received the 241-A-431 Building contact condenser cooling water via the 216-A-34 Ditch and the depleted uranium waste from the cold start-up run at the 202-A Building. The trench was deactivated by removal of surface piping and backfilling of the excavation (Lundgren 1970).

No unplanned releases are associated with this unit.

2.3.5.6 216-A-40 Trench. The 216-A-40 Trench is located approximately 150 m (500 ft) west of the 241-AX Tank Farm and approximately 150 m (500 ft) south of 7th Avenue.

This waste management unit operated from January 1968 until May 1979 and is inactive. The trench is 6 m (20 ft) wide, 122 m (400 ft) long, and 4.9 m (16 ft) deep. The side slope is 1:1.5. The unit contains three large sealed bladders designed for storing effluents. A 31 cm (12 in.) SCH 40 pipe runs horizontally, 22.6 m (74 ft) through the south end of the unit 3.7 m (12 ft) below grade. A 1.5 m (5 ft) pipe section is connected perpendicularly to the 31 cm (12 in.) pipe, forming a "T."

The bladders received the diverted cooling water and steam condensate from the 244-AR Vault. Currently, the trench is enclosed within a box-wire fence and several tumbleweeds fill the trench bottom.

One unplanned release (UPR-200-E-59) is associated with the 216-A-40 Trench.

2.3.6 Septic Tanks and Associated Drain Fields

The location of the septic tanks and drain fields are shown on Figure 2-12. The PUREX Plant Aggregate Area contains 7 septic tanks, described as follows.

2.3.6.1 2607-EA Septic Tank and Drain Field. The 2607-EA Septic Tank is located west of the 241-A Tank Farm, approximately 150 m (500 ft) north of 4th Street, and immediately south of the 244-AR Vault. This waste management unit includes a drain field.

This unit started receiving nonhazardous and nonradioactive wastewater and sewage in 1976 and is still active. The estimated rate of waste generation is 60 L/day (16 gal/day).

No unplanned releases are associated with this unit.

2.3.6.2 2607-EC Septic Tank and Drain Field. The 2607-EC Septic Tank is located inside the 241-A Tank Farm. Specifically, the tank is located in the northeast corner of the 241-A Tank Farm. A drain field is associated with this waste management unit.

The tank started receiving nonhazardous and nonradioactive wastewater and sewage in 1955 and is still active. The estimated rate of waste generation is 450 L/day (120 gal/day).

No unplanned releases are associated with this unit.

2.3.6.3 2607-ED Septic Tank and Drain Field. The 2607-ED Septic Tank is located inside the 241-AX Tank Farm, north of the 2707-AX Building. A drain field is associated with this waste management unit.

The tank started receiving nonhazardous and nonradioactive wastewater and sewage in 1980 and is still active. The estimated rate of waste generation is 28 L/day (74 gal/day).

No unplanned releases are associated with this unit.

2.3.6.4 2607-EG Septic Tank and Drain Field. The 2607-EG Septic Tank and Drain Field is located on the southeast side of the 241-C Tank Farm. The tank is marked by a large diameter vertical concrete pipe.

The tank started receiving nonhazardous and nonradioactive wastewater and sewage in 1953 and is still active. The estimated rate of waste generation is 170 L/day (45 gal/day).

No unplanned releases are associated with this unit.

2.3.6.5 2607-EJ Septic Tank and Drain Field. The 2607-EJ Septic Tank is located on the east side of the 241-AW Tank Farm, near the perimeter fence. The septic tank is surrounded by a wooden barricade and marked by a concrete pipe less than 1 m (2 ft) high with a yellow steel lid.

The tank started receiving nonhazardous and nonradioactive wastewater and sewage in 1980 and is still active. The estimated rate of waste generation is 320 L/day (85 gal/day).

No unplanned releases are associated with this unit.

2.3.6.6 2607-EL Septic Tank and Drain Field. The septic tank and associated drain field is located east of the 272-AW Building (WHC 1991a). However, the 241-AP Tank Farm is at that location and no septic tank could be found at those coordinates. The septic tank may have been removed when the 241-AP Tank Farm was constructed.

The tank started receiving nonhazardous and nonradioactive wastewater and sewage in 1983. The estimated rate of waste generation is 7,900 L/day (2,100 gal/day).

No unplanned releases are associated with this unit.

2.3.6.7 2607-E6 Septic Tank and Drain Field. The 2607-E6 Septic Tank is located north of the MO-405 Building, approximately 90 m (300 ft) west and 200 m (700 ft) north of 4th Street. The drain field is surrounded by a wooden fence and the surface is vegetated.

The tank started receiving nonhazardous and nonradioactive wastewater and sewage in 1954 and is still active. The estimated rate of waste generation is 43,500 L/day (11,500 gal/day).

No unplanned releases are associated with this unit.

2.3.7 Transfer Facilities, Diversion Boxes, and Pipelines

High-level waste transfer lines (also referred to as process lines) connect the major processing facilities with each other and with the various waste disposal and storage facilities. Most high-level waste transfer lines are 7.6 cm (3 in.) diameter stainless steel pipes with welded joints. These lines are generally enclosed in steel reinforced concrete encasements and are set below grade. The major process lines in the PUREX Plant Aggregate Area, and the facilities that they connect are shown on Figure 2-13. The high-level waste pipelines are not waste management units according to the Tri-Party Agreement and will be addressed in detail under the Decommissioning and RCRA Closure Program.

Transfer lines to liquid effluent disposal facilities (e.g., cribs) were constructed of a variety of materials including vitreous clay and galvanized metal. For the purposes of the AAMS, these transfer lines are considered part of the waste management unit into which they discharged and will be investigated as a part of their respective units.

Diversion boxes house the switching facilities where waste can be routed from one process line to another. They are concrete boxes that were designed to contain any waste that leaks from the high-level waste transfer line connections. The diversion boxes generally drain by gravity to nearby catch tanks where any spilled waste is stored. There are 27 diversion boxes, 2 valve pits, and 1 control structure in the PUREX Plant Aggregate Area.

2.3.7.1 241-A-A Diversion Box. The 241-A-A Diversion Box is located at the south end of the 241-A Tank Farm and is associated with the 241-A-350 Catch Tank. The waste management unit began operation in 1956 and is currently active.

The 241-A-A Diversion Box is 4.3 x 3.7 x 2.3 m (14 x 12 x 7.5 ft). The unit is an underground reinforced concrete structure with 0.3 m (1 ft) thick walls and floor. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.2 241-A-B Diversion Box. The 241-A-B Diversion Box is located at the south end of the 241-A Tank Farm and is associated with the 241-A-350 Catch Tank. The waste management unit began operation in 1956 and is currently active.

The 241-A-B Diversion Box is 4.3 x 3.7 x 2.3 m (14 x 12 x 7.5 ft) deep. The unit is an underground reinforced concrete structure with 0.3 m (1 ft) thick walls and floor. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.3 241-A-151 Diversion Box. The 241-A-151 Diversion Box is located approximately 15 m (50 ft) south of the east end of the 202-A Building. The diversion box is associated with the 241-A-302-A Catch Tank and the 241-A Tank Farm. The waste management unit began operation in 1956 and is currently active.

This unit routes waste solutions from processing and decontamination operations. Several unplanned releases (UN-200-E-25, UN-200-E-26, UN-200-E-31, UN-200-E-65) are associated with the 241-A-151 Diversion Box.

2.3.7.4 241-A-152 Diversion Box. The 241-A-152 Diversion Box is located 46 m (150 ft) east of tanks 241-A-103 and 241-A-106. The diversion box is associated with the 241-A-302-B Catch Tank and the 241-A Tank Farm. The waste management unit routes wastes from 241-A-151 Diversion Box to the 241-CR-151 Diversion Box.

The 241-A-152 Diversion Box is 18.6 x 7.2 x 5.6 m (61 x 23 x 18 ft). The unit is a reinforced concrete box with 8 cm (3 in.) PUREX style nozzles.

The unit operated from 1956 until May 1980 and is currently inactive. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.5 241-A-153 Diversion Box. The 241-A-153 Diversion Box is located approximately 6 m (20 ft) southwest of the 241-A-104 Tank. The waste management unit routes wastes from 241-A Tank Farm to the 244-AR Vault.

The 241-A-152 Diversion Box is 5 x 4 x 4 m (17 x 9 x 13 ft). The unit operated from 1956 until July 1985 and is currently inactive. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.6 241-AN-A Diversion Box. The 241-AN-A Diversion Box is located in the 241-AN Tank Farm just south and between double-shell tanks 241-AN-105 and 241-AN-106.

The diversion box, also known as the 241-AN-A Valve Pit, began operating in 1981 and is still active. The concrete diversion box is 4 x 4 x 2 m (14 x 14 x 7 ft). The cover block is approximately 51 cm (20 in.) thick. The waste management unit has a floor drain that leads to the 241-AN-101 Double-Shell Tank.

The diversion box has two functions (1) routes slurry from the 242-A Evaporator to the designated 241-AN tanks, and (2) routes supernate from other tank farms to the 241-AN Tanks, between tanks within the 241-AN Tank Farm and to forward material to other tank farms from the 241-AN tanks. The 241-AN-A Diversion Box is connected by slurry lines and supernatant lines to the 241-AN-104, 241-AN-105, 241-AN-106, 241-AN-107 Double-Shell Tanks, and the 241-AN-B Diversion Box.

No unplanned releases are associated with this unit.

2.3.7.7 241-AN-B Diversion Box. The 241-AN-B Diversion Box is located in the 241-AN Tank Farm just north and between double-shell tanks 241-AN-102 and 241-AN-103. The diversion box, also known as the 241-AN-B Valve Pit, began operating in 1981 and is still active. The concrete diversion box is 4 x 4 x 2 m (14 x 14 x 7 ft). The cover block is approximately 51 cm (20 in.) thick. The waste management unit has a floor drain which leads to the 241-AN-101 Double-Shell Tank.

The diversion box has two functions (1) routes slurry from the 242-A Evaporator to the designated 241-AN tanks, and (2) routes supernate from other tank farms to the 241-AN tanks, between tanks within the 241-AN Tank Farm and to forward material to other tank farms from the 241-AN tanks. Waste material is routed through the 241-AN-B Diversion Box and then to the designated double-shell tanks. The 241-AN-B Diversion Box is connected by slurry lines and supernatant lines to the 241-AN-101, 241-AN-102, 241-AN-103 Double-Shell Tanks, and the 241-AN-A Diversion Box.

No unplanned releases are associated with this unit.

2.3.7.8 241-AP Valve Pit. The 241-AP Valve Pit is located in the 241-AP Tank Farm just south of double-shell tank 241-AP-103. The waste management unit began operating in 1986 and is still active. The concrete valve pit is 19 x 5 x 2 m (61 x 15 x 8 ft). The cover block is approximately 66 cm (26 in.) thick. On the east end of the pit is a jumper storage area that is 5 m (15 ft) long separated from the process side by a 63 cm (25 in.) wall. The jumper storage area has a 10-gage stainless steel liner on the floor and walls. A floor drain is in both the process and storage side of the valve pit.

The 241-AP Valve Pit routes waste solutions from processing and decontamination operations. Process lines from the 241-AW Valve Pits and from the 241-AW-102 Central Pump Pit terminate at the 241-AP Valve Pit as do other slurry lines and supernatant lines from all 241-AP Central Pump Pits located atop the 241-AP double-shell tanks.

No unplanned releases are associated with this unit.

2.3.7.9 241-AR-151 Diversion Box. The 241-AR-151 Diversion Box is located east of the 244-AR Vault and is associated with the 241-AY and 241-AZ Tank Farms.

The waste management unit began operation in 1983 and is currently active. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.10 241-AW-A Diversion Box. The 241-AW-A Diversion Box is located in the 241-AW Tank Farm just east and between double-shell tanks 241-AW-101 and 241-AW-103. The diversion box, also known as the 241-AW-A Valve Pit, began operating in 1980 and is still active. The concrete diversion box is 4 x 4 x 2 m (14 x 14 x 7 ft). The cover block is approximately 51 cm (20 in.) thick. The waste management unit has a floor drain which leads to the 241-AW-102 Double-Shell Tank.

The diversion box has three functions (1) to routes slurry from the 242-A Evaporator to the designated 241-AW tanks, (2) to route supernate between tanks within the 241-AW Tank Farm or among other tank farms and the 241-AW Tank Farm, and (3) to route waste from the PUREX Plant to waste storage tanks. The 241-AW-A Diversion Box has a slurry line and supernatant line connecting double-shell tanks 241-AW-101, 241-AW-103, 241-AW-105, and the 241-AW-B Diversion Box.

No unplanned releases are associated with this unit.

2.3.7.11 241-AW-B Diversion Box. The 241-AW-B Diversion Box is located in the 241-AW Tank Farm just west and between double-shell tanks 241-AW-102 and 241-AW-104. The diversion box, also known as the 241-AW-B Valve Pit, began operating in 1980 and is still active. The concrete diversion box is 4 x 4 x 2 m (14 x 14 x 7 ft). The cover block is approximately 51 cm (20 in.) thick. The waste management unit has a floor drain which leads to the 241-AW-A Diversion Box and eventually to the 241-AW-102 Double-Shell Tank.

The diversion box has three functions (1) to route slurry from the 242-A Evaporator to the designated 241-AW tanks, (2) to route supernate between tanks within the 241-AW Tank Farm or among other tank farms and the 241-AW Tank Farm, and 3) to route waste from the PUREX Plant to waste storage tanks. The 241-AW-B Diversion Box has a slurry line and supernatant line connecting double-shell tanks 241-AW-102, 241-AW-104, 241-AW-106, and the 241-AW-A Diversion Box.

No unplanned releases are associated with this unit.

2.3.7.12 241-AX-A Diversion Box. The 241-AX-A Diversion Box is active and is associated with the 241-AY and 241-AX Tank Farms. The diversion box is interconnected with 241-AX-B Valve Pit, the 241-A-A Pit, the 241-A-B Pit, and the 242-A Evaporator.

The 241-AX-A Diversion Box is 4.3 x 3.7 x 2.3 m (14 x 12 x 7 ft). The waste management unit is an underground reinforced concrete box with 0.3 m (1 ft) thick walls and floor.

The unit began operation in 1965 and is currently active. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.13 241-AX-B Diversion Box. The 241-AX-B Diversion Box is active and is associated with the 241-AY and 241-AX Tank Farms. The diversion box is interconnected with 241-AX-B Valve Pit, the 241-A-A Pit, the 241-A-B Pit, and the 242-A Evaporator.

The 241-AX-B Diversion Box is 4.3 x 3.7 x 2.3 m (14 x 12 x 7 ft). The waste management unit is an underground reinforced concrete box with 0.3 m (1 ft) thick walls and floor.

The unit began operation in 1965 and is currently active. This unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.14 241-AX-151 Diversion Box. The 241-AX-151 Diversion Box is located southwest of the 241-A Tank Farm. The waste management unit routes waste from the 202-A Building to the 244-AR Vault and to the 241-AY and 241-AZ Tank Farms.

The 241-AX-151 Diversion Box is 13.4 x 3 x 7.6 m (44 x 10 x 25 ft). The unit is an underground reinforced concrete box. There are four diverter tanks in individual cells and a pump pit. Each cell has a stainless steel liner on the floor that extends approximately 0.3 m (1 ft) up the walls. The cells and pump pit are above and drain into the catch tank below.

It is unknown when the unit started operating. This active unit routes wastes from the 202-A Building.

No unplanned releases are associated with this unit.

2.3.7.15 241-AX-152DS Diversion Box. The 241-AX-152DS Diversion Box is located approximately 3 m (10 ft) inside the 241-AX Tank Farm west perimeter fence. The waste management unit is associated with the 241-AZ and 241-AY Tank Farms. This unit is also known as the 241-AX-152CT Catch Tank.

The 241-AX-152DS Diversion Box is 8 x 3 x 8.8 m (25 x 9 x 29 ft). The unit is an underground reinforced concrete box. There are two diverter tanks in a common cell with a stainless steel liner on the floor that extends approximately 0.3 m (1 ft) up the walls. There is also a pump pit that does not have a stainless steel liner. The cells and pump pit drain into the catch tank below.

The unit began operation in 1965 and is currently active. It routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.16 241-AX-155 Diversion Box. The 241-AX-155 Diversion Box is located near the 241-AX and 241-AY Tank Farm dividing fence. The waste management unit is associated with the 241-AX-152 Diversion Box.

The unit began operation in 1983 and is currently active. The 241-AX-155 Diversion Box routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.17 241-AX-501 Valve Pit. The 241-AX-501 Valve Pit is located south of the 241-AX Tank Farm, just northwest of 241-A-417 Catch Tank. The waste management unit interconnects the 241-AX Tank Farm to the 241-A-417 Catch Tank.

It is unknown when the unit started operating. This active unit routes waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.18 241-AY-151 Diversion Box. The 241-AY-151 Diversion Box is located west 241-A Tank Farm. The waste management unit, also known as the 241-AY-151 Pumpout Pit, is still considered active. The concrete diversion box is 3 x 2 x 3 m (10 x 17 x 10 ft).

The diversion box transfers aging waste from the PUREX Plant to the 241-AY and 241-AZ Tank Farms.

No unplanned releases are associated with this unit.

2.3.7.19 241-AY-152 Diversion Box. The 241-AY-152 Diversion Box is located between the 241-AY and the 241-AZ Tank Farms. The waste management unit, also known as the 241-AY-152 Sluice Transfer Box, began operating in 1971 stopped operating in 1985 and is considered inactive. The reinforced concrete diversion box is 5 x 5 x 3 m (17 x 17 x 10 ft).

The diversion box transfers aging waste form the PUREX Plant to the 241-AY and 241-AZ Tank Farms.

No unplanned releases are associated with this unit.

2.3.7.20 241-AZ-151DS Diversion Box. The 241-AZ-151DS Diversion Box is located in the 241-AZ Tank Farm, approximately 33 m (100 ft) southwest of the 241-AZ-102 Double-Shell Tank. The waste management unit, also known as the 241-AZ-151 Diverter Station, started operating in 1976 and is still active. The unit is an underground reinforced concrete structure with two diverter tanks in a common cell and a pump pit. The diversion box has a stainless steel liner on the floor that extends approximately 0.3 m (1 ft) up the walls. The diverter cell and pump pit are above and drain into the catch tank below which is lined with 16 gage stainless steel.

The diversion box is used to transfer waste solutions from processing and decontamination operations. The catch tank contains 10,017 L (2,650 gal) of waste.

No unplanned releases are associated with this unit.

2.3.7.21 241-AZ-152 Diversion Box. The 241-AZ-152 Diversion Box is located in the 241-AZ Tank Farm just south of the 241-AZ-102 Double-Shell Tank. The waste management unit, also known as the 241-AZ-152 Sluice Transfer Box, began operating in 1977 and is still active. The inside dimensions of the concrete diversion box are 6 x 3 x 2 m (18 x 10 x 6 ft). All the walls are 46 cm (18 in.) thick and taper to 30 cm (12 in.) at the top where the 30 cm (12 in.) thick cover block sits.

The diversion box is used to transfer waste solutions from processing and decontamination operations. The unit interconnects the 241-AZ Tank Farm, 241-AY Tank Farm, 241-AZ-151 Diversion Box, and the 241-AY-152 Diversion Box.

No unplanned releases are associated with this unit.

2.3.7.22 241-C-151 Diversion Box. The 241-C-151 Diversion Box is located approximately 900 m (3,000 ft) north of the 202-A Building and approximately 60 m (200 ft) southwest of the 241-C Tank Farm. The waste management unit is associated with the 241-C Tank Farm and interconnects the 241-C-153, 241-C-152, and 241-CR-151 Diversion Boxes. This unit is 6 x 3 x 3.5 m (18 x 10 x 11.5 ft).

The 241-C-151 Diversion Box started operating in 1946 and ceased operating in July 1985. This unit routes waste solutions from processing and decontamination operations.

One unplanned release (UN-200-E-68) is associated with this unit.

2.3.7.23 241-C-152 Diversion Box. The 241-C-152 Diversion Box is located approximately 45 m (150 ft) southwest of the 241-C Tank Farm, just north of the 241-C-151 Diversion Box. The waste management unit is associated with the 241-C-301 Catch Tank and interconnects the 241-B-154, 241-B-153, and 241-C Tank Farm. This unit is 8.5 x 3 x 3.5 m (28 x 10 x 11.5 ft).

The 241-C-152 Diversion Box started operating in 1946 and ceased operating in July 1985. This currently inactive unit transferred waste solutions from processing and decontamination operations.

One unplanned release (UN-200-E-82) is associated with this unit.

2.3.7.24 241-C-153 Diversion Box. The 241-C-153 Diversion Box is located west of the 241-C-107 and 241-C-110 Single-Shell Tanks. The waste management unit is associated with the 241-C-301 Catch Tank and the 241-C Tank Farm. It interconnects the 241-C-151 and 241-C-152 Diversion Boxes. This unit is 10.4 m 10.4 x 3 x 3.2 m (34 x 10 x 10.5 ft).

The 241-C-153 Diversion Box started operating in 1946 and ceased operating in July 1985. This currently inactive waste management unit transferred waste solutions from processing and decontamination operations.

2.3.7.25 241-C-252 Diversion Box. The 241-C-252 Diversion Box is located northwest of the 241-C-204 Single-Shell Tanks. The waste management unit is associated with the 241-C-301 Catch Tank and the 241-C Tank Farm. It interconnects the 241-C-151 Diversion Boxes and the 241-C Tank Farm. This unit is 11 m 11 x 3 x 4.6 m (36 x 10 x 15 ft).

The 241-C-252 Diversion Box started operating in 1946 and ceased operating in July 1985. This currently inactive unit transferred waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.26 241-CR-151 Diversion Box. The 241-CR-151 Diversion Box is located directly south of the 241-C Tank Farm, between 241-CR-152 and 241-CR-153 Diversion Boxes and the 244-CR Vault.

It is uncertain when the 241-CR-151 Diversion Box started operating; however, it is no longer active. This waste management unit transferred waste solutions from processing and decontamination operations.

One unplanned release (UN-200-E-81) is associated with this unit. More detailed information regarding unplanned releases is presented in Table 2-6 and Section 4.0.

2.3.7.27 241-CR-152 Diversion Box. The 241-CR-152 Diversion Box is located south of the 241-C Tank Farm. It interconnects the 241-C-151 Diversion Box and the tanks in the 241-C Tank Farm.

The 241-CR-152 Diversion Box started operating in 1946 and ceased operating in July 1985. This currently inactive waste management unit transferred waste solutions from processing and decontamination operations.

No unplanned releases are associated with this unit.

2.3.7.28 241-CR-153 Diversion Box. The 241-CR-153 Diversion Box interconnects the 241-CR-152 Diversion Box just northwest of the 241-CR-151 Diversion Box.

The 241-CR-153 Diversion Box started operating in 1946 and ceased operating in July 1985. This currently inactive waste management unit transferred waste solutions from processing and decontamination operations to the 241-C Tank Farm.

No unplanned releases are associated with this unit.

2.3.7.29 241-ER-153 Diversion Box. The 241-ER-153 Diversion Box is located approximately 122 m (400 ft) south of 7th Street. The unit is associated with the 244-A Lift Station.

The diversion box started operating in 1945 and is an active waste management unit. The unit transfers waste solutions from processing and decontamination operations. The quantities of waste transferred vary according to the specific plant operations.

No unplanned releases are associated with this unit.

2.3.7.30 216-A-524 Control Structure. The control structure is located at the west end of the 216-A-24 Crib area. Currently, this structure is not visible as it was covered with clean fill in 1988. The unit was a reinforced concrete box, extending 15 cm (6 in.) above grade to 3 m (10 ft) below grade. The opening into the unit was covered by a 15 cm (6 in.) thick, 1 x 4 m (3 x 12 ft) concrete cover fitted with lifting eyes.

The unit started operating in 1957 and ceased operating in 1966. The unit received condensate from the waste storage tanks in the 241-A and 241-AX Tank Farms. The waste was low salt and neutral/basic.

No unplanned releases are associated with this unit.

2.3.8 Basins

Retention basins are used for intermittent storage of liquid waste before being transferred to ponds, ditches, or cribs. There are two retention basins in the PUREX Plant Aggregate Area. The locations of the basins are shown on Figure 2-14.

2.3.8.1 207-A Retention Basin. The 207-A Retention Basin is directly east of the 242-A Evaporator.

The 207-A Retention Basin consists of 6 rubber-lined holding cells, each with an operating capacity of 205,790 L (54,370 gal). The waste management unit is 16.8 x 3 m (55 x 10 ft) and 2 m (7 ft) deep. A 10 cm (4 in.) fill line enters each cells and a 7.6 cm (3 in.) drain line exits the cells . During operations the holding cells are alternately filled, sampled, and emptied when meeting specifications.

The 207-A Retention Basin began operation in March 1977 and is still active. The basin has been receiving two liquid waste streams from the 242-A Evaporator: (1) steam condensate is sent to the three north holding cells and then to the 216-B-3 Pond System; (2) process condensate is sent to the three south holding cells and then to the double-shell tanks.

No unplanned releases are associated with this unit.

2.3.8.2 216-A-42 Retention Basin. The 216-A-42 Retention Basin is east of the 202-A Building, directly east of the 216-A-6 Crib.

The 216-A-42 Retention Basin consists of three covered concrete-lined sections. The capacity of the three basins is in excess of 6,056,000 L (1,600,000 gal). The waste management unit is 104 x 9.1 m (342 x 30 ft) and 7 m (23 ft) deep. The south end of each section of the basin has a 20.3 cm (8 in.) steam condensate pipe, and the north end of each section has a 91.4 cm (36 in.) cooling water pipe. Both lines enter at 3 m (10 ft) below grade.

The basin receives effluent from the Steam Condensate Line, cooling water line, and chemical sewer line. Waste from these lines is directed to the basin when online beta, gamma, or alpha monitors detect contamination in the line. The chemical sewer line is equipped with a pH monitor that, when triggered, diverts waste to the basin. After the diverted effluent is sampled and cleared for disposal, it is released to the normal soil column disposal sites. In the past, the effluent was discharged to the 216-B-3 Pond, 216-A-30 Crib, and 216-A-37-2 Crib. Currently, the effluent is discharged only to the 216-B-3 Pond.

One unplanned release (UPR-200-E-66) is associated with the retention basin.

2.3.9 Burial Sites

There are five burial grounds and one burning pit in the PUREX Plant Aggregate Area. The locations of the burial sites and the burning pit are shown on Figure 2-15.

2.3.9.1 200-E Burning Pit. The burning pit is located in the large excavation east of the 218-E-8 Burial Ground. The burning pit has a surface area of 119.4 x 61.3 m (392 x 201 ft) with a depth of 4.6 m (15 ft). There are no specific markers for this burning pit.

This waste management unit was active from 1950 to 1970. It received 1,500 m^3 (53,000 ft^3) of construction and office waste, paint wastes, and chemical solvents. The burning pit was used to burn nonradioactive material. This is a RCRA TSD unit.

Three enclosures are located within the basin. South of the 218-E-8 Burial Ground, a 12.2 x 12.2 m (40 x 40 ft) light chain and nylon rope barrier with surface contamination placards surrounds several drums, pallets, and sections of steel pipe. This may be a tank farm storage area. A nylon cord extends from the 218-E-8 Burial Ground eastern perimeter out about 6 m (20 ft) to a fallen steel T-post. The triangular enclosure is empty. In the middle of the basin is a 4.6 x 4.6 m (15 x 15 ft) light chain barricade with asbestos warning signs. Several small excavations are visible inside the enclosure. Northeast of the asbestos enclosure is a 4.6 x 4.6 m (15 x 15 ft) empty rope enclosure with a sign labeled "RCRA Waste Site." This enclosure marks the location of a single detonation event in 1984, used to dispose of a quantity of unstable liquids.

There is one unplanned release (UPR-200-E-106) associated with this unit.

2.3.9.2 218-E-1 Burial Ground. The 218-E-1 Burial Ground is a 3-acre dry waste burial ground located about 100 m (350 ft) west of the 202-A Building. The unit consists of fifteen 60 m (200 ft) long trenches running north and south, ranging from 4.9 x 6.1 m (16 to 20 ft) wide. All sunken trenches in the waste management unit were filled in 1974 to ground level with cinders from the 200 East Power Plant and then covered with coarse gravel and backfilled in an attempt to stabilize the unit. The overall unit dimensions are 148 x 88.4 x 3 m (486 x 290 x 9 ft) deep. In October 1981 the entire surface of the unit was covered with a minimum of 46 cm (18 in.) of clean overburden and re-vegetated. This unit was active from 1945 to 1953 and during that time it received about 3,030 m^3 (107,000 ft^3) of both mixed fission products and TRU dry waste.

There is one unplanned release (UPR-200-E-53) associated with this unit.

2.3.9.3 218-E-8 Burial Ground. The 218-E-8 Burial Ground is located 1,500 m (5,000 ft) north of the 202-A Building on the hillside between the 200-E Burning Pit and the 218-E-12B Burial Ground. The burial ground is 122 x 35 m (400 x 115 ft) to a depth of 4.6 m (15 ft). The waste management unit consists of an unknown number of backfilled

trenches. This unit adjoins the 218-E-12B Burial Ground on the east. Its surface slopes down to the basin floor and the burning area. The east side is approximately 9.1 m (30 ft) lower than the west, where it adjoins the 218-E-12B Burial Ground.

The burial ground was used from 1958 to 1959. It received mixed fission products and TRU waste, including repair and construction wastes from the 293-A Stack and the PUREX new crane addition. The burial ground received 2,265 m^3 (80,000 ft^3) of waste.

No unplanned releases are associated with this unit.

2.3.9.4 218-E-12A Burial Ground. The 218-E-12A Burial Ground is located 50 m (150 ft) northwest of the 241-C Tank Farm. The burial ground is approximately 341 x 341 m (1,200 x 1,200 ft or 33.0 acres) excavated to a depth of 5 m (16 ft). The waste management unit contains 28 dry waste burial trenches. Operational experience indicates that the trenches were often 12.2 m (40 ft) wide rather than 9.1 m (30 ft) wide. Also, the backfill was substantially less than the present requirement of 1.2 m (4 ft). Visual observations confirmed that some waste was visible at the surface prior to stabilization efforts. Several old wooden signs identifying trenches and the types of grasses sown to stabilize them, are visible on the south side of the unit. A small light chain barrier with underground contamination placards surrounding an area stabilized with sand was found on the south side of the burial ground. The 216-B-2-3 ditch and pipeline from B Plant cut along the north perimeter, which has surface contamination signs posted. The ditch empties into a pipe on the northeast corner of the burial ground.

This burial ground was used from 1953 to 1967. Trenches 1-3, 12-14, and 17-25 contain predominantly dry waste packaged in cardboard boxes and plastic bags. Trenches 4-11, 15-16, and 26-28 contain predominantly acid-soaked material. Specific contents of trench 28 are unlisted. The total volume of waste received by the burial ground is 15,249 m^3 (538,511 ft^3).

During the past years, many of the trench surfaces have settled due to voids created by the waste buried below, subsequently requiring the holes to be filled to ground level. The acid-soaked radioactive waste is buried in a shallow excavation.

This burial ground has two unplanned releases associated with it: UPR-200-E-24 and UPR-200-E-30.

2.3.9.5 218-E-12B Burial Ground. The 218-E-12B Burial Ground is active and located about 304 m (1,000 ft) north of the 241-C Tank Farm, and about 1,327 m (4,500 ft) north of PUREX. The unit consists of 138 trenches running north to south. As of September 1982, 27 of the trenches were completely full, 2 were partially filled, and the remaining 109 trenches were empty. The trenches are filled with miscellaneous wastes. A special study showed mixed fission products in part of Trench 28 and TRU in parts of Trenches 17 and 27 (Maxfield 1979). This unit is a RCRA TSD facility.

The 218-E-12B Burial Ground can be divided into two general sections, north and south, which are separated by a road. The southern section contains an eastern portion that is stabilized with soil and posted with underground contamination signs and concrete identification posts. The western half of the southern section is not stabilized and contains less vegetation than the eastern section. It has two open trenches that contain an abundant quantity of tumbleweed.

The northern portion of the burial grounds consists of Trench 94 in the east, which contains Navy reactor compartments, and several borrow pits and spoil piles in the west. A barrier with surface contamination warning signs extends along the road separating the northern and southern portions of the burial grounds. The Navy reactor compartments contain lead shielding, with an anticipated minimum life expectancy for containment of 300 years. The unit is partially stabilized.

No unplanned releases are associated with this unit.

2.3.9.6 218-E-13 Burial Ground. Burial Ground 218-E-13 is located approximately 100 (350 ft) west of the PUREX Plant Aggregate Area exclusion area patrol gate house on 4th Street. This unit is inactive and has an area of 170 m^2 (1,830 ft^2) and a depth of 2.4 m (8 ft).

While no designated unplanned releases are associated with this unit, the waste management unit does have a release site. In August 1966, broken pieces of contaminated concrete from a pipe trench were left in the excavation hole and buried following repair to the piping at that location. This resulted in the 218-E-13 Burial Ground. The contaminated soil volume is estimated at 184 m^3 (6,800 ft^3) with an overburden soil volume of 175 m^3 (6,180 ft^3) (WHC 1991a).

2.3.10 Unplanned Releases

Sixty-three unplanned releases are included in the PUREX Plant Aggregate Area. Their locations are shown on Figure 2-16. Unplanned releases designated with a "UPR" are releases from or within the operations of specific waste management units and are considered part of that unit for remediation purposes. Releases designated with a "UN" are a distinct waste management unit for remediation purposes. Many of the releases are not included as independent sites in the Tri-Party Agreement because they are closely associated with existing waste management units. 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. Most of the information available for the unplanned releases is derived from the WIDS sheets (WHC 1991a).

One additional, potentially significant, release site is known to exist in the PUREX Plant Aggregate Area but has not been officially documented as an unplanned release. More information will be compiled on this site in the future to assess the potential impacts to the environment. A formal evaluation of the regulatory status of this site will be made in accordance with EII 1-10 (WHC 1988a). If the available data indicate that the release is significant, it will be submitted for listing as an official unplanned release.

The potential site is a release of fission products from the deactivated 241-C-151 Diversion box. The release spread detectable contamination over approximately 10 km^2 (2 mi^2). Section 4.1.2.7 discusses the release detail.

2.4 WASTE GENERATING PROCESSES

The primary waste generating processes in the PUREX Plant Aggregate Area are associated with the operation of the 202-A Building and its ancillary support facilities. Operations in the 202-A Building complex have included the recovery of uranium and plutonium from spent reactor fuels, treatment and/or storage of liquid and solid wastes, and discharge of gaseous and liquid effluents that meet environmental release criteria. The PUREX Technical Manual (RHO 1980) describes these aspects in greater detail. This section describes the primary waste generating processes and the associated building locations in the PUREX Plant Aggregate Area including:

- 202-A Building and 293-A Building (PUREX Process)
- 242-A Evaporator (Waste Volume Reduction Process)
- 241-A-431 Condenser Building in the 241-A Tank Farm (Tank Farm Condensate).

In addition, some waste management units within the aggregate area received wastes from outside facilities. Some of the B Plant waste was sent to the 241-A, 241-AX, and 241-C Tank Farms. The 201-C Building (Semiworks) liquid effluent was also sent to the 241-C Tank Farm.

Several different waste streams were discharged to the various waste management units in the PUREX Plant Aggregate Area. These waste streams include, but are not limited to:

- PUREX Plant Steam Condensate: The steam condensate consists almost entirely of warm raw water and condensed steam that has been used to control the temperature of certain process vessels. These vessels could experience heat transfer surface failure and radionuclide release. The process consists of routing the water or steam through a coil or tube bundle to heat or cool the process vessels. The wastestream consists of raw water pumped from the Columbia

radionuclides and chemical contaminants deposited from the air onto jumpers (a remotely removable pipe) and nozzles when the jumpers are disconnected, (2) corrosion products from the piping used to conduct water from the Colombia River to the PUREX Plant, and, when tube failures occur, (3) elevated concentration of radionuclides arising from failure (WHC 1990c).

- PUREX Plant Cooling Water: The PUREX Cooling Water consists of 200 East raw water and steam condensate which is used to control the temperature of process vessels in the 202-A Building. In addition to the steam condensate from the 202-A Building, the cooling water receives air pump seal water, liquid from the railroad tunnel door drain, and the cooling heat transfer surfaces in the 293-A Building (WHC 1990d). Cooling water was normally sent to ponds and ditches as radioactive contamination only occurred from process equipment leaks.

- PUREX Plant Ammonia Scrubber Distillate: The ammonia scrubber distillate waste stream is generated in the PUREX Plant. The discharge is composed of two primary sources: one stream is from the dissolvers where Zircaloy fuel cladding is dissolved; and a second stream from the treatment of the cladding removal waste solution. Offgases from the decladding and waste treatment operations pass through four parallel ammonia scrubbers and are combined with other minor ammonia-bearing waste streams. The combined waste stream is transferred to a concentrator where the NH_3 is distilled and the overhead condensate is discharged to designated waste management units as the ammonia scrubber distillate waste stream (WHC 1988b).

- PUREX Plant Chemical Sewer: The PUREX Plant Chemical Sewer collects wastewater from the nonradiologically controlled service areas of the 202-A Building and supporting facilities, as well as steam condensate and cooling water from the vacuum fractionator. Most of these streams are essentially clean, consisting of steam condensate from ventilation air heaters, water cooler drains, shower drains, and assorted floor drains. The floor drains have a potential for chemical contamination (WHC 1990e). Chemical sewer effluent was normally sent to ditches and ponds as radioactive contamination only occurred from process equipment leaks.

- PUREX Plant Process Condensate: The composition of the PUREX Plant Process Condensate can vary depending on several factors. According to the process condensate stream-specific report (WHC 1990f), the possibility of a wide variety of trace organic constituents is of primary interest. The process condensate consists of water (condensed overheads from the K4 evaporator) that has been in contact with process organics tributyl phosphate and normal paraffin hydrocarbons. Because these chemicals are technical grade, they contain a variety of trace impurities: butanol, butyraldehyde, acetone, methyl ethyl ketone, and others. Additionally, in the presence of the high radiation and strong

chemical fields which exist in the PUREX process, the major and minor constituents degrade and recombine. Because of variations in the PUREX process, the flow and composition of inorganics, such as nitrate and hydroxide, are also of interest.

- N Reactor Effluent: The N Reactor Effluent consists of three process water streams. These streams consist of raw, filtered, and demineralized water supplies, each with their own characteristics. The raw water process stream supplies essentially untreated river water used to quench valve leaks from the primary coolant system. The filtered water process stream consists of raw water that is chemically treated with chlorine and alum in a mix tank, piped to the coagulator where polyacrylamide is added, and then passed through sand filters. The demineralized water process stream is essentially pure water, with few ionic materials carried over from the filtered water supply from which it is derived. Traces of dissolved low-molecular weight organic compounds such as chloroform, if present in the filtered water supply, are generally carried over into the demineralized water supply (WHC 1990g).

- 242-A Evaporator Steam Condensate: The only active contributor to the 242-A Evaporator Steam Condensate waste stream is the vacuum pump seal water. Historically, there have been eleven contributors to this waste stream: the reboiler steam condensate, the steam condensate and raw water from heating and cooling jackets, the purging system steam trap condensate, the vacuum pump seal water, the steam strainer condensate, the steam separator condensate, the steam separator strainer blowdown, the seal water pressure control valve discharge, the micro-filter catch pan drainage, the seal water pumps and filter catch pan drainage, and the R-C-1 sampler/monitor cooler raw water discharge. No chemicals are intentionally added to the 242-A Evaporator Steam Condensate system (WHC 1990h). Cooling water was normally sent to ponds and ditches as radioactive contamination only occurred from process equipment leaks.

- 242-A Evaporator Cooling Water: A total of nine contributors feed the 242-A Evaporator Cooling Water waste stream. These nine contributors, in order of volume contribution to the stream, are as follows: condenser cooling water, air compressor cooling water, emergency steam turbine condensate, steam trap condensate, compressed air dryer discharges, water filter catch pan drainage, heating, ventilating, and air conditioning (HVAC) room floor drains, steam system relief valve discharges and, compressed air receiver condensate. Minor contributions occur from the normal corrosion products associated with piping oxidation. No chemicals or constituents are added to the waste from the evaporator, condensers, and ancillary equipment. Octyldecylamine added to boiler makeup water is introduced in very small amounts as steam trap condensate, however, this is not a hazardous chemical (WHC 1990i). Cooling

water was normally sent to ponds and ditches as radioactive contamination only occurred from process equipment leaks.

- 242-A Evaporator Process Condensate: Process condensate constituents include carryover from boiloff of the evaporator feed and any chemicals added to the process condensate stream following evaporation in the main, inter-condensers, and after-condensers. The identification of all constituents is not possible at the present time because past sampling analysis of radioactive tank waste did not include volatile organic analysis (WHC 1990j).

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 PUREX Plant Aggregate Area waste streams are listed in Table 2-8; Table 2-9 lists the chemicals used in the 202-A Building Analytical Laboratory; and Table 2-10 lists radionuclides, organic and inorganic chemicals disposed of at the PUREX Plant Aggregate Area waste management facilities. These lists have been compiled from inventory data, sampling data and process descriptions. Sections 2.4.1 through 2.4.3 describe the PUREX Plant Aggregate Area waste generating processes that were previously mentioned.

2.4.1 PUREX Process

The 202-A Building was the primary location of the PUREX process. The PUREX chemical separation processes are based on dissolving jacketed fuel rods in nitric acid and conducting multiple purification operations on the resulting aqueous nitrate solution. The goal is to extract, purify and concentrate the uranium, plutonium and neptunium produced from the declad fuel elements. The driving forces for the separations consist of concentration changes, temperature changes, and chemical additions. The process steps include fuel-element decladding, uranium metal dissolution, solvent extraction, ion exchange, and product load-out.

The PUREX process begins with zirconium cladding on fuel elements being removed in an ammonium fluoride/ammonium nitrate (AFAN) solution. Ammonium nitrate is required to react with the ammonia and hydrogen that evolve during decladding due to the potential combustion hazard. Nitric acid is used to dissolve declad fuel elements for the solvent extraction process. The solvent extraction process used a light phase solvent, tributyl phosphate in a normal paraffin hydrocarbon (kerosene) diluent, to extract the uranium, plutonium and neptunium from the fission products. The organic phase is sent to the partitioning cycle where the plutonium is partitioned from the uranium and neptunium. The plutonium stream is routed through two additional solvent-extraction cycles for further purification. After purification, the plutonium stream is concentrated. The other stream from the partition cycle, which bears the neptunium and uranium, is routed to the final uranium cycle where neptunium is separated. The aqueous neptunium stream is sent to the backcycle waste system for concentration and recycling to the solvent-extraction column.

The uranium stream is routed to a column that strips the uranium from the organic stream with an aqueous nitric acid solution. The uranium product, uranyl nitrate hexahydrate, is then stored in tanks until it is shipped to the UO_3 Plant in the 200 West Area.

The 202-A Building is the source of five liquid effluent streams. These liquid effluent streams are the process condensate, cooling water, PUREX steam condensate, chemical sewer, and ammonia scrubber distillate. The process condensate stream comes from the concentration stages of the PUREX process. The concentration changes are provided by dilution with water and by removal of water by boiling. Most, but not all, of the water removed by boiling is recycled back into the dilution stages of the process. The fraction of water not recycled is disposed of through the process condensate stream. The process condensate stream is currently rerouted to TK G-7. Steam condensate and warm water constitute the liquid effluents from the PUREX process in the cooling water, PUREX steam condensate, and most of the chemical sewer streams. The steam condensate and warm water effluents are the condensed steam used for boiling process solutions and the warmed cooling water used for condensing the resulting process vapors. The rest of the chemical sewer stream comes from ventilation, heating, water services, and room drainage (mostly shower rooms, water coolers, housekeeping water, and steam and water leaks, together with occasional chemical leaks). The ammonia scrubber distillate stream is the result of the first step in fuel dissolution, which produces large quantities of gaseous ammonia. The ammonia is scrubbed from the offgas with water to prevent releasing the ammonia to the air. Then the resulting ammonia solution is boiled to concentrate the ammonia and radionuclides for disposal to underground storage tanks. The condensed vapor becomes the ammonia scrubber distillate stream. The ammonia scrubber distillate stream is currently inactive.

One of the secondary facilities within the PUREX process is the 293-A Building. This building houses the Offgas Treatment facility, which removes nitrogen oxides from the dissolver offgas stream it converts them to nitric acid. Offgases are treated with hydrogen peroxide to remove the nitrogen oxides. The nitric acid is then recycled into the PUREX process via the 206-A Building.

Process wastes from the 202-A Building were discharged to various waste management units including, but not limited to, the following:

- 216-A-1 and 216-A-2 Cribs
- 216-A-21 and 216-A-27 Cribs
- 216-A-11 and 216-A-12 French Drains
- 216-A-18 and 216-A-19 Trenches
- 216-A-29 Ditch

- 241-A, 241-AX and 241-C Tank Farms
- 216-A-42 Retention Basin.

2.4.2 Waste Volume Reduction Process

The 242-A Evaporator started operation in 1977. The purpose of this facility is to reduce the volume of radioactive liquid waste by evaporating water from the feed solution to produce a concentrated salt solution. The solution separates upon cooling to form salt cake and residual liquor. This process reduces the number of double-shell tanks required to store this type of waste by 35 to 60%.

The 242-A Building contains the evaporator vessel, supporting process equipment, and the principal process components of the evaporator-crystallizer system. The building comprises two adjoining, structurally independent structures, designated A and B. Structure A houses the processing and service areas while structure B houses operating and personnel support areas.

Process condensate from the 242-A Evaporator flows into one of the three cells at the 207-A Retention Basins until it reaches operational capacity. At this time the steam condensate flow is diverted to one of the two remaining cells. The cell that has reached capacity is then sampled and analyzed at the 222-S Laboratory for radionuclides as an indication of process control. The steam condensate from the full diversion basin is then discharged to the 216-B-3 Pond and the cooling water line via the 216-B-3-3 Ditch if the analytical results are within set radionuclide limits.

Process wastes were discharged to various waste management units including the following:

- 216-A-37-1 Crib
- 207-A Retention Basin.

2.4.3 Tank Farm Condensate

Condensate waste from the 241-A Tank Farm was condensed in the 241-A-431 Building. The waste was then directed to eight waste management units. The condensate was primarily water and included entrained radionuclides and chemicals from the waste in the tanks. The following waste management units received condensate waste:

- 216-A-8 Crib

- 216-A-16 and 216-A-17 French Drains
- 216-A-23A and 216-A-23B French Drains
- 216-A-19 and 216-A-20 Trenches
- 216-A-34 Ditch.

2.5 INTERACTIONS WITH OTHER AGGREGATE AREAS OR OPERABLE UNITS

The 200 Areas have two distinct operational areas, the 200 East and 200 West (Figures 1-3 and 1-4). These areas are used for chemical separations and waste management. The PUREX Plant Aggregate Area is bordered by the B Plant Aggregate Area on all sides with the exception of a small portion of the western border where the Semiworks Aggregate Area is present. During operation of the 202-A Building, several other processing and support facilities on the Hanford Site are utilized. The purpose of this section is to summarize facilities that interact directly with 202-A Building operations. These facilities include the Plutonium Finishing Plant, UO_3 Plant, 241-AW Tank Farm, and the double-shell storage tanks within the 241-AY and -AZ Tank Farms.

- The Plutonium Finishing Plant received product material, plutonium oxide (PuO_2) and plutonium nitrate ($PuNO_3)_4$), from the PUREX Plant.
- Uranium was recovered as uranyl nitrate and transported to the UO_3 Plant for conversion to UO_3.
- Decladding wastes and other miscellaneous PUREX process liquid wastes are stored in the double-shell waste tanks and concentrated to double-shell slurry in the 242-A Evaporator for long-term storage in double-shell tanks in AN, AW, and/or AP Tank Farms.
- PUREX process high-level wastes are adjusted at the 202-A Building to meet the storage tank specifications and transferred to double-shell tanks in 241-AY and 241-AZ Tank Farms.

In addition to the 202-A Building wastes, wastes from a variety of sources outside the PUREX Plant Aggregate Area were discharged to the PUREX Plant Aggregate Area waste management units. All of the wastes received from other aggregate areas were discharged to the tank farms. Although specific single-shell and double-shell tanks are identified as having received wastes from outside sources, any of the tanks within the associated cascade system

may have received the same wastes. Waste management units receiving wastes from aggregate areas other than the PUREX Plant Aggregate Area are identified below:

- 241-A Tank Farm: received B Plant waste fractionization, complexed and non-complexed wastes from the 241-BX and 241-SX Tank Farms, double-shell slurry feed from the 241-BX, 241-BY, and 241-SX Tank Farms.

- 241-AN Tank Farm: received dilute and concentrated phosphate waste from the 100-N Area.

- 241-AX Tank Farm: received B Plant waste fractionization.

- 241-AY Tank Farm: received supernate with double-shell slurry feed from the 241-BX Tank Farm.

- 241-AZ Tank Farm: received B Plant high-strontium waste and double-shell slurry feed from the 241-BX Tank Farm.

- 241-C Tank Farm: received S Plant ion exchange wastes, B Plant waste fractionization, N Reactor complexed waste, PNL Waste, evaporator bottoms from the 241-B and 241-BX Tank Farms, tributyl phosphate waste from the 241-BY, 241-TY, and 241-U Tank Farms, S Plant supernate, low-level and metal wastes from 241-B Tank Farm, Semiworks strontium waste, and Hanford Laboratory Operations waste.

Some wastes that were generated in the PUREX Plant Aggregate Area were sent outside of the area for disposal. These include cooling water from the 241-A-431 Building that was routed to the 216-A-25 Pond. Wastes were sent via the 216-A-29 Ditch to the 216-B-3 Pond in the B Plant Aggregate Area. The 216-B-3 Pond is addressed in the B Plant AAMS.

2.6 INTERACTION WITH RESOURCE CONSERVATION AND RECOVERY ACT PROGRAM

Appendixes B and C of the Tri-Party Agreement 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 PUREX Plant Aggregate Area there are 34 facilities which fall into this category:

- 216-A-10 Crib

- 216-A-29 Ditch

- 216-A-36B Crib
- 216-A-37-1 Crib
- 218-E-12B Burial Ground
- 218-E-14 PUREX Tunnel
- 218-E-15 PUREX Tunnel
- 241-AN Tank Farm (7 tanks)
- 241-AP Tank Farm (8 tanks)
- 241-AW Tank Farm (6 tanks)
- 241-AY Tank Farm (2 tanks/2 diversion boxes)
- 241-AZ Tank Farm (2 tanks)
- 244-AR Vault
- 244-CR Vault
- 244-A Lift Station (Receiver Tank)
- 241-A Tank Farm (6 tanks/2 diversion boxes)
- 241-AX Tank Farm (4 tanks/1 diversion box)
- 241-C Tank Farm (16 tanks/6 diversion boxes)
- 200-E Burning Pit
- 207-A Retention Basin
- 242-A Evaporator
- Neutralization Tank E-5
- Neutralization Tank F-15
- Neutralization Tank F-16

- Neutralization Tank F-18
- Neutralization Tank G-7
- Neutralization Tank U3
- Neutralization Tank U4
- E-F11 Concentrator
- Ammonia Distillate Treatment System (future tank)
- Waste Piles
- 204-AR Waste Unloading Station
- Grout Treatment Facility
- Grout Treatment Facility Landfill.

The single-shell tanks and their associated facilities will be closed under RCRA rather than seeking a RCRA operating permit. The preferred closure option will be resolved through the preparation and completion of a supplemental environmental impact statement. The waste management units in this category include all the single-shell tanks of the 241-A Tank Farm, the 241-AX Tank Farm, and the 241-C Tank Farm and associated diversion boxes, catch tanks, and ancillary facilities.

The double-shell tanks of the 241-AN Tank Farm, the 241-AP Tank Farm, the 241-AW Tank Farm, the 241-AY Tank Farm, and the 241-AZ Tank Farm as well as the 244-AR Vault, 244-CR Vault, the 244-A Lift Station (Receiver Tank), and associated diversion boxes, catch tanks, and ancillary facilities are active facilities under the control of the Waste Management Program. These units have a current RCRA operating permit.

Other waste management units that have or are seeking current RCRA operating permits include he 218-E-12B Burial Ground, the 242-A Evaporator, the 218-E-14 and 218-E-15 PUREX Tunnels, the GTF, the GTF Landfill, and the following facilities associated with the 202-A Building: Neutralization Tanks E-5, F-15, F-16, F-18, G-7, U3, and U4, E-F11 Concentrator, Ammonia Distillate Treatment System, and Waste Piles. Closure is not anticipated to occur for some time. Thus, there will be no need to interface with the past-practices program for these units at this time.

The 200-E Burning Pit, 207-A Retention Basin, the 216-A-10 Crib, the 216-A-29 Ditch, the 216-A-36B Crib, the 216-A-37-1 Crib, and the 204-AR Waste Unloading Station are slated for clean closure under RCRA. The ditch and the cribs are all inactive and are

identified as RCRA TSD facilities because of the disposal of wastes with the characteristics of ignitability, corrosivity, and EP toxicity. They also contain radioactive fission products.

2.7 INTERACTIONS WITH OTHER HANFORD PROGRAMS

Other ongoing programs include the Single-Shell Tank Closure Program (part of RCRA), the Decommissioning and RCRA Closure Program, the RARA Program, and the Waste Management Program.

The Decommissioning and RCRA Closure Program is responsible for the safe and cost-effective surveillance, maintenance, and decommissioning of surplus facilities at the Hanford Site. All of the major inactive buildings within the PUREX Plant Aggregate Area are covered under this program. This program is also responsible for managing the RCRA closure activities. It establishes the cost, schedule, and technical baselines for individual projects and provides the program management for completing the work. The work activities relative to projects are completed by various functional organizations through a matrix management system. Performing organizations are assigned work by the program office using cost account authorizations and cost account plans. Project status is reported to the program office using an earned-value system. The majority of decommissioning and RCRA Closure field work at the Hanford Site is performed by Hanford Restoration Operations (Winship and Hughes 1991). The PUREX Plant facilities identified as part of the Decommissioning and RCRA Closure Program (Hughes et al. 1990) include the following:

- 241-C-801 Cesium Loadout Facility
- 241-A-431 Tank Farm Ventilation Building.

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 in the PUREX Plant Aggregate Area covered by this program are listed in Table 2-11. Table 2-12 lists the waste management units in the PUREX Plant Aggregate Area that are monitored by this program.

The Single-Shell Tank Closure 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 single-shell tank operable units, including the 241-A, 241-AX, and 241-C Tank Farms. The primary regulatory drivers of this program are the Tri-Party Agreement and RCRA.

The Waste Management Program is responsible for all actively operating waste management units in the PUREX Plant Aggregate Area, all high-level waste process lines and their associated diversion boxes and double-shell tanks.

Figure 2-1. Operational and Waste-Related History. (sheet 1 of 11)

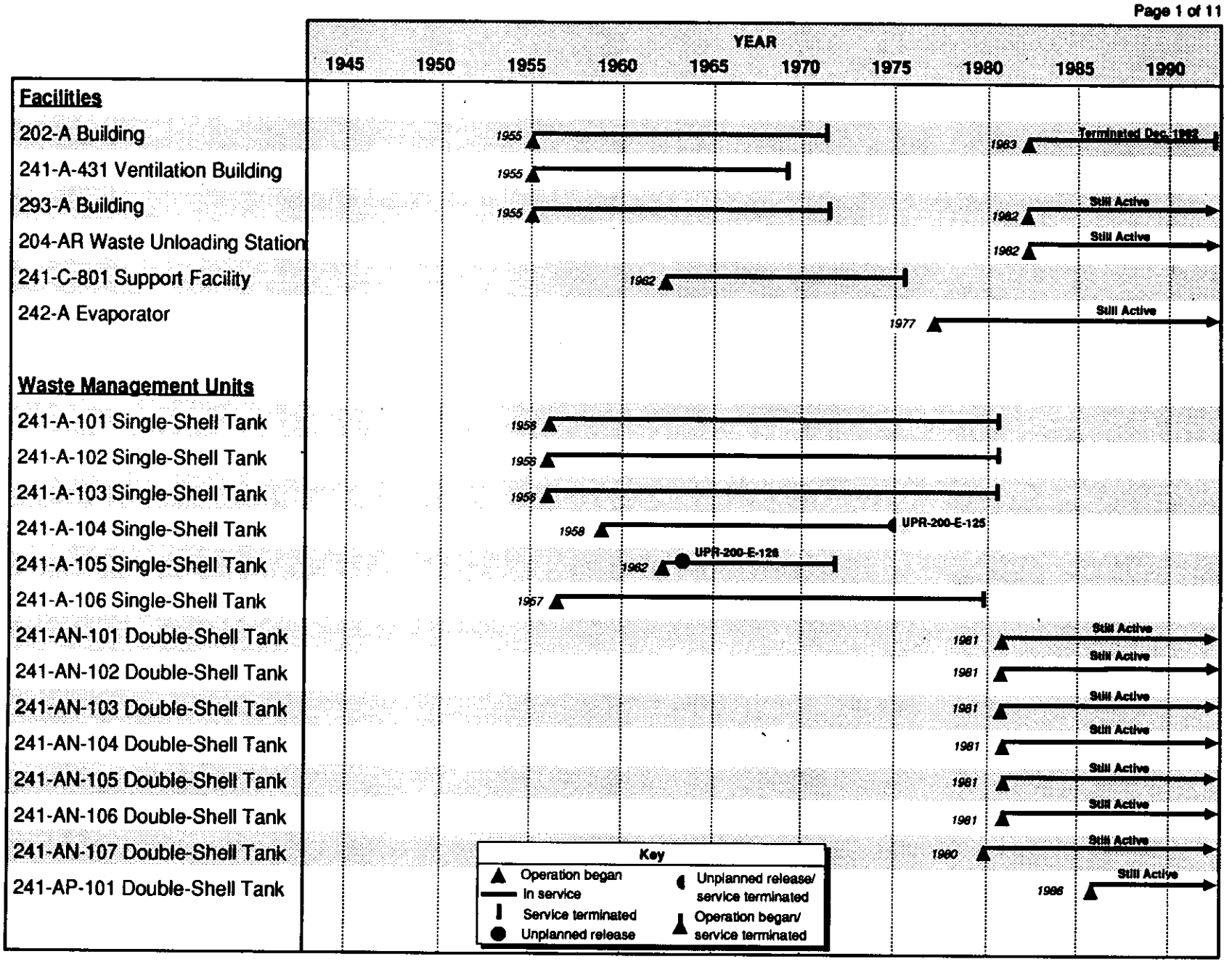

Figure 2-1. Operational and Waste-Related History. (sheet 2 of 11)

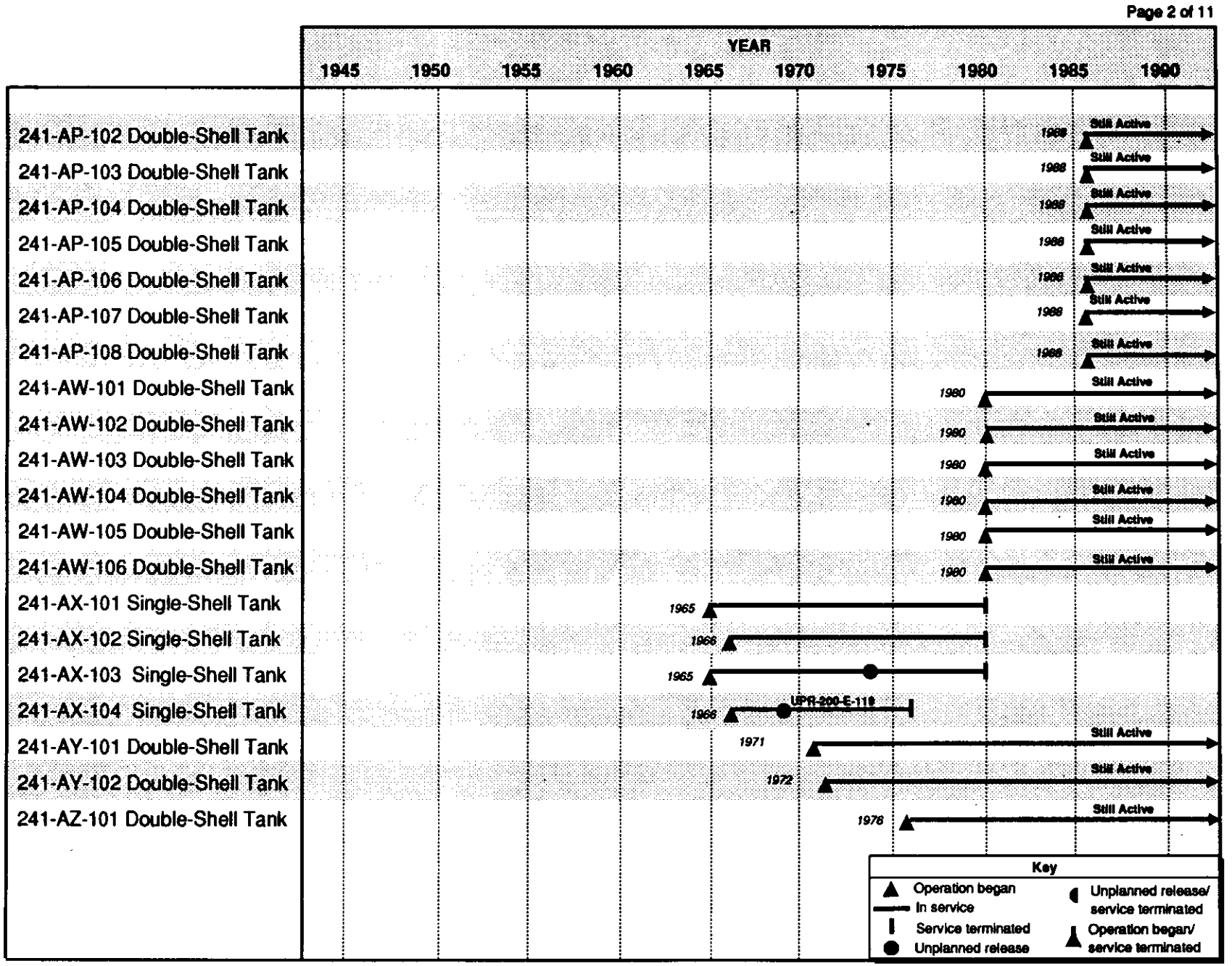

Figure 2-1. Operational and Waste-Related History. (sheet 3 of 11)

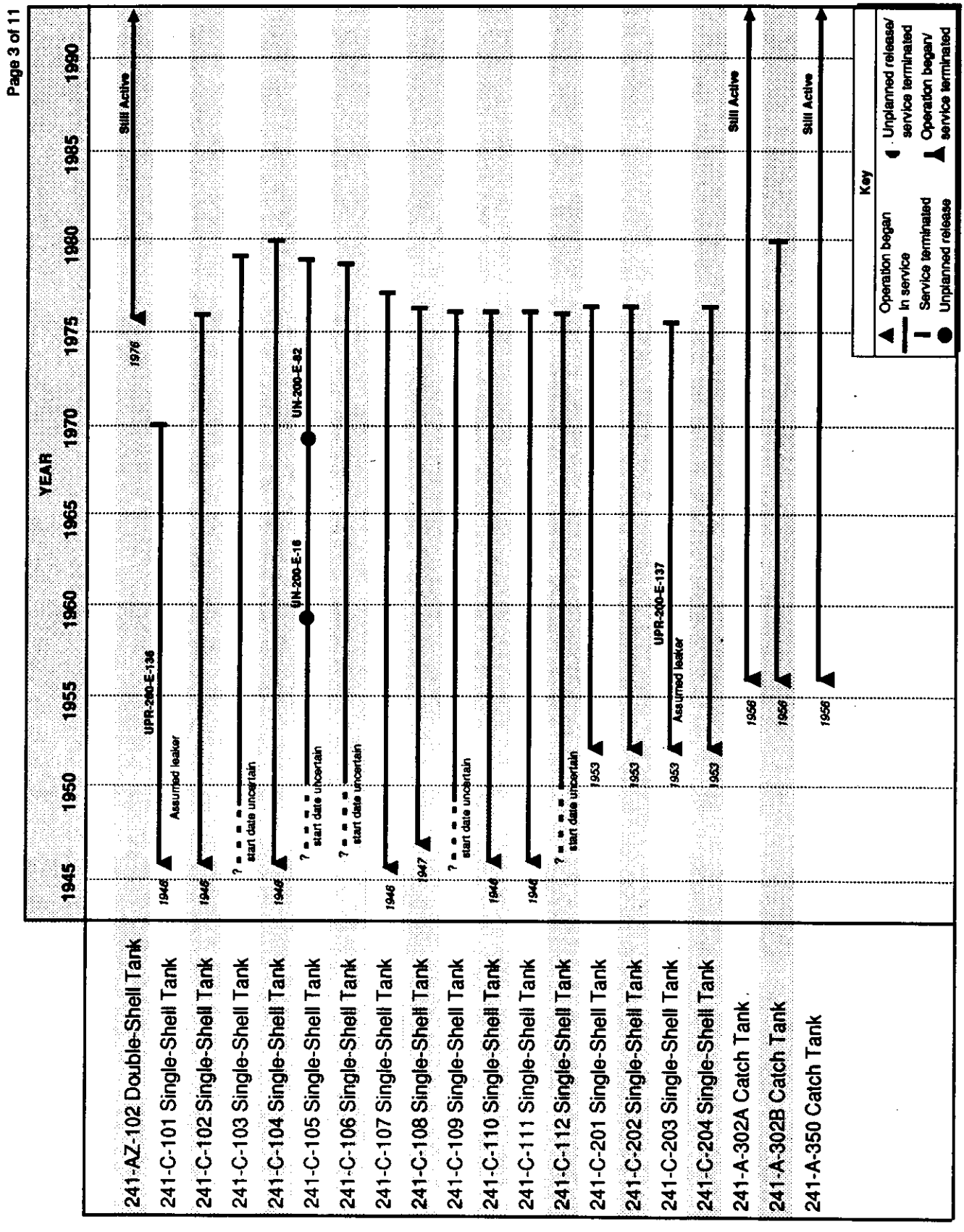

Figure 2-1. Operational and Waste-Related History. (sheet 4 of 11)

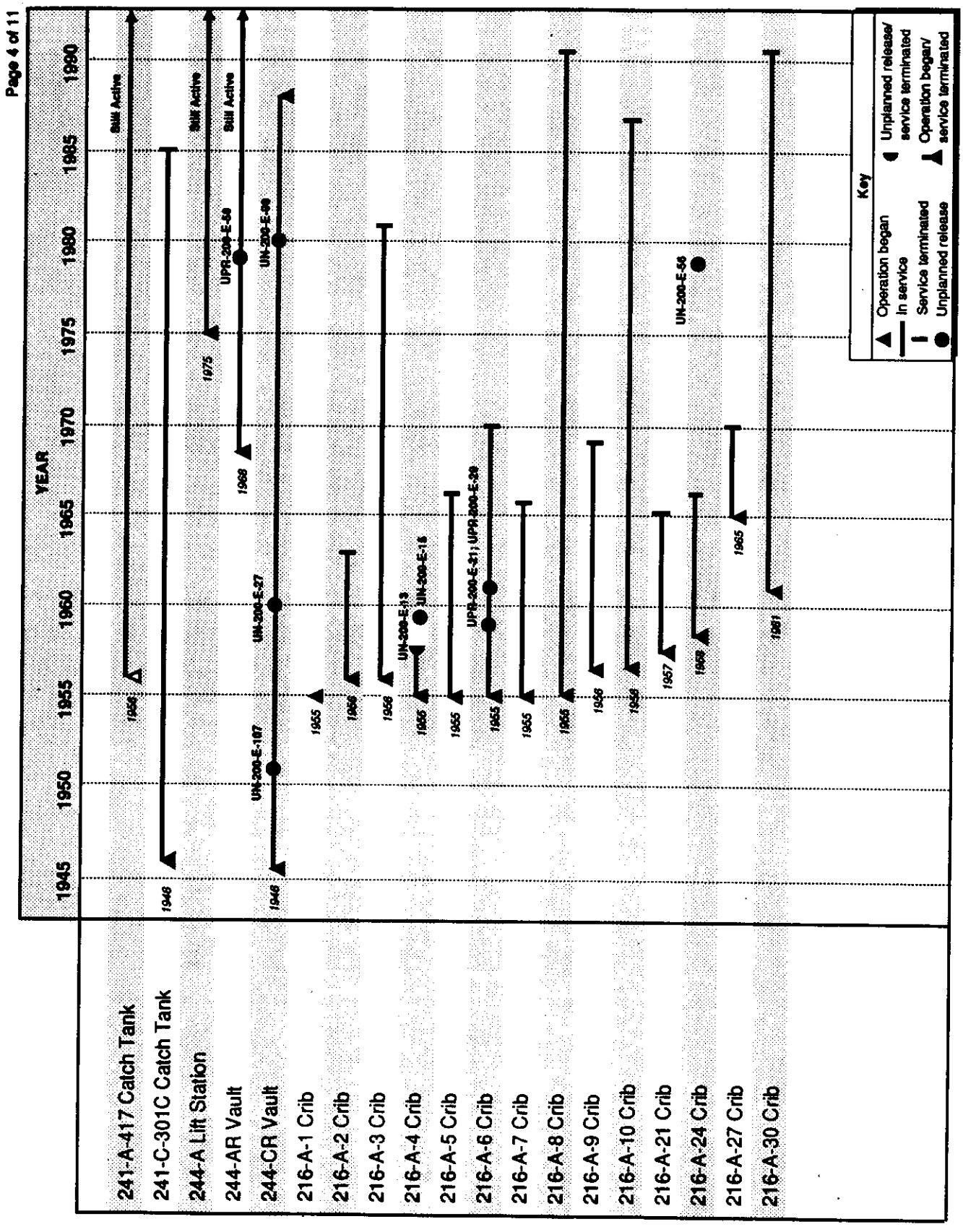

Figure 2-1. Operational and Waste-Related History. (sheet 5 of 11)

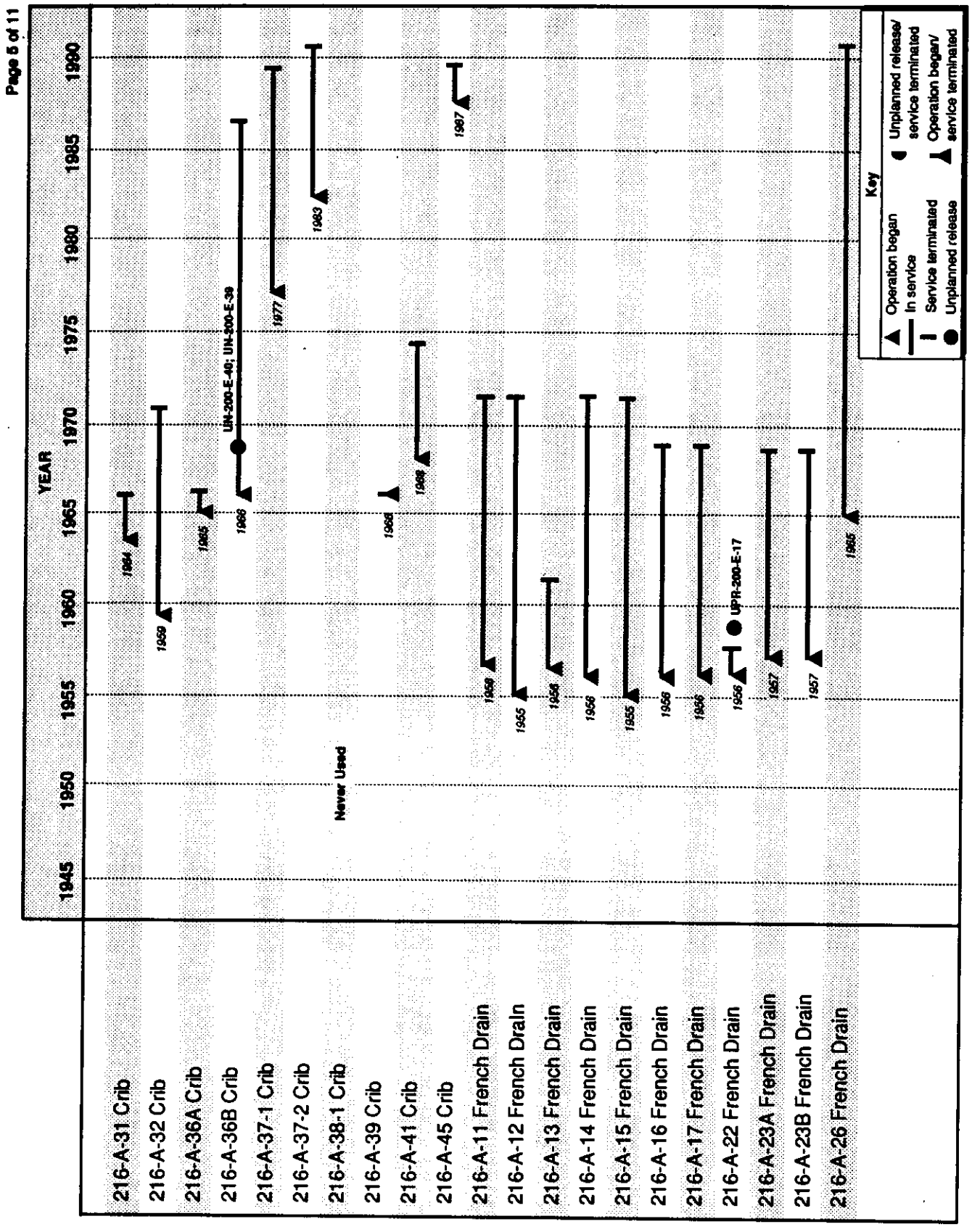

Figure 2-1. Operational and Waste-Related History. (sheet 6 of 11)

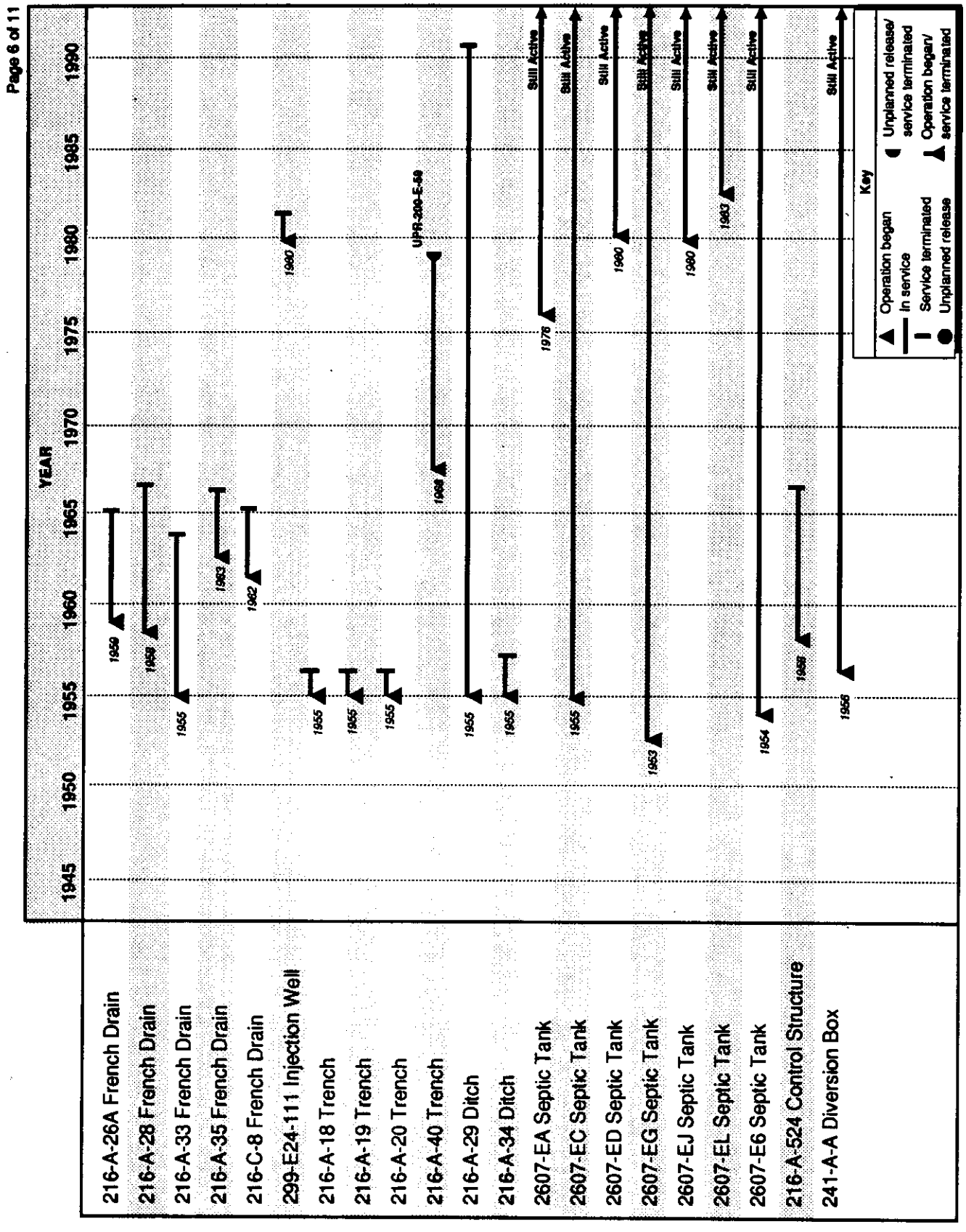

Figure 2-1. Operational and Waste-Related History. (sheet 7 of 11)

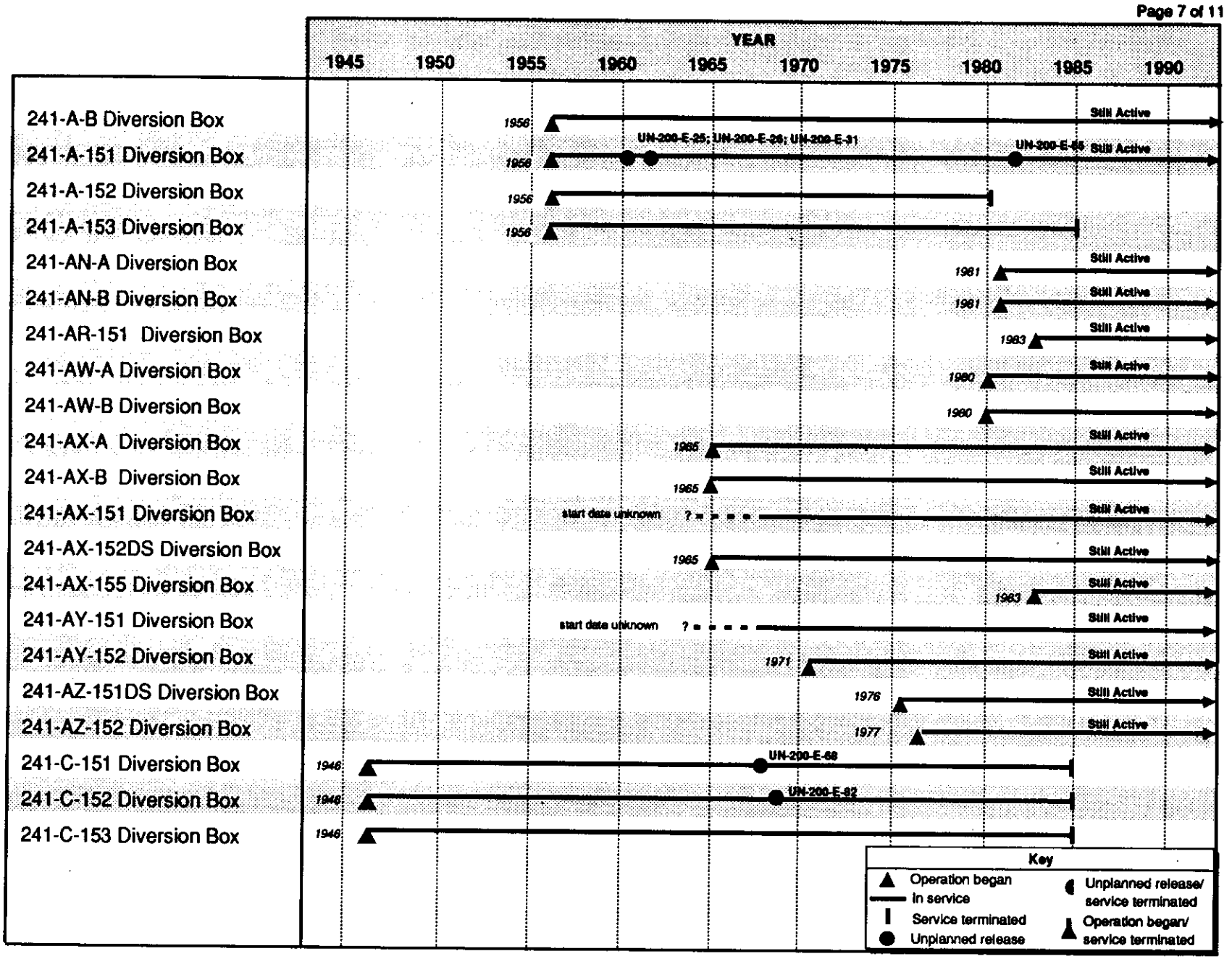

Figure 2-1. Operational and Waste-Related History. (sheet 8 of 11)

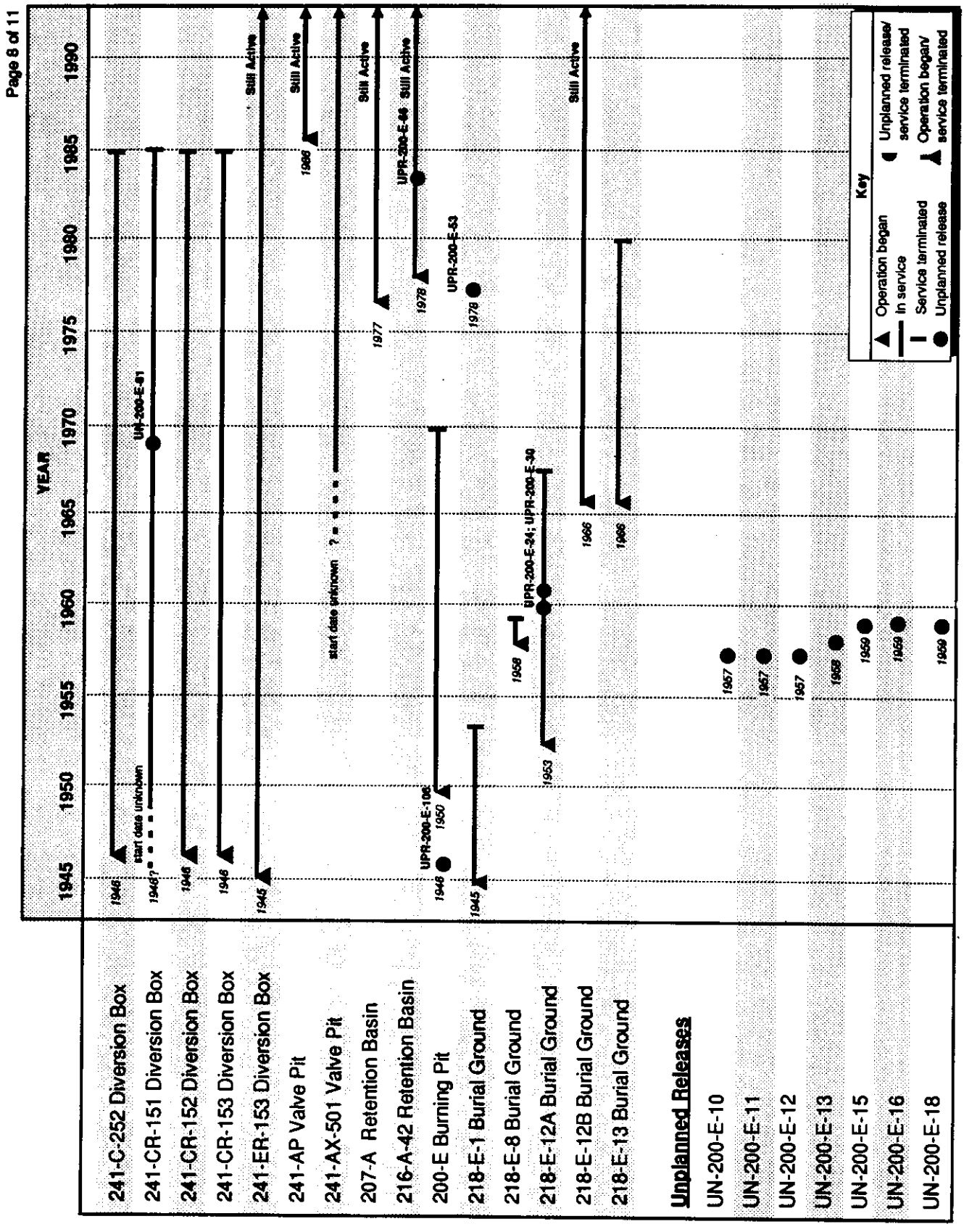

Figure 2-1. Operational and Waste-Related History. (sheet 9 of 11)

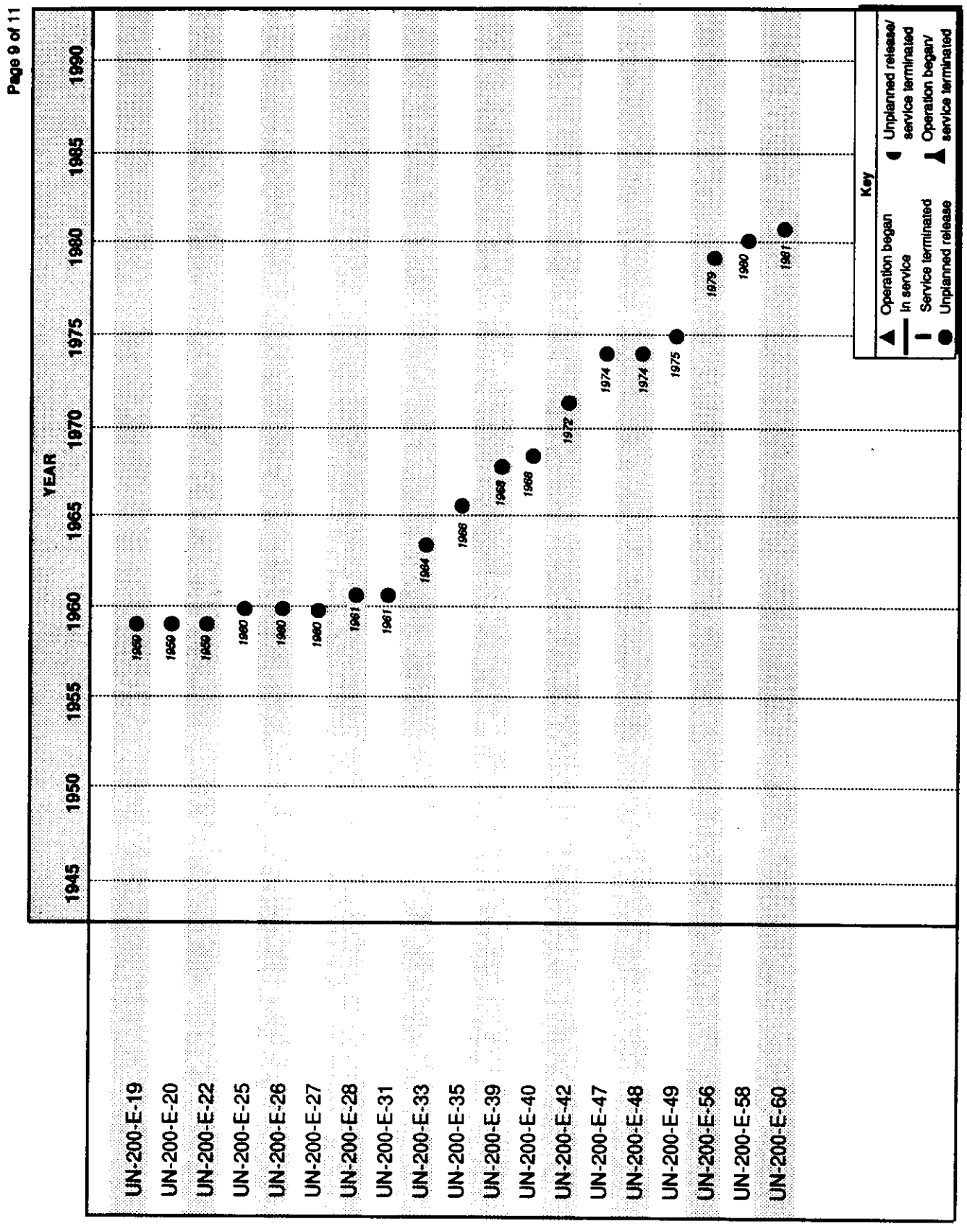

Figure 2-1. Operational and Waste-Related History. (sheet 10 of 11)

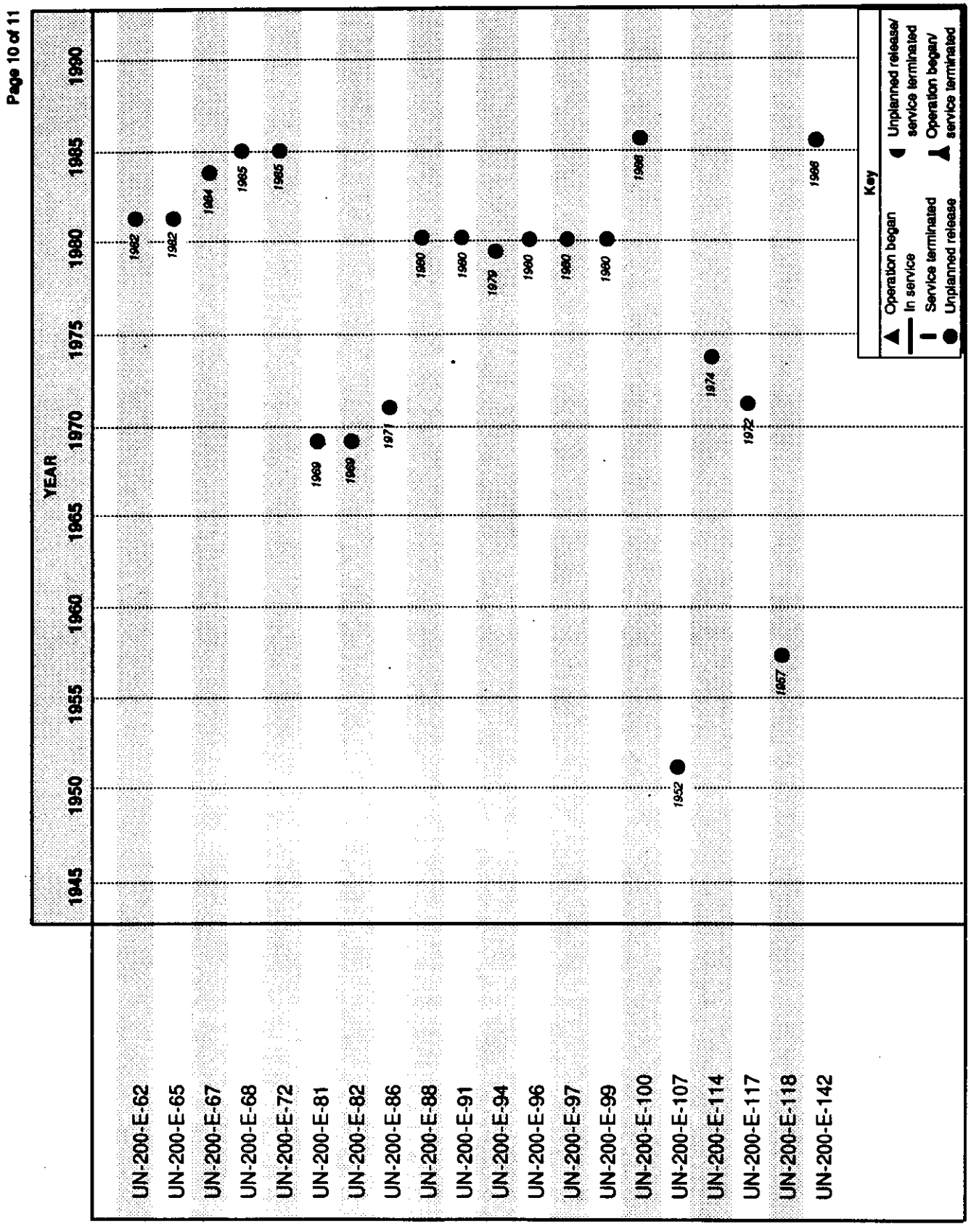

Figure 2-1. Operational and Waste-Related History. (sheet 11 of 11)

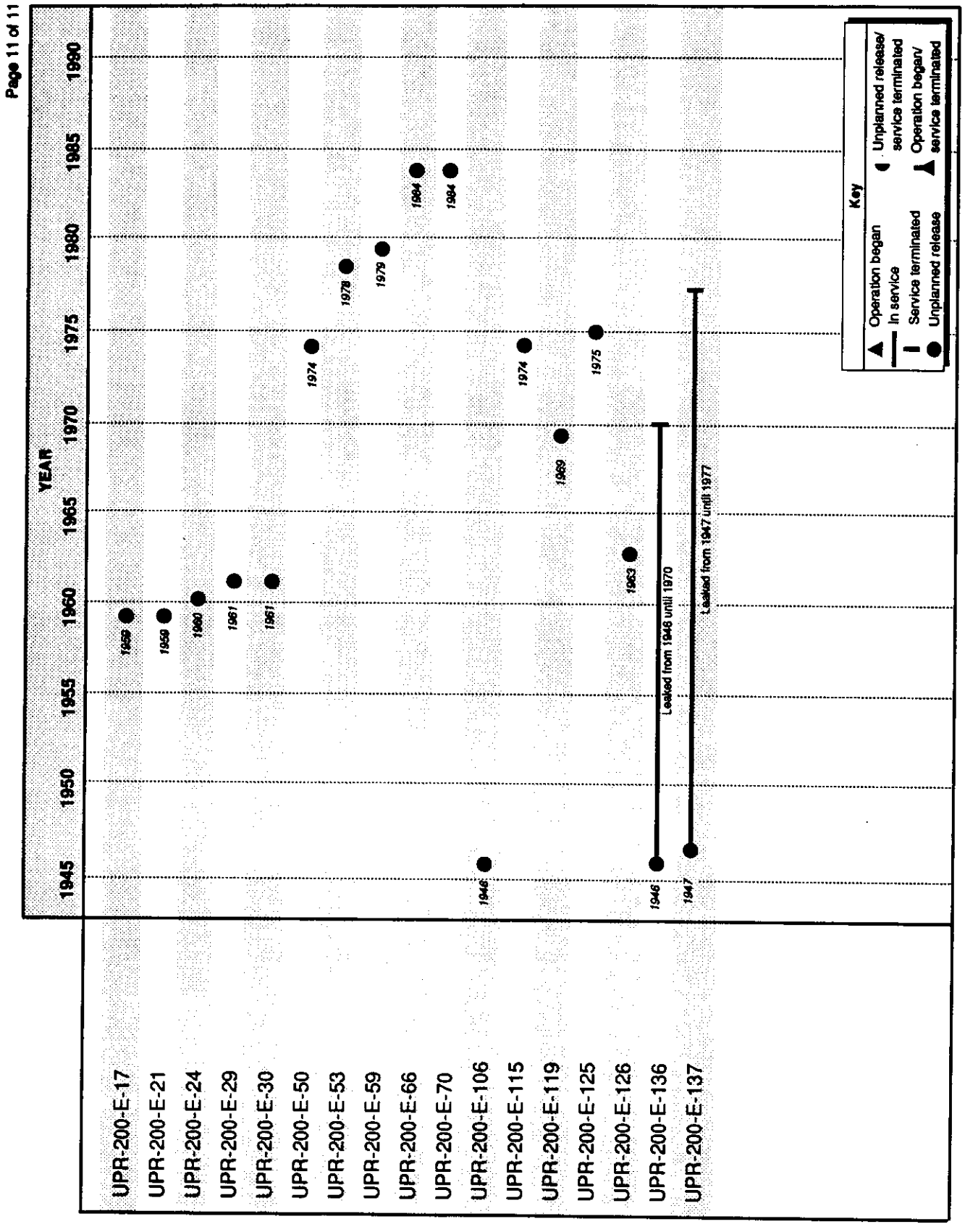

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Figure 2-2. Locations of Plants, Buildings, and Storage Areas.

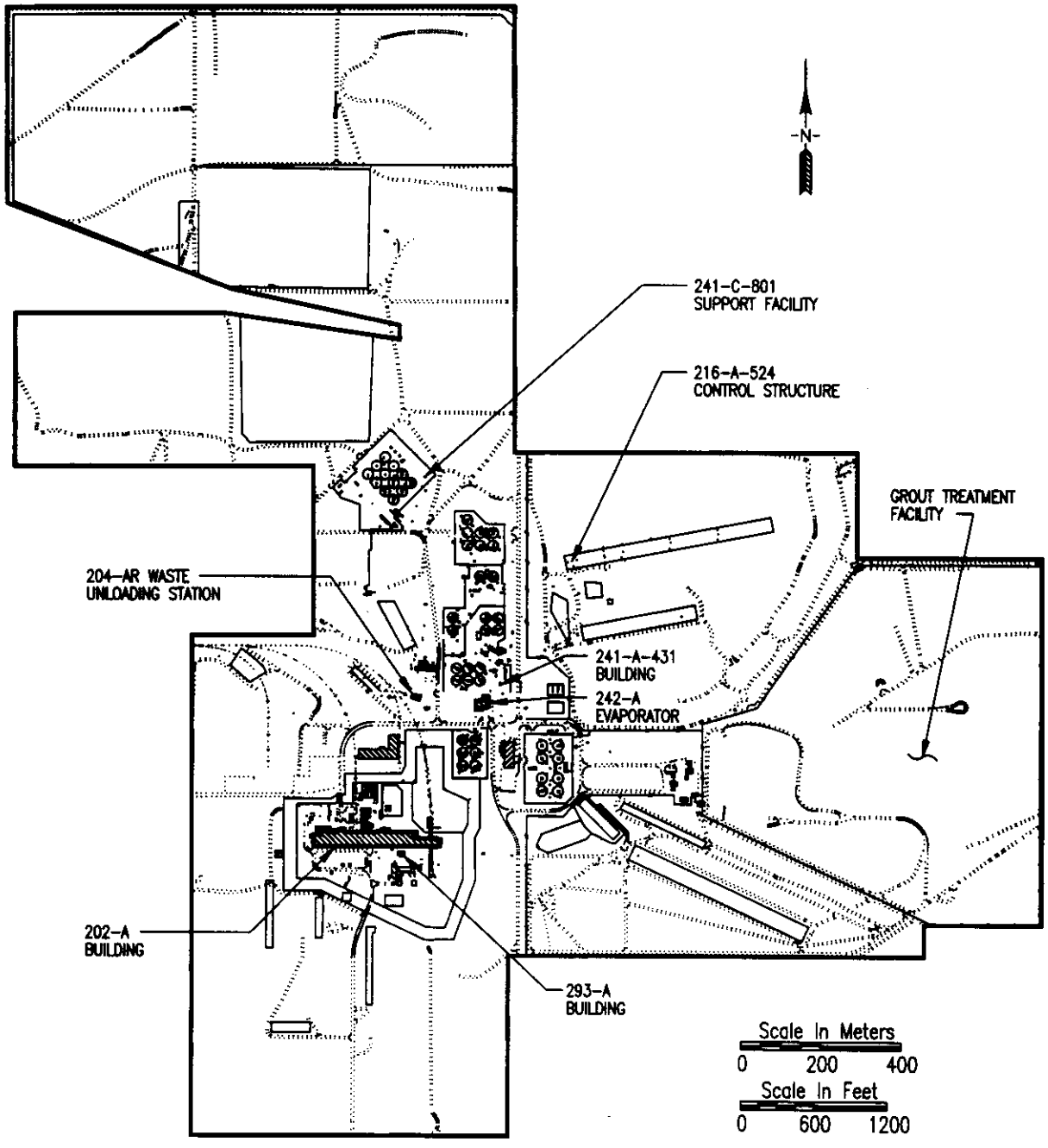

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Figure 2-3. Locations of Tanks and Vaults.

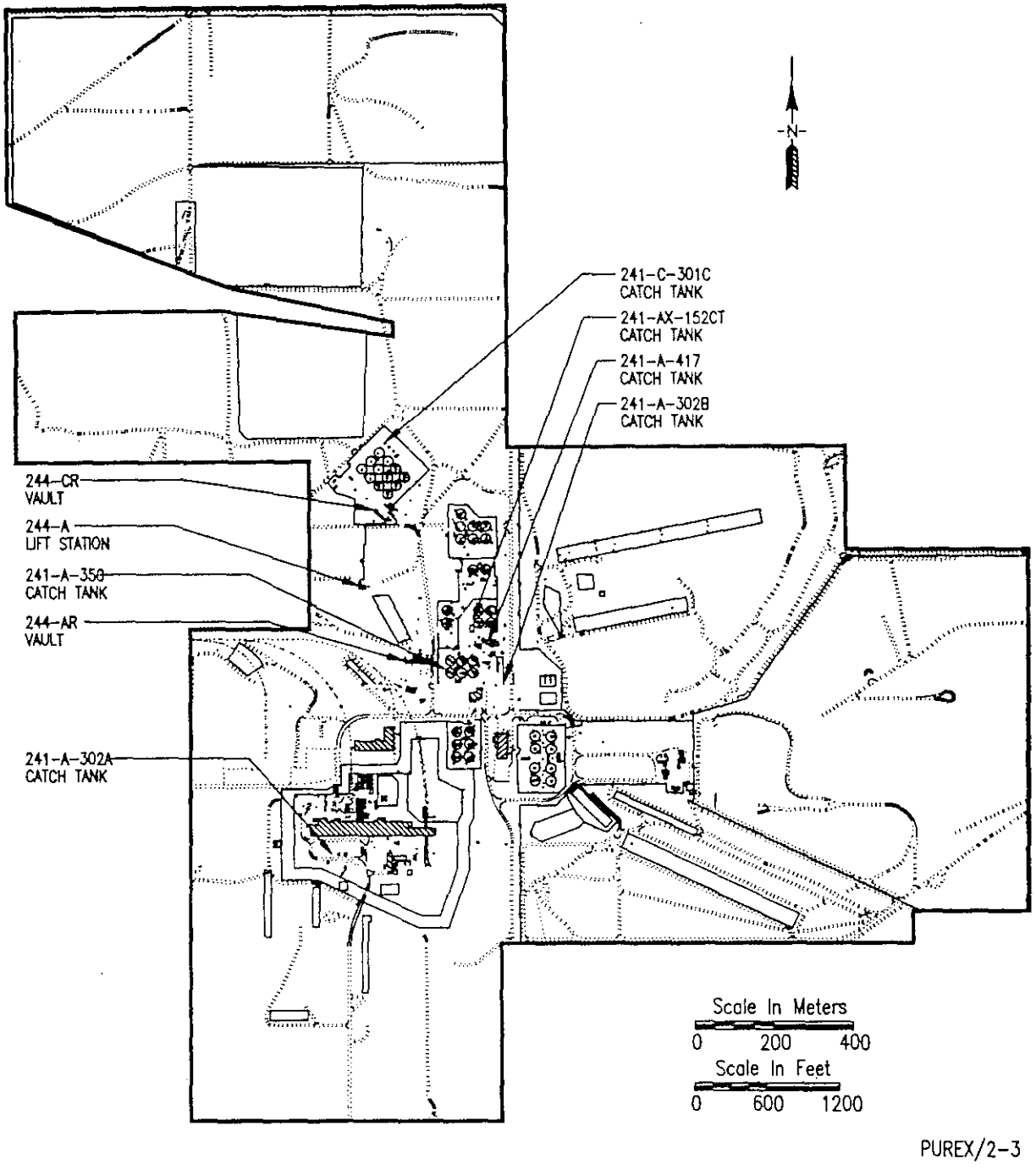


Figure 2-4. Locations of 241-A, 241-AX, 241-AY, 241-AZ, and 241-C Tank Farm.

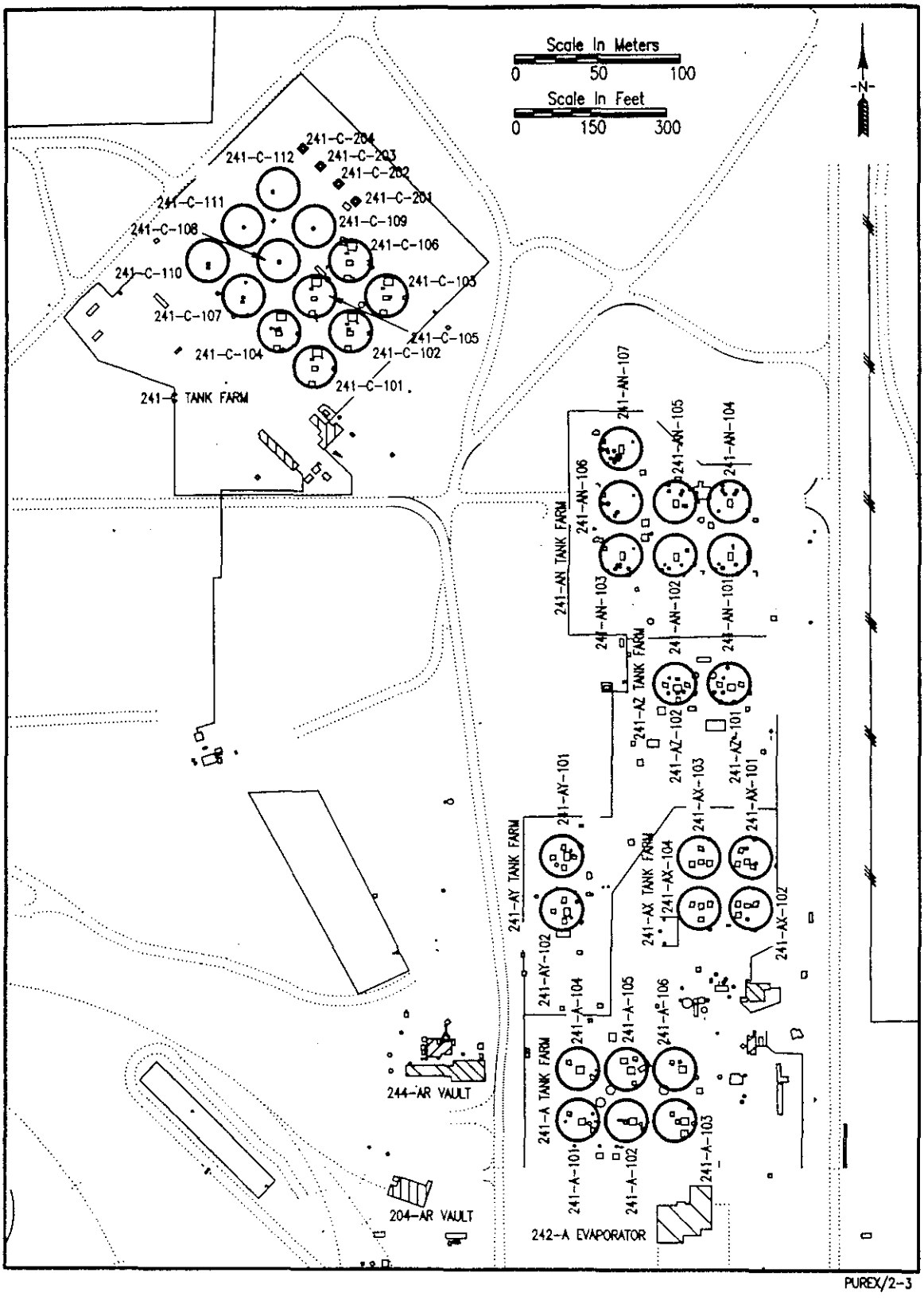
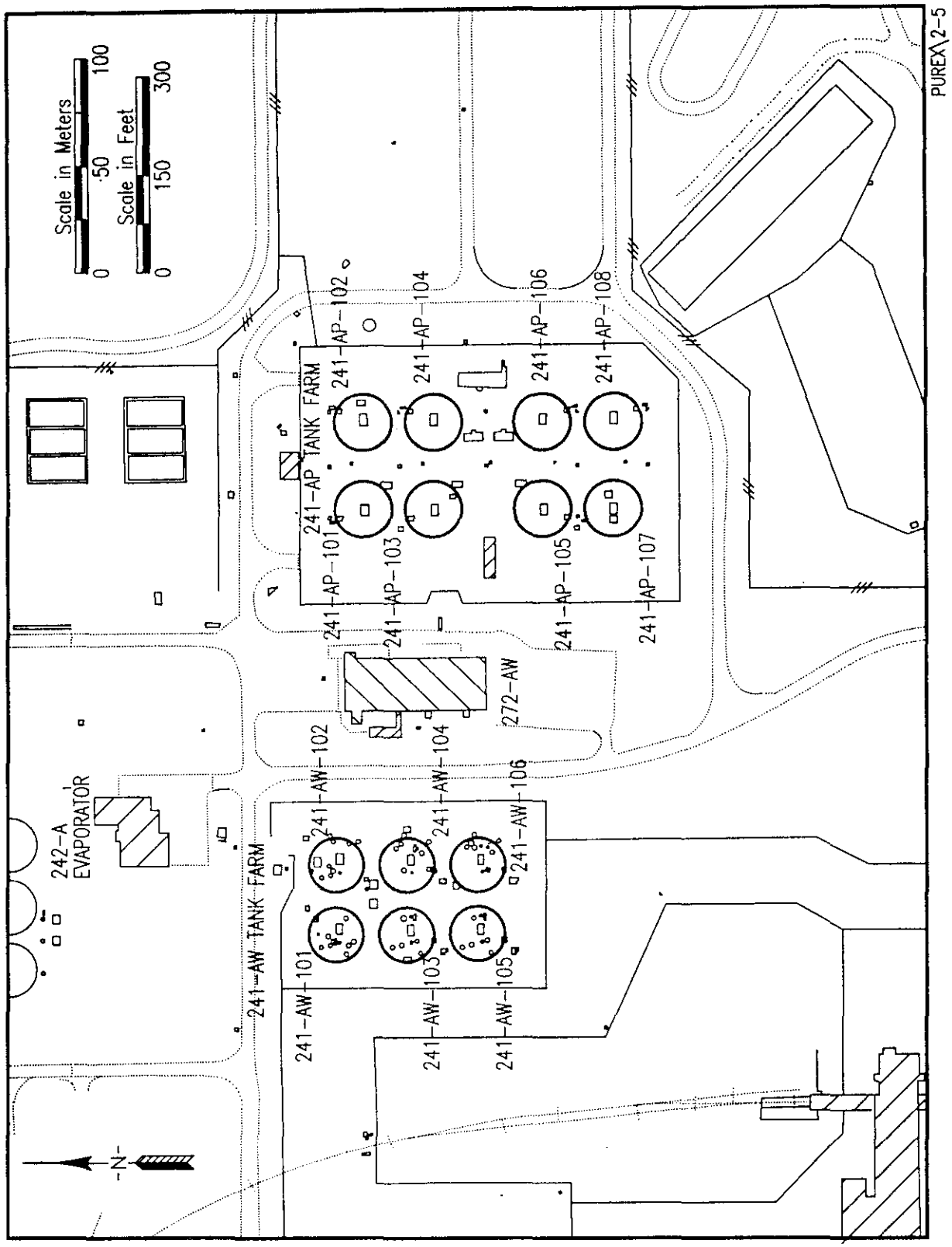


Figure 2-5. Locations of 241-AP and 241-AW Tank Farms.



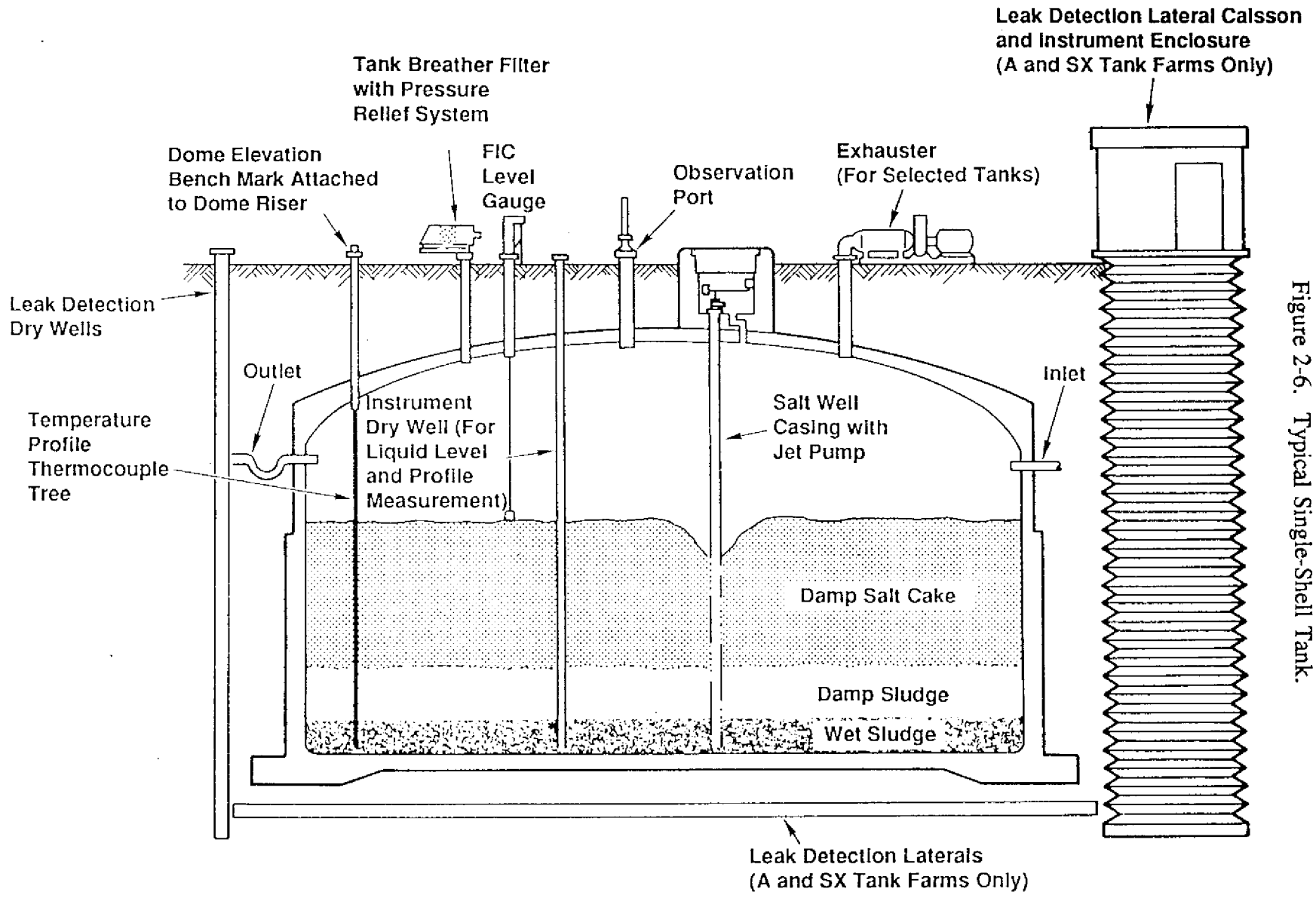


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Figure 2-6. Typical Single-Shell Tank.

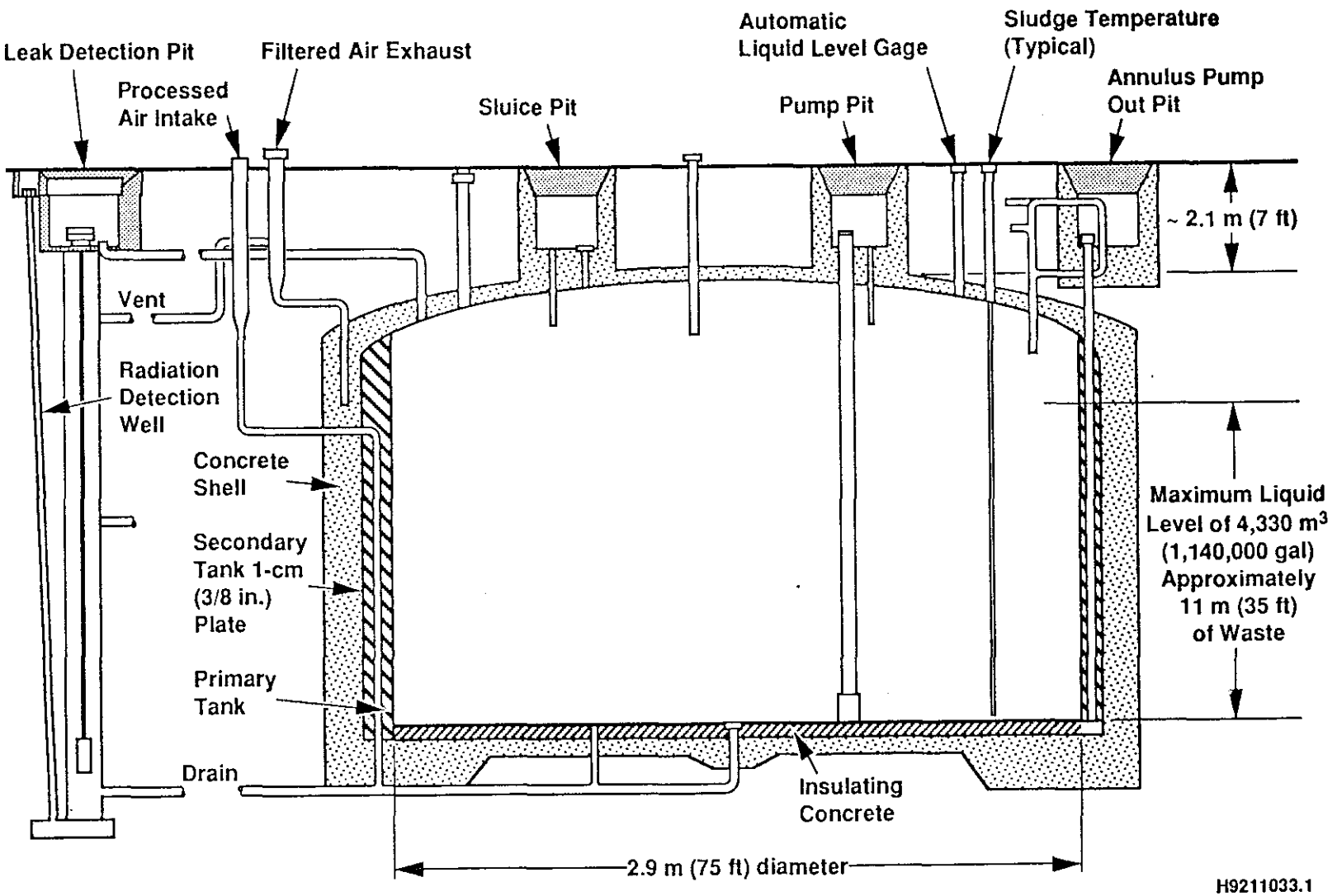


Figure 2-7. Typical Double-Shell Tank.

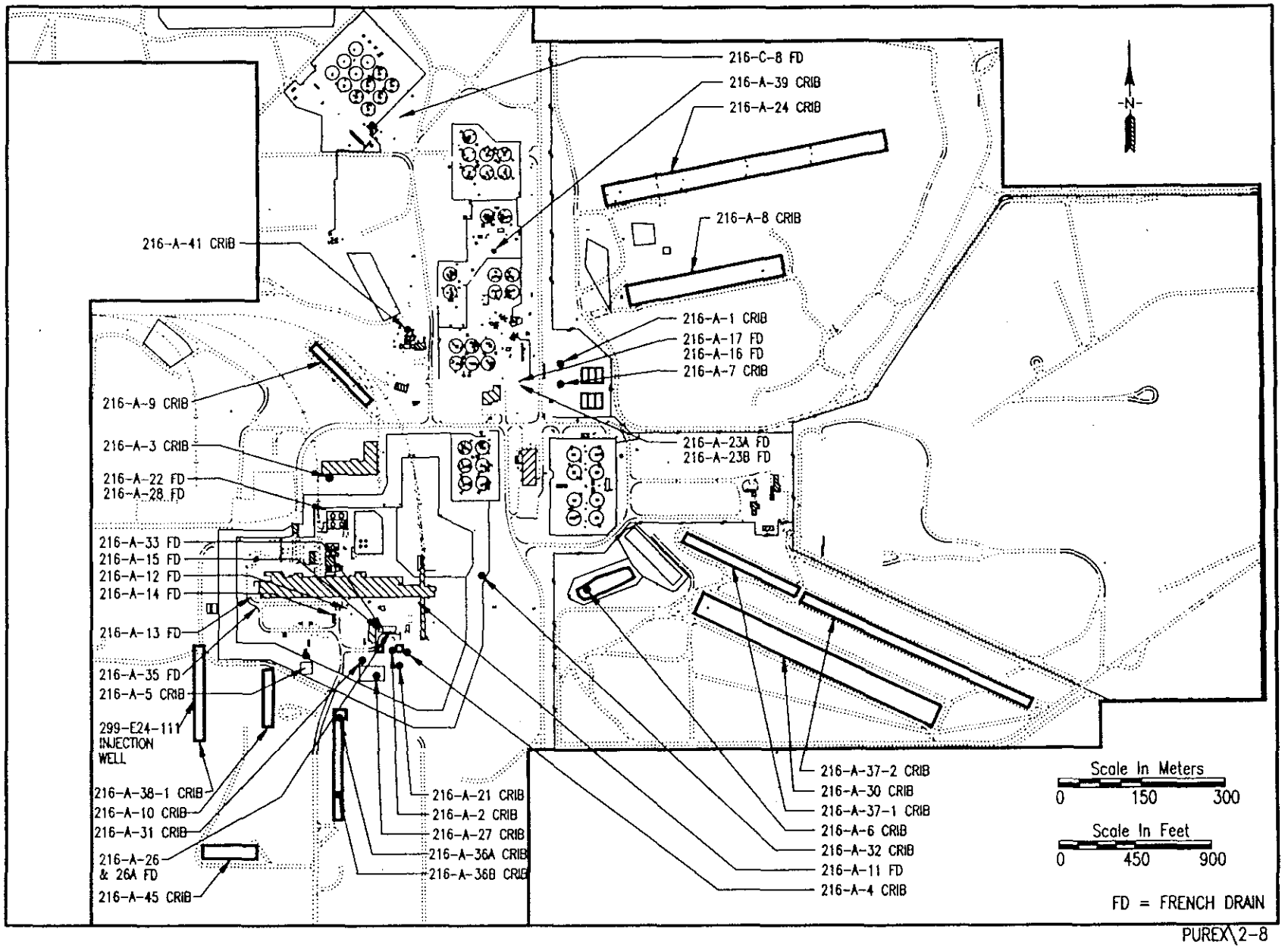
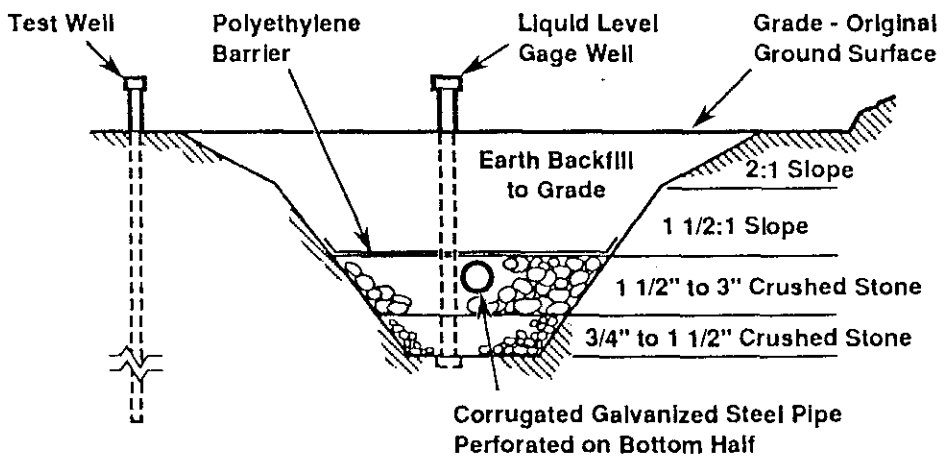


Figure 2-8. Location of Cribs, Drains, and Reverse Wells.

Figure 2-9. Typical Crib.

Typical Crib Cross Section



Typical Crib Long Section

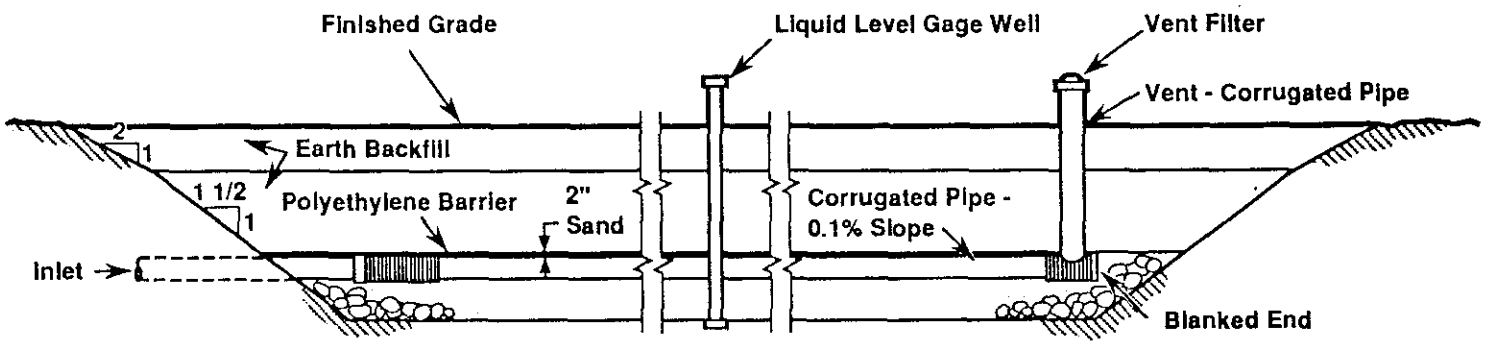


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Figure 2-10. Typical French Drain.

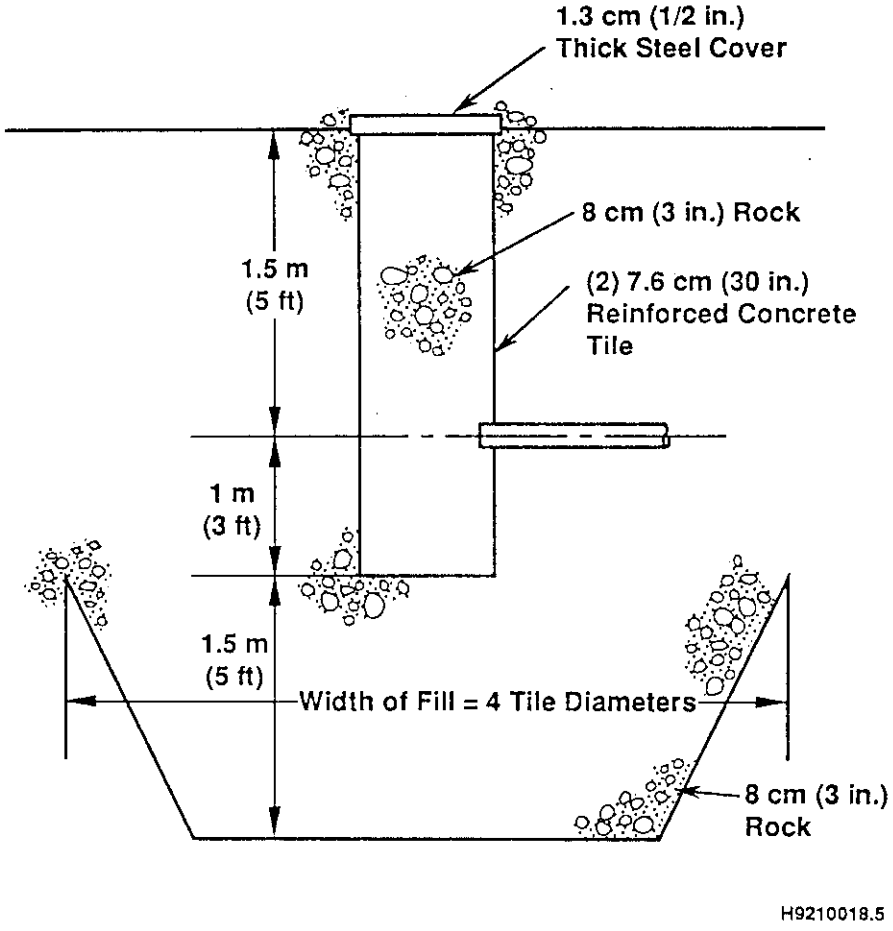

Figure 2-11. Location of Ditches and Trenches.

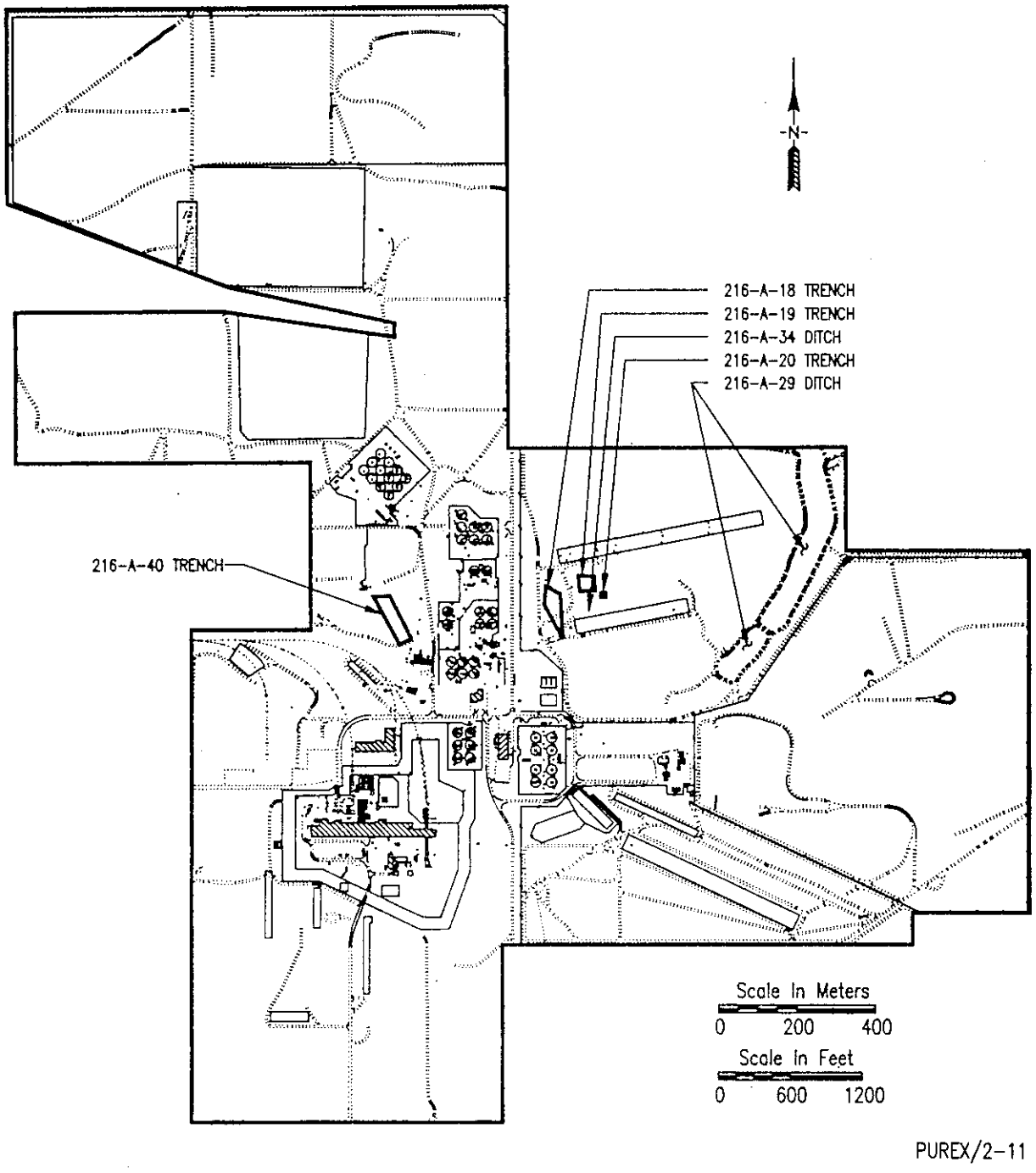

Figure 2-12. Location of Septic Tanks and Associated Drain Fields.

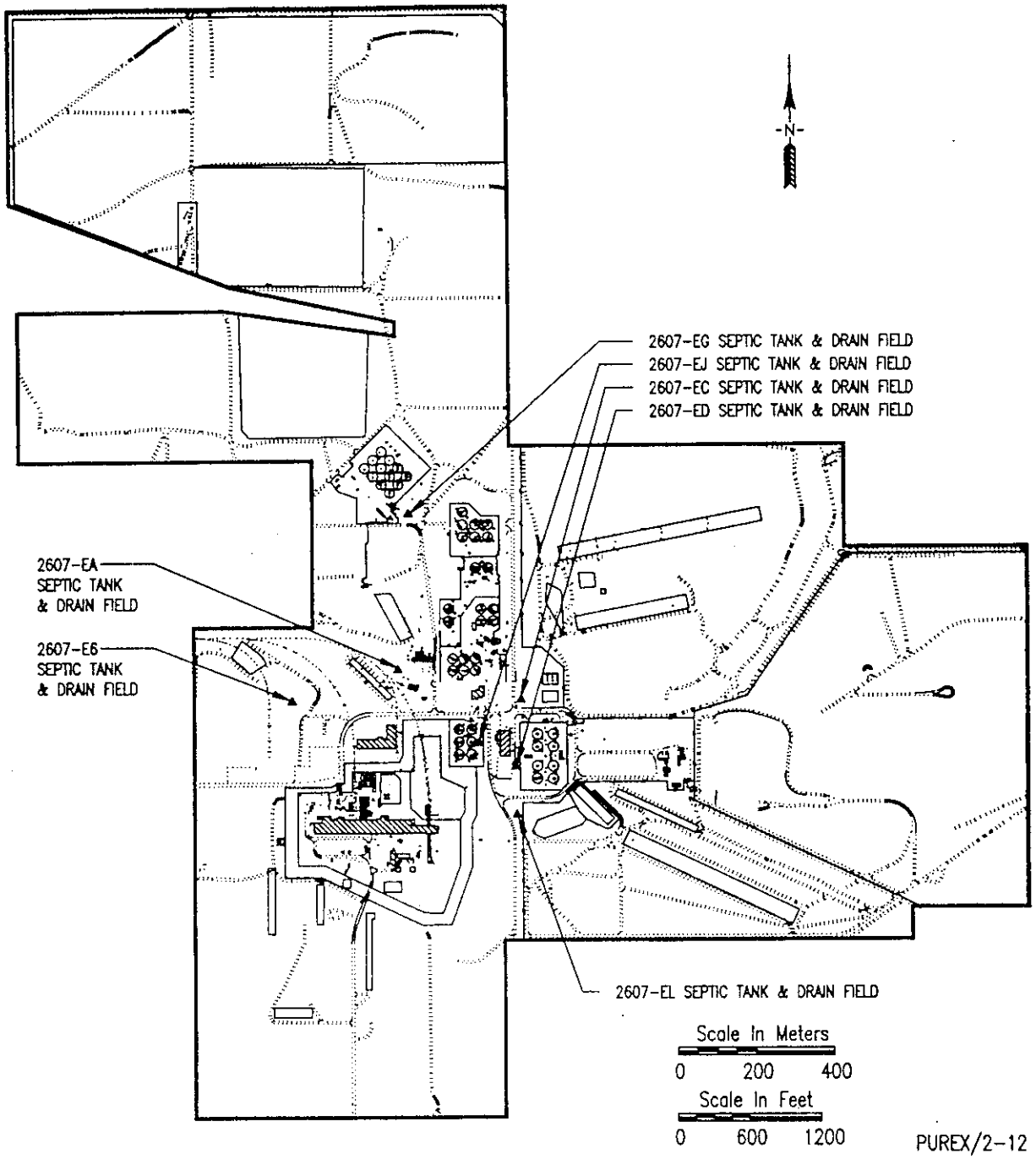

Figure 2-13. Location of Process Lines and Transfer Facilities.

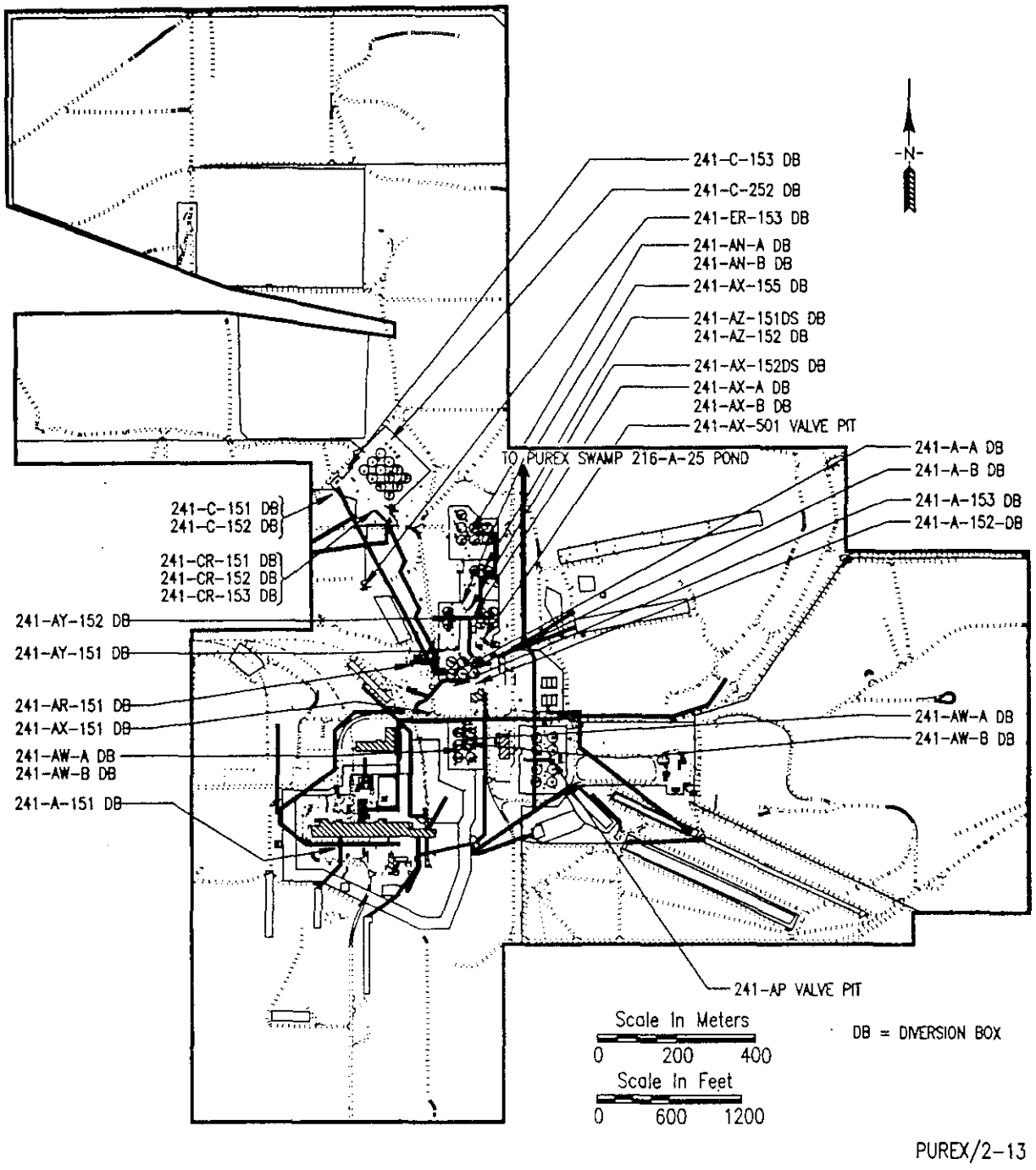

Figure 2-14. Location of Basins.

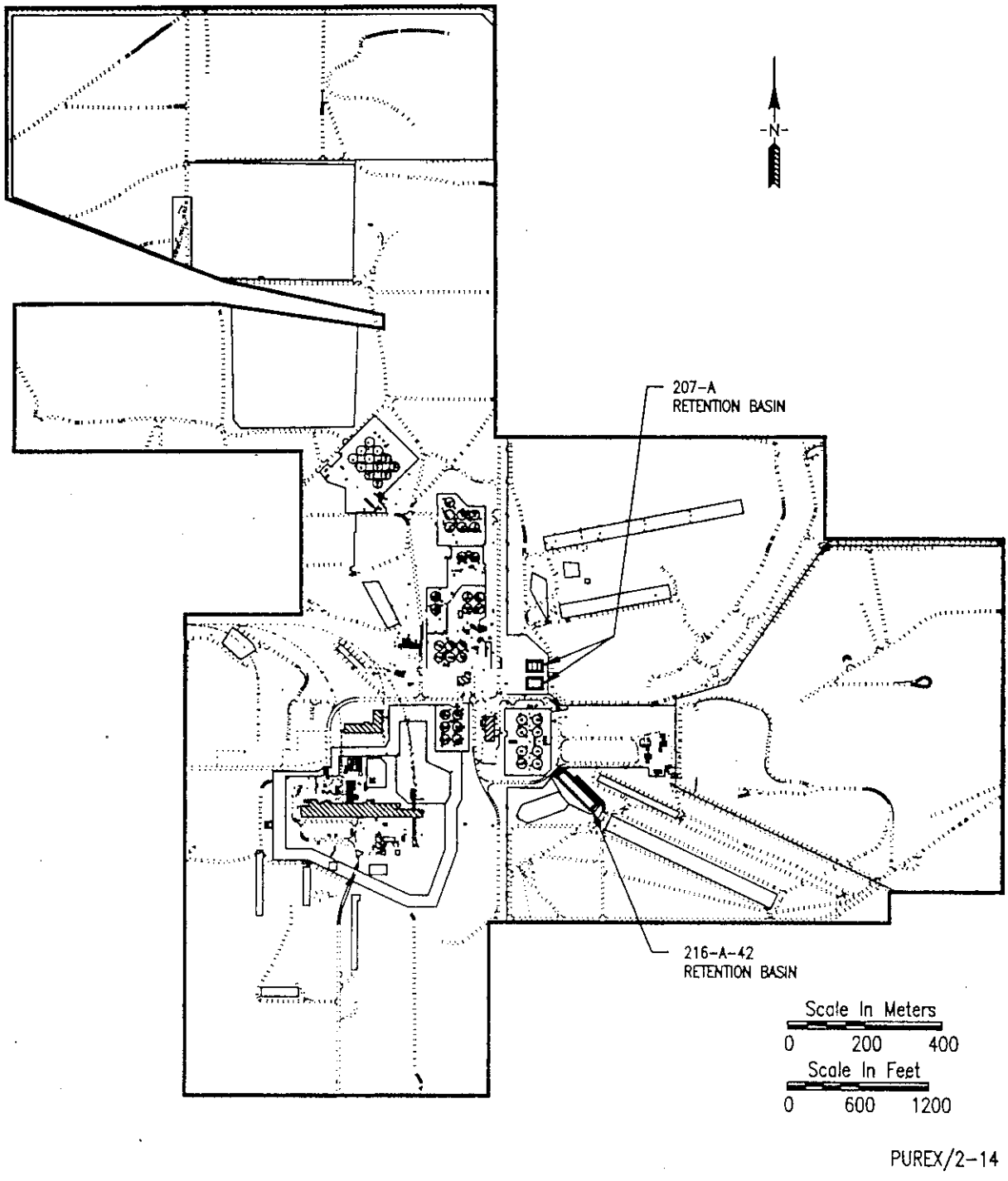

Figure 2-15. Location of Burial Sites and Burning Pits.

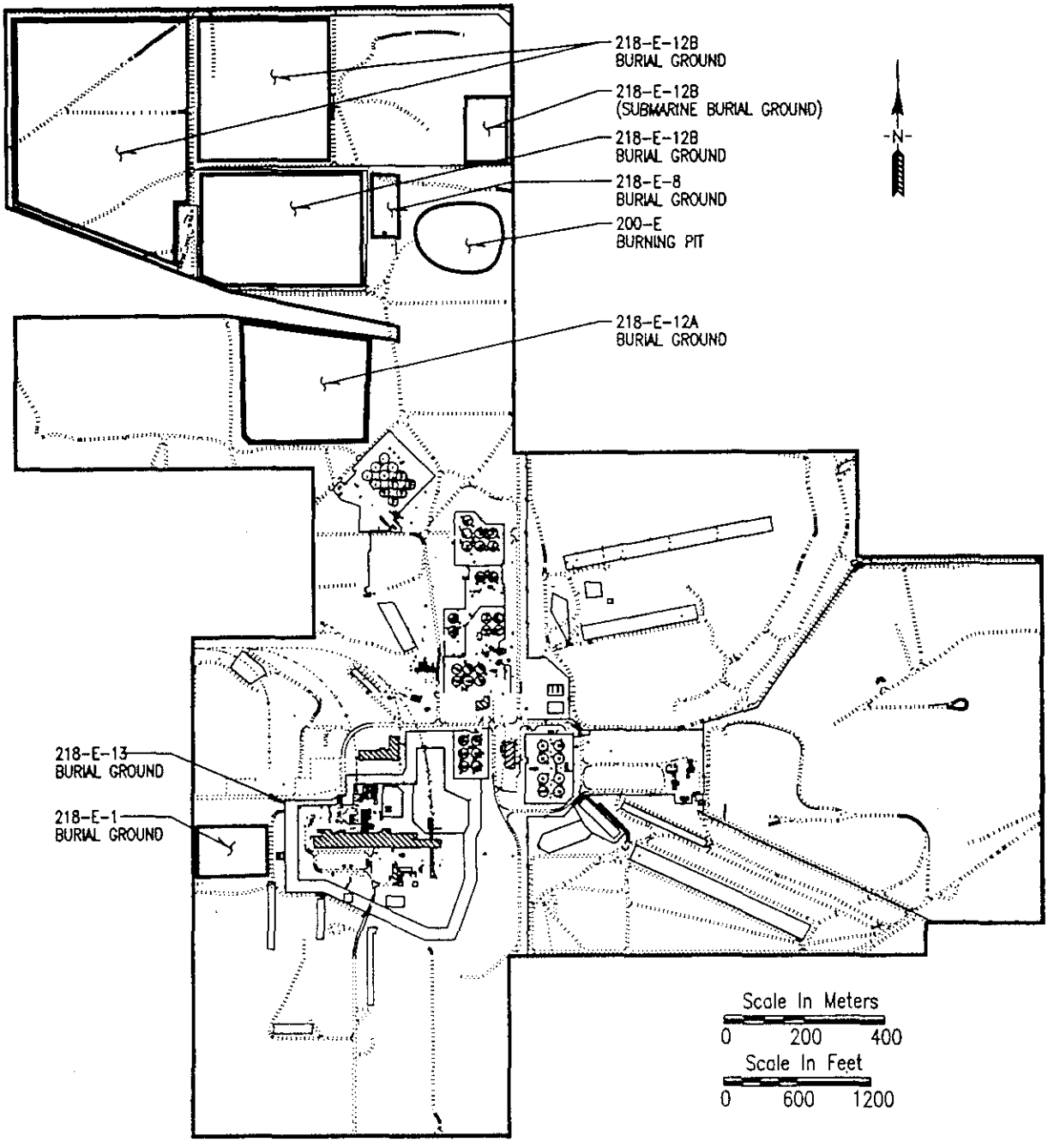

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Figure 2-16. Location of Unplanned Releases.

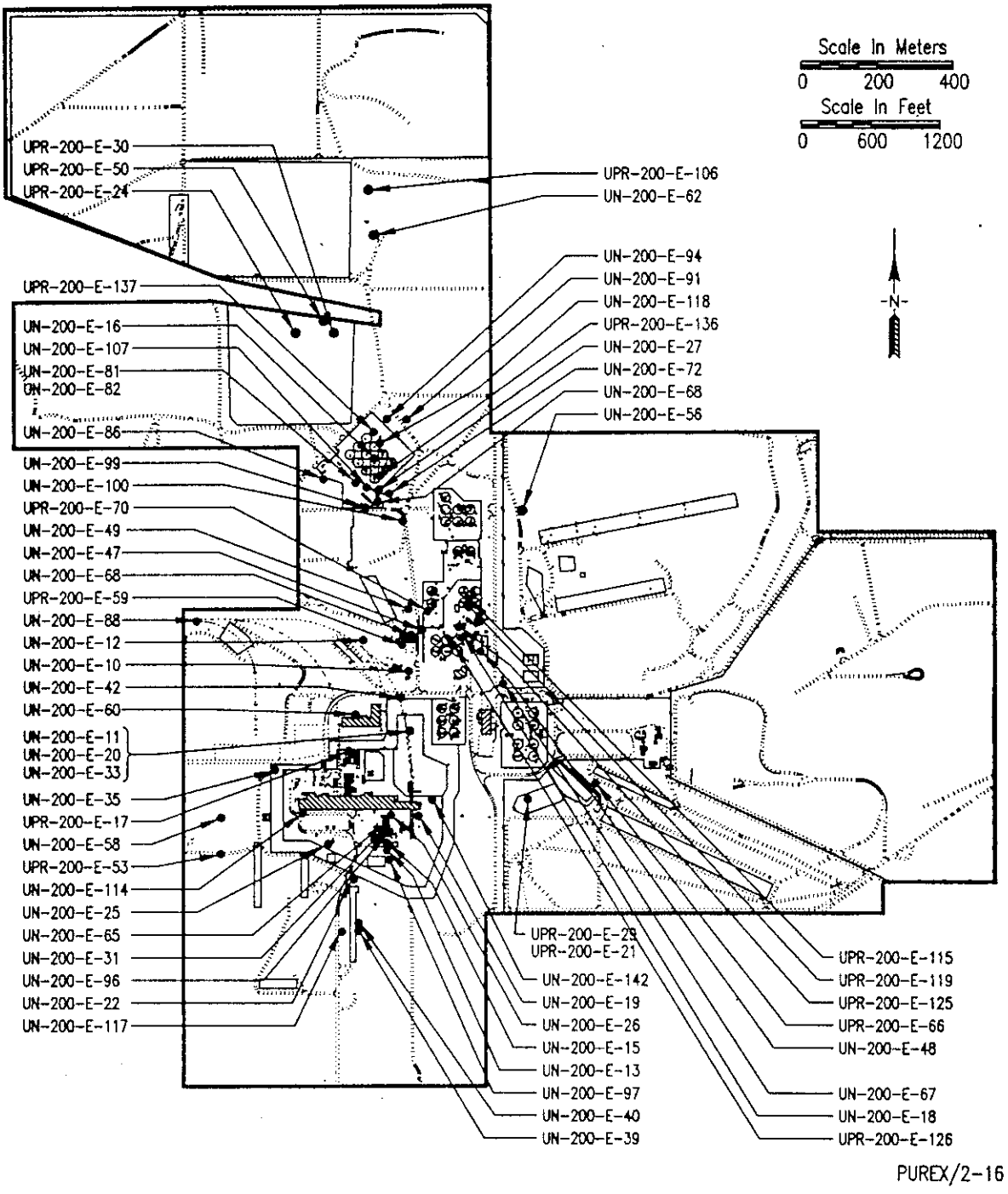

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 1 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
Plants, Buildings, and Storage Areas				
204-AR Waste Unloading Station	100 Area decontamination and regeneration wastes; 300 Area recovery, fuels fabrication, and laboratory wastes; 400 Area decontamination waste/HLW	1,966 (catch tank only)	NA	200-PO-3
241-A-431 Ventilation Building	Radioactively contaminated equipment and concrete/HLW	NA	NA	200-PO-3
241-C-801 Support Facility	This unit is a radioactively contaminated structure/HLW	NA	NA	200-PO-3
242-A Evaporator	Complexed radioactive waste, dilute noncomplexed radioactive waste; PUREX cladding removal waste; $NaNO^3$, NaOH/HLW	NA	NA	200-PO-3
Grout Treatment Facility	Stabilizes double-shell tank waste/LLW	NA	NA	200-PO-3
Tanks and Vaults				
241-A-101 Single-Shell Tank	Purex carbonate wash waste, organic wash waste, B Plant waste fractionization; PUREX double-shell slurry feed, complexed and non-complexed wastes from 241-A, -AX, -BX, -SX tanks/HLW	3,607,105[b]	NA	200-PO-3
241-A-102 Single-Shell Tank	PUREX carbonate wash waste, B Plant waste fractionization, PUREX sludge supernatant, evaporator waste, noncomplexed and complexed waste, double-shell slurry feed from 241-A, -AZ, -AY, -AZ, -BX, -C, and -SX Tank Farms and 244-AR Vault/HLW	155,185[b]	NA	200-PO-3
241-A-103 Single-Shell Tank	PUREX carbonate wash waste, organic wash waste, B Plant waste fractionization, ion exchange waste, PUREX sludge supernatant, double-shell slurry feed from 241-A, -AX, -BY, and -C Tank Farms and 244-AR, -CR Vaults/HLW	1,400,450[b]	NA	200-PO-3
241-A-104 Single-Shell Tank	PUREX carbonate wash waste, organic wash waste, B Plant waste frationization ion exchange waste, supernatant with PUREX sludge supernatant from 241-A Tank Farm and 244-AR Vault/HLW	105,980[b]	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 2 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-A-105 Single-Shell Tank	PUREX inorganic wash waste, supernatant with PUREX high-level waste from the 241-A Tank Farm/HLW	71,915[b]	NA	200-PO-3
241-A-106 Single-Shell Tank	PUREX organic and inorganic wash waste, PUREX carbonate wash waste, complexed concentrate from 241-A Tank Farm, 244-AR Vault, and B-302 Tanks/HLW	473,125[b]	NA	200-PO-3
241-AN-101 Double-Shell Tank	100/300 Area customer waste, salt well liquor, dilute noncomplexed waste/HLW	2,074,406[b]	NA	200-PO-3
241-AN-102 Double-Shell Tank	Dilute and concentrated complexant waste/HLW	4,145,026[b]	NA	200-PO-3
241-AN-103 Double-Shell Tank	Salt well liquor and dilute noncomplexed waste/HLW	3,599,927[b]	NA	200-PO-3
241-AN-104 Double-Shell Tank	Dilute noncomplexed waste, double-shell slurry feed/HLW	4,023,893[b]	NA	200-PO-3
241-AN-105 Double-Shell Tank	Dilute noncomplexed waste, double-shell slurry feed/HLW	4,288,872[b]	NA	200-PO-3
241-AN-106 Double-Shell Tank	Dilute and concentrated phosphate waste from 100-N Area/HLW	3,853,549[b]	NA	200-PO-3
241-AN-107 Double-Shell Tank	Dilute and concentrated complexant wastes/HLW	4,076,888[b]	NA	200-PO-3
241-AP-101 Double-Shell Tank	PUREX ammonia scrubber feed waste/HLW	4,023,893[b]	NA	200-PO-3
241-AP-102 Double-Shell Tank	Grout Treatment Facility feed tank, contains dilute noncomplexed customer waste/HLW	503,460[b]	NA	200-PO-3
241-AP-103 Double-Shell Tank	PUREX ammonia scrubber feed/HLW	4,296,442[b]	NA	200-PO-3
241-AP-104 Double-Shell Tank	Receiver Tank; receives dilute noncomplexed waste/HLW	75,708[b]	NA	200-PO-3
241-AP-105 Double-Shell Tank	Double-shell slurry feed/HLW	3,126,750[b]	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 3 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-AP-106 Double-Shell Tank	Neutralized cladding removal waste/HLW	4,288,872[b]	NA	200-PO-3
241-AP-107 Double-Shell Tank	NR	4,266,159[b]	NA	200-PO-3
241-AP-108 Double-Shell Tank	NR	700,301[b]	NA	200-PO-3
241-AW-101 Double-Shell Tank	Double-shell slurry feed, dilute noncomplexed waste/HLW	4,258,588[b]	NA	200-PO-3
241-AW-102 Double-Shell Tank	Unit is designated as the 242-A Evaporator feed tank/HLW	3,910,330[b]	NA	200-PO-3
241-AW-103 Double-Shell Tank	PUREX decladding supernate and TRU sludge/HLW	2,449,161[b]	NA	200-PO-3
241-AW-104 Double-Shell Tank	Double-shell slurry feed, dilute noncomplexed waste/HLW	4,262,374[b]	NA	200-PO-3
241-AW-105 Double-Shell Tank	Supernate and TRU PUREX decladding sludge/HLW	3,418,227[b]	NA	200-PO-3
241-AW-106 Double-Shell Tank	Unit is designated as the 242-A Evaporator receiver tank; contains complexed and noncomplexed waste/HLW	2,002,483[b]	NA	200-PO-3
241-AX-101 Single-Shell Tank	Fission product waste, PUREX organic wash waste, PUREX sludge supernatant, double-shell slurry feed from 241-A and 241-AX tanks/HLW	2,831,180[b]	NA	200-PO-3
241-AX-102 Single-Shell Tank	PUREX organic wash waste, B Plant waste fractionization, complexant concentrate, complexed waste from 241-A, -AX, and -C tanks, 244-AR Vault, and TK-417/HLW	147,615[b]	NA	200-PO-3
241-AX-103 Single-Shell Tank	PUREX organic and inorganic wash waste, B Plant waste fractionization, supernatant with PUREX sludge waste from 241-A, -AX, -AZ, and -C Tanks, 244-AR Vault, and 241-AX-152 Tank/HLW	423,920[b]	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 4 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-AX-104 Single-Shell Tank	PUREX organic and inorganic wash waste, B Plant waste fractionization, supernatant with PUREX sludge waste from 241-A and -AX Tanks and 244-AR-002 Tank/HLW	26,495[b]	NA	200-PO-3
241-AY-101 Double-Shell Tank	Depleted Sr and Cs, dilute noncomplexed waste from single-shell tanks, dilute complexed waste, supernatant containing complexed waste from 241-A and 241-AX Tank Farms/HLW	3,384,158[b]	NA	200-PO-3
241-AY-102 Double-Shell Tank	Neutralized high-level waste, double-shell slurry feed, dilute noncomplexed waste, supernatant with double-shell slurry feed from 241-A and 241-BX Tank Farms/HLW	3,724,845[b]	NA	200-PO-3
241-AZ-101 Double-Shell Tank	Dilute B Plant high-strontium waste, complexed waste, double-shell slurry feed, noncomplexed waste; aging waste (NCAW) from PUREX, supernatant with complexed waste, double-shell slurry feed from the 241-A, -AX, -BX, and -C Tank Farms/HLW	3,675,635[b]	NA	200-PO-3
241-AZ-102 Double-Shell Tank	Dilute B Plant high-strontium waste, complexed waste, PUREX aging waste (NCAW), supernatant with complexed waste from 241-AX Tank Farm/HLW	3,599,927[b]	NA	200-PO-3
241-C-101 Single-Shell Tank	Bismuth phosphate metal waste, tributyl phosphate waste, PUREX coating waste/HLW	333,080[b]	NA	200-PO-3
241-C-102 Single-Shell Tank	Bismuth phosphate metal waste, tributyl phosphate metal waste, PUREX coating waste thorium high-level waste, PUREX organic wash waste, supernatant with organic wash wastes and coating wastes from 241-A, -AX, and -C tanks/HLW	1,616,195[b]	NA	200-PO-3
241-C-103 Single-Shell Tank	PUREX coating waste, tributyl phosphate, B Plant waste fractionization, PUREX sludge supernatant, PUREX organic wash waste, laboratory waste, decontamination waste, REDOX ion exchange waste, noncomplexed waste, waste fractionization ion exchange waste, N Reactor waste, PNL waste, evaporator bottoms from 241-A, -B, -BX, and -C Tank Farms. This unit was used as the receiver for operating P-10 saltwater systems within the 241-C Tank Farm/HLW	738,075[b]	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 5 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-C-104 Single-Shell Tank	PUREX coating waste, bismuth phosphate metal waste, thorium low-level and high-level waste, PUREX organic wash waste, supernatant containing metal waste, PNL waste, N Reactor complexed waste, waste fractionization ion exchange waste, decontamination waste, evaporator bottoms, tributyl phosphate waste from 241-A, -AX, -C, -BY, -TY, and -U Tank Farms/HWL	1,116,575[b]	NA	200-PO-3
241-C-105 Single-Shell Tank	PUREX coating waste, tributyl phosphate waste, PUREX sludge supernatant, REDOX supernatant, supernatant containing tributyl phosphate waste, noncomplexed waste, B Plant waste fractionization low-level and metal wastes from 241-A, -AX, -AY, -B, -C, and -TX Tank Farms, solids with PUREX sludge supernatant, coating waste, and cesium feet from 241-AX and 241-A Tank Farms/HLW	567,750[b]	NA	200-PO-3
241-C-106 Single-Shell Tank	PUREX coating waste, B Plant waste fractionization, tributyl phosphate waste from 241-A and 241-C Tank Farms, solids with PUREX sludge supernatant from 241-A Tank Farm/HLW	866,765[b]	NA	200-PO-3
241-C-107 Single-Shell Tank	Bismuth phosphate first-cycle waste, Hot Semiworks waste, tributyl phosphate, PUREX coating waste, Hanford Laboratory Operations waste, supernatant with PUREX coating waste, PNL waste, N Reactor waste, laboratory waste, decontamination waste, waste fractionization ion exchange waste, evaporator bottoms waste from 241-C and 241-BX Tank Farms/HLW	1,275,545[b]	NA	200-PO-3
241-C-108 Single-Shell Tank	Bismuth phosphate first-cycle waste, Hot Semiworks waste, tributyl phosphate, PUREX coating waste, PUREX organic wash waste, fractionization ion exchange waste, PNL waste; N Reactor waste, laboratory waste, decontamination waste, REDOX high-level waste from 241-C Tank Farm/HLW	249,810[b]	NA	200-PO-3
241-C-109 Single-Shell Tank	Bismuth phosphate first-cycle waste, Hot Semiworks waste, tributyl phosphate, PUREX coating waste, evaporator bottoms, and ion exchange waste from 241-C Tank Farm/HLW	249,810[b]	NA	200-PO-3
241-C-110 Single-Shell Tank	Bismuth phosphate first-cycle waste, tributyl phosphate, supernatant with PUREX organic wash waste, ion exchange waste, coating waste evaporator bottoms, REDOX ion exchange waste/HLW	760,785[b]	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 6 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-C-111 Single-Shell Tank	Bismuth phosphate first-cycle waste, PUREX organic wash waste, evaporator bottoms, Hot Semiworks waste, supernatant with evaporator bottoms, coating waste, tributyl phosphate waste from 241-B and 241-C Tank Farms/HLW	215,745[b]	NA	200-PO-3
241-C-112 Single-Shell Tank	Tributyl phosphate waste, PUREX coating waste, Hot Semiworks waste, supernatant with coating waste, ion exchange waste from 241-C Tank Farm/HLW	393,640[b]	NA	200-PO-3
241-C-201 Single-Shell Tank	Bismuth phosphate metal waste, Semiworks strontium waste/HLW	7,570[b]	NA	200-PO-3
241-C-202 Single-Shell Tank	Bismuth phosphate metal waste, Semiworks strontium waste, supernatant with bismuth phosphate metal waste from 241-C-201 Single Shell Tank/HLW	3,785[b]	NA	200-PO-3
241-C-203 Single-Shell Tank	PUREX high-level waste/HLW	18,925[b]	NA	200-PO-3
241-C-204 Single-Shell Tank	PUREX high-level waste/HLW	11,355[b]	NA	200-PO-3
241-A-302A	Waste solutions from processing and decontamination operations/HLW	13,645	NA	200-PO-1
241-A-302B Catch Tank	Waste solutions from processing and decontamination operations/HLW	12,263	NA	200-PO-5
241-A-350 Catch Tank	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-A-417 Catch Tank	Condensate from the 241-A-401 Condenser House/HLW	120,590	NA	200-PO-3
241-C-301C Catch Tank	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
244-A Lift Station	Waste from several tank farms/HLW	13,974	NA	200-PO-3
244-AR Vault	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 7 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
244-CR Vault	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
Cribs and Drains				
216-A-1 Crib	Depleted uranium waste from cold startup run in the 202-A Building/LLW	98,400	360	200-PO-5
216-A-2 Crib	Organic wastes from 202-A Building/LLW	230,000	210	200-PO-2
216-A-3 Crib	203-A Building wastes, uranyl nitrate hexahydrate, storage pit drainage liquid from 203-A Pump House/LLW	3,050,000	360	200-PO-1
216-A-4 Crib	202-A Building Laboratory cell drainage, 291-A-1 Stack drainage/LLW	6,210,000	210	200-PO-2
216-A-5 Crib	202-A Building Process condensate/LLW	1,630,000,000	690	200-PO-2
216-A-6 Crib	Steam condensate, equipment disposal tunnel floor drainage, water-filled door drainage, 202-A Building waste/LLW	3,400,000,000	2,800	200-PO-4
216-A-7 Crib	Catch tank overflow, sump waste, 241-A-152 Diversion Box pump pit drainage, 202-A Building tributyl phosphate-kerosene organic inventory/LLW	326,000	140	200-PO-5
216-A-8 Crib	241-A, -AX, -AY, -AZ Tank Farm condensate, cooling water from contact condenser in the 241-A-431 Building/LLW	1,150,000,000	6,600	200-PO-5
216-A-9 Crib	Acid fractionator condensate and cooling water from 202-A Building, N Reactor decontamination waste/LLW	981,000,000	2,100	200-PO-1
216-A-10 Crib	Nonradioactive water, 202-A Building process condensate/LLW	3,210,000,000	33,000	200-PO-2
216-A-21 Crib	293-A Building sump waste, 202-A Building laboratory cell drainage, 291-A-1 Stack drainage/LLW	77,900,000	1,400	200-PO-2
216-A-24 Crib	241-A and 241-AX Tank Farm condensate/LLW	820,000,000	4,800	200-PO-5
216-A-27 Crib	293-A Building sump waste, 202-A Building laboratory cell drainage, 291-A-1 Stack drainage/LLW	23,200,000	7,700	200-PO-2

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 8 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
216-A-30 Crib	Steam condensate, equipment disposal tunnel floor and water-filled door drainage, 202-A-Building slug storage basin overflow waste/LLW	7,110,000,000	3,300	200-PO-4
216-A-31 Crib	202-A Building organic waste/LLW	10,000	310	200-PO-2
216-A-32 Crib	202-A Building crane maintenance facility floor, sink and shower drainage/LLW	4,000	NR	200-PO-1
216-A-36A Crib	202-A Building ammonia scrubber waste/LLW	1,070,000	110	200-PO-2
216-A-36B Crib	202-A Building ammonia scrubber waste/LLW	317,000,000	830	200-PO-2
216-A-37-1 Crib	242-A Evaporator process condensate/LLW	377,000,000	1,800	200-PO-4
216-A-37-2 Crib	202-A Building steam condensate/LLW	1,090,000,000	NR	200-PO-4
216-A-38-1 Crib	The site was never used	NA	NA	200-PO-2
216-A-39 Crib	241-AX-801-B Building floor drainage/LLW	20	240	200-PO-3
216-A-41 Crib	269-A-13 Stack drainage/LLW	10,000	NR	200-PO-1
216-A-45 Crib	202-A Building process condensate/LLW	103,000,000	NR	200-PO-2
216-A-11 French Drain	202-A Building Trap Pit No. 1 drainage/LLW	100,000	NR	200-PO-1
216-A-12 French Drain	202-A Building Steam Trap Pit No. 3 drainage/LLW	100,000	NR	200-PO-1
216-A-13 French Drain	Seal water from air sampler vacuum pumps in 202-A Building/LLW	100,000	NR	200-PO-1
216-A-14 French Drain	Vacuum cleaner filter and blower pit drainage from 202-A Building/LLW	1,000	NR	200-PO-1
216-A-15 French Drain	Drainage from 216-A-10 Process Condenser Sampler Pit/LLW	10,000,000	NR	200-PO-2
216-A-16 French Drain	Floor drainage and 296-A-11 Stack drainage from 241-A-431 Building/LLW	122,000	NR	200-PO-5
216-A-17 French Drain	Floor drainage and 296-A-11 Stack drainage from 241-A-431 Building/LLW	60,000	NR	200-PO-5
216-A-22 French Drain	Drainage from 203-A Building truck layout apron, sump waste from 203-A Building enclosure/LLW	10,000	NR	200-PO-1

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 9 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
216-A-23A French Drain	Deentrainer tank condensate, 241-A-431 Building backflush waste/LLW	6,000	NR	200-PO-5
216-A-23B French Drain	Deentrainer tank condensate, 241-A-431 Building backflush waste/LLW	6,000	NR	200-PO-5
216-A-26 French Drain	Floor drainage from the 291-A Fan Control House/LLW	NR	NR	200-PO-1
216-A-26A French Drain	Floor drainage from the 291-A Fan Control House/LLW	1,000	NR	200-PO-1
216-A-28 French Drain	203-A Building enclosure sumps, heating coil condensate from uranyl nitrate hexahydrate tanks/LLW	30,000	NR	200-PO-1
216-A-33 French Drain	Bearing coolant waste from 291-A-1 Stack electrical exhaust fans/LLW	NR	NR	200-PO-1
216-A-35 French Drain	Seal cooling water from air sampler vacuum pumps in 202-A Building/LLW	10,000	NR	200-PO-1
216-C-8 French Drain	Ion exchange waste from 271-CR Building/LLW	10,000	NR	200-PO-3
	Reverse Wells			
299-E24-111 Injection Well	Eleven injections of calcium chloride, calcium nitrate, ^{134}Cs, and ^{90}Sr /LLW	41,635	NR	200-PO-2
	Ponds, Ditches and Trenches			
216-A-29 Ditch	202-A chemical sewer, acid fractionator condensate, condenser cooling water, process cooling water, seal cooling water from air sampler vacuum pumps in 202-A Building/LLW	NR	9,600	200-PO-5
216-A-34 Ditch	Cooling water from contact condenser in 241-A-431 Building/LLW	NR	NR	200-PO-5
216-A-18 Trench	Depleted uranium from the cold startup run at 202-A Building/LLW	488,000	16,000	200-PO-5
216-A-19 Trench	241-A-431 Building contact condenser cooling water, depleted uranium waste from cold startup run at 202-A Building/LLW	1,100,000	66	200-PO-5
216-A-20 Trench	241-A-431 Building contact condenser cooling water, depleted uranium waste from cold startup run at 202-A Building/LLW	961,000	66	200-PO-5

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 10 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
216-A-40 Trench	Diverted cooling water and steam condensate from 244-AR Vault/LLW	946,000	NR	200-PO-1
Septic Tanks and Associated Drain Fields				
2607-EA Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	60/day	NR	200-PO-1
2607-EC Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	450/day	NR	200-PO-5
2607-ED Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	280/day	NR	200-PO-3
2607-EG Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	170/day	NR	200-PO-3
2607-EJ Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	320/day	NR	200-PO-3
2607-EL Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	7,900/day	NR	200-PO-4
2607-E6 Septic Tank and Drain Field	Sanitary wastewater and sewage/NRH	43,500/day	NR	200-PO-1
Transfer Facilities, Diversion Boxes, and Pipelines				
241-A-A Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-A-B Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-A-151 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-1
241-A-152 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 11 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-A-153 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AN-A Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AN-B Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AR-151 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AW-A Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AW-B Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AX-A Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AX-B Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AX-151 Diversion Box	Receives wastes from 202-A Building/HLW	NA	NA	200-PO-3
241-AX-152DS Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AX-155 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AY-151 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AY-152 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AZ-151DS Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 12 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
241-AZ-152 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-C-151 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-C-152 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-C-153 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-C-252 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-CR-151 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-CR-152 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-CR-153 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-ER-153 Diversion Box	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
216-A-524 Control Structure	Contains radioactive piping and cement/LLW	NA	NA	200-PO-5
241-AP Valve Pit	Waste solutions from processing and decontamination operations/HLW	NA	NA	200-PO-3
241-AX-501 Valve Pit	Tank farm condensate/HLW	NA	NA	200-PO-3
	Basins			
207-A Retention Basin	Waste streams from the 242-A Evaporator/LLW	NA	NA	200-PO-5

Table 2-1. Summary of PUREX Plant Aggregate Area Waste Management Units. (sheet 13 of 13)

Waste Management Unit	Source Description/Type	Waste Volume Received (L)	Contaminated Soil Volume (m^3)	Operable Unit
216-A-42 Retention Basin	Chemically or radioactively contaminated diversions from the PUREX chemical sewer line, cooling water line, and steam condensate discharge/LLW	NA	NA	200-PO-4
	Burial Sites			
218-E-1 Burial Ground	Mixed fission products and TRU dry waste/TRU	3,030 m^3	3,000	200-PO-1
218-E-8 Burial Ground	Mixed fission products and TRU waste, repair and construction wastes from 293-A and PUREX new crane addition/TRU	2,265 m^3	18,265	200-PO-6
218-E-12A Burial Ground	Dry waste and acid soaked material/LLW	15,249 m^3	83,114	200-PO-6
218-E-12B Burial Ground	Navy reactor subcomponents/TRU	NR	121,275	200-PO-6
218-E-13 Burial Ground	Pieces of concrete from pipe trench/LLW	NR	184	200-PO-1
200-E Burning Pit	Construction and office waste, paint waste, chemical solvents/LLW	1,500,000 1,000,000	NR	200-PO-6

a/ Data taken from WHC 1991a
b/ Waste volume remaining (Hanlon 1992)
NA - Not applicable
NR - No value reported
Waste Type: HLW - high-level waste
LLW - low-level waste
NRN - non-radiological, non-hazardous waste

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Table 2-2. Radionuclide Waste Inventory Summary. (sheet 1 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Co-60	Sr-90	Cs-137	Pm-147	Pu Total b/	Pu-238	Pu-239	Pu-240 c/	Pu-241
Tanks and Vaults									
241-A-302A	--	--	--	--	--	--	--	--	--
241-A-302B	--	--	--	--	--	--	--	--	--
241-A-350	--	--	--	--	--	--	--	--	--
241-A-417	--	--	--	--	--	--	--	--	--
241-C-301C	--	--	--	--	--	--	--	--	--
244-A	--	--	--	--	--	--	--	--	--
244-AR	--	--	--	--	--	--	--	--	--
244-CR	--	--	--	--	--	--	--	--	--
Cribs and Drains									
216-A-1	0.00179	0.0422	0.0444	--	0.1	--	0.00571	0.00154	--
216-A-2	0.0297	0.921	1.45	--	130	--	7.42	2	--
216-A-3	--	0.0431	0.0455	--	0.2	--	--	--	--
216-A-4	0.0226	4.39	6.93	--	140	--	7.99	2.16	--
216-A-5	3.32	41.6	12.1	--	65	--	3.71	1	--
216-A-6	0.18	44.1	105	--	35.6	--	2.09	0.548	--
216-A-7	0.00204	0.431	2.31	--	1	--	0.0571	0.0154	--
216-A-8	--	51.5	522	--	50	--	--	--	--
216-A-9	0.00583	11	4.65	--	0.5	--	0.02851	0.0077	--
216-A-10	--	82.5	80.5	0.312	350	0.329	3.49	--	42.3
216-A-21	0.471	7.51	78.5	--	150	--	8.56	2.31	--
216-A-24	0.0219	18.3	268	--	5.06	--	0.289	0.0779	--
216-A-27	0.3	24.5	32.4	--	96.5	--	5.51	1.49	--
216-A-30	--	102	117	0.429	73.1	--	0.0751	--	--
216-A-31	0.00588	1.05	82	--	9	--	0.514	0.139	--
216-A-32	--	--	--	--	--	--	--	--	--

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 2 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Co-60	Sr-90	Cs-137	Pm-147	Pu Total b/	Pu-238	Pu-239	Pu-240 c/	Pu-241
216-A-36A	0.71	978	847	–	80	–	4.57	1.23	–
216-A-36A	0.71	978	847	–	80	–	4.57	1.23	–
216-A-36B	–	331	350	1.99	178	–	0.0569	–	0.558
216-A-37-1	–	0.0542	0.0947	0.0919	0.0283	–	0.000201	–	–
216-A-37-2	–	0.307	0.204	0.196	–	–	373	–	–
216-A-38-1	–	–	–	–	–	–	–	–	–
216-A-39	–	–	14.3	–	–	–	–	–	–
216-A-41	–	–	–	–	–	–	–	–	–
216-A-45	–	0.00834	0.0097	0.0421	–	0.00613	0.0556	–	0.658
216-A-11	–	–	–	–	–	–	–	–	–
216-A-12	–	–	–	–	–	–	–	–	–
216-A-13	–	–	–	–	–	–	–	–	–
216-A-14	–	–	–	–	–	–	–	–	–
216-A-15	–	–	–	–	–	–	–	–	–
216-A-16	–	–	–	–	–	–	–	–	–
216-A-17	–	–	–	–	–	–	–	–	–
216-A-22	–	–	–	–	–	–	–	–	–
216-A-23A	–	–	–	–	–	–	–	–	–
216-A-23B	–	–	–	–	–	–	–	–	–
216-A-26	–	–	–	–	–	–	–	–	–
216-A-26A	–	–	–	–	–	–	–	–	–
216-A-28	–	–	–	–	–	–	–	–	–
216-A-33	–	–	–	–	–	–	–	–	–
216-A-35	–	–	–	–	–	–	–	–	–
216-C-8	–	–	–	–	–	–	–	–	–

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 3 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Co-60	Sr-90	Cs-137	Pm-147	Pu Total b/	Pu-238	Pu-239	Pu-240 c/	Pu-241
Reverse Wells									
299-E24-111	--	--	--	--	--	--	--	--	--
Ponds, Ditches and Trenches									
216-A-29	--	--	--	--	--	--	--	--	--
216-A-34	--	--	--	--	--	--	--	--	--
216-A-18	0.00179	0.042	0.0444	--	0.1	--	0.00571	0.00154	--
216-A-19	0.00179	0.042	0.0444	--	0.1	--	0.00571	0.00154	--
216-A-20	0.00179	0.042	0.0444	--	0.1	--	0.00571	0.00154	--
216-A-40	--	--	--	--	--	--	--	--	--
Septic Tanks and Associated Drain Fields									
2607-EA	--	--	--	--	--	--	--	--	--
2607-EC	--	--	--	--	--	--	--	--	--
2607-ED	--	--	--	--	--	--	--	--	--
2607-EG	--	--	--	--	--	--	--	--	--
2607-EJ	--	--	--	--	--	--	--	--	--
2607-EL	--	--	--	--	--	--	--	--	--
2607-E6	--	--	--	--	--	--	--	--	--
Transfer Facilities, Diversion Boxes, and Pipelines									
241-A-A	--	--	--	--	--	--	--	--	--
241-A-B	--	--	--	--	--	--	--	--	--
241-A-151	--	--	--	--	--	--	--	--	--
241-A-152	--	--	--	--	--	--	--	--	--
241-A-153	--	--	--	--	--	--	--	--	--
241-AN-A	--	--	--	--	--	--	--	--	--
241-AN-B	--	--	--	--	--	--	--	--	--
241-AR-151	--	--	--	--	--	--	--	--	--

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 4 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Co-60	Sr-90	Cs-137	Pm-147	Pu Total b/	Pu-238	Pu-239	Pu-240 c/	Pu-241
241-AW-A	--	--	--	--	--	--	--	--	--
241-AW-B	--	--	--	--	--	--	--	--	--
241-AX-A	--	--	--	--	--	--	--	--	--
241-AX-B	--	--	--	--	--	--	--	--	--
241-AX-151	--	--	--	--	--	--	--	--	--
241-AX-152DS	--	--	--	--	--	--	--	--	--
241-AX-155	--	--	--	--	--	--	--	--	--
241-AY-151	--	--	--	--	--	--	--	--	--
241-AY-152	--	--	--	--	--	--	--	--	
241-AZ-151DS	--	--	--	--	--	--	--	--	--
241-AZ-152	--	--	--	--	--	--	--	--	--
241-C-151	--	--	--	--	--	--	--	--	--
241-C-152	--	--	--	--	--	--	--	--	--
241-C-153	--	--	--	--	--	--	--	--	--
241-C-252	--	--	--	--	--	--	--	--	--
241-CR-151	--	--	--	--	--	--	--	--	--
241-CR-152	--	--	--	--	--	--	--	--	--
241-CR-153	--	--	--	--	--	--	--	--	--
241-ER-153	--	--	--	--	--	--	--	--	--
216-A-524	--	--	--	--	--	--	--	--	--
241-AP	--	--	--	--	--	--	--	--	--
241-AX-501	--	--	--	--	--	--	--	--	--
Basins									
207-A	--	--	--	--	--	--	--	--	--
216-A-42	--	--	--	--	--	--	--	--	--

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 5 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Co-60	Sr-90	Cs-137	Pm-147	Pu Total b/	Pu-238	Pu-239	Pu-240 c/	Pu-241
Burial Sites									
218-E-1	–	0.7165	0.8166	–	900	–	51.4	13.9	–
218-E-8	–	0.09058	0.1017	–	20	–	1.14	0.308	–
218-E-12A	–	9.056	10.99	–	8,930	–	510	138	–
218-E-12B	–	–	–	–	–	–	–	–	–
218-E-13	–	–	–	–	–	–	–	–	–
200-E Burning Pit	–	–	–	–	–	–	–	–	–

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 6 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Ru-106	Sn-113	Total U	U-238 c/	I-129	Am-241	H-3	Alpha	Beta c/
Tanks and Vaults									
241-A-302A	--	--	--	--	--	--	--	--	--
241-A-302B	--	--	--	--	--	--	--	--	--
241-A-350	--	--	--	--	--	--	--	--	--
241-A-417	--	--	--	--	--	--	--	--	--
241-C-301C	--	--	--	--	--	--	--	--	--
244-A	--	--	--	--	--	--	--	--	--
244-AR	--	--	--	--	--	--	--	--	--
244-CR	--	--	--	--	--	--	--	--	--
Cribs and Drains									
216-A-1	0.00000000000275	--	0.0514	0.0516	--	--	--	0.00614	0.17
216-A-2	0.0000000783	--	0.026	0.0262	--	--	--	7.98	4.71
216-A-3	0.000000152	--	0.559	--	--	--	--	0.0123	0.182
216-A-4	0.0000000438	--	0.133	0.134	--	--	--	8.6	2.21
216-A-5	0.000000108	--	0.0877	0.0881	--	--	--	3.99	109
216-A-6	0.0000055	--	0.055	0.0553	--	--	--	2.19	291
216-A-7	0.00000011	--	0.00227	0.00228	--	--	--	0.0614	5.29
216-A-8	0.0000469	--	0.123	--	--	--	0	3.07	1,110
216-A-9	0.0000000363	--	0.0000757	0.00008	--	--	4,000	0.0307	31
216-A-10	0.309	--	0.081	--	0.107	0.773	1,850	28.1	360
216-A-21	0.00000145	--	0.065	0.0653	--	--	--	9.21	166
216-A-24	0.00000132	--	0.0167	0.0168	--	--	1,400	0.311	552
216-A-27	0.0000138	--	0.0227	0.0228	--	--	--	5.92	112
216-A-30	0.0814	0.00315	0.1	--	--	0.198	16	4.64	432
216-A-31	0.0013	--	0.00683	0.00686	--	--	--	0.553	162
216-A-32	--	--	--	--	--	--	--	--	--
216-A-36A	0.000116	--	0.0484	0.0486	--	--	--	4.91	3,630

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 7 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Ru-106	Sn-113	Total U	U-238 c/	I-129	Am-241	H-3	Alpha	Beta c/
216-A-36B	3.17	0.000579	0.0398	–	0.00842	0.217	507	11	1.360
216-A-37-1	0.0415	0.00252	0.0109	–	0.00426	0.000369	1.600	0.00845	0.508
216-A-37-2	0.0407	0.00157	0.0172	–	–	0.0982	6	0.105	1.85
216-A-38-1	–	–	–	–	–	–	–	–	–
216-A-39	–	–	–	–	–	–	–	–	27.5
216-A-41	–	–	–	–	–	–	–	–	–
216-A-45	0.0133	0.0000656	0.00225	–	0.011	0.11	3.850	0.0551	0.112
216-A-11	–	–	–	–	–	–	–	–	–
216-A-12	–	–	–	–	–	–	–	–	–
216-A-13	–	–	–	–	–	–	–	–	–
216-A-14	–	–	–	–	–	–	–	–	–
216-A-15	–	–	–	–	–	–	–	–	–
216-A-16	–	–	–	–	–	–	–	–	–
216-A-17	–	–	–	–	–	–	–	–	–
216-A-22	–	–	–	–	–	–	–	–	–
216-A-23A	–	–	–	–	–	–	–	–	–
216-A-23B	–	–	–	–	–	–	–	–	–
216-A-26	–	–	–	–	–	–	–	–	–
216-A-26A	–	–	–	–	–	–	–	–	–
216-A-28	–	–	0.211	0.212	–	–	–	–	0.00747
216-A-33	–	–	–	–	–	–	–	–	–
216-A-35	–	–	–	–	–	–	–	–	–
216-C-8	–	–	–	–	–	–	–	–	–
Reverse Wells									
299-E24-111	–	–	–	–	–	–	–	–	–
Ponds, Ditches and Trenches									
216-A-29	–	–	–	–	–	–	–	–	–

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 8 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Ru-106	Sn-113	Total U	U-238 c/	I-129	Am-241	H-3	Alpha	Beta c/
216-A-34	--	--	--	--	--	--	--	--	--
216-A-18	0.00000000000275	--	0.469	0.472	--	--	--	0.00614	0.172
216-A-19	0.00000000000275	--	13	13	--	--	--	0.00614	0.17
216-A-20	0.00000000000275	--	0.135	0.135	--	--	--	0.00614	0.17
216-A-40	--	--	--	--	--	--	--	--	--
Septic Tanks and Associated Drain Fields									
2607-EA	--	--	--	--	--	--	--	--	--
2607-EC	--	--	--	--	--	--	--	--	--
2607-ED	--	--	--	--	--	--	--	--	--
2607-EG	--	--	--	--	--	--	--	--	--
2607-EJ	--	--	--	--	--	--	--	--	--
2607-EL	--	--	--	--	--	--	--	--	--
2607-E6	--	--	--	--	--	--	--	--	--
Transfer Facilities, Diversion Boxes, and Pipelines									
241-A-A	--	--	--	--	--	--	--	--	--
241-A-B	--	--	--	--	--	--	--	--	--
241-A-151	--	--	--	--	--	--	--	--	--
241-A-152	--	--	--	--	--	--	--	--	--
241-A-153	--	--	--	--	--	--	--	--	--
241-AN-A	--	--	--	--	--	--	--	--	--
241-AN-B	--	--	--	--	--	--	--	--	--
241-AR-151	--	--	--	--	--	--	--	--	--
241-AW-A	--	--	--	--	--	--	--	--	--
241-AW-B	--	--	--	--	--	--	--	--	--
241-AX-A	--	--	--	--	--	--	--	--	--
241-AX-B	--	--	--	--	--	--	--	--	--
241-AX-151	--	--	--	--	--	--	--	--	--

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 9 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Ru-106	Sn-113	Total U	U-238 c/	I-129	Am-241	H-3	Alpha	Beta c/
241-AX-152DS	–	–	–	–	–	–	–	–	–
241-AX-155	–	–	–	–	–	–	–	–	–
241-AY-151	–	–	–	–	–	–	–	–	–
241-AY-152	–	–	–	–	–	–	–	–	–
241-AZ-151DS	–	–	–	–	–	–	–	–	–
241-AZ-152	–	–	–	–	–	–	–	–	
241-C-151	–	–	–	–	–	–	–	–	–
241-C-152	–	–	–	–	–	–	–	–	–
241-C-153	–	–	–	–	–	–	–	–	–
241-C-252	–	–	–	–	–	–	–	–	–
241-CR-151	–	–	–	–	–	–	–	–	–
241-CR-152	–	–	–	–	–	–	–	–	–
241-CR-153	–	–	–	–	–	–	–	–	–
241-ER-153	–	–	–	–	–	–	–	–	–
216-A-524	–	–	–	–	–	–	–	–	–
241-AP	–	–	–	–	–	–	–	–	–
241-AX-501	–	–	–	–	–	–	–	–	–
Basins									
207-A	–	–	–	–	–	–	–	–	–
216-A-42	–	–	–	–	–	–	–	–	–
Burial Sites									
218-E-1	0.00000000000769	–	400.000	0.134	–	–	–	–	–
218-E-8	0.0000000001177	–	2.000	0.00067	–	–	–	–	–
218-E-12A	0.000001222	–	990.000	0.332	–	–	–	–	–
218-E-12B	–	–	–	–	–	–	–	–	–

Table 2-2. Radionuclide Waste Inventory Summary. (sheet 10 of 10)

Waste Management Unit Number	Quantity of Reported Radionuclides (Ci) a/								
	Ru-106	Sn-113	Total U	U-238 c/	I-129	Am-241	H-3	Alpha	Beta c/
218-E-13	–	–	–	–	–	–	–	–	–
200-E Burning Pit	–	–	–	–	–	–	–	–	–

a/ Values are decayed through December 31, 1989 unless otherwise noted.
b/ Values are reported in grams.
c/ Values are decayed through April 1, 1986.
Dashes indicate data are not available.

Table 2-3. Chemical Waste Inventory Summary. (sheet 1 of 4)

Waste Management Unit Number	Quantity of Reported Chemicals (kg) *									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
241-A-302A	–	–	–	–	–	–	–	–	–	–
241-A-302B	–	–	–	–	–	–	–	–	–	–
241-A-350	–	–	–	–	–	–	–	–	–	–
241-A-417	–	–	–	–	–	–	–	–	–	–
241-AX-152CT	–	–	–	–	–	–	–	–	–	–
241-C-301C	–	–	–	–	–	–	–	–	–	–
244-A	–	–	–	–	–	–	–	–	–	–
244-AR	–	–	–	–	–	–	–	–	–	–
244-CR	–	–	–	–	–	–	–	–	–	–
Cribs and Drains										
216-A-1	80	–	–	–	–	–	–	–	–	–
216-A-2	–	–	120,000	–	–	–	70,000	–	–	–
216-A-3	–	–	–	–	–	–	–	–	–	–
216-A-4	300	–	–	4,000	110	5,000	–	–	–	–
216-A-5	1,000,000	–	–	–	–	–	–	–	–	–
216-A-6	10,000	–	–	–	–	–	–	–	–	–
216-A-7	–	–	180,000	–	–	–	100,000	–	–	–
216-A-8	–	–	46,000	–	–	–	–	130,000	320,000	–
216-A-9	300,000	–	–	–	–	–	–	–	–	–
216-A-10	–	–	–	–	–	–	–	–	–	–
216-A-21	9,000	–	–	11,000	300	15,000	–	–	–	400,000
216-A-24	–	–	30,000	–	–	–	–	90,000	200,000	–
216-A-27	5,000	–	–	6,000	200	9,000	–	–	–	300,000
216-A-30	16,000	–	–	–	–	–	–	–	–	–
216-A-31	–	–	5,200	–	–	–	2,900	–	–	–
216-A-32	–	–	–	–	–	–	–	–	–	–
216-A-36A	–	–	–	–	–	–	–	–	–	
216-A-36B	–	331	350	1.99	178	–	0.0569	–	0.558	–

Table 2-3. Chemical Waste Inventory Summary. (sheet 2 of 4)

Waste Management Unit Number	Quantity of Reported Chemicals (kg)									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
216-A-37-1	600	–	–	–	–	–	–	–	–	–
216-A-37-2	–	–	–	–	–	–	–	–	–	–
216-A-38-1	–	–	–	–	–	–	–	–	–	–
216-A-39	6	–	–	–	–	–	–	–	–	–
216-A-41	1	–	–	–	–	–	–	–	–	–
216-A-45	–	–	–	–	–	–	–	–	–	–
216-A-11	100	–	–	–	–	–	–	–	–	–
216-A-12	100	–	–	–	–	–	–	–	–	–
216-A-13	1	–	–	–	–	–	–	–	–	–
216-A-14	1	–	–	–	–	–	–	–	–	–
216-A-15	–	1	–	–	–	–	–	–	–	–
216-A-16	1	–	–	–	–	–	–	–	–	–
216-A-17	1	–	–	–	–	–	–	–	–	–
216-A-22	1	–	–	–	–	–	–	–	–	–
216-A-23A	1	–	–	–	–	–	–	–	–	–
216-A-23B	1	–	–	–	–	–	–	–	–	–
216-A-26	–	–	–	–	–	–	–	–	–	–
216-A-26A	1	–	–	–	–	–	–	–	–	–
216-A-28	300	–	–	–	–	–	–	–	–	–
216-A-33	–	–	–	–	–	–	–	–	–	–
216-A-35	1	–	–	–	–	–	–	–	–	–
216-C-8	3	–	–	–	–	–	–	–	–	–
Reverse Wells										
299-E24-111	–	–	–	–	–	–	–	–	–	–
Ponds, Ditches and Trenches										
216-A-29	–	–	–	–	–	–	–	–	–	
216-A-34	–	–	–	–	–	–	–	–	–	–
216-A-18	730	–	–	–	–	–	–	–	–	–

Table 2-3. Chemical Waste Inventory Summary. (sheet 3 of 4)

Waste Management Unit Number	Quantity of Reported Chemicals (kg)									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
216-A-19	20,000	–	–	–	–	–	–	–	–	–
216-A-20	210	–	–	–	–	–	–	–	–	–
216-A-40	1	–	–	–	–	–	–	–	–	–
Septic Tanks and Associated Drain Fields										
2607-EA	–	–	–	–	–	–	–	–	–	–
2607-EC	–	–	–	–	–	–	–	–	–	–
2607-ED	–	–	–	–	–	–	–	–	–	–
2607-EG	–	–	–	–	–	–	–	–	–	–
2607-EJ	–	–	–	–	–	–	–	–	–	–
2607-EL	–	–	–	–	–	–	–	–	–	–
2607-E6	–	–	–	–	–	–	–	–	–	–
Transfer Facilities, Diversion Boxes, and Pipelines										
241-A-A	–	–	–	–	–	–	–	–	–	–
241-A-B	–	–	–	–	–	–	–	–	–	–
241-A-151	–	–	–	–	–	–	–	–	–	–
241-A-152	–	–	–	–	–	–	–	–	–	–
241-A-153	–	–	–	–	–	–	–	–	–	–
241-AN-A	–	–	–	–	–	–	–	–	–	–
241-AN-B	–	–	–	–	–	–	–	–	–	–
241-AR-151	–	–	–	–	–	–	–	–	–	–
241-AW-A	–	–	–	–	–	–	–	–	–	–
241-AW-B	–	–	–	–	–	–	–	–	–	–
241-AX-A	–	–	–	–	–	–	–	–	–	–
241-AX-B	–	–	–	–	–	–	–	–	–	–
241-AX-151	–	–	–	–	–	–	–	–	–	
241-AX-152DS	–	–	–	–	–	–	–	–	–	–
241-AX-155	–	–	–	–	–	–	–	–	–	–
241-AY-151	–	–	–	–	–	–	–	–	–	–

Table 2-3. Chemical Waste Inventory Summary. (sheet 4 of 4)

Waste Management Unit Number	Quantity of Reported Chemicals (kg) [a]									
	Nitrate	Nitric Acid	NPH	Sodium	Sodium Dichromate	Sulfate	TBP	BP	Ammonium Carbonate	Ammonium Nitrate
241-AY-152	–	–	–	–	–	–	–	–	–	–
241-AZ-151DS	–	–	–	–	–	–	–	–	–	–
241-AZ-152	–	–	–	–	–	–	–	–	–	–
241-C-151	–	–	–	–	–	–	–	–	–	–
241-C-152	–	–	–	–	–	–	–	–	–	–
241-C-153	–	–	–	–	–	–	–	–	–	–
241-C-252	–	–	–	–	–	–	–	–	–	–
241-CR-151	–	–	–	–	–	–	–	–	–	–
241-CR-152	–	–	–	–	–	–	–	–	–	–
241-CR-153	–	–	–	–	–	–	–	–	–	–
241-ER-153	–	–	–	–	–	–	–	–	–	–
216-A-524	–	–	–	–	–	–	–	–	–	–
241-AP	–	–	–	–	–	–	–	–	–	–
241-AX-501	–	–	–	–	–	–	–	–	–	–
Basins										
207-A	–	–	–	–	–	–	–	–	–	–
216-A-42	–	–	–	–	–	–	–	–	–	–
Burial Sites										
218-E-1	–	–	–	–	–	–	–	–	–	–
218-E-8	–	–	–	–	–	–	–	–	–	–
218-E-12A	–	–	–	–	–	–	–	–	–	–
218-E-12B	–	–	–	–	–	–	–	–	–	–
218-E-13	–	–	–	–	–	–	–	–	–	–
200-E Burning Pit	–	–	–	–	–	–	–	–	–	–

a/ Not all sites have reported inventories. These inventories do not necessarily list all of the contaminants disposed of at a site. Dashes indicate data are not available.

Table 2-4. Description of PUREX Aggregate Area Tank Farms. (sheet 1 of 2)

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume Remaining (L)	Drainable Waste Volume (L)
241-A Tank Farm						
241-A-101	single-shell	sound	no	PI	3,607,105	1,563,205
241-A-102	single-shell	sound	IS	PI	155,185	22,710
241-A-103	single-shell	assumed leaker	IS	II	1,400,450	64,345
241-A-104	single-shell	assumed leaker	IS	II	105,980	0
241-A-105	single-shell	assumed leaker	IS	II	71,915	15,140
241-A-106	single-shell	sound	IS	II	473,125	26,495
241-AN Tank Farm						
241-AN-101	double-shell	sound	no	no	987,885	987,885
241-AN-102	double-shell	sound	no	no	4,152,145	3,826,635
241-AN-103	double-shell	sound	no	no	3,603,320	56,775
241-AN-104	double-shell	sound	no	no	4,008,315	3,103,700
241-AN-105	double-shell	sound	no	no	4,280,835	4,280,835
241-AN-106	double-shell	sound	no	no	3,853,130	3,788,785
241-AN-107	double-shell	sound	no	no	4,084,015	3,610,890
241-AP Tank Farm						
241-AP-101	double-shell	sound	no	no	4,023,455	4,023,455
241-AP-102	double-shell	sound	no	no	503,405	503,405
241-AP-103	double-shell	sound	no	no	4,295,975	4,295,975
241-AP-104	double-shell	sound	no	no	79,485	79,485
241-AP-105	double-shell	sound	no	no	3,126,410	3,126,410
241-AP-106	double-shell	sound	no	no	4,292,190	4,292,190
241-AP-107	double-shell	sound	no	no	4,273,265	4,273,265
241-AP-108	double-shell	sound	no	no	662,375	662,375
241-AW Tank Farm						
241-AW-101	double-shell	sound	no	no	4,242,985	3,932,615
241-AW-102	double-shell	sound	no	no	3,875,840	3,872,055
241-AW-103	double-shell	sound	no	no	2,452,680	1,218,770
241-AW-104	double-shell	sound	no	no	4,265,695	3,353,510
241-AW-105	double-shell	sound	no	no	3,417,855	2,403,475
241-AW-106	double-shell	sound	no	no	2,006,050	1,086,295

Table 2-4. Description of PUREX Aggregate Area Tank Farms. (sheet 2 of 2)

Name	Type	Integrity	Interim Stabilized	Isolation	Total Waste Volume Remaining (L)	Drainable Waste Volume (L)
241-AX Tank Farm						
241-AX-101	single-shell	sound	no	PI	2,831,180	1,211,200
241-AX-102	single-shell	assumed leaker	IS	II	147,615	64,325
241-AX-103	single-shell	sound	IS	II	423,920	136,260
241-AX-104	single-shell	assumed leaker	IS	II	26,495	0
241-AY Tank Farm						
241-AY-101	double-shell	sound	no	no	3,402,715	3,099,915
241-AY-102	double-shell	sound	no	no	3,198,325	3,077,205
241-AZ Tank Farm						
241-AZ-101	double-shell	sound	no	no	3,652,525	3,520,050
241-AZ-102	double-shell	sound	no	no	3,569,255	3,236,175
241-C Tank Farm						
241-C-101	single-shell	assumed leaker	IS	II	333,080	11,355
241-C-102	single-shell	sound	no	PI	1,616,195	181,680
241-C-103	single-shell	sound	no	PI	738,075	503,405
241-C-104	single-shell	sound	IS	II	1,116,575	41,635
241-C-105	single-shell	sound	no	PI	567,750	41,635
241-C-106	single-shell	sound	no	PI	866,765	181,680
241-C-107	single-shell	sound	no	PI	1,275,545	128,690
241-C-108	single-shell	sound	IS	II	249,810	0
241-C-109	single-shell	sound	IS	II	249,810	15,140
241-C-110	single-shell	assumed leaker	no	PI	760,785	79,485
241-C-111	single-shell	assumed leaker	IS	II	215,745	0
241-C-112	single-shell	sound	IS	PI	393,640	121,120
241-C-201	single-shell	assumed leaker	IS	II	7,570	0
241-C-202	single-shell	assumed leaker	IS	II	3,785	0
241-C-203	single-shell	assumed leaker	IS	II	18,925	0
241-C-204	single-shell	assumed leaker	IS	II	11,355	0

Source: WHC 1991a
Notes: IS - interim stabilized
II - interim isolated
PI - partially interim isolated

Table 2-5. General Information Reference Locator. (sheet 1 of 2)

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, *Tank Farm Surveillance and Waste Status Summary Report*, 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, *Waste Storage Tank Status and Leak Detection Criteria*
West 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 6.0
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

Table 2-5. General Information Reference Locator. (sheet 2 of 2)

Desired Single-Shell Tank Information	Reference Document
Double-Shell Tank Farm Facility Safety Analysis Report: Site characteristic, facility design, process system.	WHC-SD-WM-SAR-016
Double-Shell Tank Operating Specifications:	Not Available. OSD-T-151-00007

Table 2-6. Summary of Unplanned Releases. (sheet 1 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-10	PUREX railroad right-of-way	October 23, 1957	N/A	• PUREX tube bundles in transit for burial provided some spotty ground contamination. • Extensive decontamination was required.
UN-200-E-11	Railroad tracks from PUREX tunnel entrance to west end of exclusion fence to the spur into 218-E-5 Burial Ground and to the "TC" spur	1957	N/A	• Contamination spots were found along the railroad track. Specific release details are unknown. • Waste is fission products. • Most of the contamination was removed. The tracks were marked with stakes and radiation zone signs.
UN-200-E-12	PUREX railroad bed and right-of-way	December 23, 1957	N/A	• Unknown beta/gamma with readings from 40 to 1,700 mR/h • Contaminated liquid dripped from a burial box in transit to the burial ground.
UN-200-E-13	Between the 216-A-4 Crib and the 291-A Stack	December 1958	216-A-4 Crib	• The 216-A-4 Crib became plugged and flooded an area between the crib and the 291-A Stack. • The contaminated soil was removed to a trench along the south boundary of the 216-A-4 Crib and covered with a foot of soil. • Type of soil was not identified in reference.
UN-200-E-15	The blacktop area outside of the 291-A Turbine House	January 21, 1959	216-A-4 Crib and 216-A-2 Catch Tank	• Unknown beta/gamma with readings up to 8 R/h. • The 216-A-4 Crib became plugged during the jetting of the 216-A-2 Catch Tank, causing ground contamination.
UN-200-E-16	18 m (60 ft) northeast of the 105-C Tank Pit	1959	241-C-105	• Waste type was PUREX coating waste. • The 241-C-105 to 241-C-108 overground transfer line broke and contaminated the soil northeast of the 241-C-105 Single-Shell Tank pit. • The contaminated pipe was buried in a trench near the 241-C fence. The original site was marked with chain and underground radiation zone signs.

Table 2-6. Summary of Unplanned Releases. (sheet 2 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-18	30 m (100 ft) east of the 241-A-271 Building	1959	N/A	• Moisture dripping from a vent pipe bonnet at the 216-A-8 Proportional Sample Pit contaminated the ground near the 241-A-271 Building. • Waste type was low-level fission products. • The area is marked with stakes, chains, and radiation zone signs.
UN-200-E-19	183 m (600 ft) east of the 202-A Building	1959	N/A	• A drip in the vent pipe bonnet at the 216-A-6 Proportional Sample Pit contaminated the ground near the 202-A Building. • Waste type was low-level fission products. • The area is marked with stake, chain, and radiation zone signs.
UN-200-E-20	The PUREX railroad right-of-way	November 20, 1959	N/A	• Readings were to 3 R/h at 46 cm (18 in.). • PUREX tube bundles in transit for burial provided some spotty ground contamination.
UN-200-E-22	Ground around the 291-A Stack	1959	N/A	• General contamination has built up around the 291-A Stack. The heaviest concentrations are northwest and southeast of the stack within approximately 91 m (300 ft). • Waste type is mixed fission products. • The area was staked and chained off with radiation zone signs.
UN-200-E-25	Southwest of PUREX to 61 m (200 ft) beyond the limited area fence	September 5, 1960	241-A-151 Diversion Box	• Unknown beta/gamma with readings to 100,000 ct/min • Leakage from the 241-A-151 Diversion Box contaminated an area southwest of PUREX.

Table 2-6. Summary of Unplanned Releases. (sheet 3 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-26	South of the 241-A-151 Diversion Box outside the 200 East Area perimeter fence. The contamination also crossed Route 4S	September 30, 1960	241-A-151 Diversion Box	• Unknown beta/gamma with readings from 1 to 3 mR/h near the diversion box and just outside the exclusion fence. General contamination was up to 3,000 ct/min. • Leakage from the 241-A-151 Diversion Box caused an operator to stop transfer, but the process tank emptied and steam blew out of the jumper connection.
UN-200-E-27	Generally east from 244-CR Vault up to several hundred feet beyond the limited area fence	November 1, 1960	244-CR Vault	• Unknown beta/gamma with readings near the vault on the order of 50 to 100 mR/h. Readings outside the fence area were up to 40,000 ct/min. • Near the 244-CR Vault winds provided some spotty ground contamination beyond the area fence.
UN-200-E-28	Eastern half of the PUREX exclusion area	December 21, 1961	N/A	• A process vessel steam coil failed, causing ground contamination. • Waste type was fission products.
UN-200-E-31	Contamination spread over PUREX exclusion area and east of PUREX to the west bank of the Columbia River	October 7, 1961	241-A-151 Diversion Box	• Unknown beta/gamma with readings from 40,000 to 100,000 ct/min in the vicinity of PUREX. Readings outside of the limited area fence were an order of magnitude lower and decreased to 1,000 ct/min. • Leakage from the 241-A-151 Diversion Box.
UN-200-E-33	The railroad right-of-way from PUREX to the 200 East Burial Ground	March 20, 1964	216-A-9 Crib	• A leaking tube bundle burial box in transit to the burial ground contaminated a portion of the railroad right-of-way and area adjacent to the 216-A-9 Crib. • The site was surface stabilized in 1981.

Table 2-6. Summary of Unplanned Releases. (sheet 4 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-35	218-E-13 Burial Ground excavation	October 1966	N/A	• Contaminated concrete from an underground encasement was left in the pit excavated to repair the broken pipe. This site is also known as 218-E-13 Burial Ground and UN-218-E-1. • This site is scheduled for deletion. It is duplicate of 218-E-13 Burial Ground. • An area about 107 m (350 ft) west of the PUREX Exclusion Area Patrol Gatehouse on Fourth Street was contaminated.
UN-200-E-39	Ground and blacktop outside the 216-A-36B Crib Sampler Shack	February 6, 1968	216-A-36B Crib	• Pressurized ammonia scrubber waste containing fission products. The readings were 20 to 450 mR/h. • Pressured ammonia scrubber waste was inadvertently released through the vent at the 216-A-36B Crib sampling shack.
UN-200-E-40	Blacktop outside the 216-A-36B Crib Sampler Shack	August 5, 1968	216-A-36B Crib	• Unknown beta/gamma with readings to a maximum of 150 mR/h. • The vent line valve at the 216-A-36B Crib Sampler Shack was inadvertently left open and contaminated the blacktop outside the shack.
UN-200-E-42	The dirt bank east of the 241-AX-151 Diversion Box and weeds east of the established parking lot	November 6, 1972	N/A	• Unknown beta/gamma with readings of 300 to 3,000 ct/min. • Surveys revealed contamination thought to be a result of pressurization of a 244-AR Diverter Tank, which was inadvertently left on. • The area was cleaned.
UN-200-E-47	The parking lot east of the 702-A Building	October 15, 1974	241-A Tank Farm	• Unknown beta/gamma with readings of 500 to 20,000 ct/min from the 241-A Tank Farm. • Contaminated soil was detected in the 241-A Tank Farm. • The contaminated soil was removed and the area released for normal service.

Table 2-6. Summary of Unplanned Releases. (sheet 5 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-48	The 241-A Tank Farm parking lot	November 22, 1974	N/A	• Unknown beta/gamma with readings of 1,000 to 2,000 ct/min • The 241-A-106 pump pit contaminated the 241-A Tank Farm parking lot. • The parking area was cleaned and returned to normal operation by 6:45 p.m. the same day.
UN-200-E-49	The roadway between the 241-AY Tank Farm and 218-E-12B Burial Ground.	February 7, 1975	N/A	• Unknown beta/gamma with readings of 100,000 ct/min. • A thermocouple well being transferred to the burial ground from the 241-AY Tank Farm contaminated a section of the road. Contamination was confined to the snow cover and did not reach the ground surface. • The contaminated sections of road immediately northwest of the 241-AY Tank Farm and northeast of the 241-C Tank Farm, were barricaded and cleaned up.
UN-200-E-56	An excavation east of the 200 Areas perimeter fence	June 13, 1979	216-A-24 Crib	• Unknown beta/gamma with readings up to 8,000 ct/min. • Contaminated soil was found during an excavation for clean soil to be used around the 241-AN tanks. • The area was zoned off and posted.
UN-200-E-58	A dirt roadway leading to the 218-E-1 Burial Ground	March 4, 1980	N/A	• Unknown beta/gamma with readings to 100,000 ct/min. • Contaminated tumbleweeds were detected along the roadway near the 218-E-1 Burial Ground. • The roadway was cleaned up.

Table 2-6. Summary of Unplanned Releases. (sheet 6 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-60	An area about 0.3 to 1 m (1 to 2 ft) wide and 12 m (40 ft) long on the roadway near 275-EA Building	June 3, 1981	N/A	• Radioactive contamination with unknown beta/gamma readings from 200 to 500 ct/min. • Contaminated dirt was spilled from an overfilled dump truck en route to the burial grounds. • There is no potential for further release from this spill site; only background levels of radiation remain. • The roadway was decontaminated to background radiation levels.
UN-200-E-62	An area about 5 cm (2 in.) wide and 30 m (100 ft) long on a hill near the 200 East Overground Storage Area	March 19, 1982	N/A	• Contamination consisted of unknown beta/gamma readings to 350 mR/h. • Radioactive liquid was spilled from a pressure test assembly while in transit. • There is no potential for further release from this spill site; only background levels of radiation remain. • The ground contamination was picked up, placed in barrels, and removed to the burial ground. The area was released from area posting on March 22, 1982.
UN-200-E-65	The immediate ground area around the 241-A-151 Diversion Box and 21 m (70 ft) to the west	September 1, 1982	241-A-151 Diversion Box	• The contamination consists of unknown beta/gamma, with spot readings from 600 to 5,000 ct/min. • The wind spread contamination from the 241-A-151 Diversion Box. • The potential for release is very low; contamination is physically fixed in place. • The contaminated ground was kept wet until it could be decontaminated to background radiation levels and stabilized. The diversion box cover blocks were sprayed with film, which is used to physically fix contamination to a solid surface.

Table 2-6. Summary of Unplanned Releases. (sheet 7 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-67	Excavation site north of the parking lot at 272-AW Building	May 7, 1984	N/A	• The contamination consists of unknown beta/gamma, with readings from 1,000 to 1,500 mR/h. • An old, contaminated pipe encasement was encountered during the excavation. • No potential for release from this spill site exists; only background levels of radiation remain. • The area was decontaminated to background radiation levels and stabilized.
UN-200-E-68	The general vicinity of the 244-AR Vault and the 241-C Tank Farm	January 11, 1985	241-C-151 Diversion Box	• The contamination consisted of unknown beta/gamma, with readings of 2,000 ct/min and dose rates of 5 R/h on the diversion box. • Wind-borne contamination spread from the 241-C-151 Diversion Box. • The affected areas were either decontaminated to background radiation levels or covered for later decontamination.
UN-200-E-72	South of the 241-C Tank Farm	April 20, 1985	N/A	• The contamination consists of unknown beta/gamma with readings to 7 R/h. • Buried contaminated waste was excavated. • Low release potential; the contamination is physically fixed in place. • The source of the contamination was stabilized and the area was chained off and posted as a surface contamination area.

Table 2-6. Summary of Unplanned Releases. (sheet 8 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-81	A few feet west of the 241-CR-151 Diversion Box	October 1969	241-CR-151 Diversion Box	• PUREX coating waste was lost to the soil, including 360 Ci of ^{90}Sr, 720 Ci of ^{137}Cs, 360 Ci of ^{144}Ce, 1,080 Ci of ^{95}Zr/Nb, and 1,080 Ci ^{106}Ru. This is a Transuranic-Fission product disposal site containing high salt and neutral/basic wastes. • A puddle of contaminated liquid was discovered near the 241-CR-151 Diversion Box, the source determined as the underground transfer line from the 202-A Building to the 241-C-102 Single-Shell Tank waste storage tank via the diversion box. • A radiological survey on 10/75 showed surface contamination of 10,000 to 100,000 ct/min. • The contamination was covered with earth backfill and clean gravel.
UN-200-E-82	Across from the 241-C-152 Diversion Box, outside the 241-C Tank Farm fence line	December 19, 1969	241-C-152 Diversion Box, 241-C-105 Single-Shell Tank	• The leak consisted of waste containing 100 Ci of ^{134}Cs, 11,300 Ci of ^{137}Cs, 260 Ci of ^{144}Ce, 260 Ci of ^{95}Zr, and 130 Ci of ^{106}Ru. This is a Transuranic-Fission product disposal site containing high salt and neutral/basic wastes. • A leak was discovered near the 241-C-152 Diversion Box, the source determined as the feed line that runs from 241-C-105 Single-Shell Tank to the 221-B Building. The leak waste stream flowed through a surface area of about 1 ft^2 northeastward, downgrade, until it pooled into an estimated 5 ft^2 area outside the tank farm fence line. • The contaminated soil was covered with clean gravel. The site was cleaned up during a decontamination outage of the 241-C Tank Farm following the 241-C-151 Diversion Box release in 1985.

Table 2-6. Summary of Unplanned Releases. (sheet 9 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-86	Outside the southwest corner of the 241-C Tank Farm	March 1971	N/A	• Waste from the process transfer line containing 25,000 Ci of ^{137}Cs. This is a TRU fission product waste site containing high salt and neutral/basic waste. • During a routine line monitoring near the southwest corner of 241-C Tank Farm, a radiation zone was detected in the vicinity of Line No. 812, which is used to transfer process waste from 244-AR Vault to the 241-C Tank Farm. At this location, the No. 812 line is 2.4 m (8 ft) deep. • Test wells driven into the ground indicated the contamination did not extend below a depth of 6 m (20 ft). The contaminated soil zone was estimated at 1,300 ft^3.
UN-200-E-88	About 274 m (900 ft) northwest of the 202-A Building at the TC-4 railroad spur	September 11, 1980	N/A	• The large radiation zone was incorrectly designated as an unplanned release site. This site in question was properly known as a Regulated Equipment Storage Area. • Gamma dose rates from radioactive equipment parked on the railroad spur would be less than 1 mR/h. • The site was stabilized, but recontamination has occurred.
UN-200-E-91	Along the northeast corner of 241-C Tank Farm	September 1980	N/A	• This condition resulted from the migration of low-level radioactivity from the neighboring 241-C Tank Farm. The occurrence date is unknown. • The contaminated soil was removed from the area and placed in the excavation adjacent to the north side of the 216-A-24 Crib. It has been released from the status of an "Unplanned Release" site.

Table 2-6. Summary of Unplanned Releases. (sheet 10 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-94	Outside the perimeter fence directly north of 216-B-3-1 and 1,600 ft northeast of 241-C Tank Farm	June 1979	N/A	• Residue contamination to 300 ct/min activity was on the ground in the bottom of the gravel pit. • Radiation monitoring surveys on the soil in the area detected 8,000 ct/min in the moisture on the earthmoving equipment and in the soil.
UN-200-E-96	From the south side of the 202-A Building to the southern fence	September 1980	N/A	• This site originated from the residue contamination from the 291-A Stack and diversion box work during the operational years of the 202-A Building. • Surface contamination, debris, and vegetation were removed from the south side of the 202-A Building to the southern fence during September 1980. The area was covered with 10 to 15 cm (4 to 6 in.) of 5/8-inch crushed gravel. The surface contamination posting has been removed, but the area has been recontaminated following the restarting of the 202-A Building.
UN-200-E-97	South of the 202-A Building near the railroad tunnel	September 1980	N/A	• Ground contamination from an unknown source was detected south of PUREX near the railroad tunnel. • On a field survey 9/22/81, the site could not be located. The actual occurrence date is unknown. • Apparently, the surface contamination was removed and the zone eliminated when the double-exclusion fence was built around the 202-A Building. The area was released from zone posting and established as an unplanned release site in 9/80.

Table 2-6. Summary of Unplanned Releases. (sheet 11 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-99	Approximately 122 m (400 ft) south of the 241-C Tank	September 1980	244-CR Vault	• A portion of the ground surface surrounding the 244-CR Vault became contaminated during the numerous piping changes associated with that facility. • The actual occurrence date is unknown. It was established as a site in September 1980. • The site was decontaminated during the summer of 1981 and released from zone posting.
UN-200-E-100	South and east of 241-C Tank Farm surrounding the 244-A Lift Station	1986	244-A Lift Station	• Radioactive contamination, amount unknown. • Known release was a spill to the ground.
UN-200-E-107	Inside the 241-C Tank Farm at the 244-CR Vault Tank	November 26, 1952	100-CR Tank	• Known waste was tributyl phosphate waste from the 221-U Building. Contaminated liquid was discharged before the pump could be shut off. A maximum dose of 4.2 rep/h at the surface and 200 mR/h at a depth of 5 cm (2 in.) was observed for the ground contamination. • Contamination spread to ground and equipment during a transfer pump installation in the 244-CR Vault in the 241-C Tank Farm.
UN-200-E-114	Valve pit outside the 202-A Building	March 12, 1974	N/A	• Readings of 8,000 ct/min beta and 1,000 ct/min alpha were detected on an employee. An employee had been working in an area where contamination was found.
UN-200-E-117	Within a few inches of the top of the waste encasement on the west side of PUREX railroad tunnel	April 20, 1972	N/A	• Up to 2,000 mR/h of Cs and Sr including 500 mR/h at 1 ft from the liquid. • An excavation exposed liquid spurting up out of ground in the 200 East/PUREX Plant Aggregate Area.

Table 2-6. Summary of Unplanned Releases. (sheet 12 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UN-200-E-118	241-C Tank Farm; inside the fence: 100 to 300 yards north of the badgehouse; outside the fence: to the south bank of the parking lot	April 20, 1957	N/A	• Readings to 3,000 ct/min were measured. The highest exposure rate at the surface was estimated at 50 mR/h, with one particle deposited per square foot. • The 241-C-107 Single-Shell Tank effluent tank released airborne contamination in the 200 East Area.
UN-200-E-142	North of the 202-A Building at the 202-A Building diesel fuel tank	November 17, 1986	N/A	• The release consisted of diesel fuel. • The tank of a diesel-fueled compressor overflowed during filling. • The diesel fuel was absorbed, cleaned up and drummed for disposal.
UPR-200-E-17	The ground on top of the 216-A-22 French Drain	1959	216-A-22 French Drain	• Uranium was the waste type. • The 216-A-22 French Drain inlet failed and contaminated the soil.
UPR-200-E-21	Adjacent to the 216-A-6 Crib	March 20, 1959	216-A-6 Crib	• Unknown beta/gamma with readings to 500 mR/h. • The 216-A-6 Crib overflowed and caused some soil contamination adjacent to the crib.
UPR-200-E-24	From the 200 East Burial Ground to the 200 East Area perimeter fence, a distance of about 3 km (2 mi)	June 17, 1960	218-E-12A Burial Ground	• Unknown beta/gamma with readings up to 2,000 mR/h at the trench. Average radiation level inside the burial ground fence was 30 mR/h at 10 cm (4 in.). • A burial box collapsed during burial operations, causing spotty ground contamination.
UPR-200-E-29	In the area of the 216-A-6 Crib	January 20, 1961	216-A-6 Crib	• Unknown beta/gamma with readings to 30 R/h at 1.2 m (4 ft). • The 216-A-6 Crib overflowed outside the area of the crib.

Table 2-6. Summary of Unplanned Releases. (sheet 13 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-30	The majority was confined to the 200 East Area Burial Ground chained area	April 20, 1961	218-E-12A Burial Ground	• Unknown beta/gamma with readings up to 500 R/h. • A burial box collapsed during routine operation, spreading contamination within the burial ground. • Contamination stabilization started immediately after the burial trench involved was backfilled.
UPR-200-E-50	Southeast of the Overground Radioactive Equipment Storage Yard, north of 241-C Tank Farm	September 27, 1974		• Unknown beta/gamma with readings of 3,000 to 100,000 ct/min. • Wind spread contamination from an adjacent radiation zone to the 241-C Tank Farm.
UPR-200-E-53	At the south end of a waste trench in the 200 East Burial Ground 218-E-1	October 17, 1978	218-E-1 Burial Ground	• Beta/gamma with readings to 150 mR/h. • During a burial operation, contamination was spread by uncovering previously buried waste.
UPR-200-E-59	The eaves of the 244-AR Vault and the walls of the 216-A-40 Trench	May 23, 1979	244-AR Vault 216-A-40 Trench	• Contaminated mud containing ^{137}Cs and ^{60}Co with readings of 10,000 to 20,000 ct/min. • Contaminated mud and tumbleweeds from the 216-A-40 Trench were used by swallows to build nests at the 244-AR Vault. • The nests were removed from the 244-AR Vault. The tumbleweeds were removed from 216-A-40 Trench, packaged, and placed in the burial ground. The sides of the 216-A-40 Trench were washed and the contaminated mud removed.
UPR-200-E-66	The 216-A-42 Retention Basin and immediate vicinity	November 7, 1984	216-A-42 Retention Basin	• The contamination consists of unknown beta/gamma, with readings inside the area to 40,000 ct/min and outside to 3,000 ct/min. • The wind spread contamination from the 216-A-42 Retention Basin. • The ground was wet down and the basin flushed.

Table 2-6. Summary of Unplanned Releases. (sheet 14 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-70	Around the 244-A Lift Station	October 15, 1984	244-A Lift Station	• The contamination consisted of unknown beta/gamma with readings of 1,000 to 50,000 ct/min and an isolated area at 100,000 ct/min. • The contamination spread during a jumper removal at the lift station. • There is no release potential; radiation contamination was removed to background levels. • The area was decontaminated to background radiation levels and stabilized.
UPR-200-E-106	200-E Burning Pit	September 5, 1946	200-E Burning Pit	• Contaminated paper towels. The radiation level was measured to be as high as 2.5 rep/h. • Considerable contamination has been found at the burning ground.
UPR-200-E-115	The ground adjacent to the 241-AX-103 Pump Pit in the 241-AX Tank Farm	February 12, 1974	241-AX-103 Pump Pit	• Beta/gamma with readings to 2,000 mR/h. • During bleeding of air from a line, air flowed up (instead of down), causing contaminated liquid to spray on 2 employees and the ground in an area within the 241-AX Tank Farm.
UPR-200-E-119	Next to 241-AX-104 Single-Shell Tank	December 22, 1969	241-AX-104 Single-Shell Tank	• High-level waste. • An employee mistakenly pulled 4.6 m (15 ft) of a contaminated electrode cable out of tank 241-AX-104 Single-Shell Tank and set it on the ground. He then removed his contaminated gloves and set them on the ground. Contamination was limited to a small area near the 241-AX-104 Single-Shell Tank, the employee, and the change house.

Table 2-6. Summary of Unplanned Releases. (sheet 15 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-125	The 241-A-104 Single-Shell Tank and soil beneath	May 1975	241-A-104 Single-Shell Tank	• 9,463 L (2,500 gal) of waste from the 241-A-104 Single-Shell Tank containing 18,000 Ci of ^{137}Cs with readings to 6,450 ct/min. • 241-A-104 Single-Shell Tank was classified a "Confirmed Leaker" on April 16, 1975. The basis for declaration of status was leak detection lateral indications of increasing radiation at several locations beneath the tank. • The tank was pumped down to a sludge heel.
UPR-200-E-126	The 241-A-105 Single-Shell Tank and soil beneath	1963	241-A-105 Single-Shell Tank	• 18,925 L (5,000 gal) of waste from the 241-A-105 Single-Shell Tank. • The 241-A-105 Single-Shell Tank was suspected of leaking and was taken out of service in December 1963 but was immediately put back into service. Soon after when the tank was filled there was a sudden steam release of severe intensity. It was determined that the liner had bulged to maximum elevation of 2.6 m (8.5 ft) creating a void space of 302,800 L (80,000 gal). • The tank was pumped to a residual liquid heel. 3,785 L (1,000 gal) of water were applied weekly to prevent sludge from overheating.
UPR-200-E-136	The 241-C-101 Single-Shell Tank and soil beneath	1946-1970	241-C-101 Single-Shell Tank	• 64,345 to 90,840 L (17,000 to 24,000 gal) of waste from the 241-C-101 Tank containing 2,000 Ci. • Because of a liquid level decrease, 241-C-104 Single-Shell Tank was categorized "Questionable Integrity" in 1970. • The tank was pumped to a minimum heel (112 cm, 44 in.) in December 1969, and a salt well system was installed.

Table 2-6. Summary of Unplanned Releases. (sheet 16 of 16)

Unplanned Release No.	Location	Date	Associated Waste Management Unit	Reported Waste-Related History
UPR-200-E-137	The 241-C-203 Single-Shell Tank and soil beneath	1947-1977	241-C-203 Single-Shell Tank	• 1,514 L (400 gal) of PUREX high-level waste from the 241-C-203 Single-Shell Tank. • Over a period of 2 to 3 years, natural water apparently entered the tank, migrated through the salt cake, and either became entrained in the salt cake or leaked out. • The tank was stabilized and isolated in 1982.

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

Process	Waste Generated	Major Chemical Constituents	Ionic Strength	pH	Organic Concentration	Radioactivity
Plutonium Uranium Extraction (PUREX 202-A Building)	Process Waste	Nitric acid Tributyl phosphate Bismuth phosphate Paraffin hydrocarbon	High	Acidic (neutralized before disposal)	Low	High
	Wastewater	Nitrates	Low	Acidic to neutral/ basic	Low	Low
Waste Reduction (242 Evaporator)	Cooling water	Beta Activity Cadmium Copper Potassium Sodium Nitrate	Unknown	Basic	Low	Low
Tank Farm Condensate (241-A-431 Building)	Wastewater	Unknown	Low	Neutral/basic	Low	Low

Table 2-8. Chemicals Used or Produced in Separation/Recovery Processes.

RADIONUCLIDES

Actinium-225
Actinium-227
Americium-241
Americium-242
Americium-242m
Americium-243
Antimony-126
Antimony-126m
Astitine-217
Barium-135m
Barium-137m
Beryllium-7
Bismuth-210
Bismuth-211
Bismuth-213
Bismuth-214
Carbon-14
Cerium-141
Cerium-144
Cesium-134
Cesium-135
Cesium-137
Cobalt-58
Cobalt-60
Curium-242
Curium-244
Curium-245
Europium-152
Europium-154
Europium-155
Francium-221
Francium-223
Iodine-129
Lead 211
Lead 210
Lead-209
Lead-212
Lead-214
Manganese-54
Neptunium-237
Neptunium-239
Nickel 63
Nickel-59
Niobium-93m
Palladium-107
Plutonium-238
Plutonium-239/240
Plutonium-241
Polonium-210
Polonium-213
Polonium-214
Polonium-215
Polonium-218
Potassium-40
Promethium-147
Protactinium-231
Protactinium-233
Protactinium-234m
Radium
Radium-223
Radium-225
Radium-226
Ruthenium-103
Ruthenium-106
Samarium-151
Selenium-79
Strontium-90
Technetium-99
Thallium-207
Thallium-208
Thorium-227
Thorium-229
Thorium-230
Thorium-231
Thorium-233
Thorium-234
Tin-113
Tin-126
Tritium
Uranium-233
Uranium-234
Uranium-235
Uranium-238
Yttrium-90
Zinc-65
Zirconium-93
Zirconium-95

INORGANIC CHEMICALS

Aluminum
Aluminum nitrate nonahydrate
Aluminum nitrate (mono basic)
Ammonium fluoride
Ammonium nitrate
Beryllium
Cadmium nitrate
Ferric nitrate
Ferrous sulfamate
Hydrazine
Hydroxylamine nitrate
Iron
Lead nitrate
Mercuric nitrate
Nickel nitrate
Nitric acid
Phosphoric acid
Potassium fluoride
Potassium hydroxide
Potassium permanganate
Silicon
Silver nitrate
Sodium carbonate
Sodium ferrocyanide
Sodium fluoride
Sodium hydroxide
Sodium nitrate
Sodium nitrite
Sodium sulfate
Sodium thiosulfate
Sulfamic acid
Sulfuric acid
Zirconium

ORGANIC CHEMICALS

Acetic acid
Dibutyl butyl phosphonate
Formaldehyde (solution)
Hydroxyacetic acid
Normal paraffin hydrocarbon
Oxalic acid
Sugar
Tartaric acid
Tributyl phosphate
Trichloroethane
Tri-n-dodecylamine

Table 2-9. Partial List of Chemicals Used in the 202-A Building Laboratory.

Compound Name	Formula
Acetone	$CH_3C_2OH_3$
Carbon Tetrachloride	CCl_4
Ceric Fluoride	CeF_4
Ceric Sulfate	$Ce(SO_4)_2$
Ferrous Sulfate	$FeSO_4$
Hydrobromic Acid	HBr
Hydrochloric Acid	HCl
Hydrogen Peroxide	H_2O_2
Hydroxylamine Hydrochloride	NH_2OH HCl
Isopropyl Alcohol	C_3H_7OH
Lanthanum Fluoride	LAF_3
Lanthanum Hydroxide	$LA(OH_3)$
Lanthanum Nitrate	LA $(NO_3)_3$
Magnesium	Mg
Nitric Acid	HNO_3
Periodic Acid	HIO_4
Phosphorous Pentoxide	P_2O_5
Potassium Oxalate	$K_2C_2O_4$
Potassium Permanganate	$KMnO_4$
Silver Nitrate	$AgNO_3$
Sodium Bisulfate	$NaHSO_4$ H_2O
Sodium Bromate	$NaBrO_3$
Sodium Carbonate	Na_2CO_3
Sodium Fluoride	NaF
Sodium Hydroxide	NaOH
Sodium Nitrate	$NaNO_3$
Sulfuric Acid	H_2SO_4
Thenoyltrifluoroacetone	$(CH)_3SCOCH_2COCF_3$
Zirconyl Phosphate	$ZrOPO_4$

Source: Klem 1990

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Table 2-10. Radionuclides and Chemicals Disposed of to PUREX Plant Aggregate Area Waste Management Units. (sheet 1 of 2)

RADIONUCLIDES		
Actinium-225	Plutonium-239/240	Ammonium nitrate
Actinium-227	Plutonium-241	Arsenic
Americium-241	Polonium-210	Barium
Americium-242	Polonium-213	Beryllium
Americium-242m	Polonium-214	Bismuth
Americium-243	Polonium-215	Bismuth phosphate
Antimony-126	Polonium-218	Boron
Antimony-126m	Potassium-40	Cadmium
Astitine-217	Promethium-147	Cadmium nitrate
Barium-135m	Protactinium-231	Calcium
Barium-137m	Protactinium-233	Carbonate
Beryllium-7	Protactinium-234m	Cerium
Bismuth-210	Radium	Chloride
Bismuth-211	Radium-223	Chromium
Bismuth-213	Radium-225	Copper
Bismuth-214	Radium-226	Cyanide
Carbon-14	Ruthenium-103	Ferric cyanide
Cerium-141	Ruthenium-106	Ferric nitrate
Cerium-144	Samarium-151	Ferrous sulfamate
Cesium-134	Selenium-79	Fluoride
Cesium-135	Strontium-90	Gold
Cesium-137	Technetium-99	Hydrazine
Cobalt-58	Thallium-207	Hydrogen peroxide
Cobalt-60	Thallium-208	Hydroxide
Curium-242	Thorium-227	Hydroxylamine nitrate
Curium-244	Thorium-229	Iron
Curium-245	Thorium-230	Lanthanum
Europium-152	Thorium-231	Lead
Europium-154	Thorium-233	Magnesium
Europium-155	Thorium-234	Manganese
Francium-221	Tin-113	Mercury
Francium-223	Tin-126	Nickel
Iodine-129	Tritium	Nitrate
Lead-211	Uranium-233	Nitric acid
Lead-210	Uranium-234	Nitrite
Lead-209	Uranium-235	Phosphate
Lead-212	Uranium-238	Potassium
Lead-214	Yttrium-90	Potassium fluoride
Manganese-54	Zinc-65	Potassium hydroxide
Neptunium-237	Zirconium-93	Potassium permanganate
Neptunium-239	Zirconium-95	Selenium
Nickel 63		Selenium tetroxide
Nickel-59	INORGANIC CHEMICALS	Silicon trioxide
Niobium-93m		Silver
Palladium-107	Aluminum	Silver nitrate
Plutonium-238	Aluminum nitrate	Sodium
	Ammonium carbonate	Sodium carbonate
	Ammonium fluoride	Sodium dichromate

Table 2-10. Radionuclides and Chemicals Disposed of to PUREX Plant Aggregate Area Waste Management Units. (sheet 2 of 2)

INORGANIC CHEMICALS (Cont.)
Sodium nitrate
Sodium nitrite
Sodium thiosulfate
Strontium
Sulfamic acid
Sulfate
Sulfuric acid
Tin
Tungsten tetroxide
Uranium
Vanadium
Zinc
Zirconium oxide
ORGANIC CHEMICALS
Acetone
Chloroform
Citrate
Ethylene diamine tetraacetate (EDTA)
Gylcolate
Methylene chloride
N-(2-hydroxyethyl) ethylenediaminetriacetate (HEDTA)
Oxalate
Oxalic acid
Paraffin hydrocarbons
Sugar (sucrose)
Tartaric acid
Toluene
Tributyl phosphate
Other degradation products

Table 2-11. Radiation Area Remedial Action Units in the PUREX Plant Aggregate Area.

Waste Management Unit	Type	Operable Unit
200-E Burning Pit	Burning Pit	200-PO-6
216-A-1	Crib	200-PO-5
216-A-2	Crib	200-PO-2
216-A-3	Crib	200-PO-1
216-A-4	Crib	200-PO-2
216-A-5	Crib	200-PO-2
216-A-6	Crib	200-PO-4
216-A-7	Crib	200-PO-5
216-A-9	Crib	200-PO-1
216-A-10	Crib	200-PO-2
216-A-11	French Drain	200-PO-1
216-A-12	French Drain	200-PO-1
216-A-13	French Drain	200-PO-1
216-A-14	French Drain	200-PO-1
216-A-15	French Drain	200-PO-2
216-A-16	French Drain	200-PO-5
216-A-17	French Drain	200-PO-5
216-A-18	Trench	200-PO-5
216-A-19	Trench	200-PO-5
216-A-20	Trench	200-PO-5
216-A-21	Crib	200-PO-2
216-A-22	French Drain	200-PO-1
216-A-23A	French Drain	200-PO-5
216-A-23B	French Drain	200-PO-5
216-A-24	Crib	200-PO-5
216-A-26A	French Drain	200-PO-1
216-A-27	Crib	200-PO-2
216-A-28	French Drain	200-PO-1
216-A-31	Crib	200-PO-2
216-A-32	Crib	200-PO-1
216-A-33	French Drain	200-PO-1
216-A-34	Ditch	200-PO-5
216-A-35	French Drain	200-PO-1
216-A-36A	Crib	200-PO-2
216-A-38-1	Crib	200-PO-2
216-A-39	Crib	200-PO-3
216-A-40	Trench	200-PO-1
216-A-41	Crib	200-PO-1
216-C-8	French Drain	200-PO-3
218-E-1	Burial Ground	200-PO-1
218-E-8	Burial Ground	200-PO-6
218-E-12A	Burial Ground	200-PO-6
218-E-13	Burial Ground	200-PO-1

Table 2-12. Waste Management Program Units in the PUREX Plant Aggregate Area.

Waste Management Unit	Type	Operable Unit
241-A-302A	Catch Tank	200-PO-1
241-A-350	Catch Tank	200-PO-3
241-A-417	Catch Tank	200-PO-3
241-AX-152CT	Catch Tank	200-PO-3
216-A-8	Crib	200-PO-5
216-A-30	Crib	200-PO-4
216-A-37-1	Crib	200-PO-4
216-A-37-2	Crib	200-PO-4
216-A-45	Crib	200-PO-2
216-A-26	French Drain	200-PO-1
216-A-29	Ditch	200-PO-5
241-A-A	Diversion Box	200-PO-3
241-A-B	Diversion Box	200-PO-3
241-A-151	Diversion Box	200-PO-1
241-AR-151	Diversion Box	200-PO-3
241-AX-A	Diversion Box	200-PO-3
241-AX-B	Diversion Box	200-PO-3
241-AX-151	Diversion Box	200-PO-3
241-AX-152DS	Diversion Box	200-PO-3
241-AX-155	Diversion Box	200-PO-3
241-ER-153	Diversion Box	200-PO-3
241-AX-501	Valve Pit	200-PO-3
207-A	Retention Basin	200-PO-5
216-A-42	Retention Basin	200-PO-4

3.0 SITE CONDITIONS

The following sections describe the physical nature and setting of the Hanford Site, the 200 East Area, and the PUREX 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; Lindsey 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 Hanford 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 PUREX Plant Aggregate Area ranges from approximately 219 m (720 ft) in the eastern part of the unit to about 197 m (647 ft) above msl in the western 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. The maximum 25 yr/24 h storm event has been calculated at 3.8 cm (1.5 in.) (Stone et al. 1983). The maximum 100 yr/24 h storm event is approximately 5 cm (2 in.). 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). During 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 PUREX 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 (USGS) gage below Priest Rapids Dam, and outflow is recorded below McNary Dam. Average annual flow at these recording stations is approximately 1.1×10^{11} m^3 (8.7×10^7 acre-ft) at the USGS gage and 1.6×10^{11} 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 3.1×10^7 m^3/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 (WPPSS) 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 PUREX Plant Aggregate Area Surface Hydrology

No natural surface water bodies exist in the PUREX Plant Aggregate Area which lays within the Columbia River drainage system. The only existing manmade surface water bodies are the 207-A Retention Basin and, until July 1991, the open stretches of the 216-A-29 Ditch. The 216-A-29 Ditch is located outside the perimeter fence, southeast of the southeast corner of the 241-A Tank Farm. The ditch empties into the 216-B-3-3 Ditch which, in turn, terminates at the main lobe of the 216-B-3 Pond. During July through September of 1991, the 216-A-29 Ditch was dramatically changed. The southern portion of the ditch, located within the Grout Treatment Facility (GTF), has been stabilized, filled to grade with gravel, surrounded with a light chain barricade, and posted with underground contamination placards. The section of the ditch north of the GTF has been cleared of vegetation and graded to a gentle side slope. Several gravel covered ridges cross the ditch. These discontinuous open portions of the ditch represent minor, if any, ponding and infiltration potential due to the nature of the soil that allows the entry of surface water into the ground. The 207-A Retention Basin presents no threat of flooding because the north cells discharge to the B Pond and the south cells are discharged to the 216-A-37-1 Crib.

The 200 East Area, and specifically the PUREX 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 1991b).

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).

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 Umptanum 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 volcaniclastic 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 km^2 (63,000 mi^2) in Washington, Oregon, and Idaho and

have an estimated volume of about 174,356 km^3 (40,800 mi^3) (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: volcaniclastics (Reidel and Fecht 1981; Smith et al. 1989), and siliciclastics (DOE 1988b). The volcaniclastics 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 Gable 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-gained 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 gniessic 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 PUREX Plant Aggregate Area Geology

The following subsections 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 PUREX 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 PUREX 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 PUREX Plant Aggregate Area were reviewed and a selection was made of the most relevant to the PUREX Plant Aggregate Area. Chamness et al. (1992) provides a compilation of a number of geologic logs from the PUREX Plant Aggregate Area and a listing of other logs which are available and additional geological, geochemical and geophysical, data available from these and other boreholes. The cross sections depict subsurface geology in the PUREX Plant Aggregate Area. For each cross-section, locations of PUREX Plant Aggregate Area waste management units are identified for reference. Figures 3-19 through 3-31 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 PUREX Plant Aggregate Area. The structure and isopach maps are included from Lindsey et al. (1992). Plate 1 should be consulted to identify locations of PUREX Plant Aggregate Area buildings and waste management units referenced in the text.

3.4.3.1 Elephant Mountain Basalt. The Elephant Mountain Member of the Saddle Mountains Basalt is continuous beneath most of the 200 East Area. At one location north of the 200 East Area, the Elephant Mountain Member is absent due to erosion by cataclysmic flooding, and the uppermost basalt encountered is the Pomona Member. Where the Elephant Mountain Member is absent the Rattlesnake Ridge Interbed, the sedimentary unit that commonly separates the Elephant Mountain and Pomona Members, is in direct contact with overlying suprabasalt sediments.

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 24 m (79 ft) in the south. 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. These strata are found throughout the southern two-thirds of the 200 East Area where it disconformably overlies basalt. The Ringold Formation is absent from the north-central part of the area where sediment of the overlying Hanford formation directly overlie basalt or sedimentary interbeds in the basalt. Ringold units B, C, and D are not found in the immediate vicinity 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 PUREX Plant Aggregate Area, the Ringold unit A is present throughout the area except in the northern portion near the 218-E-12B Burial Ground (Figures 3-19 and 3-20).

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 B 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 PUREX Plant Aggregate Area, the lower mud sequence is thickest in the GTF near the 216-A-30 Crib where the sequence reaches a thickness of approximately 15.2 m (50 ft). The lower mud sequence is absent just north of the southern corner of the 241-C Tank Farm (Figures 3-21 and 3-22).

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 3-12, 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 PUREX Plant Aggregate Area, the Ringold unit E is not present north of the 241-AX Tank Farm. The Ringold Unit E is found throughout the southern part of the PUREX Plant Aggregate Area and is thickest (34 m, 105 ft) near the 216-A-36B Crib (Figures 3-23, 3-24, and 3-25).

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 PUREX 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. The distribution of the facies types and similarities in lithologic succession across the 200 East Area indicates that the Hanford formation can be divided into three stratigraphic sequences which are designated as: (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 is 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 form 0 to 41 m (0 to 133 ft) thick and is found throughout most of the 200 East Area. In the northern portion of the PUREX Plant Aggregate Area the lower gravel sequence is not differentiated from the upper gravel sequence due to the absence of the sandy sequence which is used to distinguish the two gravel sequences from one another. The contact between the lower coarse sequence and the overlying sandy sequence is 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 PUREX Plant Aggregate Area the lower gravel sequence is thickest near the northeastern border near the 218-E-12B Burial Ground. In the center of the PUREX Plant Aggregate Area, near the 202-A Building and the 241-C Tank Farm, the lower gravel sequence is absent (Figures 3-26 and 3-27).

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 84 m (0 to 275 ft) thick. This sequence is dominated by the sand-dominated facies in the north, and the silt-dominated facies becomes more common towards the south. Gravels, occurring as single clasts and as interbeds are common in the sandy sequence, especially towards the north. 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 difficult to place. 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 PUREX Plant Aggregate Area, the thickness of the sequence ranges from 14 m (44 ft) near the northeast corner to 87 m (265 ft) near the 202-A Building (Figures 3-28 and 3-29).

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 55 m (180 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 gravel and lower gravel sequences are not differentiated in this area where the intervening sandy sequence is absent. In the PUREX Plant Aggregate Area the thickness of the upper gravel sequence ranges from approximately 8 m (25 ft) near the 216-A-45 Crib to 32 m (98 ft) in the northeast corner near the 218-E-12B Burial Ground (Figures 3-30 and 3-31).

3.4.3.6 Surficial Deposits. Surficial deposits in the 200 East Area are dominated by very fine- to medium-grained to occasionally silty eolian sheet 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 sheets (<3 m, 10 ft) that cover the ground. Longitudinal (southwest to northeast trending) dunes are well developed in the southern part of the 200 East Area. The Holocene-age 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 PUREX Plant Aggregate Area.

3.5 HYDROGEOLOGY

Regional hydrogeology and hydrogeology of the 200 East Area are summarized in the following sections. Where sufficient data exists, interpretations of the hydrogeology beneath the PUREX Plant Aggregate Area are presented. The information presented in these sections is principally taken from the standardized text (Delaney et al. 1991) provided by Westinghouse Hanford for this purpose.

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 volcaniclastic 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 3-32). 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) 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 and the Hanford formation.

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:

$$q = K(\theta) \times \partial\varphi/\partial\theta \times \partial\theta/\partial x \text{ (Richards' Equation)}$$

where

- $K(\theta)$ is the water-content-dependent unsaturated hydraulic conductivity in cm/s

- $\partial\varphi/\partial\theta$ 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 3-33 from Gee and Heller (1985) for an example)

- $\partial\theta/\partial x$ 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 et al. 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" soil, 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 3-33.

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 low 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 PUREX 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., saturated conditions 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 PUREX 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 (338 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 a generally unconfined water-bearing zone within the Ringold unit E. In the northern part of the PUREX Plant Aggregate Area the Ringold Formation has been eroded and the water-bearing zone is found within the Hanford formation. The lower part of the uppermost aquifer consists of a confined to semi-confined water-bearing zone within the gravelly sediments of Ringold unit A. The Ringold unit A is generally confined by fine-grained sediments of the lower mud sequence.

Due to 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 can be found 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 west of the 200 West Area, 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 (0 to 4 in/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 3-34. 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 km^2 (100 mi^2) 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 4,600,000 m^3/day (3,700 acre-ft/day) versus 1,200,000 m^3/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. Historically, much greater recharge occurred from a number of waste management units in the 200 Areas. Man-made recharge probably substantially exceeded 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). Generally, groundwater flow is from the west towards the east-southeast. Artificial recharge from the 216-B-3 Pond System in the neighboring B Plant Aggregate Area has produced a groundwater mound which has altered the hydraulic gradients and groundwater flow direction throughout the 200 East Area. The result of this flow convergence in the development of a large groundwater "saddle" beneath the 200 East Area. The overall effect of the "saddle" is that groundwater flow is partitioned in two primary directions: north through the Gable Gap area and southeast towards Richland. Locally, within the 200 East Area groundwater, flow direction is difficult to determine and can be variable due to extremely low hydraulic gradient and effects of variable discharges to the 216-B-3 Pond System.

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 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 3-35, a distinct groundwater mound

is still apparent east of the 200 East Area near the B Pond. The B Pond has caused the groundwater flow direction to change to a northwest-southeast flow pattern.

3.5.3 PUREX Plant Aggregate Area Hydrogeology

This section presents additional hydrogeologic information identified with specific application to the PUREX Plant Aggregate Area.

3.5.3.1 Hydrostratigraphy. As shown on Figure 3-36, the hydrostratigraphic units of concern beneath the PUREX 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 PUREX 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 PUREX 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 can be found in the 200 East Groundwater AAMSR.

3.5.3.1.1 Vadose Zone. The vadose zone beneath the PUREX Plant Aggregate Area ranges in thickness from about 104 m (317 ft) along the southern part of the eastern aggregate area boundary to 58 m (193 ft) in the vicinity of the 218-E-12B Burial Ground 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 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 PUREX 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 boarder of the U Plant Aggregate Area (Goodwin 1990). Because of the nearly identical stratigraphy, it is probable the PUREX 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 it is likely 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, because of the large quantity of liquid waste disposed of and the variability of grain size/stratigraphy and the occurrence of intercalated lenses, perched water zones are possible.

3.5.3.2 Natural Groundwater Recharge. As discussed in Section 3.3.3, no natural surface water bodies exist within the PUREX Plant Aggregate Area. Therefore, the potential for natural groundwater recharge within the PUREX Plant Aggregate Area is limited to precipitation infiltration. No precipitation infiltration data were identified with specific reference to the PUREX 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 (0 to 4 in./yr).

As suggested in Section 3.5.2.2, precipitation infiltration rates probably vary with respect to location within the PUREX Plant Aggregate Area. Higher infiltration rates are expected in unvegetated areas or areas with shallow rooting plants, in areas with gravelly soils exposed at the surface, and in areas where the topography is flat.

3.5.3.3 Groundwater Flow Beneath the PUREX Plant Aggregate Area. Within the PUREX Plant Aggregate Area, groundwater flow is generally toward the west, based on December 1990 Hanford wells groundwater elevation data (Kasza et al. 1990) (Figure 3-35). Flow is generally away from the groundwater mound located below the B Pond just east of the PUREX 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 PUREX Plant Aggregate Area.

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 x 10^{11} L (9.082×10^{10} gal) 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 (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 commode*), and prairie junegrass (*Koleria cristata*). Common and important herbaceous species include turpentine cymopteris (*Cymopteris terebinthinus*), globemallow (*Spheracea munroana*), balsamroot (*Basamorhiza careyana*), several milkvetch 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 area 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, Persistantsepal 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 (*Artemisia campestris spp. borealis*) 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 3-3 have been observed on the Hanford Site. The Columbia milkvetch (*Astragalus columbianus*) 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 (*Lomatium tubersoum*) 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 (*Carex densa*), shining flatsedge (*Cyperus rivularis*), southern mudwort (*Limosella acoulis*), and false pimpernel (*Lindernia anagallidea*) 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 (*Collinsia sparsiflora var. bruria*) may also occur in these habitats. The gray cryptantha (*Cyrptantha leucophaea*) occurs on open dunes throughout the Hanford Site. Piper's daisy (*Erigeron piperianus*) 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 (*Crypthantha interrupta*), and dwarf evening-primrose (*Oenothera pygmaea*) 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 (*Astragalus arractus*) and coyote tobacco (*Nicotiana attenuata*) 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, amphibians inhabiting the 200 Areas Plateau are discussed below.

3.6.1.3.1 Mammals. The largest mammal occurring on the 200 Areas 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 (Landeen 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 (*Tyranus virticalis*), 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 sparvarius*), 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 macroura*) 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*), rufflehead (*Bucephala albeola*) and great blue heron (*Ardea herodius*).

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 (*Phryosoma 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 erythroryhnchos*), 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 PUREX Plant Aggregate Area is the location of the 202-A Building and its attendant facilities and structures (242-A Evaporator, 244-AR Vault, etc.). Past activities at the 202-A Building and related facilities were mainly the extraction of uranium and plutonium from fuel rods. Other buildings within the aggregate area served mainly as storage or office space. Currently, the 202-A Building is on standby. Waste management units that remain active are noted on Figure 2-1, Operational and Waste-Related History. Access to the entire Hanford Site is administratively controlled and is expected to remain this way to ensure public health and safety and for reasons of national security.

3.6.3 Water Use

There is no consumptive use of groundwater within the PUREX Plant Aggregate Area. 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 an Arid Lands Ecology field station building near Rattlesnake Springs (Well 699-24-95) about 10 km (6 mi) west southwest of the 200 West Area; 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. There is one well, 299-E26-6, used by the 241-A Tank Farm as an emergency water supply for the tank farm vent cooling system. This well is located approximately 240 m (800 ft) north of the 241-A-701 Building. 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. Two wells for emergency cooling water supply are located near the B Plant and one well located near the 241-AY and 241-AZ Tank Farms in the 200 East Area.

3.7 HUMAN RESOURCES

The environmental conditions at the PUREX 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 PUREX Plant Aggregate Area. There are approximately 411,000 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 archaeologic survey has been conducted of undeveloped portions of the 200 East Area by the Hanford Cultural Resources Laboratory. Isolated artifacts and sites of interest were identified in the 200 East Area but not within the PUREX 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).

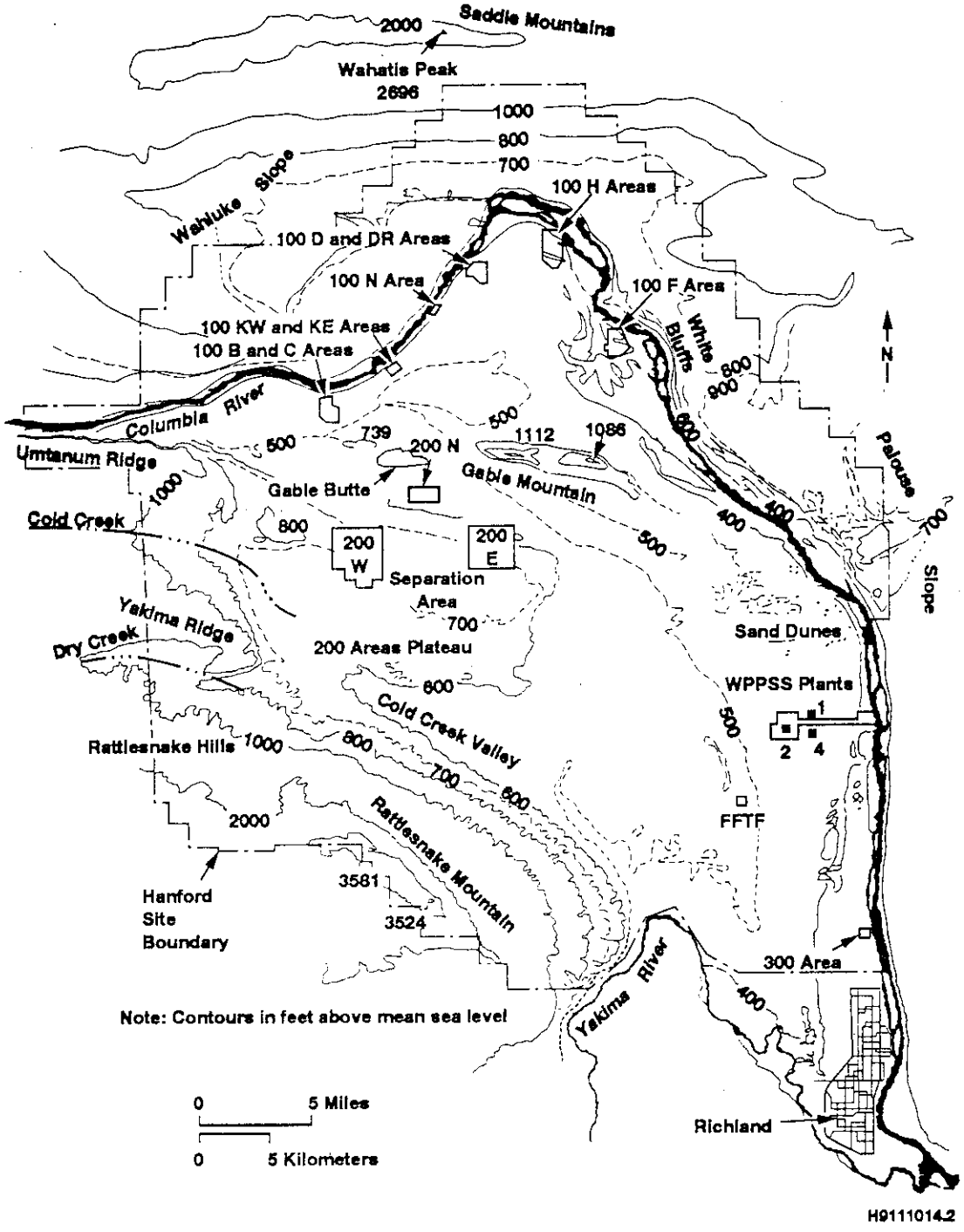
3.7.3 Historical Resources

The only historic site in 200 East Area is the old White Bluffs freight road which is located to the northwest. 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 PUREX 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.

Figure 3-1. Topography and Location Map for the Hanford Site.



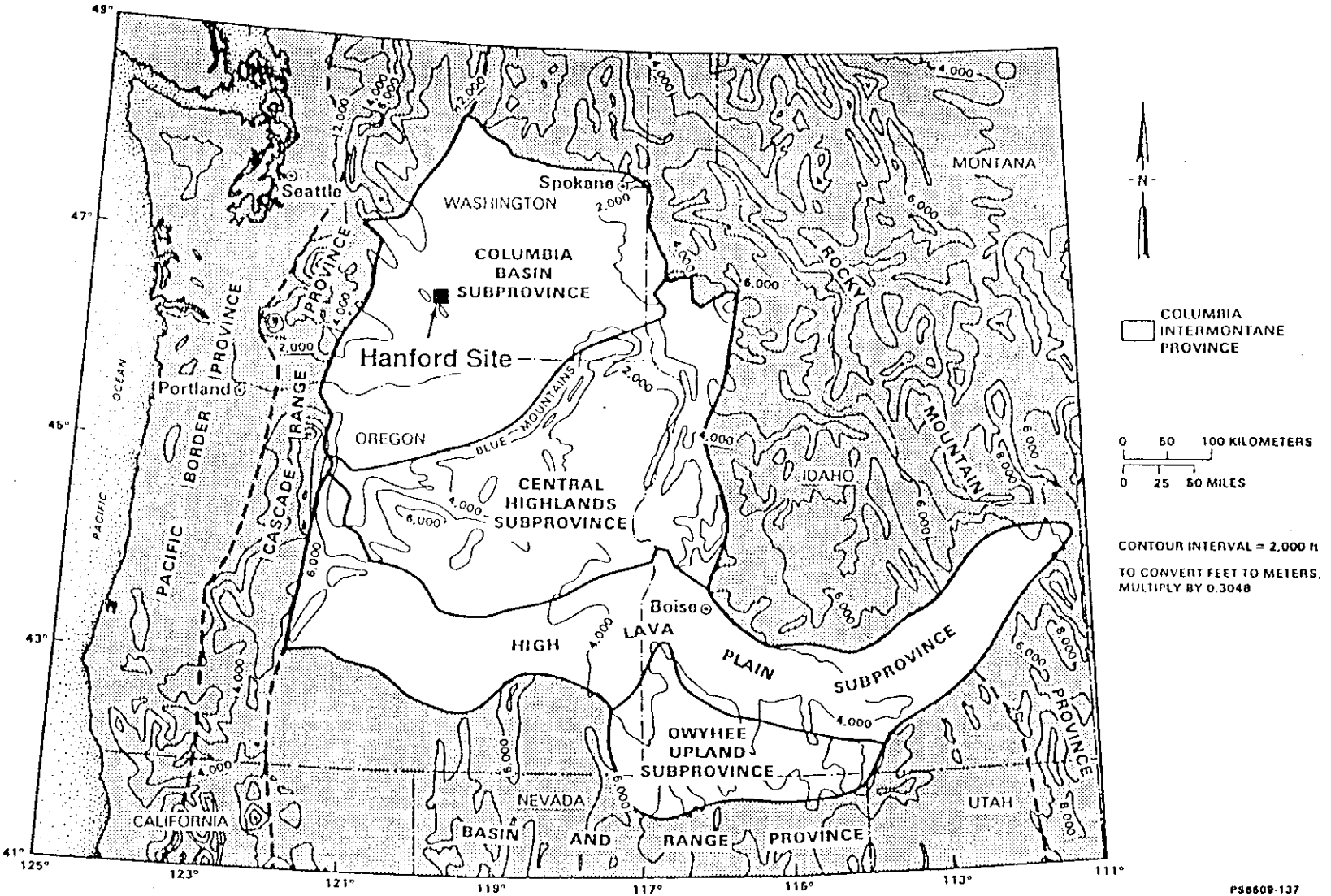


Figure 3-2. Divisions of the Columbia Intermontane Province and Adjacent Snake River Plains Province.

Figure 3-3. Geomorphic Units Within the Central Highlands and Columbia Basin Subprovinces that Contain the Columbia River Basalt Group.

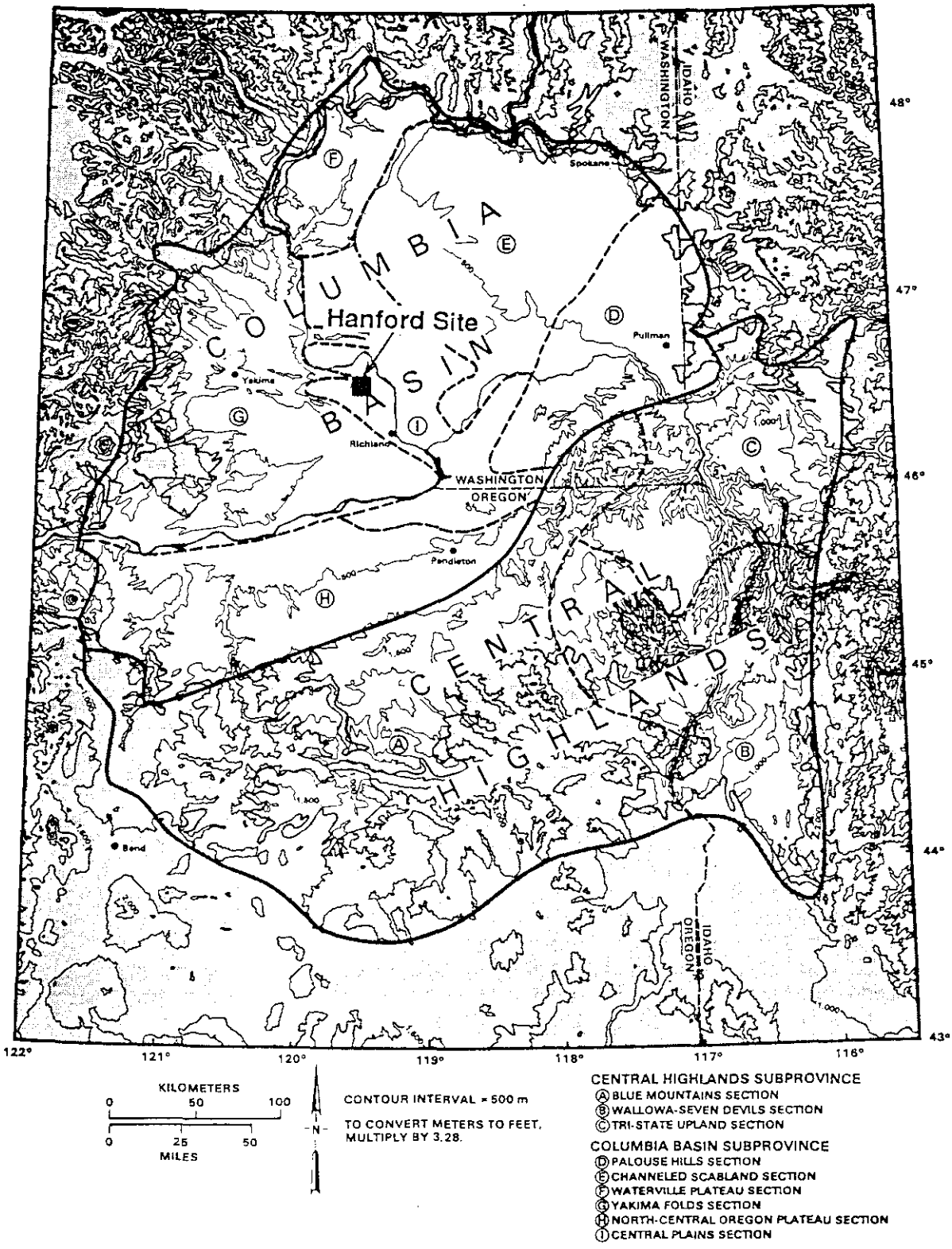


Figure 3-4. Landforms of the Pasco Basin and the Hanford Site.

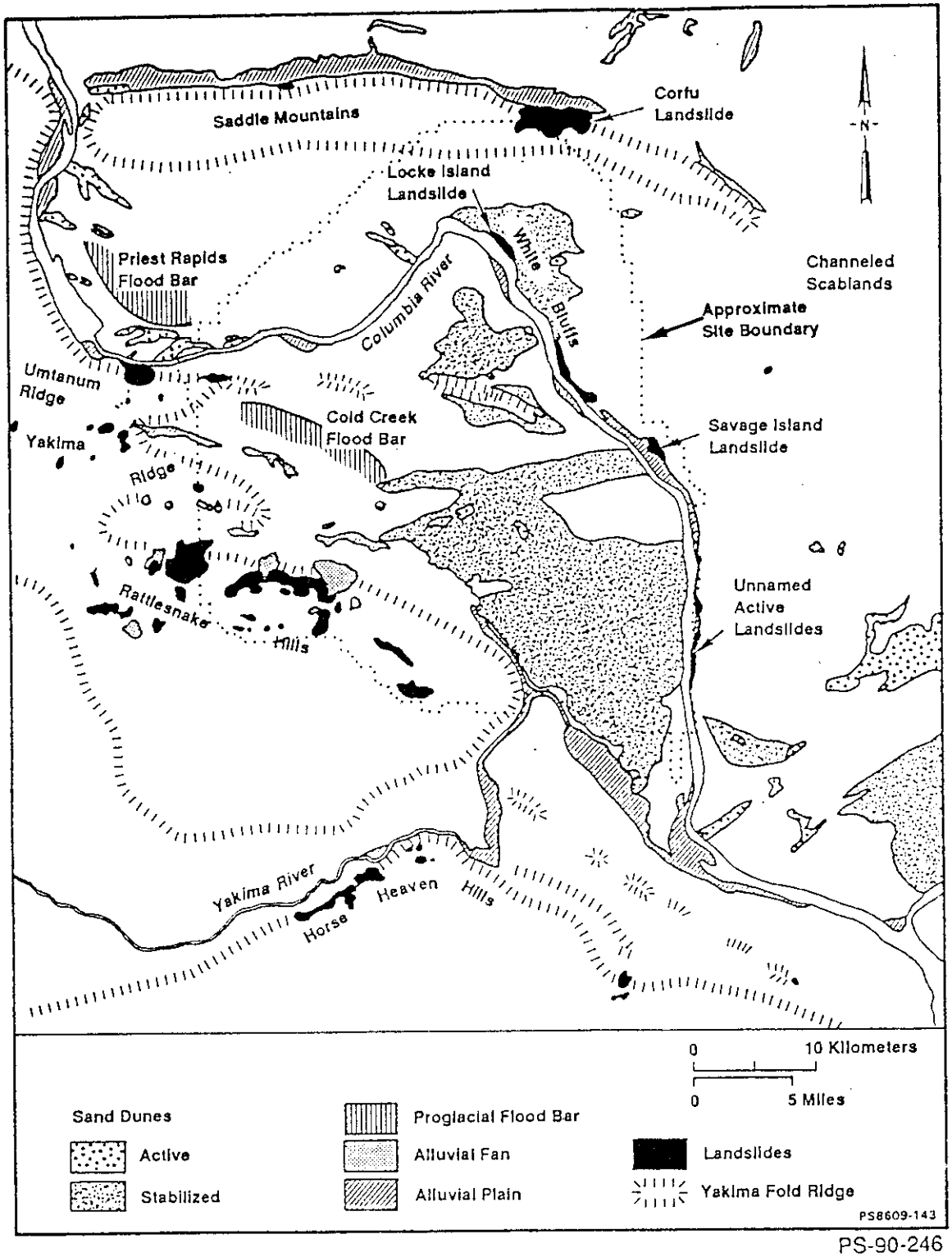


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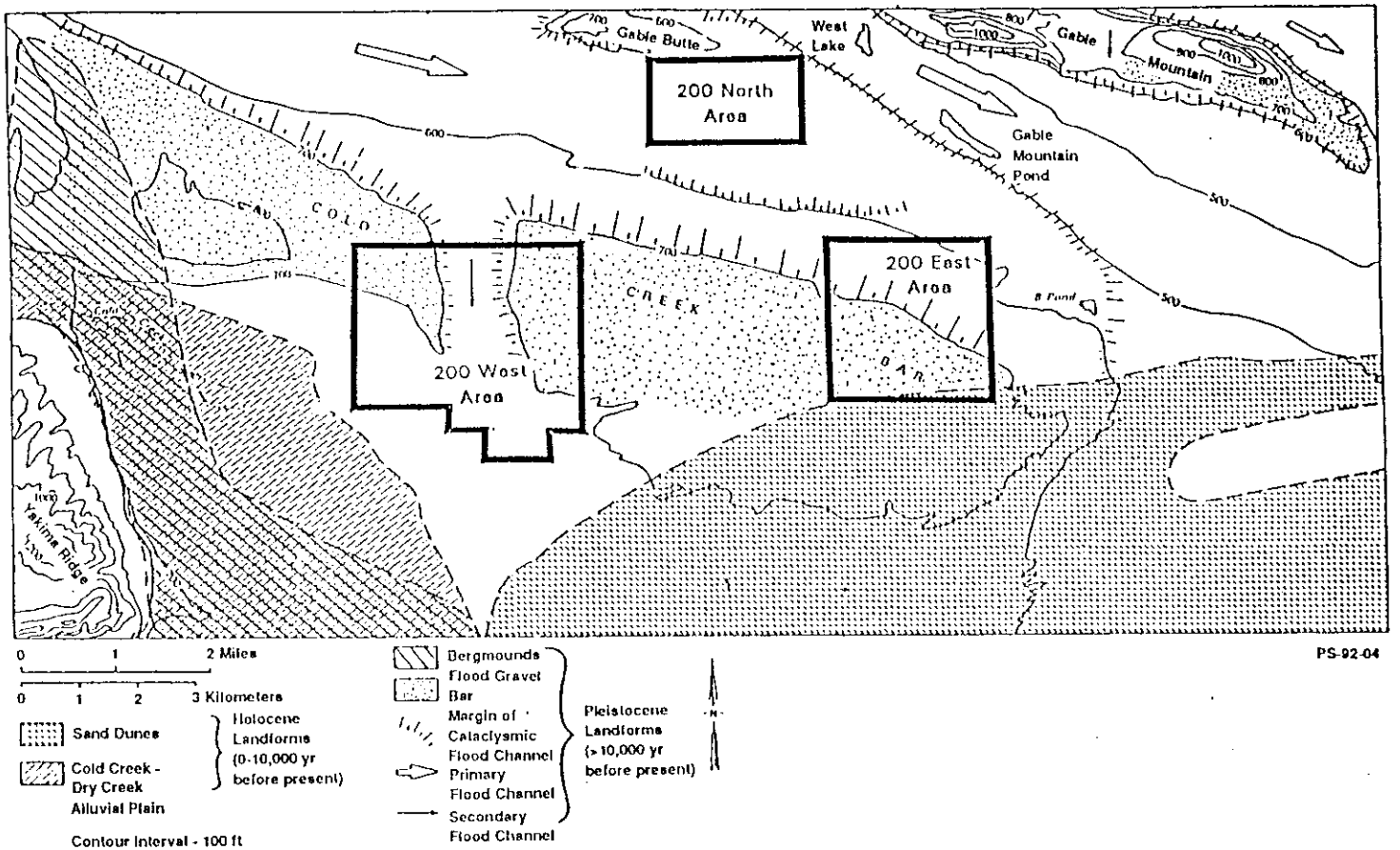
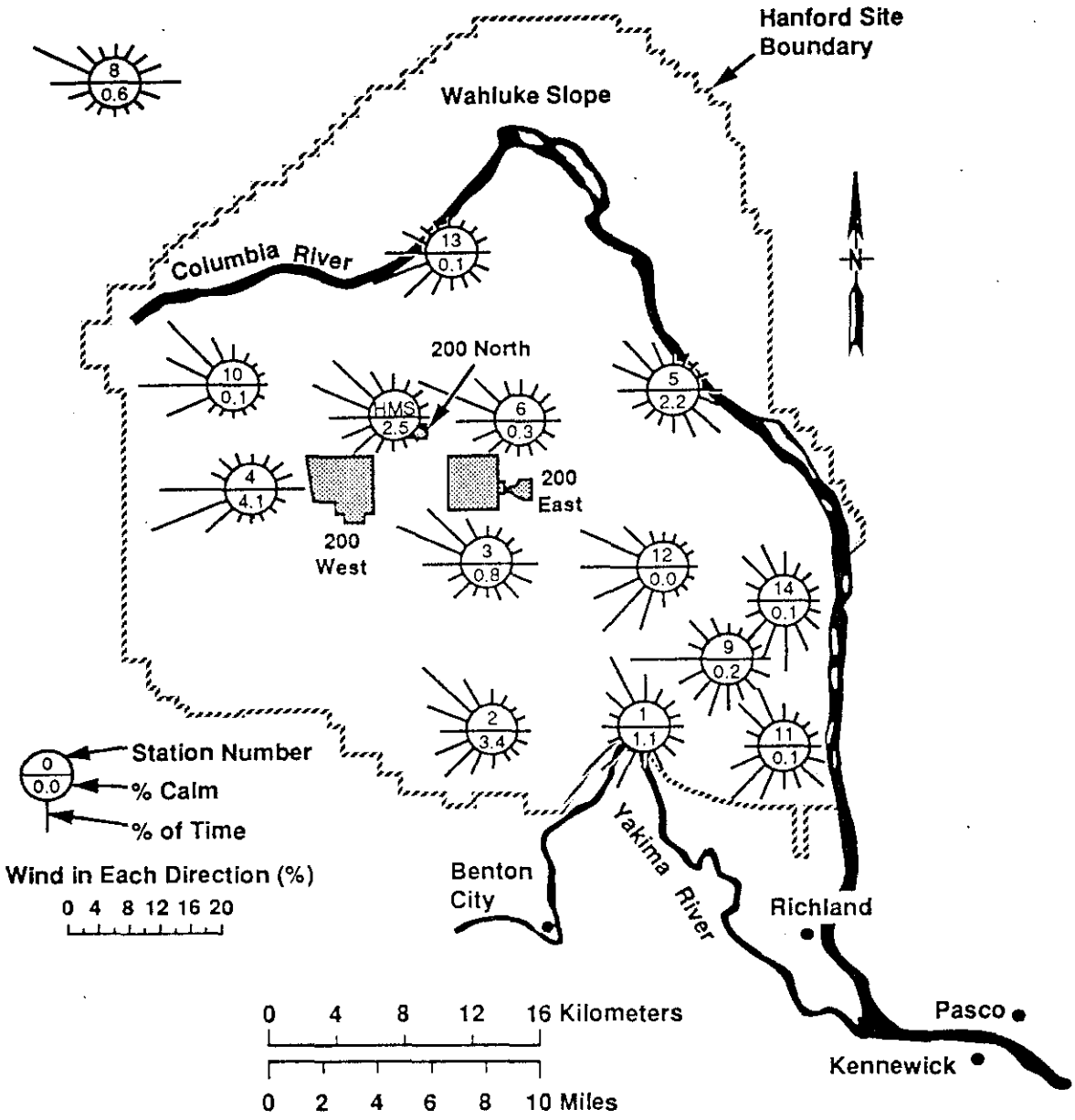
Figure 3-5. Geomorphic Features Surrounding the 200 Areas.



* Keyed features are specifically selected and do not encompass all features.

Figure 3-6. Hanford Site Wind Roses, 1979 through 1982.



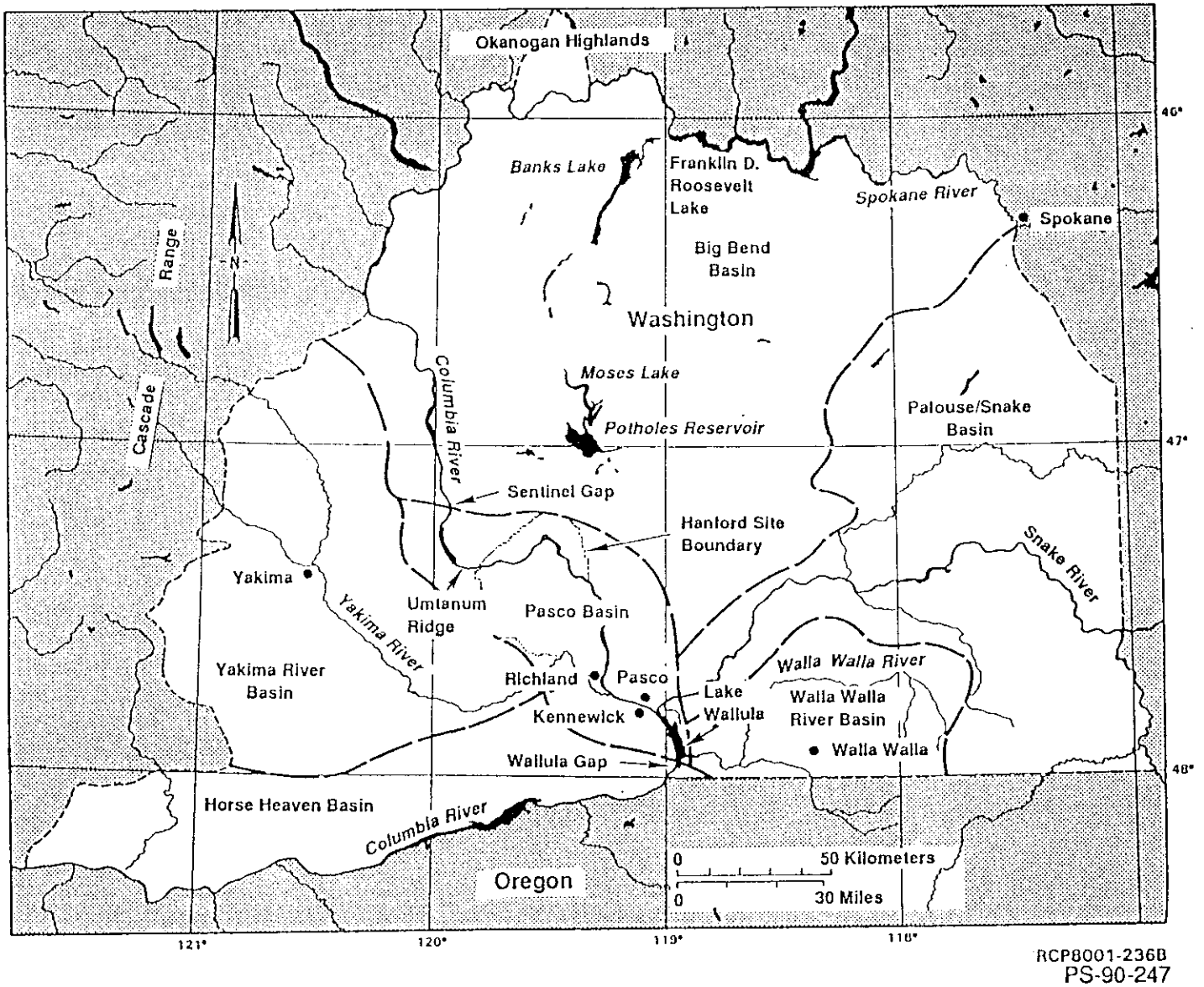
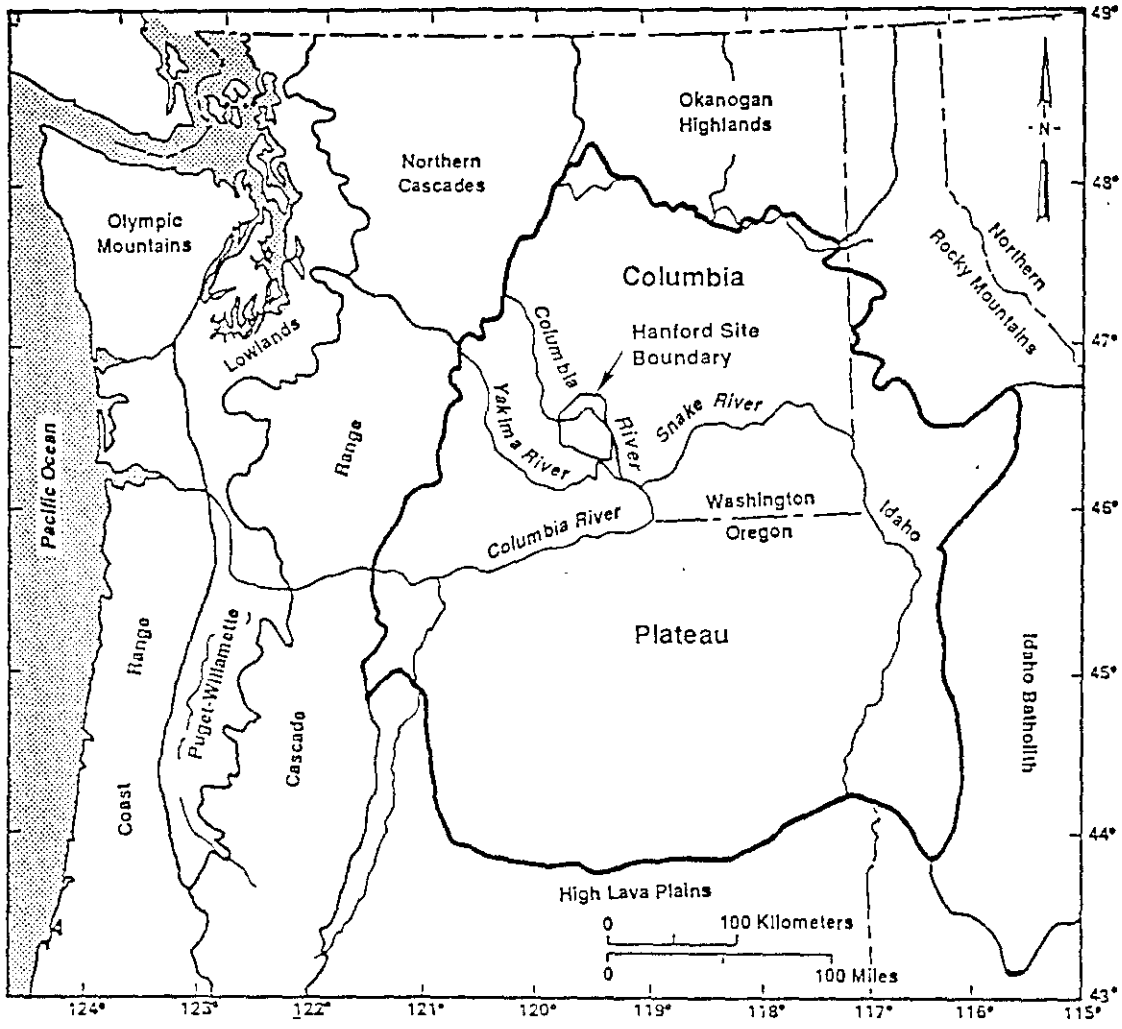


Figure 3-7. Hydrologic Basins Designated for the Washington State Portion of the Columbia Plateau.

Figure 3-8. Columbia Plateau and Surrounding Structural Provinces.



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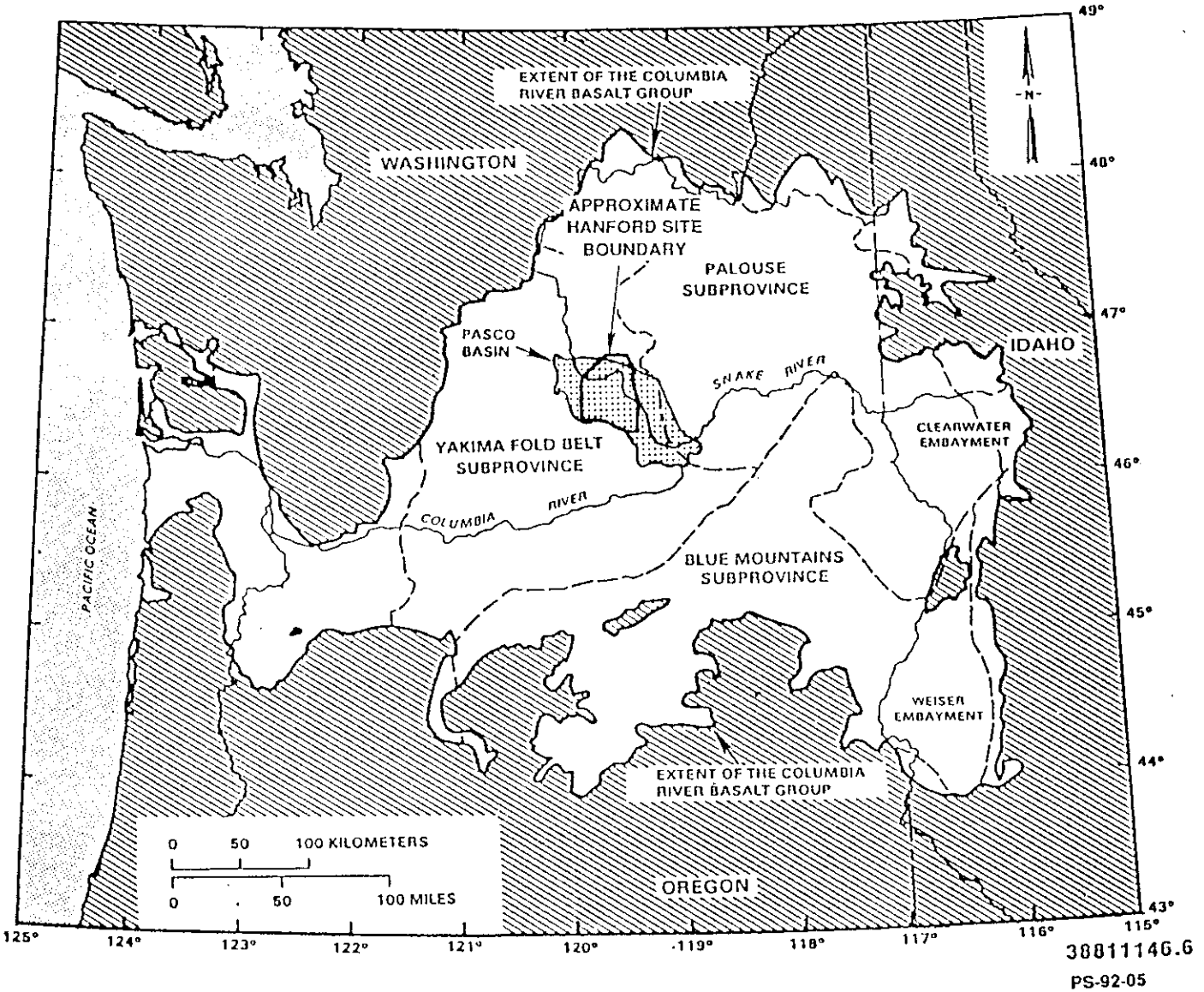


Figure 3-9. Structural Subprovinces of the Columbia Plateau.

Figure 3-10. Structural Elements of the Yakima Fold Belt Subprovince.

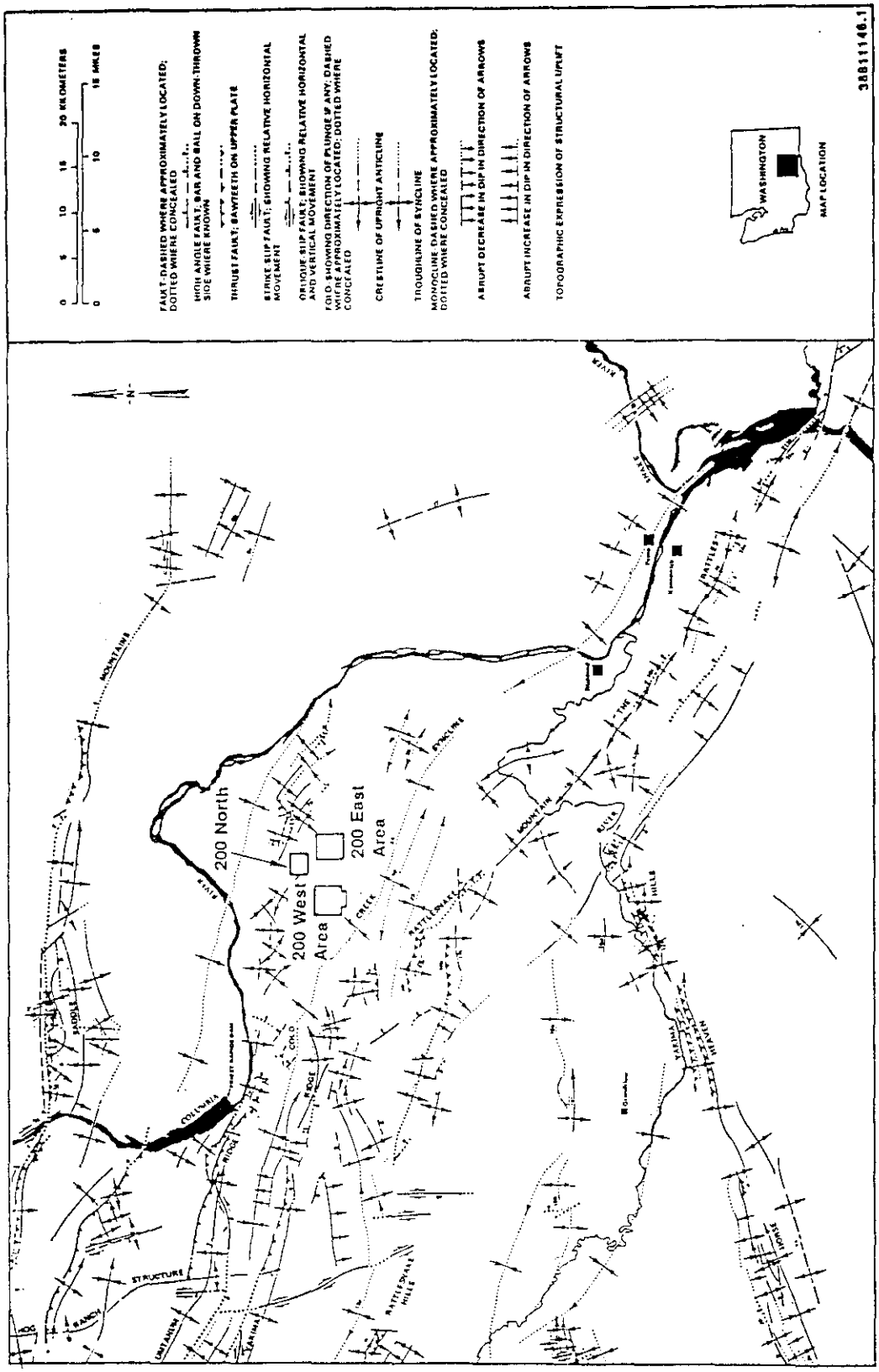


Figure 3-11. Geologic Structures of the Pasco Basin and the Hanford Site.

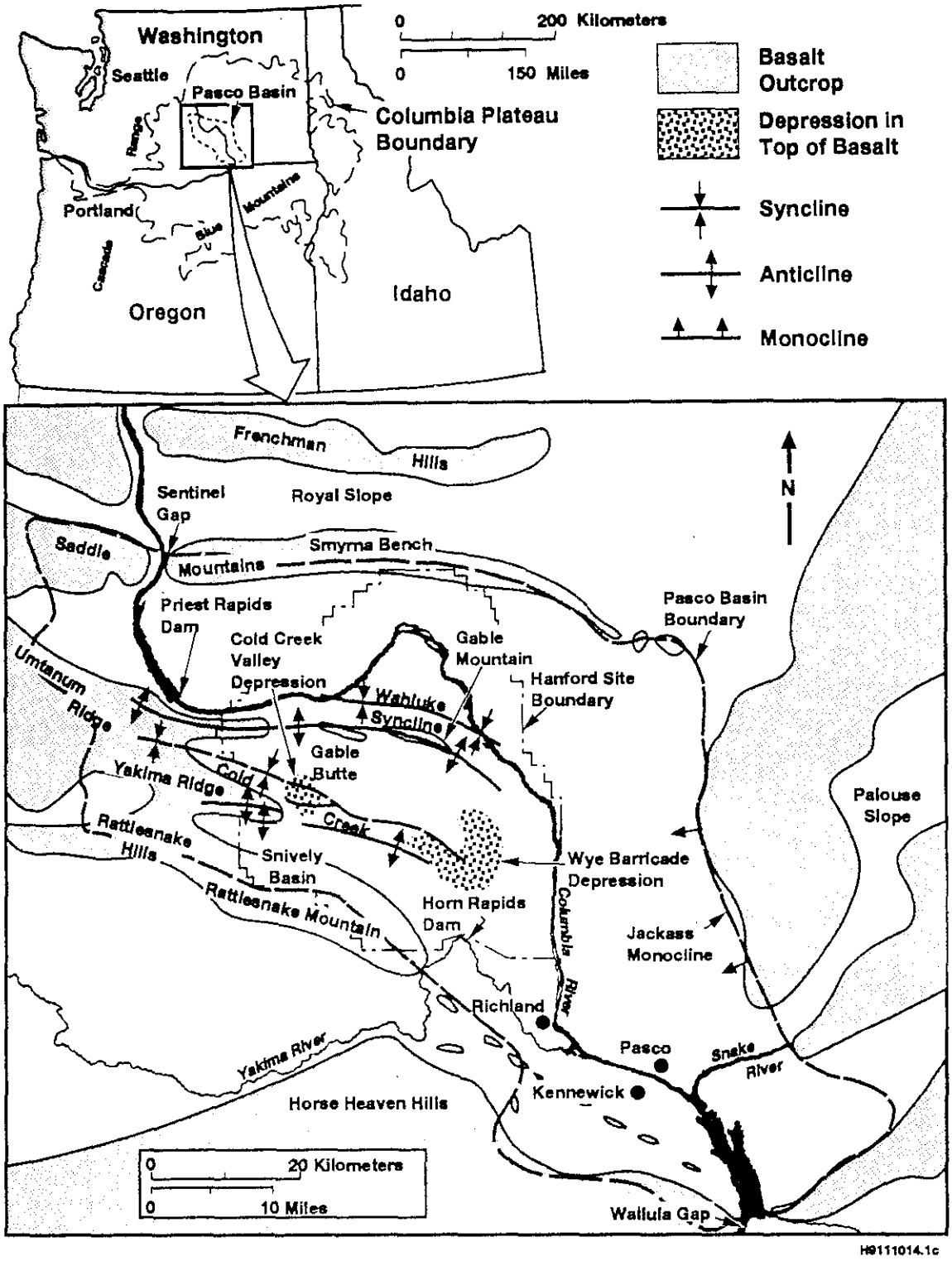
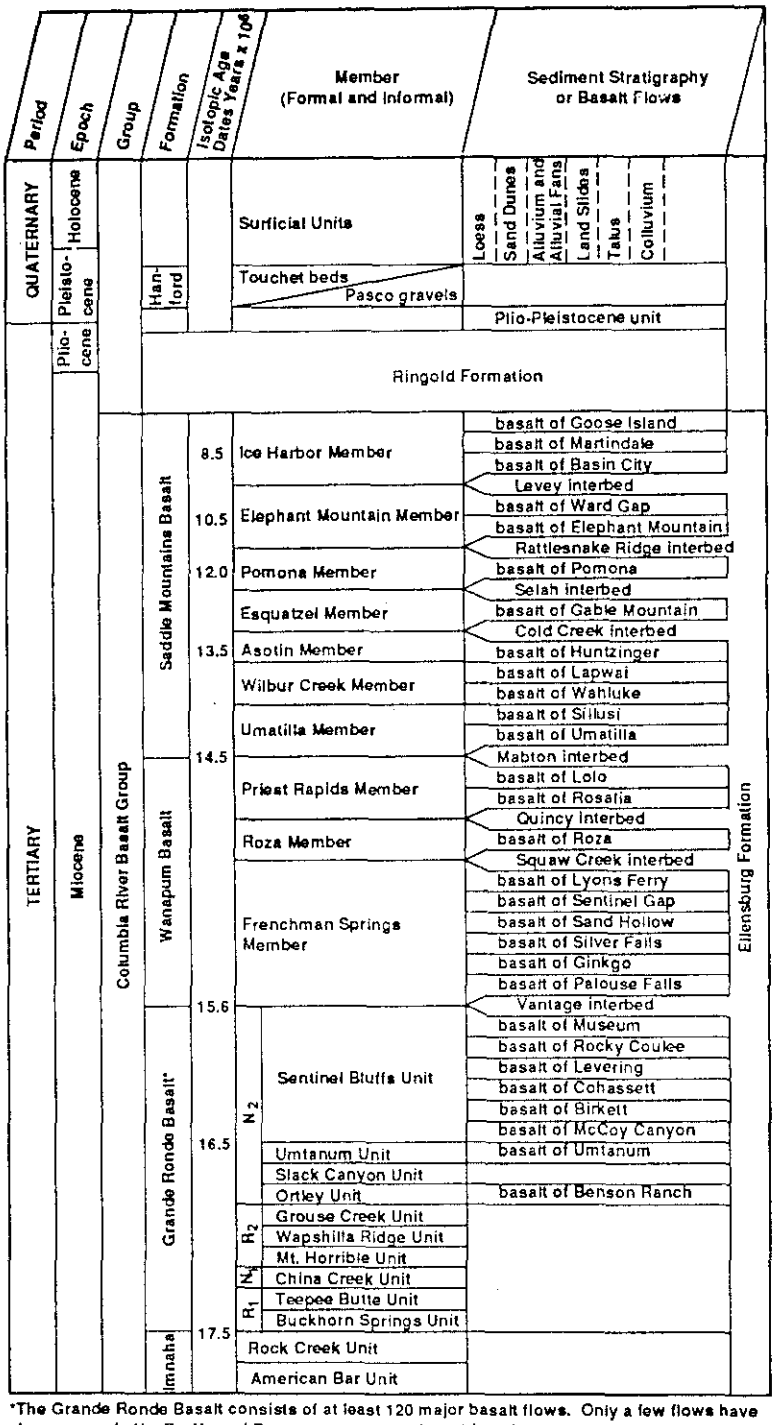


Figure 3-12. Generalized Stratigraphy of the Hanford Site.



*The Grande Ronde Basalt consists of at least 120 major basalt flows. Only a few flows have been named. N_2, R_2, N_1 and R_1 are magnetostratigraphic units.

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Figure 3-13. Generalized Stratigraphy of the Suprabasalt Sediments Beneath the Hanford Site.

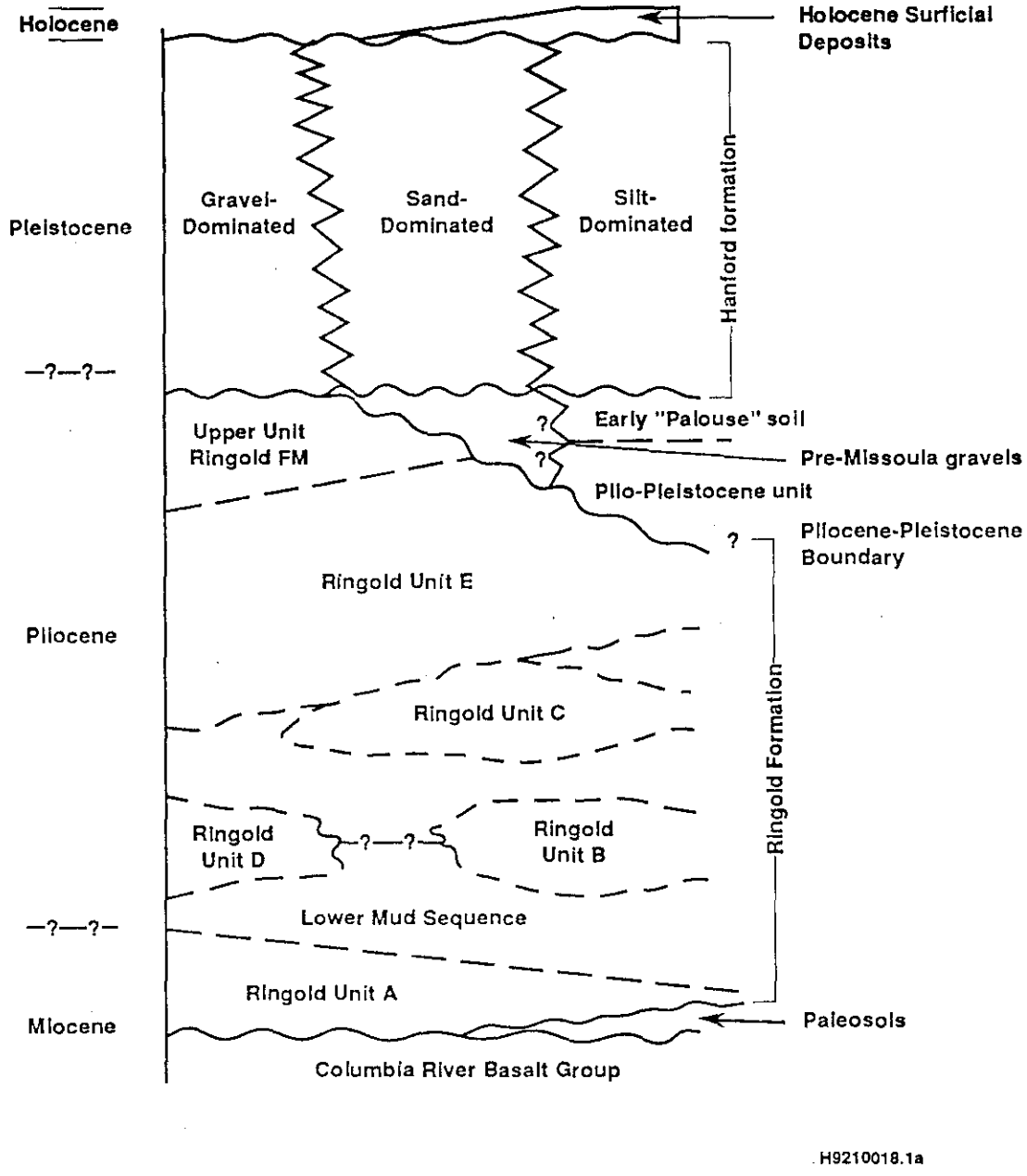

Figure 3-14. Location of 200 East Area Geologic Cross-Sections.

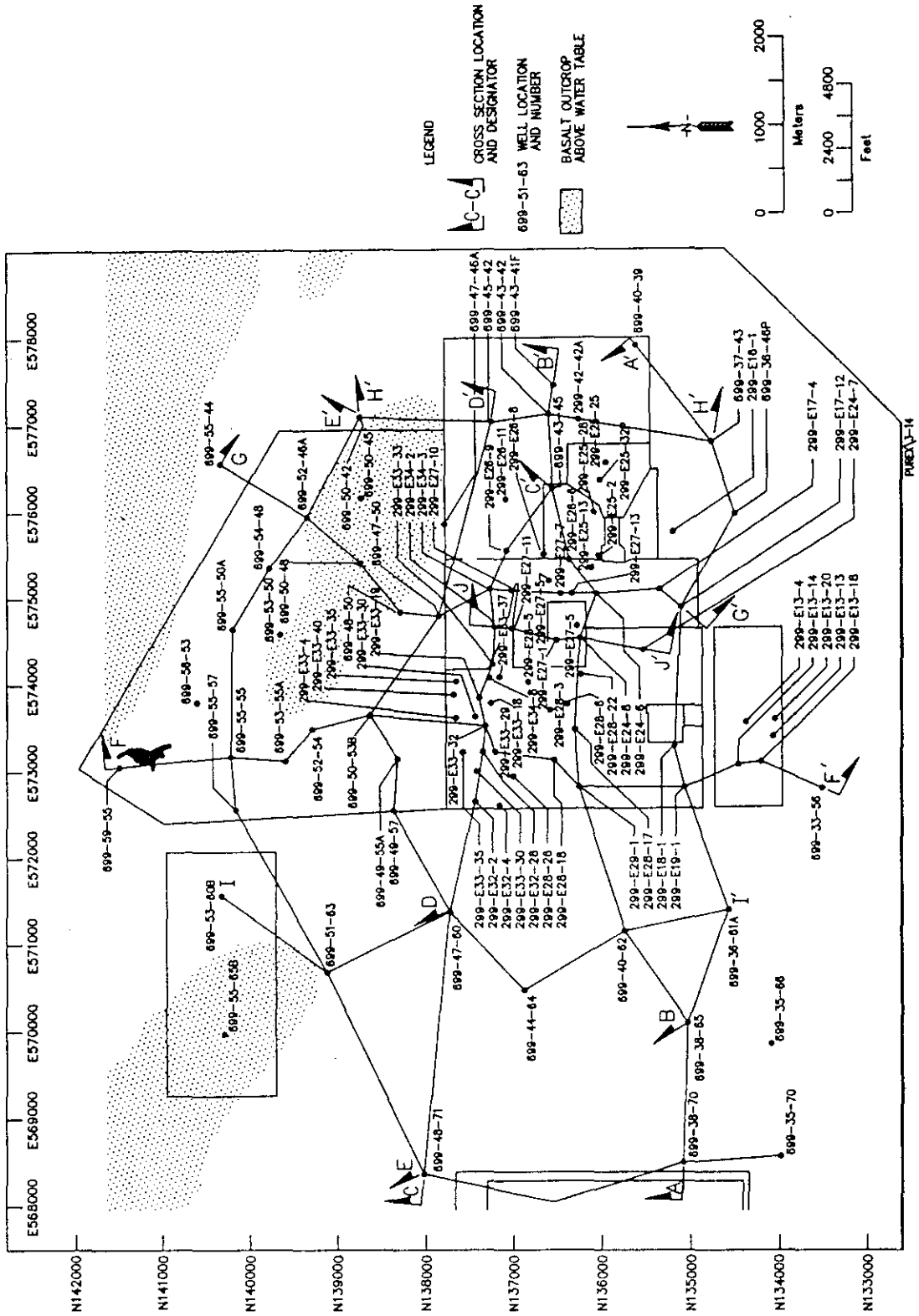

Figure 3-15. Legend for Cross-Sections.

UNIT ABREVIATIONS

Hug Hanford Upper Gravels
Hun Hanford Undifferentiated
H Hanford formation
Hc Upper Coarse Unit, Hanford formation
Hf Lower Fine Unit, Hanford formation
Hs Hanford Sands
Hlg Hanford Lower Gravels
EP Early "Palouse" Soil
PP Plio–Pleistocene Unit
UR Upper Unit, Ringold Formation
R Ringold Formation
E Gravel Unit E, Ringold Formation
LM Lower Mud Sequence, Ringold Formation
A Gravel Unit A, Ringold Formation
EM Elephant Mountain Member

SYMBOLS

—?——— Formational Contact, ? Where Inferred

— · —?— · — Unit Contact, ? Where Inferred

– – – – – Major Facies Contact

Pedogenic Calcium Carbonate

Paleosols

Ringold Clast Supported Gravels

Open Framework Hanford Gravels

Laminated Muds

Basalt

Blank portions of cross section well logs represent sediments (dominantly sand) which do not fit into sediment categories depicted by symbols listed above.

NOTES

1. Refer to Figure 3–14 for cross section locations and designation. Cross sections presented on Figures 3–16 through 3–18.

2. Figures based on Lindsey et al. 1991.

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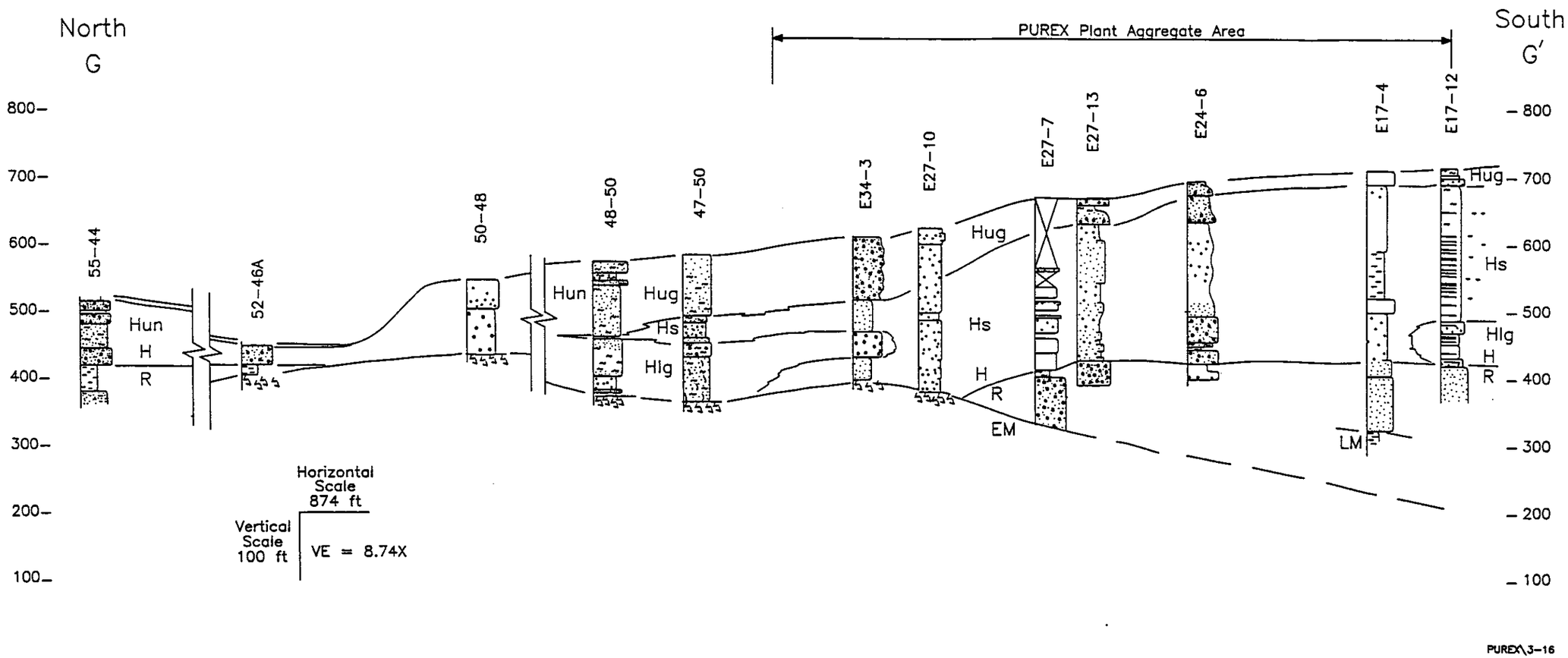

Figure 3-16. Geologic Cross-Section - G-G'.

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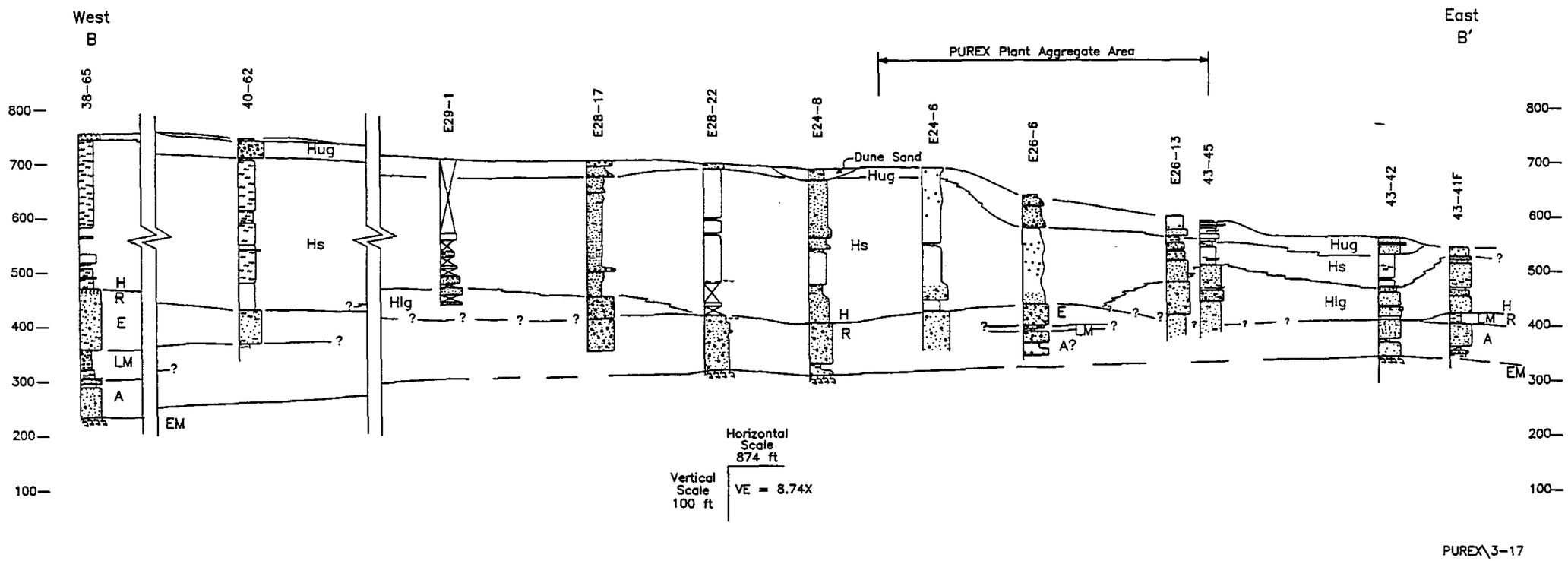

Figure 3-17. Geologic Cross-Section - B-B'.

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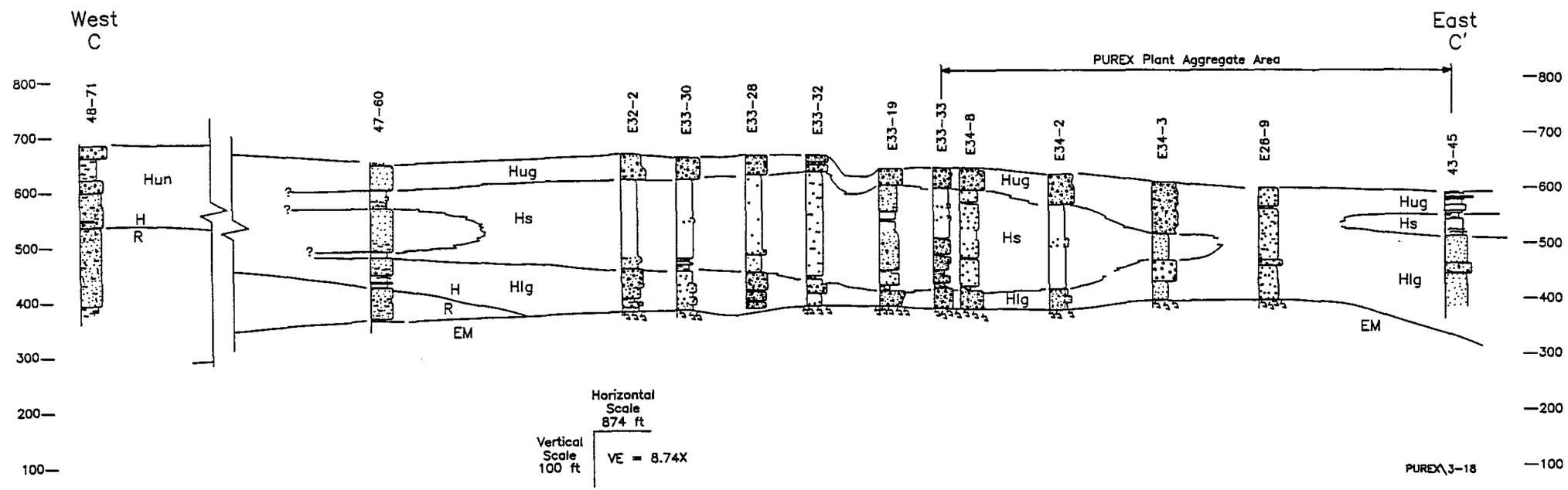

Figure 3-18. Geologic Cross-Section - C-C'.

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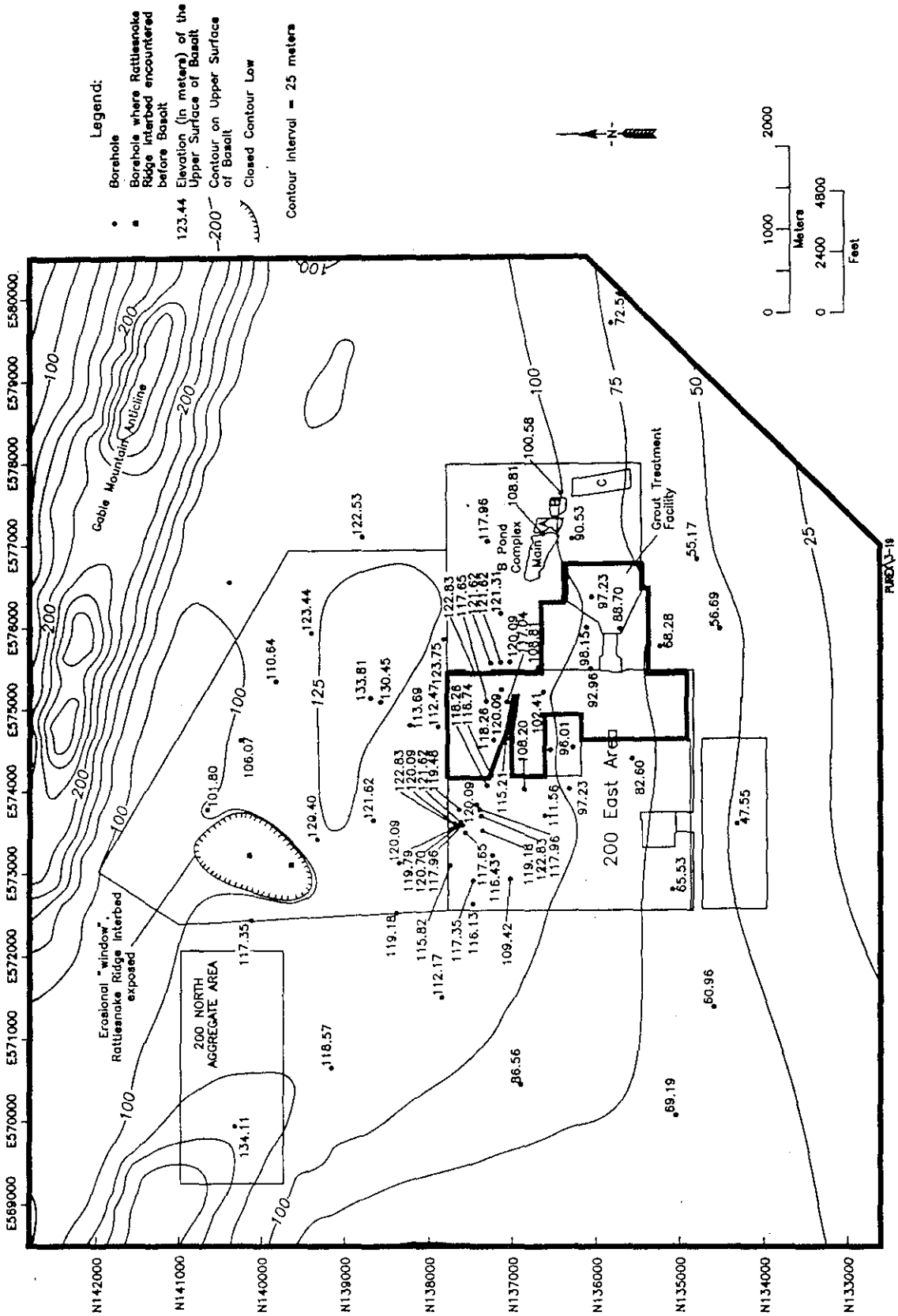
Figure 3-19. Structure Contour Map of Surface of the Top of Basalt.



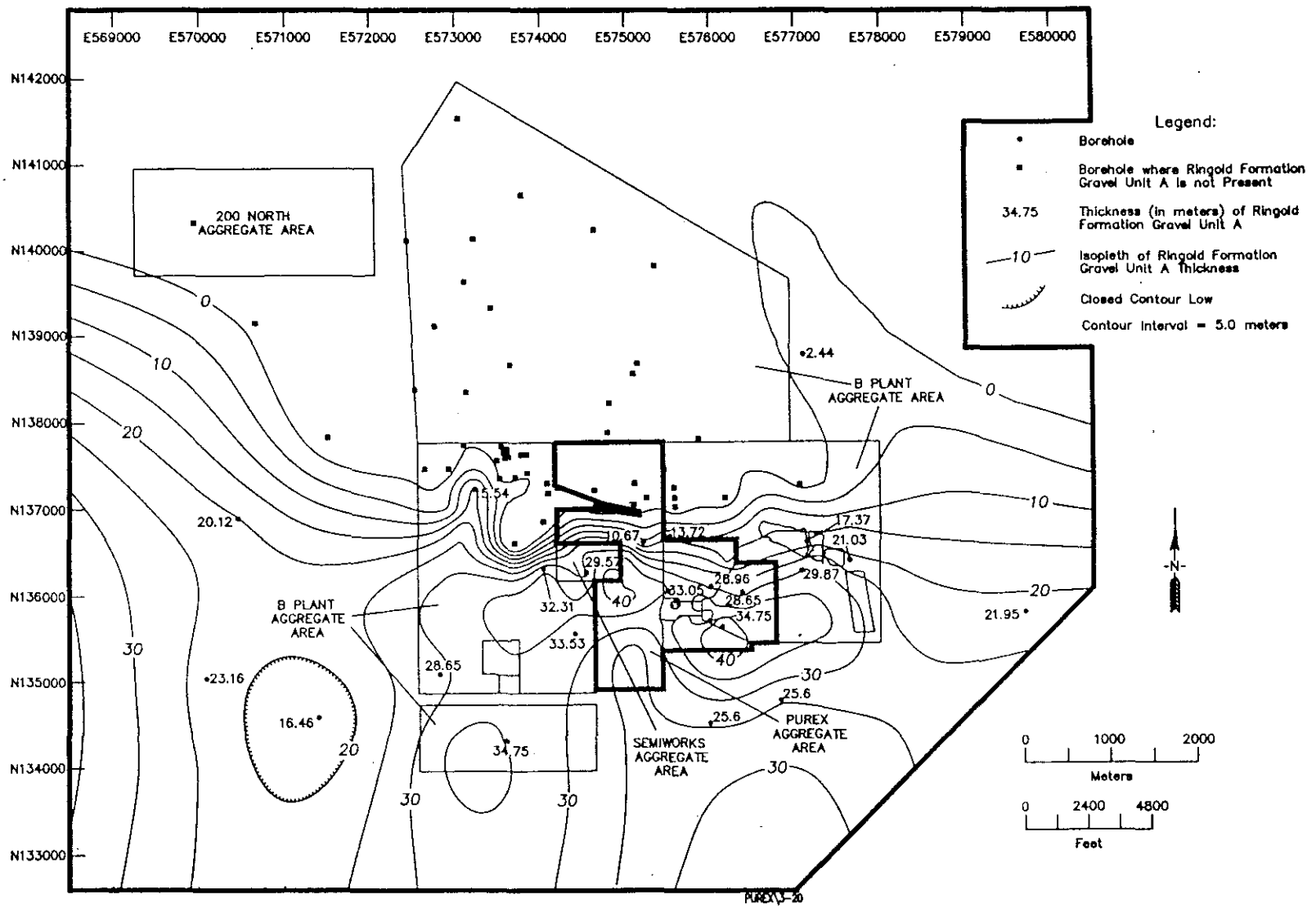


Figure 3-20. Isopach Map of the Ringold Gravel Unit A.

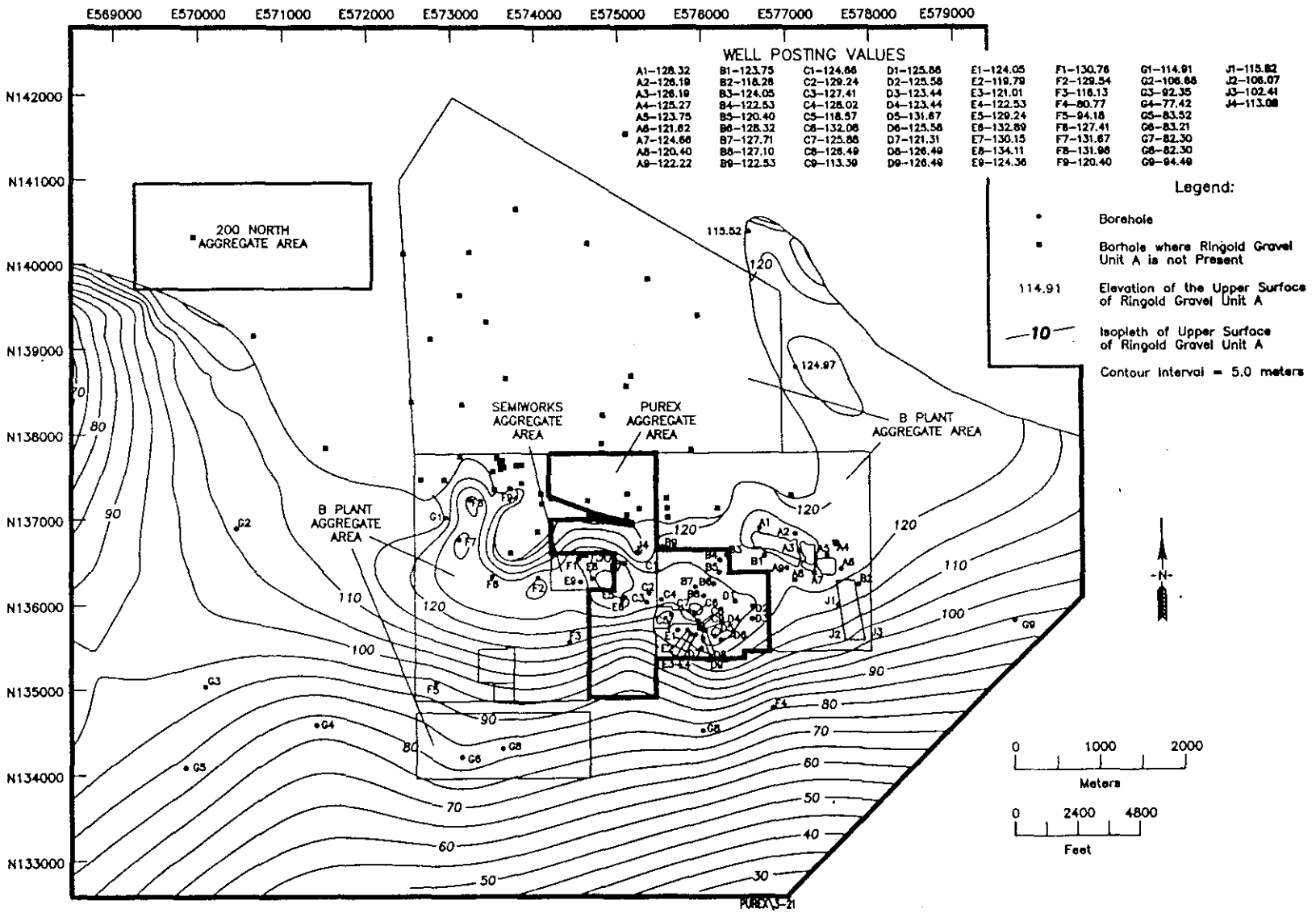
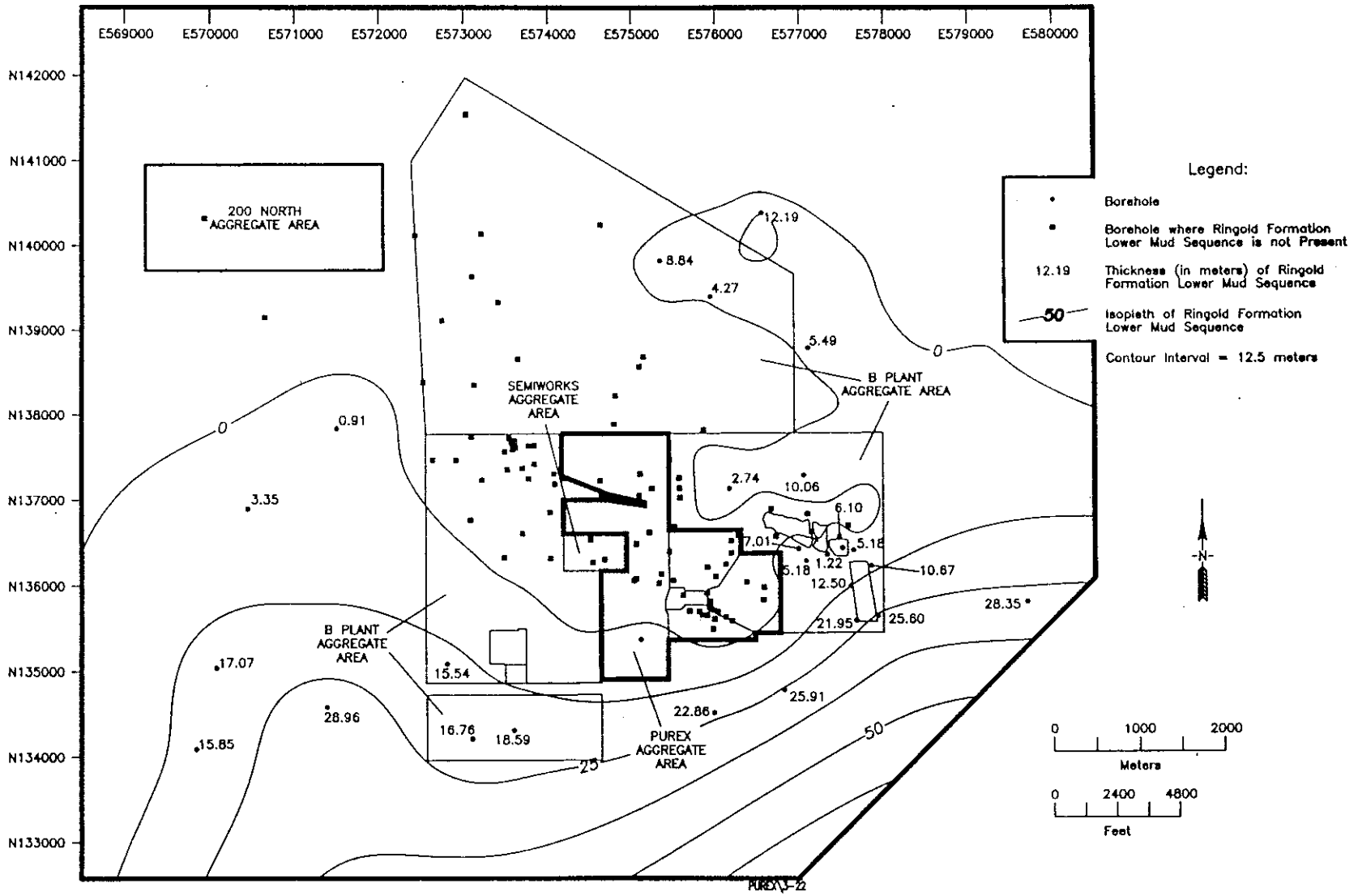


Figure 3-21. Structure Map of the Formation Top of the Ringold Gravel Unit A.

Figure 3-22. Isopach Map of the Lower Mud Sequence, Ringold Formation.



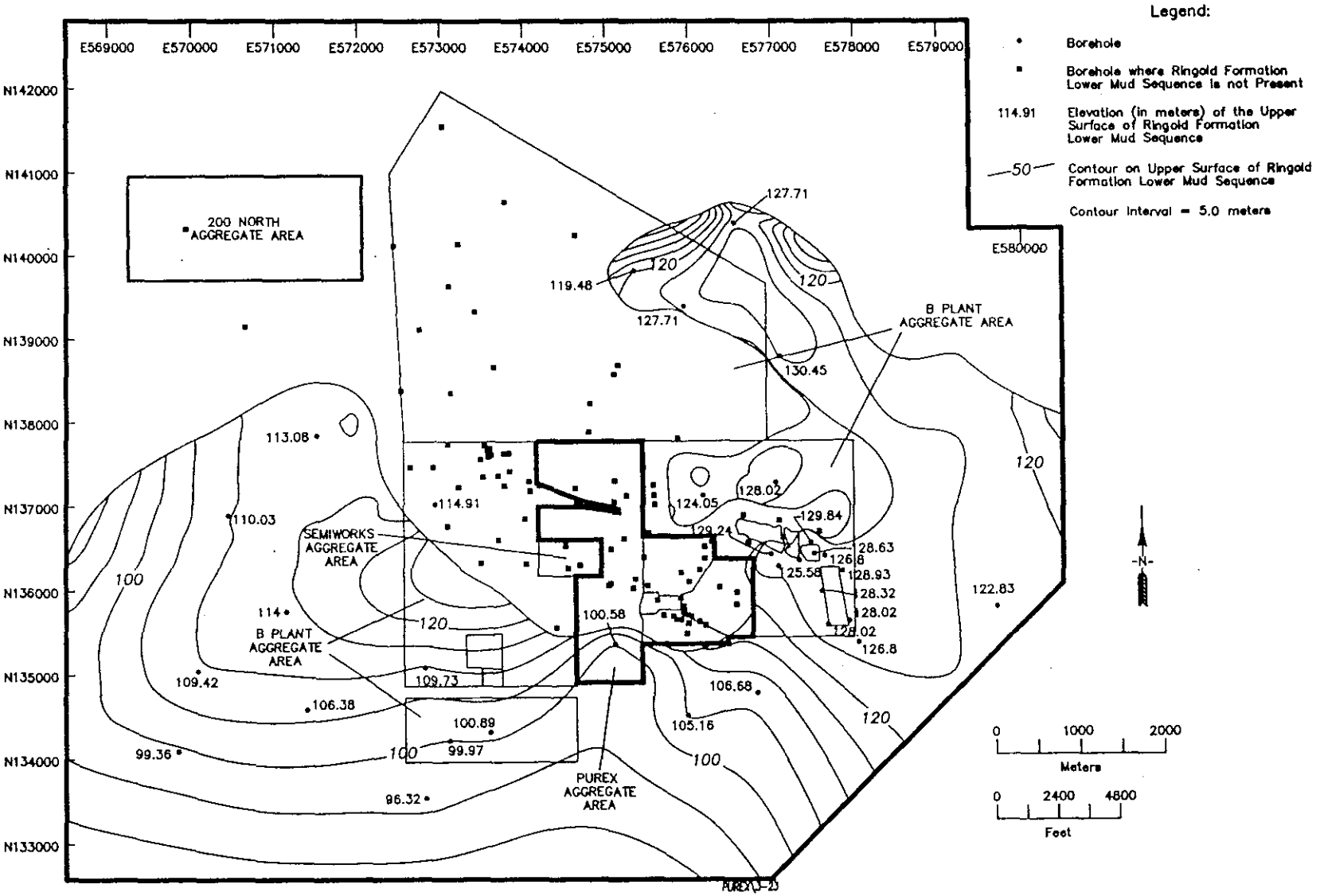


Figure 3-23. Structure Map of the Lower Mud Sequence, Ringold Formation.

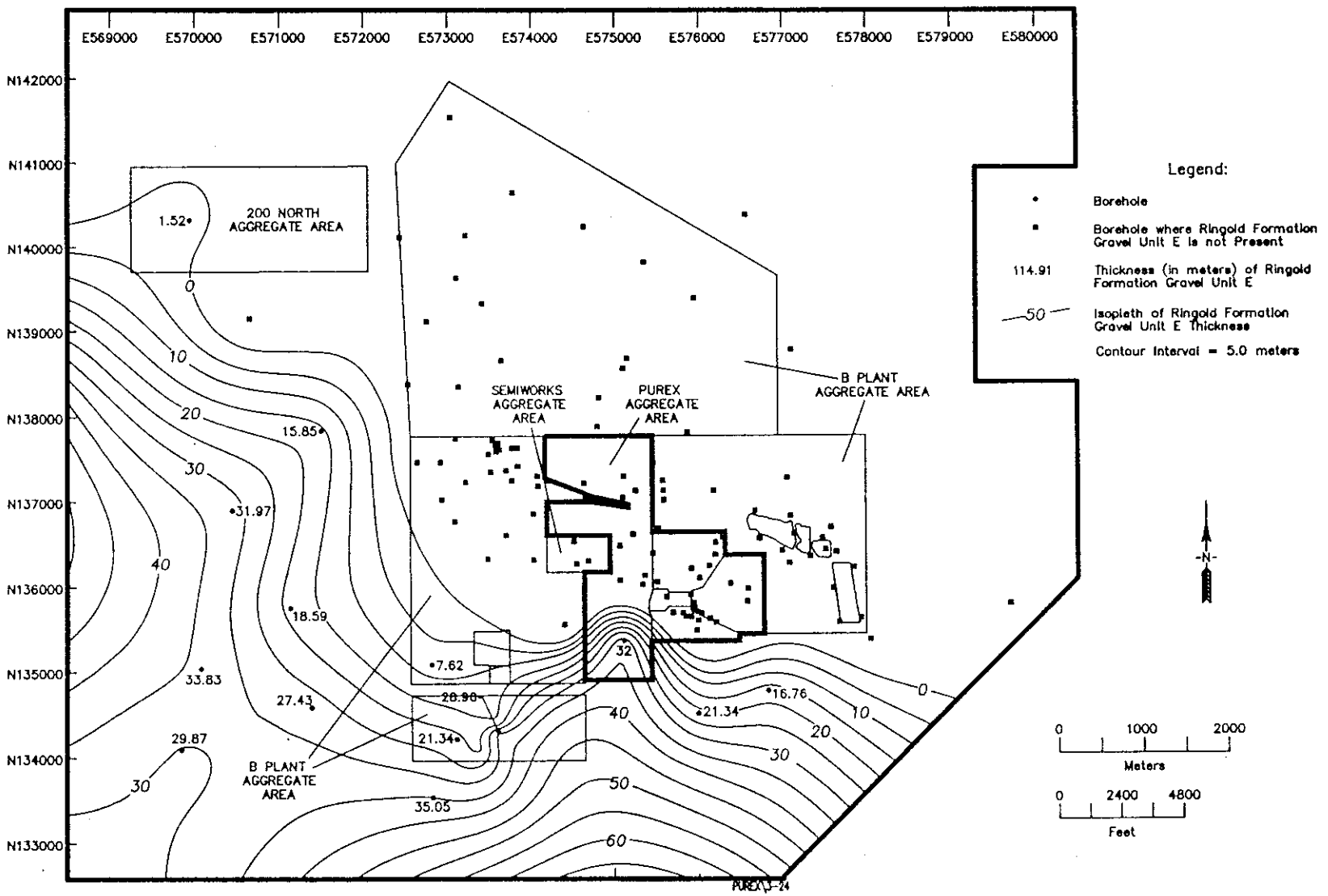


Figure 3-24. Isopach Map of the Gravel Unit E, Ringold Formation.

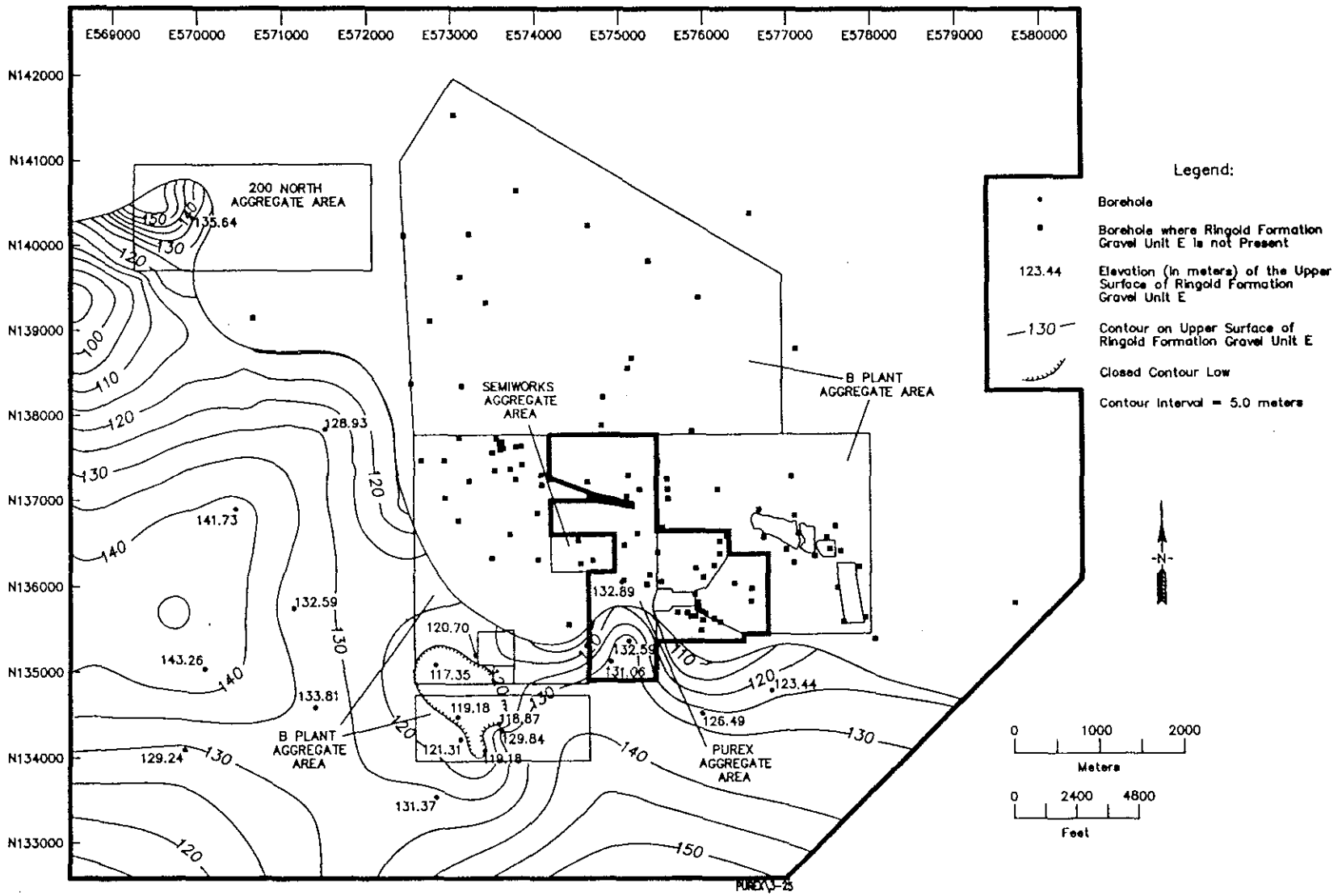


Figure 3-25. Structure Map of the Gravel Unit E, Ringold Formation.

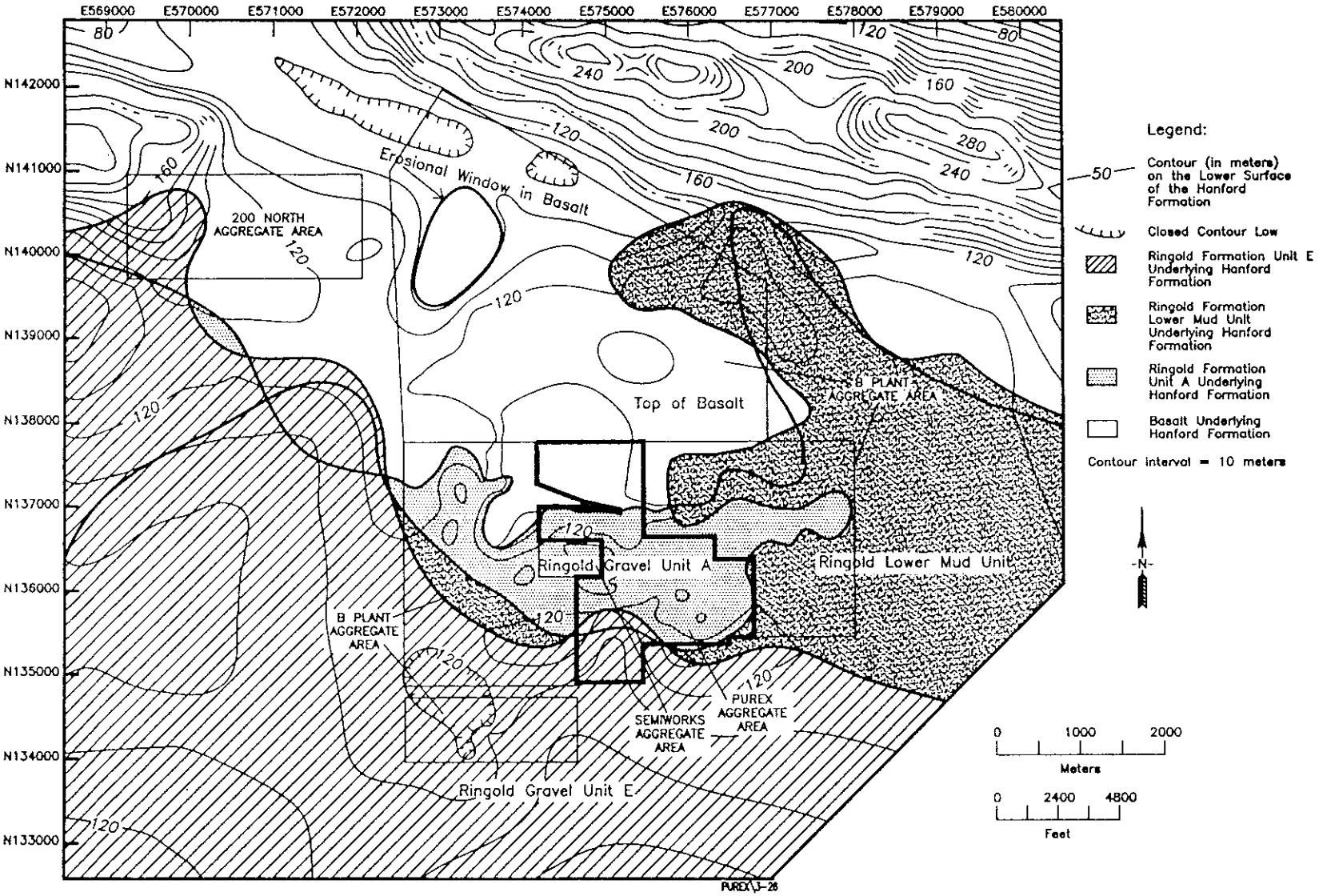


Figure 3-26. Structure Map of the Ringold Formation.

Figure 3-27. Isopach Map of the Lower Gravel Sequence, Hanford Formation.

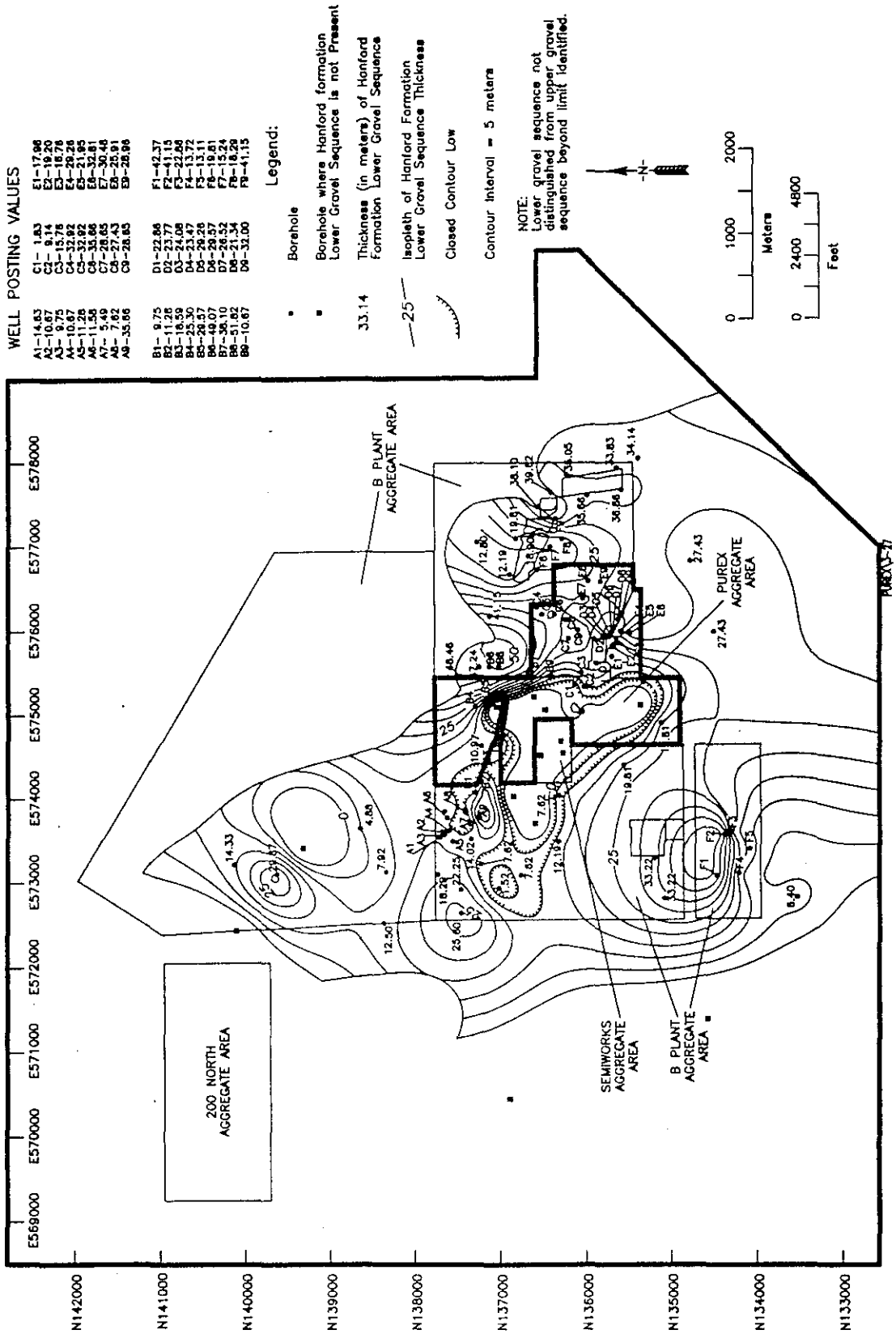


Figure 3-28. Structure Map of the Lower Gravel Sequence, Hanford Formation.

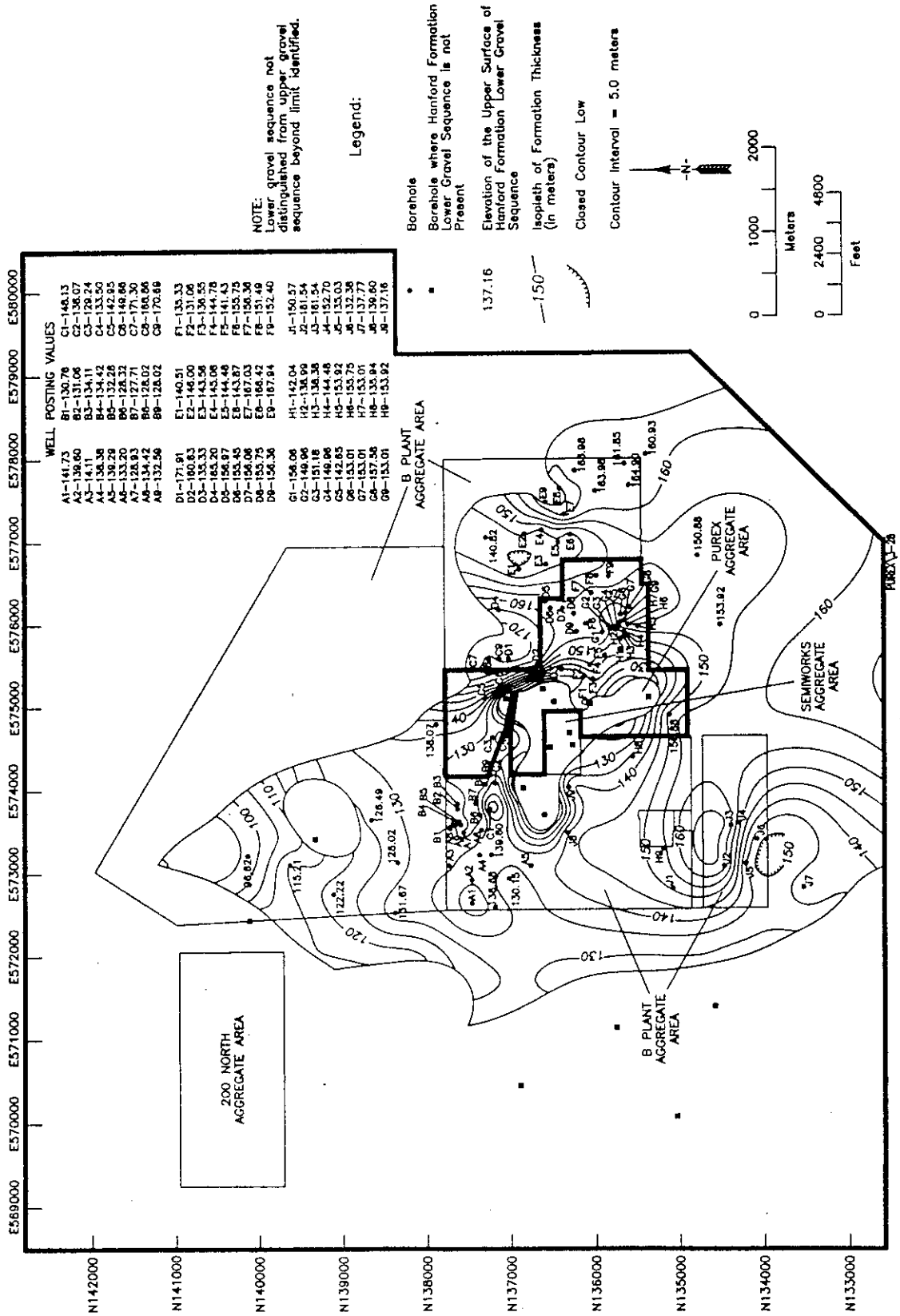


Figure 3-29. Isopach Map of the Sandy Sequence, Hanford Formation.

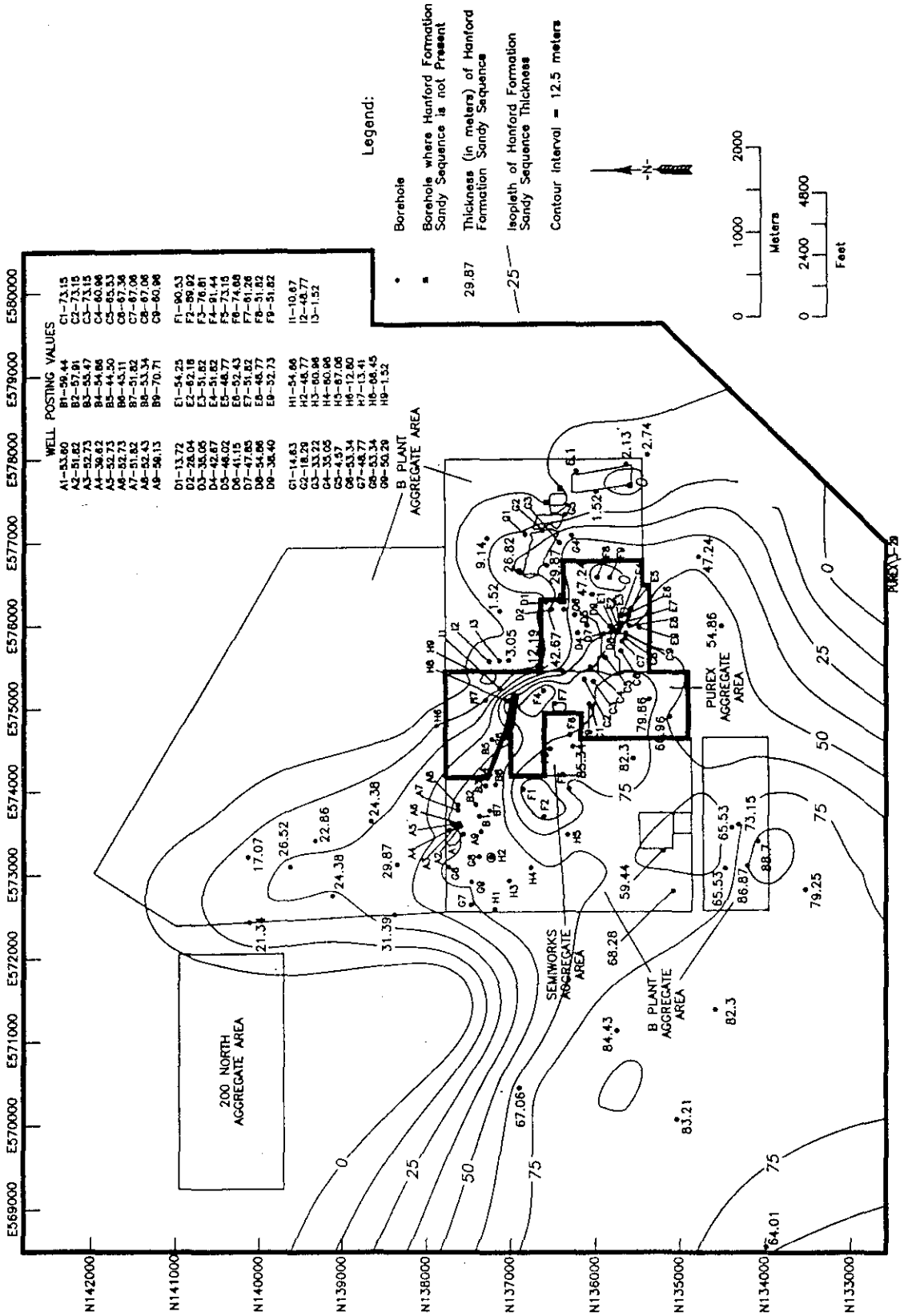
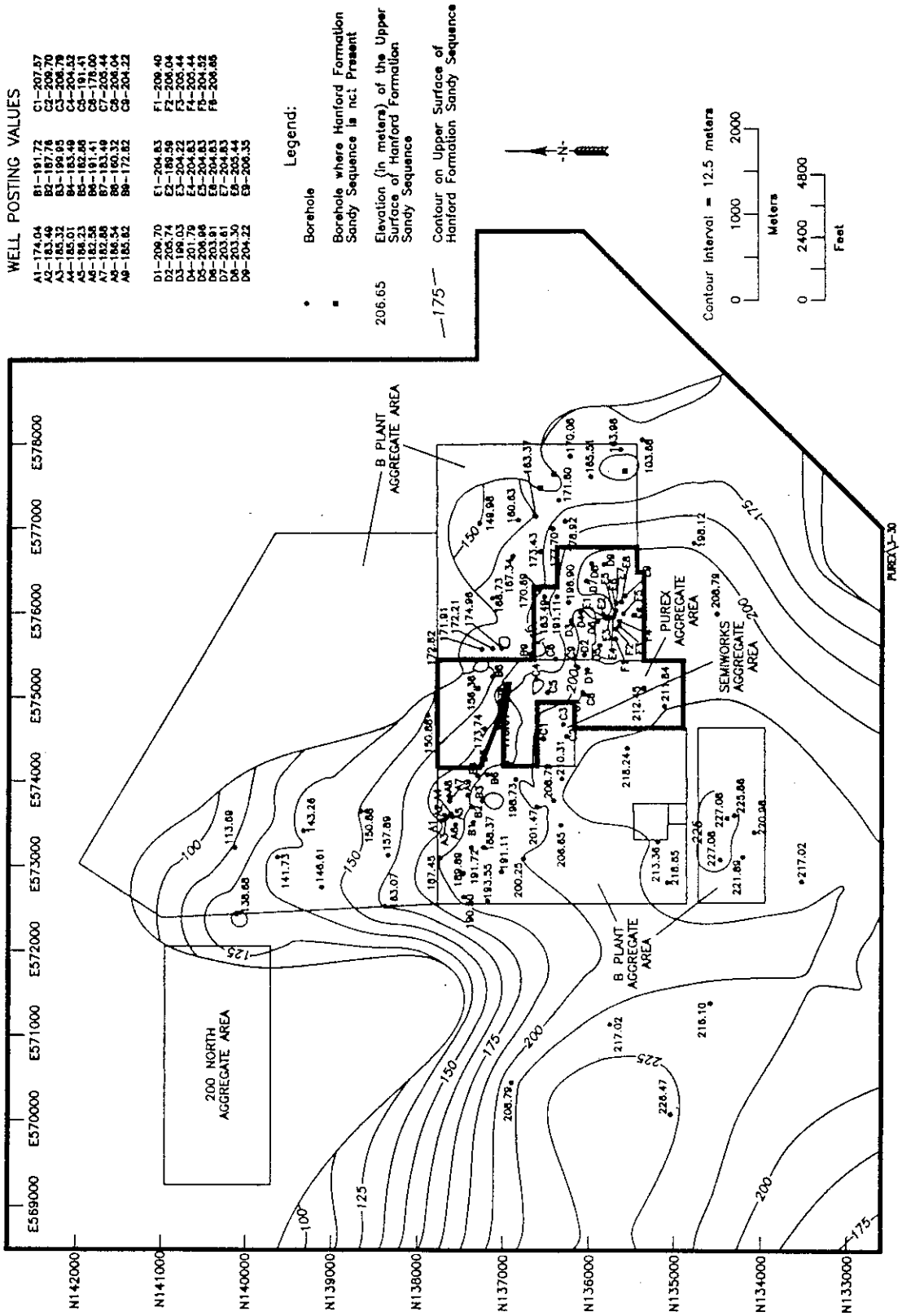


Figure 3-30. Structure Map of the Sandy Sequence, Hanford Formation.



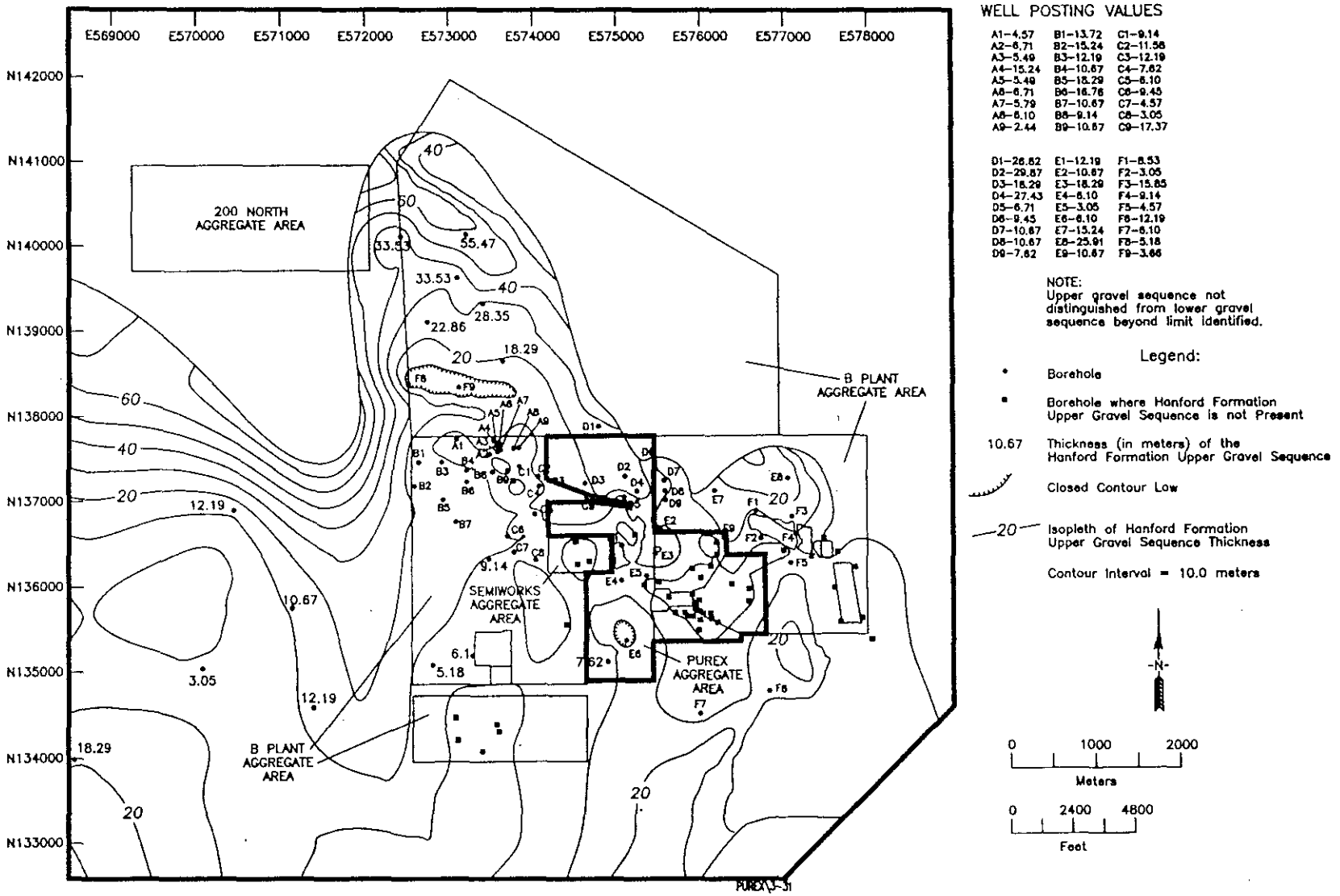


Figure 3-31. Isopach Map of the Upper Gravel Sequence, Hanford Formation.

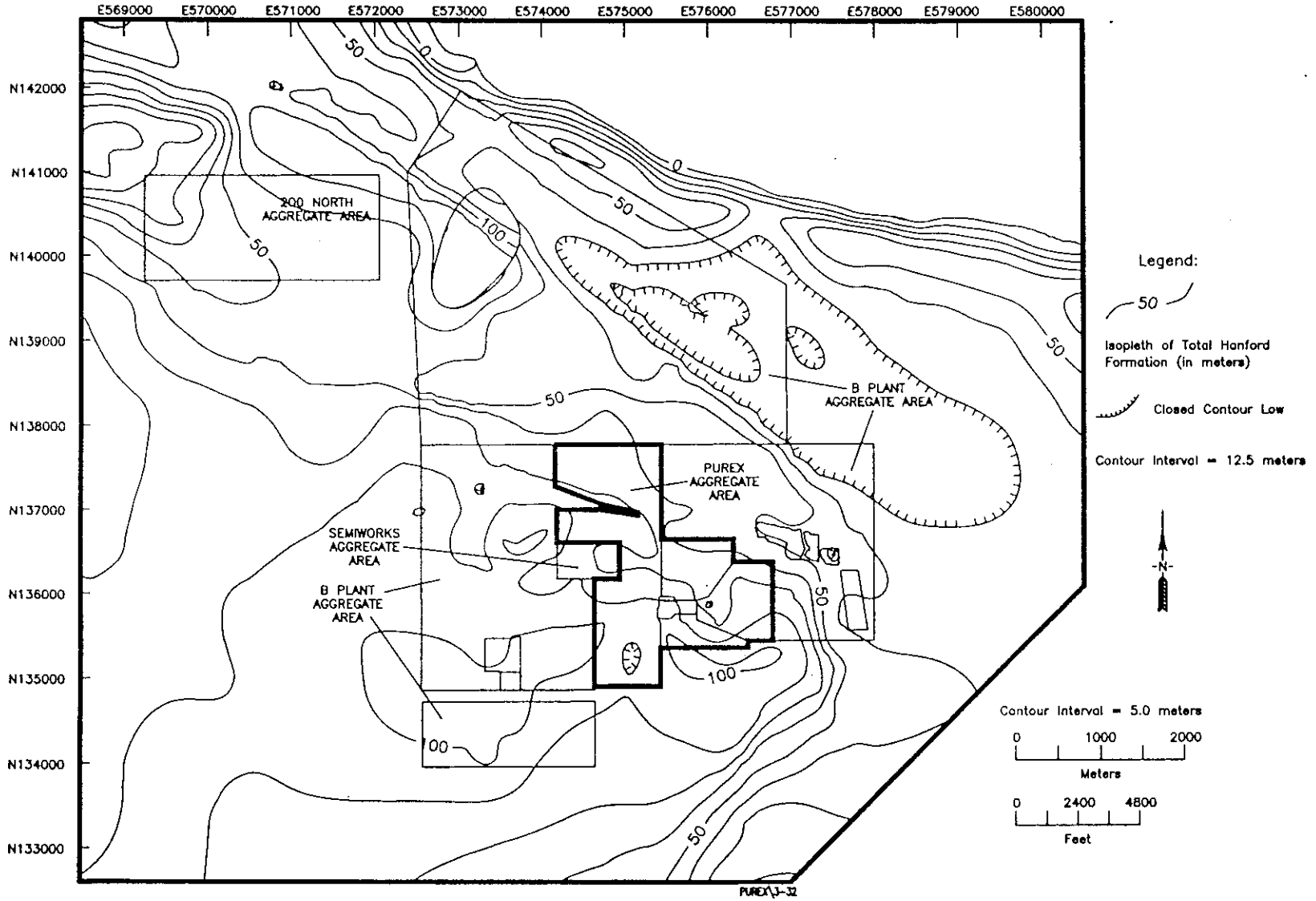
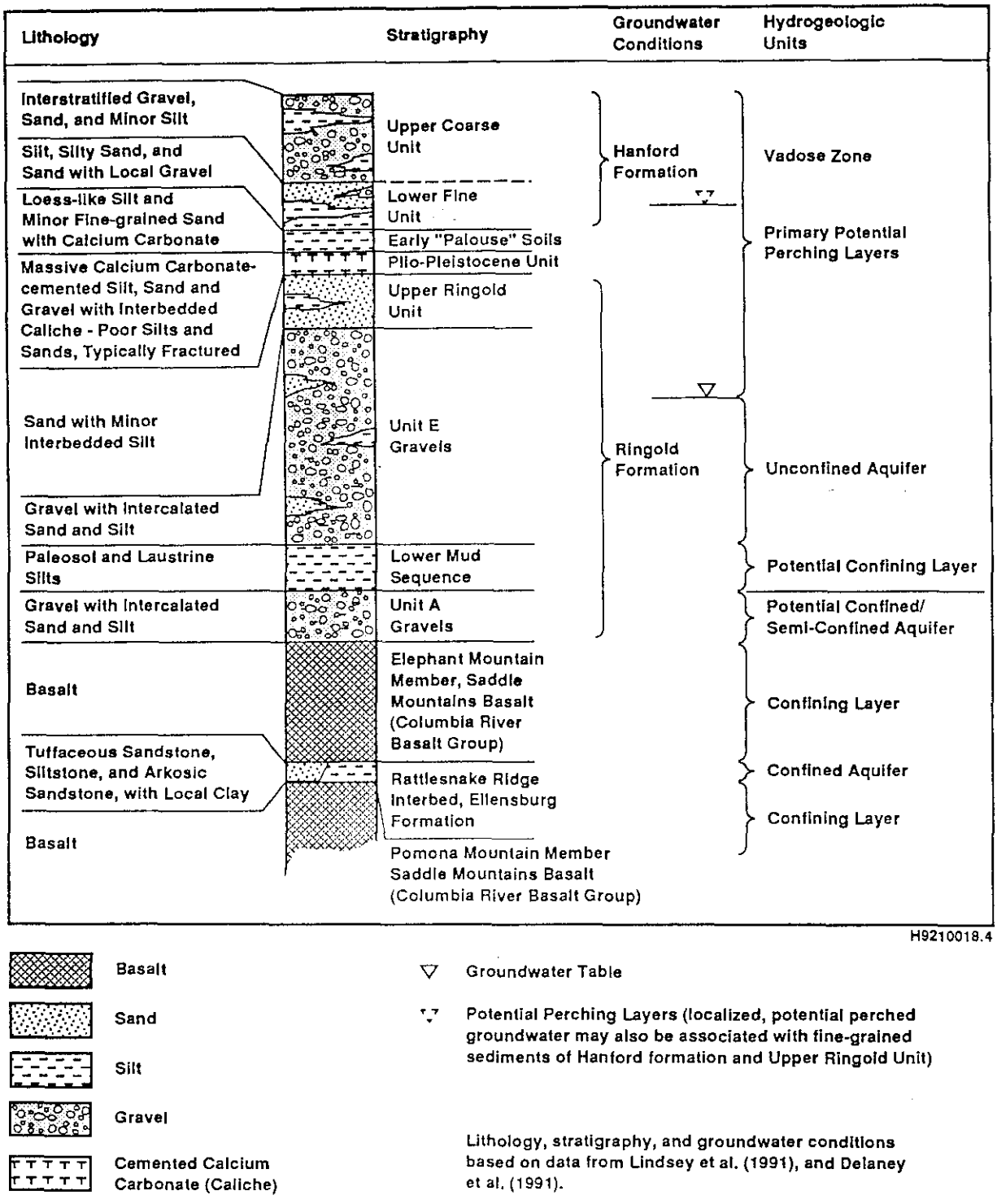


Figure 3-32. Isopach Map of the Entire Hanford Formation.

Figure 3-33. Conceptual Hydrogeologic Column for the Hanford Site.



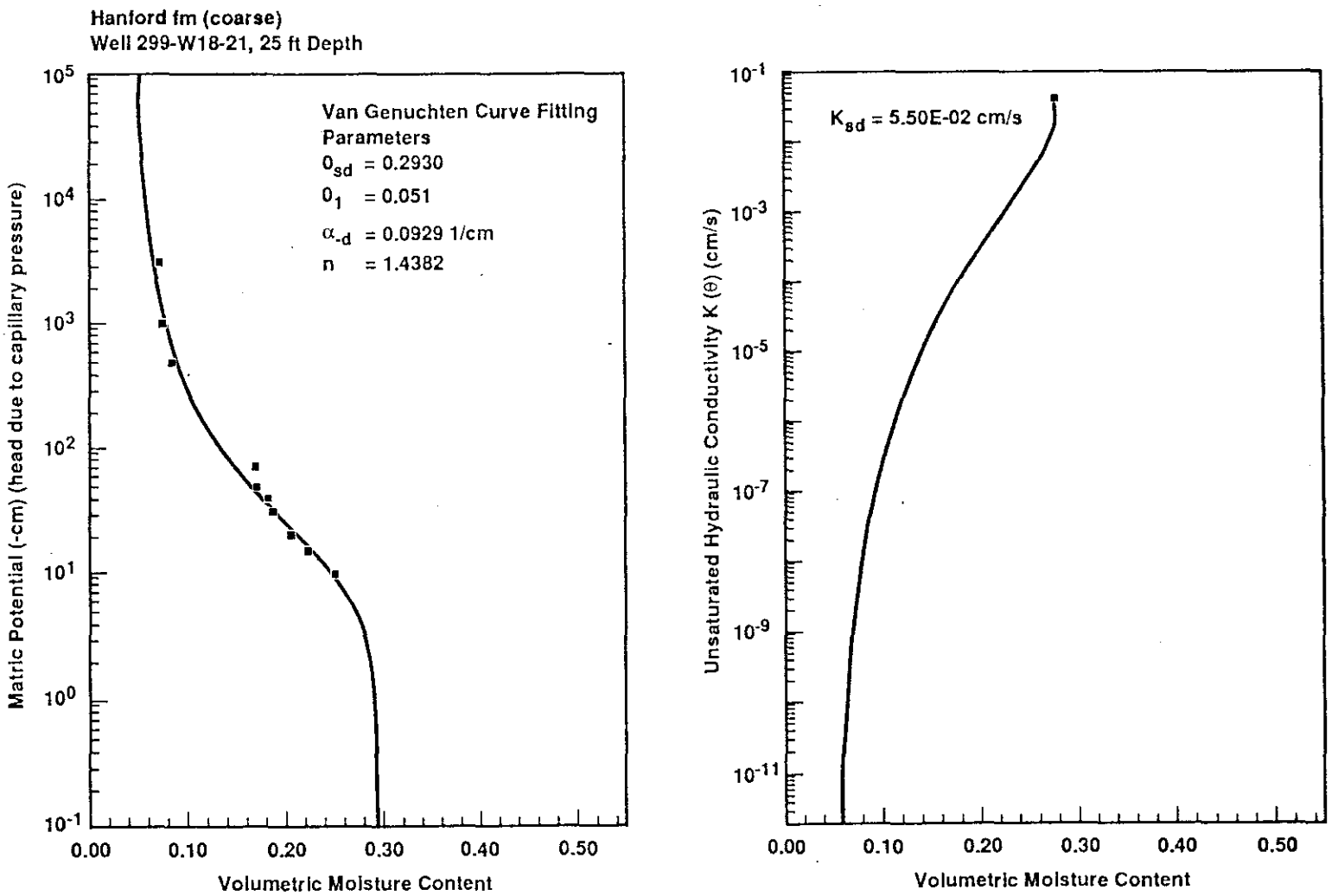
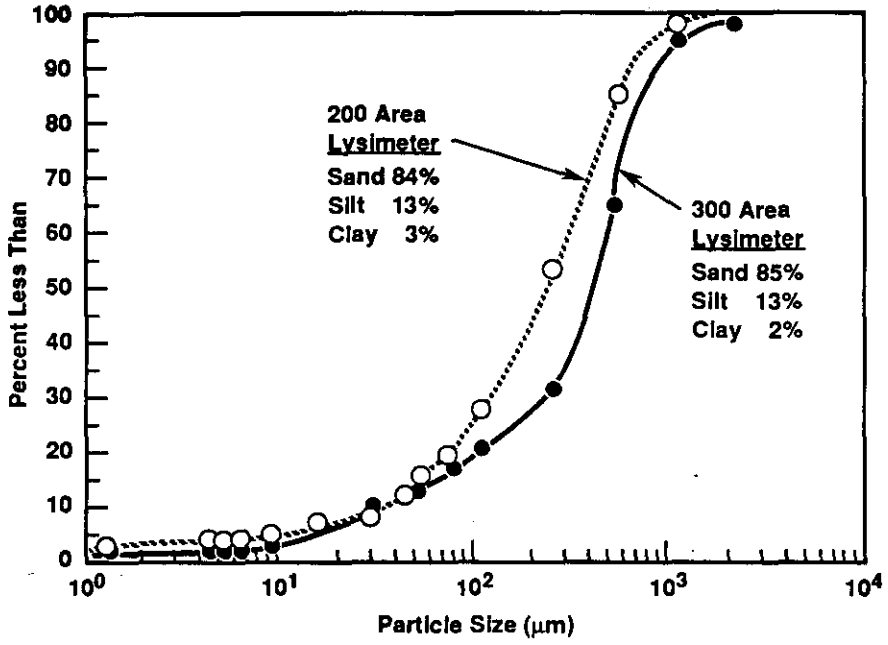
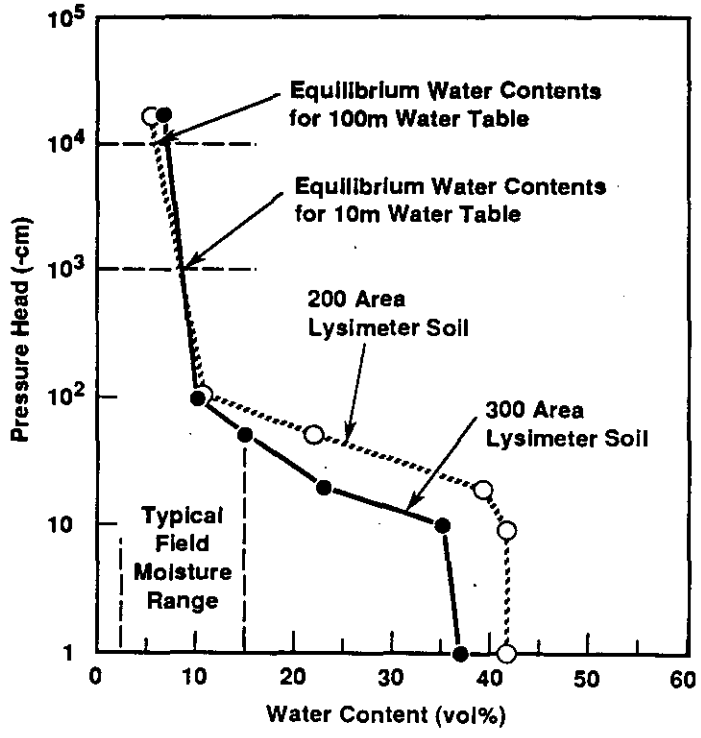


Figure 3-34. Wetting and Drying Curves for Well 299-W18-21.

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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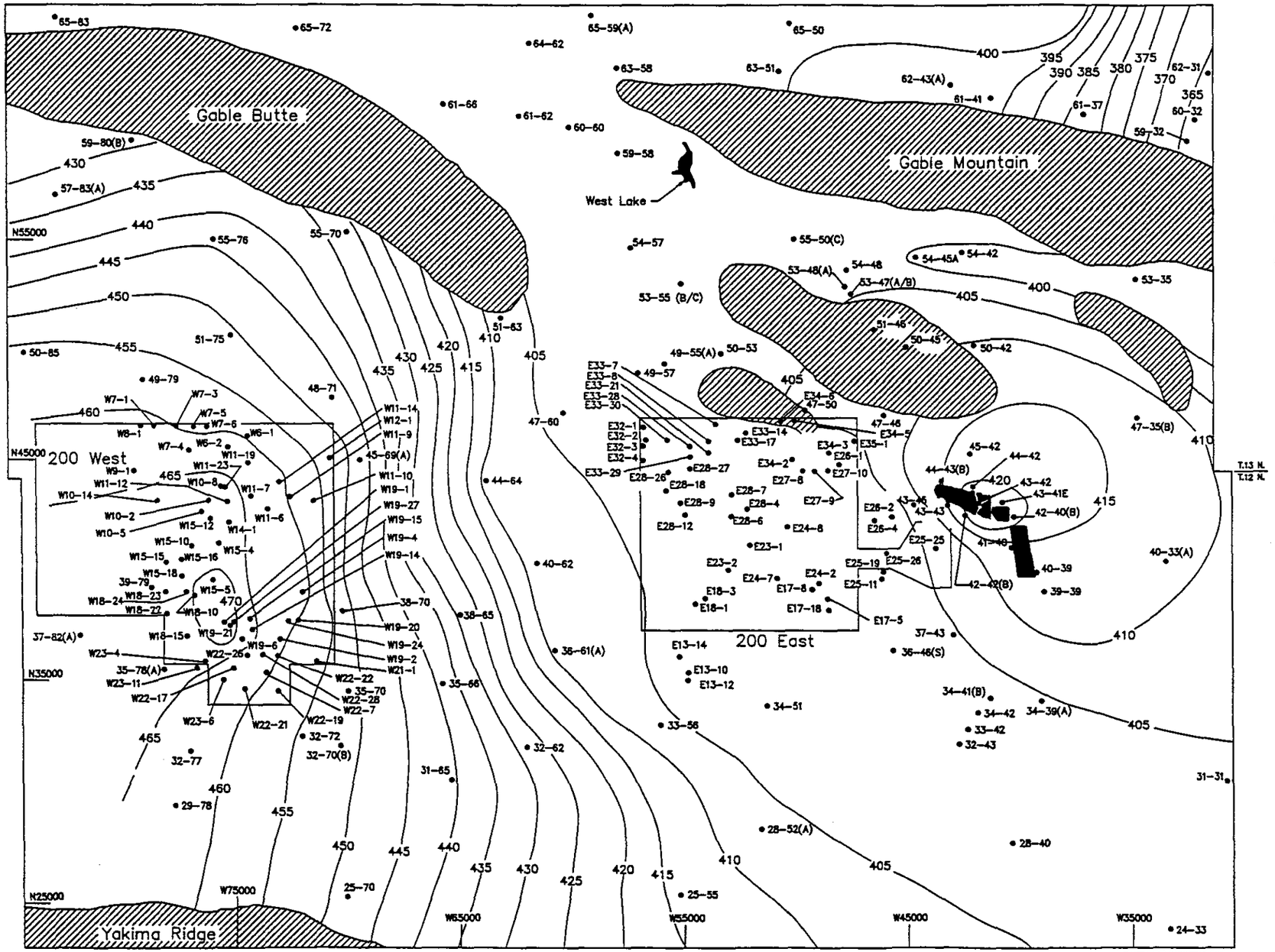

200 Areas Water Table Map June 1990

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).

0 1 Mile

0 1 Kilometer

-N-

Figure 3-36. 200 Areas Water Table Map, June 1990.

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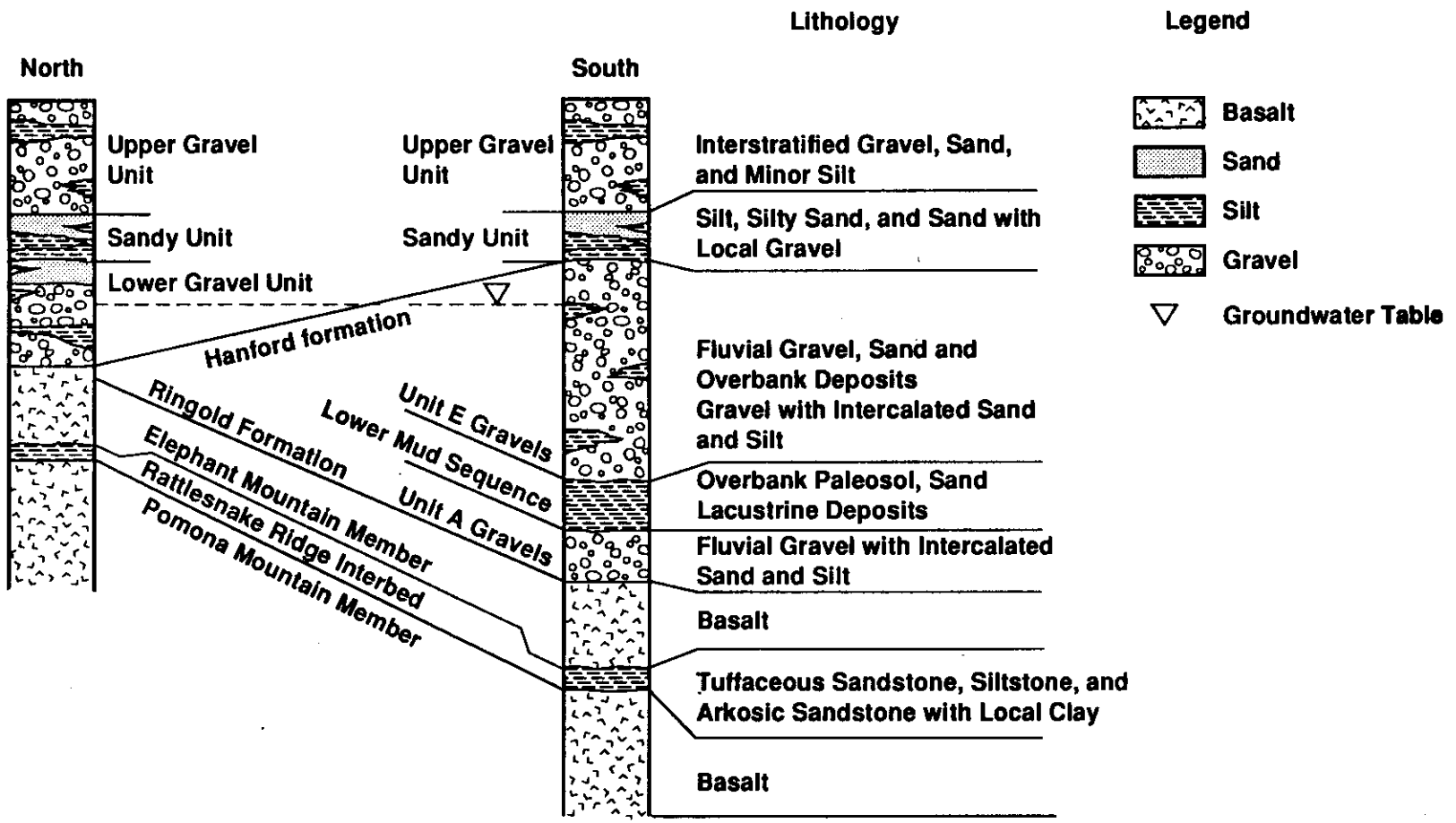

Figure 3-37. Conceptual Hydrogeologic Column for the PUREX Plant Aggregate Area.

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Table 3-1. Hydraulic Parameters for Various Areas and Geologic Units at the Hanford Site.

Location	Interval tested	Hydraulic conductivity (m/day)
Pasco Basin	Hanford formation	150 - 6,200
	Ringold Formation Unit E	6 - 180
	Ringold Formation Unit A	0.03 - 3
100 Area	Ringold Formation Unit E	9 - 395
200 Areas	Hanford formation	610 - 3,050
	Ringold Formation Unit E	2.7 - 70
	Ringold Formation Unit A	0.3 - 3.6
200 West Area	Ringold Formation Unit E	0.02 - 61
	Ringold Formation Unit A	0.5 - 1.2
	Lower Ringold laboratory	9×10^{-6} - 2.4×10^{-5}
Slug Tests at 216-U-12 Crib	Upper Ringold	2.4 - 13
300 Area	Hanford Formation	3,350 - 15,250
300 Area	Ringold Formation	0.58 - 3,050
1100 Area	Ringold Formation Units C/B	0.09 -1.5
1100 Area	Ringold Formation	2.4×10^{-4}
	Overbank Deposits	0.03

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Table 3-2. Summary of Reported Hydraulic Conductivity Values for Hanford Site Vadose Zone Sediments. (sheet 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
6.7×10^{-7}	10	Sand	200 Area	Lysimeter Soil Experiments
1.7×10^{-8}	7			
1.7×10^{-9}	5.5			
1.7×10^{-10}	5			
1.3×10^{-11}	4.3			
2.6×10^{-3}	31	Sandy soil reported as "typical or many surface materials at the Hanford Site."		Unsaturated column studies.
5.7×10^{-4} (sat)	56			
6.3×10^{-11}	2.9	Near-surface soils	2-km south of 200 East Area	K estimates using water retention curve data.
2.2×10^{-11}	2.8			
5.40×10^{-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.
9.78×10^{-3} (sat)	42.2			
8.4×10^{-3} (sat, arithmetic mean of four measurements)	na			
8×10^{-8}	11	na	BWTF: Southeast Caisson, and North Caisson	Unsteady drainage-flux field measurements.
4×10^{-3} (Southeast Caisson	26	na		
1×10^{-8}	10	na		
1×10^{-2} (North Caisson)	29	na		
4.5×10^{-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. (sheet 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
1×10^{-3} (Upper Soil, arithmetic mean of 7 measurements) 9.2×10^{-3} (Lower Soil, arithmetic mean of 4 measurements)	Field Saturation Field Saturation	Loam sand over sand na	Grass Site; 3 km of BWTF	Guelph permeameter field measurements
8×10^{-7} 9×10^{-4}	16 40	Loam to sandy loam	McGee Ranch:NW of 200 West Area on State Rt. 240	Unsteady drainage-flux field measurements.
9×10^{-4} (arithmetic mean of 9 measurements	Field Saturation	na		Guelph permeameter field measurements.
5×10^{-3} (sat) 1×10^{-3} (sat) 5×10^{-4} (sat) 1×10^{-4} (sat) 5×10^{-5} (sat)	50 50 40 40 40	Sand, Gravel Coarse Sand Fine Sand Sand, Silt Caliche	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.
1.2×10^{-5} (sat) 6.7×10^{-6} to 2.8×10^{-1} (sat) 1.10×10^{-3} (sat) 1.80×10^{-4} to 3.00×10^{-4} (sat)	19.6 to 18.9 37.6 to 41.4 18.3 to 21 24 to 25	Hanford formation Early "Palouse" Soils Upper Ringold Middle Ringold	Well 299-W7-9, 218-W-5 Burial Ground	van Genuchten equation fitted to moisture characteristic curves for Well 299-W7-9 soil samples

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
Rorippa columbiae[a/] Suksd. ex Howell	Persistantsepal Yellowcress	Brassicaceae	Endangered
Artemesia campestris L ssp. *borealis* (Pall.) Hall & Clem. var. *wormskioldii*[a/] (Bess.) Cronq.	Northern Wormwood	Asteraceae	Endangered
Astragulus columbianus[a/] Barneby	Columbia Milk Vetch	Fabaceae	Threatened
Lomatium tuberosum[a/] Hoover	Hoover's Desert-Parsley	Apiaceae	Threatened
Astragalus arrectus Gray	Palouse Milk Vetch	Fabaceae	Sensitive
Collinsia sparsiflora Fisch.&Mey. var *bruciae* (Jones) Newsom	Few-Flowered Collinsia	Scrophulariaceae	Sensitive
Cryptantha interrupta (Greene)Pays.	Bristly Cryptantha	Boraginaceae	Sensitive
Cryptantha leucophaea Dougl. Pays	Gray Cryptantha	Boraginaceae	Sensitive
Erigeron piperianus Cronq.	Piper's Daisy	Asteraceae	Sensitive
Carex densa L.H. Bailey	Dense Sedge	Cyperaceae	Sensitive
Cyperus rivularis Kunth	Shining Flatsedge	Cyperaceae	Sensitive
Limosella acaulis Ses.&Moc.	Southern Mudwort	Scrophulariaceae	Sensitive
Lindernia anagallidea (Michx.)Pennell	False-pimpernel	Scrophulariaceae	Sensitive
Nicotiana attenuata Torr.	Coyote Tobacco	Solanaceae	Sensitive
Oenothera pygmaea Dougl.	Dwarf Evening-Primrose	Onagraceae	Sensitive

a/ Indicates candidates on the 1991 Federal Register, Notice of Review.

Table 3-4. Federal and State Classification of Animals that Could Occur on the 200 Areas Plateau.

Common Name	Status Federal	State
Peregrine Falcon *(Falco peregrinus)*	FE	SE
Sandhill Crane *(Grus canadensis)*	--	SE
Bald Eagle *(Haliaeetus leucocephalus)*	FT	ST
Ferruginous Hawk *(Buteo regalis)*	FC2	ST
Swainson's Hawk *(Buteo swainsoni)*	FC2	SC
Golden Eagle *(Aquila chrysaetos)*	--	SC
Burrowing Owl *(Athene cuniculuria)*	--	SC
Loggerhead Shrike *(Lanius lucovicianus)*	--	SC
Sage Sparrow *(Amphispiza belli)*	--	SC
Great Blue Heron *(Casmerodius albus)*	--	SM
Merlin *(Falco columbarius)*	--	SM
Prairie Falcon *(Falco mexicanus)*	--	SM
Long-billed Curlew *(Numenius americanus)*	--	SM
Striped Whipsnake *(Masticophis taeniatus*	--	SC

FE - Federal Endangered
FT - Federal Threatened
FC2 - Federal Candidate
SE - State Endangered
ST - State Threatened
SC - State Candidate
SM - State Monitor

Above information taken from Washington Department of Wildlife June 1991. Species of Concern in Washington.

4.0 PRELIMINARY CONCEPTUAL MODEL

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

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

4.1 KNOWN AND SUSPECTED CONTAMINATION

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

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

Table 4-3 summarizes the types of unit-specific data available for each of the waste management units. It should be emphasized that the table only summarizes what types of data are available; it does not indicate the sufficiency of the data, either in terms of quality or quantity. These concerns are addressed in Section 8.0. The unit-specific information is presented for each waste management unit in Section 4.1.2.

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

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

The most recent environmental monitoring of the Hanford Site was conducted by the Pacific Northwest Laboratory (PNL) (Eberhardt et al. 1989) and Westinghouse Hanford. However, most of the data applicable to the PUREX Plant Aggregate Area have been published by Westinghouse Hanford. The latest Quarterly Environmental Radiological Survey Summary Reports (Huckfeldt 1991a, 1991b) were reviewed during the current study, as well as the last six annually published environmental surveillance reports (Elder et al. 1986, 1987, 1988, 1989; Schmidt et al. 1990, 1992). The quarterly reports only contain surface radiological survey results. The annual reports describe several different sampling and survey programs including surface soil sampling, external radiation measurements, biota sampling, air sampling, surface water sampling, groundwater sampling, and radiological surveys.

Air, soil, surface water, and biota samples were collected each year at the same locations within the 200 East Area. External radiation measurements were also taken annually at several locations. Until 1990, few of the sample locations were directly associated with any of the identified waste management units and so most of this information is only useful in characterizing area-wide trends. In 1990, however, new sampling locations were established that are near areas of known surface contamination. Currently, only external radiation data are available for these new sample locations. Both the new and old sampling locations are shown on Plate 3.

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

evidence for contamination migration within the vadose zone to the unconfined aquifer underlying the site. Additional assessment of the nature and extent of groundwater contamination is presented in the 200 East Groundwater Aggregate Area Management Study Report (AAMSR).

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

Available data were reviewed to assess whether air, surface soil, vadose zone soil, or groundwater was potentially impacted by waste handling activities at each PUREX Plant Aggregate Area waste management unit. Table 4-1 summarizes available information regarding known or suspected radionuclide contamination at the PUREX Plant Aggregate Area. Table 4-2 summarizes available information regarding known and suspected chemical contamination. In Tables 4-1 and 4-2, waste management units are arranged by physical type (cribs, burial grounds, unplanned releases, etc.). Entries in the tables identify known or suspected releases based on available sampling information or historical waste inventory data.

4.1.1 Affected Media

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

The filters are analyzed quarterly for ^{90}Sr, ^{137}Cs, ^{239}Pu, and U total. The results have shown a steady decline in the concentration of these radionuclides from 1985 to 1987, a slight increase in 1988, and then a decline again in 1989 throughout the 200 East Area (Schmidt et al. 1990). The increased radionuclide concentrations in 1988 was on the average greater than 1987 concentrations; however, they were still lower than the first samples taken in 1985. In 1989, four of the seventeen air sampling stations were removed from service

because they did not meet newly revised DOE air sampler siting guidance. The stations removed from service included N006, N007, N008, and N012, located north, south, and east, respectively, of the 241-AP Tank Farm and northeast of the 207-A Retention Basins. The last 5 years of data for the PUREX Plant Aggregate Area have been averaged and the values are summarized in Table 4-4. The complete data set since 1985 is summarized in Appendix A.2.

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

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

The entire area has gross gamma counts that are above background. However, several high gamma count anomalies can be identified within the aggregate area. The highest gross count results in the PUREX Plant Aggregate Area were between 220,000 and 700,000 ct/s measured over the railroad spur northwest of the 202-A Building (site number 4 on Figure 4-1). This is where equipment is stored that has been contaminated with fission products. The second highest results were between 70,000 and 220,000 ct/s as measured over the 241-C and 241-A Tank Farms (sites number 5 and 2, respectively, on Figure 4-1). The third highest results were between 22,000 and 70,000 ct/s measured around the perimeter of the tank farms. The only other elevated radiation area in the aggregate area had counts of between 7,000 and 22,000 ct/s and was centered over the 202-A Building (site number 3 on Figure 4-1).

It is impossible to accurately convert these gross gamma counts to a meaningful exposure rate because of the complex distribution of radionuclides on the site. Many of the spectra do not have readily identifiable photo peaks, but rather occur on a smear or continuum. Also, aerial systems integrate radiation levels over an area whose diameter may

be ten times the height of the platform above the ground. Because of the large-area integration of the airborne system, localized anomalies will appear to be spread over a larger area with lower activities than actually exist on the ground (Reiman and Dahlstrom 1988). Spectral logs were only generated for four sites within the PUREX Plant Aggregate Area in this survey and these had identifiable photopeaks in three cases. A photopeak is the specific energy or wavelength that can be associated with the emissions from a specific radionuclide. Cesium-137 was the only radionuclide that could be identified from spectra information collected over the 241-C and 241-A, -AN, -AW, -AX, -AY, and -AZ Tank Farms during the 1988 survey. Both ^{137}Cs and ^{60}Co were found near the railroad spur north of the 202-A Building where equipment is stored that has been contaminated with fission products. As such, the aerial radiation survey data should only be used as a qualitative tool for identifying more highly contaminated areas within the survey boundaries. In addition, the gamma counts noted in the survey probably result from both surface and shallow buried radionuclides, and are thus not entirely indicative of surface contamination.

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

- The 241-A, 241-AN, 241-AP, 241-AW, 241-AX, 241-AY, and 241-AZ Tank Farms
- The 241-C Tank Farm
- The 218-E-12B Burial Ground
- The miscellaneous site adjacent to the railroad spur northwest of the 202-A Building
- Along the railroad spur leading into the east end of the 202-A Building.

Most of these areas fall within the anomalously high zones noted in the radiation survey. Areas of active surface radiological contaminant migration include (Huckfeldt 1991):

- The northeast side of the 241-C Tank Farm
- Small patches north and south of 8th Street
- The south and west sides of the 241-ER-153 Diversion Box
- An area southeast of the 202-A Building and south of UN-200-E-142.

Table 4-5 summarizes the radiological survey results for each waste management unit and unplanned release. The areas of surface contamination and contaminant migration will be discussed in more detail in the section dealing with the individual waste management units and unplanned releases (Section 4.1.2). Surface radiological surveys are done quarterly, semiannually, or annually at the waste management units. The surface contamination posting may change often because of resurveying and because of cleanups affected under the Radiation Area Remedial Action (RARA) Program. These surveys yield data on gross contaminant levels (ct/min and dis/min) which are useful in identifying the presence of contamination at a waste management unit and in making available comparisons between waste management units.

4.1.1.2.2 External Radiation Dose Rate Measurements. Dose rates from penetrating radiation were measured annually at 40 locations within or adjacent to the PUREX Plant Aggregate Area between 1985 and 1989. The sample locations are shown on Plate 3, and the survey results are listed on Table 4-6. The measurements were taken with thermoluminescent dosimeters (TLDs) and are reported in mrem/yr. The TLDs measure dose rates resulting from all types of external radiation sources including cosmic radiation, naturally occurring radioactivity, fallout from nuclear weapons testing and contributions from other Hanford Site activities. Most of the results averaged around or just below 100 mrem/yr except for the 241-A -AN, -AX, and -AZ Tank Farms perimeter locations. The 1989 results from the 241-A Tank Farms had external radiation levels ranging from 125 to 2,519 mrem/yr, but readings were much lower in previous years. Sites 241-A Tank Farm No. 8, 241-A Tank Farm No. 9, and 241-A Tank Farm No. 10, near the 241-A Tank Farm, had consistently high readings throughout the 5-year period. The 242-A Evaporator is located just east of the 241-A Tank Farm No. 10 sampling location.

In an effort to get more site specific data, 25 new dosimeter sampling locations were established in 1990, to replace the forty original abandoned sites in the PUREX Plant Aggregate Area. The new sites were generally located on or near areas of known contamination and the results appeared to be slightly elevated over the previous sampling rounds. Measurements were generally a little above 100 mrem/yr. The highest average reading was 1,200 mrem/yr from the 241-A Tank Farm No. 8, adjacent to the 241-A Tank Farm. These results, summarized in Table 4-7, present a range of values measured and the average for the year.

4.1.1.2.3 Surface Soil Sampling. Between 1978 and 1989, surface soil samples were collected annually from a regular rectangular grid that covers the 200 East Area with 36 sampling points. Eight of these sampling sites are located within or adjacent to the PUREX Plant Aggregate Area. The sample points have never been exactly surveyed, but are generally located close to the intersections of Hanford Site coordinate lines at 305 m (1,000 ft) spacings. In addition, between 1985 and 1989, soils have been sampled along fences enclosing the tank farms in the 200 East Area. There are two soil samples associated with the 241-C Tank Farm and one soil sample associated with each of the following tank

farms; 241-A, 241-AN, 241-AW, and 241-AZ. None of the soil sampling locations were at waste management units or unplanned release sites, so these data cannot be applied directly.

The results of the two soil sampling programs since 1985 are summarized in Tables 4-8, 4-9, and 4-10. Tables that present all of the data collected since 1985 are contained in Appendix A.2. Counting errors are included with each analytical result and those entries that are greater than the accompanying counting errors are denoted with shading.

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

The highest radionuclide concentrations were generally noted in the vicinity of the 241-C Tank Farm. The highest concentrations of ^{90}Sr were consistently found at Site 2E17, adjacent to the 241-C Tank Farm. The trend at these locations has been generally upward since 1984. This is believed to be due to residual low-level contamination from the 241-C-151 Diversion Box incident which is discussed in detail in Section 4.1.2.7 (Schmidt et al. 1990).

In 1990, new soil sampling locations were established that are located close to areas of known surface contamination. The locations of these new sites are shown on Plate 3. There are 18 new sample locations within or adjacent to the PUREX Plant Aggregate Area.

4.1.1.3 Surface Water. No natural surface water bodies exist within the PUREX Plant Aggregate Area. However, the manmade 216-A-29 Ditch, commonly referred to as Snow's Canyon, formerly received a variety of wastes. The surface water and sediment within the ditch were suspected to be contaminated. The unit has recently undergone dramatic change. In October 1991 the ditch was surface stabilized with gravel to grade and surrounded with a light chain barricade, posted with underground contamination placards. The 207-A and 216-A-42 Retention Basins have also received a variety of aqueous wastes; thus, sediments and water within the basins may also be contaminated. No recent data from these basins are available.

There are data for water quality in the 216-A-29 Ditch before it was stabilized. The samples were taken weekly, composited, and analyzed monthly for total beta, total alpha, ^{137}Cs, and ^{90}Sr. The results are presented in Table 4-11, in the form of maximum and minimum recorded levels. Judging from the maximum concentrations (as the minimum levels were generally below detection) the radioactivities appeared to be trending downward.

4.1.1.4 Biota. Westinghouse Hanford and PNL have conducted various biota sampling activities beginning in 1971 through 1988 inside and outside the Hanford Site. No upward

trends in radionuclide concentrations were detected for any of the wildlife species examined (Eberhardt et al. 1989). A significant downward trend was exhibited in many analytes, particularly ^{137}Cs.

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

Biota samples have been collected since 1978 from sixteen locations within or adjacent to the PUREX Plant Aggregate Area. Vegetation samples were collected from the same locations as the grid soil samples described in Section 4.1.1.2 (Plate 3). Average analytical results from 1985 through 1991 are compiled on Tables 4-12 and 4-13. The complete data set from this sampling is presented in Appendix A.2.

Vegetation samples have radionuclide concentrations that are slightly elevated above regional background, but have not exhibited statistically significant trends since 1979 (Schmidt et al. 1990). The most commonly detected radionuclides include ^{7}Be, ^{40}K, ^{99}Tc, and ^{106}Ru. Grid site 2E29, south of the 202-A Building, has usually had the highest ^{106}Ru concentrations in the area.

4.1.1.5 Vadose Zone. The extent of contamination in the vadose zone has been most extensively studied by geophysical well logging. This technique has been conducted in the PUREX Plant Aggregate Area since the late 1950's. Gross gamma-ray logs have been used since that time to evaluate radionuclide migration in the vadose zone beneath selected waste management units. However, very little gross gamma data have been published. Table 4-14 lists all of the logs that were reviewed as part of this study. The log interpretation generally consisted of identifying zones with anomalously high gamma-ray counts that could be indicative of radionuclide contamination. The depths, thicknesses, and intensities of these zones were then compared for logs from the same holes. Any significant changes may be indicative of contaminant migration in the vadose zone. Interpretations were complicated by the fact that logging equipment and procedures have evolved over time. Consequently, a standardized, comparative baseline for interpreting gamma log results is not available. The log interpretations are discussed in detail in Appendix A. The results of the log interpretations are also summarized with the appropriate waste management units in Section 4.1.2.

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

Waste management units that have received large volumes of liquid are more likely to have caused subsurface contaminant migration. The potential for liquid wastes to have migrated through the vadose zone to the groundwater was estimated by comparing the volume of waste discharged at each waste management unit to the estimated pore volume in the vadose zone soil column below the waste management unit. If the volume of liquid discharged to the ground is larger than the soil column pore volume, then it is likely that wastewater would reach the groundwater. These calculations are summarized on Table 4-15. They are based upon several conservative assumptions: (1) the discharged water does not spread out laterally from the point of discharge (i.e., the volume of affected vadose zone is equal to the depth to groundwater times the plan view cross-sectional area of the base of the waste management unit); (2) there is no significant change in liquid volume being introduced to the soil column due to evapotranspiration ; and (3) the average porosity of the soil column is between 0.10 and 0.30 (the upper and lower estimates shown on Table 4-15). If the amount of waste received was greater than the porosity (0.1) then the waste management unit was considered to have the potential to migrate to the groundwater. According to these calculations, 26 waste management units had the potential for the migration of liquid discharges to the unconfined aquifer from past operations. This analysis does not take into account long-term drainage which may be occurring at all units which received liquid waste.

As discussed in Section 3.0, perched water zones may form locally under waste management units with large liquid discharges. However, the occurrence of contaminated perched water has not been documented in the PUREX Plant Aggregate Area (Baker et al. 1988).

4.1.2 Site-Specific Data

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

4.1.2.1 Plants, Buildings, and Storage Areas. The Grout Treatment Facility (GTF) is the only structure within the PUREX Plant Aggregate Area to have site-specific data compiled for it. The GTF has five locations for soil and vegetation sampling, and three locations for TLD sampling. The greatest concentrations of radionuclides present in the soil sampling were ^{40}K at 15.1 pCi/g and ^{137}Cs at 1.93 pCi/g (Table 4-8). The greatest radionuclides present in the vegetation sampling were ^{40}K at 13.0 pCi/g, ^{7}Be at 3.22 pCi/g, and ^{99}Tc at 2.58 pCi/g (Table 4-12). The external radiation monitoring TLDs averaged 100, 104, and 194 mrem/yr for 1990 (Table 4-7).

4.1.2.2 Tanks and Vaults. The data available for the single-shell and double-shell tanks generally include: inventory information, limited waste sampling, surface radiological surveys, vadose zone well geophysics, and internal tank monitoring of chemical and physical

parameters. In the past, there has been less emphasis in characterizing the catch tanks, settling tanks, and vaults, and little information is available regarding these units. The following section is subdivided between single-shell and double-shell tanks, and other tanks to reflect this difference.

4.1.2.2.1 Single-Shell and Double-Shell Tanks. All of the single-shell and double-shell tanks in the PUREX Plant Aggregate Area are located within the boundaries of the tank farms (241-A, 241-AN, 241-AP, 241-AW, 241-AX, 241-AY, 241-AZ, and 241-C). The tank farms are characterized as an area of surface contamination and there is an area of active surface migration on the northern end of the tank farm properties.

There are twelve TLDs surrounding some of the 241-A, -AN, -AP, -AW, -AX, -AY, and -AZ Tank Farms. Four of the TLDs are located near the 241-A Tank Farm. The TLDs stationed on the western margin of the 241-A Tank Farm averaged between 224 and 220 mrem/yr between 1985 and 1989 (Table 4-6). During the same period, the southern-most station averaged 883 mrem/yr while the eastern-most station had the highest average of 2,585 mrem/yr. The monitoring period for 1990 saw a decrease in all stations with the exception of the TLD station on the southern margin of the 241-A Tank Farm. This station showed a slight average increase to 908 mrem/yr. These results are higher than any other monitoring location in the PUREX Plant Aggregate Area. The high annual dose rate is probably indicative of a combination of surface contamination in the tank farm area and some emissions from the tanks themselves. The upper surfaces of tanks 241-A-101 through 241-A-106 are all 2 m (7 ft) below grade so the waste contained within the tanks is largely, but not entirely shielded from the ground surface. There are no TLDs stationed close to the 241-AP and 241-AX Tank Farms nor are there any near the 241-C Tank Farm.

Surface radiation dose rate surveys are also performed regularly over the tank farm areas. The highest readings observed in the A tank farm during the September 1991 survey were 50,000 dis/min and 40 mrem/h over the 241-A-104 Single-Shell Tank and 50 mrad/h over the 241-A-101 Single-Shell Tank. The highest survey rate observed in the 241-AN Tank Farm was 20,000 dis/min between 241-AN-104 and 241-AN-105 Single-Shell Tanks, and a contact reading of 50 mrem/h on the 241-AN-105 Single-Shell Tank. The 241-AP Tank Farm had its highest contact reading on the 105-AP Valve Pit of 2.5 mrem/h. The 241-AW Tank Farm had two contact readings of 40 mrem/h with the 241-AW-101 Single-Shell Tank and the exhaust filter. There was also a dose rate reading of 50,000 dis/min on the ground under the deentrainer. The highest dose rate observed in the 241-AX Tank Farm was 20 mrem/h over the 241-AX-103 Single-Shell Tank. The 241-AY Tank Farm had its highest reading of 70 mrad/h on the plastic wrapped raiser over the 101-AY Tank. The 241-AZ Tank Farm's highest contact reading was 30 mrem/h on the 241-AZ-101 Single-Shell Tank. The 241-C Tank Farm had dose rates taken in the general area, on contact, and a scan at 0.3 m (1 ft). The highest general area dose rate was 110 mrem/h near the 241-C-105 Single-Shell Tank breather. The highest contact reading for the 241-C Tank Farm was 12 mrem/h on the 241-C-112 Single-Shell Tank observation port. The highest reading for a scan at 0.3 m (1 ft) was <1.0 mrem/h. These data were compiled

directly from the Supplemental Scheduled Radiation Survey Reports kept at the Tank Farm Health Physics Department for the 200 East Area.

Several studies have been conducted to estimate tank contents and the probability of their release to the environment. The primary potential release mechanisms are tank failure and leaking, and the potential buildup and ignition of flammable material in the tanks. Three of the six single-shell tanks in the 241-A Tank Farm, two of the four single-shell tanks in the 241-AX Tank Farm, and seven of the sixteen single-shell tanks in the 241-C Tank Farm have failed in the past, so it seems likely that some of the remaining tanks will fail in the future. Tank leaks are identified by monitoring liquid levels in the tanks and by running gamma logs in the monitoring wells surrounding each tank. There is less concern of potential release mechanisms for the double-shell tanks. All of them are of sound integrity. However, three of the tanks are on a watch list for potential buildup and ignition of flammable material (Hanlon 1992).

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

The TRAC inventory data are presented in Table 4-16. These data are for the total tank inventories and do not differentiate between drainable liquid and solids within the single-shell tanks. As shown in Table 2-4, some of the nonstabilized tanks still contain large volumes of liquid, drainable waste. It is the radionuclides that are partitioned to this liquid phase that are of primary concern should a tank begin to leak. From a comparison of solid and liquid phase data presented in an earlier TRAC report, it appears that ^{241}Am, ^{14}C, ^{135}Cs, ^{137}Cs, ^{93}Nb, ^{99}Tc, ^{79}Se, and ^{90}Sr are most strongly partitioned to the liquid phase in the tanks and would be the most likely radionuclides, present at high concentrations, to migrate in the event of a leak (Jungfleisch 1984).

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

The available waste tank sampling data are summarized in Tables 4-17 through 4-25. Table 4-17 contains the results of analysis of supernatant liquid from 241-AX-102 Single-Shell Tank. Based on available results, the solution contains chelating compounds (> 10g/L total organic carbon, TOC) and transuranic (> 100 nCi/g Pu + Am) waste. The isotopes with the highest concentration present in the 241-AX-102 Single-Shell Tank are ^{137}Cs and ^{90}Sr. Table 4-18 shows the results of analysis of volatile priority pollutants in vapor samples taken from 241-C-101 and 241-C-102 Single-Shell Tanks. The only analytes above detection level were benzene, tetrachloroethane, toluene, and 1,1,1-trichloroethane. Table 4-19 contains the results of analysis of vapor samples and a liquid sample from tank 241-C-103. The vapor samples only detected 1,1-dichloroethene, toluene, 1,1,1-trichloroethane and trichlorofluoromethane. No analytes were above the detection limit for the liquid sample from tank 241-C-103. Tables 4-20, 4-21, and 4-22 are results of an analysis of a core sample from the 241-C-103, 241-C-104, and 241-C-105 Single-Shell Tanks, respectively. Tables 4-23 (McCown 1988) and 4-24 (Walker 1977) show the results of an analysis of sludge samples from the 241-C-106 and 241-C-105 Single-Shell Tanks, respectively. The sludge was analyzed for organics and radionuclides. Finally, Table 4-25 shows the results of analysis from two double-shell tanks, 241-AY-101 and 241-AZ-102.

Chemical Explosion Potential. There are three possible mechanisms recognized as having chemical explosion potential for Hanford single-shell and double-shell tanks. The three are ferrocyanide in excess of 1,000 gram moles, hydrogen gas generation, and TOC greater than 3 wt%. None of the single-shell or double-shell tanks is suspected of having a ferrocyanide problem, but several have the potential to generate significant quantities of hydrogen gas (Hanlon 1992). A watch list has been generated by the U.S. Department of Energy (DOE) that ranks tanks according to their potential for explosion. The factors in this ranking include: surface level fluctuation, temperature, total curies of waste, organic content, volume of solids, waste type, pressurization, crust formation, and past flammable gas detections. Twelve tanks in the 241-A, 241-AX, 241-AN, and 241-C Tank Farms are on the hydrogen gas watch list 241-A-101, 241-AX-101, 241-AX-103, 241-C-103, 241-C-106, 241-C-108, 241-C-109, 241-C-111, 241-C-112, 241-AN-103, 241-AN-104, and 241-AN-105. There are a total of 53 tanks on the watch list.

The 241-C-103 Single-Shell Tank is on the watch list for tanks containing concentrations of organic salts greater than 3 wt% TOCs. The 241-C-106 Single-Shell Tank is on the watch list for tanks having a high heat load (>40,000 BTU/m). The 241-C-108 and -109 Single-Shell Tanks are on the watch list for tanks containing ferrocyanide (> 1,000 gram mole). These tanks have organic chemicals which are potentially flammable and mixtures of organic materials mixed with nitrate and nitrate salts can deflagrate.

Vadose Zone Well Geophysical Logging. Most of the single-shell and double-shell tanks are surrounded by an array of vadose zone wells. Gamma logging is performed on these wells on a regular basis to identify new tank leaks and to monitor the migration of existing contaminant releases to the soil. Table 4-26 summarizes the borehole geophysical data available for each tank

Single-Shell and Double-Shell Tanks Unplanned Releases. There are five unplanned releases associated with the single-shell tanks in the 241-A, -AX, and -C Tank Farms. There are no unplanned releases associated with the double-shell tanks. Four of these unplanned releases resulted from tank leaks (UPR-200-E-125, -126, -136, and -137) and one release occurred when an employee mistakenly pulled approximately 5 m (15 ft) of a contaminated electrode cable out of the 241-AX-104 Single-Shell Tank and set it on the ground (UPR-200-E-119). Most of the available information on these releases is summarized in Table 2-6. Cesium inventory data for each of the four tank leaks are summarized in Table 4-27.

4.1.2.2.2 Catch Tanks, Vaults, and Lift Stations. Very little data are available for the catch tanks and vaults. For most units the total volume of waste is known but there is no chemical or radiological information available. The vaults only transported waste; therefore, there is little volume, chemical, or radiological data available for these units.

4.1.2.2.2.1 244-AR Vault. There is no data available for the 244-AR Vault. However, there is data on an unplanned release that occurred at this unit.

Unplanned Release UPR-200-E-59 occurred in May 1979. Contaminated mud and tumbleweeds from the 216-A-40 Trench were used by swallows to build nests at the vault. The contaminated mud contained ^{137}Cs and ^{60}Co with reading of 10,000 to 20,000 ct/min. The nests were removed from the vault. The tumbleweeds were removed from the 216-A-40 Trench, packaged, placed in the burial ground, and the sides of the trench were washed and the contaminated mud was removed.

4.1.2.2.2.2 244-CR Vault. There is no data available for the 244-CR Vault. However, there is data available for two of the three unplanned releases that occurred at the unit.

Three unplanned releases (UN-200-E-27, UN-200-E-99, and UN-200-E-107) are associated with the 244-CR Vault. UN-200-E-27 occurred on November 1, 1960, east of the 244-CR Vault and extended several hundred feet beyond the limited area fence. Unknown beta/gamma readings were found near the vault on the order of 50 to 100 mR/h (WHC 1991a). Readings outside the fence area were up to 40,000 ct/min. Winds provided some spotty ground contamination beyond the area fence. No data were available for UN-200-E-99. On November 26, 1952, UN-200-E-107 occurred inside the 244-CR Vault. Contamination spread to the ground and equipment during a transfer installation in the 100-CR Tank. Approximately 71.4 L (18.9 gal) of contaminated tributyl phosphate waste from the 221-U Building was discharged before the pump could be shut off. A maximum reading of 4.2 rem/h at the surface and 200 mR/h at a depth of 5 cm (2 in.) was observed for the ground contamination.

4.1.2.2.2.3 244-A Lift Station. In 1991 special samples were collected from the 244-A Lift Station. Eight mice were analyzed for radionuclides and found to have strontium contamination ranging from less than detected to 2.46E+09 pCi/g.

Two unplanned releases are associated with this unit. In 1986 UN-200-E-100 occurred when an unknown amount of radioactive liquid was spilled. Contamination was detected surrounding the 244-A Lift Station. On October 15, 1984 UPR-200-E-70 occurred when contamination was spread during a jumper removal at the lift station. The contamination consisted of unknown beta/gamma with readings of 1,000 to 50,000 ct/min and an isolated area of 100,000 ct/min. The area was decontaminated to background levels and surface stabilized.

4.1.2.3 Crib and Drains. The types of information available for the cribs and drains include inventory data, radiological survey results, and borehole geophysical data. Soil, vegetation, and air monitoring data are generally unavailable for these waste management units. Inventory and radiological information have largely been compiled from the WIDS sheets (WHC 1991a) and the HISS database (DOE 1986) entries.

4.1.2.3.1 216-A-1 Crib. This is an inactive waste management unit. It is currently barricaded as a surface contamination site.

The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.1, approximately 98,400 L (25,997 gal) of uranium waste was discharged to the crib (DeFord 1991). The waste contained ^{137}Cs, ^{106}Ru, and ^{90}Sr. In 1984 a few spots were found reading 90,000 ct/min. In 1990, 3,000 dis/min (beta) spots were found, but in 1991 a surface radiological survey showed the area to be below detection limits.

Grid sampling site 2E24 is near the 216-A-1 Crib. This site was monitored for external radiation, vegetation sampling, and grid soil sampling. The external radiation monitoring TLDs averaged 111 mrem/yr for 1985 to 1989 (Table 4-6). The greatest concentration of radionuclides present in the vegetation sampling were ^{40}K at 13.0 pCi/g, ^{7}Be at 3.23 pCi/g, and ^{106}Ru at 2.25 pCi/g (Table 4-12). The greatest radionuclide concentrations detected in the grid soil sampling were ^{137}Cs at 5.49 pCi/g, and ^{40}K at 13.7 pCi/g (Table 4-8).

4.1.2.3.2 216-A-2 Crib. This is an inactive waste management unit. It is currently marked as a surface contamination site.

The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.2, approximately 230,000 L (60,766 gal) of organic waste containing normal paraffin hydrocarbons and tributyl phosphate was discharged to the crib (DeFord 1991). The radioisotopes thought to be present are ^{137}Cs, ^{106}Ru, and ^{90}Sr. The 1990 radiological survey did not identify any areas of surface contamination at this site.

4.1.2.3.3 216-A-3 Crib. This is an inactive waste management unit. Inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.3, the crib received over 3,000,000 L (800,000 gal) of waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. The unit is monitored annually and no contamination was detected in the 1990 survey. The unit received waste from silica-gel regeneration, uranyl nitrate hexahydrate, liquid waste, liquid drainage, and heating soil condensate.

4.1.2.3.4 216-A-4 Crib. This is an inactive waste management unit. Inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.4, the crib received 6,210,000 L (1,640,000 gal) of laboratory cell drainage waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr.

Two unplanned releases (UN-200-E-13 and UN-200-E-15) are associated with this crib. Unplanned release UN-200-E-13 occured in December 1958 when the crib became plugged and flooded an area between the unit and the 291-A Stack, contaminating the ground surface. UN-200-E-15 occurred January 21, 1959, when the crib became plugged during the jetting of the 216-A-2 Catch Tank. Ground contamination up to 8 R/h unknown beta/gamma was measured (WHC 1991a).

4.1.2.3.5 216-A-5 Crib. This is an inactive waste management unit. Inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.5, the crib received 1,630,000,000 L (431,000,000 gal) of acidic waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. Data from Wells 299-E24-1, 299-E24-10, 299-E24-56, 299-E24-57, and 299-E24-58 indicate that breakthrough to the groundwater could have occurred. In November 1983, the unit was stabilized when PUREX Plant exclusion area fences were installed (WHC 1991a). No contamination was detected in the 1989 radiological survey.

4.1.2.3.6 216-A-6 Crib. This is an inactive waste management unit. Inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.6, the crib received 3,400,000,000 L (900,000,000 gal) of waste containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. The radiation zone denoting this crib was enlarged to include a contaminated ground surface northeast of the unit.

This waste management unit has an unplanned release (UPR-200-E-21). It was an overflow from the crib that contaminated the soil adjacent to the crib with unknown beta/gamma reading to 500 mR/h. Almost two years later another unplanned release occurred (UPR-200-E-29). This release was also an overflow from the crib with unknown beta/gamma with readings to 30 R/h at 1.2 m (4 ft). After both of these releases, the ground was covered and the liquid level risers were filled with concrete. The valve station is barricaded with surface contamination placards and the crib is posted with both surface and underground radiation contamination signs. The 1990 radiological survey identified a new area of contamination of 2,000 to 5,000 dis/min (WHC 1991a).

Grid sampling site 2E30 is just south of the 216-A-6 Crib. This site was monitored for external radiation, vegetation sampling, and grid soil sampling. The external radiation monitoring TLDs averaged 80 mrem/yr for 1985 to 1989 (Table 4-6). The greatest concentration of radionuclides present in the vegetation sampling were ^{40}K at 10.9 pCi/g, ^{7}Be at 1.5 pCi/g, and ^{106}Ru at 1.73 pCi/g (Table 4-12). The greatest radionuclide concentration detected in the grid soil sampling was ^{40}K at 13.5 pCi/g (Table 4-8).

Site 2E-3 is also near the 216-A-6 Crib where fenceline soil sampling was taken. The radionuclide with the highest concentration was ^{40}K at 14.3 pCi/g (Table 4-9).

4.1.2.3.7 216-A-7 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.7, the crib received 326,000 L (86,000 gal) of waste expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. In 1990 and 1991, spots of contamination with readings up to 30,000 dis/min (beta) were found (WHC 1991a). The surface radiation is generally at background levels, but radioactive tumbleweed are found occasionally.

4.1.2.3.8 216-A-8 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.8, the crib received 1,150,000,000 L (304,000,000 gal) of waste containing ^{137}Cs, ^{3}H, ^{106}Ru, and ^{90}Sr. In 1988, weeds with 500 to 20,000 ct/min, and soil with 400 to 70,000 ct/min, were found onsite. Contamination on risers was detected in 1990, but in 1991 the risers were below detection limit. The site surface was stabilized in September 1988. According to Tri-Party Agreement milestone M-17-28, all discharge to the 216-A-8 Crib was to cease September 1991. There shall be no further soil column discharge to this unit until BAT/AKART is implemented. In the interim, effluent will be routed to the double-shell tanks. Following implementation of BAT/AKART and approval of the sampling and nnalysis plan, discharge to the crib may resume if supported by the environmental impact assessment agreed to by the Washington State Department of Ecology, Department of Energy, and Environmental Protection Agency (Ecology et al. 1992).

External radiation monitoring was taken at two sites within the 216-A-8 Crib area. From 1985 to 1989 the average TLD readings for site No. 1 was 106 mrem/yr, and for site No. 2 was 124 mrem/yr (Table 4-6). In 1990 the sampling sites were designated as 216-A-8 S and 218-A-8 E. The average TLD readings for 216-A-8 S was 106 mrem/yr, and for 216-A-8 E was 121 mrem/yr (Table 4-7).

4.1.2.3.9 216-A-9 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.9, the crib received 981,000,000 L (259,000,000 gal) of waste containing the following radionuclides: ^{137}Cs, ^{106}Ru, and ^{90}Sr. The monitoring Wells 299-E-24-3 and 299-E-24-4 detected elevated radiation levels in 1963, yet by 1976 the radiation level was near background. The April 1990 surface radiological survey found one spot with a level of 3,000 dis/min, which is an increase from 1989.

Grid sampling site 2E23 is near the 216-A-9 Crib. This site was monitored for external radiation, vegetation sampling, and grid soil sampling. The external radiation monitoring TLDs averaged 103 mrem/yr for 1985 to 1989 (Table 4-6). The greatest concentration of radionuclides present in the vegetation sampling were ^{106}Ru at 3.25 pCi/g, and ^{99}Tc at 1.1 pCi/g (Table 4-12). The greatest radionuclide concentrations detected in the grid soil sampling were ^{137}Cs at 9.97 pCi/g, and ^{90}Sr at 2.2 pCi/g (Table 4-8).

One unplanned release is associated with this crib. On March 20, 1964, Unplanned Release UN-200-E-33 occurred when a leaking tube bundle burial box in transit to a burial ground contaminated a portion of the railroad right-of-way and an area adjacent to the 216-A-9 Crib. The site was surface stabilized in 1981.

4.1.2.3.10 216-A-10 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.10, the crib received a total of 3,210,000,000 L (848,000,000 gal) of waste containing ^{241}Am, ^{137}Cs, ^{3}H, ^{129}I, ^{147}Pm, ^{238}Pu, ^{239}Pu, ^{214}Pu, ^{106}Ru, and ^{90}Sr. Surveillance information suggests that since the beginning of 1984, ^{3}H concentrations beneath the site have been increasing for the first time since PUREX resumed operations. Nitrate concentrations have also been continually increasing since March 1984, tripling since September 1985. Measurements of alpha radiation in well number 299-E24-02 have increased sixfold since September 1985, and are presently twice the ^{238}U concentration limit. The nitrate level is currently fluctuating at about five times the drinking water standards since June 1985. However, no surface contamination was identified by the 1990 radiological survey.

External radiation monitoring was taken at two sampling sites within the 216-A-10 Crib area and at one site near the crib, Site 2E29. From 1985 to 1989 the average TLD readings for Site No.1 was 88 mrem/yr, Site No.2 was 82 mrem/yr, and Site 2E29 was 80 mrem/yr (Table 4-6). In 1990, only Sites No.1 and No.2 were sampled for external radiation. The average TLD readings for 216-A-10 No.1 was 99 mrem/yr, and for 216-A-10 No.2 was 107 mrem/yr (Table 4-7).

Sampling site 2E29 also had vegetation sampling and grid soil sampling. The greatest concentration of radionuclides present in the vegetation sampling were ^{40}K at 14.9 pCi/g, and ^{106}Ru at 3.33 pCi/g (Table 4-12). The greatest radionuclide concentrations detected in the grid soil sampling were ^{40}K at 15.4 pCi/g, and ^{137}Cs at 2.62 pCi/g (Table 4-8).

4.1.2.3.11 216-A-21 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.11, the crib received a total of 77,900,000 L (20,581,242 gal) of sump waste and cell drainage expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. The unit was taken out of service in June 1958 for six months when a vitrified clay distribution pipe failed. The waste volume and waste inventory indicate breakthrough to groundwater has most likely not occurred. However, direct contamination was identified on the riser closest to the crib vent during the 1990 radiological survey. The contamination level was 15,000 dis/min (beta-gamma).

4.1.2.3.12 216-A-24 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Table 2-2 and 2-3. As detailed in Section 2.3.3.12, the crib received 820,000,000 L (216,644,650 gal) of condensate from the waste storage tanks in the 241-A and 241-AX Tank Farms containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. Because of inadvertent use, the radionuclide inventory is unknown for 1967 through 1979. In September 1990 the surface of the waste management unit was stabilized.

On June 13, 1979, unplanned release UN-200-E-56 occurred. Contaminated soil was found during an excavation for clean soil near the crib. Unknown beta/gamma readings up to 8,000 ct/min were measured (WHC 1991a).

Sampling of rabbitbrush plants for radioactivity on the 216-A-24 Crib detected higher concentrations of primarily ^{137}Cs than other plant parts. Concentrations of ^{137}Cs in leaves averaged 145 nCi/g (Dry Weight) and those for ^{90}Sr averaged 0.316 nCi/g (Dry Weight). Cesium-137 was detectable in the upper 1 cm (0.3 in.) of soil; however, at the 15 cm (6 in.) depth, ^{137}Cs was not detectable. Consequently, deep excavation may not be required for decontamination (Klepper et al. 1979).

Some insect and mammal samples collected on the crib contained ^{137}Cs. Those insect species associated with a rabbitbrush shrub containing ^{137}Cs and its litter showed higher levels of ^{137}Cs than other wider-ranging species caught in pitfall traps and by hand. Mammal samples of pocket mice indicated detectable amounts of ^{137}Cs with 70% of the total body burden in the muscle and skeleton (Klepper et al. 1979).

Data from wells 299-E26-2,-3,-4,-5, and -7 indicate that breakthrough to groundwater could have occurred from the first and second sections of the unit. Prior to 1988, radiation surveys identified brush with up to 30,000 ct/min (beta). Since then, the crib area has generally been below detectable limits. The unit was surface stabilized in 1988.

Grid sampling site 2E18 is just west of the 216-A-24 Crib. This site was monitored for external radiation, vegetation sampling, and grid soil sampling. The external radiation monitoring TLDs averaged 111 mrem/yr for 1985 to 1989 (Table 4-6). The greatest concentration of radionuclides present in the vegetation sampling were ^{40}K at 14.5 pCi/g, and ^{7}Be at 2.63 pCi/g (Table 4-12). The greatest radionuclide concentrations detected in the grid soil sampling were ^{40}K at 15.1 pCi/g, and ^{137}Cs at 6.24 pCi/g (Table 4-8).

There are also two fenceline soil sampling sites near the 216-A-24 Crib. Site A-TF-E2 is northwest of the crib and Site A-TF-E3 is just west of the crib. The radionuclides with the highest concentrations at Site A-TF-E2 were ^{137}Cs at 7.29 pCi/g, and ^{40}K at 13.9 pCi/g. The radionuclides with the highest concentrations at Site A-TF-E3 were ^{137}Cs at 10.3 pCi/g, and ^{40}K at 15.1 pCi/g (Table 4-9).

4.1.2.3.13 216-A-27 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.13, the

crib received 23,200,000 L of waste expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. Data from Wells 299-E17-2 and 299-E17-3 indicate that breakthrough to groundwater has not occurred at this site and the 1990 radiological survey did not detect any contamination (WHC 1991a).

4.1.2.3.14 216-A-30 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.14, the crib received over 7,000,000,000 L (1,849,405,548 gal) of waste containing ^{241}Am, ^{137}Cs, ^{3}H, ^{147}Pm, ^{239}Pu, ^{106}Ru, ^{113}Sn, and ^{90}Sr. During the winter of 1971 to 1972, an alkaline deposit formed over the surface of the crib. It appeared to be a salt deposit condensing out of vapors being emitted from the unit through the porous soil. In June 1972, the ground was covered with layers of sand and plastic. A surface radiological survey in 1990 did not find any evidence of radioactivity above detection limits.

External radiation monitoring was performed at two sites within the 216-A-30 Crib area. From 1985 to 1989 the average TLD readings for Site No.1 was 87 mrem/yr, and for Site No.2 was 84 mrem/yr (Table 4-6).

4.1.2.3.15 216-A-31 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.15, the crib received 10,000 L (2,642 gal) of neutral organic waste from the 202-A Building. The waste was expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. The waste inventory and the waste volume indicate that no breakthrough to groundwater has occurred and no surface contamination was detected during the 1988 radiological survey.

4.1.2.3.16 216-A-32 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.16, the crib received approximately 4,000 L (1,057 gal) of waste expected to contain less than 1 Ci total beta activity (WHC 1991a). There was intent to dispose of 246,025 L (65,000 gal) of 50% kerosene diluent in this crib. To this date, this proposed disposal has not been confirmed as having taken place and there will be no future disposal of waste to this crib. The 1990 radiological survey failed to identify any contamination at this unit.

4.1.2.3.17 216-A-36A Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.17, the crib received 1,070,000 L (282,695 gal) of ammonia scrubber waste. The waste was expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. The site was deactivated soon after initial operation when it became too radioactively contaminated for further use. Data from monitoring wells indicate breakthrough to the groundwater could have occurred at this unit (Fecht et al. 1977). The 1990 radiological survey did not identify any area of contamination.

4.1.2.3.18 216-A-36B Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.18, the crib received 317,000,000 L (83,751,651 gal) of waste expected to contain ^{241}Am, ^{137}Cs, ^{3}H, ^{239}Pu, ^{241}Pu, ^{106}Ru, ^{113}Sn, and ^{90}Sr. The waste, ammonia scrubber

distillate as, came from the PUREX fuel-element decladding operations. The crib operated until 1987 when sampling and analysis of the ammonia scrubber distillate confirmed the presence of ammonium hydroxide in concentrations exceeding the State of Washington Department of Ecology Dangerous Waste Regulations (Chapter 173-303 Washington Administrative Code, WAC). The criteria for waste designation is WAC 173-303-070. Since then no waste has been discharged to the crib.

Table 4-28 shows data collected from three groundwater sampling locations, included is organics, pH, alkalinity, conductivity, ^{3}H, cations, and anions. Highest concentrations found in the groundwater were calcium, potassium, sodium, silicon and nitrate (Buelt et al. 1988).

Table 4-29 is a list of the waste inventory for the 216-A-36B Crib. The inventory includes volume, Pu, beta, ^{90}Sr, ^{106}Ru, ^{137}Cs, and ^{238}U for 1966 through 1972 and 1981 through 1987, excluding 1982. Over the years the quantities of radionuclides have had a decreasing trend. Table 4-30 shows the average concentrations of radiological parameters for PUREX ammonia scrubber waste effluent and groundwater near the 216-A-36B Crib from 1983 to 1987. Two monitoring wells were sampled for total alpha, total beta, ^{3}H, ^{90}Sr, ^{137}Cs, ^{106}Ru, ^{60}Co, uranium, and nitrate. The concentrations generally increased from 1984 to 1985 and then began to decrease again. Table 4-31 shows groundwater parameters measured in Wells 299-E17-5 and 299-E17-9. The parameters measured included ammonia, fluoride, nitrate, pH, TOC, chloride and conductivity. Most of the ammonia and fluoride readings were below detection, nitrate ranged from 89.5 to 261.0 ppm, and TOC ranged from 0.414 to 0.763 ppm (WHC 1988b).

Data from Well 299-E17-05 shows total alpha and total uranium concentrations are two times the concentration limit from ^{238}U. However, concentration of isotopes are below concentration limits. There is an increasing trend in ^{3}H since August 1984, and NO_3 from June 1984 to February 1985. Nitrate currently fluctuates around two times the drinking water standards. However, no surface contamination was detected during the 1990 survey.

External radiation monitoring was performed at two sampling sites within the 216-A-36B Crib area. In 1990 the average TLD readings for Site No.1 was 100 mrem/yr, and for Site No. 2 was also 100 mrem/yr (Table 4-7).

On February 6, 1968, unplanned release UN-200-E-39 occurred on the blacktop outside the 216-A-36B Crib sample shack. Pressured ammonia scrubber waste containing fission products was inadvertently released through the vent at the sampling shack over an area 8 x 8 m (26 x 26 ft). The readings were 20 to 450 mR/h (WHC 1991a). On August 5, 1968, unplanned release UN-200-E-40 occurred on the blacktop outside the 216-A-36B Crib sample shack. A vent line valve at the shack was inadvertently left open and contaminated the blacktop over a 8 m^2 (50 ft^2) area. Unknown beta/gamma readings to a maximum of 150 mR/h were measured (WHC 1991a).

4.1.2.3.19 216-A-37-1 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.19, the crib receives process condensate from the 242-A Evaporator. The 1990 annual radiological survey indicates a total volume of 377,000,000 L (99,603,699 gal) of waste received by the crib. The waste contains ^{241}Am, ^{137}Cs, ^{3}H, ^{129}I, ^{147}Pm, ^{239}Pu, ^{106}Ru, ^{113}Sn, and ^{90}Sr. Data from Well 299-E25-19 showed an increase in beta activity (excluding tritium) over the last seven months of 1985, but limits have not been exceeded. Tritium showed a decrease from April to October of 1985. The November 1985 sample was twice as high as the previous month and has shown an increase since then. Nitrate remains between two and four times the drinking water standards. Well 299-E25-20 shows that a decreasing trend of ^{3}H has been exhibited since February 1985. In August 1986 nitrate remained between three and five times the drinking water standard. A surface radiation survey did not detect any contamination (WHC 1991a). The crib surface is moderately covered with deep and shallow rooted vegetation.

External radiation monitoring was performed at one sampling site within the 216-A-37-1 Crib area. From 1985 to 1989 the average TLD reading was 87 mrem/yr (Table 4-6).

4.1.2.3.20 216-A-37-2 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.20, the crib received 1,090,000,000 L (287,978,864 gal) of waste expected to contain ^{241}Am, ^{137}Cs, ^{147}Pm, ^{239}Pu, ^{106}Ru, ^{113}Sn, and ^{90}Sr. The radionuclide inventory has been included in the inventory for the 216-A-30 Crib since the fourth quarter of 1983. The 1991 radiological survey found contamination at levels of 500 dis/min (alpha) and 20 dis/min (beta). The 1990 radiation survey results were below detection limits (WHC 1991a).

External radiation monitoring was performed at one sampling site within the 216-A-37-2 Crib area. From 1985 to 1989 the average TLD reading was 88 mrem/yr (Table 4-6).

4.1.2.3.21 216-A-38-1 Crib. This crib was never activated. It is discussed in detail in Section 2.3.3.21. It was intended to receive the liquid process condensate waste discharged to the 261-A-10 Crib, but was instead sent to the 216-A-45 crib.

4.1.2.3.22 216-A-39 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.22, the crib only received 20 L (5.3 gal) of floor drainage waste. The waste is expected to contain ^{137}Cs.

4.1.2.3.23 216-A-41 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.23, the crib received 10,000 L (2,642 gal) of drainage waste from the 244-AR vault's 296-A-13 Stack. The waste is slightly acidic and expected to contain less than 1 Ci total beta

activity (WHC 1991a). Exact location of this site has not been confirmed; several temporary buildings are located in the vicinity of the crib at the present time.

4.1.2.3.24 216-A-45 Crib. This is an inactive waste management unit. The inventory data for this unit are summarized in Tables 2-2 and 2-3. As detailed in Section 2.3.3.24, the 1990 survey indicates that this unit has received a total of 103,000,000 L (27,212,682 gal) of process condensate waste. The waste contains ^{241}Am, ^{137}Cs, ^{3}H, ^{129}I, ^{147}Pm, ^{238}Pu, ^{239}Pu, ^{241}Pu, ^{106}Ru, ^{113}Sn, and ^{90}Sr. The 1990 radiological survey did not identify areas of contamination at this site.

4.1.2.3.25 216-A-11 French Drain. This is an inactive waste management unit. It received a total of 100,000 L (26,420 gal) of drainage waste expected to contain less than 50 Ci total beta activity (WHC 1991a). The 1990 radiological survey did not identify any surface contamination.

4.1.2.3.26 216-A-12 French Drain. This is an inactive waste management unit. It received a total of 100,000 L (26,420 gal) of drainage waste expected to contain less than 50 Ci total beta activity (WHC 1991a). There has been no contamination detected or any change in activity between the 1987 survey and the 1988 survey.

4.1.2.3.27 216-A-13 French Drain. This is an inactive waste management unit. As detailed in Section 2.3.3.27, it received a total of 100,000 L (26,420 gal) of seal water expected to contain less than 1 Ci total beta activity (WHC 1991a). The base of the drain is in common with the underground radiation zone associated with the 216-A-35 French Drain. The 1990 survey did not detect any surface contamination.

4.1.2.3.28 216-A-14 French Drain. This is an inactive waste management unit. It received 1,000 L (305 gal) drainage waste containing less than 1 Ci total beta activity (WHC 1991a). The 1990 radiological survey identified spots of 56,000 dis/min (alpha) and 20,000 dis/min (beta) direct contamination. Smearable contamination of 700 dis/min (alpha) was also detected.

4.1.2.3.29 216-A-15 French Drain. This is an inactive waste management unit. It received 10,000,000 L (2,642,008 gal) of drainage waste containing less than 50 Ci total beta activity (WHC 1991a). This unit is also registered as an underground injection well. No surface contamination was detected during the 1988 annual radiological survey.

4.1.2.3.30 216-A-16 French Drain. This is an inactive waste management unit. It received 122,000 L (32,232 gal) of waste expected to contain less than 10 Ci total beta activity (WHC 1991a). Currently there is no piping, or other surface feature, to indicate the location of this drain.

4.1.2.3.31 216-A-17 French Drain. This is an inactive waste management unit. It received 60,000 L (15,852 gal) of waste expected to contain less than 1 Ci total beta activity (WHC 1991a).

4.1.2.3.32 216-A-22 French Drain. This is an inactive waste management unit. It received 10,000 L (2,642 gal) of drainage containing less than 1 Ci total beta activity (WHC 1991a). The 1988 radiological survey did not detect any surface contamination or any change from the last survey in 1987.

The 216-A-22 French Drain has one unplanned release associated with it: UPR-200-E-17. The release occurred when a crib inlet failed and contaminated the soil on top of the crib. The waste type and amount deposited during the spill is unknown.

4.1.2.3.33 216-A-23A French Drain. This is an inactive waste management unit. It received 6,000 L (1,585 gal) of waste expected to contain less than 50 Ci total beta activity (WHC 1991a).

4.1.2.3.34 216-A-23B French Drain. This is an inactive waste management unit. It received 6,000 L (1,585 gal) of waste containing less than 5 Ci total beta activity (WHC 1991a).

4.1.2.3.35 216-A-26 French Drain. This is an inactive waste management unit. The unit has been receiving floor drainage containing less than 1 Ci of total beta activity (WHC 1991a). The 1990 radiological survey did not identify any surface contamination.

4.1.2.3.36 216-A-26A French Drain. This is an inactive waste management unit. It has received 1,000 L (304.8 gal) of waste containing less than 1 Ci total beta activity (WHC 1991a). The construction design is the same as the 216-A-26 French Drain. The 1990 radiological survey did not identify any surface contamination. This unit cannot be distinguished from the 216-A-26 French Drain from indications at the surface.

4.1.2.3.37 216-A-28 French Drain. This is an inactive waste management unit. It has received 30,000 L (7,926 gal) of waste.

In 1981, the center of the unit was excavated and disposed of prior to installation of a PUREX Plant security system. After the security system was installed and the unit backfilled to grade, no posting or identification markers were placed at the french drain. Currently, the french drain is inside a posted surface contamination area immediately north of the uranyl nitrate hexahydrate tanks and south of the security fence. The 1988 survey did not identify any surface contamination at this unit. However, during the 1990 radiological survey direct readings of 10,000 dis/min (beta-gamma) and 2,300 dis/min (alpha) were identified.

4.1.2.3.38 216-A-33 French Drain. This is an inactive waste management unit. It was designed to receive bearing cooling waste from the 291-A-1 Stack electrical exhaust

fans. However, no coolant was ever used; therefore, no waste was ever discharged to this unit. The 1990 radiological survey did not detect any contamination at this french drain.

4.1.2.3.39 216-A-35 French Drain. This is an inactive waste management unit. It received 10,000 L (2,642 gal) seal cooling water from the air sampler vacuum pumps in the 202-A Building. The waste is expected to contain less than 1 Ci total beta activity (WHC 1991a). The drain is marked by a large diameter yellow concrete pipe with a "confined space" warning posted; however, there are no identification posts. It is as in the same posted radiation zone as the 216-A-13 French Drain. No contamination was detected in the 1990 radiological survey.

4.1.2.3.40 216-C-8 French Drain. This is an inactive waste management unit. It received an unknown volume of ion-exchange waste from the 271-C Building. The waste is expected to contain less than 10 Ci total beta (WHC 1991a). The 1988 survey identified 2,000 ct/min contamination on the surface. The french drain was surface stabilized in April 1991 and is posted "Underground Radioactive Material."

4.1.2.4 Reverse Wells. Well 299-E24-111 is the only injection well in the PUREX Plant Aggregate Area. It is located just west of the 216-A-38-1 Crib and has similar functions to a reverse well. The unit received eleven 3,785 L (1,000 gal) injections of uniform solutions of calcium chloride, calcium nitrate and selected tracers composed of ^{134}Cs and ^{90}Sr. The well was built for testing purposes only and was never activated to accept waste from any operations on the Hanford Site. No analytical data are available.

4.1.2.5 Ponds, Ditches, and Trenches. The PUREX Plant Aggregate Area has two ditches, 216-A-29 and 216-A-34, and four trenches, 216-A-18 through -20 and 216-A-40. A series of sediment and vegetation samples have been analyzed from these waste management units.

4.1.2.5.1 216-A-29 Ditch. This is an inactive waste management unit. The ditch was surface stabilized in July through October 1991. The depth of the ditch varies from 0.6 to 4.6 m (2 to 15 ft). This unit received discharge from PUREX Plant chemical sewer that was composed of acid fractionator condensate, demineralizer recharge effluents, nonprocess steam condensate, and chemical storage tank overflows. The waste from the PUREX Plant was directed to the 216-B-3-3 Ditch which leads to the 216-B-3 Pond, which is active. The flow rates varied from approximately 378 to 5,290 L/min (100 to 1,400 gal/min). Average flow was about 3,670 L/min (970 gal/min). Discharges of sodium hydroxide and sulfuric acid solution occurred on a daily basis until February 1986.

Known and potential discharges include demineralizer regenerant, oxalic acid, nitric acid, hydrogen peroxide, calcium nitrate, potassium permanganate, sodium carbonate solution, hydrate solution, potassium hydroxide, sodium nitrate, sodium hydroxide, cadmium nitrate, and hydrazine. The majority of these discharges were Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) reportable releases. The document

216-A-29 Ditch Preliminary Closure/Post-Closure Plan has a table of a single sampling period of organics and inorganics in the PUREX chemical sewer (DOE/RL 1987). These could possibly have been in the discharge to the 216-A-29 Ditch.

The U.S. Department of Energy, Richland Operations Office (DOE/RL 1987) has a plan to administer the unit so that any future releases are within acceptable limits and will not harm the public or the environment. The general closure plan involves several steps, some of which have already been initiated as a demonstration of DOE/RL intent. The general steps are the following:

(1) Discontinue discharges of hazardous materials to the facility

(2) Sample site soils and sediments

(3) Analyze soil and sediment samples for hazardous components

(4) Close facility under Resource Conservation and Recovery Act (RCRA) (inventory removal/decontamination or alternate closure option).

Within the 216-A-29 Ditch area surface water sampling and aquatic vegetation sampling was conducted. The surface water sampling looked for total beta, total alpha, ^{137}Cs, and ^{90}Sr. From 1985 to 1990 the majority of the readings were below detection limit (Table 4-10). The aquatic vegetation sampling was conducted from 1985 to 1989 and looked for the following radionuclides: ^{214}Bi, ^{134}Cs, ^{212}Pb, ^{214}Pb, ^{239}Pu, ^{106}Ru, ^{125}Sb, ^{90}Sr, ^{208}Tl, and U. The highest readings were ^{137}Cs at 36 pCi/g, ^{239}Pu at 8.3 pCi/g, ^{106}Ru at 280 pCi/g, and ^{125}Sb at 19 pCi/g.

In 1991, vegetation samples were collected at the head end of the 216-A-29 Ditch. The maximum uranium concentrations were 0.15 pCi/g of ^{234}U, 0.005 pCi/g of ^{235}U, 0.04 pCi/g of ^{238}U, or 0.2 pCi/g total uranium. This total concentration is 6 times greater than the reported in the previous year.

In early spring 1991, samples were taken of soil and trees to determine the possible radionuclide uptake. Samples were collected of the surrounding surface soils, new growth limbs and leaves, and cores taken from the trunks of trees. Six sample points were chosen, three from each side: two at the north end of the ditch, two from the midsection, and two from the south end. Soil had a maximum value of 2.3 pCi/g of ^{137}Cs, $<$ 0.28 pCi/g of ^{239,240}Pu, 0.65 pCi/g of ^{90}Sr, and 5.5(E-07) g/g of uranium. The grid soil and vegetation sampling location that correlates to the 216-A-29 Ditch is sample location 92. Appendix A-2 lists complete sampling data.

Water samples were also collected in 1991 from the 216-A-29 Ditch. The average pH value was 7.7. Aquatic vegetation samples collected in 1991 indicated the presence of

uranium at 2.9E-07 g/g and ^{90}Sr at 0.44 pCi/g. Sediment samples collected indicated uranium at 1.1E-06 g/g, ^{137}Cs at 3.3 pCi/g, ^{90}Sr at 0.65, and plutonium below the detection limit.

4.1.2.5.2 216-A-34 Ditch. This is an inactive waste management unit. The ditch contains an inlet pipe which is placed 0.6 m (2 ft) below grade. This unit has been designated as an underground contamination site. No unit specific sampling data is available for the 216-A-34 Ditch.

4.1.2.5.3 216-A-18 Trench. This is an inactive waste management unit. The trench was 4.6 m (15 ft) deep. The trench received the depleted uranium waste from the cold start-up run at the 202-A Building. It was surface stabilized in September 1990. The inventory for the trench is summarized in Tables 2-2 and 2-3. The trench received waste containing nitrate, ^{137}Cs, ^{106}Ru, ^{90}Sr, plutonium, and gross uranium. The trench was deactivated by removing the overground piping and backfilling the excavation after the specific retention capacity was reached (WHC 1991a). The trench was surface stabilized in September 1990.

4.1.2.5.4 216-A-19 Trench. This is an inactive waste management unit. The trench was 4.6 m (15 ft) deep. The trench received contact condenser cooling water via the 216-A-34 Ditch and the depleted uranium waste from the cold start-up run at the 202-A Building. The inventory for the trench is summarized in Tables 2-2 and 2-3. The trench received waste containing nitrate, ^{137}Cs, ^{106}Ru, ^{90}Sr, plutonium, and gross uranium. The trench was deactivated by removing the overground piping and backfilling the excavation after the specific retention capacity was reached (WHC 1991a). The site was surface stabilized in September 1990.

4.1.2.5.5 216-A-20 Trench. This is an inactive waste management unit. The trench was 4.6 m (15 ft) deep. The trench received the 241-A-431 Building contact condenser cooling water via the 216-A-34 Ditch, and the depleted uranium waste from the cold start-up run at the 202-A Building. This unit received the same waste as the 216-A-19 Trench. The inventory for the trench is summarized in Tables 2-2 and 2-3. The trench received waste containing nitrate, ^{137}Cs, ^{106}Ru, ^{90}Sr, plutonium, and gross uranium. The trench was deactivated by removing the overground piping and backfilling the excavation after the specific retention capacity was reached (WHC 1991a). The site was surface stabilized in September 1990.

4.1.2.5.6 216-A-40 Trench. This is an inactive waste management unit. This trench is 4.9 m (16 ft) deep. The unit contains three large sealed bladders designed for storing effluents. A pipe runs through the trench horizontally 3.7 m (12 ft) below grade. The trench received the diverted cooling water and steam condensate from the 244-AR Vault. The trench is enclosed within a box-wire fence.

The inventory for the 216-A-40 Trench is summarized in Table 2-3. The trench received waste containing nitrate. Survey data form 1990 indicated gross contamination up to 3.5 mrem/hr which signified an increase in activity since the 1989 survey.

One unplanned release is associated with this unit. On May 23, 1979 Unplanned Release UPR-200-E-59 occurred when contaminated mud and tumbleweeds from the 216-A-40 Trench were used by swallows to build nests at the 244-AR Vault. Cleanup actions included removing the tumbleweeds from the trench, washing the sides of the trench, and removing the contaminated mud.

4.1.2.6 Septic Tanks and Associated Drain Fields. None of the septic tanks and drain fields are thought to have received any hazardous waste so there is no significant sampling information available.

4.1.2.7 Transfer Facilities, Diversion Boxes, and Pipelines. The types of information available for the transfer facilities include surface radiological surveys. Radiological and chemical inventory, soil, vegetation, and air data are not available for these units. Only one unit (216-A-524 Control Structure) has survey data. Several unplanned releases are associated with the diversion boxes.

The 241-A-151 Diversion Box has four unplanned releases associated with it. Unplanned release UN-200-E-25 occurred on September 5, 1960 when leakage from the diversion box contaminated an area southwest of the 202-A Building. The contamination consisted of unknown beta/gamma with readings up to 100,000 ct/min (WHC 1991a). Unplanned release UN-200-E-26 occurred on September 30, 1960 when leakage from the diversion box caused an operator to stop transfer, however, the process tank emptied and steam blew out of the jumper connection. The contamination consisted of unknown beta/gamma with readings from 1 to 3 mR/h near the diversion box and just outside the exclusion fence. General contamination was up to 3,000 ct/min (WHC 1991a). On October 7, 1961 Unplanned Release UN-200-E-31 occurred when the diversion box leaked again. The contamination consisted of unknown beta/gamma with readings from 40,000 to 100,000 ct/min in the vicinity of the 202-A Building. Readings outside of the limited area fences were an order of magnitude lower and decreased to 1,000 ct/min (WHC 1991a). Unplanned Release UN-200-E-65 occurred on September 1, 1982 when wind spread contamination from the 241-A-151 Diversion Box approximately 21 m (70 ft) to the west. The contamination consisted of unknown beta/gamma with spot readings from 600 to 5,000 ct/min. The contaminated ground was kept wet until it could be decontaminated to background levels and stabilized.

The 241-CR-151 Diversion Box has one unplanned release associated with it, UN-200-E-81. This release occurred in October 1969 when a puddle of contaminated liquid was discovered near the diversion box. The source was determined to be the underground transfer line from the 202-A Building to the 241-C-102 Single-shell Tank via the 241-CR-151 Diversion Box. The waste consisted of PUREX coating waste, included 360 Ci of ^{90}Sr,

720 Ci of ^{137}Cs, 360 Ci of ^{144}Ce, 1,080 Ci of $^{95}Zr/Nb$, and 1,080 Ci of ^{103}Ru. A survey in October 1975 showed surface contamination of 10,000 to 100,000 ct/min. The contamination was covered with earth backfill and clean gravel.

Unplanned release UN-200-E-68 occurred on January 11, 1985 when Rockwell Radiation Protection Technologists reported that a release of fission products had been detected in the eastern section of the 200 East Area. The source of the release was the deactivated 241-C-151 Diversion Box. The release, estimated at less than 500 millicuries of ^{90}Sr, spread detectable contamination over approximately a 10 Km^2(2 mi^2) area, primarily within the 200 East Area fence. There was no evidence that any significant contamination had migrated from the Hanford Site.

The cause of the release could not be positively determined but evidence pointed strongly towards a scenario involving a transfer jet in the 244-AR Vault facility connected to a line terminating in an open nozzle in the 241-C-151 Diversion Box. An air blow of this transfer jet most likely blew contaminated particulates into the diversion box and the resulting pressurization was sufficient to force contaminated air out through gaps in the diversion box cover blocks. The contamination consisted of unknown beta/gamma with readings of 2,000 ct/min and exposure rates of 5 R/h on the diversion box (WHC 1991a). The affected areas were either decontaminated to background radiation levels or covered for later decontamination.

Unplanned Release UN-200-E-82 occurred on December 19, 1969 when a leak was discovered near the 241-C-152 Diversion Box. The source was determined to be the feed line that runs from the 241-C-105 Single-Shell Tank to the 221-B Building. The leak waste stream flowed through a surface area of approximately 0.1 m^2 (1 ft^2) northeastward, and downgrade until it pooled into an estimate 0.5 m^2 (5 ft^2) area outside the tank farm fence.

4.1.2.7.1 216-A-524 Control Structure. No chemical or radiological inventory data is available for this unit. Radiological surveys of the unit indicate contaminated piping and count at 500 ct/min smearable, 10,000 ct/min beta/gamma, 40 mR/h non-penetrating, and 0.7 mrem/h penetrating radiation. The 216-E-524 Control Structure was buried when the 216-A-24 Crib was surface stabilized.

4.1.2.8 Basins. There are two retention basins in the PUREX Plant Aggregate Area. Most of the data available for the basins are summarized from WIDS (WHC 1991a).

4.1.2.8.1 207-A Retention Basin. This is an active waste management unit. The cells are constructed to a depth of 2.1 m (7 ft). No inventory data are available for this unit. A 1990 radiation survey at the 207-A basins indicated surface contamination of 1500 ct/min. In the past it has generally received only low-level waste, steam condensate and process condensate from the 242-A Evaporator.

4.1.2.8.2 216-A-42 Retention Basin. This is an active waste management unit. The retention basin is constructed to a depth of 7 m (23 ft). No inventory data are available for this unit. A 1988 radiation survey at the 216-A-42 retention basin indicated surface contamination of 20,000 ct/min. The basin receives chemically or radioactively contaminated diversions from the PUREX chemical sewer line, cooling water line, and steam condensate discharge.

In November 1984, wind-spread contamination (UPR-200-E-66) was discovered in the basin consisting of unknown beta/gamma contamination with readings inside the area to 40,000 ct/min and outside to 3,000 ct/min. The ground was wet down and the basin was flushed.

4.1.2.9 Burial Sites. There are five burial grounds and one burning pit in the PUREX Plant Aggregate Area. Most of the data available for the burial sites and burning pit are summarized from WIDS (WHC 1991a).

4.1.2.9.1 200-E Burning Pit. This is an inactive waste management unit. It is reported to have received 1,500 m^3 (52,972 ft^3) of construction and office waste, paint wastes, and chemical solvents. There are three areas within the burning pit that are designated as areas of surface contamination and one area warning of asbestos in the middle of the basin. There is a an area roped off with a sign labeled "RCRA Waste Site." This enclosure marks the location of a single detonation event in 1984, used to dispose of a quantity of unstable liquids. The chemicals detonated include:

Butoxyethanol	19 L (5 gal)
Dioxane	0.95 L (0.25 gal)
1,4-Dioxane	1.25 L (0.33 gal)
Hydrogen Peroxide	11.36 L (3.00 gal)
Isopropyl Ether	8 L (2.1 gal)
Methyl Ethyl Ketone	0.18 L (0.05 gal)
Phosphoric Acid	189 L (50 gal)
Polyethylene Glycol Monoethyl Ether	0.95 L (0.25 gal)
Sodium Azide	0.47 L (0.12 gal)

This unit has one unplanned release associated with it: UPR-200-E-106. Unplanned release UPR-200-E-106 consisted of contaminated paper towels from the control laboratory with radiation readings as high as 2.5 R/h found at the burning ground.

Site 2E12 is just west of the 200-E Burning Pit. This site was monitored for external radiation, vegetation sampling, and grid soil sampling. The external radiation monitoring TLDs averaged 89 mrem/yr for 1985 to 1989 (Table 4-6). The greatest concentration of radionuclides present in the vegetation sampling were ^{40}K at 10.6 pCi/g, ^{7}Be at 1.85 pCi/g, and ^{90}Sr at 1.75 pCi/g (Table 4-12). The greatest radionuclide concentrations detected in the grid soil sampling were ^{40}K at 11.9 pCi/g, and ^{137}Cs at 13.6 pCi/g (Table 4-8).

4.1.2.9.2 218-E-1 Burial Ground. This is an inactive waste management unit. The unit is made up of fifteen 61 m (200 ft) long trenches, all have been filled to ground level since 1974. The trenches were filled with cinders from the 200 East Power Plant and then covered with coarse gravel and backfilled in an attempt to stabilize the site. In October 1981 the entire surface of the unit was covered with a minimum of 46 cm (18 in.) of clean overburden and revegetated.

The unit received about 3,030 m^3 (107,003 ft^3) of both mixed fission products and transuranic (TRU) dry waste. This waste is expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. The 1990 annual radiological survey identified weeds in the southeast corner of the site that were contaminated to a level of 5,000 ct/min.

The 218-E-1 Burial Ground has an unplanned release associated with it, UPR-200-E-53. The release occurred during a burial operation when contamination was spread by uncovering previously buried waste at the south end of a waste trench in the burial ground. The release had unknown beta/gamma contamination with readings to 150 mR/h. Currently, there are no signs indicative of an unplanned release.

4.1.2.9.3 218-E-8 Burial Ground. This is an inactive waste management unit. The unit is constructed to a depth of 4.6 m (15 ft) with an unknown number of backfilled trenches. The burial ground received mixed fission products and transuranic waste, including repair and construction wastes from the 293-A Building and the PUREX Plant new crane addition. The unit received 2,265 m^3 (80,000 ft^3) of waste expected to contain ^{137}Cs, ^{106}Ru, and ^{90}Sr. On February 21, 1979, residue from broken tumbleweeds blown in along the west boundary line of this site were found to be reading greater than 100,000 ct/min beta/gamma activity.

4.1.2.9.4 218-E-12A Burial Ground. This is an inactive waste management unit. The site is constructed to a depth of 4.9 m (16 ft) with 28 dry waste burial trenches. Operational experience has shown that the backfill was substantially less than the present requirement of 1.2 m (4 ft). Some waste was visible at the surface prior to stabilization efforts. The unit is designated as an area of underground contamination and surface contamination.

The wastes received by the trenches included dry waste packaged in cardboard boxes and plastic bags, and acid-soaked material. The total volume of waste received by the burial ground is 15,249 m^3 (538,511 ft^3) containing ^{137}Cs, ^{106}Ru, and ^{90}Sr. The 1990 survey detected unidentified contamination in small areas reading 20,000 dis/min and contaminated tumbleweed up to 40,000 dis/min.

The 218-E-12A Burial Ground has two unplanned releases associated with it. Unplanned release UPR-200-E-24 occurred on June 17, 1960 when a burial box collapsed during burial operations, causing spotty ground contamination from the burial ground to the east area perimeter fence, a distance of about 3.2 km (2 mi). The contamination had

unknown beta/gamma readings up to 2,000 mR/h at the site. Average radiation level inside the burial ground fence was 30 mR/h at 10 cm (4 in.). Unplanned release UPR-200-E-30 occurred on April 20, 1961 when another burial box collapsed during burial operations spreading contamination throughout the burial ground. The contamination had unknown beta/gamma with readings up to 500 R/h. The unit was stabilized immediately after the burial and the trench involved was backfilled.

4.1.2.9.5 218-E-12B Burial Ground. This is an active waste management unit. The burial ground is divided into two general sections, north and south. The southern section contains an eastern portion that is stabilized with soil and designated as an area of underground contamination. A barrier with surface contamination warning signs extends along the road separating the northern and southern portions of the burial grounds. One of the trenches in the northern portion contains Navy reactor compartments that contain lead shielding with an anticipated minimum life expectancy for containment of 300 years. The burial ground is partially stabilized.

Grid sampling site 2E5 is near the 218-E-12B Burial Ground and sampling site 2E11 is just north of the burial ground. These sampling sites were both monitored for external radiation. However, only Site 2E11 also had vegetation sampling and soil sampling performed. The external radiation monitoring TLDs averaged 94 mrem/yr for Site 2E5 and 100 mrem/yr for Site 2E11 from 1985 to 1989 (Table 4-6). The greatest quantity of radionuclides present in the vegetation sampling were ^{212}Pb at 0.93 pCi/g and ^{214}Pb at 2.0 pCi/g (Table 4-12). The greatest radionuclide concentrations detected in the grid soil sampling were ^{137}Cs at 11.9 pCi/g, and ^{90}Sr at 1.92 pCi/g (Table 4-8).

4.1.2.9.6 218-E-13 Burial Ground. This is an inactive waste management unit. This was an unplanned site constructed to a depth of 2.4 m (8 ft). In August 1966, this unit received broken pieces of contaminated concrete from a pipe trench, which were left in the excavation hole and buried following repair to the piping at that location. The unit contains less than 1 Ci fission products. The contaminated soil volume is estimated at 184 m^3 (6,498 ft^3) with an overburden soil volume of 175 m^3 (6,180 ft^3).

4.1.2.10 Unplanned Releases. There is very little chemical or radiological data available for any of the other unplanned releases. Any information which was found is summarized in Table 2-6.

4.2 POTENTIAL IMPACTS TO HUMAN HEALTH AND THE ENVIRONMENT

This preliminary assessment is intended to provide a qualitative evaluation of potential human health and environmental hazards associated with the known and suspected contaminants at the PUREX Plant Aggregate Area. The assessment includes a discussion of release mechanisms, potential transport pathways, develops a conceptual model of human

and environmental exposure based on these pathways, and presents the physical, radiological, and toxicological characteristics of the known or suspected contaminants. As discussed in Section 5.1, the onsite worker has been identified as the primary receptor for exposure to contaminants.

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

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

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

4.2.1 Release Mechanisms

The PUREX Plant Aggregate Area waste management units can be divided into two general categories based on the nature of the waste release: (1) units where waste was discharged directly to the environment; and (2) units where waste was disposed of inside a containment structure and bypassed an engineered barrier to reach the environment.

In the first group are those waste management units where release of wastes to the soil column was an integral part of the waste disposal strategy. Included in this group are tile fields, septic system drain fields, ditches, french drains, seepage basins, cribs, reverse wells, and some disposal trenches. Also in this group are unplanned releases that involved waste

material released to the soil. For this group of waste management units, if discharges to the unit contained contaminants of concern, it can be assumed that soils underlying the waste management unit are contaminated. The first task in developing a conceptual model for these units is to determine whether contaminants of concern are retained in soil near the waste management unit, or are likely to migrate to the underlying aquifer and then to receptor points such as drinking water wells or surface water bodies. Factors affecting migration of chemicals away from the point of release will be discussed in the following section.

In the second group are waste management units that were intended to act as a barrier to environmental releases. Included in this group are burial grounds containing drums or other containers, cribs with membrane liners, vaults, tanks, waste transfer facilities, and unplanned releases that occurred within containment structures. Waste management units that received only dry waste could also be included in this category, since the potential for wastes to migrate to soils outside of the unit is low due to the negligible natural recharge rate in the 200 Areas at the Hanford Site. For these waste management units, the first consideration to be addressed in developing a conceptual model is the integrity of the containment structure.

The ability of this report to evaluate the efficacy of engineered barriers is limited by the lack of vadose zone soil sampling data and air sampling data for many waste management units. Available sampling information for the waste management units and unplanned releases has been summarized in Section 4.1. The data indicate that membrane liner systems used in waste management units with significant liquid inputs (e.g., 216-A-40 Trench) were ineffective in preventing releases to the subsurface.

The efficacy and integrity of concrete liners (e.g., 216-A-42 Retention Basin) and steel tanks (vaults) have not been determined. For those units that received only dry wastes, such as gloves, pumps, contaminated dirt, and process equipment, the potential for release is expected to be low. However, small amounts of liquid wastes (^3H, lab wastes) are known to have been disposed of in these waste management units, and early disposal records (prior to about 1968) are incomplete. Thus, releases from these structures to the surrounding soil are possible.

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

4.2.2 Transport Pathways

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

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

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

Following transport, exposure may occur through the following pathways:

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

4.2.2.1 Transport from Soils to Groundwater. Soil is the initial receiving medium for waste discharges in the PUREX Plant Aggregate Area, whether the release is directly to soil or through failure of a containment system. Several factors determine whether chemicals that are introduced into the vadose zone will reach the unconfined aquifer, which lies at a depth of approximately 61 m (200 ft) below ground surface. These factors are discussed in the following sections.

4.2.2.1.1 Depth of Release. As a general rule, for a given volume, waste management units that released wastes at a greater depth below the surface have a higher

potential to contaminate groundwater than waste management units where the release was shallow. Other factors, however, such as rate of discharge, underlying geology, and many others will all significantly impact contaminant movement.

4.2.2.1.2 Liquid Volume or Recharge Rate. For waste constituents to migrate to the underlying water table, some source of recharge must be present. In the PUREX Plant Aggregate Area, the primary source of moisture for mobilizing contaminants are waste management units that discharge liquid waste to the soil column and, to a much lesser extent, precipitation recharge. As discussed in Section 3.5.2, a number of studies have estimated natural precipitation recharge in a range from 0 to 10 cm/yr (0 to 4 in./yr), depending primarily on surface soil type, vegetation, and topography. The upper value in the range was a computer model generated estimation rather than actual measurement. The actual natural precipitation recharge for the PUREX Plant Aggregate Area is likely to fall at the lower end of this range. Gravelly surface soils with no or minor shallow-rooted vegetation appear to facilitate precipitation recharge. One modelling study (Smoot et al. 1989) indicated that some radionuclide (^{137}Cs and ^{106}Ru) transport could occur with as little as 5 cm/yr (2 in./yr) of natural recharge. However, other researchers (Routson and Johnson 1990) have concluded that no net precipitation recharge occurs in the 200 Areas, particularly at waste management units that are capped with fine-grained soils or impermeable covers.

With respect to artificial recharge, some waste management units (e.g., the 216-A-6 Crib) were identified in which the known volume of liquid waste discharged substantially exceeded the total estimated soil pore volume present below the footprint of the facility. In this case, the moisture content of soil below the waste management units likely approached saturation during the periods of use of these facilities. Because vadose zone hydraulic conductivities are maximized at water contents near saturation, the volume of liquid wastewater historically discharged to the waste management units probably enhanced fluid migration in the vadose zone beneath these units.

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

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

4.2.2.1.3 Soil Moisture Transport Properties. The moisture flux in the vadose zone is dependent on hydraulic conductivity as well as gradients of moisture content or matrix

suction. Higher unsaturated hydraulic conductivities are associated with higher moisture contents. However, higher unsaturated hydraulic conductivities may be associated with fine-grained soils compared to coarse-grained soils at low moisture contents. Because of the stratified nature of the Hanford Site vadose zone soils and the moisture content dependence of unsaturated hydraulic conductivity, vertical anisotropy is expected, i.e., vadose zone soils are likely to be more permeable in the horizontal direction than in the vertical. This vertical anisotropy may reduce the potential for contaminant migration to the unconfined aquifer.

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

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

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

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

- **Ionic Strength of Waste.** For some inorganics, the dominant mechanism leading to desorption from the soil matrix is ion exchange. Leachate having high ionic

strength (high salt content) can bias the sorption equilibrium toward desorption, leading to higher concentrations of the contaminant in the soil pore water.

- **Waste pH.** The pH of a leachant has a strong effect on inorganic contaminant transport. Acidic leachates tend to increase migration both by increasing the solubility of precipitates and by changing the distribution of charged species in solution. The exact impact of acidic or basic wastes will depend on whether the chemical is normally in cationic, anionic, or neutral form, and the form that it takes at the new pH. Cationic species tend to be more strongly adsorbed to soils than neutral or anionic species. The extent to which addition of acidic leachate will cause a contaminant to migrate will also depend on the buffering or neutralizing capacity of the soil, which is correlated with the calcium carbonate ($CaCO_3$) content of the soil. The soils in the Hanford formation beneath the PUREX Plant Aggregate Area generally have carbonate contents in the range of 0.1 to 5%. Higher carbonate contents (20 to 30%) are observed within the Plio-Pleistocene caliche layer.

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

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

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

4.2.2.1.5 Complexation by Organics. Certain organic materials disposed of at the PUREX Plant Aggregate Area are known to form complexes with inorganic ions, which can enhance their solubility and mobility. Tributyl phosphate is the primary organic complexing agent disposed of at the PUREX Plant Aggregate Area.

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

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

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

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

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

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

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

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

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

The PUREX Plant Aggregate Area has been suspected of contributing to the overall fugitive dust emissions at the Hanford Site. A 2.5 Km^2(1 mi^2) area just northeast of the northeast corner of the 200 East Area was posted for contamination from windblown vegetation that has jumped the fence. The nearest upwind sources for this contamination would be the PUREX burial grounds.

4.2.2.3 Transport from Soils to Surface Water. The only surface water available in the PUREX Plant Aggregate Area is at the 216-A-42 and 207-A Retention Basins. Transport of contaminants to surface water bodies outside of the PUREX Plant Aggregate Area via

groundwater discharge and deposition of fugitive dust on water bodies are the primary pathways of potential concern for surface water effects. Groundwater discharge will be addressed in the 200 East Groundwater AAMSR.

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

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

4.2.2.4.2 Transport by Animals. Disturbance of waste management unit barriers by animals occasionally leads to release of contaminants to the surface. Subsurface soils can be transported to the surface by burrowing animals, thus exposing contaminants for release to the air. Additionally, animals that become contaminated by direct contact with subsurface waste or through ingestion of subsurface contaminants (e.g., chemical salts) and contaminated vegetation, water, or other animals can spread contamination in their feces on the surface and outside of the waste management unit. Burrowing rodents and harvester ants can transport near-surface contaminants to the surface. Rabbits were noted as causing the greatest spread of contamination in the separations area in 1985 (Elder et al. 1986).

4.2.3 Conceptual Model

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

The sources of contamination include stack emissions and drainage, process wastes (condensates, cooling water, chemical sewage, pump waste) from PUREX, and 242-A; condensate from 241-A Tank Farm, laboratory wastes, depleted uranium wastes, tributyl phosphate and bismuth phosphate metal wastes, high-level liquid wastes, drainage from diversion boxes, sanitary wastes, process feed materials, materials from outside the aggregate area (e.g., 201-C Building (Semiworks), N Reactor, reduction-oxidation (REDOX), PNL, Hanford laboratory, and B Plant wastes), and contaminated equipment or waste material that was spilled during transit or disposed of in the burial grounds.

Contaminants from these sources have been disposed of at the waste management units that are under investigation. These include the ditches, retention basins, settling tanks, trenches, cribs, french drains, reverse wells, diversion boxes and catch tanks, septic tanks and drain fields, single-shell tanks, burial grounds, and the various unplanned releases that have occurred on the site. These releases and disposal activities are described in Sections 2.0 and 4.1. Some of the unplanned releases are associated with specific waste management groups, and are shown on Figure 4-3 as dashed lines with "U" designations.

From these waste management units, contaminants may have been released via several mechanisms to the potentially affected media. Volatilization could release chemicals from surface waters into the atmosphere. Some of the more volatile constituents could be released from the vadose zone to the atmosphere through the soil gas system. Materials in the ditches flowing toward the ponds may have infiltrated/percolated into the vadose zone, or sorbed to the sediments in the ditch. The 207-A Retention Basin may have released contaminants in a similar fashion, with the exception of offsite flow. Biota may have taken up contaminants from the surface water and near-surface contaminated soils (via deep roots or burrowing animals).

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

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

Figure 4-4 is a schematic diagram illustrating these processes and describing probable contaminant distributions in the vadose zone. For liquid waste management units, the point of release shown on this figure may be in the subsurface, such as at cribs, drains, and reverse wells, or it may be exposed to the surface, such as at ponds, ditches, trenches, or at most unplanned releases. Small-scale contaminant releases are much less likely to impact the lower vadose zone or groundwater than large scale releases. Liquid disposal units in the PUREX Plant Aggregate Area are dominated by cribs. Table 4-15 identifies those units that had liquid discharges large enough to reach the unconfined aquifer.

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

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

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

In the past, drilling and sampling programs have been conducted at the 216-Z-1A Tile Field (Price et al. 1979), the 216-Z-9 Trench (Smith 1973), the 216-Z-12 Crib (Kasper 1981), the 200-BP-1 Operable Unit cribs (the BY Cribs) (Buckmaster and Kaczor 1992), the 216-U-10 Pond (Last and Duncan 1980), and the 216-Z-19 Ditch (Last

and Duncan 1980). These studies, in conjunction with geophysical well logging data, have been used to estimate the expected contaminant distributions beneath comparable waste management units in the PUREX Plant Aggregate Area.

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

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

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

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

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

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

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

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

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

4.2.4 Characteristics of Contaminants

Table 4-32 is a list of radioactive and nonradioactive chemical substances that represent candidate contaminants of potential concern for this study based on their known presence in wastes, usage, disposal in waste management units, historical association, or detection in environmental media at the PUREX Plant Aggregate Area. Table 4-33 summarizes the types of known or suspected contamination that are thought to exist at the individual waste management units. Known contaminants have been proven to exist from sampling and inventory data (Tables 2-2 and 2-3). Suspected contaminants are those which could have occurred at a unit based upon historical practices, chemical associations Given the large number of chemicals known or suspected to be present, it is appropriate to focus this assessment on those contaminants that have been detected through sampling efforts and which pose the greatest risk to human health or the environment.

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

Table 4-34 lists the contaminants of potential concern for the PUREX Plant Aggregate Area. This list was developed from Table 4-32 and includes only those contaminants which meet the following criteria:

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

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

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

The following characteristics will be discussed for the contaminants listed in Table 4-35:

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

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

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

4.2.4.2 Historical Association with PUREX Plant Aggregate Area Activities. Radionuclides that are known components of PUREX Plant Aggregate Area waste streams are listed in Table 2-10. This list includes chemicals in the process wastes as well as chemicals that were detected at elevated levels in wastewater. Since these waste streams are

known to have been disposed of directly to the soil column in some waste management units, it is probable that the chemicals on this list have affected environmental media.

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

- ^{239}Pu
- ^{240}Pu
- ^{241}Pu
- ^{137}Cs
- ^{90}Sr
- ^{3}H
- ^{99}Tc
- ^{238}U.

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

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

4.2.4.3 Mobility. Since most wastes at the PUREX Plant Aggregate Area were released directly to subsurface soils via injection, infiltration, or burial, the mobility of the wastes in the subsurface will determine the potential for future exposures. The mobility of the contaminants listed in Table 4-32 varies widely and depends on site-specific factors as well as the intrinsic properties of the contaminant. These site-specific factors include site stratigraphy, hydraulic conductivity, porosity, and other factors. Much of the site-specific information needed to characterize mobility is not available and will need to be obtained during future field investigations. However, it is possible to make general statements about the relative mobility of the candidate contaminants of concern.

4.2.4.3.1. Transport to the Subsurface. The mobility of radionuclides and other inorganic elements in groundwater depends on the chemical form and charge of the element

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

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

A soil-water distribution coefficient (K_d) can be used to predict mobility of inorganic chemicals in the subsurface. Table 4-36 presents a summary of K_d values that have been developed for many of the inorganic chemicals of concern at the PUREX Plant Aggregate Area. As discussed above, the pH and ionic strength of the leaching medium has an impact on the absorption of inorganics to soil; thus, the listed K_d values are valid only for a limited range of pH and waste composition. In addition, soil sorption of inorganics is highly dependent on the mineral composition of the soil, the ionic composition of the soil pore water, and other site-specific factors. Thus, a high degree of uncertainty is involved with use of $K_d$values that have not been verified by experimentation with site soils.

Serne and Wood (1990) recommended K_d values for use with Hanford waste assessments for a limited number of important radionuclides (americum, cesium, cobalt, copper, iodine, plutonium, ruthenium, strontium, tritium) based on soil column or batch desorption studies, and have proposed conservative average values for a more extensive list of elements based on a review of the literature. An assumed K_d of <1 is recommended for americium, cesium, plutonium, and strontium under acidic conditions.

Strenge and Peterson (1989) developed default K_d values for a large number of elements for use in the Multimedia Environmental Pollution Assessment System (MEPAS) (Droppo et al. 1989), a computerized waste management unit evaluation system. The K_d values were based on findings in the scientific literature, and include non-site-specific as well as Hanford Site values. Values are provided for nine sets of environmental conditions: three ranges of waste pH and three ranges of soil adsorbent material (sum of percent clay, organic material, and metal hydrous oxides). The values presented in Table 4-36 are for conditions of neutral waste pH and less than 10% adsorbent material, which is likely to be most representative of Hanford Site soils.

The mobility of inorganic species in soil can be divided roughly into three classes, using site-specific values (Serne and Wood 1990) where available and generic values otherwise: highly mobile ($K_d < 5$), moderately mobile ($5 < K_d < 100$), and low mobility ($K_d > 100$). Table 4-36 lists the class ranking for each of the inorganic contaminants of concern. The ranking presented in this table indicates general mobility characteristics. Actual mobility of specific contaminants will be influenced by their valence state and ligands. Specific mobilities will be determined in future site investigations and will address these potential influences.

The tendency of organic compounds to adsorb to the organic fraction of soils is indicated by the soil organic matter partition coefficient, K_{oc}. Partition coefficients for the organic chemicals of concern at the PUREX Plant Aggregate Area are listed in Table 4-35. Chemicals with low K_{oc} values are weakly absorbed by soils and will tend to migrate in the subsurface, although their rate of travel will be retarded somewhat relative to the pore water or groundwater flow. Soils at the Hanford Site have very little organic carbon content and thus sorption to the inorganic fraction of soils may dominate over sorption to soil organic matter.

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

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

The tendency of an organic compound to volatilize can be predicted from its Henry's Law Constant, K_h, a measured or calculated parameter with units of atmospheres per cubic meter per mole of chemical. Henry's Law Constants of the organic candidate contaminants of concern are presented in Table 4-37. Compounds with a K_h greater than about 10^{-3} will be lost rapidly to the atmosphere from surface water and shallow soils. Organic contaminants of concern that fall into this class include:

- Chloroform
- Methylene chloride
- Toluene

- Tributyl phosphate
- 1,1,1-Trichloroethane.

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

The persistence of radionuclides depends primarily on their half-lives. A comparison of the radiological properties for most radionuclide contaminants of concern for PUREX Plant Aggregate Area is presented in Table 4-38. The specific activity is the decay rate per unit mass, and is inversely proportional to the half-life of the radionuclide. Half-lives for the radionuclides listed in Table 4-38 range from seconds to over one billion years. Also listed are the principal radiation emissions of concern for the radionuclide. Note that radionuclides can emit multiple types of radiation and often undergo several decay steps in quick succession, (e.g., beta decay followed by release of one or more gamma rays associated with daughter radionuclides). The daughter products of these decays are often themselves radioactive.

Decay will occur during transport (e.g., through the vadose zone to the aquifer, through the aquifer) and may lead to significant reductions in levels ultimately produced offsite. For direct exposures (e.g., to surface soils or air), the half-life of the radionuclide is of less importance, unless the half-life is so short that the radionuclide undergoes substantial decay between the time of disposal and release to the environment.

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

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

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

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

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

Excess cancer risks for exposure to the primary radionuclide contaminants of concern by inhaling air, drinking water, ingesting soil, and by external irradiation are shown in Table 4-39. These values represent the increase in probability of cancer to an individual exposed for a lifetime to a radionuclide at a level of 1 pCi/m^3 in air, 1 pCi/L in drinking water, 1 pCi/g in ingested soil, or to external radiation from soil having a radionuclide content of 1 pCi/g (EPA 1991a). These values are computed as the slope factor (risk per unit intake or exposure) multiplied by the inhalation or ingestion rate and the number of days in a 70-year lifetime (EPA 1991b).

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

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

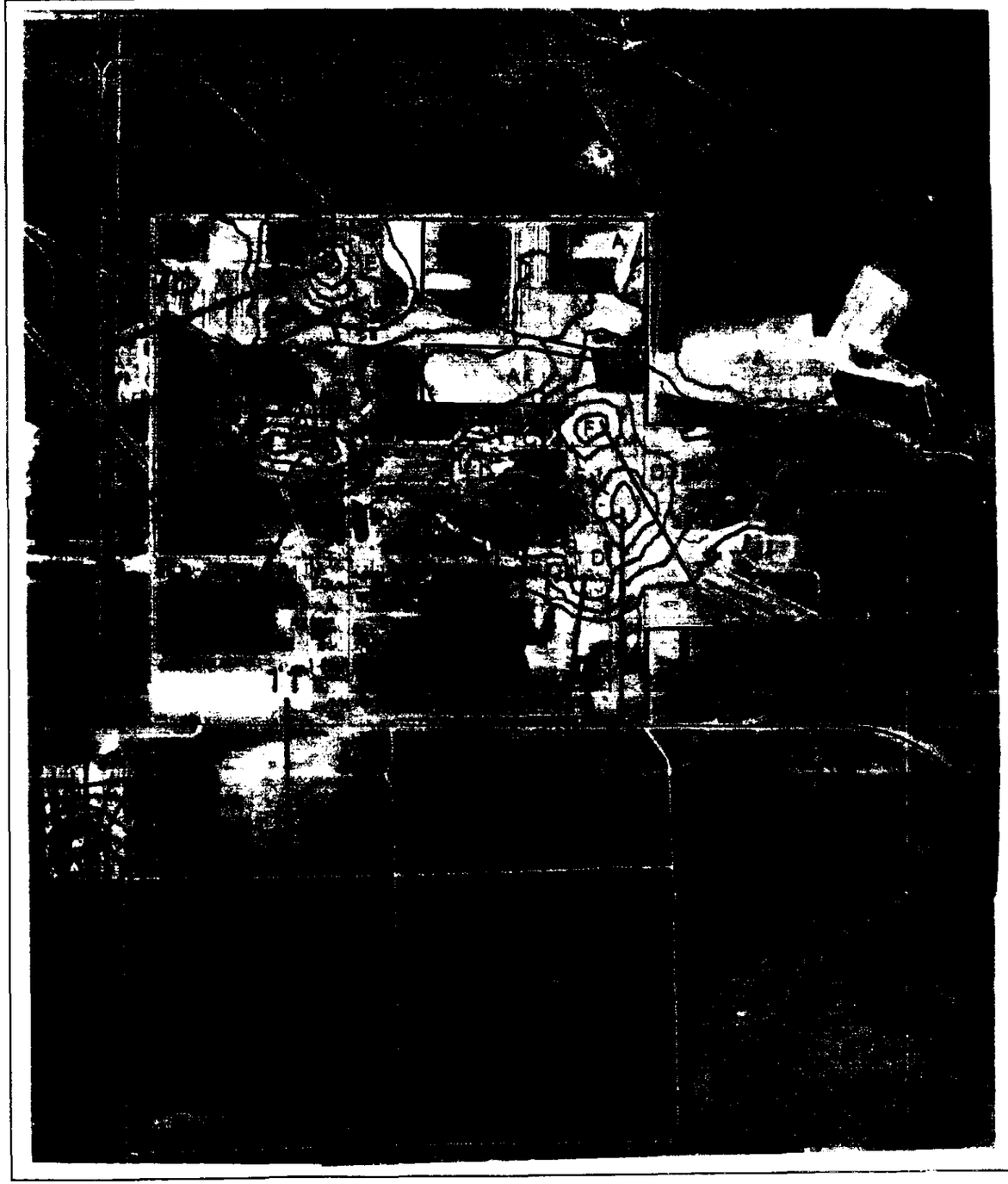
Based on the factors listed in Table 4-39, the highest risk for continuous exposure to 1 pCi/m^3 in air is from plutonium, americium and uranium isotopes, which are alpha emitters. Among the radionuclide contaminants of concern for the PUREX Plant Aggregate Area, the highest risks from ingestion of soil at 1 pCi/g are from ^{227}Ac, ^{241}Am, ^{243}Am, ^{238}Pu, ^{244}Cm, ^{134}Cs, ^{129}I, ^{237}Np, ^{231}Pa, ^{210}Pb, ^{225}Ra, ^{226}Ra, ^{229}Th, and the uranium isotopes. The primary gamma-emitters are ^{214}Bi, ^{60}Co, ^{134}Cs, ^{137}Cs (because of its metastable decay product, ^{137m}Ba), ^{152}Eu, ^{154}Eu, ^{239}Np, and ^{214}Pb. It is important to note that this table only presents unit risk factors for the listed radionuclides and does not include potential contributions from daughter products.

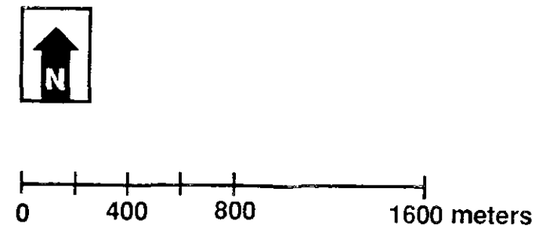
The standard EPA risk assessment methodology assumes that the probability of a carcinogenic effect increases linearly with dose at low dose levels, i.e., there is no threshold for carcinogenic response. The EPA methodology also assumes that the combined effect of exposure to multiple carcinogens is additive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

4.2.4.5.2 Hazardous Chemicals. Carcinogenic and non-carcinogenic health effects associated with chemicals anticipated at the aggregate area are summarized in Table 4-40. The basis for these potential health effects is described in the respective reference documents and may be associated with either human or animal data. Health effects were developed according to the hierarchy established in the Risk Assessment Guidance for Superfund (EPA 1989a). References were consulted in the following order: IRIS (Integrated Risk Information System) (EPA 1991b), HEAST (Health Effects Assessment Summary Tables) (EPA 1991c), and other toxicity articles and documents.

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

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





Zone A = <700 ct/s
Zone B = 700 to 2,200 ct/s
Zone C = 2,200 to 7,000 ct/s
Zone D = 7,000 to 22,000 ct/s
Zone E = 22,000 to 70,000 ct/s
Zone F = 70,000 to 220,000 ct/s
Zone G = 220,000 to 700,000 ct/s
Zone H = 700,000 to 2,200,000 ct/s
2 = 241-A Tank Farm
3 = 202-A Building
4 = Railroad spur northwest of the 202-A Building
5 = 241-C Tank Farm
Other numbers refer to sites outside the PUREX Plant Aggregate Area.
PUREX Plant Aggregate Area is outlined in red.
The results are displayed as relative levels of manmade radionuclide activity.

Aerial survey taken July-August 1988.

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

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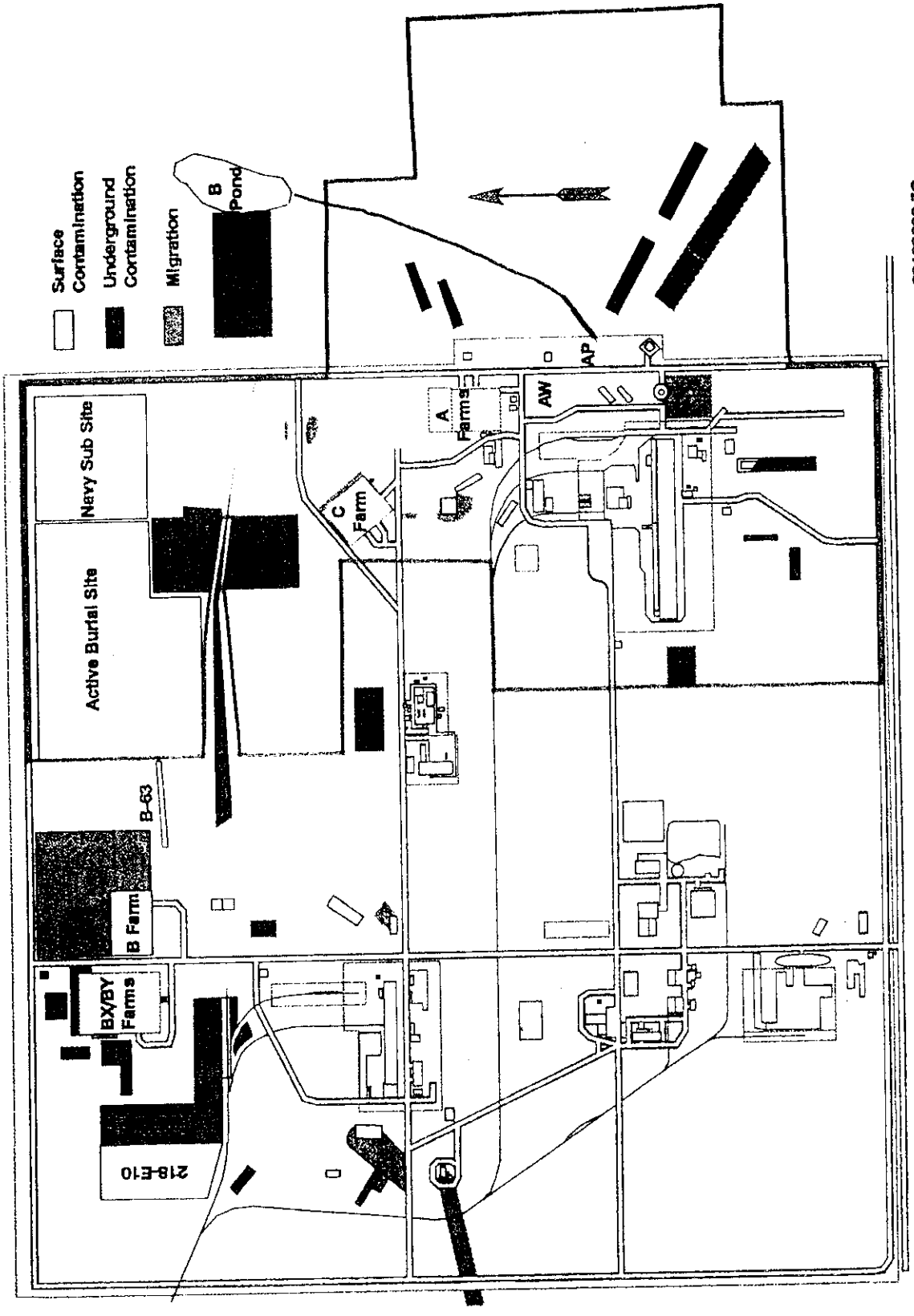
Figure 4-2. Surface, Underground, and Migrating Contamination Map of the 200 East Area (Huckfeldt 1991).



PUREX Plant Aggregate Area is outlined in red.

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

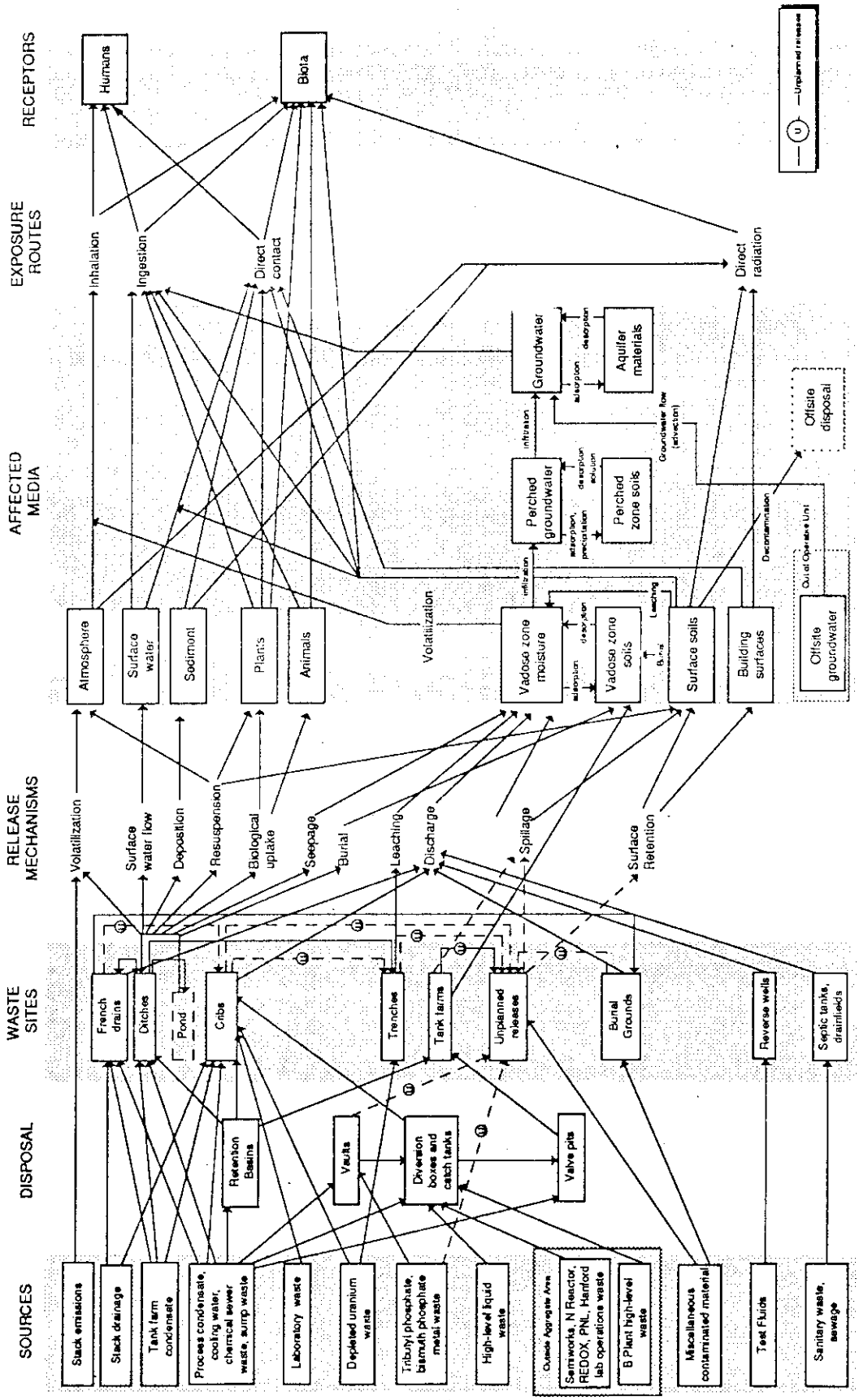
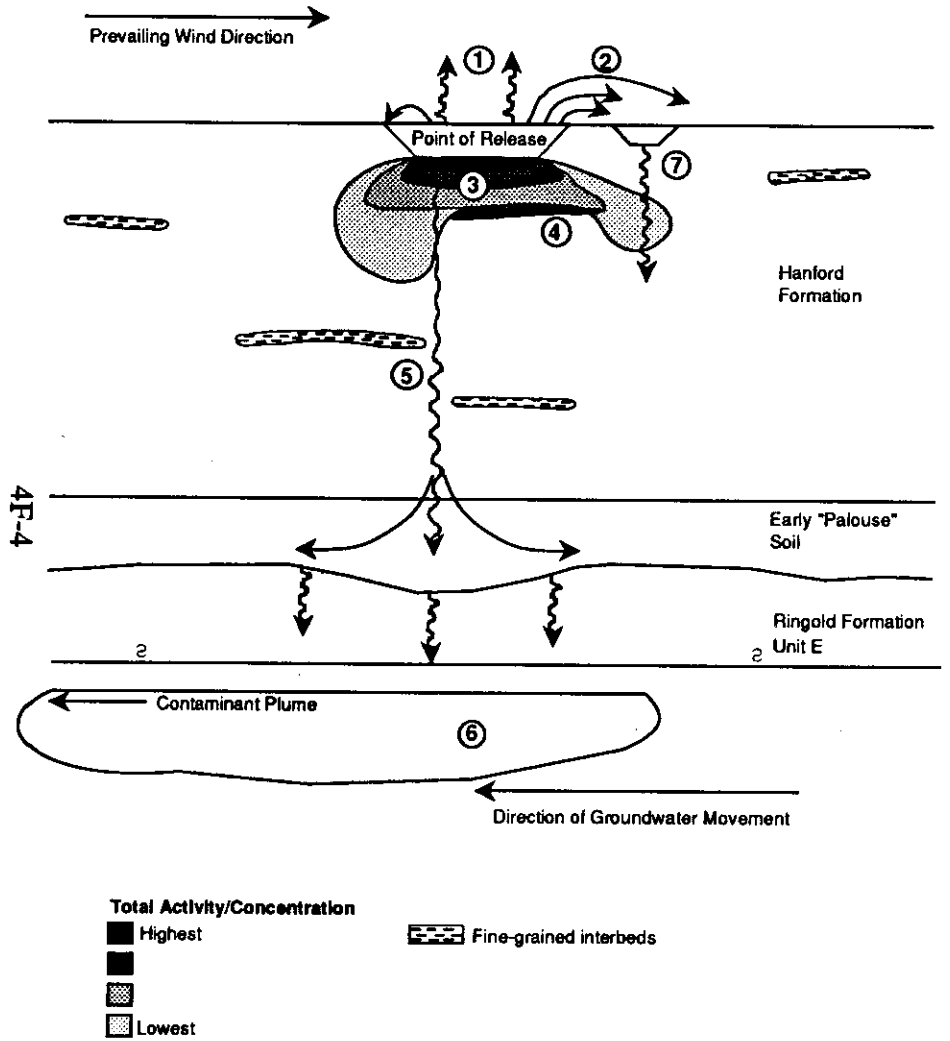


Figure 4-4. Physical Conceptual Model of Contaminant Distribution.



1. Some contaminants may volatilize and enter the atmosphere after release.
2. Wind may move contaminants laterally at the surface. For a surface release, this may occur immediately. For subsurface releases, contaminants must first be moved to the surface by biological activity.
3. The majority of contaminants are held in the vadose zone soils immediately beneath the point of release. The highest total activities will be immediately beneath the point of release and less mobile contaminants such as TRUs should be restricted to this area.
4. Thin discontinuous aquitards may cause small perched water zones. Some lateral migration of contaminants may occur above such a zone, particularly if it occurs close to the point of release.
5. The majority of liquid travels downward through the vadose zone carrying some more mobile contaminants such as fission products. Contaminants may be locally concentrated in fine-grained horizons, though at much lower concentrations than occur immediately beneath the point of release.
6. Some of the most mobile contaminants (tritium, cyanide, iodine, nitrates, nitrites, fluoride) reach the groundwater and may form contaminant plumes.
7. Waste water from adjacent active waste management units may remobilize contaminants in the underlying vadose zone.

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Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 1 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Plants, Buildings, and Storage Areas						
204-AR Waste Unloading Station	--	--	--	--	--	
241-A-431 Ventilation Building	--	--	--	--	--	
241-C-801 Support Facility	--	--	--	--	--	
242-A Evaporator	--	--	--	--	--	
Grout Treatment Facility	--	--	--	--	--	
Tanks and Vaults						
241-A-101 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-A-102 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-A-103 Single-Shell Tank	--	S	--	--	S	Assumed Leaker
241-A-104 Single-Shell Tank	--	S	--	--	S	Assumed Leaker
241-A-105 Single-Shell Tank	--	S	--	--	S	Assumed Leaker
241-A-106 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-AN-101 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AN-102 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AN-103 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AN-104 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AN-105 Double-Shell Tank	--	--	--	--	--	Tank status is sound

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 2 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AN-106 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AN-107 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-101 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-102 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-103 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-104 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-105 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-106 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-107 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AP-108 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AW-101 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AW-102 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AW-103 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AW-104 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AW-105 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AW-106 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AX-101 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-AX-102 Single-Shell Tank	--	S	--	--	S	Assumed leaker

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 3 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AX-103 Single-Shell Tank	--	--	--	--	--	Tank status is sound; UPR-200-E-115
241-AX-104 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-AY-101 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AY-102 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AZ-101 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-AZ-102 Double-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-101 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-C-102 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-103 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-104 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-105 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-106 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-107 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-108 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-109 Single-Shell Tank	--	--	--	--	--	Tank status is sound
241-C-110 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-C-111 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-C-112 Single-Shell Tank	--	--	--	--	--	Tank status is sound

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 4 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-C-201 Single-Shell Tank	--	S	--	--	S	Tank status is sound
241-C-202 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-C-203 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-C-204 Single-Shell Tank	--	S	--	--	S	Assumed leaker
241-A-302A Catch Tank	--	--	--	--	--	
241-A-302B Catch Tank	--	--	--	--	--	
241-A-350 Catch Tank	--	--	--	--	--	
241-A-417 Catch Tank	--	--	--	--	--	
241-C-301C Catch Tank	--	--	--	--	--	
244-A Lift Station	--	S	--	--	S	
244-AR Vault	--	S, R?	--	--	S, R?	UPR-200-E-59
244-CR Vault	--	--	--	--	--	
Cribs and Drains						
216-A-1 Crib	--	K	--	--	S	
216-A-2 Crib	--	S	--	--	S	
216-A-3 Crib	--	S	--	--	S	
216-A-4 Crib	--	S, R?	--	--	S, R?	Known release in 1958; UN-200-E-13
216-A-5 Crib	--	S	--	--	S	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 5 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-A-6 Crib	--	K	--	--	K	UPR-200-E-21; UPR-200-E-29
216-A-7 Crib	--	K	--	--	K	
216-A-8 Crib	--	S	--	--	S	
216-A-9 Crib	--	S	--	--	S	
216-A-10 Crib	--	S	--	--	S	
216-A-21 Crib	--	K	--	--	K	
216-A-24 Crib	--	S	--	--	S	UN-200-E-56
216-A-27 Crib	--	S	--	--	S	
216-A-30 Crib	--	S, R?	--	--	S, R?	
216-A-31 Crib	--	S	--	--	S	
216-A-32 Crib	--	S	--	--	S	
216-A-36A Crib	--	S	--	--	S	
216-A-36B Crib	--	K	--	--	K	
216-A-37-1 Crib	--	S	--	--	S	
216-A-37-2 Crib	--	S	--	--	S	
216-A-38-1 Crib	--	S	--	--	S	
216-A-39 Crib	--	S	--	--	S	
216-A-41 Crib	--	S	--	--	S	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 6 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-A-45 Crib	--	S	--	--	S	
216-A-11 French Drain	--	S	--	--	S	
216-A-12 French Drain	--	S	--	--	S	
216-A-13 French Drain	--	S	--	--	S	
216-A-14 French Drain	--	S	--	--	S	
216-A-15 French Drain	--	S	--	--	S	
216-A-16 French Drain	--	--	--	--	--	
216-A-17 French Drain	--	--	--	--	--	
216-A-22 French Drain	--	S	--	--	S	UPR-206-E-17
216-A-23A French Drain	--	--	--	--	--	
216-A-23B French Drain	--	--	--	--	--	
216-A-26 French Drain	--	S	--	--	S	
216-A-26A French Drain	--	S	--	--	S	
216-A-28 French Drain	--	S	--	--	S	
216-A-33 French Drain	--	S	--	--	S	
216-A-35 French Drain	--	S	--	--	S	
216-C-8 French Drain	--	K	--	--	K	Cave in potential

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 7 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Reverse Wells						
299-E24-111 Injection Well	--	--	--	--	--	No reported release
Ponds, Trenches, and Ditches						
216-A-18 Trench	--	S	--	--	S	
216-A-19 Trench	--	--	--	--	--	
216-A-20 Trench	--	S	--	--	S	
216-A-40 Trench	--	S	--	--	S	UPR-200-E-59
216-A-29 Ditch	--	K	S	K	K	
216-A-34 Ditch	--	S	--	--	S	
Septic Tanks and Associated Drain Fields						
2607-EA Septic Tank/Drain Field	--	--	--	--	--	No reported release
2607-EC Septic Tank/Drain Field	--	--	--	--	--	No reported release
2607-ED Septic Tank/Drain Field	--	--	--	--	--	No reported release
2607-EG Septic Tank/Drain Field	--	--	--	--	--	No reported release
2607-EJ Septic Tank/Drain Field	--	--	--	--	--	No reported release
2607-EL Septic Tank/Drain Field	--	--	--	--	--	No reported release
2607-E6 Septic Tank/Drain Field	--	--	--	--	--	No reported release

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 8 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Transfer Facilities, Diversion Boxes, and Pipelines						
241-A-A Diversion Box	--	--	--	--	--	
241-A-B Diversion Box	--	--	--	--	--	
241-A-151 Diversion Box	--	S	--	--	S	UN-200-E-26; UN-200-E-65
241-A-152 Diversion Box	--	--	--	--	--	
241-A-153 Diversion Box	--	--	--	--	--	
241-AN-A Diversion Box	--	--	--	--	--	
214-AN-B Diversion Box	--	--	--	--	--	
214-AR-151 Diversion Box	--	--	--	--	--	
214-AW-A Diversion Box	--	--	--	--	--	
214-AW-B Diversion Box	--	--	--	--	--	
214-AX-A Diversion Box	--	--	--	--	--	
214-AX-B Diversion Box	--	--	--	--	--	
214-AX-151 Diversion Box	--	--	--	--	--	
214-AX-152DS Diversion Box	--	--	--	--	--	
214-AX-155 Diversion Box	--	--	--	--	--	
241-AY-151 Diversion Box	--	--	--	--	--	
241-AY-152 Diversion Box	--	--	--	--	--	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 9 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AZ-151DS Diversion Box	--	--	--	--	--	
241-AZ-152 Diversion Box	S	S	--	--	--	
241-C-151 Diversion Box	--	--	--	--	--	
241-C-152 Diversion Box	--	--	--	--	--	
241-C-153 Diversion Box	--	--	--	--	--	
241-C-252 Diversion Box	--	--	--	--	--	
241-CR-151 Diversion Box	--	--	--	--	--	
241-CR-152 Diversion Box	--	--	--	--	--	
241-CR-153 Diversion Box	--	--	--	--	--	
241-ER-153 Diversion Box	--	--	--	--	--	
216-A-524 Control Structure	S	S	--	--	S	
241-AP Valve Pit	--	--	--	--	--	
241-AX-501 Valve Pit	--	--	--	--	--	
Basins						
207-A Retention Basin	--	S	--	--	S	
216-A-42 Retention Basin	--	S	S	--	S	UPR-200-E-66
Burial Sites						
218-E-1 Burial Ground	--	S, R?	--	--	S, R?	UPR-200-E-53
218-E-8 Burial Ground	--	S	--	K	S	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 10 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
218-E-12A Burial Ground	--	S, R?	--	--	S, R?	UPR-200-E-24; UPR-200-E-30
218-E-12B Burial Ground	--	--	--	--	--	
218-E-13 Burial Ground	--	--	--	--	--	
200-E Burning Pit	--	--	--	--	--	UN-200-E-62; UPR-200-E-106
Unplanned Releases						
UN-200-E-10	--	S, R?	--	--	S, R?	
UN-200-E-11	--	S, R?	--	--	S, R?	
UN-200-E-12	--	S	--	--	S	
UN-200-E-13	--	R	--	--	--	
UN-200-E-15	--	S	--	--	S	
UN-200-E-16	--	S	--	--	S	
UN-200-E-18	--	S	--	--	S	
UN-200-E-19	--	S	--	--	S	
UN-200-E-20	--	S	--	--	S	
UN-200-E-22	--	S	--	--	S	
UN-200-E-25	--	S	--	--	S	
UN-200-E-26	--	S	--	--	S	
UN-200-E-27	--	S	--	--	S	
UN-200-E-28	--	S	--	--	S	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 11 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-31	--	S	--	--	S	
UN-200-E-33	--	R	--	--	--	
UN-200-E-35	--	S	--	--	S	
UN-200-E-39	--	S	--	--	S	
UN-200-E-40	--	S	--	--	S	
UN-200-E-42	--	--	--	--	--	
UN-200-E-47	--	R	--	--	--	
UN-200-E-48	--	R	--	--	--	
UN-200-E-49	--	R	--	--	--	
UN-200-E-56	--	S	--	--	S	
UN-200-E-58	--	R	--	--	--	
UN-200-E-60	--	R	--	--	--	
UN-200-E-62	--	R	--	--	--	
UN-200-E-65	--	R	--	--	--	
UN-200-E-67	--	R	--	--	--	
UN-200-E-68	--	R?	--	--	--	
UN-200-E-72	--	--	--	--	--	
UN-200-E-81	--	S	--	--	S	
UN-200-E-82	--	R	--	--	--	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 12 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-86	--	S	--	--	S	
UN-200-E-88	--	S	--	--	S	
UN-200-E-91	--	R	--	--	--	
UN-200-E-94	--	--	--	--	--	
UN-200-E-96	--	S, R	--	--	S	
UN-200-E-97	--	R?	--	--	--	
UN-200-E-99	--	R	--	--	--	
UN-200-E-100	--	S	--	--	S	
UN-200-E-107	--	S	--	--	S	
UN-200-E-114	--	--	--	--	--	
UN-200-E-117	--	S	--	--	S	
UN-200-E-118	--	--	--	--	--	
UN-200-E-142	--	--	--	--	--	
UPR-200-E-17	--	S	--	--	S	
UPR-200-E-21	--	S	--	--	S	
UPR-200-E-24	--	S	--	--	S	
UPR-200-E-29	--	S	--	--	S	
UPR-200-E-30	--	R?	--	--	--	
UPR-200-E-50	--	S	--	--	S	

Table 4-1. Summary of Known and Suspected Radionuclide Concentration. (sheet 13 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UPR-200-E-53	--	S	--	--	S	
UPR-200-E-59	--	R	--	--	--	
UPR-200-E-66	--	R	--	--	--	
UPR-200-E-70	--	R	--	--	--	
UPR-200-E-106	--	S	--	--	S	
UPR-200-E-115	--	S	--	--	S	
UPR-200-E-119	--	S	--	--	S	
UPR-200-E-125	--	S	--	--	S	
UPR-200-E-126	--	S	--	--	S	
UPR-200-E-136	--	S	--	--	S	
UPR-200-E-137	--	--	--	--	--	

S = Suspected contamination, primarily based on WIDS (WHC 1991a) and other inventory data.
K = Known contamination, primarily based on chemical analytical data, WIDS (WHC 1991a) or other sources.
R = Complete remediation reported.
R? = Remediation attempted, effectiveness not determined.
-- = Dashes indicate no contamination suspected.

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Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 1 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
Plants, Buildings, and Storage Areas						
204-AR Waste Unloading Station	--	--	--	--	--	
241-A-431 Ventilation Building	--	--	--	--	--	
241-C-801 Support Facility	--	--	--	--	--	
242-A Evaporator	--	--	--	--	--	
Grout Treatment Facility	--	--	--	--	--	
Tanks and Vaults						
241-A-101 Single-Shell Tank	--	--	--	--	--	
241-A-102 Single-Shell Tank	--	--	--	--	--	
241-A-103 Single-Shell Tank	--	S	--	--	S	
241-A-104 Single-Shell Tank	--	S	--	--	S	Associated with UPR-200-E-125
241-A-105 Single-Shell Tank	--	S	--	--	S	Associated with UPR-200-E-126
241-A-106 Single-Shell Tank	--	--	--	--	--	
241-AN-101 Double-Shell Tank	--	--	--	--	--	
241-AN-102 Double-Shell Tank	--	--	--	--	--	
241-AN-103 Double-Shell Tank	--	--	--	--	--	
241-AN-104 Double-Shell Tank	--	--	--	--	--	
241-AN-105 Double-Shell Tank	--	--	--	--	--	
241-AN-106 Double-Shell Tank	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 2 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AN-107 Double-Shell Tank	--	--	--	--	--	
241-AP-101 Double-Shell Tank	--	--	--	--	--	
241-AP-102 Double-Shell Tank	--	--	--	--	--	
241-AP-103 Double-Shell Tank	--	--	--	--	--	
241-AP-104 Double-Shell Tank	--	--	--	--	--	
241-AP-105 Double-Shell Tank	--	--	--	--	--	
241-AP-106 Double-Shell Tank	--	--	--	--	--	
241-AP-107 Double-Shell Tank	--	--	--	--	--	
241-AP-108 Double-Shell Tank	--	--	--	--	--	
241-AW-101 Double-Shell Tank	--	--	--	--	--	
241-AW-102 Double-Shell Tank	--	--	--	--	--	
241-AW-103 Double-Shell Tank	--	--	--	--	--	
241-AW-104 Double-Shell Tank	--	--	--	--	--	
241-AW-105 Double-Shell Tank	--	--	--	--	--	
241-AW-106 Double-Shell Tank	--	--	--	--	--	
241-AX-101 Single-Shell Tank	--	--	--	--	--	
241-AX-102 Single-Shell Tank	--	S	--	--	S	
241-AX-103 Single-Shell Tank	--	--	--	--	--	UPR-200-E-115
241-AX-104 Single-Shell Tank	--	S	--	--	S	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 3 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-AY-101 Double-Shell Tank	--	--	--	--	--	
241-AY-102 Double-Shell Tank	--	--	--	--	--	
241-AZ-101 Double-Shell Tank	--	--	--	--	--	
241-AZ-102 Double-Shell Tank	--	--	--	--	--	
241-C-101 Single-Shell Tank	--	S	--	--	S	UPR-200-E-136
241-C-102 Single-Shell Tank	--	--	--	--	--	
241-C-103 Single-Shell Tank	--	--	--	--	--	
241-C-104 Single-Shell Tank	--	--	--	--	--	
241-C-105 Single-Shell Tank	--	--	--	--	--	
241-C-106 Single-Shell Tank	--	--	--	--	--	
241-C-107 Single-Shell Tank	--	--	--	--	--	
241-C-108 Single-Shell Tank	--	--	--	--	--	
241-C-109 Single-Shell Tank	--	--	--	--	--	
241-C-110 Single-Shell Tank	--	S	--	--	S	
241-C-111 Single-Shell Tank	--	S	--	--	S	
241-C-112 Single-Shell Tank	--	--	--	--	--	
241-C-201 Single-Shell Tank	--	S	--	--	S	
241-C-202 Single-Shell Tank	--	S	--	--	S	
241-C-203 Single-Shell Tank	--	S	--	--	S	UPR-200-E-137

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 4 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
241-C-204 Single-Shell Tank	--	S	--	--	S	
241-A-302A Catch Tank	--	--	--	--	--	
241-A-302B Catch Tank	--	--	--	--	--	
241-A-350 Catch Tank	--	--	--	--	--	
241-A-417 Catch Tank	--	--	--	--	--	
241-C-301C Catch Tank	--	--	--	--	--	
244-A Lift Station	--	S	--	--	S	
244-AR Vault	--	--	--	--	--	UPR-200-E-59
244-CR Vault	--	--	--	--	--	
Cribs and Drains						
216-A-1 Crib	--	K	--	--	K	
216-A-2 Crib	--	S	--	--	S	
216-A-3 Crib	--	S	--	--	S	
216-A-4 Crib	--	S, R?	--	--	S, R?	Known release in December 1958; UN-200-E-13
216-A-5 Crib	--	S	--	--	S	
216-A-6 Crib	--	K, R?	--	--	K, R?	UPR-200-E-21; UPR-200-E-29
216-A-7 Crib	--	K	--	--	K	
216-A-8 Crib	--	S	--	--	S	
216-A-9 Crib	--	K	--	--	K	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 5 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-A-10 Crib	--	S	--	--	S	
216-A-21 Crib	--	K	--	--	K	
216-A-24 Crib	--	S	--	--	S	UN-200-E-56
216-A-27 Crib	--	S	--	--	S	
216-A-30 Crib	--	S	--	--	S	
216-A-31 Crib	--	S	--	--	S	
216-A-32 Crib	--	S	--	--	S	
216-A-36A Crib	--	S	--	--	S	
216-A-36B Crib	--	S	--	--	S	
216-A-37-1 Crib	--	S	--	--	S	
216-A-37-2 Crib	--	S	--	--	S	
216-A-38-1 Crib	--	S	--	--	S	
216-A-39 Crib	--	S	--	--	S	
216-A-41 Crib	--	S	--	--	S	
216-A-45 Crib	--	S	--	--	S	
216-A-11 French Drain	--	S	--	--	S	
216-A-12 French Drain	--	S	--	--	S	
216-A-13 French Drain	--	S	--	--	S	
216-A-14 French Drain	--	S	--	--	S	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 6 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-A-15 French Drain	--	S	--	--	S	
216-A-16 French Drain	--	S	--	--	S	
216-A-17 French Drain	--	S	--	--	S	
216-A-22 French Drain	--	S	--	--	S	UPR-216-E-17
216-A-23A French Drain	--	S	--	--	S	
216-A-23B French Drain	--	S	--	--	S	
216-A-26 French Drain	--	S	--	--	S	
216-A-26A French Drain	--	S	--	--	S	
216-A-28 French Drain	--	S	--	--	S	
216-A-33 French Drain	--	S	--	--	S	
216-A-35 French Drain	--	S	--	--	S	
216-C-8 French Drain	--	K	--	--	K	
Reverse Wells						
299-E24-111 Injection Well	--	--	--	--	--	
Ponds, Trenches, and Ditches						
216-A-18 Trench	--	S	--	--	S	
216-A-19 Trench	--	S	--	--	S	
216-A-20 Trench	--	S	--	--	S	
216-A-40 Trench	--	K	--	--	K	UPR-200-E-59

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 7 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-A-29 Ditch	--	S	--	--	S	Several known releases including hydrazine
216-A-34 Ditch	--	S	--	--	S	
Septic Tanks and Associated Drain Fields						
2607-EA Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
2607-EC Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
2607-ED Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
2607-EG Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
2607-EJ Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
2607-EL Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
2607-E6 Septic Tank/Drain Field	--	--	--	--	--	No reported release of contaminants
Transfer Facilities, Diversion Boxes, and Pipelines						
241-A-A Diversion Box	--	--	--	--	--	
241-A-B Diversion Box	--	--	--	--	--	
241-A-151 Diversion Box	--	S	--	--	S	UN-200-E-26; UN-200-E-65
241-A-152 Diversion Box	--	--	--	--	--	
241-A-153 Diversion Box	--	--	--	--	--	
241-AN-A Diversion Box	--	--	--	--	--	
214-AN-B Diversion Box	--	--	--	--	--	
214-AR-151 Diversion Box	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 8 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
214-AW-A Diversion Box	--	--	--	--	--	
214-AW-B Diversion Box	--	--	--	--	--	
214-AX-A Diversion Box	--	--	--	--	--	
214-AX-B Diversion Box	--	--	--	--	--	
214-AX-151 Diversion Box	--	--	--	--	--	
214-AX-152DS Diversion Box	--	--	--	--	--	
214-AX-155 Diversion Box	--	--	--	--	--	
241-AY-151 Diversion Box	--	--	--	--	--	
241-AY-152 Diversion Box	--	--	--	--	--	
241-AZ-151DS Diversion Box	--	--	--	--	--	
241-AZ-152 Diversion Box	--	--	--	--	--	
241-C-151 Diversion Box	S	S	--	--	--	
241-C-152 Diversion Box	--	--	--	--	--	
241-C-153 Diversion Box	--	--	--	--	--	
241-C-252 Diversion Box	--	--	--	--	--	
241-CR-151 Diversion Box	--	--	--	--	--	
241-CR-152 Diversion Box	--	--	--	--	--	
241-CR-153 Diversion Box	--	--	--	--	--	
241-ER-153 Diversion Box	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 9 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
216-A-524 Control Structure	--	--	--	--	--	
241-AP Valve Pit	--	--	--	--	--	
241-AX-501 Valve Pit	--	--	--	--	--	
Basins						
207-A Retention Basin	--	--	--	--	--	
216-A-42 Retention Basin	--	S	--	--	S	UPR-200-E-66
Burial Sites						
218-E-1 Burial Ground	--	S	--	K	S	UPR-200-E-53
218-E-8 Burial Ground	--	S	--	--	S	
218-E-12A Burial Ground	--	K	--	--	K	UPR-200-E-24; UPR-200-E-30
218-E-12B Burial Ground	--	S	--	--	S	
218-E-13 Burial Ground	--	S	--	--	S	
200-E Burning Pit	--	--	--	--	--	UN-200-E-62; UPR-200-106
Unplanned Releases						
UN-200-E-10	--	R?	--	--	R?	
UN-200-E-11	--	R?	--	--	R?	
UN-200-E-12	--	S	--	--	S	
UN-200-E-13	--	R?	--	--	R?	
UN-200-E-15	--	S	--	--	S	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 10 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-16	--	S	--	--	S	
UN-200-E-18	--	S	--	--	S	
UN-200-E-19	--	S	--	--	S	
UN-200-E-20	--	S	--	--	S	
UN-200-E-22	--	S	--	--	S	
UN-200-E-25	--	S	--	--	S	
UN-200-E-26	--	K	--	--	K	
UN-200-E-27	--	K	--	--	K	
UN-200-E-28	--	S	--	--	S	
UN-200-E-31	--	K	--	--	K	
UN-200-E-33	--	S, R	--	--	S, R	
UN-200-E-35	--	--	--	--	--	Scheduled for deletion, duplicate of 218-E-13
UN-200-E-39	--	S	--	--	S	
UN-200-E-40	--	K	--	--	K	
UN-200-E-42	--	K	--	--	K	
UN-200-E-47	--	K	--	--	K	
UN-200-E-48	--	K	--	--	K	
UN-200-E-49	--	K	--	--	K	
UN-200-E-56	--	K	--	--	K	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 11 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-58	--	S, R?	--	S	S, R?	
UN-200-E-60	--	--	--	--	--	
UN-200-E-62	--	--	--	--	--	
UN-200-E-65	S	S	--	--	S	
UN-200-E-67	--	--	--	--	--	
UN-200-E-68	S	--	--	--	--	
UN-200-E-72	--	S	--	--	S	
UN-200-E-81	--	S	--	--	S	
UN-200-E-82	--	S	--	--	S	
UN-200-E-86	--	K	--	--	K	
UN-200-E-88	--	K	--	--	K	
UN-200-E-91	--	--	--	--	--	
UN-200-E-94	--	S	--	--	S	
UN-200-E-96	--	--	--	--	--	
UN-200-E-97	--	R	--	--	R	
UN-200-E-99	--	R	--	--	R	
UN-200-E-100	--	S	--	--	S	
UN-200-E-107	--	S	--	--	S	
UN-200-E-114	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 12 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UN-200-E-117	--	S	--	--	S	
UN-200-E-118	S	--	--	--	--	
UN-200-E-142	--	S, R?	--	--	S, R?	
UPR-200-E-17	--	S	--	--	S	
UPR-200-E-21	--	S	--	--	S	
UPR-200-E-24	--	S	--	--	S	
UPR-200-E-29	--	S	--	--	S	
UPR-200-E-30	--	--	--	--	--	
UPR-200-E-50	S	S	--	--	S	
UPR-200-E-53	--	S	--	--	S	
UPR-200-E-59	--	R?	--	--	R?	
UPR-200-E-66	--	S, R?	--	--	S, R?	
UPR-200-E-70	--	R	--	--	R	
UPR-200-E-106	--	--	--	--	--	
UPR-200-E-115	--	S	--	--	S	
UPR-200-E-119	--	--	--	--	--	
UPR-200-E-125	--	--	--	--	--	
UPR-200-E-126	--	--	--	--	--	

Table 4-2. Summary of Chemical Contamination in Various Affected Media for PUREX Plant Aggregate Area. (sheet 13 of 13)

Source Waste Management Unit	Air	Surface Soil (0-1 m)	Surface Water	Biota	Vadose Zone	Remarks
UPR-200-E-136	--	--	--	--	--	
UPR-200-E-137	--	--	--	--	--	

S = Suspected contamination, based on WIDS (WHC 1991a), or other inventory data, and available sampling and analysis information.
K = Known contamination, based on WIDS (WHC 1991a), or other sources.
R = Complete remediation reported.
R? = Remediation attempted, effectiveness not determined.
-- = Dashes indicate no contamination expected.

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Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 1 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
Plants, Buildings, and Storage Areas						
204-AR Waste Unloading Station	--	--	--	--	--	--
241-A-431 Ventilation Building	--	--	--	--	--	--
241-C-801 Support Facility	--	--	--	--	--	--
242-A Evaporator	--	--	--	--	--	--
Grout Treatment Facility	--	--	--	--	--	--
Tanks and Vaults						
241-A-101 Single-Shell Tank	R,C	R	R	--	--	R
241-A-102 Single-Shell Tank	R,C	R	R	--	--	R
241-A-103 Single-Shell Tank	R,C	R	R	--	--	R
241-A-104 Single-Shell Tank	R,C	R	R	--	--	R
241-A-105 Single-Shell Tank	R,C	R	R	--	--	R
241-A-106 Single-Shell Tank	R,C	R	R	--	--	R
241-AN-101 Double-Shell Tank	--	R	R	--	--	R
241-AN-102 Double-Shell Tank	--	R	R	--	--	R
241-AN-103 Double-Shell Tank	--	R	R	--	--	R
241-AN-104 Double-Shell Tank	--	R	R	--	--	R
241-AN-105 Double-Shell Tank	--	R	R	--	--	R
241-AN-106 Double-Shell Tank	--	R	R	--	--	R

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 2 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
241-AN-107 Double-Shell Tank	--	R	R	--	--	R
241-AP-101 Double-Shell Tank	--	R	R	--	--	R
241-AP-102 Double-Shell Tank	--	R	R	--	--	R
241-AP-103 Double-Shell Tank	--	R	R	--	--	R
241-AP-104 Double-Shell Tank	--	R	R	--	--	R
241-AP-105 Double-Shell Tank	--	R	R	--	--	R
241-AP-106 Double-Shell Tank	--	R	R	--	--	R
241-AP-107 Double-Shell Tank	--	R	R	--	--	R
241-AP-108 Double-Shell Tank	--	R	R	--	--	R
241-AW-101 Double-Shell Tank	--	R	R	--	--	R
241-AW-102 Double-Shell Tank	--	R	R	--	--	R
241-AW-103 Double-Shell Tank	--	R	R	--	--	R
241-AW-104 Double-Shell Tank	--	R	R	--	--	R
241-AW-105 Double-Shell Tank	--	R	R	--	--	R
241-AW-106 Double-Shell Tank	--	R	R	--	--	R
241-AX-101 Single-Shell Tank	R,C	R	R	--	--	R
241-AX-102 Single-Shell Tank	R,C	R	R	--	--	R
241-AX-103 Single-Shell Tank	R,C	R	R	--	--	R
241-AX-104 Single-Shell Tank	R,C	R	R	--	--	R

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 3 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
241-AY-101 Double-Shell Tank	--	R	R	--	--	R
241-AY-102 Double-Shell Tank	--	R	R	--	--	R
241-AZ-101 Double-Shell Tank	--	R	R	--	--	R
241-AZ-102 Double-Shell Tank	--	R	R	--	--	R
241-C-101 Single-Shell Tank	R,C	R	R	--	--	R
241-C-102 Single-Shell Tank	R,C	R	R	--	--	R
241-C-103 Single-Shell Tank	R,C	R	R	R,C	--	R
241-C-104 Single-Shell Tank	R,C	R	R	R,C	--	R
241-C-105 Single-Shell Tank	R,C	R	R	R,C	--	R
241-C-106 Single-Shell Tank	R,C	R	R	R,C	--	R
241-C-107 Single-Shell Tank	R,C	R	R	--	--	R
241-C-108 Single-Shell Tank	R,C	R	R	--	--	R
241-C-109 Single-Shell Tank	R,C	R	R	--	--	R
241-C-110 Single-Shell Tank	R,C	R	R	--	--	R
241-C-111 Single-Shell Tank	R,C	R	R	--	--	R
241-C-112 Single-Shell Tank	R,C	R	R	--	--	R
241-C-201 Single-Shell Tank	R,C	R	R	--	--	R
241-C-202 Single-Shell Tank	R,C	R	R	--	--	R
241-C-203 Single-Shell Tank	R,C	R	R	--	--	R

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 4 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
241-C-204 Single-Shell Tank	R,C	R	R	--	--	R
241-A-302A Catch Tank	--	--	--	--	--	--
241-A-302B Catch Tank	--	--	--	--	--	--
241-A-350 Catch Tank	--	--	--	--	--	--
241-A-417 Catch Tank	--	--	--	--	--	--
241-C-301C Catch Tank	--	--	--	--	--	--
244-A Lift Station	--	R	R	--	--	R
244-AR Vault	--	R	R	--	--	R
244-CR Vault	--	R	R	--	--	R
Cribs and Drains						
216-A-1 Crib	R,C	R	R	R	R	--
216-A-2 Crib	R,C	R	--	R	--	--
216-A-3 Crib	R	R	--	R	--	--
216-A-4 Crib	R,C	R	--	R	--	--
216-A-5 Crib	R,C	R	--	R	--	--
216-A-6 Crib	R,C	R	R	R	R	--
216-A-7 Crib	R,C	R	--	R	--	--
216-A-8 Crib	R,C	R	R	R	--	--
216-A-9 Crib	R,C	R	R	R	R	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 5 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
216-A-10 Crib	R	R	R	R	R	--
216-A-21 Crib	R,C	R	--	R	--	--
216-A-24 Crib	R,C	R	R	R	R	--
216-A-27 Crib	R,C	R	--	R	--	--
216-A-30 Crib	R,C	R	R	R	--	--
216-A-31 Crib	R,C	R	--	R	--	--
216-A-32 Crib	--	R	--	--	--	--
216-A-36A Crib	R,C	R	--	R	--	--
216-A-36B Crib	R,C	R	R	R	--	--
216-A-37-1 Crib	R,C	R	R	R	--	--
216-A-37-2 Crib	R,C	R	R	R	--	
216-A-38-1 Crib	--	R	--	--	--	--
216-A-39 Crib	R,C	--	--	R	--	--
216-A-41 Crib	C	--	--	--	--	--
216-A-45 Crib	R	R	--	R	--	--
216-A-11 French Drain	C	R	--	R	--	--
216-A-12 French Drain	C	R	--	R	--	--
216-A-13 French Drain	C	R	--	R	--	--
216-A-14 French Drain	C	R	--	R	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 6 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
216-A-15 French Drain	C	R	--	R	--	--
216-A-16 French Drain	C	R	--	R	--	--
216-A-17 French Drain	C	R	--	R	--	--
216-A-22 French Drain	C	R	--	R	--	--
216-A-23A French Drain	C	--	--	--	--	--
216-A-23B French Drain	C	--	--	--	--	--
216-A-26 French Drain	--	R	--	--	--	--
216-A-26A French Drain	C	R	--	--	--	--
216-A-28 French Drain	R,C	R	--	R	--	--
216-A-33 French Drain	--	R	--	--	--	--
216-A-35 French Drain	C	R	--	--	--	--
216-C-8 French Drain	C	R	--	--	--	--
Reverse Wells						
299-E24-111 Injection Well	R,C	--	--	--	--	--
Ponds, Trenches, and Ditches						
216-A-18 Trench	R,C	R	--	R	--	--
216-A-19 Trench	R,C	R	--	R	--	--
216-A-20 Trench	R,C	R	--	R	--	--
216-A-40 Trench	C	R	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 7 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
216-A-29 Ditch	--	R	R	R	R	--
216-A-34 Ditch	--	R	--	--	--	--
Septic Tanks and Associated Drain Fields						
2607-EA Septic Tank/Drain Field	--	--	--	--	--	--
2607-EC Septic Tank/Drain Field	--	--	--	--	--	--
2607-ED Septic Tank/Drain Field	--	--	--	--	--	--
2607-EG Septic Tank/Drain Field	--	--	--	--	--	--
2607-EJ Septic Tank/Drain Field	--	--	--	--	--	--
2607-EL Septic Tank/Drain Field	--	--	--	--	--	--
2607-E6 Septic Tank/Drain Field	--	--	--	--	--	--
Transfer Facilities, Diversion Boxes, and Pipelines						
241-A-A Diversion Box	--	--	--	--	--	--
241-A-B Diversion Box	--	--	--	--	--	--
241-A-151 Diversion Box	--	R	--	--	--	--
241-A-152 Diversion Box	--	--	--	--	--	--
241-A-153 Diversion Box	--	--	--	--	--	--
241-AN-A Diversion Box	--	--	--	--	--	--
214-AN-B Diversion Box	--	--	--	--	--	--
214-AR-151 Diversion Box	--	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 8 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
214-AW-A Diversion Box	--	--	--	--	--	--
214-AW-B Diversion Box	--	--	--	--	--	--
214-AX-A Diversion Box	--	--	--	--	--	--
214-AX-B Diversion Box	--	--	--	--	--	--
214-AX-151 Diversion Box	--	--	--	--	--	--
214-AX-152DS Diversion Box	--	--	--	--	--	--
214-AX-155 Diversion Box	--	--	--	--	--	--
241-AY-151 Diversion Box	--	--	--	--	--	--
241-AY-152 Diversion Box	--	--	--	--	--	--
241-AZ-151DS Diversion Box	--	--	--	--	--	--
241-AZ-152 Diversion Box	--	--	--	--	--	--
241-C-151 Diversion Box	--	R	--	--	--	--
241-C-152 Diversion Box	--	--	--	--	--	--
241-C-153 Diversion Box	--	--	--	--	--	
241-C-252 Diversion Box	--	--	--	--	--	--
241-CR-151 Diversion Box	--	--	--	--	--	--
241-CR-152 Diversion Box	--	--	--	--	--	--
241-CR-153 Diversion Box	--	--	--	--	--	--
241-ER Diversion Box	--	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 9 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
216-A-524 Control Structure	--	--	--	--	--	--
241-AP Valve Pit	--	--	--	--	--	--
241-AX-501 Valve Pit	--	--	--	--	--	--
Basins						
207-A Retention Basin	R,C	R	--	--	--	--
216-A-42 Retention Basin	--	--	--	--	--	--
Burial Sites						
218-E-1 Burial Ground	R	R	--	R	--	--
218-E-8 Burial Ground	--	--	--	R	--	--
218-E-12A Burial Ground	--	R	--	R	--	--
218-E-12B Burial Ground	--	--	R	--	--	--
218-E-13 Burial Ground	--	--	R	--	--	--
200-E Burning Pit	--	--	--	--	--	--
Unplanned Releases						
UN-200-E-10	--	--	--	--	--	--
UN-200-E-11	--	--	--	--	--	--
UN-200-E-12	--	R	--	--	--	--
UN-200-E-13	--	--	--	--	--	--
UN-200-E-15	--	R	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 10 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
UN-200-E-16	--	--	--	--	--	--
UN-200-E-18	--	--	--	--	--	--
UN-200-E-19	--	--	--	--	--	--
UN-200-E-20	--	R	--	--	--	--
UN-200-E-22	--	--	--	--	--	--
UN-200-E-25	--	R	--	--	--	--
UN-200-E-26	--	R	--	--	--	
UN-200-E-27	--	R	--	--	--	--
UN-200-E-28	--	--	--	--	--	--
UN-200-E-31	--	R	--	--	--	--
UN-200-E-33	--	--	--	--	--	--
UN-200-E-35	--	--	--	--	--	--
UN-200-E-39	--	R	--	--	--	--
UN-200-E-40	--	R	--	--	--	--
UN-200-E-42	--	R	--	--	--	--
UN-200-E-47	--	R	--	--	--	--
UN-200-E-48	--	R	--	--	--	--
UN-200-E-49	--	R	--	--	--	--
UN-200-E-56	--	R	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 11 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
UN-200-E-58	--	R	--	--	--	--
UN-200-E-60	--	R	--	--	--	--
UN-200-E-62	--	R	--	--	--	--
UN-200-E-65	--	R	--	--	--	--
UN-200-E-67	--	R	--	--	--	--
UN-200-E-68	--	R	--	--	--	--
UN-200-E-72	--	R	--	--	--	--
UN-200-E-81	R	R	--	--	--	--
UN-200-E-82	R	--	--	--	--	--
UN-200-E-86	R	R	--	--	--	--
UN-200-E-88	--	R	--	--	--	--
UN-200-E-91	--	--	--	--	--	--
UN-200-E-94	--	R	--	--	--	--
UN-200-E-96	--	--	--	--	--	--
UN-200-E-97	--	--	--	--	--	--
UN-200-E-99	--	--	--	--	--	--
UN-200-E-100	--	--	--	--	--	--
UN-200-E-107	--	R	--	--	--	
UN-200-E-114	--	R	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 12 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
UN-200-E-117	--	R	--	--	--	--
UN-200-E-118	--	R	--	--	--	--
UN-200-E-142	--	--	--	--	--	--
UPR-200-E-17	--	--	--	--	--	--
UPR-200-E-21	--	R	--	--	--	--
UPR-200-E-24	--	R	--	--	--	--
UPR-200-E-29	--	R	--	--	--	--
UPR-200-E-30	--	R	--	--	--	--
UPR-200-E-50	--	R	--	--	--	--
UPR-200-E-53	--	R	--	--	--	--
UPR-200-E-59	--	R	--	--	--	--
UPR-200-E-66	R	R	--	--	--	--
UPR-200-E-70	--	R	--	--	--	--
UPR-200-E-106	--	R	--	--	--	--
UPR-200-E-115	--	R	--	--	--	--
UPR-200-E-119	--	--	--	--	--	--
UPR-200-E-125	R	--	--	--	--	--
UPR-200-E-126	C	--	--	--	--	--

Table 4-3. Types of Data Available for Each Waste Management Unit. (sheet 13 of 13)

Waste Management Unit	Inventory	Surface Radiological Survey (0-1 m)	External Radiation Monitoring	Waste, Soil, or Sediment Sampling	Biota Sampling	Borehole Geophysics
UPR-200-E-136	R	--	--	--	--	--
UPR-200-E-137	C	--	--	--	--	--

R = Radionuclide-related data
C = Chemical-related data.
Dashes indicate data types are not available.

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Table 4-4. Summary of Air Monitoring Results from 1985 to 1989.

	RADIONUCLIDE (pCi/m^3)			
SITE	Sr-90	Cs-137	Pu-239	U (total)
N006	1.46E-04	2.62E-04	6.28E-06	-9.25E-07
N007	1.19E-04	1.17E-04	2.46E-06	6.70E-06
N008	1.10E-04	8.55E-05	3.42E-06	2.03E-05
N012	2.18E-04	5.53E-04	2.49E-06	-9.06E-06
N158	6.07E-04	1.72E-03	1.34E-04	4.18E-05
N969	3.20E-04	1.30E-04	2.67E-05	7.96E-05
N970	2.21E-04	4.72E-04	3.46E-05	6.10E-05
N971	9.65E-04	3.59E-04	4.08E-05	2.69E-05
N976	7.75E-04	3.26E-04	5.41E-06	4.68E-05
N977	5.40E-04	3.07E-04	2.13E-05	3.98E-05
N984	9.31E-04	1.39E-03	9.53E-06	3.41E-05
N985	3.70E-04	4.32E-04	3.87E-05	4.95E-05
N991	1.17E-04	3.03E-04	1.50E-05	3.97E-05
N992	1.89E-04	1.22E-04	1.79E-06	2.10E-05
N993	1.63E-04	7.43E-04	7.11E-06	4.95E-05
N996	2.00E-04	1.76E-04	7.92E-06	3.66E-05
N997	3.57E-04	9.68E-04	8.51E-06	3.17E-05

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

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Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 1 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
Plants, Buildings, and Storage Areas						
204-AR	Waste Unloading Station	NA	NA	NA	--	--
241-A-431	Ventilation Building	NA	NA	NA	--	--
241-C-801	Support Facility	NA	NA	NA	--	--
242-A	Evaporator	NA	NA	NA	--	--
Grout Treatment Facility	--	NA	NA	NA	--	--
Tanks and Vaults						
241-A-101	Single-Shell Tank	NA	NA	NA	--	--
241-A-102	Single-Shell Tank	NA	NA	NA	--	--
241-A-103	Single-Shell Tank	NA	NA	NA	--	--
241-A-104	Single-Shell Tank	NA	NA	NA	--	--
241-A-105	Single-Shell Tank	NA	NA	NA	--	--
241-A-106	Single-Shell Tank	NA	NA	NA	--	--
241-AN-101	Double-Shell Tank	NA	NA	NA	--	--
241-AN-102	Double-Shell Tank	NA	NA	NA	--	--
241-AN-103	Double-Shell Tank	NA	NA	NA	--	--
241-AN-104	Double-Shell Tank	NA	NA	NA	--	--
241-AN-105	Double-Shell Tank	NA	NA	NA	--	--
241-AN-106	Double-Shell Tank	NA	NA	NA	--	--
241-AN-107	Double-Shell Tank	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 2 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
241-AP-101	Double-Shell Tank	NA	NA	NA	--	--
241-AP-102	Double-Shell Tank	NA	NA	NA	--	--
241-AP-103	Double-Shell Tank	NA	NA	NA	--	--
241-AP-104	Double-Shell Tank	NA	NA	NA	--	--
241-AP-105	Double-Shell Tank	NA	NA	NA	--	--
241-AP-106	Double-Shell Tank	NA	NA	NA	--	--
241-AP-107	Double-Shell Tank	NA	NA	NA	--	--
241-AP-108	Double-Shell Tank	NA	NA	NA	--	--
241-AW-101	Double-Shell Tank	NA	NA	NA	--	--
241-AW-102	Double-Shell Tank	NA	NA	NA	--	--
241-AW-103	Double-Shell Tank	NA	NA	NA	--	--
241-AW-104	Double-Shell Tank	NA	NA	NA	--	--
241-AW-105	Double-Shell Tank	NA	NA	NA	--	--
241-AW-106	Double-Shell Tank	NA	NA	NA	--	--
241-AX-101	Single-Shell Tank	NA	NA	NA	--	--
241-AX-102	Single-Shell Tank	NA	NA	NA	--	--
241-AX-103	Single-Shell Tank	NA	NA	NA	--	--
241-AX-104	Single-Shell Tank	NA	NA	NA	--	--
241-AY-101	Double-Shell Tank	NA	NA	NA	--	--
241-AY-102	Double-Shell Tank	NA	NA	NA	--	--
241-AZ-101	Double-Shell Tank	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 3 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
241-AZ-102	Double-Shell Tank	NA	NA	NA	--	--
241-C-101	Single-Shell Tank	NA	NA	NA	--	--
241-C-102	Single-Shell Tank	NA	NA	NA	--	--
241-C-103	Single-Shell Tank	NA	NA	NA	--	--
241-C-104	Single-Shell Tank	NA	NA	NA	--	--
241-C-105	Single-Shell Tank	NA	NA	NA	--	--
241-C-106	Single-Shell Tank	NA	NA	NA	--	--
241-C-107	Single-Shell Tank	NA	NA	NA	--	--
241-C-108	Single-Shell Tank	NA	NA	NA	--	--
241-C-109	Single-Shell Tank	NA	NA	NA	--	--
241-C-110	Single-Shell Tank	NA	NA	NA	--	--
241-C-111	Single-Shell Tank	NA	NA	NA	--	--
241-C-112	Single-Shell Tank	NA	NA	NA	--	--
241-C-201	Single-Shell Tank	NA	NA	NA	--	--
241-C-202	Single-Shell Tank	NA	NA	NA	--	--
241-C-203	Single-Shell Tank	NA	NA	NA	--	--
241-C-204	Single-Shell Tank	NA	NA	NA	--	--
241-A-302A	Catch Tank	NA	NA	NA	--	--
241-A-302B	Catch Tank	NA	NA	NA	--	--
241-A-350	Catch Tank	NA	NA	NA	--	--
241-A-417	Catch Tank	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 4 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
241-C-301C	Catch Tank	NA	NA	NA	--	--
244-A	Lift Station	NA	NA	NA	--	--
244-AR	Vault	NA	NA	NA	--	--
244-CR	Vault	NA	NA	NA	--	--
Cribs and Drains						
216-A-1	Crib	NC	NC	NC	1991	--
216-A-2	Crib	NC	NC	NC	1990	--
216-A-3	Crib	NC	NC	NC	1990	--
216-A-4	Crib	NC	NC	NC	1990	--
216-A-5	Crib	NC	NC	NC	1989	--
216-A-6	Crib	--	5,000	00	1990	unknown
216-A-7	Crib	--	30,000	--	1991	beta
216-A-8	Crib	NC	NC	0.01	1990	--
216-A-9	Crib	--	30,000	--	1990	unknown
216-A-10	Crib	NC	NC	NC	1990	--
216-A-21	Crib	--	15,000	--	1990	beta, gamma
216-A-24	Crib	NC	NC	NC	Oct-90	--
216-A-27	Crib	NC	NC	NC	1990	--
216-A-30	Crib	NC	NC	0.01	1990	--
216-A-31	Crib	NC	NC	NC	1988	--
216-A-32	Crib	NC	NC	NC	1990	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 5 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
216-A-36A	Crib	NC	NC	NC	1990	--
216-A-36B	Crib	NC	NC	NC	1990	--
216-A-37-1	Crib	NC	NC	NC	1990	--
216-A-37-2	Crib	--	500	--	1991	alpha
		--	200	--	1991	beta
216-A-38-1	Crib	NC	NC	NC	1989	--
216-A-39	Crib	NA	NA	NA	--	--
216-A-41	Crib	NA	NA	NA	--	--
216-A-45	Crib	NC	NC	NC	1990	--
216-A-11	French Drain	NC	NC	NC	1990	--
216-A-12	French Drain	NC	NC	NC	1988	--
216-A-13	French Drain	NC	NC	NC	1990	--
216-A-14	French Drain	--	56,000	--	1990	alpha
216-A-15	French Drain	NC	NC	NC	1988	--
216-A-16	French Drain	NA	NA	NA	--	--
216-A-17	French Drain	NA	NA	NA	--	--
216-A-22	French Drain	NC	NC	NC	1988	--
216-A-23A	French Drain	NA	NA	NA	--	--
216-A-23B	French Drain	NA	NA	NA	--	--
216-A-26	French Drain	NC	NC	NC	1990	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 6 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
216-A-26A	French Drain	NC	NC	NC	1990	--
216-A-28	French Drain	--	10,000	--	1990	beta, gamma
		--	2,300	--	1990	alpha
216-A-33	French Drain	NC	NC	NC	1990	--
216-A-35	French Drain	NC	NC	NC	1990	--
216-C-8	French Drain	2,000	--	--	1988	unknown
Reverse Wells						
299-E24-111	Injection Well	NA	NA	NA	--	--
Ponds, Ditches, and Trenches						
216-A-29	Ditch	2,000	--	--	1989	beta
216-A-34	Ditch	NC	NC	NC	1991	--
216-A-18	Trench	NC	NC	NC	1990	--
216-A-19	Trench	NC	NC	NC	1990	--
216-A-20	Trench	NC	NC	NC	1990	--
216-A-40	Trench	--	--	4	Apr-90	gamma
Septic Tanks and Associated Drain Fields						
2607-EA	Septic Tank/Drain Field	NA	NA	NA	--	--
2607-EC	Septic Tank/Drain Field	NA	NA	NA	--	--
2607-ED	Septic Tank/Drain Field	NA	NA	NA	--	--
2607-EG	Septic Tank/Drain Field	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 7 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
2607-EJ	Septic Tank/Drain Field	NA	NA	NA	--	--
2607-EL	Septic Tank/Drain Field	NA	NA	NA	--	--
2607-E6	Septic Tank/Drain Field	NA	NA	NA	--	--
Transfer Facilities, Diversion Boxes, and Pipelines						
241-A-A	Diversion Box	NA	NA	NA	--	--
241-A-B	Diversion Box	NA	NA	NA	--	--
241-A-151	Diversion Box	NC	NC	NC	1988	--
241-A-152	Diversion Box	NA	NA	NA	--	--
241-A-153	Diversion Box	NA	NA	NA	--	--
241-AN-A	Diversion Box	NA	NA	NA	--	--
241-AN-B	Diversion Box	NA	NA	NA	--	--
241-AR-151	Diversion Box	NA	NA	NA	--	--
241-AW-A	Diversion Box	NA	NA	NA	--	--
241-AW-B	Diversion Box	NA	NA	NA	--	--
241-AX-A	Diversion Box	NA	NA	NA	--	--
241-AX-B	Diversion Box	NA	NA	NA	--	--
241-AX-151	Diversion Box	NA	NA	NA	--	--
241-AX-152DS	Diversion Box	NA	NA	NA	--	--
241-AX-155	Diversion Box	NA	NA	NA	--	--
241-AY-151	Diversion Box	NA	NA	NA	--	--
241-AY-152	Diversion Box	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 8 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
241-AZ-151DS	Diversion Box	NA	NA	NA	--	--
241-AZ-152	Diversion Box	NC	NC	NC	--	--
241-C-151	Diversion Box	NA	NA	NA	--	--
241-C-152	Diversion Box	NA	NA	NA	--	--
241-C-153	Diversion Box	NA	NA	NA	--	--
241-C-252	Diversion Box	NA	NA	NA	--	--
241-CR-151	Diversion Box	NA	NA	NA	--	--
241-CR-152	Diversion Box	NA	NA	NA	--	--
241-CR-153	Diversion Box	NA	NA	NA	--	--
241-ER-153	Diversion Box	NA	NA	NA	--	--
216-A-524	Control Structure	NA	NA	NA	--	--
241-AP	Valve Pit	NA	NA	NA	--	--
241-AX-501	Valve Pit	NA	NA	NA	--	--
Basins						
207-A	Retention Basin	1,500	NA	NA	1990	unknown
216-A-42	Retention Basin	NA	200,000	NA	1988	unknown
Burial Sites						
200-E	Burning Pit	NA	NA	0.01	1989	--
218-E-1	Burial Ground	5,000	NA	NA	1990	unknown
218-E-8	Burial Ground	NA	NA	NA	--	--
218-E-12A	Burial Ground	NA	20,000	NA	1990	unknown

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 9 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
218-E-12B	Burial Ground	NA	NA	0.01	1989	--
218-E-13	Burial Ground	NA	NA	NA	--	--
Unplanned Releases						
UN-200-E-10	Unplanned Release	NA	NA	NA	--	--
UN-200-E-11	Unplanned Release	NA	NA	NA	--	--
UN-200-E-12	Unplanned Release	NA	NA	NA	--	--
UN-200-E-13	Unplanned Release	NA	NA	NA	--	--
UN-200-E-15	Unplanned Release	NA	NA	NA	--	--
UN-200-E-16	Unplanned Release	NA	NA	NA	--	--
UN-200-E-18	Unplanned Release	NA	NA	NA	--	--
UN-200-E-19	Unplanned Release	NA	NA	NA	--	--
UN-200-E-20	Unplanned Release	NA	NA	NA	--	--
UN-200-E-22	Unplanned Release	NA	NA	NA	--	--
UN-200-E-25	Unplanned Release	NA	NA	NA	--	--
UN-200-E-26	Unplanned Release	NA	NA	NA	--	--
UN-200-E-27	Unplanned Release	NA	NA	NA	--	--
UN-200-E-28	Unplanned Release	NA	NA	NA	--	--
UN-200-E-31	Unplanned Release	NC	NC	NC	1991	--
UN-200-E-33	Unplanned Release	NA	NA	NA	--	--
UN-200-E-35	Unplanned Release	NA	NA	NA	--	--
UN-200-E-39	Unplanned Release	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 10 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
UN-200-E-40	Unplanned Release	NA	NA	NA	--	--
UN-200-E-42	Unplanned Release	NA	NA	NA	--	--
UN-200-E-47	Unplanned Release	NA	NA	NA	--	--
UN-200-E-48	Unplanned Release	NA	NA	NA	--	--
UN-200-E-49	Unplanned Release	NA	NA	NA	--	--
UN-200-E-56	Unplanned Release	NA	NA	NA	--	--
UN-200-E-58	Unplanned Release	NA	NA	NA	--	--
UN-200-E-60	Unplanned Release	NA	NA	NA	--	--
UN-200-E-62	Unplanned Release	NA	NA	NA	--	--
UN-200-E-65	Unplanned Release	NA	NA	NA	--	--
UN-200-E-67	Unplanned Release	NA	NA	NA	--	--
UN-200-E-68	Unplanned Release	NA	NA	NA	--	--
UN-200-E-72	Unplanned Release	NA	NA	NA	--	--
UN-200-E-81	Unplanned Release	NA	NA	NA	--	--
UN-200-E-82	Unplanned Release	NA	NA	NA	--	--
UN-200-E-86	Unplanned Release	NC	NC	NC	Sep-91	--
UN-200-E-88	Unplanned Release	NA	60,000	NA	1991	unknown
UN-200-E-91	Unplanned Release	NA	NA	NA	--	--
UN-200-E-94	Unplanned Release	NA	NA	NA	--	--
UN-200-E-96	Unplanned Release	NA	NA	NA	--	--
UN-200-E-97	Unplanned Release	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 11 of 12)

Site Name	Site Type	Radiation Surveys ct/min	dis/min	mrem/h	Survey Date	Radiation Type
UN-200-E-99	Unplanned Release	NA	NA	NA	--	--
UN-200-E-100	Unplanned Release	NA	NA	5	Oct-91	unknown
UN-200-E-107	Unplanned Release	NA	NA	NA	--	--
UN-200-E-114	Unplanned Release	NA	NA	NA	--	--
UN-200-E-117	Unplanned Release	NA	NA	NA	--	--
UN-200-E-118	Unplanned Release	NA	NA	NA	--	--
UN-200-E-142	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-17	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-21	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-23	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-24	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-29	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-30	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-50	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-53	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-106	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-66	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-70	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-115	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-119	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-125	Unplanned Release	NA	NA	NA	--	--

Table 4-5. Radiation and Dose Rate Surveys at the PUREX Plant Aggregate Area Waste Management Units. (sheet 12 of 12)

Site Name	Site Type	Radiation Surveys				
		ct/min	dis/min	mrem/h	Survey Date	Radiation Type
UPR-200-E-126	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-136	Unplanned Release	NA	NA	NA	--	--
UPR-200-E-137	Unplanned Release	NA	NA	NA	--	--

NA = No data available
NC = No contamination detected
Note: Values presented in the table represent the maximum value reported in the radiation survey results.
Dashes indicate no data are available.

Table 4-6. Results of External Radiation Monitoring, 1985 through 1989 TLDs (mrem/yr).

Site	Average Total
2E 5: 218-E-12B	94
2E 6: 200-E NE	91
2E 11: 218-E-12B N	100
2E 12: 218-E-12B E	89
2E 17: 241-C TF W	107
2E 18: 241-C TF E	111
2E 23: PUREX N	103
2E 24: PUREX NE	111
2E 29: PUREX S	80
2E 30: PUREX SE	80
2E 35: 200-E S	80
2E 36: 200-E SW	82
2E D: 216-A-29 Ditch E	96
216-A-29 Ditch	86
216-A-36B Crib #1	86
216-A-36B Crib #2	100
216-A-10 Crib #1	88
216-A-10 Crib #2	82
PUREX #1	85
PUREX #2	88
PUREX #3	92
241-A TF #1	244
241-A TF #2	220
241-A TF #3	324
241-A TF #4	590
241-A TF #5	94
241-A TF #6	101
241-A TF #7	132
241-A TF #8	2,585
241-A TF #9	665
241-A TF #10	883
241-A TF #11	115
241-A TF #12	157
241-A TF #13	132
216-A-30 Crib #1	87
216-A-30 Crib #2	84
216-A-37-1 Crib #1	87
216-A-37-1 Crib #2	88
216-A-8 Crib #1	106
216-A-8 Crib #2	124
GTF NE	95*
GTF SE	99*
GTF SW	97*

Elder et al. 1986, 1987, 1988, 1989
Schmidt et al. 1990
*Average over 2 years, 1988 & 1989.

Table 4-7. Results of External Radiation Monitoring 1990 TLds (mrem/yr).

Site	Maximum	Minimum	Average Total
216-A-37-1 E	116	100	107
216-A-37-1 N	124	96	103
216-A-29	104	88	98
216-A-8 S	120	100	106
216-A-8 E	132	100	121
218-E-12	116	100	105
216-A-10-1	112	92	99
216-A-10-2	120	96	107
216-A-36-1	112	92	100
216-A-36-B-2	120	88	100
202-A-1 (PUREX)	112	96	100
202-A-1 SE (PUREX)	108	96	104
202-A-1 PL (PUREX)	280	96	194
241-A TF No. 1	332	136	216
241-A TF No. 2	160	116	132
241-A TF No. 3	144	108	122
241-A TF No. 4	140	100	113
241-A TF No. 5	124	104	110
241-A TF No. 6	128	96	116
241-A TF No. 7	2300	112	1100
241-A TF No. 8	2000	384	1200
241-A TF No. 10	1900	384	908
241-A TF No. 11	576	132	236
241-A TF No. 12	140	124	129
241-A TF No. 13	156	92	112
Grout Treatment Facility	116	100	107
N. of Grout Vaults	120	92	103
Grout Facility	116	88	95

Schmidt et al. 1992a

Table 4-8. Summary of Grid Soil Sampling Results from 1985 to 1989 (pCi/g). (sheet 1 of 2)

Radionuclide	Site 2E 11	Site 2E 12	Site 2E 17	Site 2E 18	Site 2E 23	Site 2E 24	Site 2E 29	Site 2E 30
Ce-141	-1.80E-02	4.88E-02	5.38E-02	-1.13E-02	2.00E-02	2.59E-02	3.03E-02	-3.44E-02
Ce-144	1.35E-01	1.07E-01	1.24E-02	-1.30E-02	3.50E-02	2.20E-03	-1.03E-01	-5.43E-03
Co-58	-5.00E-03	-9.73E-04	2.04E-02	-4.18E-03	-1.24E-02	-3.28E-03	2.91E-02	-4.03E-03
Co-60	1.39E-02	5.01E-03	-2.44E-03	2.65E-03	2.43E-02	6.90E-03	7.21E-03	2.05E-03
Cs-134	3.99E-02	4.20E-02	3.19E-02	2.65E-02	-6.67E-04	3.95E-02	3.53E-02	-4.20E-03
Cs-137	1.19E+01	1.36E+01	4.35E+00	6.24E+00	9.97E+00	5.49E+00	2.62E+00	2.79E-01
Eu-152	1.77E-01	6.52E-02	4.93E-02	8.72E-02	1.46E-01	1.24E-01	6.80E-02	5.85E-02
Eu-154	-5.50E-02	1.78E-02	6.51E-02	2.75E-02	3.90E-02	-5.96E-03	6.74E-03	9.03E-03
Eu-155	1.80E-02	9.54E-02	1.39E-02	3.82E-02	1.24E-01	1.52E-02	2.12E-02	4.82E-02
I-129	--	2.37E-02	3.55E-02	1.85E-01	--	-7.30E-02	1.74E-01	6.30E-02
K-40	--	1.19E+01	1.50E+01	1.51E+01	--	1.37E+01	1.54E+01	1.35E+01
Mn-54	2.60E-02	2.14E-02	5.49E-03	1.75E-02	1.22E-02	-1.30E-03	-4.83E-03	3.96E-03
Nb-95	--	1.21E-01	7.69E-02	3.44E-02	--	-1.07E-01	4.52E-02	-1.14E-02
Pb-212	--	7.85E-01	7.90E-01	7.48E-01	--	8.55E-01	8.75E-01	7.04E-01
Pb-214	7.90E-01	6.91E-01	5.79E-01	6.89E-01	6.80E-01	6.72E-01	7.14E-01	6.26E-01
Pu-238	1.49E-03	1.39E-03	7.47E-04	2.63E-04	4.11E-02	6.84E-04	1.84E-03	1.13E-03
Pu-239	6.27E-02	3.97E-02	2.34E-02	9.98E-03	1.26E-01	3.03E-02	6.04E-02	2.23E-02
Ru-106	3.50E-02	-3.33E-04	1.46E-01	-2.64E-02	7.55E-02	1.80E-02	2.23E-01	3.83E-01
Sr-90	1.92E+00	1.24E+00	3.49E+00	1.33E+00	2.20E+00	7.94E-01	7.86E-01	3.68E-01
Tc-99	--	3.41E-01	2.35E-01	6.86E-01	--	1.66E-01	2.24E-01	1.66E-01
U (total)	3.12E-01	2.06E-01	2.29E-01	3.38E-01	3.48E-01	3.32E-01	4.48E-01	3.07E-01
Zn-65	-1.60E-02	-4.31-02	-1.28E-02	-1.42E-02	2.03E-02	-2.47E-02	-1.74E-02	-1.44E-02
Zr-95	1.40E-02	5.52E-02	4.10E-02	1.98E-02	4.47E-02	1.98E-02	2.13E-02	1.90E-02

Table 4-8. Summary of Grid Soil Sampling Results from 1985 to 1989 (pCi/g). (sheet 2 of 2)

Radionuclide	Site 2ED	Site 2EDB	Site GRT1	Site GRT2	Site GRT4	Site GRT5	Site GRT6
Ce-141	5.30E-02	1.90E-02	-2.44E-02	4.85E-03	-5.80E-03	-1.60E-02	-3.00E-02
Ce-144	-1.12E-02	9.20E-03	-4.10E-02	-1.26E-02	-7.00E-04	-2.61E-02	-2.71E-02
Co-58	7.70E-03	7.60E-03	4.47E-03	3.40E-03	5.73E-03	-9.86E-03	-8.13E-03
Co-60	3.00E-03	8.40E-03	-1.24E-02	-1.23E-03	-1.85E-02	1.43E-03	5.27E-03
Cs-134	3.43E-02	6.60E-02	1.14E-02	-5.87E-03	-7.77E-03	2.45E-02	1.19E-02
Cs-137	3.82E+00	2.80E+00	1.50E+00	1.93E+00	1.01E+00	1.61E+00	1.73E+00
Eu-152	1.06E-01	1.50E-01	1.08E-01	4.78E-02	1.06E-01	6.05E-02	5.70E-02
Eu-154	3.28E-02	-3.90E-02	2.13E-02	1.38E-02	-7.13E-03	-4.67E-03	1.63E-02
Eu-155	6.45E-02	5.80E-02	4.53E-02	3.24E-02	5.81E-02	2.95E-02	4.71E-02
I-129	1.54E-01	1.00E-01	5.00E-03	9.73E-02	-5.90E-01	-7.90E-02	3.20E-01
K-40	1.63E+01	--	1.45E+01	1.42E+01	1.51E+01	1.48E+01	1.50E+01
Mn-54	9.00E-03	1.70E-02	2.12E-02	1.64E-03	9.69E-03	6.62E-03	9.73E-04
Nb-95	-6.84E-02	--	-5.28E-02	-8.71E-02	-2.89E-02	-1.49E-01	-1.38E-01
Pb-212	7.70E-01	--	7.63E-01	8.43E-01	7.91E-01	7.67E-01	8.28E-01
Pb-214	6.83E-01	--	5.89E-01	6.22E-01	6.44E-01	6.71E-01	6.24E-01
Pu-238	9.42E-04	5.00E-04	3.55E-04	4.96E-04	4.45E-04	3.37E-04	3.31E-04
Pu-239	4.08E-02	4.00E-02	1.48E-02	3.05E-02	1.45E-02	1.28E-02	1.07E-02
Ru-106	5.37E-02	1.00E-01	-7.75E-02	9.04E-02	3.59E-02	-5.18E-02	-5.37E-03
Sr-90	9.00E-01	6.60E-01	3.68E-01	3.51E-01	3.00E-01	5.09E-01	2.86E-01
Tc-99	1.26E-01	5.20E-01	2.85E-01	3.89E-01	3.32E-01	4.16E-01	3.05E-01
U (total)	4.96E-01	3.70E-01	3.31E-01	3.86E-01	3.17E-01	3.82E-01	3.99E-01
Zn-65	-6.68E-02	4.00E-03	-8.67E-03	-3.20E-02	-5.46E-02	-2.77E-02	-4.53E-03
Zr-95	1.44E-02	-2.00E-03	1.93E-02	1.62E-02	8.10E-03	5.70E-03	4.23E-02

-- Dashes indicate data is not available

Table 4-9. Summary of Fenceline Soil Sampling Results from 1985 to 1989 (pCi/g). (sheet 1 of 2)

Radionuclide	Site 2E 1	Site 2E 2	Site 2E 3	Site 2E 4	Site 2E-NE	Site 2E-SE	Site A-TF-E1	Site A-TF-E2
Ce-141	-9.67E-04	7.83E-03	-6.87E-03	--	-7.60E-03	-8.67E-04	-2.46E-02	1.62E-02
Ce-144	1.43E-02	1.88E-02	-8.49E-02	--	-2.37E-02	2.50E-02	-4.20E-02	-1.79E-02
Co-58	1.70E-03	-5.95E-03	-3.45E-04	--	-9.58E-03	-6.05E-04	1.39E-02	2.20E-02
Co-60	2.49E-02	-4.40E-03	5.93E-03	--	1.02E-02	1.57E-020	-5.00E-04	6.28E-03
Cs-134	1.32E-02	2.94E-02	4.13E-02	--	4.38E-02	2.26E-02	2.01E-02	3.76E-02
Cs-137	2.47E+00	1.80E+01	4.77E-01	8.60E+01	1.19E+00	3.58E-01	2.40E+00	7.29E+00
Eu-152	1.21E-01	9.25E-02	1.10E-01	--	3.17E-02	8.28E-02	1.06E-01	9.50E-02
Eu-154	3.79E-02	3.69E-02	8.36E-03	--	1.94E-02	8.43E-03	1.37E-02	-1.85E-02
Eu-155	5.40E-03	4.82E-02	3.42E-02	--	4.30E-02	4.16E-02	5.11E-02	5.48E-02
K-40	1.32E+01	1.36E+01	1.43E+01	--	1.38E+01	1.51E+01	1.21E+01	1.39E+01
Mn-54	6.43E-03	1.06E-02	1.25E-02	--	2.36E-02	4.98E-03	3.08E-03	2.03E-02
Nb-95	2.00E-03	-1.64E-02	-4.15E-02	--	-4.63E-02	-5.54E-02	-4.77E-02	2.95E-02
Pb-212	6.29E-01	6.13E-01	6.61E-01	--	7.27E-01	7.48E-01	4.82E-01	6.68E-01
Pb-214	4.60E-01	4.69E-01	5.28E-01	--	6.00E-01	6.14E-01	5.01E-01	5.27E-01
Pu-238	7.60E-05	2.46E-04	3.85E-04	--	3.27E-04	2.19E-04	4.88E-04	5.03E-04
Pu-239	8.18E-03	6.65E-03	1.88E-02	1.20E+01	5.40E-03	1.60E-03	2.04E-03	4.08E-03
Ru-106	6.18E-02	2.19E-01	3.80E-01	--	-6.50E-03	6.64E-02	8.43E-02	8.30E-02
Sr-90	6.08E-01	2.43E+00	5.32E-01	7.80E+00	1.64E+00	6.93E-01	4.28E-01	2.15E+00
U (total)	2.65E-01	3.29E-01	3.06E-01	--	2.30E-01	3.02E-01	2.22E-01	3.62E-01
Zn-65	-8.40E-02	2.94E-02	8.50E-03	--	1.43E-02	-4.99E-02	-5.25E-02	-1.71E-02
Zr-95	-6.72E-03	-1.41E-02	1.01E-02	--	3.76E-02	1.56E-02	4.79E-03	3.87E-02

Table 4-9. Summary of Fenceline Soil Sampling Results from 1985 to 1989 (pCi/g). (sheet 2 of 2)

Radionuclide	Site A-TF-E3	Site A-TF-E4	Site A-TF-W1	Site A-TF-W2	Site A-TF-E	Site C-TF-NE	Site C-TF-SE
Ce-141	8.40E-01	-1.87E-03	5.23E-02	-1.50E-02	-8.65E-03	1.30E-02	-2.80E-03
Ce-144	-2.99E-02	-7.96E-03	8.75E-03	-1.35E-02	5.30E-04	7.82E-02	-7.85E-02
Co-58	1.54E-03	1.65E-02	1.55E-03	-1.54E-02	-1.30E-02	1.38E-02	-2.81E-03
Co-60	9.03E-03	-5.93E-03	1.81E-02	5.60E-03	1.10E-02	1.38E-02	2.06E-02
Cs-134	5.63E-02	1.07E-02	1.09E-02	1.26E-02	3.85E-02	3.00E-02	-1.59E-02
Cs-137	1.03E+01	3.67E+01	2.24E+01	3.31E+00	3.27E-01	2.35E+01	3.19E+01
Eu-152	6.32E-02	7.07E-02	8.99E-02	5.15E-02	1.94E-02	5.17E-02	7.49E-02
Eu-154	3.17E-02	2.82E-02	2.68E-02	-1.13E-02	-3.50E-03	6.50E-02	3.17E-03
Eu-155	3.60E-02	8.32E-02	3.05E-02	4.92E-02	-3.60E-03	5.23E-02	4.77E-02
K-40	1.51E+01	1.29E+01	1.49E+01	1.55E+01	2.43E-02	1.45E+01	1.56E+01
Mn-54	2.29E-02	9.44E-03	6.40E-03	9.21E-03	1.05E-01	3.90E-03	2.00E-03
Nb-95	-8.16E-02	-2.98E-02	-4.25E-02	-1.52E-01	--	6.66E-02	-8.14E-02
Pb-212	7.07E-01	6.06E-01	6.41E-01	9.38E-01	--	7.40E-01	6.19E-01
Pb-214	5.00E-01	5.25E-01	5.96E-01	8.16E-01	--	6.57E-01	5.56E-01
Pu-238	2.10E-04	6.93E-04	1.80E-04	2.30E-04	9.37E-04	5.43E-04	7.50E-04
Pu-239	2.93E-03	1.03E-02	3.13E-03	1.90E-03	2.04E-02	1.83E-02	9.80E-03
Ru-106	2.44E-01	5.06E-02	4.43E-02	4.87E-02	6.27E-02	-8.33E-02	-1.77E-02
Sr-90	2.45E+00	5.55E+00	1.11E+00	2.98E+00	2.93E-01	5.54E+00	1.68E+01
U (total)	2.55E-01	2.87E-01	2.63E-01	3.15E-01	3.83E-01	3.36E-01	2.55E-01
Zn-65	2.12E-02	-1.51E-02	-3.58E-02	-4.20E-02	1.10E-02	1.53E-02	-1.90E-02
Zr-95	-7.13E-02	1.21E-02	2.43E-02	3.77E-02	1.80E-03	-4.23E-03	3.11E-02

-- Dashes indicate data not available

Table 4-10. Summary of Soil Sampling Results: 1990 and 1991 (pCi/g). (sheet 1 of 2)

	Sampling Location							
Radionuclide	2E64	2E65	2E66	2E67	2E68	2E69	2E67	2E61
Be-7	2.25E+01	1.61E+01	3.11E+00	7.08E+00	1.47E+01	3.38E+00	9.95E+00	1.29E+01
CePr-144	8.47E-02	1.77E-01	5.50E-01	1.09E-01	3.74E-02	2.73E-01	5.69E-02	5.03E-01
Co-60	8.64E-03	1.20E-02	2.33E-02	1.24E-02	2.18E-02	4.41E-02	1.21E-02	1.56E-02
Cs-134	1.96E-01	2.01E-01	2.28E-01	1.97E-01	1.08E-01	3.10E-01	6.31E-02	1.36E-01
Cs-137	2.94E+00	1.20E+01	1.10E+01	7.70E-01	4.43E-01	1.93E+00	4.23E-01	5.04E-01
Eu-154	3.59E-02	5.49E-02	2.09E-02	3.37E-02	9.07E-02	2.29E-02	1.81E-02	4.11E-02
Eu-155	5.22E-02	2.04E-02	3.81E-02	3.96E-02	1.65E-02	6.36E-02	3.55E-02	2.71E-02
K-40	1.61E+01	1.57E+01	1.56E+01	1.43E+01	1.65E+01	1.45E+01	1.63E+01	1.38E+01
Pb-212	7.01E-01	6.33E-01	8.22E-01	7.51E-01	7.51E-01	6.82E-01	6.43E-01	5.77E-01
Pb-214	5.34E-01	4.77E-01	7.06E-01	5.72E-01	7.67E-01	6.19E-01	5.54E-01	4.81E-01
Pu-238	4.16E-04	5.48E-04	1.50E-04	6.77E-05	6.85E-04	2.42E-04	1.01E-04	8.23E-05
Pu-239/240	1.41E-02	3.00E-02	8.19E-03	4.54E-03	8.52E-03	2.68E-03	3.17E-03	2.12E-03
Ra-226	5.66E-01	4.31E-01	--	5.56E-01	6.03E-01	5.77E-01	5.48E-01	4.01E-01
Ru-106	1.04E-01	5.92E-02	1.76E-01	2.21E-01	3.10E-01	3.39E-01	1.25E-01	3.58E-01
Sb-125	4.38E-02	2.48E-02	6.46E-02	1.21E-02	5.24E-02	2.62E-02	1.04E-02	9.32E-03
Sr-90	3.01E+00	2.37E+00	1.82E+00	9.00E-01	2.17E+00	5.39E-01	4.60E-01	7.27E-01
U-234	7.30E-01	7.30E-01	7.50E-01	6.50E-01	7.30E-01	9.70E-01	7.50E-01	8.50E-01
U-235	1.61E-02	2.92E-02	2.61E-02	3.37E-02	3.69E-02	1.94E-02	3.58E-02	5.17E-02
U-238	7.11E-01	7.57E-01	7.28E-01	7.57E-01	6.67E-01	9.41E-01	9.97E-01	9.25E-01
U (total)	8.18E-01	7.04E-01	7.17E-01	9.14E-01	5.91E-01	1.15E+00	8.52E-01	1.12E+00
Zn-65	3.74E-01	1.66E-01	2.26E-01	2.67E-01	3.36E-01	3.97E-01	2.97E-01	3.39E-01
ZrNb-95	8.93E-01	1.56E+00	3.68E-01	6.90E-01	1.24E+00	1.99E+00	6.80E-01	7.10E-01

Table 4-10. Summary of Soil Sampling Results: 1990 and 1991 (pCi/g). (sheet 2 of 2)

Radionuclide	Sampling Location							
	2E72	2E73	2E74	2E75	2E76	2E77	2E78	2E79
Be-7	9.52E+00	1.81E+01	2.68E+00	1.07E+01	1.64E+01	1.01E+00	9.90E+00	8.95E+00
CePr-144	2.65E-01	8.40E-01	1.41E-01	2.34E-01	6.49E-02	1.91E-01	1.19E-01	7.11E-02
Co-60	1.13E-02	9.83E-03	2.97E-02	1.26E-02	4.75E-03	7.60E-03	1.82E-02	6.10E-03
Cs-134	1.58E-01	1.16E-01	1.18E-01	2.53E-01	5.67E-02	1.94E-01	1.75E-01	3.16E-01
Cs-137	3.02E-01	1.88E+01	7.36E-01	1.04E+00	.96E-01	4.79E-01	1.35E+00	1.66E+00
Eu-154	3.56E-02	9.90E-02	2.56E-02	1.29E-02	2.25E-02	6.40E-03	2.45E-02	8.20E-02
Eu-155	6.46E-02	6.62E-02	2.37E-02	2.55E-02	9.80E-02	3.43E-02	3.74E-02	6.75E-02
K-40	1.39E+01	1.22E+01	1.57E+01	1.59E+01	1.36E+01	1.48E+01	1.80E+01	1.35E+01
Pb-212	5.59E-01	5.24E-01	5.68E-01	--	7.43E-01	5.96E-01	7.83E-01	6.43E-01
Pb-214	5.02E-01	4.73E-01	--	--	5.85E-01	5.46E-01	6.46E-01	7.25E-01
Pu-238	4.86E-04	3.31E-03	1.63E-04	1.37E-03	5.85E-04	5.78E-04	1.10E-03	2.87E-03
Pu-239/240	1.16E-02	9.01E-02	5.98E-03	2.74E-02	4.08E-02	1.50E-02	4.32E-02	9.20E-02
Ra-226	4.53E-01	5.05E-01	--	--	5.84E-01	5.28E-01	6.20E-01	5.93E-01.
Ru-106	1.49E-01	1.43E-01	1.40E-01	6.10E-01	8.76E-02	1.62E-01	4.97E-02	9.75E-02
Sb-125	5.64E-02	6.50E-02	4.58E-02	2.71E-02	6.27E-03	5.74E-02	2.96E-02	2.82E-02
Sr-90	4.52E-01	5.75E+00	9.18E-02	1.09E+00	2.16E-01	1.48E-01	3.05E-01	4.81E-01
U-234	5.50E-01	6.60E-01	8.00E-01	8.90E-01	7.20E-01	7.20E-01	8.90E-01	7.50E-01
U-235	2.45E-02	1.87E-02	1.65E-02	2.39E-02	2.75E-02	3.60E-02	2.18E-02	2.39E-02
U-238	6.48E-01	7.36E-01	6.84E-01	7.56E-01	7.80E-01	6.96E-01	9.40E-01	7.71E-01
U (total)	6.86E-01	7.91E-01	7.02E-01	--	9.11E-01	6.74E-01	7.58E-01	9.15E-01
Zn-65	2.19E-01	2.95E-01	1.19E-01	4.06E-01	2.58E-01	1.93E-01	4.35E-01	5.56E-01
ZrNb-95	3.64E-01	3.30E+00	9.30E-01	1.11E+00	1.45E+00	2.07E+00	1.49E+00	1.74E+00

Source: Schmidt et al. 1992a, 1992b.
Dashes indicate data is not available.

Table 4-11. Results of Surface Water Sampling (pCi/L).

RM20: 216-A-29 Ditch

	1985		1986		1987		1988		1989		1990	
Radionuclide	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error	Result	Error
Total beta												
Max	8.8E-02		1.24E-01		2.7E-02		<1.00E+02		<1.00E+02		<4.0E+01	
Min	1.7E-02		<1E-01		<1E-01		<1.00E+02		<1.00E+02		<4.0E+01	
Average	4.9E-02											
SD	5.1E-02											
Total alpha												
Max	1.2E-02		<1.0E-02		1.1E-02		5E+00		<1.00E+02		1.04E+02	
Min	1E-03		<1E-01		<1E-01		<1.00E+02		<1.00E+02		<4.0E+01	
Average	3E-03											
SD	6E-03											
Cesium-137												
Max	5.8E-02		<9.0E-02		1.27E-01		<1.00E+02		6.2E+01		<4.0E+01	
Min	4.2E-02		<1E-01		1E-01		<1.00E+02		<1.00E+02		<4.0E+01	
Average	4.7E-02											
SD	9E-03											
Strontium-90												
Max	4.0E-02		<8.3E-02		<3.0E-02		<1.00E+02		<4.0E+01			
Min	1.5E-02		<1E-01		<1E-01		<1.00E+02		<4.0E+01			
Average	2.7E-02											
SD	1.7E-02											

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Table 4-12. Summary of Vegetation Sampling Results (pCi/g). (sheet 1 of 2)

Radionuclide	Site 2E 11	Site 2E 12	Site 2E 17	Site 2E 18	Site 2E 23	Site 2E 24	Site 2E 29	Site 2E 30
Be-7	< -1.8E-02	1.85E+00	2.64E+00	2.63E+00	--	3.23E+00	2.01E+00	1.50E+00
Ce-141	< 1.10E-03	1.46E-03	-8.41E-03	-1.99E-02	2.10E-02	1.90E-03	-3.64E-02	3.05E-03
Co-60	8.81E-02	9.38E-03	2.12E-02	6.63E-03	-1.12E-02	2.75E-02	1.56E-02	5.94E-03
Cs-134	2.85E-01	1.06E-01	2.46E-01	1.50E-01	7.80E-02	1.26E-01	1.16E-01	--
Cs-137	5.85E-02	3.23E-01	6.79E-01	9.83E-01	1.51E-01	1.10E+00	1.23E-01	2.33E-01
Eu-152	9.10E-02	2.16E-02	2.32E-03	5.13E-02	-3.10E-02	8.63E-03	-5.70E-02	-1.55E-02
Eu-154	5.64E-02	1.32E-02	6.18E-02	-1.29E-02	-1.04E-02	4.30E-02	9.35E-03	-2.34E-02
Eu-155	--	-5.56E-03	9.83E-02	2.77E-02	-2.10E-02	-2.06E-03	-1.07E-02	8.60E-03
I-129	--	6.08E-02	-2.30E-02	2.76E-01	-3.80E-01	2.67E-03	0.00E+00	7.35E-02
K-40	--	1.06E+01	1.39E+01	1.45E+01	--	1.30E+01	1.49E+01	1.09E+01
Nb-95	< -5.60E-02	-9.50E-03	1.26E-02	-8.93E-04	-2.37E-02	-8.44E-03	-1.43E-02	-3.05E-03
Pb-212	9.30E-01	2.78E-02	7.77E-02	5.86E-02	--	5.13E-02	1.98E-02	7.60E-02
Pb-214	2.00E+00	4.11E-02	8.68E-02	8.79E-02	--	9.76E-02	3.28E-02	7.13E-02
Pu-238	--	3.03E-04	1.27E-03	2.72E-04	1.94E-04	6.40E-04	2.47E-04	5.30E-04
Pu-239	--	1.08E-03	6.56E-03	1.63E-03	2.45E-03	8.90E-03	1.17E-03	4.67E-03
Ru-103	--	1.13E-01	4.85E-01	2.16E-01	5.12E-01	2.57E-01	5.38E-01	--
Ru-106	--	--	7.25E-01	3.23E-01	3.25E+00	2.25E+00	3.33E+00	1.73E+00
Sr-90	--	1.75E+00	1.19E+01	6.09E-01	4.34E-01	9.97E-01	1.61E-01	5.20E-01
Tc-99	--	7.38E-01	1.76E+00	1.36E+00	1.10E+00	1.33E+00	1.11E+00	5.78E-01
Zr-95	< 4.20E-02	1.45E-02	1.74E-02	2.98E-02	2.98E-02	-2.77E-03	1.43E-02	2.44E-02

Note: Values are averages for each year with a detection since 1985.

Table 4-12. Summary of Vegetation Sampling Results (pCi/g). (sheet 2 of 2)

Radionuclide	Site 2ED	Site 2EDB	Site 2EDC	Site GRT1	Site GRT2	Site GRT4	Site GRT5	Site GRT6
Be-7	--	--	2.98E+00	3.00E+00	2.61E+00	322E+00	2.82E+00	2.09E+00
Ce-141	-9.50E-02	--	-2.25E-02	-1.34E-02	-2.78E-03	1.96E-02	7.83E-03	-2.45E-04
Co-60	8.80E-03	1.40E-02	6.69E-03	1.30E-03	-3.67E-04	9.09E-03	-3.57E-03	5.95E-03
Cs-134	1.19E-01	5.20E-02	--	6.10E-02	8.30E-02	5.00E-02	8.50E-02	5.55E-02
Cs-137	7.83E-01	2.80E-01	4.27E+00	5.77E-01	8.53E-01	3.57E-01	2.98E-01	4.33E-01
Eu-152	1.50E-02	4.80E-02	6.64E-02	5.09E-02	4.21E-02	2.33E-02	-1.41E-02	2.75E-02
Eu-154	-6.45E-02	-2.90E-02	6.04E-02	-1.42E-02	2.53E-02	8.53E-03	-2.44E-02	-1.92E-02
Eu-155	1.77E-02	1.40E-02	2.10E-02	-8.07E-03	3.57E-03	-3.37E-03	-2.41E-02	7.12E-03
I-129	3.00E-02	-1.40E-01	-5.80E-02	-4.77E-02	-7.63E-02	1.24E-01	-1.43E-02	1.19E-01
K-40	--	--	1.32E+01	1.18E+01	1.30E+01	1.17E-01	1.29E+01	1.10E+00
Nb-95	6.93E-02	1.80E-02	7.19E-03	-6.17E-03	-6.37E-04	-3.60E-03	3.49E-03	-4.73E-03
Pb-212	--	--	1.06E-01	9.51E-02	1.05E-01	7.78E-02	6.58E-02	5.95E-02
Pb-214	--	--	9.76E-02	3.71E-02	1.37E-01	1.15E-01	5.77E-02	7.54E-02
Pu-238	9.05E-05	8.90E-05	4.83E-04	1.92E-03	2.38E-04	1.75E-04	2.47E-04	4.48E-05
Pu-239	1.15E-02	8.00E-03	1.60E-02	6.45E-03	3.62E-03	5.88E-03	2.91E-03	7.68E-03
Ru-103	2.36E-01	--	--	--	--	--	--	--
Ru-106	1.10E+00	--	5.09E-01	1.05E+00	2.53E-01	2.34E+00	4.60E-01	4.24E-01
Sr-90	3.35E-01	3.30E-01	4.19E-01	3.15E-01	2.48E-01	2.39E-01	2.57E-01	3.38E-01
Tc-99	8.90E-01	9.60E-01	7.47E-01	1.48E+00	2.58E+00	9.78E-01	1.25E+00	9.79E-01
Zr-95	6.56E-02	8.90E-03	2.16E-02	7.40E-03	8.57E-03	-7.87E-03	-2.03E-04	5.60E-03

Note: Values are averages for each year with a detection since 1985.

Table 4-13. Summary of Vegetation Sampling Results for 1990 and 1991 (pCi/g).

	Sampling Location		
Radionuclide	2E67	2E78	2E79
Be-7	3.00E+00	7.03E+00	1.80E+00
CePr-144	2.00E+00	1.56E-01	1.40E-01
Co-60	3.70E-01	1.37E-02	6.80E-02
Cs-134	1.60E-01	2.23E-02	1.10E-01
Cs-137	4.10E-01	1.83E-01	7.00E-02
Eu-154	3.70E-01	7.62E-02	1.80E-01
Eu-155	8.30E-02	7.45E-03	2.80E-02
K-40	2.70E+01	1.40E+01	2.90E+01
Pb-212	--	3.66E-02	--
Pb-214	--	--	--
Pu-238	4.50E-05	1.06E-04	9.20E-05
Pu-239/240	8.00E-04	5.16E-03	1.90E-03
Ru-106	1.60E+00	9.93E-02	1.10E+00
Sb-125	1.00E-02	3.34E-02	1.10E-01
Sr-90	3.80E-01	2.57E-02	1.30E-01
U-234	9.00E-02	1.80E-02	5.90E-02
U-235	3.70E-04	5.60E-04	3.40E-04
U-238	2.40E-02	1.00E-02	2.10E-02
U (Total)	--	4.53E-02	--
Zn-65	5.20E-01	7.54E-02	3.50E-01
ZrNb-95	3.50E-01	2.51E-01	9.80E-01

Source: Schmidt et al. 1992a, 1992b.
Dashes indicate data are not available.

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Table 4-14. Summary of Gamma-Ray Logs that were Reviewed. (sheet 1 of 2)

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-A-1 Crib	E25-2		
216-A-2 Crib	E24-53	3	5/63 to 8/82
216-A-4 Crib	E24-54	2	5/63 to 9/87
216-A-6 Crib	E25-3		
	E25-53	3	5/63 to 8/82
216-A-7 Crib	E25-54	2	5/63 to 9/87
216-A-21 Crib	E24-12	2	4/70 to 4/76
216-A-26 French Drain	E24-53	3	5/63 to 8/82
216-A-26A French Drain	E24-54	2	5/63 to 9/87
216-A-27 Crib	E17-2	4	5/63 to 7/87
	E17-3	5	5/63 to 7/86
216-A-30 Crib	E16-2	4	5/63 to 9/82
	E25-11	3	5/63 to 10/80
	E25-12	4	5/63 to 3/90
	(01-30-06)		
	E25-190	2	10/82 to 3/90
	(01-30-11)		
	E25-191	2	10/82 to 3/90
	(01-30-23)		
	E25-193	2	10/82 to 9/90
	(01-30-03)		
216-A-31 Crib	E24-9	4	5/63 to 9/87
216-A-36A Crib	E17-4	4	4/68 to 7/87
	(01-36-01)		
	E17-9	4	4/68 to 4/79
	E17-10	3	4/70 to 9/86
216-A-36B Crib	E17-5	5	10/65 to 9/82
	E17-6	3	7/65 to 4/76
	E17-7	5	7/65 to 9/88
	(01-36-07)		
	E17-11	2	9/82 to 9/88
	(01-36-11)		
	E17-51	2	9/82 to 9/88
	(01-36-06)		

Table 4-14. Summary of Gamma-Ray Logs that were Reviewed. (sheet 2 of 2)

Waste Management Unit	Well Number	Number of Times Logged	Inclusive Dates
216-A-37-1 Crib	E25-17	4	12/76 to 3/90
	E25-18	3	12/76 to 6/88
	(01-37-11)		
	E25-19	4	12/76 to 9/82
	(01-37-05)		
	E25-20	4	12/76 to 9/82
216-A-37-2 Crib	E25-21	--	--
	E25-22	--	--
	(01-37-22)		
	E25-23	--	--
	(01-37-17)		
	E25-24	--	--
216-A-45 Crib	E25-12	4	5/63 to 3/90
	E25-13		
	E25-53	3	5/63 to 8/82
	E25-54		
	E17-12	1	4/86
	E17-13	1	8/86
	E17-53	1	9/88
	E17-54	1	9/88

-- = not available

Table 4-15. Potential for Past Migration of Liquid Discharges to the Unconfined Aquifer. (sheet 1 of 3)

Waste Management Unit	Range of Soil Column Pore Volumes (m^3) [a]	Liquid Effluent Volume Received (m^3)	Past Migration to Unconfined Aquifer
Cribs and Drains			
216-A-1 Crib	660 to 1,980	98	No
216-A-2 Crib	307 to 921	230	No
216-A-3 Crib	317 to 952	3,050	Yes
216-A-4 Crib	316 to 948	6,210	Yes
216-A-5 Crib	975 to 2,925	1,630,049	Yes
216-A-6 Crib	7,675 to 23,024	3,400,102	Yes
216-A-7 Crib	73 to 220	326	Yes
216-A-8 Crib	11,747 to 35,241	1,150,035	Yes
216-A-9 Crib	6,685 to 20,054	981,029	Yes
216-A-10 Crib	9,357 to 28,072	3,210,096	Yes
216-A-21 Crib	791 to 2,373	77,902	Yes
216-A-24 Crib	18,000 to 54,001	820,025	Yes
216-A-27 Crib	1,665 to 4,996	23,201	Yes
216-A-30 Crib	10,586 to 31,758	7,110,213	Yes
216-A-31 Crib	567 to 1,701	10	No
216-A-32 Crib	446 to 1,337	4	No
216-A-36A Crib	910 to 2,729	1,070	Yes[b]
216-A-36B Crib	4,533 to 13,598	317,010	Yes
216-A-37-1 Crib	5,293 to 15,879	377,011	Yes
216-A-37-2 Crib	10,190 to 30,569	1,090,033	Yes
216-A-38 Crib	6,163 to 18,489	ni	ni
216-A-39 Crib	ni	ni	ni

Table 4-15. Potential for Past Migration of Liquid Discharges to the Unconfined Aquifer. (sheet 2 of 3)

Waste Management Unit	Range of Soil Column Pore Volumes (m^3) [a]	Liquid Effluent Volume Received (m^3)	Past Migration to Unconfined Aquifer
216-A-41 Crib	79 to 237	10	No
216-A-45 Crib	19,358 to 58,074	103,003	Yes
216-A-11 French Drain	4 to 11	100	Yes
216-A-12 French Drain	4 to 11	100	Yes
216-A-13 French Drain	6 to 17	100	Yes
216-A-14 French Drain	4 to 12	1	No
216-A-15 French Drain	10 to 29	10,000	Yes
216-A-16 French Drain	7 to 22	122	Yes
216-A-17 French Drain	7 to 22	60	Yes
216-A-22 French Drain	23 to 68	10	No
216-A-23A French Drain	7 to 22	6	No
216-A-23B French Drain	7 to 22	6	No
216-A-26 French Drain	10 to 31	ni	ni
216-A-26A French Drain	6 to 17	1	No
216-A-28 French Drain	64 to 191	30	No
216-A-33 French Drain	23 to 70	ni	ni
216-A-35 French Drain	23 to 70	10	No
216-C-8 French Drain	20 to 61	10	No
Ponds, Ditches, and Trenches			
216-A-29 Ditch	14,341 to 43,024	10,400,312	Yes
216-A-34 Ditch	3,997 to 11,990	ni	ni
216-A-18 Trench	4,350 to 13,050	488	No
216-A-19 Trench	411 to 1,232	1,100	Yes[b]

Table 4-15. Potential for Past Migration of Liquid Discharges to the Unconfined Aquifer. (sheet 3 of 3)

Waste Management Unit	Range of Soil Column Pore Volumes (m^3) [a/]	Liquid Effluent Volume Received (m^3)	Past Migration to Unconfined Aquifer
216-A-20 Trench	425 to 1,274	961	Yes[b/]
216-A-40 Trench	6,072 to 18,215	946	No

Source: WHC 1991a.

a/ Pore volume calculation: (waste unit section area) x (nominal depth to groundwater) x (porosity). Lower pore volume value reflects 0.10 porosity, higher pore volume reflects 0.30 porosity. Pore volume calculation does not account for the ability of soil to retain the liquid discharged.

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

ni = no information availabile

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Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 1 of 17)

Total	A-101	A-102	A-103	A-104	A-105	A-106	AX-101	AX-102	AX-103	AX-104
1. Ac-225	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
2. Ac-227	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
3. Am-241	1E+03	3E+03	5E+02	8E+02	1E-05	3E+02	3E+01	2E+01	2E+01	1E+02
4. Am-242	9E-01	5E+00	9E-01	8E-01	1E-08	2E-01	9E-11	6E-17	3E-02	6E-02
5. Am-242m	9E-01	5E+00	9E-01	8E-01	1E-08	2E-01	9E-11	6E-17	3E-02	6E-02
6. Am-243	3E-01	2E+00	6E-01	3E-01	4E-09	7E-02	6E-11	1E-17	1E-02	3E-02
7. At-217	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
8. Ba-135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba-137m	0E+00	3E+05	2E+04	1E-13	3E+04	3E-04	3E-06	4E-12	2E+04	1E+05
10. Bi-210	3E-10	7E-10	1E-10	1E-10	9E-14	2E-10	5E-11	4E-11	6E-12	9E-11
11. Bi-211	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
12. Bi-213	8E-07	6E-07	5E-08	4E-07	5E-09	3E-07	3E-08	1E-08	3E-09	1E-08
13. Bi-214	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
14. C-14	0E+00	4E+02	3E+01	7E+02	5E+00	6E-02	1E-01	2E-15	9E+00	9E+01
15. Cm-242	8E-01	4E+00	7E-01	7E-01	9E-09	2E-01	7E-11	5E-17	3E-02	5E-02
16. Cm-244	0E+00	5E+00	4E+00	2E-20	4E-03	8E-10	5E-10	1E-18	6E-02	2E-01
17. Cm-245	0E+00	3E-04	2E-04	7E-25	1E-07	4E-14	3E-14	7E-23	4E-06	1E-05
18. Cs-135	0E+00	1E+00	8E-02	7E-19	1E-01	2E-09	1E-11	2E-17	1E-01	3E-01
19. Cs-137	0E+00	3E+05	2E+04	1E-13	4E+04	3E-04	3E-06	4E-12	2E+04	1E+05
20. Fr-221	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
21. Fr-223	3E-07	2E-06	6E-07	1E-07	4E-08	1E-07	3E-08	1E-09	6E-08	1E-07

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 2 of 17)

Total	A-101	A-102	A-103	A-104	A-105	A-106	AX-101	AX-102	AX-103	AX-104
22. I-129	0E+00	3E-01	1E-01	1E-19	1E-02	3E-10	1E-11	3E-18	2E-02	4E-02
23. Nb-93m	4E+02	3E+02	9E+01	9E+01	1E-01	2E+02	8E+01	4E+01	3E+00	2E+02
24. Ni-59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni-63	4E+04	1E+04	2E+04	7E+03	2E-05	4E+04	7E+02	2E+00	3E+02	8E+02
26. Np-237	4E-03	3E-01	1E-02	5E-03	4E-02	1E-03	5E-05	4E-05	2E-02	3E-02
27. Np-239	3E-01	2E+00	5E-01	3E-01	4E-09	7E-02	6E-11	1E-17	1E-02	3E-02
28. Pa-231	9E-05	2E-04	1E-04	3E-05	4E-06	5E-05	1E-05	5E-07	8E-06	2E-05
29. Pa-233	4E-03	3E-01	1E-02	5E-03	4E-02	1E-03	5E-05	4E-05	2E-02	3E-02
30. Pa-234m	7E+00	1E+00	1E+00	2E+00	5E-09	4E+00	1E+00	4E-02	5E-09	1E-01
31. Pb-209	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
32. Pb-210	3E-10	6E-10	1E-10	1E-10	9E-14	2E-10	5E-11	4E-11	6E-12	9E-11
33. Pb-211	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
34. Pb-214	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
35. Pd-107	0E+00	6E-01	2E-01	1E-19	3E-02	4E-10	3E-11	6E-18	3E-02	8E-02
36. Po-210	3E-10	6E-10	1E-10	1E-10	9E-14	2E-10	5E-11	4E-11	5E-12	8E-11
37. Po-213	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
38. Po-214	3E-09	4E-09	7E-10	1E-09	2E-13	1E-09	3E-10	1E-10	4E-11	5E-10
39. Po-215	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
40. Po-218	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
41. Pu-238	8E+01	1E+01	2E+01	2E+01	4E-04	5E+01	2E+01	9E+00	2E-03	2E+01
42. Pu-239	2E+03	3E+02	3E+02	6E+02	2E-06	1E+03	3E+02	1E+02	3E-05	3E+02

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 3 of 17)

Total	A-101	A-102	A-103	A-104	A-105	A-106	AX-101	AX-102	AX-103	AX-104
43. Pu-240	6E+02	8E+01	9E+01	1E+02	1E-05	3E+02	8E+01	4E+01	1E-04	8E+01
44. Pu-241	6E+03	7E+02	1E+03	1E+03	2E-06	3E+03	1E+03	7E-02	9E-05	1E+03
45. Ra-223	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
46. Ra-225	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
47. Ra-226	2E-09	3E-09	5E-10	8E-10	2E-13	1E-09	3E-10	1E-10	3E-11	4E-10
48. Ru-106	4E-01	3E-01	2E+00	4E-02	1E-07	1E+00	8E+00	7E+00	7E-03	6E+00
49. Sb-126	3E+01	1E+02	7E-01	3E+01	1E-07	6E+00	7E-11	2E+01	2E+00	6E+01
50. Sb-126m	3E+01	1E+02	7E-01	3E+01	1E-07	6E+00	7E-11	2E+01	2E+00	6E+01
51. Se-79	0E+00	6E+00	2E+00	2E-18	3E-01	5E-09	2E-10	4E-17	4E-01	8E-01
52. Sm-151	4E+04	1E+05	7E+02	3E+04	9E-05	7E+03	7E-08	1E+04	2E+03	6E+04
53. Sn-126	3E+01	1E+02	7E-01	3E+01	1E-07	6E+00	7E-11	2E+01	2E+00	6E+01
54. Sr-90	3E+06	7E+06	2E+04	4E+06	3E-02	5E-03	3E-06	1E-10	2E+04	9E+06
55. Tc-99	0E+00	2E+02	7E+01	6E-17	1E+01	2E-07	2E-08	1E-15	1E+01	3E+01
56. Th-227	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	4E-06	9E-06
57. Th-229	8E-07	6E-07	5E-08	4E-07	4E-09	3E-07	3E-08	1E-08	3E-09	1E-08
58. Th-230	8E-07	5E-07	2E-07	2E-07	3E-12	4E-07	1E-07	4E-08	5E-09	1E-07
59. Th-231	3E-01	4E-02	6E-02	8E-02	1E-10	2E-01	5E-02	2E-03	3E-13	6E-03
60. Th-233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th-234	7E+00	1E+00	1E+00	2E+00	5E-09	4E+00	1E+00	4E-02	5E-09	1E-01
62. Tl-207	2E-05	1E-04	4E-05	7E-06	3E-06	9E-06	2E-06	8E-08	5E-06	1E-05
63. U-233	6E-04	7E-05	5E-05	2E-04	4E-06	2E-04	3E-05	5E-06	9E-07	5E-06

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 4 of 17)

Total	A-101	A-102	A-103	A-104	A-105	A-106	AX-101	AX-102	AX-103	AX-104
64. U-234	8E-03	1E-03	2E-03	2E-03	3E-08	4E-03	2E-03	5E-04	6E-08	1E-03
65. U-235	3E-01	4E-02	6E-02	8E-02	1E-10	2E-01	5E-02	2E-03	3E-13	6E-03
66. U-238	7E+00	1E+00	1E+00	2E+00	5E-09	4E+00	1E+00	4E-02	5E-09	1E-01
67. Y-90	3E+06	7E+06	2E+04	4E+06	3E-02	5E-03	3E-06	1E-10	2E+04	9E+06
68. Zr-93	7E+02	1E+02	2E+02	1E+02	5E-07	5E+02	2E+02	8E+01	9E-07	3E+02
TOTAL CURIES	6.09E+06 6.09E+06	1.47E+07 1.47E+07	1.03E+05 1.03E+05	8.04E+06 8.04E+06	7.00E+04 7.00E+04	5.24E+04 5.24E+04	2.42E+03 2.42E+03	1.11E+04 1.11E+04	8.23E+04 8.23E+04	1.83E+07 1.83E+07
TOTAL TRU	3083.204041	3748.6609	873.72023	2122.908	5.040.181	1350.801	350.10005	129.00004	29.13214	520.26423

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 5 of 17)

Total	A-101	A-102	A-103	A-104	A-105	A-106	AX-101	AX-102	AX-103	AX-104
69. Ag	0E+00	2E-05	8E-06	8E-24	1E-06	2E-14	1E-15	2E-22	1E-06	3E-06
70. Al	2E+05	1E+06	4E+05	1E-06	7E+04	6E+05	2E+05	2E+03	1E+05	5E+04
71. Ba	5E+02	8E+01	9E+01	1E+02	2E+00	3E+02	1E+02	1E+01	4E-01	2E+02
72. Bi	2E-11	1E-11	1E-12	1E-11	6E-14	8E-12	4E-13	8E-13	7E-14	3E-13
73. C2H303	6E-39	4E+04	4E+02	0E+00	0E+00	3E-05	4E-08	5E-13	1E+03	0E+00
74. C6H507	2E-38	9E+04	3E+04	0E+00	0E+00	6E-05	5E-06	1E-13	5E+03	2E+03
75. CO3	4E-37	1E+06	1E+04	5E+05	7E+03	1E+02	8E+02	1E-11	4E+04	1E+04
76. C2O4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	1E+01	7E+01	2E+02	6E-29	2E-17	1E+02	8E+02	5E-20	3E-02	5E+03
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
79. Ce	0E+00	6E+01	2E+00	3E-23	4E-05	1E-07	3E-10	2E-21	6E+00	7E-02
80. Cl	0E+00	2E-05	6E-07	4E-27	2E-09	3E-14	8E-17	2E-25	2E-06	3E-07
81. Cr	2E-04	4E+03	3E+03	5E-37	6E-19	1E+03	2E+04	1E+04	1E+02	9E+04
82. EDTA	1E-38	6E+04	6E+02	0E+00	0E+00	6E-05	8E-08	9E-13	2E+03	0E+00
83. F	1E-38	1E+04	5E+02	1E-19	3E-02	2E-05	4E-08	2E-18	1E+03	6E+03
84. Fe	2E+06	3E+05	2E+05	5E+05	5E-04	8E+05	7E+04	4E+04	2E+03	1E+05
85. Fe(CN)6	0E+00	3E+00	4E-03	2E-20	2E-02	4E-09	7E-01	7E-18	1E-01	7E+01
86. HEDTA	2E-38	1E+05	1E+03	0E+00	0E+00	1E-04	2E-07	2E-12	4E+03	0E+00
87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	6E-39	9E+03	6E+02	6E-16	2E+02	2E-05	8E-08	1E-14	1E+03	4E+02
89. La	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 6 of 17)

Total	A-101	A-102	A-103	A-104	A-105	A-106	AX-101	AX-102	AX-103	AX-104
90. Mn	8E+03	2E+04	4E+02	1E+04	7E-01	5E+03	2E+03	9E+02	1E+03	9E+03
91. NO2	2E-37	3E+05	9E+03	4E-14	2E+04	5E-04	1E-06	9E-13	3E+04	8E+03
92. NO3	2E+07	2E+07	5E+05	2E+07	1E+05	3E-02	8E-05	1E-10	5E+05	3E+05
93. Na	2E+07	2E+07	5E+05	2E+07	2E+05	4E+01	3E+02	2E+01	3E+05	2E+05
94. Ni	2E+03	2E+03	9E+02	7E-27	4E-31	1E+02	5E+02	5E+00	2E+02	1E+03
95. OH	6E+06	1E+06	2E+06	1E+06	2E+05	4E+06	8E+05	2E+05	1E+03	7E+05
96. PO4	6E-39	7E+03	5E+02	1E-16	2E+02	2E-05	8E-08	1E-14	8E+02	6E+02
97. Pb	3E+01	1E-01	3E+00	8E-10	8E-11	3E+00	6E+01	5E+00	1E-02	4E+02
98. SeO4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO3	1E-38	1E+04	5E+02	6E-16	4E+02	2E-05	8E-08	1E-14	2E+03	3E+03
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO4	5E+02	6E+05	3E+03	7E+05	4E+03	3E+02	1E+02	1E+01	8E+03	2E+03
102. Sr	6E-08	3E+02	4E-01	3E-21	0E+00	6E-08	4E-11	7E-15	9E-01	1E-01
103. WO4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	8E+02	3E+02	2E+02	3E+02	3E-06	5E+02	4E+01	3E+01	5E-01	6E+02
105. Volume (kgal)	1E+03	3E+02	5E+02	3E+02	2E+01	1E+02	8E+02	5E+01	1E+02	6E+00

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 7 of 17)

Total	C-101	C-102	C-103	C-104	C-105	C-106	C-107	C-108	C-109	C-110	C-111
1. Ac-225	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
2. Ac-227	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
3. Am-241	5E+01	1E+03	1E+02	9E+02	1E+04	4E+02	1E+02	4E+01	1E-01	2E+01	2E+01
4. Am-242	3E-02	1E+00	1E-01	1E+00	2E+01	4E-01	7E-02	3E-02	3E-06	4E-04	9E-03
5. Am-242m	3E-02	1E+00	1E-01	1E+00	2E+01	4E-01	7E-02	3E-02	3E-06	4E-04	9E-03
6. Am-243	1E-02	7E-01	7E-02	7E-01	1E+01	1E-01	3E-02	8E-03	6E-06	2E-04	4E-03
7. At-217	3E-07	8E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	4E-10	1E-08
8. Ba-135m	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba-137m	2E+05	1E-04	1E-04	4E-05	2E+05	0E+00	8E+03	4E+00	5E+03	1E-06	4E+03
10. Bi-210	9E-11	4E-10	2E-10	7E-10	2E-09	2E-10	9E-11	7E-11	1E-11	1E-10	1E-10
11. Bi-211	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
12. Bi-213	4E-07	9E-09	4E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
13. Bi-214	3E-10	2E-09	9E-10	4E-09	8E-09	7E-10	4E-10	3E-10	6E-11	6E-10	4E-10
14. C-14	2E+01	1E-03	5E+02	3E-05	5E+02	8E-01	3E+00	3E-01	2E+00	8E-11	8E-01
15. Cm-242	2E-02	1E+00	1E-01	9E-01	1E+01	3E-01	6E-02	2E-02	2E-06	3E-04	7E-03
16. Cm-244	2E-02	1E-09	9E-11	1E-11	7E+01	0E+00	7E-03	1E-07	6E-04	7E-13	5E-04
17. Cm-245	4E-07	9E-14	5E-15	8E-16	4E-03	0E+00	4E-07	4E-12	2E-08	3E-17	1E-08
18. Cs-135	7E-01	4E-10	3E-10	2E-10	9E-01	0E+00	3E-02	6E-05	3E-02	6E-12	2E-02
19. Cs-137	2E+05	1E-04	1E-04	4E-05	3E+05	0E+00	8E+03	4E+00	5E+03	1E-06	4E+03
20. Fr-221	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
21. Fr-223	4E-07	2E-06	7E-07	9E-07	1E-05	4E-07	5E-07	2E-07	6E-08	3E-08	2E-07
22. I-129	7E-02	5E-11	4E-11	1E-11	2E+00	0E+00	3E-03	2E-06	2E-03	5E-13	2E-03
23. Nb-93m	6E+00	5E+01	8E+00	1E+01	3E+02	4E+01	8E+00	5E+00	2E-01	7E-01	3E+00
24. Ni-59	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni-63	1E+02	3E+03	9E+03	7E+02	5E+04	8E+02	9E+00	5E+02	6E+02	5E-10	5E+02

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 8 of 17)

Total	C-101	C-102	C-103	C-104	C-105	C-106	C-107	C-108	C-109	C-110	C-111
26. Np-237	2E-01	7E-03	9E-04	5E-03	8E-02	2E-03	8E-03	3E-04	6E-03	1E-04	5E-03
27. Np-239	1E-02	6E-01	6E-02	7E-01	9E+00	1E-01	3E-02	7E-03	6E-06	2E-04	4E-03
28. Pa-231	7E-05	4E-04	2E-04	2E-04	1E-03	7E-05	9E-05	4E-05	9E-06	5E-06	3E-05
29. Pa-233	2E-01	7E-03	1E-03	5E-03	8E-02	2E-03	8E-03	3E-04	6E-03	1E-04	5E-03
30. Pa-234m	2E+00	2E+01	7E+00	9E+00	1E+01	3E+00	4E+00	1E+00	2E-01	1E-01	1E+00
31. Pb-209	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
32. Pb-210	8E-11	4E-10	2E-10	7E-10	2E-09	2E-10	8E-11	7E-11	1E-11	1E-10	9E-11
33. Pb-211	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
34. Pb-214	3E-10	2E-09	9E-10	4E-09	9E-09	8E-10	4E-10	3E-10	6E-11	6E-10	4E-10
35. Pd-107	1E-01	1E-10	5E-11	3E-11	4E+00	0E+00	6E-03	3E-06	4E-03	6E-13	3E-03
36. Po-210	8E-11	4E-10	2E-10	6E-10	2E-09	2E-10	8E-11	7E-11	1E-11	1E-10	9E-11
37. Po-213	3E-07	8E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	4E-10	1E-08
38. Po-214	4E-10	3E-09	1E-09	5E-09	1E-08	9E-10	5E-10	3E-10	7E-11	8E-10	5E-10
39. Po-215	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
40. Po-218	3E-10	2E-09	9E-10	4E-09	9E-09	8E-10	4E-10	3E-10	6E-11	6E-10	4E-10
41. Pu-238	2E+00	5E+01	9E+00	5E+01	6E+01	7E+00	4E+00	2E+00	1E-01	1E+01	3E+00
42. Pu-239	1E+02	2E+03	3E+02	7E+02	1E+03	3E+02	3E+02	9E+01	1E+00	1E+02	7E+01
43. Pu-240	3E+01	5E+02	8E+01	2E+02	3E+02	7E+01	6E+01	2E+01	8E-02	3E+01	1E+01
44. Pu-241	3E+02	7E+03	1E+03	3E+03	3E+03	7E+02	6E+02	2E+02	1E-01	2E+02	1E+02
45. Ra-223	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
46. Ra-225	3E-07	9E-09	4E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	5E-10	1E-08
47. Ra-226	3E-10	2E-09	9E-10	4E-09	9E-09	8E-10	4E-10	3E-10	6E-11	6E-10	4E-10
48. Ru-106	2E-03	1E+00	1E-01	2E+00	3E+00	4E-02	4E-03	1E-03	4E-08	5E-09	3E-05
49. Sb-126	1E+00	1E+01	2E+00	3E+00	6E+01	1E+01	3E+00	9E-01	4E-02	1E-01	6E-01
50. Sb-126m	1E+00	1E+01	2E+00	3E+00	6E+01	1E+01	3E+00	9E-01	4E-02	1E-01	6E-01

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 9 of 17)

Total	C-101	C-102	C-103	C-104	C-105	C-106	C-107	C-108	C-109	C-110	C-111
51. Se-79	1E+00	8E-10	6E-10	4E-10	3E+01	0E+00	6E-02	4E-05	4E-02	1E-11	3E-02
52. Sm-151	2E+03	1E+04	2E+03	4E+03	7E+04	1E+04	3E+03	2E+03	1E+02	3E+02	1E+03
53. Sn-126	1E+00	1E+01	2E+00	3E+00	6E+01	1E+01	3E+00	9E-01	4E-02	1E-01	6E-01
54. Sr-90	7E+04	1E+06	4E+05	4E+05	3E+06	5E+05	9E+04	2E+04	7E+01	1E+04	9E+04
55. Tc-99	5E+01	3E-08	3E-08	8E-09	1E+03	0E+00	2E+00	1E-03	1E+00	3E-10	1E+00
56. Th-227	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	1E-05	4E-06	2E-06	1E-05
57. Th-229	3E-07	9E-09	3E-07	2E-08	3E-07	3E-07	1E-08	6E-09	1E-08	4E-10	1E-08
58. Th-230	6E-08	7E-07	2E-07	9E-07	1E-06	1E-07	1E-07	5E-08	1E-08	1E-07	7E-08
59. Th-231	8E-02	6E-01	3E-01	4E-01	6E-01	1E-01	1E-01	6E-02	1E-02	6E-03	4E-02
60. Th-233	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th-234	2E+00	2E+01	7E+00	9E+00	1E+01	3E+00	4E+00	1E+00	2E-01	1E-01	1E+00
62. Tl-207	3E-05	1E-04	5E-05	6E-05	8E-04	3E-05	3E-05	2E-05	4E-06	2E-06	1E-05
63. U-233	2E-04	3E-06	2E-04	1E-05	1E-04	1E-04	4E-06	2E-06	6E-06	2E-08	4E-06
64. U-234	4E-04	5E-03	2E-03	7E-03	7E-03	8E-04	7E-04	3E-04	5E-05	8E-04	4E-04
65. U-235	8E-02	6E-01	3E-01	4E-01	6E-01	1E-01	1E-01	6E-02	1E-02	6E-03	4E-02
66. U-238	2E+00	2E+01	7E+00	9E+00	1E+01	3E+00	4E+00	1E+00	2E-01	1E-01	1E+00
67. Y-90	7E+04	1E+06	4E+05	4E+05	3E+06	5E+05	9E+04	2E+04	7E+01	1E+04	9E+04
68. Zr-93	7E+00	7E+01	1E+01	2E+01	4E+02	6E+01	1E+01	6E+00	3E-01	8E-01	4E+00
TOTAL CURIES	5.44E+05 5.44E+05	2.02E+06 2.02E+06	8.13E+05 8.13E+05	8.10E+05 8.10E+05	6.64E+06 6.64E+06	1.01E+06 1.01E+06	1.90E+05 1.90E+05	4.29E+04 4.29E+04	1.09E+04 1.09E+04	2.07E+04 2.07E+04	1.90E+05 1.90E+05
TOTAL TRU	172.39049	3054.3082	909.431	1654.3052	11429.377	709.10206	427.27387	132.39735	3.1061196	130.0016	93.788321

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 10 of 17)

Total	C-101	C-102	C-103	C-104	C-105	C-106	C-107	C-108	C-109	C-110	C-111
69. Ag	7E-06	5E-15	3E-15	2E-15	1E-04	0E+00	3E-07	2E-10	2E-07	4E-17	2E-07
70. Al	1E+06	7E+06	5E+06	6E+06	1E+07	7E+05	2E+06	5E+05	5E+04	8E+02	4E+05
71. Ba	1E+02	3E+00	1E+02	8E+00	3E+02	1E+02	2E+00	3E+00	4E+00	6E-01	4E+00
72. Bi	8E-12	3E-13	8E-12	1E-12	1E-11	7E-12	7E+04	1E+04	1E+03	7E+04	7E+03
73. C2H3O3	0E+00	0E+00	2E-05	5E-06	6E+02	0E+00	1E+03	0E+00	0E+00	0E+00	0E+00
74. C6H5O7	0E+00	0E+00	1E-06	1E-06	6E+05	0E+00	1E+02	0E+00	0E+00	0E+00	0E+00
75. C03	3E+04	4E+03	1E+06	1E-01	8E+04	4E+04	5E+04	4E+04	1E+05	4E-05	5E+04
76. C204	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	0E+00	5E-22	5E-02	1E-01	1E+03	0E+00	3E-05	3E+04	1E+05	4E-14	3E+04
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
79. Ce	6E-03	3E-16	7E-09	9E-15	3E-04	6E-39	6E-01	1E-02	2E+00	1E-08	1E+00
80. Cl	3E-07	3E-22	1E-14	6E-19	3E-09	0E+00	2E-06	4E-08	6E-06	1E-14	3E-06
81. Cr	1E-16	5E-31	3E-08	2E+01	6E+03	0E+00	9E+03	1E+03	2E+02	1E+04	1E+03
82. EDTA	0E+00	0E+00	2E-05	5E-06	9E+02	0E+00	1E+03	0E+00	0E+00	0E+00	0E+00
83. F	5E+00	3E+06	1E+07	9E-12	3E+01	0E+00	6E+02	1E+01	3E+03	4E-05	9E+02
84. Fe	8E-02	5E-02	1E+02	2E+01	8E+05	1E+05	1E+05	2E+04	3E+03	2E+05	2E+04
85. Fe(CN)6	4E+00	1E-16	7E-12	9E-12	7E+01	0E+00	5E-04	9E+03	3E+04	1E-08	1E+04
86. HEDTA	0E+00	0E+00	3E-05	1E-05	2E+03	0E+00	3E+03	0E+00	0E+00	0E+00	0E+00
87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	0E+00	0E+00	1E-07	8E-08	5E+03	1E-39	1E+01	1E-36	3E+00	2E-08	0E+00
89. La	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 11 of 17)

Total	C-101	C-102	C-103	C-104	C-105	C-106	C-107	C-108	C-109	C-110	C-111
90. Mn	0E+00	2E+04	3E+03	8E+04	7E+03	9E+03	3E+02	0E+00	0E+00	0E+00	0E+00
91. NO2	9E+03	1E-03	5E-04	1E-05	2E+03	5E-38	4E+04	2E+01	7E+04	1E-05	5E+04
92. NO3	4E+06	5E-03	6E+07	5E+06	2E+07	3E+06	5E+05	4E+06	4E+05	2E-04	3E+05
93. Na	4E+06	3E+06	8E+07	5E+06	2E+07	3E+06	5E+05	4E+06	4E+05	8E+01	3E+05
94. Ni	5E-02	4E-04	2E+04	3E+00	3E+04	1E-20	4E-07	2E+04	6E+04	2E-11	3E+04
95. OH	3E+06	3E+07	2E+07	2E+07	3E+07	3E+06	8E+06	2E+06	1E+04	6E+05	1E+06
96. PO4	2E+02	6E-13	9E+04	4E-08	4E+03	0E+00	6E+04	1E+04	5E+03	7E+04	9E+03
97. Pb	9E-10	2E-09	2E+04	5E-06	1E+02	6E-10	1E-08	4E-10	1E-10	6E-11	3E-10
98. SeO4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO3	2E+02	1E-05	2E-05	2E-07	4E+01	1E-39	1E+03	2E+00	2E+03	1E-06	1E+03
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO4	1E+04	3E+00	1E+06	8E+00	3E+03	1E+02	8E+03	3E+01	5E+03	6E-01	2E+03
102. Sr	0E+00	0E+00	7E-12	1E-07	2E+00	7E-09	4E-04	0E+00	1E+01	8E-08	0E+00
103. WO4	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	1E+01	3E+06	3E+05	5E+01	4E+02	8E+01	2E+04	3E+03	4E+02	2E+04	2E+03
105. Volume (kgal)	8E+01	5E+02	9E+02	3E+02	3E+02	3E+02	3E+02	7E+01	6E+01	2E+02	6E+01

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 12 of 17)

Total	C-112	C-201	C-202	C-203	C-204
1. AC-225	9E-09	1E-11	3E-10	3E-10	5E-14
2. Ac-227	1E-05	3E-08	4E-06	4E-07	1E-09
3. Am-241	2E+01	1E-02	3E-02	3E-03	9E-06
4. Am-242	2E-02	2E-07	5E-07	5E-08	1E-10
5. Am-242m	2E-02	2E-07	5E-07	5E-08	1E-10
6. Am-243	4E-03	4E-07	1E-06	1E-07	3E-10
7. At-217	9E-09	1E-11	3E-10	3E-10	5E-14
8. Ba-135m	0E+00	0E+00	0E+00	0E+00	0E+00
9. Ba-135m	3E+03	2E+00	4E-13	5E-06	7E-02
10. Bi-210	1E-10	1E-12	8E-12	8E-13	3E-15
11. Bi-211	1E-05	3E-08	4E-06	4E-07	1E-09
12. Bi-213	9E-09	1E-11	3E-10	3E-10	5E-14
13. Bi-214	4E-10	4E-12	3E-11	3E-12	1E-14
14. C-14	2E+00	5E-05	3E-03	3E-04	2E-06
15. Cm-242	2E-02	1E-07	4E-07	4E-08	1E-10
16. Cm-244	6E-04	4E-10	1E-22	1E-15	2E-11
17. Cm-245	3E-08	5E-15	1E-27	1E-20	2E-16
18. Cs-135	1E-02	3E-05	9E-18	8E-11	1E-06

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 13 of 17)

Total	C-112	C-201	C-202	C-203	C-204
19. Cs-137	4E+03	2E+00	4E-13	6E-06	8E-02
20. Fr-221	9E-09	1E-11	3E-10	3E-10	5E-14
21. Fr-223	2E-07	5E-10	6E-08	6E-09	2E-11
22. I-129	1E-03	9E-07	3E-19	3E-12	4E-08
23. Nb-93m	3E+00	1E-02	5E-02	5E-03	1E-05
24. Ni-59	0E+00	0E+00	0E+00	0E+00	0E+00
25. Ni-63	2E+03	7E-04	9E-17	2E-09	3E-05
26. Np-237	4E-03	2E-06	4E-07	4E-08	9E-08
27. Np-239	4E-03	4E-07	1E-06	1E-07	3E-10
28. Pa-231	4E-05	8E-08	9E-06	9E-07	3E-09
29. Pa-233	4E-03	2E-06	4E-07	4E-08	1E-07
30. Pa-234m	1E+00	2E-03	2E-01	2E-02	9E-05
31. Pb-209	9E-09	1E-11	3E-10	3E-10	5E-14
32. Pb-210	1E-10	1E-12	7E-12	7E-13	3E-15
33. Pb-211	1E-05	3E-08	4E-06	4E-07	1E-09
34. Pb-214	4E-10	4E-12	3E-11	3E-12	1E-14
35. Pd-107	2E-03	9E-07	2E-19	2E-12	4E-08
36. Po-210	1E-10	1E-12	7E-12	7E-13	3E-15

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 14 of 17)

Total	C-112	C-201	C-202	C-203	C-204
37. Po-213	9E-09	1E-11	3E-10	3E-10	5E-14
38. Po-214	5E-10	5E-12	4E-11	4E-12	1E-14
39. Po-215	1E-05	3E-08	4E-06	4E-07	1E-09
40. Po-218	4E-10	4E-12	3E-11	3E-12	1E-14
41. Pu-238	1E+00	3E-05	1E-04	2E-05	4E-08
42. Pu-239	6E+01	2E-02	6E-02	6E-03	2E-05
43. Pu-240	1E+01	2E-03	5E-03	5E-04	2E-06
44. Pu-241	1E+02	3E-03	7E-03	7E-04	3E-06
45. Ra-223	1E-05	3E-08	4E-06	4E-07	1E-09
46. Ra-225	9E-09	1E-11	3E-10	3E-10	5E-14
47. Ra-226	4E-10	4E-12	3E-11	3E-12	1E-14
48. Ru-106	5E-04	6E-12	9E-10	8E-11	2E-13
49. Sb-126	6E-01	3E-03	8E-03	8E-04	3E-06
50. Sb-126m	6E-01	3E-03	8E-03	8E-04	3E-06
51. Se-79	3E-02	2E-05	5E-18	5E-11	8E-07
52. Sm-151	9E+02	8E+00	2E+01	2E+00	9E-03
53. Sn-126	6E-01	3E-03	8E-03	8E-04	3E-06
54. Sr-90	4E+04	6E+00	5E-14	6E+02	3E-01

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 15 of 17)

Total	C-112	C-201	C-202	C-203	C-204
55. Tc-99	9E-01	6E-04	2E-16	2E-09	3E-05
56. Th-227	1E-05	3E-08	4E-06	4E-07	1E-09
57. Th-229	9E-09	1E-11	3E-10	3E-10	5E-14
58. Th-230	6E-08	6E-10	5E-09	5E-10	2E-12
59. Th-231	6E-02	1E-04	1E-02	1E-03	4E-06
60. Th-233	0E+00	0E+00	0E+00	0E+00	0E+00
61. Th-234	1E+00	2E-03	2E-01	2E-02	9E-05
62. Tl-207	1E-05	3E-08	4E-06	4E-07	1E-09
63. U-233	3E-06	5E-10	7E-08	9E-08	2E-11
64. U-234	3E-04	3E-07	3E-05	3E-06	1E-08
65. U-235	6E-02	1E-04	1E-02	1E-03	4E-06
66. U-238	1E+00	2E-03	2E-01	2E-02	9E-05
67. Y-90	4E+04	6E+00	5E-14	6E+02	3E-01
68. Zr-93	4E+00	2E-02	5E-02	5E-03	2E-05
TOTAL CURIES	9.01E+04 9.01E+04	2.41E+01 2.41E+01	2.08E+01 2.08E+01	1.20E+03 1.20E+03	7.59E-01 7.59E-01
TOTAL TRU	83.472424	0.0300864	0.0931118	0.0093212	3.123E-05

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 16 of 17)

Total	C-112	C-201	C-202	C-203	C-204
69. Ag	1E-07	7E-11	1E-23	2E-16	3E-12
70. Al	4E+05	0E+00	0E+00	0E+00	0E+00
71. Ba	2E+00	6E-03	8E-02	8E-02	1E-05
72. Bi	8E+02	5E-16	1E-14	1E-14	1E-18
73. C2H303	0E+00	0E+00	0E+00	0E+00	0E+00
74. C6H507	0E+00	0E+00	0E+00	0E+00	0E+00
75. CO3	1E+05	2E+02	8E+03	8E+02	7E+00
76. C204	0E+00	0E+00	0E+00	0E+00	0E+00
77. Ca	1E+05	0E+00	0E+00	0E+00	0E+00
78. Cd	0E+00	0E+00	0E+00	0E+00	0E+00
79. Ce	6E+00	0E+00	0E+00	0E+00	0E+00
80. Cl	3E-06	0E+00	0E+00	0E+00	0E+00
81. Cr	1E+02	0E+00	0E+00	0E+00	0E+00
82. EDTA	0E+00	0E+00	0E+00	0E+00	0E+00
83. F	1E+04	0E+00	0E+00	0E+00	0E+00
84. Fe	2E+03	0E+00	0E+00	0E+00	0E+00
85. Fe(CN)6	5E+04	0E+00	0E+00	0E+00	0E+00
86. HEDTA	0E+00	0E+00	0E+00	0E+00	0E+00
87. Hg	0E+00	0E+00	0E+00	0E+00	0E+00
88. K	2E+01	0E+00	0E+00	0E+00	0E+00

Table 4-16. TRAC Estimated Waste Tank Radiological and Chemical Inventory Data for 241-A, -AX, and -C Tank Farms (Radionuclides in Curies, Chemicals in Moles). (sheet 17 of 17)

Total	C-112	C-201	C-202	C-203	C-204
89. La	0E+00	0E+00	0E+00	0E+00	0E+00
90. Mn	0E+00	0E+00	0E+00	0E+00	0E+00
91. NO2	4E+04	0E+00	0E+00	0E+00	0E+00
92. NO3	3E+05	1E+01	2E-07	4E-05	6E-01
93. Na	3E+05	4E+02	1E+04	1E+03	4E+01
94. Ni	1E+05	0E+00	0E+00	0E+00	0E+00
95. OH	1E+06	2E+01	9E+01	5E+01	2E+01
96. PO4	9E+03	2E+01	7E-12	7E-05	1E+00
97. Pb	4E-10	9E-13	1E-10	1E-11	4E-14
98. SeO4	0E+00	0E+00	0E+00	0E+00	0E+00
99. SiO3	2E+03	0E+00	0E+00	0E+00	0E+00
100. Sn	0E+00	0E+00	0E+00	0E+00	0E+00
101. SO4	3E+03	3E+01	8E-02	8E-02	1E+00
102. Sr	1E+02	0E+00	0E+00	0E+00	0E+00
103. WO4	0E+00	0E+00	0E+00	0E+00	0E+00
104. ZrO	3E+02	3E-02	1E-02	9E-02	5E-05
105. Volume (kgal)	1E+02	4E+00	1E+00	9E+00	3E+00

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Table 4-17. Results of Analysis of Supernatant Liquid from 241-AX-102 Single-Shell Tank. (sheet 1 of 2)

Analyte	Results	Results (ug/L)
Aluminum	6.00E-03 M	1.60E+05 ug/L
Ammonium	2.50E-02 M	4.50E+04 ug/L
Barium	< 1.00E-04 M	< 1.40E+04 ug/L
Bismuth	< 4.00E-04 M	<8.40E+04 ug/L
Boron	2.00E-03 M	2.00E+04 ug/L
Cadmium	< 4.00E-04 M	< 4.50E+06 ug/L
Calcium	1.40E-02 M	5.60E+05 ug/L
Carbonate	9.80E-01 M	5.88E+07 ug/L
Cerium	9.00E-04 M	1.30E+05 ug/L
Chromium	4.00E-03 M	2.10E+05 ug/L
Cobalt	<9.00E-04 M	< 5.30E+06 ug/L
Copper	6.00E-04 M	3.80E+06 ug/L
Iron	3.30E-02 M	1.84E+07 ug/L
Lanthanum	4.00E-04 M	5.60E+06 ug/L
Lead	2.00E-03 M	4.10E+05 ug/L
Lithium	<2.00E-03 M	1.40E+06 ug/L
Magnesium	5.00E-04 M	1.20E+06 ug/L
Manganese	1.10E-02 M	6.00E+05 ug/L
Molybdenum	4.00E-04 M	3.80E+04 ug/L
Neodymium	1.00E-03 M	1.14E+05 ug/L
Nickel	9.00E-03 M	5.30E+05 ug/L
Nitrate	3.70E+00 M	2.30E+08 ug/L
Nitrite	1.40E+00 M	6.40E+07 ug/L
Palladium	6.00E-04 M	6.40E+04 ug/L
pH	11.3	na
Phosphate	< 5.60E-02 M	5.30E+06 ug/L
Phosphorus	2.30E-02 M	7.10E+05 ug/L
Potassium	2.00E-03 M	7.80E+06 ug/L
Silicon	9.00E-04 M	2.50E+04 ug/L
Silver	< 4.00E-03 M	4.00E+05 ug/L
Sodium	7.32E+00 M	1.70E+08 ug/L

Table 4-17. Results of Analysis of Supernatant Liquid from 241-AX-102 Single-Shell Tank. (sheet 2 of 2)

Analyte	Results	Results (ug/L)
Strontium	< 3.00E-04 M	2.60E+04 ug/L
Tantium	< 3.00E-04 M	5.40E+04 ug/L
Tin	< 1.00E-03 M	1.20E+05 ug/L
Titanium	7.00E-05 M	3.40E+03 ug/L
TOC	3.68E+01 g/L	3.68E+07 ug/L
Zinc	1.30E-03 M	8.50E+04 ug/L
Zirconium	1.60E-03 M	1.50E+05 ug/L
Americium	1.00E+03 uCi/L	na
Cesium-137	3.50E+05 uCi/L	na
Cobalt-60	7.10E+02 uCi/L	na
Europium-154	3.50E+03 uCi/L	na
Europium-155	4.70E+03 uCi/L	na
Plutonium	9.70E+01 uCi/L	na
Strontium-90	1.70E+05 uCi/L	na

na = not applicable

Table 4-18. Results of Analysis of Volatile Priority Pollutants in Vapor Samples (ng).

Analyte	Tank 241-C-101		Tank 241-C-102	
	52454-32-A	52454-32-B	52454-32-F	52454-32-G
Benzene	5	6	27	6
Bromodichloromethane	< 5	< 5	< 5	< 5
Bromoform	< 5	< 5	< 5	< 5
Carbon Tetrachloride	< 5	< 5	< 5	< 5
Chlorobenzene	< 5	< 5	< 5	< 5
Chloroform	< 5	< 5	< 5	< 5
Dibromochloromethane	< 5	< 5	< 5	< 5
1,2-Dichloroethane	< 5	< 5	< 5	< 5
1,1-Dichloroethene	< 5	< 5	< 5	< 5
cis-1,2-Dichloroethene	< 5	< 5	< 5	< 5
trans-1,2-Dichloroethene	< 5	< 5	< 5	< 5
1,2-Dichloropropane	< 5	< 5	< 5	< 5
cis-1,3-Dichloropropene	< 5	< 5	< 5	< 5
trans-1,3-Dichloropropene	< 5	< 5	< 5	< 5
Ethylbenzene	< 5	< 5	< 5	< 5
Methylene Chloride	a	a	a	a
1,1,2,2-Tetrachloroethane	< 5	< 5	< 5	< 5
Tetrachloroethene	5	7	51	28
Toluene	19	20	67	26
1,1,1-Trichloroethane	18	17	< 5	< 5
1,1,2-Trichloroethane	< 5	< 5	< 5	< 5
1,1,2-Trichloroethene	< 5	< 5	< 5	< 5
Trichlorofluoromethane	< 5	< 5	< 5	< 5

a - Methylene chloride was found as a contaminant in the internal standard spike at approximately the same levels as found in the sample.

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Table 4-19. Results of Analysis of Volatile Priority Pollutants in Vapor Samples and a Liquid Sample.

Analyte	Tank 241-C-103			
	52454-4-A (ng)	52454-4-B (ng)	52454-4-C (ng)	52454-3 (ug/L)
Benzene	51	< 25	< 25	< 5
Bromodichloromethane	< 25	< 25	< 25	< 5
Bromoform	< 25	< 25	< 25	< 5
Carbon Tetrachloride	< 25	< 25	< 25	< 5
Chlorobenzene	< 25	< 25	< 25	< 5
Chloroform	< 25	< 25	< 25	< 5
Dibromochloromethane	< 25	< 25	< 25	< 5
1,2-Dichloroethane	< 25	< 25	< 25	< 5
1,1-Dichloroethene	1530	< 25	1240	< 5
cis-1,2-Dichloroethene	< 25	< 25	< 25	< 5
trans-1,2-Dichloroethene	< 25	< 25	< 25	< 5
1,2-Dichloropropane	< 25	< 25	< 25	< 5
cis-1,3-Dichloropropene	< 25	< 25	< 25	< 5
trans-1,3-Dichloropropene	< 25	< 25	< 25	< 5
Ethylbenzene	< 25	< 25	< 25	< 5
Methylene Chloride	< 25	< 25	< 25	< 5
1,1,2,2-Tetrachloroethane	< 25	< 25	< 25	< 5
Tetrachloroethene	< 25	< 25	< 25	< 5
Toluene	53	< 25	< 25	< 5
1,1,1-Trichloroethane	2110	< 25	1722	< 5
1,1,2-Trichloroethane	< 25	< 25	< 25	< 5
1,1,2-Trichloroethene	< 25	< 25	< 25	< 5
Trichlorofluoromethane	190	< 25	130	< 5

Table 4-20. Results of Analysis of a Core Sample from 241-C-103 Single-Shell Tank, Riser R-2.

Analyte	Units	Report Total a/	Maximum Total b/	Drainable Liquor
Aluminum	ug/g	1.53E+04	1.53E+04	< 1.390E+01
Barium	ug/g	4.92E+03	4.92E+03	2.170E+00
Bismuth	ug/g	2.54E+02	6.80E+02	1.610E+02
Boron	ug/g	0.00E+00	0.00E+00	4.480E+00
Cadmium	ug/g	2.19E+02	5.70E+02	< 1.020E+01
Calcium	ug/g	1.07E+04	1.07E+04	1.520E+01
Chromium	ug/g	7.31E+02	7.31E+02	6.660E+01
Cobalt	ug/g	5.42E+01	5.42E+01	--
Copper	ug/g	1.53E+03	1.53E+03	1.970E+02
Iron	ug/g	1.05E+05	1.05E+05	9.690E+00
Lead	ug/g	4.33E+03	4.37E+03	< 3.320E+01
Magnesium	ug/g	5.81E+03	5.81E+03	5.490E+00
Manganese	ug/g	2.56E+03	2.56E+03	< 8.200E+01
Nickel	ug/g	3.27E+03	3.27E+03	6.040E+01
Phosphorus	ug/g	4.09E+03	4.09E+03	1.450E+03
Potassium	ug/g	1.45E+03	1.45E+03	3.510E+02
Silicon	ug/g	6.80E+04	6.80E+04	1.290E+02
Silver	ug/g	3.73E+02	3.73E+02	2.360E+01
Sodium	ug/g	4.03E+04	4.03E+04	4.020E+04
Strontium	ug/g	1.38E+02	1.38E+02	4.770E-01
Zinc	ug/g	2.69E+02	2.69E+02	7.300E+00
Zirconium	ug/g	1.55E+04	1.55E+04	3.590E+02
Uranium	ug/g	2.19E+03	2.19E+03	2.630E+00
Nitrate	ug/g	1.79E+03	1.79E+03	7.540E-02
TOC	ug/g	3.90E+03	3.90E+03	7.370E+00
Pu-239,240	uCi/g	1.90E+01	1.15E+01	3.320E+01
C-14	uCi/g	3.81E-04	3.81E-04	9.690E-01
Sr-90	uCi/g	4.16E+03	4.16E+03	1.950E+03
Tc-99	uCi/g	4.67E-01	4.67E-01	3.700E+01
Am-241	uCi/g	0.00E+00	1.57E+00	< 3.740E+00
Co-60	uCi/g	6.06E+00	6.75E+00	< 5.730E+00
Cs-137	uCi/g	1.39E+02	1.39E+02	2.210E+04
I-129	uCi/g	2.30E-05	2.30E-05	2.700E-01
Total Gamma	uCi/g	2.26E+02	2.26E+02	2.200E+04
Radiation	mR/h	2.00E+03	2.00E+03	7.000E+01

a/ Sum of all values reported greater than limit of confirmation ("less than values" not summed).
b/ Sum of all values reported with limit of confirmation values taken as actual value.

Table 4-21. Results of Anlaysis of a Core Sample from 241-C-104 Single-Shell Tank.

Analyte	Units	Report Total a/	Maximum Total b/	Drainable Liquor
Aluminum	μg/g	3.01E+04	3.01E+04	--
Barium	μg/g	3.90E+03	3.90E+03	--
Bismuth	μg/g	3.64E+03	3.70E+03	--
Boron	μg/g	1.71E+01	1.71E+01	--
Cadmium	μg/g	1.28E+03	1.28E+03	--
Calcium	μg/g	1.13E+04	1.13E+04	--
Chromium	μg/g	1.12E+03	1.12E+03	--
Cobalt	μg/g	1.62E+01	1.62E+01	--
Copper	μg/g	1.12E+02	1.12E+02	--
Iron	μg/g	2.61E+04	2.61E+04	--
Lead	μg/g	8.18E+02	9.98E+02	--
Magnesium	μg/g	5.46E+03	5.46E+03	--
Manganese	μg/g	3.28E+03	3.30E+03	--
Nickel	μg/g	1.91E+03	1.91E+03	--
Phosphorous	μg/g	3.13E+03	3.13E+03	--
Potassium	μg/g	1.35E+03	1.35E+03	--
Silicon	μg/g	5.64E+04	5.64E+04	--
Silver	μg/g	4.68E+02	4.69E+02	--
Sodium	μg/g	9.55E+04	9.55E+04	--
Strontium	μg/g	8.12E+01	8.12E+01	--
Zinc	μg/g	1.17E+02	1.17E+02	--
Zirconium	μg/g	6.18E+04	6.18E+04	--
Uranium	μg/g	2.48E+04	2.48E+04	2.540E-02
Nitrate	μg/g	2.34E+04	2.34E+04	--
TOC	μg/g	4.41E+03	4.41E+03	1.030E+01
Pu-239, 240	μCi/g	9.72E+00	8.68E+00	7.730E+00
C-14	μCi/g	6.22E-04	7.66E-04	1.330E+00
Sr-90	μCi/g	3.70E+02	3.70E+02	1.300E+04
Tc-99	μCi/g	2.77E+00	2.77E+00	2.780E+01
Am-241	μCi/g	3.11E+00	3.12E+00	< 8.230E-01
Co-60	μCi/g	5.58E-01	5.58E-01	3.980E+02
Cs-137	μCi/g	3.14E+01	3.14E+01	1.180E+05
I-129	μCi/g	0.00E+00	0.00E+00	--
Total Gamma	μCi/g	4.84E+01	4.84E+01	1.180E+05
Radiation	mR/h	1.00E+02	1.00E+02	5.000E+01

a/ Sum of all values reported greater than limit of confirmation ("less than values" not summed).
b/ Sum of all values reported with limit of confirmation values taken as actual value.
Dashes indicate data are not available.

Table 4-22. Results of Analysis of a Core Sample from 241-C-105 Single-Shell Tank.

Analyte	Units	Report Total a/	Maximum total b/	Drainable Liquor
Aluminum	µg/g	6.18E+04	6.18E+04	< 9.020E+00
Barium	µg/g	2.56E+03	2.56E+03	2.660E+00
Bismuth	µg/g	4.80E+02	6.25E+02	1.101E+02
Boron	µg/g	1.23E+01	1.23E+01	3.700E+00
Cadmium	µg/g	0.00E+00	1.58E+02	--
Calcium	µg/g	7.79E+03	7.79E+03	4.150E+00
Chromium	µg/g	9.43E+02	9.43E+02	1.120E+03
Cobalt	µg/g	1.03E+01	1.03E+01	--
Copper	µg/g	1.55E+02	1.55E+02	3.620E+00
Iron	µg/g	1.06E+04	1.06E+04	3.290E+00
Lead	µg/g	4.63E+02	8.98E+02	< 1.230E+02
Magnesium	µg/g	3.69E+03	3.69E+03	5.670E+00
Manganese	µg/g	2.45E+03	2.47E+03	< 1.360E+01
Nickel	µg/g	2.14E+03	2.15E+03	< 6.150E+00
Phosphorous	µg/g	2.53E+03	2.53E+03	2.563E+03
Potassium	µg/g	1.11E+03	1.11E+03	1.567E+03
Silicon	µg/g	3.99E+04	3.99E+04	1.030E+02
Silver	µg/g	6.69E+01	6.69E+01	< 2.050E+01
Sodium	µg/g	7.18E+04	7.18E+04	1.148E+05
Strontium	µg/g	1.84E+02	1.84E+02	--
Zinc	µg/g	1.54E+02	1.54E+02	--
Zirconium	µg/g	7.03E+02	7.15E+02	3.640E+02
Uranium	µg/g	1.27E+04	1.27E+04	9.660E-01
Nitrate	µg/g	1.05E+04	1.05E+04	5.530E-01
TOC	µg/g	9.99E+02	9.99E+02	2.870E+00
Pu-239,240	µCi/g	3.06E+00	2.90E+00	3.320E+01
C-14	µCi/g	6.55E-04	8.57E-04	2.820E+00
Sr-90	µCi/g	8.64E+02	8.64E+02	5.120E+03
Tc-99	µCi/g	1.05E-01	1.05E-01	2.580E+02
Am-241	µCi/g	1.50E+00	1.51E+00	< 5.700E+00
Co-60	µCi/g	7.34E-01	7.35E-01	< 1.660E+01
Cs-137	µCi/g	1.47E+02	1.47E+02	4.420E+05
I-129	µCi/g	1.20E-04	1.20E-04	2.700E-01
Total Gamma	µCi/g	1.62E+02	1.62E+02	4.480E+05
Radiation	mR/h	1.00E+02	1.00E+02	2.000E+02

a/ Sum of all values reported greater than limit of confirmation ("less than values" not summed).
b/ Sum of all values reported with limit of confirmation values taken as actual value.
Dashes indicate data are not available.

Table 4-23. Results of Analysis of a Sludge Sample from 241-C-106 Single-Shell Tank.

Analyte	Units	Sample	Blank
Aluminum	g/kg	110	< 1
Antimony	mg/kg	<50	< 50
Arsenic	mg/kg	37	< 10
Barium	mg/kg	345	7
Beryllium	mg/kg	0.72	< 0.2
Cadmium	mg/kg	48	< 2
Calcium	mg/kg	1,480	53
Chromium	mg/kg	1,560	< 2
Cobalt	mg/kg	9.7	< 5
Copper	mg/kg	227	< 5
Cyanide	mg/kg	60	--
Iron	g/kg	78.2	< 0.1
Lead	mg/kg	2,750	< 200
Magnesium	mg/kg	372	< 29
Manganese	mg/kg	4,130	< 2
Mercury	mg/kg	327	< 1
Nickel	mg/kg	1,450	< 7
Selenium	mg/kg	< 10	< 1
Silicon	mg/kg	2,580	116
Silver	mg/kg	104	5
Sodium	g/kg	16.1	0.4
Thallium	mg/kg	< 10	< 10
Zinc	mg/kg	113	7
Zirconium	mg/kg	33.8	< 5
Fluoride	mg/kg	205	< 3
Chloride	mg/kg	255	< 3
Nitrite	mg/kg	26,320	6
Nitrate	mg/kg	1,690	< 26
Phosphate	mg/kg	1,170	< 13
Sulfate	mg/kg	5,170	< 26
TIC	mg/kg	18,900	178
TOC	mg/kg	7,500	385
Total Alpha	μCi/kg	7.8	--
Total Beta	μCi/kg	9,330	--
Sr-90	μCi/g	4,030	--
Tc-99	μCi/g	0.055	--
Co-60	μCi/g	1.15	--
Cs-137	μCi/g	536	--
Sb-125	μCi/g	6.49	--
Eu-154	μCi/g	14.4	--

Dashes indicate data are not available.

Table 4-24. Results of Analysis of a Sludge Sample from 241-C-105 Single-Shell Tank.

Analyte	Units	241-C-105
Sr	μCi/g	1.49E+04
Cs-137	μCi/g	1.73E+03
Cs-134	μCi/g	1.80E+01
Ce-144 and Pr-144	μCi/g	1.08E+02
Eu-154	μCi/g	2.40E+01
Eu-155	μCi/g	7.90E+01
Sb-125	μCi/g	2.60E+01
Ru-106	μCi/g	1.30E+01
Zr-98	μCi/g	3.00E+00
Co-57	μCi/g	1.10E+01
Co-60	μCi/g	1.30E+01

Table 4-25. Sampling Analysis of Completed Double-Shell Tanks.

Analyte	241-AY-101 Liquid	214-AZ-102	
		Total	Filtrate
Sodium	5.47	7.1	8.14
Aluminum	0.315	0.06	0.025
Fluorine	0.028	0.0546	0.0165
EDTA	0.0046	0.072	0.0585
HEDTA	0.025	0.211	0.206

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Table 4-26. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results. (sheet 1 of 2)

Single-Shell Tank	Number of Assoc. Dry Wells	Geophysical Evidence of Leaking?	Comments
A Tank Farm			
241-A-101	18	No	High levels of activity in fill attributed to surface source
241-A-102	7	Yes	Recent appearance of low activity levels on two intervals beneath tank
241-A-103	7	Yes	Persistent low activity levels found on fixed interval beneath tank
241-A-104	7	No	Tank is classified as an assumed leaker
241-A-105	7	Yes	Thick interval of elevated radiation associated with known leak
241-A-206	7	No	
AX Tank Farm			
241-AX-101	7	No	
241-AX-102	10	Yes	Near surface elevated radiation attributed to leak from tank ventilation system
241-AX-103	6	No	Thick interval of elevated radiation in the near surface with unknown source
241-AX-104	7	Yes	Elevated levels attributed to leaking tank have reached background levels
C Tank Farm			
241-C-101	4	Yes	Elevated radiation found on two intervals beneath tank attributed to leaking tank
241-C-102	0	No	No monitoring wells in place
241-C-103	5	Yes	Two intervals of elevated radiation: upper has possible surface source near background levels detected on lower interval have unknown source
241-C-104	7	No	Elevated radiation in two areas attributed to near surface sources
241-C-105	9	No	Region of elevated radiation attributed to tank overflow
241-C-106	6	No	No comment
241-C-107	7	No	No comment
241-C-108	3	No	Area of elevated radiation attributed to migration of surface contamination
241-C-109	6	Yes	Three areas of elevated radiation: two attributed to migration of surface contamination; one of unknown origin
241-C-110	4	Yes	Small region of elevated radiation attributed to leaking tank

Table 4-26. Summary of Tank Farm Vadose Zone Well Geophysical Logging Results. (sheet 2 of 2)

Single-Shell Tank	Number of Assoc. Dry Wells	Geophysical Evidence of Leaking?	Comments
241-C-111	5	No	Tank is an assumed leaker
241-C-112	4	No	Region of elevated radiation attributed to leaking transfer line
241-C-201	0	No	Tank is an assumed leaker; no monitoring wells in place
241-C-202	0	No	Tank is an assumed leaker; no monitoring wells in place
241-C-203	0	No	Tank is an assumed leaker; no monitoring wells in place
241-C-204	0	No	Tank is an assumed leaker; no monitoring wells in place

Source: Welty et al. 1988.

Table 4-27. Cesium Inventories for Tank Leak Unplanned Releases.

Unplanned Release	Tank	Gallons/Liters Leaked	Cesium-137
UPR-200-E-125	241-A-104	2,500/9,450	18,000 Ci
UPR-200-E-126	241-A-105	5,000/18,900	NA
UPR-200-E-136	241-C-101	24,000/90,720	2,000 Ci
UPR-200-E-137	241-C-203	400/1,512	NA

NA = Information not available.

Table 4-28. Results of Groundwater Sampling for the 216-A-36B Crib (mg/L).

Analyte	Well No. 299-E-17-5	Well No. 299-E-27-7	Well No. 299-E-28-18
Aluminum	<0.03	<0.03	<0.03
Boron	0.017	<0.01	<0.01
Barium	0.035	0.005	0.012
Calcium	81.4	25.2	70.4
Iron	0.02	0.02	0.01
Potassium	9.7	5.3	5.0
Lithium	0.01	<0.01	0.01
Magnesium	24.3	7.2	16.2
Manganese	0.003	0.002	0.007
Sodium	32.7	10.3	27.6
Silicon	21.2	17.8	19.4
Strontium	0.41	0.11	0.24
Ammonium	0.123	<0.04	0.134
Chloride	5.8	4.6	11
Nitrate	240	1.9	48
Sulfate	40	16	120
Alkalinity (as CO_3)	60.72	57.9	66.2
Conductivity (S/cm)	776	233	580
pH (laboratory)	7.80	8.05	7.91
pH (field)	7.7	7.90	7.35
Eh (mv)	397	391	394
Temperature (°C)	20.5	20.5	20.8
Titrium (Ci/L)	1.8	<0.02	<0.02
Cations (meq/L)	7.74	2.44	6.18
Anions (meq/L)	6.89	2.42	5.79

Samples taken on September 25, 1987.
Source: Buelt et al. 1988.

Table 4-29. Waste Inventory for the 216-A-36B Crib.

Date	Volume	Pu (g)	Beta (Ci)	Sr-90 (Ci)	Ru-106 (Ci)	Cs-137 (Ci)	U-238 (Kg)
1966	4.19E+06	7.00E+01	4.20E+03	6.00E+01	2.00E+02	5.80E+01	5.00E+01
1967	4.94E+06	1.39E+01	5.00E+03	2.50E+01	7.00E+01	1.50E+01	1.03E+01
1968	1.26E+07	1.94E+01	9.28E+02	1.40E+01	1.61E+02	1.48E+01	1.83E+01
1969	1.78E+07	7.20E+00	1.79E+03	9.91E+01	4.54E+02	1.10E+02	1.00E+01
1970	9.00E+06	3.58E+00	1.13E+04	2.29E+02	1.67E+03	1.31E+02	2.62E+01
1971	2.27E+07	<1.49E+01	7.01E+03	<2.11E+01	3.28E+03	7.01E+01	2.09E+00
1972	2.28E+07	4.81E+01	3.28E+03	9.84E+01	7.73E+02	1.65E+02	1.95E+00
Total Decayed through 1981	9.40E+07	1.77E+02	<1.72E+03	4.08E+02	4.07E+00	4.27E+02	1.19E+02
1983	1.00E+07	3.68E+01	1.88E-01	2.28E-02	--	6.59E-02	4.13E+01
1984	4.78E+07	2.21E+01	1.54E+01	3.53E-02	7.08E+00	4.05E-01	<3.81E-01
1985	7.54E+07	2.66E-01	4.68E+01	2.42E+00	2.54E+01	7.49E-01	--
1986	5.66E+07	3.50E-02	4.77E+01	2.11E-01	2.38E+00	3.48E-01	--
1987	2.82E+07	2.37E-03	7.87E-01	2.49E-02	4.30E-01	9.32E-02	--

Source: WHC 1988b
Dashes indicate no data are available.

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Table 4-30. Average Concentrations of Radiological Parameters for PUREX Waste Effluent and Groundwater Near the 216-A-36B Crib from 1983 through 1987. (sheet 1 of 3)

1983	Total Alpha (pCi/ml)	Total Beta (pCi/ml)	Tritium (pCi/ml)	Sr-90 (pCi/ml)	Cs-137 (pCi/ml)	Ru-106 (pCi/ml)	Co-60 (pCi/ml)	Uranium (pCi/ml)	Nitrate (mg/L)
PUREX (ASD)	1.61E+00	1.88E+01	5.63E+02	2.28E+00	6.59E+00	NA	NA	1.38E+00	NA
Monitoring Wells									
299-E17-5	1.39E-02	4.59E-02	5.01E+02	1.04E-02	3.91E-03	1.36E-02	2.47E-03	7.69E-03	2.50E+01
299-E17-9	1.19E-03	4.09E-02	7.02E+03	4.24E-03	5.43E-03	4.79E-03	2.8E-03	NA	1.06E+02

1984	Total Alpha (pCi/ml)	Total Beta (pCi/ml)	Tritium (pCi/ml)	Sr-90 (pCi/ml)	Cs-137 (pCi/ml)	Ru-106 (pCi/ml)	Co-60 (pCi/ml)	Uranium (pCi/ml)	Nitrate (mg/L)
PUREX (ASD)	9.00E-02	3.00E+02	5.00E+03	1.62E+01	7.00E-01	8.00E+00	NA	2.00E+02	BDL
Monitoring Wells									
299-E17-5	4.45E-03	5.95E-02	1.06E+03	4.47E+01	3.31E-03	1.35E-03	1.75E-03	1.97E-02	5.15E-03
299-E17-9	BDL	4.05E-02	3.03E+03	7.33E+01	6.75E-03	1.98E-03	6.51E-03	2.69E-02	BDL

Table 4-30. Average Concentrations of Radiological Parameters for PUREX Waste Effluent and Groundwater Near the 216-A-36B Crib from 1983 through 1987. (sheet 2 of 3)

1985	Total Alpha (pCi/ml)	Total Beta (pCi/ml)	Tritium (pCi/ml)	Sr-90 (pCi/ml)	Cs-137 (pCi/ml)	Ru-106 (pCi/ml)	Co-60 (pCi/ml)	Uranium (pCi/ml)	Nitrate (mg/L)
PUREX (ASD)	<4E+02	6E+05	3E+06	NA	3E+04	1E+04	NA	3E+05	NN
Monitoring Wells									
299-E17-5	8.29E+00	3.28E+01	2.03E+06	9.18E+01	3.14E+00	-4.65E-01	2.11E+00	-5.24E+00	1.17E+01
299-E17-9	3.54E+00	2.71E+01	4.68E+06	1.40E+02	4.17E+00	-4.87E+02	1.96E+00	1.32E+01	5.24E+00

1986	Total Alpha (pCi/ml)	Total Beta (pCi/ml)	Tritium (pCi/ml)	Sr-90 (pCi/ml)	Cs-137 (pCi/ml)	Ru-106 (pCi/ml)	Co-60 (pCi/ml)	Uranium (pCi/ml)	Nitrate (mg/L)
PUREX (ASD)	3.71E+02	8.44E+05	2.42E+06	NA	3.72E+03	6.14E+03	NA	4E+05	NN
Monitoring Wells									
299-E17-5	9.18E+00	3.37E+01	3.88E+06	9.90E+06	2.84E+00	5.55E-01	1.51E+00	5.48E+00	6.60E+00
299-E17-9	3.90E+00	2.10E+01	5.84E+06	1.38E+02	3.67E+00	9.24E-01	-1.90E-01	1.31E+01	NN

Table 4-30. Average Concentrations of Radiological Parameters for PUREX Waste Effluent and Groundwater Near the 216-A-36B Crib from 1983 through 1987. (sheet 3 of 3)

1987	Total Alpha (pCi/ml)	Total Beta (pCi/ml)	Tritium (pCi/ml)	Sr-90 (pCi/ml)	Cs-137 (pCi/ml)	Ru-106 (pCi/ml)	Co-60 (pCi/ml)	Uranium (pCi/ml)	Nitrate (mg/L)
299-E17-5	6.68E+00	1.75E+02	4.42E+06	9.78E+01	2.78E+00	9.65E-01	1.22E+01	9.28E+01	8.16E+00
299-E17-9	3.26E+00	2.32E+01	5.53E+06	1.54E+02	3.33E+00	-1.49E+00	-1.53E+00	1.91E+01	3.61E+00

NA = No analysis for this constituent.
BDL = Below detectable limit.
NN = Analysis not necessary (as determined from inventory, effluent history, or gross alpha/beta analyses).
ASD = Ammonia Scrubber Distillate
Source: WHC, 1988b

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Table 4-31. Groundwater Parameters Measured in Monitoring Wells for the 216-A-36B Crib.

Well	Date	Ammonia (ppm)	Fluoride (ppm)	Nitrate (ppm)	pH	TOC (ppm)	Chloride (ppm)	Conductivity (mho/cm)
299-E17-5	4-Mar-87	<0.050	<0.050	99.8	7.85	0.516	6.87	452
	9-Apr-87	<0.050	<0.050	89.5	7.62	0.763	6.83	435
	20-Jul-87	0.064	0.675	118.0	7.77	0.531	6.22	422
	10-Oct-87	<0.050	261.0	261.0	NA	NA	NA	NA
299-E17-9	4-Mar-87	<0.050	<0.050	171.0	7.63	0.414	8.31	639
	9-Apr-87	<0.050	<0.050	153.0	7.50	0.455	6.87	728
	20-Jul-87	<0.050	0.812	128.0	7.54	0.466	6.95	477
	10-Oct-87	<0.050	<0.050	123.0	NA	NA	NA	NA

NA = Not received from the laboratory at the time the report was prepared.
Source: WHC 1988b

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Table 4-32. Candidate Contaminants of Potential Concern for the PUREX Plant Aggregate Area. (sheet 1 of 2)

RADIONUCLIDES	Cesium-137	Thorium-230
	Cobalt-58[a]	Thorium-231
Gross alpha	Cobalt-60	Thorium-233[a]
Gross beta	Europium-152	Thorium-234
		Tin-113[a]
TRANSURANICS	FISSION PRODUCTS (Cont.)	Tin-126[a]
		Tritium
Americium-241	Europium-154	Yttrium-90
Americium-242	Europium-155	Zinc-65[a]
Americium-242m	Francium-221	Zirconium-93
Americium-243	Francium-223[a]	Zirconium-95[a]
Curium-242	Iodine-129	
Curium-244	Lead-209	HEAVY METALS
Curium-245	Lead 210	
Neptunium-237	Lead 211	Aluminum
Neptunium-239	Lead-212[a]	Arsenic
Plutonium-238	Lead-214	Beryllium
Plutonium-239/240	Manganese-54[a]	Bismuth
Plutonium-241	Nickel-59	Cadmium
	Nickel 63	Cerium
URANIUM	Niobium-93m	Chromium
	Palladium-107[a]	Copper
Uranium-233	Polonium-210	Iron
Uranium-234	Polonium-213[a]	Lanthanum
Uranium-235	Polonium-214	Lead
Uranium-238	Polonium-215	Manganese
	Polonium-218	Mercury
FISSION PRODUCTS	Potassium-40	Nickel
	Promethium-147[a]	Selenium
Actinium-225	Protactinium-231	Silver
Actinium-227	Protactinium-233[a]	Strontium
Antimony-126	Protactinium-234m[a]	Tin
Antimony-126m	Radium	Uranium
Astitine-217[a]	Radium-223	Vanadium
Barium-135m[a]	Radium-225	Zinc
Barium-137m	Radium-226	
Beryllium-7[a]	Ruthenium-103[a]	OTHER INORGANICS
Bismuth-210	Ruthenium-106	
Bismuth-211	Samarium-151	Aluminum nitrate
Bismuth-213	Selenium-79	Ammonium carbonate
Bismuth-214	Strontium-90	Ammonium fluoride
Carbon-14	Technetium-99	Ammonium nitrate
Cerium-141[a]	Thallium-207	Bismuth phosphate
Cerium-144[a]	Thallium-208[a]	Boron
Cesium-134	Thorium-227	Cadmium nitrate
Cesium-135	Thorium-229	Carbonate

Table 4-32. Candidate Contaminants of Potential Concern for the PUREX Plant Aggregate Area. (sheet 2 of 2)

OTHER INORGANICS (Cont.)	Sodium	Toluene
	Sodium carbonate	
	Sodium dichromate	SEMIVOLATILE ORGANICS
Chloride	Sodium nitrate	
Cyanide	Sodium nitrite	Ethylene diamine tetraacetate (EDTA)
Ferric cyanide	Sodium thiosulfate	Gylcolate
Ferric nitrate	Sulfamic acid	N-(2-hydroxyethyl) ethylenediaminetriacetate (HEDTA)
Magnesium	Sulfate	Oxalate
Nitrate	Sulfuric acid	Oxalic Acid
Nitric acid	Tungsten	Paraffin hydrocarbons
Nitrite	Zirconium oxide	Sugar (sucrose)
Phosphate		Tartaric acid
Potassium fluoride	VOLATILE ORGANICS	Tributyl phosphate
Potassium hydroxide		
Potassium permanganate	Acetone	
Silicon trioxide	Chloroform	
Silver nitrate	Methylene chloride	

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

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 1 of 10)

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
Plants, Buildings, and Storage Areas							
204-AR Waste Unloading Station	--	--	--	--	--	--	--
241-A-431 Ventilation Building	--	--	--	--	--	--	--
241-C-801 Support Facility	--	--	--	--	--	--	--
242-A Evaporator	--	--	--	--	--	--	--
Grout Treatment Facility	--	--	--	--	--	--	--
244-A Lift Station	K	K	S	S	S	S	S
Tanks and Vaults							
241-A-101 Single-Shell Tank	K	K	K	K	K	K	K
241-A-102 Single-Shell Tank	K	K	K	K	K	K	K
241-A-103 Single-Shell Tank	K	K	K	K	K	K	K
241-A-104 Single-Shell Tank	K	K	K	K	K	K	K
241-A-105 Single-Shell Tank	K	K	K	K	K	K	K
241-A-106 Single-Shell Tank	K	K	K	K	K	K	K
241-AN-101 Double-Shell Tank	K	K	K	K	K	K	K
241-AN-102 Double-Shell Tank	K	K	K	K	K	K	K
241-AN-103 Double-Shell Tank	K	K	K	K	K	K	K
241-AN-104 Double-Shell Tank	K	K	K	K	K	K	K
241-AN-105 Double-Shell Tank	K	K	K	K	K	K	K
241-AN-106 Double-Shell Tank	K	K	K	K	K	K	K
241-AN-107 Double-Shell Tank	K	K	K	K	K	K	K
241-AP-101 Double-Shell Tank	K	K	K	K	K	K	K
241-AP-102 Double-Shell Tank	K	K	K	K	K	K	K
241-AP-103 Double-Shell Tank	K	K	K	K	K	K	K

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 2 of 10)

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
241-AP-104	Double-Shell Tank	K	K	K	K	K	K	K
241-AP-105	Double-Shell Tank	K	K	K	K	K	K	K
241-AP-106	Double-Shell Tank	K	K	K	K	K	K	K
241-AP-107	Double-Shell Tank	K	K	K	K	K	K	K
241-AP-108	Double-Shell Tank	K	K	K	K	K	K	K
241-AW-101	Double-Shell Tank	K	K	K	K	K	K	K
241-AW-102	Double-Shell Tank	K	K	K	K	K	K	K
241-AW-103	Double-Shell Tank	K	K	K	K	K	K	K
241-AW-104	Double-Shell Tank	K	K	K	K	K	K	K
241-AW-105	Double-Shell Tank	K	K	K	K	K	K	K
241-AW-106	Double-Shell Tank	K	K	K	K	K	K	K
241-AX-101	Single-Shell Tank	K	K	K	K	K	K	K
241-AX-102	Single-Shell Tank	K	K	K	K	K	K	K
241-AX-103	Single-Shell Tank	K	K	K	K	K	K	K
241-AX-104	Single-Shell Tank	K	K	K	K	K	K	K
241-AY-101	Double-Shell Tank	K	K	K	K	K	K	K
241-AY-102	Double-Shell Tank	K	K	K	K	K	K	K
241-AZ-101	Double-Shell Tank	K	K	K	K	K	K	K
241-AZ-102	Double-Shell Tank	K	K	K	K	K	K	K
241-C-101	Single-Shell Tank	K	K	K	K	K	K	K
241-C-102	Single-Shell Tank	K	K	K	K	K	K	K
241-C-103	Single-Shell Tank	K	K	K	K	K	K	K
241-C-104	Single-Shell Tank	K	K	K	K	K	K	K
241-C-105	Single-Shell Tank	K	K	K	K	K	K	K

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 3 of 10)

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
241-C-106	Single-Shell Tank	K	K	K	K	K	K	K
241-C-107	Single-Shell Tank	K	K	K	K	K	K	K
241-C-108	Single-Shell Tank	K	K	K	K	K	K	K
241-C-109	Single-Shell Tank	K	K	K	K	K	K	K
241-C-110	Single-Shell Tank	K	K	K	K	K	K	K
241-C-111	Single-Shell Tank	K	K	K	K	K	K	K
241-C-112	Single-Shell Tank	K	K	K	K	K	K	K
241-C-201	Single-Shell Tank	K	K	K	K	K	K	K
241-C-202	Single-Shell Tank	K	K	K	K	K	K	K
241-C-203	Single-Shell Tank	K	K	K	K	K	K	K
241-C-204	Single-Shell Tank	K	K	K	K	K	K	K
241-A-302A	Catch Tank	S	S	S	S	S	S	S
241-A-302B	Catch Tank	S	S	S	S	S	S	S
241-A-350	Catch Tank	S	S	S	S	S	S	S
241-A-417	Catch Tank	S	S	S	S	S	S	S
241-C-301C	Catch Tank	S	S	S	S	S	S	S
244-A	Lift Station	S	S	S	S	S	S	S
244-AR	Vault	S	S	S	S	S	S	S
244-CR	Vault	S	S	S	S	S	S	S
Cribs and Drains								
216-A-1	Crib	K	K	K	K	S	S	S
216-A-2	Crib	K	K	K	S	S	K	K
216-A-3	Crib	K	K	K	S	S	S	S
216-A-4	Crib	K	K	K	K	K	S	S

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 4 of 10)

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
216-A-5	Crib	K	K	K	S	K	S	S
216-A-6	Crib	K	K	K	S	K	S	S
216-A-7	Crib	K	K	K	S	S	K	K
216-A-8	Crib	K	K	K	S	S	K	K
216-A-9	Crib	K	K	K	S	K	S	S
216-A-10	Crib	K	K	K	S	S	S	S
216-A-21	Crib	K	K	K	K	K	S	S
216-A-24	Crib	K	K	K	S	K	K	K
216-A-26	Crib	S	S	S	S	S	S	S
216-A-27	Crib	K	K	K	K	K	S	S
216-A-30	Crib	K	K	K	S	K	S	S
216-A-31	Crib	K	K	K	S	S	K	K
216-A-32	Crib	S	S	S	S	S	S	S
216-A-36A	Crib	S	S	S	S	S	S	S
216-A-36B	Crib	S	S	S	S	S	S	S
216-A-37-1	Crib	K	K	K	S	K	S	S
216-A-37-2	Crib	K	K	K	S	S	S	S
216-A-38-1	Crib	S	S	S	S	S	S	S
216-A-39	Crib	S	S	S	S	K	S	S
216-A-41	Crib	S	S	S	S	K	S	S
216-A-45	Crib	K	K	K	S	S	S	S
216-A-11	French Drain	S	S	S	S	K	S	S
216-A-12	French Drain	S	S	S	S	K	S	S
216-A-13	French Drain	S	S	S	S	K	S	S

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 5 of 10)

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
216-A-14	French Drain	S	S	S	S	K	S	S
216-A-15	French Drain	S	S	S	S	K	S	S
216-A-16	French Drain	S	S	S	S	K	S	S
216-A-17	French Drain	S	S	S	S	K	S	S
216-A-22	French Drain	S	S	S	S	K	S	S
216-A-23A	French Drain	S	S	S	S	K	S	S
216-A-23B	French Drain	S	S	S	S	K	S	S
216-A-26A	French Drain	S	S	S	S	K	S	S
216-A-28	French Drain	S	S	S	S	K	S	S
216-A-33	French Drain	S	S	S	S	S	S	S
216-A-35	French Drain	S	S	S	S	K	S	S
216-C-8	French Drain	S	S	S	S	K	S	S
Reverse Wells								
299-E24-111	Injection Well	--	--	--	--	--	--	--
Ponds, Ditches, and Trenches								
216-A-29	Ditch	S	S	S	S	S	S	S
216-A-34	Ditch	S	S	S	S	S	S	S
216-A-18	Trench	K	K	K	S	K	S	S
216-A-19	Trench	K	K	K	S	K	S	S
216-A-20	Trench	K	K	K	S	K	S	S
216-A-40	Trench	S	S	S	S	K	S	S
Septic Tanks and Associated Drain Fields								
2607-EA	Septic Tank	--	--	--	--	--	--	--
2607-EC	Septic Tank	--	--	--	--	--	--	--

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 6 of 10)

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
2607-ED	Septic Tank	--	--	--	--	--	--	--
2607-EG	Septic Tank	--	--	--	--	--	--	--
2607-EJ	Septic Tank	--	--	--	--	--	--	--
2607-EL	Septic Tank	--	--	--	--	--	--	--
2607-E6	Septic Tank	--	--	--	--	--	--	--
Transfer Facilities, Diversion Boxes, and Pipelines								
216-A-524	Control Structure	S	S	S	S	--	--	--
241-AX-501	Valve Pit	S	S	S	S	S	S	S
241-A-A	Diversion Box	S	S	S	S	S	S	S
241-A-B	Diversion Box	S	S	S	S	S	S	S
241-A-151	Diversion Box	S	S	S	S	S	S	S
241-A-152	Diversion Box	S	S	S	S	S	S	S
241-A-153	Diversion Box	S	S	S	S	S	S	S
241-AN-A	Diversion Box	S	S	S	S	S	S	S
241-AN-B	Diversion Box	S	S	S	S	S	S	S
241-AR-151	Diversion Box	S	S	S	S	S	S	S
241-AW-A	Diversion Box	S	S	S	S	S	S	S
241-AW-B	Diversion Box	S	S	S	S	S	S	S
241-AX-A	Diversion Box	S	S	S	S	S	S	S
241-AX-B	Diversion Box	S	S	S	S	S	S	S
241-AX-151	Diversion Box	S	S	S	S	S	S	S
241-AX-152DS	Diversion Box	S	S	S	S	S	S	S
241-AX-155	Diversion Box	S	S	S	S	S	S	S
241-AY-151	Diversion Box	S	S	S	S	S	S	S

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 7 of 10)

Waste Management Unit		TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
241-AY-152	Diversion Box	S	S	S	S	S	S	S
241-AZ-151DS	Diversion Box	S	S	S	S	S	S	S
241-AZ-152	Diversion Box	S	S	S	S	S	S	S
241-C-151	Diversion Box	S	S	S	S	S	S	S
241-C-152	Diversion Box	S	S	S	S	S	S	S
241-C-153	Diversion Box	S	S	S	S	S	S	S
241-C-252	Diversion Box	S	S	S	S	S	S	S
241-C-252	Diversion Box	S	S	S	S	S	S	S
241-CR-151	Diversion Box	S	S	S	S	S	S	S
241-CR-152	Diversion Box	S	S	S	S	S	S	S
241-CR-153	Diversion Box	S	S	S	S	S	S	S
241-ER-153	Diversion Box	S	S	S	S	S	S	S
241-AP-501	Valve Pit	S	S	S	S	S	S	S
Retention Basins								
207-A	Retention Basin	S	S	S	S	S	S	S
216-A-42	Retention Basin	S	S	S	S	S	S	S
Burial Sites								
218-E-1	Burial Ground	K	K	K	--	--	--	--
218-E-8	Burial Ground	K	K	K	--	--	--	--
218-E-12A	Burial Ground	K	K	K	--	--	--	--
218-E-12B	Burial Ground	S	K	S	--	--	--	--
218-E-13	Burial Ground	S	S	S	--	--	--	--
200-E	Burning Pit	S	S	S	K	K	K	K

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 8 of 10)

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
Unplanned Releases							
UN-200-E-10 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-11 Unplanned Release	--	S	--	--	--	--	--
UN-200-E-12 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-13 Unplanned Release	S	S	S	S	S	S	S
UN-200-E-15 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-16 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-18 Unplanned Release	S	S	S	S	S	S	S
UN-200-E-19 Unplanned Release	S	S	S	S	S	S	S
UN-200-E-20 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-22 Unplanned Release	--	S	--	--	--	--	--
UN-200-E-25 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-26 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-27 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-28 Unplanned Release	--	S	--	--	--	--	--
UN-200-E-31 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-33 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-35 Unplanned Release	--	S	--	--	--	--	--
UN-200-E-39 Unplanned Release	--	S	--	--	S	S	S
UN-200-E-40 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-42 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-47 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-48 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-49 Unplanned Release	S	S	S	S	--	--	--

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 9 of 10)

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
UN-200-E-56 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-58 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-60 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-62 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-65 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-67 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-68 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-72 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-81 Unplanned Release	S	K	S	S	--	--	--
UN-200-E-82 Unplanned Release	S	K	S	S	--	--	--
UN-200-E-86 Unplanned Release	K	K	S	S	--	--	--
UN-200-E-88 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-91 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-94 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-96 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-97 Unplanned Release	--	--	--	--	--	--	--
UN-200-E-99 Unplanned Release	S	S	S	S	S	S	S
UN-200-E-100 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-107 Unplanned Release	S	S	S	S	--	K	K
UN-200-E-114 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-117 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-118 Unplanned Release	S	S	S	S	--	--	--
UN-200-E-142 Unplanned Release	--	--	--	--	--	K	K
UPR-200-E-17 Unplanned Release	--	--	K	--	--	--	--

Table 4-33. Summary of Known and Suspected Contamination at Each Waste Management Unit and Unplanned Release Site. (sheet 10 of 10)

Waste Management Unit	TRU	Fission Products	Uranium	Heavy Metals	Other Inorganics	Volatiles	Semi-Volatiles
UPR-200-E-21 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-24 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-29 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-30 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-50 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-53 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-59 Unplanned Release	--	K	--	--	--	--	--
UPR-200-E-66 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-70 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-106 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-115 Unplanned Release	S	S	S	S	--	--	--
UPR-200-E-119 Unplanned Release	S	S	S	S	S	S	S
UPR-200-E-125 Unplanned Release	S	S	S	S	S	S	S
UPR-200-E-126 Unplanned Release	S	S	S	S	S	S	S
UPR-200-E-136 Unplanned Release	S	S	S	S	S	S	S
UPR-200-E-137 Unplanned Release	S	S	S	S	S	S	S

K = Known contamination (contaminants identified from inventory or sampling data).
S = Suspected contamination (contaminants that could occur at site). Evidence includes process data, historical records, and chemical associations.

Table 4-34. Contaminants of Potential Concern for the PUREX Plant Aggregate Area.

RADIONUCLIDES	FISSION PRODUCTS (continued)	OTHER INORGANICS
Gross alpha		Beryllium
Gross beta	Lead-210	Boron
	Lead-211	Cyanide
TRANSURANICS	Lead-212	Fluoride
	Lead-214	Hydrazine
Americium-241	Nickel-59	Nitrate
Americium-242	Nickel-63	
Americium-242m	Niobium-93m	VOLATILE ORGANICS
Americium-243	Polonium-214	
Curium-242	Polonium-215	Acetone
Curium-244	Polonium-218	Chloroform
Curium-245	Potassium-40	Methylene chloride
Neptunium-237	Protactinium-231	Toluene
Neptunium-239	Protactinium-234m	1,1,1-Trichloroethane
Plutonium-238	Radium-225	
Plutonium-239/240	Radium-226	SEMIVOLATILE ORGANICS
Plutonium-241	Ruthenium-106	
	Samarium-151	Tributyl phosphate
URANIUM	Selenium-79	
	Strontium-90	
Uranium-233	Technetium-99	
Uranium-234	Thallium-207	
Uranium-235	Thorium-227	
Uranium-238	Thorium-229	
	Thorium-230	
FISSION PRODUCTS	Thorium-231	
	Tritium	
Actinium-225	Yttrium-90	
Actinium-227	Zirconium-93	
Antimony-126		
Antimony-126m	HEAVY METALS	
Barium-137m		
Bismuth-210	Arsenic	
Bismuth-211	Barium	
Bismuth-213	Cadmium	
Bismuth-214	Chromium	
Carbon-14	Copper	
Cesium-134	Iron	
Cesium-135	Lead	
Cesium-137	Manganese	
Cobalt-60	Mercury	
Europium-152	Nickel	
Europium-154	Silver	
Europium-155	Vanadium	
Francium-221	Zinc	
Iodine-129		
Lead-209		

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Table 4-35. Soil-Water Distribution Coefficient K_d for Radionuclides and Inorganics of Concern at PUREX Plant Waste Management Units. (sheet 1 of 2)

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[a] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[b] (Strenge and Peterson 1989) in mL/g	Mobility Class
Actinium	--	--	228	low
Americium	2 100 - 1000 (<1 @ pH 1-3)	100	82	low
Antimony	--	--	2	high
Arsenic	--	0	5.86	moderate
Barium	--	50	530	moderate
Beryllium	--	--	70	unknown
Bismuth	--	20	--	moderate
Boron	--	--	0.19	high
Cadmium	--	15	14.9	moderate
Carbon (^{14}C)	--	--	0	high
Cesium	200 - 1,000 1 - 200 (acidic waste)	50	51	low
Chromium	--	0	16.8	moderate
Cobalt	500 - 2000	10	1.9	low
Copper	--	15	41.9	moderate
Curium	100 - >2,000	100	82	low
Cyanide	--	--	--	unknown
Europium	--	--	228	low
Fluoride	--	--	0	high
Francium	--	--	--	unknown
Hyrdazine	--	--	0	unknown
Iodine	<1	0	0	high
Iron	--	20	15	moderate
Lead	--	30	234	moderate
Manganese	--	20	16.5	moderate
Mercury	--	--	322	low
Neptunium	<1-5	3	3	high
Nickel	--	15	12.2	moderate
Niobium	--	--	50	moderate
Nitrate/nitric acid	--	--	0	high

Table 4-35. Soil-Water Distribution Coefficient K_d for Radionuclides and Inorganics of Concern at PUREX Plant Waste Management Units. (sheet 2 of 2)

Element or Chemical	Recommended K_d for Hanford Site (Serne and Wood 1990) in mL/g	Conservative Default K_d[a] (Serne and Wood 1990) in mL/g	MEPAS Default K_d pH 6-9[b] (Strenge and Peterson 1989) in mL/g	Mobility Class
Plutonium	100 - 1,000 < 1 at pH 1 - 3	100	10	low
Polonium	--	--	5.9	high
Potassium	--	--	--	unknown
Protactinium	--	--	0	high
Radium	--	20	24.3	moderate
Ruthenium	20 - 700 (<2 at >1 M nitrate)	--	274	moderate
Samarium	--	--	228	low
Silver	--	20	0.4	moderate
Strontium	5 - 100 3 - 5 (acidic conditions) 200 - 500 (w/phosphate or oxalate)	10	24.3	moderate
Technetium	0 - 1	0	3	high
Thallium	--	--	0	high
Thorium	--	50	100	moderate
Tritium	0	0	0	unknown
Uranium	--	0	0	high
Vanadium	--	--	50	moderate
Yttrium	--	--	278	low
Zinc	--	15	12.7	moderate
Zirconium	--	30	50	moderate

[a] Average K_Ds for low salt and organic solutions with neutral pH.
[b] Default values for pH 6-9 and soil content of [clay + organic matter + metal oxyhydroxides] < 10% (Strenge and Peterson 1989).
MEPAS = Multimedia Enviornmental Pollution Assessment System

Table 4-36. Mobility of Inorganic Species in Soil.

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

Table 4-37. Physical/Chemical Properties of Organics Contaminants of Concern for PUREX Plant Waste Management Units.

Compound	Molecular Weight in g/mole	Water Solubility in mg/L	Vapor Pressure in mm Hg	Henry's Law Constant in atm-m^3/mo	Soil/Organic Matter Partition Coef. K_{oc} in mL/g
Acetone	58.0	miscible	270	2.1×10^{-5}	2.2
Chloroform (trichloromethane)	119	8,200	150	2.9×10^{-3}	31
Methylene chloride	84.9	20,000	360	2×10^{-3}	8.8
Toluene	92.15	540	28	6.4×10^{-3}	300
Tributyl phosphate	266.3	280	15	1.9×10^{-2}	6,000
1,1,1-Trichloroethane	133.41	1,500	120	1.4×10^{-2}	150

Source: Strenge and Peterson (1989).

Table 4-38. Radiological Properties of Potential Radionuclides of Concern in PUREX Plant Waste Management Units. (sheet 1 of 2)

Radionuclide	Half-Life	Specific Activity[a] in Ci/g	Principal Radiation of Concern[b]
^{225}Ac	10 day	5.8×10^{4}	α
^{227}Ac	21.8 yr	7.2×10^{1}	β, α
^{241}Am	432 yr	3.4×10^{0}	α
^{242}Am	16 h	8.1×10^{5}	β
^{242m}Am	152 yr	9.7×10^{0}	α
^{243}Am	7,380 yr	2.0×10^{-1}	α
^{137m}Ba	2.6 min	5.3×10^{8}	γ
^{210}Bi	5.01 day	1.2×10^{5}	β
^{211}Bi	2.13 min	4.2×10^{8}	α, β
^{213}Bi	45.6 min	1.9×10^{7}	β, α
^{214}Bi	19.9 min	4.4×10^{7}	β, γ
^{14}C	5,730 yr	4.5×10^{0}	β
^{242}Cm	163.2 day	3.3×10^{3}	α
^{244}Cm	18.1 yr	8.1×10^{1}	α
^{245}Cm	8,500 yr	1.7×10^{-1}	α, γ
^{60}Co	5.3 yr	1.1×10^{3}	γ
^{134}Cs	2.06 yr	1.3×10^{3}	γ
^{135}Cs	3×10^{6} yr	8.8×10^{-4}	β
^{137}Cs	30 yr	8.7×10^{1}	γ
^{152}Eu	13.3 yr	7.7×10^{2}	β, γ[c]
^{154}Eu	8.8 yr	2.7×10^{2}	β, γ[c]
^{155}Eu	4.96 yr	4.6×10^{2}	β, γ
^{221}Fr	4.8 min	1.8×10^{8}	α, γ
^{3}H	12.3 yr	9.7×10^{3}	β
^{129}I	1.6×10^{7} yr	1.7×10^{-4}	β
^{40}K	1.3×10^{9} yr	6.7×10^{-6}	β, γ[c]
^{93m}Nb	14.6 yr	2.8×10^{2}	γ[c]
^{95}Nb	34.97 day	3.9×10^{4}	β, γ
^{59}Ni	8×10^{4} yr	7.6×10^{-2}	γ
^{63}Ni	92 yr	6.2×10^{2}	β
^{237}Np	2.14×10^{6} yr	7.0×10^{-4}	α, γ
^{239}Np	2.35 day	2.3×10^{5}	β
^{231}Pa	32,800 yr	4.7×10^{-2}	α
^{234m}Pa	1.2 min	6.7×10^{8}	β, γ
^{209}Pb	3.25 h	4.5×10^{6}	β
^{210}Pb	22.3 yr	7.6×10^{1}	β

Table 4-38. Radiological Properties of Potential Radionuclides of Concern in PUREX Plant Waste Management Units. (sheet 2 of 2)

Radionuclide	Half-Life	Specific Activity[a] in Ci/g	Principal Radiation of Concern[b]
^{211}Pb	36.1 min	2.5×10^{7}	β
^{212}Pb	10.6 h	1.4×10^{6}	β, γ[c]
^{214}Pb	26.8 min	3.3×10^{7}	β, γ[c]
^{214}Po	6×10^{-5}	8.8×10^{14}	α
^{215}Po	7.8×10^{-4}	2.9×10^{13}	α
^{218}Po	3.05 min	2.8×10^{8}	α
^{238}Pu	87.7 yr	1.7×10^{1}	α
^{239}Pu	24,400 yr	6.2×10^{-2}	α
^{240}Pu	6,560 yr	2.3×10^{-1}	α
^{241}Pu	14.4 yr	1.0×10^{2}	β
^{225}Ra	14.8 day	3.9×10^{4}	β
^{226}Ra	1,600 yr	9.9×10^{-1}	α
^{106}Ru	1.0 yr	3.4×10^{3}	β, γ[c]
^{126}Sb	12.5 day	4.1×10^{5}	β, γ
^{126m}Sb	19 min	7.9×10^{7}	β, γ
^{79}Se	<65,000 yr	7.0×10^{-2}	β
^{151}Sm	90 yr	2.6×10^{1}	β
^{90}Sr	28.5 yr	1.4×10^{2}	β
^{99}Tc	213,000 yr	1.7×10^{-2}	β
^{227}Th	18.7 day	3.1×10^{4}	α
^{229}Th	7,340 yr	2.1×10^{-1}	α
^{230}Th	77,000 yr	2.1×10^{-2}	α
^{231}Th	25.5 h	5.3×10^{5}	β
^{207}Tl	4.8 min	1.9×10^{8}	β, γ
^{233}U	159,000 yr	9.7×10^{-3}	α
^{234}U	244,500 yr	6.2×10^{-3}	α
^{235}U	7.0×10^{8} yr	2.2×10^{-6}	α, γ
^{238}U	4.5×10^{9} yr	3.4×10^{-7}	α
^{90}Y	6.41 h	5.4×10^{5}	β
^{93}Zr	1.5×10^{6} yr	2.6×10^{-3}	β

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

Table 4-39. Comparison of Radionuclide Relative Risks for Radionuclides of Concern at the PUREX Plant Aggregate Area. (sheet 1 of 3)

Radionuclide	Air Unit Risk[a] in $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[b] in $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[c] in $(pCi/g)^{-1}$	External Exposure Unit Risk[d] in $(pCi/g)^{-1}$
^{225}Ac	1.2×10^{-3}	8.7×10^{-7}	4.6×10^{-8}	9.4×10^{-6}
^{227}Ac	4.2×10^{-2}	1.8×10^{-5}	9.5×10^{-7}	1.3×10^{-7}
^{241}Am	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-7}	1.6×10^{-5}
^{242}Am	NA	NA	NA	NA
^{242m}Am	NA	NA	NA	NA
^{243}Am	2.1×10^{-2}	1.5×10^{-5}	8.1×10^{-7}	3.6×10^{-5}
^{210}Bi	4.1×10^{-5}	9.7×10^{-8}	5.1×10^{-9}	0
^{211}Bi	9.7×10^{-8}	6.1×10^{-10}	3.2×10^{-11}	2.8×10^{-5}
^{213}Bi	1.6×10^{-7}	1.2×10^{-8}	6.2×10^{-10}	8.1×10^{-5}
^{214}Bi	1.1×10^{-6}	7.2×10^{-9}	3.8×10^{-10}	8.0×10^{-4}
^{14}C	3.2×10^{-9}	4.7×10^{-8}	2.5×10^{-9}	0
^{242}Cm	NA	NA	NA	NA
^{244}Cm	1.4×10^{-2}	1.0×10^{-5}	5.4×10^{-7}	5.9×10^{-7}
^{245}Cm	NA	NA	NA	NA
^{60}Co	8.1×10^{-5}	7.8×10^{-7}	4.1×10^{-8}	1.3×10^{-3}
^{134}Cs	1.4×10^{-5}	2.1×10^{-6}	1.1×10^{-7}	8.9×10^{-4}
^{135}Cs	1.4×10^{-6}	2.1×10^{-7}	1.1×10^{-8}	0
^{137}Cs	9.6×10^{-6}	1.4×10^{-6}	7.6×10^{-8}	0 (3.4×10^{-4})[e]
^{152}Eu	6.1×10^{-3}	1.1×10^{-7}	5.7×10^{-9}	6.3×10^{-4}
^{154}Eu	7.2×10^{-5}	1.5×10^{-7}	8.1×10^{-9}	6.8×10^{-4}
^{155}Eu	NA	NA	NA	NA
^{221}Fr	4.7×10^{-7}	3.0×10^{-9}	1.6×10^{-10}	1.9×10^{-5}
^{3}H	4.0×10^{-8}	2.8×10^{-9}	1.5×10^{-10}	0
^{129}I	6.1×10^{-5}	9.6×10^{-6}	5.1×10^{-7}	1.5×10^{-5}
^{40}K	4.0×10^{-6}	5.7×10^{-7}	3.0×10^{-8}	7.8×10^{-5}
^{93m}Nb	NA	NA	NA	NA
^{59}Ni	3.5×10^{-7}	4.4×10^{-9}	2.3×10^{-10}	3.4×10^{-7}

Table 4-39. Comparison of Radionuclide Relative Risks for Radionuclides of Concern at the PUREX Plant Aggregate Area. (sheet 2 of 3)

Radionuclide	Air Unit Risk[a] in $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[b] in $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[c] in $(pCi/g)^{-1}$	External Exposure Unit Risk[d] in $(pCi/g)^{-1}$
^{63}Ni	8.7×10^{-7}	1.2×10^{-8}	6.2×10^{-10}	0
^{237}Np	1.8×10^{-2}	1.4×10^{-5}	7.3×10^{-7}	1.8×10^{-5}
^{239}Np	7.7×10^{-7}	4.8×10^{-8}	2.5×10^{-9}	1.1×10^{-4}
^{231}Pa	2.0×10^{-2}	9.7×10^{-6}	5.1×10^{-7}	2.0×10^{-5}
^{234m}Pa	8.2×10^{-10}	3.0×10^{-10}	1.6×10^{-11}	6.4×10^{-6}
^{209}Pb	3.6×10^{-8}	4.3×10^{-9}	2.3×10^{-10}	0
^{210}Pb	8.7×10^{-4}	3.4×10^{-5}	1.8×10^{-6}	1.8×10^{-6}
^{211}Pb	1.5×10^{-6}	9.2×10^{-9}	4.9×10^{-10}	2.9×10^{-5}
^{212}Pb	2.4×10^{-5}	3.7×10^{-7}	1.9×10^{-8}	9.2×10^{-5}
^{214}Pb	1.5×10^{-6}	9.2×10^{-9}	4.9×10^{-10}	1.5×10^{-4}
^{214}Po	1.4×10^{-13}	5.1×10^{-16}	2.7×10^{-17}	4.7×10^{-8}
^{215}Po	2.9×10^{-12}	1.4×10^{-14}	7.6×10^{-16}	8.7×10^{-8}
^{218}Po	3.0×10^{-7}	1.4×10^{-9}	7.6×10^{-11}	0
^{238}Pu	2.1×10^{-2}	1.4×10^{-5}	7.6×10^{-7}	5.9×10^{-7}
^{239}Pu	2.6×10^{-2}	1.6×10^{-5}	8.4×10^{-8}	2.6×10^{-7}
^{240}Pu	2.1×10^{-2}	1.6×10^{-5}	8.4×10^{-8}	5.9×10^{-7}
^{241}Pu	1.5×10^{-4}	2.5×10^{-7}	1.3×10^{-8}	0
^{225}Ra	8.2×10^{-4}	3.4×10^{-6}	1.8×10^{-7}	8.0×10^{-6}
^{226}Ra	1.5×10^{-3}	6.1×10^{-6}	3.2×10^{-7}	4.1×10^{-6}
^{106}Ru	2.3×10^{-4}	4.9×10^{-7}	2.6×10^{-8}	0
^{126}Sb	NA	NA	NA	NA
^{126m}Sb	NA	NA	NA	NA
^{79}Se	NA	NA	NA	NA
^{151}Sm	NA	NA	NA	NA
^{90}Sr	2.8×10^{-5}	1.7×10^{-6}	8.9×10^{-8}	0
^{99}Tc	4.2×10^{-6}	6.6×10^{-8}	3.5×10^{-9}	0
^{227}Th	2.5×10^{-3}	2.5×10^{-7}	1.3×10^{-8}	6.6×10^{-6}
^{229}Th	3.9×10^{-2}	2.0×10^{-6}	1.1×10^{-7}	5.8×10^{-5}

Table 4-39. Comparison of Radionuclide Relative Risks for Radionuclides of Concern at the PUREX Plant Aggregate Area. (sheet 3 of 3)

Radionuclide	Air Unit Risk[a] in $(pCi/m^3)^{-1}$	Drinking Water Unit Risk[b] in $(pCi/L)^{-1}$	Soil Ingestion Unit Risk[c] in $(pCi/g)^{-1}$	External Exposure Unit Risk[d] in $(pCi/g)^{-1}$
^{230}Th	1.6×10^{-2}	1.2×10^{-6}	6.5×10^{-8}	5.9×10^{-7}
^{231}Th	2.5×10^{-7}	2.0×10^{-8}	1.1×10^{-9}	1.1×10^{-5}
^{207}Tl	2.3×10^{-9}	6.6×10^{-10}	3.5×10^{-11}	1.2×10^{-6}
^{233}U	1.4×10^{-2}	7.2×10^{-6}	3.3×10^{-7}	3.2×10^{-7}
^{234}U	1.4×10^{-2}	7.2×10^{-6}	3.8×10^{-7}	5.6×10^{-7}
^{235}U	1.3×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	9.7×10^{-5}
^{238}U	1.2×10^{-2}	6.6×10^{-6}	3.5×10^{-7}	4.5×10^{-7}
^{90}Y	2.8×10^{-6}	1.6×10^{-7}	8.6×10^{-9}	0
^{93}Zr	NA	NA	NA	NA

[a] Excess cancer risk associated with lifetime exposure to 1 pCi/m^3 (10^{-12} curies) per day in air (EPA 1991).
[b] Excess cancer risk associated with lifetime exposure to 1 pCi (10^{-12} curies) per day in drinking water (EPA 1991).
[c] Excess cancer risk associated with lifetime exposure to 1 pCi/g (10^{-12} curies/g) per day in soil (EPA 1991).
[d] Excess cancer risk associated with lifetime exposure to surface soils containing 1 pCi/g of gamma-emitting radionuclides (EPA 1991).
[e] External radiation risk from ^{137m}Ba, a short-lived decay product of ^{137}Cs.

NA No information available.

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Table 4-40. Potential Chronic Human Health Effects of Chemicals Detected or Disposed of at PUREX Plant Aggregate Area. (sheet 1 of 2)

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route	Reference
INORGANIC CHEMICALS			
Arsenic	respiratory tract [A]; skin [A]	NA; keratosis and hyperpigmentation	
Barium	--	fetotoxicity; increased blood pressure	EPA 1991b
Beryllium	Lung; NA	--	
Boron	--	NA; testicular lesions	EPA 1991b
Cadmium	respiratory tract [B1]; NA	cancer; renal damage	EPA 1991b
Chromium	lung [A] - Cr(VI) only; NA	nasal mucosa atrophy; hepatotoxicity	EPA 1991b
Copper	--	NA; gastrointestinal irritation	EPA 1991b
Cyanide	--	NA; weight loss, thyroid effects, and myelin degeneration	
Fluoride	--	NA; dental flurosis at high levels	EPA 1991a
Hydrazine	Nasal cavity [B2]; liver [B2]	--	
Iron	--	--	
Lead	[B2][b]; [B2]	central nervous system (CNS) effects[b]; CNS effects	EPA 1991a
Manganese	--	respiratory symptoms and psychomotor disturbances; no effect	
Mercury	--	neurotoxicity; kidney effects	EPA 1991b
Nickel	respiratory tract [A]; NA	cancer; reduced weight gain	EPA 1991b
Nitrate/Nitrite	--	NA; methemoglobinemia in infants[c]	EPA 1991a
Silver	--	NA; argyria	
Vanadium	--	NA; none observed	
Zinc	--	NA; anemia	EPA 1991b

Table 4-40. Potential Chronic Human Health Effects of Chemicals Detected or Disposed of at PUREX Plant Aggregate Area. (sheet 2 of 2)

Chemical	Tumor Site Inhalation Route; Oral Route [Weight of Evidence Group[a]]	Non-carcinogenic Chronic Health Effects Inhalation Route; Oral Route	Reference
ORGANIC CHEMICALS			
Acetone	--	NA; kidney and liver effects	EPA 1991a
Chloroform	liver; kidney [B2]	NA; liver lesions	EPA 1991b
Methylene chloride	lung, liver [B2]; liver [B2]	NA; liver toxicity	EPA 1991a
Toluene	--	CNS effects, eye irritation; change in liver and kidney weights	EPA 1991a
Tributyl phosphate	--	respiratory irritant; kidney damage	NIOSH 1987
1,1,1-Trichloroethane	--	heptotoxicity; heptotoxicity	EPA 1991b

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

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

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

NA Information not available.